Santos
GLNG Project

GLNG
Gas Transmission Pipeline

Significant Species Management Plan
for
KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69

Part 1 - Overview

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Abbreviations

APIA	Australian Pipeline Industry Association
APPEA	Australian Petroleum Production and Exploration Association
ASSMP	Acid Sulphate Soil Management Plan
AVMP	Aquatic Values Management Plan
CAMBA	China-Australia Migratory Bird Agreement
CEMP	Construction Environmental Management Plan
CG	Coordinator General
CICSDA	Callide Infrastructure Corridor State Development Area
cm	Centimetre
CSG	Coal Seam Gas
DECC	Department of Conservation and Climate Change
DEHP	Department of Environment and Heritage Protection
DERM	Department of Environment and Resource Management
DEWHA	Department of Water, Heritage and the Arts
DoEE	Department of the Environment and Energy
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
E	Endangered
EA	Environmental Authority
EHSMS	Santos Environment, Health, Safety & Management System
EIS	Environmental Impact Statement
EO	Environment Officer
EP Act	*Environmental Protection Act 1994*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESCP	Erosion and Sediment Control Plan
FHP	Fauna Handling Plan
GSDA	Gladstone State Development Area
GIS	Geographical Information System
GLNG	Gladstone Liquefied Natural Gas
GTP	Gas Transmission Pipeline
GTP ROW	Gas Transmission Pipeline Right of Way
ha	Hectares
HDD	Horizontal Directional Drilling
HERBRECS	Queensland Herbarium database
JAMBA	Japan-Australia Migratory Bird Agreement
LNG	Liquefied Natural Gas
LRMP	Landscape Rehabilitation Management Plan
LZ	Land Zone
m	Metres
Mi	Migratory

Mm	Millimetres
MNES	Matters of National Environmental Significance
NC Act	*Nature Conservation Act 1992*
NT	Near Threatened
OHS	Occupational Health and Safety
PEM	The Proponent Pipeline Environment Manager
Proponent	Santos GLNG Pty Ltd, PETRONAS Australia Pty Ltd, Total E&P Australia and KOGAS
PWMP	Pest and Weed Management Plan
QLD	Queensland
QPIF	Queensland Primary Industries and Fisheries
RE	Regional Ecosystem
ROKAMBA	Republic of Korea-Australia Migratory Bird Agreement
ROW	Right of Way
SEIS	Supplementary Environmental Impact Statement
SEQ	South East Queensland
SEVT	Semi-evergreen Vine Thicket
SLC	Special Least Concern
SMESCP	Stormwater Management and Erosion and Sediment Control Plan
SMP	Species Management Plan
SOCI	Species of Conservation Interest Logbook
SSMP	Significant Species and Ecological Communities Management Plan
TEC	Threatened Ecological Communities
The Project	The GLNG GTP Project
V	Vulnerable
VM Act	*Vegetation Management Act 1999*
WONS	Weeds of National Significance

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Part 1 – Overview

1 Introduction

1.1 Background and purpose

GLNG Operations, a joint venture between Santos GLNG Pty Ltd (Santos), PAPL (Downstream) Pty Ltd (PETRONAS), Total GLNG Australia (TOTAL) and KGLNG Liquefaction Pty Ltd (KOGAS) propose to construct a high pressure Gas Transmission Pipeline (GTP) to transport coal seam gas (CSG) from the CSG fields at Roma and Fairview to a proposed liquefied natural gas (LNG) facility on Curtis Island. The GTP forms one component of the Gladstone LNG (GLNG) Project (the Project), which includes the following:

- Exploration and production of CSG in the Surat and Bowen Basin gas fields
- Construction and operation of an approximate 420 km GTP from the CSG fields in Roma and Fairview to the LNG Facility on Curtis Island (Santos GLNG GTP)
- Construction and operation of a gas liquefaction and export facility on Curtis Island and associated infrastructure

On 16 July 2007, the Coordinator-General declared the GLNG Project to be a 'significant project' for which an Environmental Impact Statement (EIS) is required in accordance with Part 4 of the *State Development and Public Works Organisation Act 1971* (Qld).

On 31 March 2008 and 14 April 2008, the Australian Government Minister for the Environment, Heritage and the Arts determined that the five referrals relating to the project, being CSG fields, the GTP, LNG terminal, marine environment and bridge to Curtis Island, were each a 'controlled action' pursuant to the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The EIS process was finalised on the 28 May 2010, GLNG became Australia's first major coal seam gas to LNG project to receive its environmental approval from the Qld Coordinator-General. On 22 October 2010, the Project received its environmental approval from the Commonwealth Environment Minister under the EPBC Act.

The EPBC Act controlled action approval for the GLNG GTP Project (EPBC No. 2008/4096) contained conditions relating to the preparation of a Significant Species Management Plan (SSMP):

8. If a listed threatened species or migratory species or their habitat, or a listed ecological community is encountered during the surveys undertaken as required by condition 5 and is not specified in the Table 1 or 2 at condition 11 and 12, the proponent must submit a separate management plan for each species or ecological community to manage the unexpected impacts of clearing. In relation to each listed species or ecological community, each plan must address:

a. the relevant characteristics describing each ecological community;

b. a map of the location of species, species' habitat, or ecological community in proximity to the ROW;

c. measures that will be employed to avoid impact on the species, species' habitat, or ecological community;

d. a quantification of the unavoidable impact (in hectares and/or individual specimens);

e. where impacts are unavoidable and a disturbance limit is not specified for the listed species or ecological community under condition 11, propose offsets to compensate for the impact on the population of the species' habitat, or the ecological community;

f. current legal status (under the EPBC Act);

g. known distribution.

For listed species, each plan must also include:

a. known species' populations and their relationships within the region;

b. biology and reproduction;

c. preferred habitat and microhabitat including associations with geology, soils, landscape features and associations with other native fauna and/or flora or ecological communities;

d. anticipated threats to MNES from pipeline construction, operation and decommissioning;

e. management practices and methods to minimise impacts such as:

- *i. site rehabilitation timeframes, standards and methods;*
- *ii. use of sequential clearing to direct fauna away from impact zones;*
- *iii. re-establishment of native vegetation in linear infrastructure corridors;*
- *iv. handling practices for flora specimens;*
- *v. translocation and/or propagation practices and monitoring for translocation/propagation success;*
- *vi. monitoring methods including for rehabilitation success and recovery;*

f. Reference to relevant conservation advice, recovery plans, or other policies, practices, standards or guidelines relevant to MNES published or approved from time to time by the Department.

Note: Management plans should include sufficient detail to inform pipeline construction, management and decommissioning to minimise adverse impacts on MNES throughout the life of the project.

9. Each plan required under condition 8 must be submitted for approval of the Minister. Commencement in the location covered by the management plan must not occur without approval. Each approved plan must be implemented.

10. If, during construction a listed threatened species or migratory species or their habitat, or a listed ecological community is encountered and is not specified in the table at condition 11 or 12, the proponent must submit a separate management plan for each species or ecological community in accordance with condition 8 within 20 business days of encountering that MNES. Work must not continue at the condition site where the MNES is encountered until the relevant management plan has been approved.

Condition 11 contains disturbance limits for EPBC Act listed threatened ecological communities (TEC) and the EPBC Act 'endangered' *Cycas megacarpa* (Large-fruited zamia).

In addition, conditions 12 and 13 contain the requirement to prepare a management plan for specifically listed flora and fauna species

12. *The proponent must prepare a management plan for each species in the table below. Each plan must be prepared in accordance with the requirements for condition 8.*

Table 2: Species management plans required before commencement

Listed species	EPBC Act Status
Philotheca sporadica	Vulnerable
Cadelia pentasylis (Ooline)	Vulnerable
Furina dunmalli (Dunmall's snake)	Vulnerable
Egernia rugosa (Yakka skink)	Vulnerable
Geophaps scripta scripta (Squatter pigeon – southern)	Vulnerable
Nyctophilus timoriensis (Eastern long-eared bat)	Vulnerable
Chalinolobus dwyeri (Large-eared pied bat)	Vulnerable
Xeromys myoides (Water mouse)	Vulnerable

Note: The intent of the table above is to require preparation of management plans for those species that are likely to be encountered along the ROW, but where a disturbance limit has not been quantified. To the extent that the requirements of condition 8 are satisfied for each species, a single Species Management Plan may be prepared for this purpose.

13. *Each management plant must be submitted for the approval of the Minister. Commencement must not occur without approval. Commencement in the location covered by the management plan must not occur without approval. Each approved plan must be implemented.*

It is proposed that a number of species or ecological communities will be addressed in this SSMP and the SSMP will address sections of the GTP in a sequential manner. Due to the proposed construction schedule of the GLNG GTP, the SSMP will be submitted to the Department of the Environment and Energy (DoEE) for approval on a locational basis as pre-clearance ecological surveys are completed. The SSMP will address listed threatened species, migratory species and/or their habitat, and EPBC Act listed TECs relevant to the specific location of disturbance covered by each GTP section. Where listed species are present in more than one location, the management plans for these species will be updated to include the findings of the pre-clearance surveys. The revised plan will be submitted to DoEE for approval prior to commencement of works in the location covered by the plan. At this stage the breakdown of the SSMP is likely to be:

- KP40 to KP130 (Rev F approved by the Department of Sustainability, Environment, Water, Populations and Communities [DSEWPaC] [now known as DoEE] on 31 July 2012) (included in this revision – Rev V)
- KP0 to KP30 (Rev J approved by DSEWPaC on 13 September 2012 and RCR for Baffle Creek realignment of the GTP ROW at KP20 to KP21 (Rev O) approved by DSEWPaC on 6 February 2013 (included in this revision - Rev V)

- KP30 to KP40 (Rev N approved by DSEWPaC on 19 December 2012 included in this revision – Rev V)
- KP130 to KP312 (Rev L approved by DSEWPaC on 15 November 2012) (included in this revision – Rev V)
- KP312 to KP408.81 (Rev Q approved by DSEWPaC on 26 March 2012) (included in this revision – Rev V)
- KP408.81 to KP409.04 and associated ancillary areas (ie access road and mainland construction launch pad) (Rev K approved by DSEWPaC on 26 September 2012) (included in this revision – Rev V)
- KP413.57 to KP419.69 (Rev T approved by DSEWPaC on 7 June 2013) (included in this revision – Rev V)

The location covered by this SSMP is from GTP kilometre point (KP) 0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 (refer Figure 1).

The purpose of this SSMP is to:

- Address the EPBC Act controlled action conditions 8 to 10 for the following EPBC Act listed threatened species and migratory species encountered as part of pre-clearance surveys and habitat assessment:
  - *Chalinolobus dwyeri* (Large-eared pied bat)
  - *Ardea ibis* (Cattle egret)
  - *Ardea modesta* (Great egret)
  - *Merops ornatus* (Rainbow bee-eater)
  - *Apus pacificus* (Fork-tailed swift)
  - *Maliaeetus leucogaster* (White-bellied sea-eagle)
  - *Pandion haliaetus* (Eastern osprey)
  - *Monarcha melanopsis* (Black-faced monarch)
  - *Monarcha trivirgatus* (Spectacled monarch)
  - *Myiagra cyanoleuca* (Satin flycatcher)
  - *Rhipidura rufifrons* (Rufous fantail)
  - *Eurystomus orientalis* (Dollarbird)
  - *Cuculus optatus* (Oriental cuckoo)
  - *Egretta sacra* (Eastern reef egret)
  - *Charadrius mongolus* (Lesser sand plover)
  - *Charadrius ruficapillus* (Red-capped plover)
  - *Pluvialis fulva* (Pacific golden plover)
  - *Charadrius bicinctus* (Double-banded plover)
  - *Actitis hypoleucos* (Common sandpiper)
  - *Numenius minutus* (Little curlew)
  - *Tringa stagnatilis* (Marsh sandpiper)

  - *Calidris canutus* (Red knot)
  - *Xenus cinereus* (Terek sandpiper)
  - *Calidris acuminata* (Sharp-tailed sandpiper)
  - *Limosa limosa* (Black-tailed godwit)
  - *Limosa lapponica* (Bar-tailed godwit)
  - *Numenius madagascariensis* (Eastern curlew)
  - *Numenius phaeopus* (Whimbrel)
  - *Tringa nebularia* (Common greenshank)
  - *Tringa brevipes* (Grey-tailed tattler)
  - *Calidris tenuirostris* (Great knot)
  - *Calidris ruficollis* (Red-necked stint)
  - *Arenaria interpres* (Ruddy turnstone)
  - *Recurvirostra novaehollandiae* (Red-necked avocet)
  - *Calidris alba* (Sanderling)
  - *Limicola falcinellus* (Broad-billed sandpiper)
  - *Himantopus himantopus* (Black-winged stilt)
  - *Calidris ferruginea* (Curlew sandpiper)
  - *Charadrius leschenaultii* (Greater sand plover)
  - *Gallinago hardwickii* (Latham's snipe)
  - *Pluvialis squatarola* (Grey plover)
  - *Sternula albifrons* (Little tern)
  - *Sterna caspia* (Caspian tern)
  - *Geophaps scripta scripta* (Squatter pigeon – southern)
  - *Delma torquata* (Collared delma)
  - *Furina dunmalli* (Dunmall's snake)
  - *Xeromys myoides* (Water mouse)

- Address the EPBC Act controlled action conditions 12 and 13 for EPBC Act listed threatened flora species confirmed from pre-clearance surveys, and threatened fauna species with habitat to be directly disturbed by the GTP Project. The relevant Condition 12, Table 2 threatened species between KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 are:
  - *Cadellia pentasylis* (Ooline)
  - *Xerothamnella herbacea*
  - *Philotheca sporadica*
  - *Cycas megacarpa* (Large-fruited zamia)
  - *Turnix melanogaster* (Black-breasted button-quail)

- *Erythrotriorchis radiatus* (Red goshawk)
- *Dasyurus hallucatus* (Northern quoll)
- *Egernia rugosa* (Yakka skink)
- *Nyctophilus corbeni* (South-eastern long-eared bat)
- *Denisonia maculate* (Ornamental snake)
- *Rheodytes leukops* (Fitzroy river turtle)
- *Rostratula australis* (Australian painted snipe)
- *Botaurus poiciloptilus* (Australasian bittern)

- Confirm the direct disturbance area of Brigalow (*Acacia harpophylla* dominant and co-dominant) and Semi-evergreen Vine Thickets (SEVT) within KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312 and KP312 to KP408.81 which are EPBC Act listed TEC's listed under condition 11 (Table 1). Brigalow and SEVT were not identified within KP408.81 to KP409.04 and KP413.57 to KP419.69.
- Present the area of adverse (offsetable) impact associated with clearing and construction activities for the GTP to habitat for threatened and migratory fauna species subject to the Project EPBC Act controlled action.

1.2 Structure of SSMP

The structure of this SSMP is divided into the following parts:

Part 1 – contains the general information and requirements that are relevant for each EPBC Act listed threatened species and migratory species, and their habitat

Part 2 – contains the individual specific Management Plans for each EPBC Act listed threatened species and migratory species, and their habitat

Part 3 – contains relevant information, management requirements and the area of direct disturbance for the Brigalow and SEVT TECs between KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312 and KP312 to KP408.81

1.3 Definitions

In this SSMP, the following definitions apply:

Table 1.1 Glossary

Term	Meaning
Ancillary work areas	All areas outside of the GTP ROW required to develop and operate the GTP. This includes laydown sites, stockpile areas, camps, low hazard dams and pump areas, and access tracks (permanent and temporary)
Approximately	Used throughout the document as a way to quantify impacts, particularly when working with decimal places. Use of this term should not be interpreted that the impacts are greater than those provided. For the purposes of this document, quantities have been rounded up and therefore actual impacts are slightly less than indicated in the SSMP
Bioregion	A geographic area characterised by a combination of physical and biological characteristics, for example, terrain, climate and ecological communities

Term	Meaning
Breeding places	An animal breeding place is a place being used by a protected animal to incubate or rear the animal's offspring if: • The animal is preparing, or has prepared, the place for incubating or rearing the animal's offspring • The animal is breeding, or is about to breed, and is physically occupying the place; or The animal and the animal's offspring are physically occupying the place, even if the occupation is only periodical • The animal has used the place to incubate or rear the animal's offspring and is of a species generally known to return to the space place to incubate or rear offspring in each breeding season for the animal
Brigalow regrowth	Brigalow which has not been cleared in the last 15 years (in addition to meeting other threshold conditions such as 0.5 ha in size and understory is less than 50% introduced grasses)
Coastal zone	Lands and waters adjacent to the coast that exert an influence on the uses of the sea and its ecology, or whose uses and ecology are affected by the sea
Contiguous (habitats)	Adjoining; connecting
Cryptic	Inconspicuous or secretive by way of colour, pattern or behaviour
Depauperate	Severely diminished
Directly adjacent to the ROW	Within 100 m of the ROW
Disturbance	Any activity that has an impact on the environment. This may include clearance of trees, movement of soil, blasting of rock, construction of man-made structures, and also extends to human activities resulting in noise, light, pollution or rubbish
Disturbance limit	Proposed extent of potential habitat to be cleared with the GTP ROW an Ancillary work areas
Ecological community	An assemblage of native species that: a. inhabits a particular area in nature b. meets the additional criteria specified in the regulations (if any) made for the purposes of this definition Ecological communities include all the species of plants, animals and micro-organisms that naturally occur together in a particular area or environmental domain in nature in assemblages which can change over time
Endangered (EPBC Act)	When a native species that is not critically endangered and is facing a very high-risk of extinction in the wild in the near future as determined in accordance with the prescribed criteria
Environmental Sensitive Area	Environmentally Sensitive Areas (ESAs) include national parks, world heritage areas, Ramsar wetlands, nationally important wetlands and Essential Habitat In accordance with the CG Report, ESAs within and adjacent to the ROW must be considered. For the purposes of this SSMP, Category A and B ESAs have been defined pursuant to Sections 25 and 26 of *the Environmental Protection Regulation 2008*, whilst Category C ESAs that have been defined pursuant to the DEHP guideline "*Preparing an Environmental Management Plan (EM Plan) for Coal Seam Gas (CSG) Activities*"

Term	Meaning
Exclusion zone	Essentially a 'No Go' zone or an area with important environmental values that cannot be accessed. The exclusion zones typically detail the radial distance from the particular environmental value being protected. The following gives an indication of exclusion zones for specific types of animals listed throughout the SSMP: • Raptors: 200 m • Reptiles: 50 m • Woodland birds: 50 m • Migratory wetland birds: 50 m • Bats: 50 m • Marsupials: 100 m • Mammals: 100 m
Expert advice	Based on literature reviews, pre-clearance survey data and personal communication with a person(s) who has extensive knowledge on a particular species. All expert advice is included in the references section of this SSMP
Fauna handler	A person that has been approved by DEHP under Section 12(d) of the Nature Conservation (Administration) Regulation 2006 and holds a valid Rehabilitation Permit
Fidelity	Showing a strong attachment to
Gestation	The period between conception and birth in live-bearing animals
Gilgai	Gentle mounds and depressions associated with swelling and cracking clay soils on alluvial floodplains
Granivore	An animal that subsist primarily on seeds
Gregarious	Living loosely in organised groups, social
GTP footprint	All areas required to develop and operate the Pipeline including the GTP ROW and ancillary work areas
Habitat	An area providing the physical and biological requirements for a species
High value regrowth	High-value regrowth vegetation is mature native vegetation that hasn't been cleared since 31 December 1989
In close proximity to the ROW	Generally relates to fauna species and refers to species or habitats identified within 100 m of ROW or seen flying overhead of ROW (Due to the mobile nature of fauna, it can be difficult to quantify specific distances)
Insectivorous	An animal which subsists on insects
Known habitat:	Habitats in which the species or a breeding place has been positively identified during the pre-clearing surveys or in habitat contiguous or intersecting a 5 km radius buffer around each known point record of the species (eg Queensland Museum, Wetland Info etc). Known habitat also refers to sites already known to exist by relevant scientific/government agencies or other consultants working in the area
Land zone	Land zones represent significant differences in geology, landforms and soil. Land zones generally correspond to broad geological categories and can be identified using geological maps
Microhabitat	A small, specialized habitat that provides a unique habitat for certain species. Microhabitats may include rocky outcrops, piles of woody debris, leaf litter
Migratory species	Those animals that migrate to Australia and its external territories, or pass through or over Australian waters during their annual migrations
Nocturnal	Active by night
Omnivore	Species that eat both plant and animal material as their primary food sources
Population	Of a species or ecological community relating to an occurrence of the species or community in a particular area
Pre-clearing survey	An ecological survey undertaken by an approved ecologist in accordance with relevant Commonwealth Survey guidelines and/or industry practices

Term	Meaning
Project personnel	All staff, contractors and consultants that may undertake onsite works
Regional Ecosystems (REs)	Vegetation communities that are consistently associated with a particular combination of geology, land form and soil in a bioregion
Relocation	Removal of native fauna from tree or habitats which are to be removed or cleared for development and relocated to an appropriate relocation site. This may also include removal of native fauna from trenches or other man-made structure to an appropriate relocation site. Wildlife relocation and release may only be undertaken by an approved Fauna Handler (ie rehabilitation permit issued by DEHP). The activity must be conducted in accordance with relevant management plans and the conditions of their licence
Remnant vegetation	Remnant woody vegetation is defined as vegetation where the dominant canopy has >70% of the height and >50% of the cover relative to the undisturbed height and cover of that stratum and is dominated by species characteristic of the vegetation's undisturbed canopy
Roost habitat	Where a bat spends its day
Sensitive area	An area known or potentially providing habitat for threatened species
Snake handler	A fauna handler who has been accredited to handle venomous snakes
Special Least Concern	• Echidna (*Tachyglossus aculeatus*) • Platypus (*Ornithorhynchus anatinus*) • a least concern bird to which any of the following apply— (i) the agreement called 'Agreement Between the Government of Australia and the Government of Japan for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment' and signed at Tokyo on 6 February 1974; (ii) the agreement called 'Agreement Between the Government of Australia and the Government of the People's Republic of China for the Protection of Migratory Birds and their Environment' and signed at Canberra on 20 October 1986; (iii) the convention called 'Convention on the Conservation of Migratory Species of Wild Animals' and signed at Bonn on 23 June 1979
Spotter Catcher	A person that has been approved by DEHP under Section 12(d) of the *Nature Conservation (Administration) Regulation 2006* and holds a valid Rehabilitation Permit
Suitably qualified Ecologist	An Ecologist who has been approved to work on ecological aspects of this project by the Commonwealth in writing
Targeted survey	A survey specifically targeting a key ecological feature, including habitat features such as hollow-bearing trees, burrows and nests
Threatened ecological community	An ecological community listed EPBC Act as Critically Endangered, Endangered or Vulnerable
Threatened species	A plant or animal assigned a conservation status (Vulnerable, Endangered or Critically Endangered) under the EPBC Act
Translocation	The term translocation for the purposes of this management plan will follow the guidelines for translocation of threatened plants in Australia (Vallee *et al* 2004) which includes the following: seed collection and propagation; propagation via cuttings or tissue culture; direct seeding; transplantation of seedlings or mature plants; and the transfer of soil, leaf litter or brush
Unavoidable impacts	Impacts as a result of the construction activities within the current GTP ROW and ancillary work areas on core, essential (known and potential) and general habitat for threatened fauna, including migratory species. Unavoidable impacts also include direct impacts on threatened flora populations and threatened ecological communities
Vulnerable (EPBC Act)	A native species that is not critically endangered or endangered and is facing a high-risk of extinction in the wild in the medium term future as determined in accordance with the prescribed criteria

1.4 Limitations

Every effort has been made to ensure the accuracy of species and ecological community information available within this SSMP. However, it is important to note that due to seasonal limitations, survey methodologies, access constraints and limitations in available data, not all flora and fauna present or utilising habitat within the GTP footprint may have been identified and recorded.

This could be attributed to limitations in publically available knowledge for some significant species and communities, as well as the extent of the Project area, plants being unidentifiable due to lack of fertile material, dormancy periods (eg terrestrial orchids and torpor for some fauna), fauna migration patterns and access constraints at the time of the survey periods.

2 Project description

2.1 Overview

The GLNG GTP runs from the CSG fields in Fairview to the LNG facility on Curtis Island (refer Mainland EMP and Marine Crossing EMP for details), and covers a distance of approximately 420 km (refer Figure 1). From Fairview, it will traverse mostly rural land and numerous ranges. The route departs Fairview in a northerly direction continuing north through the Arcadia Valley. It then turns east and crosses the Expedition Range, the Dawson Range and then a wide section of the Dawson River. The GTP continues in an easterly direction, crossing the Callide and Calliope Ranges (within the Callide Infrastructure Corridor State Development Area). It will approach Gladstone from the southwest and pass through the Gladstone State Development Area. After crossing the Calliope Range, the GTP crosses the Bruce Highway and continues towards Port Curtis and The Narrows area. The marine crossing between the mainland and Curtis Island involves bored tunnelling using a tunnel boring machine (TBM) under the intertidal area south of Kangaroo Island and The Narrows. From the marine crossing, the GTP then travels south on Curtis Island (refer Curtis Island EMP) where it terminates at the LNG facility on Curtis Island.

This SSMP also covers the tunnelling operations under the Narrows from the mainland to Curtis Island, although potential impacts to MNES are restricted to the launch pad (at KP408.81 on the mainland) and retrieval pad (at KP413.8 on Curtis Island). There is no known direct impact or potential impact to MNES from the tunnelling operations. Please note that the approved Marine Crossing EMP states:

“Construction works within the terrestrial environment of the Marine Crossing GTP will occur outside any protected areas as defined under the NC Act, *Forestry Act 1959* (FA Act) and/or the EPBC Act. The works will not occur within the GBRMP (Cth) and are sufficiently removed by distance that any indirect impacts are likely to be negligible”.

The Marine Crossing EMP also further controls construction related activities in order to limit potential impacts to environmental values, including MNES. Consequently, the tunnelling activities are expected to have a negligible impact (if any) on MNES.

The GTP right of way (ROW) will generally be 40 m wide (a 30 m easement with a 10 m work area), and narrowed to 30 m wide for areas defined as an Environmental Sensitive Area (ESA). Exceptions to this include a further decrease in the ROW width in the vicinity of some protected plants and an increase in the RoW width in some watercourses consistent with the AVMP, due to constructability and safety issues.

2.2 Construction methodology

An overview of the proposed construction methodology, including ancillary work areas is outlined in Table 2.1. For full explanations of the construction methodology refer to the GLNG GTP Mainland EMP and GLNG GTP Marine Crossing EMP. For additional watercourse crossing information refer to the GLNG GTP Aquatic Values Management Plan (AVMP).

Table 2.1 Overview of the proposed construction methodology for the GTP (KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69)

Method	Description
Clear and grade	Protected or retained vegetation will be marked with coloured flagging or marker tape to indicate that it is to be avoided. Vegetation cleared shall be stockpiled with selected vegetation re-spread during rehabilitation to optimise re-growth and ROW reinstatement. Existing water flows across the ROW will be maintained during clearing and grading, where necessary by the use of temporary drainage structures. Topsoil will be stripped from the ROW to a depth not more than 200 mm, and will generally be stockpiled for reinstatement or restoring contours
Construction of mainland construction site pad	The mainland construction site pad will be levelled to provide a flat working surface by a cut and fill operation using conventional earth moving equipment (bulldozers, excavators, trucks, graders and rollers). Additional fill material will be imported to site to raise the pad level to approximately 5 m Australian height datum (AHD), 2.4 m above highest astronomical tide (HAT), and 2.1 m above the 100 year storm surge level. Material for the launch pad will be sourced from an external approved quarry. Cross fall on the launch pad will be designed so that any surface water will runoff into erosion and sediment control devices. Stormwater discharge from the launch pad will comply with the Marine Crossing GTP Environmental Authority conditions
Construction of Curtis Island construction site pad	Following clearing and grading activities, the Curtis Island construction site pad will be levelled through a cut and fill process. This will be undertaken with conventional earth moving equipment (bulldozers, excavators, trucks, graders and rollers). The construction site pad will be designed with sufficient crossfall so that surface water will runoff into the erosion and sediment control devices as detailed in the GLNG GTP Stormwater Management and Erosion and Sediment Control Plan (SMESCP). Hardstand areas will be provided within the construction site pads for storage areas and this hardstand will be constructed of compacted aggregate. Concrete hardstand areas will be constructed for liquid and chemical storage areas, washdown pads and workshops. Concrete footings and floors will also be poured for any sheds and demountable site buildings required

Method	Description
Construction of the mainland and Curtis Island tunnel shafts (launch and receptor)	Interlocking steel sheetpiles will be driven into the ground by a crawler crane around the perimeter of the shaft by either vibrating hydraulic hammer or hydraulic impact hammer until competent rock is hit. Once the sheetpiles have been installed around the perimeter enclosing the structure and providing a water tight seal, excavators will remove the soil. If the shaft depth is deeper than the level the sheetpiles can be driven, then ground support in the form of rock bolts and mesh will be installed as the excavation progresses. Soil will be stockpiled within the construction site pads prior to disposal or reuse during rehabilitation works Once the TBM shaft has been excavated and reached the finished depth, a reinforced concrete floor will be constructed at the bottom of each shaft to provide a clean, level working surface. The TBM launch shaft will be used to assemble the TBM and then after launching of the TBM it will support the temporary railway. A concrete sump will be incorporated into the TBM shafts concrete floor to allow any groundwater seepage to be collected and pumped to the WTP for treatment and then storage in tanks for reuse during construction. The concrete floor within each TBM shaft will be left in place and backfilled during rehabilitation works Two gantry cranes will be utilised, a 25 tonne and 40 tonne, to service the TBM launch shaft and unload deliveries. These cranes will be installed onto a common rail, which sits on a concrete foundation above the shaft on a hardstand area. A crawler crane (250 tonne) will be used at the construction site pad (Curtis Island) to lift the TBM up and out of the TBM receptor shaft on completion of the tunnel construction works. The TBM will be dismantled on Curtis Island and transported to the mainland
Construction of mainland construction site pad access road	All vegetation clearing will be in accordance with the GLNG GTP Mainland and Marine Crossing EMPs, the GLNG GTP Species Management Plan (SMP) (document no. 3380-GLNG-3-1.3-0036) and this SSMP. The Access Road will be suitable for heavy vehicles and will be graded (including cut and fill) to minimise dips and rises within the vertical alignment. Swale drains and culverts will be installed as appropriate to overland flow drainage lines. Progressive import and placement of road base material will achieve all-weather traffic requirements. The proposed Access Road corridor will also include erosion and sediment controls (eg diversion berms) and an acid sulfate soil (ASS) treatment area. All erosion and sediment controls and ASS treatment will be in accordance with the SMESCP (document no. SC12-0029/R001631) and the GLNG GTP Acid Sulfate Soil Management Plan (ASSMP) (report no. 127683005-006-R-Rev E). Water carts will be used during the road construction for dust suppression and to ensure the correct moisture content of any compacted material
Stockpile areas	Pipe will be stored at stockpile sites prior to stringing along the ROW. Pipe sections are between 11-12 m in length and are stockpiled in stacks 4 pipes high. Two pipe stockpiles are proposed within the area of KP40-130, two pipe stockpiles are proposed between KP130 and 312 and one stockpile is proposed at KP0, with each being approximately 10 ha. Stockpiles sites are cleared and graded prior to use. The site surface is compacted and capped with road base material. Erosion and sediment control measures are installed
Weed wash down stations	Weed wash facilities will be placed at KP106, KP383 and KP397 to allow vehicles to be cleaned prior to moving between management zones. The facility will consist of an existing loop road (currently leading to existing cattle yards), a water supply dam, wastewater sump and pump station
Low hazard dams and pump areas	Water for hydro static testing will be stored in dams along the ROW. Each dam will also have a pump station to allow the movement of hydrotest water along the pipe sections

Method	Description
Transport along the mainland GTP ROW and access tracks/roads	All access to and from the ROW which will include the access tracks and hauls roads will be via dedicated wash down facilities to control pest and weeds. These wash down facilities will be operated in accordance with the Pest and Weed Management Plan (PWMP). Access tracks will be maintained during construction and rehabilitated to the pre-existing state following completion of construction Water carts will be used during construction and operation of the mainland construction site pad access road for dust suppression and to ensure the correct moisture content of any compacted material tunnelling or trenching work associated with the Marine Crossing GTP construction
Construction camps	Three construction camps will be established within KP0 to KP312 (Camp 1, Camp 2 and Camp 3). Each Camp will accommodate approximately 450 persons and will be approximately 35 ha. These sites will be demobilised post construction.
Stringing and bending	Involves laying the pipe out in lengths in preparation for welding. Pipe will be transported to the Mainland GTP ROW to temporary pipe storages sites adjacent to the ROW on trucks
Welding and coating	Once the pipe is strung it will then be positioned using side boom tractors and clamped for welding
Trenching	Trench spoil will be properly windrowed beside the trench allowing gaps at regular intervals for access tracks and surface drainage. All water in the bottom of the trench will be removed where practical and disposed of in accordance with the water management measures proposed in the Mainland EMP
Lowering and backfilling	Pipe shall be placed directly on the trench bottom. Trapped fauna will be removed from the trench prior to lowering-in. The trench will be visually inspected before bedding, padding and backfilling operations commence
Hydrostatic testing	Pipe integrity is verified by hydrostatic testing. During hydrostatic testing the pipe will be filled with water sourced from nearby dams, rivers, bores or town supplies
Cleaning and commissioning	After completion of hydrotesting the pipeline will be de-watered, cleaned and dried such that all residual free water is removed and drained to land in accordance with the Hydrotesting Management Plan (HTMP)
Watercourse crossings	Refer GLNG AVMP
Road crossings	Open cut or bored techniques will be used on road crossings according to the road function, road design and the size and quality of vehicles that use the road
Rehabilitation after GTP construction	Waste will be disposed of in accordance with the Waste Management Plan (refer Mainland EMP). The ROW will be rehabilitated in accordance with the Landscape Rehabilitation Management Plan (LRMP)

3 Sources of information

3.1 Pre-clearance surveys

3.1.1 KP0 to KP130

In accordance with the requirements of conditions 6 and 7 of the EPBC Act controlled action approval, a Pre-Clearance Survey Report for KP0-KP130 of the GLNG Pipeline Project has been prepared by Ecologica Consulting (Ecologica Consulting 2012). This report outlines the findings from pre-clearing ecological surveys between KP0 and KP130 of the GTP ROW which were undertaken in accordance with conditions 5, 6 and 7 of the EPBC Act controlled action approval (EPBC No. 2008/4096). These surveys were led by EPBC Act approved ecologists, Mr Craig Eddie from Boobook Consulting and Alicia Wain, Michael Price and Bree Wilson from Ecologica Consulting.

The survey methodology for flora included a desktop and spatial analysis to obtain information on the mapped vegetation communities, the likely floral assemblages and the potential location of significant species. Ecologists conducted field surveys between October and November 2011, March 2012 and May 2012 recording location and extent of listed threatened species and Threatened Ecological Communities (TEC), declared weeds and Type A Restricted species under the NC Act. Quaternary assessments were conducted within relevant vegetation communities and bio-condition assessment was conducted at four locations between KP0 and KP37.

The survey methodology for fauna included a desktop and spatial analysis to obtain information on the mapped vegetation communities, the likely fauna assemblages and the potential location of significant species. Ecologists conducted field surveys between October and November 2011. Survey techniques adopted included habitat assessment, diurnal and nocturnal searches of core and essential habitat areas, roost searches, harp trapping, passive and active acoustic, cage trapping, Elliot trapping, call playbacks, pitfall trapping, remote cameras, flushing surveys, land-based searches, targeted searches, flushing surveys, road traversing at night and scats, hair and traces searches. In addition, water searches were conducted using cathedra traps, fyke nets, muddling, dip netting, diurnal and nocturnal observations from the bank and boat.

Additional observations were made by Ausecology Pty Ltd as part of a pre-clearance ecological survey undertaken for Saipem Australia Pty Ltd (Saipem) which has been awarded the detailed design, procurement and construction of the 420 km GTP. This pre-clearance survey has been reviewed by Dr Chris Schell (a Commonwealth approved ecologist) and is considered appropriate for use as part of this SSMP.

The survey was undertaken in accordance with the pre-clearance ecological survey methodology prepared by Saipem. The survey was undertaken by Ausecology ecologists from 6 to 15 April 2012 (KP70 to KP130), 24 April to 1 May 2012 (KP37 to KP70) and 25 June to 10 July 2012 (KP0 to KP37).

In order to assess the ecological values of the site, the following activities were conducted (Ausecology 2012):

- An initial desktop-based review of existing information on the vegetation communities, flora species and fauna species of the study area
- A baseline botanical survey and broad habitat assessment to confirm and enhance information collated during the desktop review

Targeted *Xerothamnella herbacea* surveys were undertaken by Aurecon and led by Dr Chris Schell (a Commonwealth approved ecologist) for KP30 to KP35. The surveys were undertaken by Aurecon ecologists from 17 to 20 September 2012 and 7 to 9 November 2012.

The survey methodology for *Xerothamnella herbacea* included a desktop and spatial analysis to obtain information on the mapped *Xerothamnella herbacea* population and the potential location of *Xerothamnella herbacea*. Ecologists recorded location and extent of *Xerothamnella herbacea* based on surveying 20 m either side of the centre alignment for the GTP ROW and realignment options and quadrat sampling was undertaken within the GTP ROW between KP32.5 and KP32.595 to assess the location and distribution of *Xerothamnella herbacea*.

A pre-clearance survey was also undertaken for a realignment of the GTP ROW at Baffle Creek near KP20 by Aurecon and led by Dr Chris Schell. The survey was undertaken by

Aurecon ecologists over a period of four consecutive days and three nights between 6 and 9 November 2012.

The survey methodology included a desktop and spatial analysis prior to field investigations in order to determine site access and identify potential habitat for target species.

Random meander sampling within the GTP alignment involved the identification of all terrestrial flora species (excluding mosses and lichens) encountered. All areas proposed for disturbance and atypical vegetation communities were sampled. Targeted searches for conservation significant flora species and detailed habitat descriptions for significant fauna species as listed under the provisions of the EPBC Act and/or the NC Act as well as Type A species as identified under the provisions of the NC Act were also undertaken at each survey location.

Plant identifications were undertaken utilising available flora and botanical reference material. Samples of flora species unable to be identified *in situ*, or with the assistance of appropriate field guides, as well as vouchers of conservation significant species, were pressed and sent to the Queensland Herbarium for identification/verification.

Sites were also assessed for their habitat value for significant native fauna species. The assessment focussed on identifying habitat attributes associated with threatened species, as well as other native fauna groups. Particular attention was paid to habitat features such as:

- The presence of mature trees with hollows, fissures and/or other suitable roosting/nesting places
- Structure, integrity and density of vegetation
- Presence of hollow logs/debris and areas of dense leaf litter
- Presence of fruiting/blossoming flora species
- Vegetation connectivity and proximity to neighbouring areas of intact vegetation
- Presence of caves and/or man-made structures suitable for micro-chiropteran bat roost sites

Fauna were recorded by five methods as detailed below:

1. Opportunistically in association with the vegetation surveys conducted by Aurecon. Fauna was identified by direct observation, via characteristic vocalisations (eg bird and frog calls) or though detection of species characteristic traces (ie scats, nests etc)
2. Ground searches were undertaken throughout the site at targeted locations using the following methods:
   - Active searches for cryptic fauna (such as reptiles and amphibians) via methods such as turning over logs, disturbing woodpiles, lifting loose bark on trees, investigating hollow logs and disturbing leaf litter
   - Tracks, scats, animal remains, movement pathways, feeding signs and any other traces of animal presence were recorded when observed
   - Trees were closely observed for scratch marks, nests and hollows to determine their potential value as habitat
3. Use of remote, Infra-red, motion-sensing cameras located along distinct fauna paths
4. Use of baited Hair-traps

5. Use of an ANABAT device and sampling methodology

3.1.2 KP130 to KP312

In accordance with the requirements of conditions 6 and 7 of the EPBC Act controlled action approval, a Pre-Clearance Survey Report for KP130-KP312 of the GLNG Pipeline Project has been prepared by Ausecology and Aurecon for Santos GLNG (Santos GLNG 2012).

The information for the Pre-Clearance Survey Report for KP130 to KP312 was generated through the following stages:

1. Initial desktop-based review of existing information on the vegetation communities, flora species and fauna species within the study area
2. Baseline botanical surveys and broad habitat assessment to confirm and enhance information collated during the desktop review
3. A targeted threatened fauna species habitat assessment within areas determined from the desk-top assessments, reviews of the baseline botanical surveys and vegetation habitat assessments

The following databases were used to undertake the desktop review of the area between KP130 to KP312: HERBRECS data, Regrowth Vegetation Mapping (DEHP) v2.1, Property Maps of Assessable Vegetation (DEHP), VMA Regional Ecosystem and Remnant Mapping v6.1 (DEHP), VMA Essential Habitat Mapping v3.1 (DEHP), Environmentally Sensitive Areas mapping (DEHP), a Wildlife Online database search, Referable Wetlands mapping (Queensland wetland data Version 3), and an EPBC Act Protected Matters Search. A number of existing guidelines, reports and approvals were also used as references for the Pre-clearance Survey Report, and assisted in the development of the survey methodology and provided supporting information for the reporting.

Information and data has been collected from a series of pre-clearance surveys for the GTP Project that were undertaken by Ausecology and Aurecon in 2012. The surveys included:

- Pre-clearance ecological survey for KP130 to KP234 undertaken by the Ausecology team Jason Halford – Senior Ecologist, Ralf Regeer –Senior Ecologist and Lainie Grigg – Ecologist
- Pre-clearance ecological survey for KP234 to KP312 undertaken by the Ausecology team of Robbie Kristenson – Ecologist, Lainie Grigg – Ecologist and Ralf Regeer – Senior Ecologist
- Pre-clearance ecological survey for EPBC Act listed fauna species within KP130 to KP312 undertaken by Aurecon team members: Leesa Leathbridge – Ecologist, Emma Joss – Environmental Scientist, Sarah Glauert – Ecologist, John Lynn – Ecologist, Kellie Butler – Ecologist and Grant Paterson – Senior Ecologist

The pre-clearance surveys for this section of the GTP alignment were undertaken in three stages between 14 May 2012 and 12 October 2012. Dr Chris Schell (Aurecon), a DoEE approved ecologist for the GLNG GTP Project has verified the pre-clearance ecological surveys and report.

The 182 km section (KP130 to KP312) of the 420 km GTP ROW running from the northern end of the Arcadia Valley to the western edge of the Callide Ranges at the Anglo American coal haul road, was surveyed on foot (where access was permitted by land holders) with emphasis placed on the following:

- Locations of Type A species listed under the *Nature Conservation Act 1992*
- Locations of Class 2 declared weeds and weeds of national significance (WONS)
- Verification of high value regrowth or remnant vegetation mapped as endangered or of concern
- Locations of EVNT flora species
- Presence of potential fauna habitat (as defined as per the approved SSMP) (hollow-bearing trees, scats, rocky outcrops etc)
- Targeted habitat areas (as defined as per the approved SSMP) associated with threatened fauna species listed under the provision of the EPBC Act and/or the NC Act
- Assessment of the type and ecological value of vegetation not classified as being remnant or high value regrowth vegetation by DEHP
- Wetlands, gilgai/melon holes, springs, watercourses and ephemeral creeks
- Observations of areas of disturbance

Fauna within this area was recorded by two methods; opportunistically in association with the vegetation surveys completed by Aurecon and Ausecology and by means of direct observation and call verification, and through targeted active searches for rare and threatened species. Elliot, cage, pitfall and funnel traps were also utilised at two trap sites (KP148.8 and KP184).The targeted fauna survey also focused on detailed habitat assessments to assess the habitat values throughout the section of GTP ROW from KP130 to KP312 with respect to viability of feeding and/or nesting attributes for potentially occurring significant species.

Furthermore, all water features encountered during the pre-clearance ecological survey were recorded, and mapped watercourses were verified. Water features were assessed to determine if they meet the definition of a watercourse under the *Water Act 2000* or a waterway under the *Fisheries Act 1994*. These areas were assessed from an overall habitat potential perspective, with the aquatic values contained in the GLNG Aquatic Values Assessment Reports.

3.1.3 KP312 to KP408.81

In accordance with the requirements of conditions 6 and 7 of the EPBC Act controlled action approval, a Pre-Clearance Survey Report for KP312 to KP408.81 of the GLNG Pipeline Project has been prepared by Aurecon for Santos GLNG (Santos GLNG 2013).

The information for the Pre-Clearance Survey Report for KP312 to KP408.81 was generated through the following stages:

1. Initial desktop-based review of existing information on the vegetation communities, flora species and fauna species within the study area
2. Baseline botanical surveys and broad habitat assessment to confirm and enhance information collated during the desktop review
3. A targeted threatened fauna species habitat assessment within areas determined from the desk-top assessments, reviews of the baseline botanical surveys and vegetation habitat assessments

The following databases were used to undertake the desktop review of the area between KP312 to KP408.81: HERBRECS data, Regrowth Vegetation Mapping (DEHP) v2.1,

Property Maps of Assessable Vegetation (DEHP), VMA Regional Ecosystem and Remnant Mapping v6.1 (DEHP), VMA Essential Habitat Mapping v3.1 (DEHP), Environmentally Sensitive Areas mapping (DEHP), a Wildlife Online database search, Referable Wetlands mapping (Queensland wetland data Version 3), and an EPBC Act Protected Matters Search. A number of existing guidelines, reports and approvals were also used as references for the Pre-clearance Survey Report, and assisted in the development of the survey methodology and provided supporting information for the reporting.

The KP312 to KP408.81 section (including ancillary works areas) of the ROW alignment was surveyed in full through surveys undertaken by Ausecology and Footprints Environmental Consultants in 2012 and Aurecon in 2013 with areas possessing habitat potentially suitable for MNES fauna species targeted to assess the micro habitat attributes in more detail. The surveys included:

- Pre-clearance ecological survey for KP312 to KP341 undertaken by Ausecology and lead by Ralf Regeer – Senior Ecologist (DoEE approved ecologist for the GLNG GTP Project) with assistance from Jason Halford – Ecologist, Robbie Kristenson – Ecologist, Simon Bush – Ecologist and Kathie Grigg - Ecologist
- Pre-clearance ecological survey for KP341 to KP409 undertaken by Ausecology and lead by Ralf Regeer – Senior Ecologist (DoEE approved ecologist for the GLNG GTP Project) with assistance from Robbie Kristenson – Ecologist, Simon Bush – Ecologist and Lainie Grigg – Ecologist
- Pre-clearance ecological survey for NC Act and EPBC Act listed fauna species within KP350 to KP413 undertaken by Footprints Environmental Consultants and lead by Andrew Veary (BSc (Hons)) and Elle Veary (BAppSc) (DoEE approved ecologists for the GLNG GTP Project) with assistance from Dr Kris Murray (PhD).. Greg Ford (BAppSc, Grad Dip Resource Management) of Balance Environmental, was commissioned by Footprints Environmental Consultants to undertake the Anabat microchiropteran bat call recording analysis and Barbara Triggs of Dead Finish, undertook the hair tube sample analysis
- Pre-clearance ecological survey for EPBC Act listed fauna species within KP312 to KP408.81 undertaken by Aurecon and lead by Dr Chris Schell – Senior Ecologist/Environmental Scientist (DoEE approved ecologist for the GLNG GTP Project) with assistance from Leesa Leathbridge – Ecologist, Emma Joss – Environmental Scientist, Kim Tuart-Haynes – Environmental Scientist and Dylan McWhinney – Environmental Scientist

The pre-clearance surveys for this section of the GTP alignment were undertaken in four stages between mid-December 2011 and 25 January 2013. Dr Chris Schell (Aurecon) has verified the pre-clearance ecological surveys and report.

The 97 km section (KP312 to KP408.81) of the 420 km GTP ROW running from the Anglo American coal haul road to the start of the GLNG mainland construction launch pad and ancillary areas, was surveyed on foot (where access was permitted by land holders) with emphasis placed on the following:

- Locations of Type A species listed under the *Nature Conservation Act 1992*
- Locations of Class 2 declared weeds and weeds of national significance (WONS)
- Verification of high value regrowth or remnant vegetation mapped as endangered or of concern
- Locations of EVNT flora species

- Presence of potential fauna habitat (as defined as per the approved SSMP) (hollow-bearing trees, scats, rocky outcrops etc)
- Targeted habitat areas (as defined as per the approved SSMP) associated with threatened fauna species listed under the provision of the EPBC Act and/or the NC Act
- Assessment of the type and ecological value of vegetation not classified as being remnant or high value regrowth vegetation by DEHP
- Wetlands, gilgai/melon holes, springs, watercourses and ephemeral creeks
- Observations of areas of disturbance
- Mapping of hollow bearing trees within and adjacent to the GTP ROW

Fauna within this area were recorded by the following methods:

- Opportunistically in association with the vegetation and habitat surveys
- Pitfall trapping for reptiles
- Cage/Elliott Type B trapping for mammals
- Diurnal bird census
- Active diurnal and nocturnal ground searching for reptiles and frogs
- Anabat detection for microchiropteran bats
- Harp trapping for microchiropteran bats
- Hair tube surveys
- Call playback for nocturnal birds
- Area searches for large mammals and birds
- Remote detection trigger cameras for mammals
- Driving spotlight transects

The targeted fauna survey also focused on detailed habitat assessments to assess the habitat values throughout the section of GTP ROW from KP312 to KP408.81 with respect to viability of feeding and/or nesting attributes for potentially occurring significant species.

Furthermore, all water features encountered during the pre-clearance ecological survey were recorded, and mapped watercourses were verified. Water features were assessed to determine if they meet the definition of a watercourse under the *Water Act 2000* or a waterway under the *Fisheries Act 1994*. These areas were assessed from an overall habitat potential perspective, with the aquatic values contained in the GLNG Aquatic Values Assessment Reports. Where the GLNG Aquatic Values Assessment Reports identified suitable habitat for EPBC listed species within the KP312 to KP408.81 section of the GTP ROW, these areas were incorporated into the pre-clearance survey report.

3.1.4 KP408.81 to KP409.04

A consolidated GLNG GTP pre-clearance report for KP408.81 to KP409.04 and associated ancillary areas (ie access road and mainland construction launch pad) for the marine crossing early works has been prepared.

The report consolidates the series of Pre-clearance Survey Reports encompassing KP408.81 to KP409.04 and the marine crossing early works area of the GLNG GTP Project

and have been prepared by RPS (RPS 2012) and Footprints Environmental Consulting (FEC 2012a), (FEC 2012b) and (FEC 2012c). The reports detail the results of flora, fauna and migratory bird assessments in addition to a targeted Water mouse assessment.

The 'Flora Pre-clearance for the Crossing Pads and Access Tracks' (RPS 2012) outlines the findings from pre-clearing floral surveys associated with KP408.81 to KP409.04 of the GTP ROW. The survey methodology for flora included a desktop and spatial analysis to obtain information on the mapped vegetation communities, the likely floral assemblages and the potential location of significant species. Ecologists conducted field surveys in April 2012 recording the location and extent of listed threatened species, Threatened Ecological Communities (TEC), declared weeds and Type A Restricted species under the provisions of the *Nature Conservation Act 1992* (NC Act) and/or the EPBC Act. Quaternary assessments were conducted within relevant vegetation communities and bio-condition assessments were conducted at four locations within KP408.81 to KP409.04 of the GTP and ancillary areas.

The 'Water mouse Assessment Report' (FEC 2012a) outlines the findings from pre-clearing Water mouse surveys associated with KP408.81 to KP409.04 of the GTP ROW. The survey methodology for Water mouse included a desktop and spatial analysis to obtain information on the mapped vegetation communities and field work completed in December 2011, January 2012, February 2012 and April 2012, in accordance with the EPBC Act 'significant impact guidelines for the vulnerable Water mouse *Xeromys myoides*, nationally threatened species and ecological communities background paper to the EPBC Act policy statement 3.20'.

The 'Threatened Vertebrate Fauna Species Assessment Report' (FEC 2012b) outlines the findings from pre-clearing fauna surveys from KP350 to KP413 of the GTP. The survey methodology for fauna included a desktop and spatial analysis to obtain information on the mapped vegetation communities and field work completed from December 2011 to March 2012. Survey techniques adopted included habitat assessment, diurnal and nocturnal searches of core and essential habitat areas, roost searches, harp trapping, passive and active acoustic, cage trapping, Elliot trapping, call playbacks, pitfall trapping, remote cameras, flushing surveys, land-based searches, targeted searches, flushing surveys, road traversing at night and scats, hair and traces searches.

The 'Kangaroo Island Wetland Complex Migratory Bird Surveys, Baseline Assessment Report' (FEC 2012c) outlines the findings of a baseline migratory bird survey undertaken in areas adjacent to KP408.81 to KP409.04 of the GTP ROW. The survey methodology for marine migratory birds included a desktop and spatial analysis to obtain information on potential high tide roosts and foraging areas. Field work completed from August 2011 to March 2012. Survey techniques adopted include habitat assessment, through assessing (by boat and foot) the Kangaroo Island wetland completed and Laird Point areas.

3.1.5 KP413.57 to KP419.69

In accordance with the requirements of conditions 6 and 7 of the EPBC Act controlled action approval, a Pre-Clearance Survey Report for KP413.57 to KP419.69 of the GLNG Pipeline Project has been prepared by Santos GLNG (Santos GLNG 2013a).

The information for the Pre-Clearance Survey Report for KP413.57 to KP419.69 was generated through the following stages:

1. Initial desktop-based review of existing information on the vegetation communities, flora species and fauna species within the study area

2. Baseline botanical surveys and broad habitat assessment to confirm and enhance information collated during the desktop review

3. A targeted threatened fauna species habitat assessment within areas determined from the desk-top assessments, reviews of the baseline botanical surveys and vegetation habitat assessments

The following databases were used to undertake the desktop review of the area between KP312 to KP408.81: HERBRECS data, Regrowth Vegetation Mapping (DEHP) v2.1, Property Maps of Assessable Vegetation (DEHP), VMA Regional Ecosystem and Remnant Mapping v6.1 (DEHP), VMA Essential Habitat Mapping v3.1 (DEHP), Environmentally Sensitive Areas mapping (DEHP), a Wildlife Online database search, Referable Wetlands mapping (Queensland wetland data Version 3), and an EPBC Act Protected Matters Search. A number of existing guidelines, reports and approvals were also used as references for the Pre-clearance Survey Report, and assisted in the development of the survey methodology and provided supporting information for the reporting.

The KP413.57 to KP419.69 section (including ancillary works areas) of the ROW alignment was surveyed in full through surveys undertaken by Ausecology and Footprints Environmental Consultants in 2012 with areas possessing habitat potentially suitable for MNES fauna species targeted to assess the micro habitat attributes in more detail. The surveys included:

- Pre-clearance ecological survey for KP413.5 to KP419.6 undertaken by Ausecology and lead by Ralf Regeer – Senior Ecologist (DoEE approved ecologist for the GLNG GTP Project) with assistance from Simon Bush – Ecologist
- Pre-clearance ecological survey for NC Act and EPBC Act listed fauna species within KP350 to KP419 undertaken by Footprints Environmental Consultants and lead by Andrew Veary (BSc (Hons)) and Elle Veary (BAppSc) (DoEE approved ecologists for the GLNG GTP Project) with assistance from Dr Kris Murray (PhD). Greg Ford (BAppSc, Grad Dip Resource Management) of Balance Environmental, was commissioned by Footprints Environmental Consultants to undertake the Anabat microchiropteran bat call recording analysis and Barbara Triggs of Dead Finish, undertook the hair tube sample analysis

The pre-clearance surveys for this section of the GTP alignment were undertaken in two stages between mid-December 2011 and end of March 2012 and 13 to 14 November 2012. Dr Chris Schell (Aurecon) has verified the pre-clearance ecological surveys and report.

The 6.1 km section (KP413.57 to KP419.69) of the 420 km GTP ROW on Curtis Island, from the launch pad at KP413.57 to the GLNG facility tie-in at KP419.69 located in the Gladstone Regional Council, was surveyed on foot (where access was permitted by land holders) with emphasis placed on the following:

- Locations of Type A species listed under the *Nature Conservation Act 1992*
- Locations of Class 2 declared weeds and weeds of national significance (WONS)
- Verification of high value regrowth or remnant vegetation mapped as endangered or of concern
- Locations of EVNT flora species
- Presence of potential fauna habitat (as defined as per the approved SSMP) (hollow-bearing trees, scats, rocky outcrops etc)
- Targeted habitat areas (as defined as per the approved SSMP) associated with threatened fauna species listed under the provision of the EPBC Act and/or the NC Act

- Assessment of the type and ecological value of vegetation not classified as being remnant or high value regrowth vegetation by DEHP
- Wetlands, gilgai/melon holes, springs, watercourses and ephemeral creeks
- Observations of areas of disturbance
- Mapping of hollow bearing trees within and adjacent to the GTP ROW

Fauna within this area were recorded by the following methods:

- Opportunistically in association with the vegetation and habitat surveys
- Pitfall trapping for reptiles
- Cage/Elliott Type B trapping for mammals
- Diurnal bird census
- Active diurnal and nocturnal ground searching for reptiles and frogs
- Anabat detection for microchiropteran bats
- Harp trapping for microchiropteran bats
- Hair tube surveys
- Call playback for nocturnal birds
- Area searches for large mammals and birds
- Remote detection trigger cameras for mammals
- Driving spotlight transects

The targeted fauna survey also focused on detailed habitat assessments to assess the habitat values throughout the section of GTP ROW from KP413.57 to KP419.69 with respect to viability of feeding and/or nesting attributes for potentially occurring significant species.

The pre-clearance report for KP413.57 to KP419.69 refers to the 'Water mouse Assessment Report' (FEC 2012a) which was undertaken separately due to the very specific methodology and time constrained survey methods required to survey for this species. The report outlines the findings from pre-clearing Water mouse surveys associated with the mainland and Curtis Island. The survey methodology for Water mouse included a desktop and spatial analysis to obtain information on the mapped vegetation communities and field work completed in December 2011, January 2012, February 2012 and April 2012, in accordance with the EPBC Act 'significant impact guidelines for the vulnerable Water mouse *Xeromys myoides*, nationally threatened species and ecological communities background paper to the EPBC Act policy statement 3.20'.

Furthermore, all water features encountered during the pre-clearance ecological survey were recorded, and mapped watercourses were verified. Water features were assessed to determine if they meet the definition of a watercourse under the *Water Act 2000* or a waterway under the *Fisheries Act 1994*. These areas were assessed from an overall habitat potential perspective, with the aquatic values contained in the GLNG Aquatic Values Assessment Reports. Where the GLNG Aquatic Values Assessment Reports identified suitable habitat for EPBC listed species within the KP413.57 to KP419.69 section of the GTP ROW, these areas were incorporated into the pre-clearance survey report.

3.2 Mainland Environmental Management Plan (Mainland EMP)

The Mainland EMP is applicable to the mainland section of the GTP which runs from the gas fields at Fairview to the start point of the Marine Crossing EMP near Port Curtis. In accordance with conditions 2, 3 and 4 of the EPBC Act controlled action approval this EMP outlines the impacts of construction, operation and decommissioning of the GTP on listed threatened species and ecological communities, listed migratory species and values of the World and National Heritage listed Great Barrier Reef. The Mainland EMP was approved by DSEWPaC (now known as DoEE) on 21 June 2012.

3.3 Marine Crossing Environmental Management Plan (MEMP)

The Marine Crossing EMP is applicable to the Marine Crossing GTP section which runs from the north of Humpy Creek on the mainland in a south east direction, crossing The Narrows to the south of Kangaroo Island and terminating on Curtis Island. In accordance with conditions 2, 3 and 4 of the EPBC Act controlled action approval this EMP outlines the impacts of construction, operation and decommissioning of the GTP on listed threatened species and ecological communities, listed migratory species and values of the World and National Heritage listed Great Barrier Reef.

3.4 Curtis Island Environmental Management Plan (Curtis Island EMP)

The Curtis Island EMP is applicable to the Curtis Island section of the GTP which originates near Laird Point and connects to the LNG facility on Curtis Island, a distance of approximately 5 km. In accordance with conditions 2, 3 and 4 of the EPBC Act controlled action approval, this EMP outlines the impacts of construction, operation and decommissioning of the GTP on listed threatened species and ecological communities, listed migratory species and values of the World and National Heritage listed Great Barrier Reef.

3.5 Aquatic Values Management Plan (AVMP)

In accordance with conditions 37 and 38 of the EPBC Act controlled action approval, an AVMP has been prepared to identify the overall aquatic ecological values, and potentially suitable habitat for relevant species, within the proposed watercourse crossings. The AVMP outlines the design and construction phases in addition to identifying strategies to avoid, minimise and mitigate potential impacts of watercourse crossings. The AVMP will be submitted to DoEE and address all the mainland, tidal and Curtis Island watercourses within the GTP.

3.6 GLNG GTP Adverse Impact Assessment Methodology

The GLNG GTP Adverse Impact Assessment Methodology (AIAM) has been prepared to determine the significant, residual, adverse project impacts on fauna species and migratory species subject to the approval no. 2008/4096 granted under the EPBC Act Approval for the GTP.

The AIAM includes an investigation of MNES fauna species and their associated habitat's resilience to disturbance which was conducted via review of published, peer-reviewed scientific literature. This investigation identified MNES fauna species that are considered to be disturbance tolerant or disturbance specialists and habitat areas that are considered to represent disturbance resilient habitat.

The AIAM included the development of an assessment matrix which provided for a consistent, transparent and repeatable method by which the Project's impacts to MNES fauna species could be ranked and reflected in a GIS model. Key inputs to the assessment

matrix included assessments of the target species resilience, habitat resilience, habitat type and the key landscape attributes of the habitat area.

Species resilience was assessed via a 'species resilience questionnaire' which was developed to rank species in order of their resilience using a set of defined criteria. Habitat resilience was defined by the natural regeneration time associated with each key vegetation community which occurs within the GTP ROW. Habitat type was ranked using the habitat categories defined in this SSMP (i.e. core, essential, general or unlikely habitat). The potential impact of the proposed disturbance on regionally availably habitat for each species was assessed via a landscape attribute assessment which provided for assessment of three key landscape attributes; size of habitat patch, habitat connectivity and habitat context.

When the aforementioned inputs were combined into the AIAM assessment matrix, the matrix determined when an impact was considered to be a residual, adverse impact which is significant to a MNES fauna species and subject to offsets.

The AIAM provided the provision of a 'fatal flaw' trigger which identified extreme risk factors that result in a significant, residual, adverse impact on the target species and/or their preferred habitat and subsequently, the requirement for offset.

Revised MNES fauna habitat disturbance areas were calculated by a comparison of the assessment matrix outputs with the fauna habitat mapping presented in this SSMP to reflect areas that represent significant, residual, adverse impact to the species and/or its habitat values. The revised MNES fauna habitat disturbance area calculations were derived to be consistent with the Commonwealth's EPBC Act Environmental Offsets Policy (DSEWPaC 2013), and reflect that which represents the significant, residual, adverse impact to the species and/or its habitat values.

On the 16 July 2015 DotE accepted the use of the AIAM to determine the significant, residual, adverse impacts from the GLNG GTP project on the MNES fauna species subject to the project EPBC Act approval.

3.7 Standards and guidelines

Activities will be undertaken in consideration of the relevant components of the following guidelines, recovery plans and industry Codes of Practice:

- (Draft) Recovery Plan for the "Brigalow (*Acacia harpophylla* dominant and co-dominant)" Endangered Ecological Community (Butler 2007)
- (Draft) National Recovery Plan for the South-eastern Long-eared Bat *Nyctophilus corbeni* (Schulz & Lumsden 2010)
- The Action Plan for Australian Bats (Environment Australia 1999)
- The Action Plan for Australian Birds 2010 (Garnett *et al* 2011)
- Queensland Brigalow Belt Reptile Recovery Plan (Richardson 2006)
- National recovery plan for the large-eared pied bat *Chalinolobus dwyeri* (DERM 2011a)
- Japan-Australia Migratory Bird Agreement (JAMBA) (1981)
- China-Australia Migratory Bird Agreement (CAMBA) (1988)
- Republic of Korea- Australia Migratory Bird Agreement (ROKAMBA) (2007)
- BONN Convention (1983)

- Australian Petroleum Production and Exploration Association's (APPEA) Code of Environmental Practice (2008)
- Australian Pipeline Industry Association's (APIA) Code of Environmental Practice (Operations) (2005)
- Survey Guidelines for Australia's Threatened Birds (DEWHA 2010a)
- Survey Guidelines for Australia's Threatened Bats (DEWHA 2010b)
- Survey Guidelines for Australia's Threatened Frogs (DEWHA 2010c)
- Survey Guidelines for Australia's Threatened Mammals (DSEWPaC 2011b)
- Survey Guidelines for Australia's Threatened Reptiles (DSEWPaC 2011c)
- National Recovery Plan for the Water Mouse (False Water Rat) *Xeromys myoides* (DEHP 2010)
- Draft Significant impact guidelines for the vulnerable water mouse *Xeromys myoides* (DEWHA 2010)
- Draft Referral guidelines for the nationally listed Brigalow Belt reptiles (DSEWPaC 2011a)
- Collecting and preserving plant specimens, a manual: Queensland Herbarium (Bean 2010)
- Guidelines for the Translocation of Threatened Species in Australia (Vallee *et al* 2004)

Relevant standards include:

- Australian Standard 4801:2000 Occupational Health and Safety Management Systems – Specification with guidance for use, and AS/NZS ISO 14001:1996 Environmental Management Systems
- AS2885.1-1997 Gas and Liquid Petroleum – Design and Construction
- AS2885.3-1997 Gas and Liquid Petroleum – Operation and Maintenance
- Santos Environmental Health Safety Management System (EHSMS) Standards, as per the Construction Environmental Management Plan (CEMP)
- EIS Commitments and Approval Conditions

From time to time these standards and guidelines may be updated. GLNG Operations commits to ensuring the most up to date information, including guidelines, conservation advice and recovery plans for surveying, rehabilitation and all other relevant activities will be adopted and form part of the SSMP. Following any revisions, the revised SSMP will be submitted to DoEE for approval in accordance with conditions 41 to 43 of the EPBC Act controlled action approval.

4 Fauna habitat assessment

For the purpose of this SSMP, fauna habitat has been segregated into the following four distinct categories based on pre-clearance surveys, available scientific information, and expert advice contained within the Biodiversity Planning Assessment (BPA) (EPA 2006):

- 'Core habitat'
- 'Essential habitat'

- ‘General habitat’
- ‘Unlikely habitat’

Each of these habitat classifications are defined below. These habitat classifications have been used to assess direct disturbance impacts to EPBC Act threatened fauna species and migratory species habitat assessed within this SSMP. A specific set of habitat assumptions regarding each of the species contained within this SSMP have been made to categorise habitat into these categories. The species specific habitat assumptions are outlined within Part 2 of this SSMP.

4.1 Core habitat

‘Core habitat’ consists of ‘essential habitat’ in which the species is known and the habitat is recognised under relevant recovery plans or other relevant plans/policies/regulations. Also included within this category are populations that are limited geographically within the region.

4.2 Essential habitat

‘Essential habitat’ is an area containing resources that are considered essential for the maintenance of populations of the species (eg potential habitat for breeding, roosting, foraging, shelter, for either migratory or non-migratory species). ‘Essential habitat’ is defined from known records and/or expert advice (including the findings of pre-clearance surveys).

4.3 General habitat

‘General habitat’ consists of areas or locations that are used by transient individuals or where species may have been recorded but where there is insufficient information to assess the area as essential/core habitat. ‘General habitat’ also includes areas defined from known records or habitat that is considered to potentially support a species according to expert knowledge of habitat relationships, despite the absence of specimen backed records. ‘General habitat’ may include areas of suboptimal habitat for species. As potential habitat for many species contained within this SSMP may include most of the regional ecosystems of the Brigalow Belt Bioregion, the ‘general habitat’ category restricts the habitat to a more limited and realistic set of environmental parameters that are supported by literature and field based observation.

4.4 Unlikely habitat

‘Unlikely habitat’ areas are those areas that do not contain records of the particular species and contain no habitat values to support the presence or existence of resident or migratory individuals or populations of the species.

5 Significant Species Management Plans

The specific EPBC Act listed threatened species, migratory species and their habitat covered under this SSMP are shown in Table 5.1.

Table 5.1 Fauna species covered by this SSMP

Species	Part 2 (Management Plan) location
Cadelia pentasylis (Ooline)	Section 1
Xerothamnella herbacea	Section 3
Philotheca sporadica	Section 4
Cycas megacarpa (Large-fruited zamia)	Section 5
Geophaps scripta scripta (Squatter pigeon – southern)	Section 6
Turnix melanogaster (Black-breasted button-quail)	Section 8
Erythrotriorchis radiatus (Red goshawk)	Section 9
Botaurus poiciloptilus (Australasian bittern)	Section 10
Chalinolobus dwyeri (Large-eared pied bat)	Section 12
Nyctophilus corbeni (South-eastern long-eared bat)	Section 13
Dasyurus hallucatus (Northern quoll)	Section 14
Xeromys myoides (Water mouse)	Section 16
Denisonia maculata (Ornamental snake)	Section 17
Furina dunmalli (Dunmall's snake)	Section 18
Egernia rugosa (Yakka skink)	Section 20
Delma torquata (Collared delma)	Section 21
Rheodytes leukops (Fitzroy River turtle)	Section 22
Merops ornatus (Rainbow bee-eater)	Section 23.1
Apus pacificus (Fork-tailed swift)	Section 23.2
Haliaeetus leucogaster (White-bellied sea-eagle)	Section 23.3
Ardea modesta (Great egret)	Section 23.4
Ardea ibis (Cattle egret)	Section 23.5
Rostratula australis (Australian painted snipe)	Section 23.6
Pandion haliaetus (Eastern osprey)	Section 23.8
Monarcha melanopsis (Black-faced monarch)	Section 24.1
Monarcha trivirgatus (Spectacled monarch)	Section 24.2
Myiagra cyanoleuca (Satin flycatcher)	Section 24.3
Rhipidura rufifrons (Rufous fantail)	Section 24.4
Cuculus optatus (Oriental cuckoo)	Section 24.5
Eurystomus orientalis (Dollarbird)	Section 24.6
Egretta sacra (Eastern reef egret)	Section 25.1
Charadrius mongolus (Lesser sand plover)	Section 25.2
Charadrius ruficapillus (Red-capped plover)	Section 25.3
Pluvialis fulva (Pacific golden plover)	Section 25.4
Charadrius bicinctus (Double-banded plover)	Section 25.5
Actitis hypoleucos (Common sandpiper)	Section 25.6
Numenius minutus (Little curlew)	Section 25.7
Tringa stagnatilis (Marsh sandpiper)	Section 25.8

Species	Part 2 (Management Plan) location
Calidris canutus (Red knot)	Section 25.9
Xenus cinereus (Terek sandpiper)	Section 25.10
Calidris acuminata (Sharp-tailed sandpiper)	Section 25.11
Limosa limosa (Black-tailed godwit)	Section 25.12
Limosa lapponica (Bar-tailed godwit)	Section 25.13
Numenius madagascariensis (Far-eastern curlew)	Section 25.14
Numenius phaeopus (Whimbrel)	Section 25.15
Tringa nebularia (Common greenshank)	Section 25.16
Tringa brevipes (Grey-tailed tattler)	Section 25.17
Calidris tenuirostris (Great knot)	Section 25.18
Calidris ruficollis (Red-necked stint)	Section 25.19
Arenaria interpres (Ruddy turnstone)	Section 25.20
Recurvirostra novaehollandiae (Red-necked avocet)	Section 25.21
Calidris alba (Sanderling)	Section 25.22
Limicola falcinellus (Broad-billed sandpiper)	Section 25.23
Himantopus himantopus (Black-winged stilt)	Section 25.24
Calidris ferruginea (Curlew sandpiper)	Section 25.25
Charadrius leschenaultii (Great sand-plover)	Section 25.26
Gallinago hardwickii (Latham's snipe)	Section 25.27
Pluvialis squatarola (Grey plover)	Section 25.28
Sternula albifrons (Little tern)	Section 26.1
Sterna caspia (Caspian tern)	Section 26.2

6 Offsets

6.1 Background

On 27 April 2011, GLNG Operations submitted to the DSEWPaC (now known as DoEE) the 'Gas Transmission Pipeline Environmental Offset Plan'. The Plan was prepared by Ecofund Queensland on behalf of GLNG Operations and in accordance with the conditions of the EPBC Act approval.

Since the development of the Gas Transmission Pipeline Environmental Offset Plan, Santos GLNG has continued to advance offset delivery for the GLNG project. The Offset Plan detailing the final acquittal of offsets for the GTP is discussed in Section 6.3.

GLNG has and will continue to engage with the Commonwealth Government to progress the assessment and approval of this Offset Plan.

6.2 Offset requirements

The GLNG EIS and Supplementary EIS (SEIS) outlined the proposed route alignment and construction methodology for the GTP that was determined on a "Base Case" route alignment. The GTP requires a broad range of environmental offsets for a diverse suite of

environmental values. This is due to the extent of the geographic area that the GTP spans and the diversity of ecosystems and habitats proposed to be impacted.

The offset requirements for the GTP were developed in consultation with DotE and DEHP policies at the time of approval. Final ratios and numbers were estimated by Ecofund Queensland based on the following considerations:

- The environmental impacts from the construction of the GTP recorded in the GLNG EIS and SEIS
- The offset ratios provided in the EPBC Act approval
- Environmental offsets under the Draft Policy Statement: Use of environmental offsets under the EPBC Act
- The Queensland Government offset policies including:
  - *Vegetation management offsets under the Policy for vegetation management offsets (2009) under the VM Act*
  - *Protected flora and fauna offsets under Nature Conservation (Protected Plants) Conservation Plan 2000 (Qld) under the NC Act*
  - *Marine plants and fisheries habitat offsets under the Mitigation and Compensation for Works and Activities Causing Marine Fish Habitat Loss 2002*
  - *Biodiversity offsets under the Draft Policy for Biodiversity Offsets 2008*

Table 6.1 shows the final ratios used to determine the offset requirements for the various protected matters potentially impacted by the GTP and ancillary work areas. Additional EPBC Act listed fauna species and their conservation status will be included in Table 6.1 for subsequent SSMP revisions where these species have their habitat impacted by the GTP.

Table 6.1 Ratios used to determine offset requirements

MNES matter	Offset ratio	Source
Endangered ecological community	8:1	EPBC Act approval conditions
Endangered flora	6:1	
World heritage values	5:1	
Migratory birds	8:1	
Vulnerable reptiles	8:1	
Vulnerable birds	8:1	
Endangered birds	8:1	
Vulnerable mammals	8:1	
Endangered mammals	8:1	

Where offsets are required under more than one policy, where possible, a single offset will be secured to meet multiple policy requirements. Similarly, where possible, multiple offset requirements under a single offset policy will be acquitted with a single offset property.

Since the granting of the respective approvals for the GLNG GTP, the pipeline route has been further refined and detailed pre-clearance surveys have been undertaken along the proposed ROW and ancillary work areas to map environmentally sensitive areas, remnant

ecosystems, threatened ecological communities, and habitat areas for EPBC Act listed species, and confirm potential impacts to threatened flora, fauna and migratory species (ie MNES species). The unavoidable impacts on EPBC Act listed threatened species and migratory species habitats are contained in Part 2 of this SSMP.

The '*Environment Protection and Biodiversity Conservation Act 1999* Environmental Offsets Policy' (DSEWPaC 2012bk) states that 'environmental offsets' are measures that compensate for the residual adverse impacts of an action on the environment and defines residual, adverse impacts as those impacts which remain after avoidance and mitigation measures have been implemented. The EPBC Act only requires residual, adverse impacts to be offset if the impact is considered to be 'significant' as defined by the 'Matters of National Environmental Significance – Significant Impact Guidelines Version 1.1' (DoEE 2013).

On the 16 July 2015, DoEE accepted the use of the AIAM (as discussed in Section 3.6 of this SSMP) to determine the significant, residual, adverse impacts from the GLNG GTP project on the MNES fauna species subject to the projects EPBC Act approval. By identifying areas of residual adverse impacts for MNES species, it allows the project to focus on developing offset strategies that account for the residual, adverse impacts to species and habitat which is a more practical approach and consistent with the EPBC Act Environmental Offsets Policy.

The identified significant, residual, adverse impacts to the MNES fauna species and/or their habitat values subject to the project EPBC Act approval will work in conjunction with the ratios provided in this SSMP and provide the Project's offset contributions in accordance with Project the EPBC Act approval.

Table 6.2 Proposed MNES offset quantities (KP0 to KP30, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69)

MNES Species	Species number or habitat area disturbed (ha)									Proposed offset ratio	Proposed number of species or habitat offset area (ha)
	KP0 to KP30	KP30 to KP40	KP40 to KP130	KP130 to KP312	KP312 to KP408.81	KP408.81 to KP409.04	KP413.57 to KP419.69	Total	Total offsetable habitat area (AIAM applied)		
Cadelia pentasylis (Ooline)	0	0	36 ind	0	0	0	0	36 ind	N/A	6:1	216 ind
Xerothamnella herbacea	0	42 ind	0	0	0	0	0	42 ind[1]	N/A	6:1	252 ind
Philotheca sporadica	0	0	0	0	0	0	0	0	N/A	6:1	0 ind
Cycas megacarpa (Large-fruited zamia)	0	0	0	0	1,100 ind	0	0	1,100 ind[2]	N/A	No ratio	3,990 ind[2]
Geophaps scripta scripta (Squatter pigeon)	55.11	24.32	441.60	476.97	393.42	12.29	0	1,403.71	225.15	8:1	1801.2
Turnix melanogaster (Black-breasted button-quail)	0.24	0	0	0	2.37	0	0	2.61	2.61	8:1	20.88
Erythrotriorchis radiatus (Red goshawk)	9.03	6.94	0	9.24	43.70	0	0	68.91	68.91	8:1	551.28
Botaurus poiciloptilus (Australasian bittern)	0	0	0	0.37	1.15	0	0	1.52	0.80	8:1	6.4
Chalinolobus dwyeri (Large-eared pied bat)	6.33	16.67	0	24.52	0.91	0	0	48.43	44.11	8:1	352.88
Nyctophilus corbeni (South-eastern long-eared bat)	10.80	16.67	4.24	79.82	58.16	3.50	0	173.19	142.91	8:1	1143.28

[1] final number of *Xerothamnella herbacea* individual plants to be cleared has been determined prior to construction commencing and has been reported to DotE in accordance with Part 1, Section 7.2 of this SSMP

[2] offset requirements are in accordance with EPBC approval 2008/4096 Condition 23 (a)

MNES Species	Species number or habitat area disturbed (ha)									Proposed offset ratio	Proposed number of species or habitat offset area (ha)
	KP0 to KP30	KP30 to KP40	KP40 to KP130	KP130 to KP312	KP312 to KP408.81	KP408.81 to KP409.04	KP413.57 to KP419.69	Total	Total offsetable habitat area (AIAM applied)		
Xeromys myoides (Water mouse)	0	0	0	0	0	0.33	0.01	0.34	0.01	8:1	0.08
Dasyurus hallucatus (Northern quoll)	0.67	0	0	0	0.86	0	0	1.53	1.53	8:1	12.24
Denisonia maculata (Ornamental snake)	0.93	16.12	0.01	9.16	0	0	0	26.22	25.46	8:1	203.68
Furina dunmalli (Dunmall's snake)	28.65	12.21	0	52.53	2.36	0	0.42	96.17	79.78	8:1	638.24
Egernia rugosa (Yakka skink)	10.80	15.34	0	37.48	13.45	0	0	77.07	63.11	8:1	504.88
Delma torquata (Collared delma)	40.09	16.12	0	44.98	0.88	0	0.42	102.49	86.22	8:1	689.76
Rheodytes leukops (Fitzroy river turtle)	0.49	0	0	1.93	0.17	0	0	2.59	1.05	8:1	8.4
Merops ornatus (Rainbow bee-eater)	118.84	42.58	397.39	872.52	405.78	2.71	12.89	1,852.71	225.39	8:1	1803.12
Apus pacificus (Fork-tailed swift)	0	0	0	0	0	0	0	0	0	8:1	0
Haliaeetus leucogaster (White-bellied sea-eagle)	25.73	6.94	10.38	129.49	34.81	0	3.20	210.55	25.09	8:1	200.72
Ardea modesta (Great egret)	0	0	0.06	11.18	1.52	0	0	12.76	3.83	8:1	30.64
Ardea ibis (Cattle egret)	4.79	21.79	447.04	774.82	315.15	4.73	0	1,568.32	1.67	8:1	13.36
Rostratula australis (Australian painted snipe)	0	0	0.06	4.12	1.52	0	0	5.70	4.79	8:1	38.32
Pandion haliaetus (Eastern osprey)	0	0	0	0	30.96	0	0	30.96	1.40	8:1	11.2

MNES Species	Species number or habitat area disturbed (ha)									Proposed offset ratio	Proposed number of species or habitat offset area (ha)
	KP0 to KP30	KP30 to KP40	KP40 to KP130	KP130 to KP312	KP312 to KP408.81	KP408.81 to KP409.04	KP413.57 to KP419.69	Total	Total offsetable habitat area (AIAM applied)		
Migratory woodland species *Monarcha melanopsis* (Black-faced monarch) *Monarcha trivirgatus* (Spectacled monarch) *Myiagra cyanoleuca* (Satin flycatcher) *Rhipidura rufifrons* (Rufous fantail) *Cuculus optatus* (Oriental cuckoo) *Eurystomus orientalis* (Dollarbird)	0	0	0	0	9.63	2.79	3.29	15.71	14.68	8:1	117.44
Egretta sacra (Eastern reef egret)	0	0	0	0.37	0.81	0.33	0.01	1.52	0.80	8:1	6.40
Charadrius mongolus (Lesser sand plover)	0	0	0	0.37	0.81	0.33	0.01	1.52	0.80	8:1	6.40
Charadrius ruficapillus (Red-capped plover)	0	0	0	0.37	0.81	0.33	0.01	1.52	0.80	8:1	6.40
Pluvialis fulva (Pacific golden plover)	0	0	0	0.37	0.81	0.33	0.01	1.52	0.80	8:1	6.40
Charadrius bicinctus (Double-banded plover)	0	0	0	0.37	0.81	0.33	0.01	1.52	0.80	8:1	6.40
Actitis hypoleucos (Common sandpiper)	0	0	0	0.37	0.81	0.33	0.01	1.52	0.80	8:1	6.40
Numenius minutus (Little surlew)	0	0	0	0.37	0.81	0.33	0.01	1.52	0.80	8:1	6.40
Tringa stagnatilis (Marsh sandpiper)	0	0	0	0.37	0.81	0.33	0.01	1.52	0.80	8:1	6.40

MNES Species	Species number or habitat area disturbed (ha)									Proposed offset ratio	Proposed number of species or habitat offset area (ha)
	KP0 to KP30	KP30 to KP40	KP40 to KP130	KP130 to KP312	KP312 to KP408.81	KP408.81 to KP409.04	KP413.57 to KP419.69	Total	Total offsetable habitat area (AIAM applied)		
Calidris canutus (Red knot)	0	0	0	0.37	0.81	0.33	0.01	1.52	0.80	8:1	6.40
Xenus cinereus (Terek sandpiper)	0	0	0	0.37	0.81	0.33	0.01	1.52	0.80	8:1	6.40
Calidris acuminata (Sharp-tailed sandpiper)	0	0	0	0.37	0.81	0.33	0.01	1.52	0.80	8:1	6.40
Limosa limosa (Black-tailed godwit)	0	0	0	0.37	0.81	0.33	0.01	1.52	0.80	8:1	6.40
Limosa lapponica (Bar-tailed godwit)	0	0	0	0.37	0.81	0.33	0.01	1.52	0.80	8:1	6.40
Numenius madagascariensis (Eastern curlew)	0	0	0	0.37	0.81	0.33	0.01	1.52	0.80	8:1	6.40
Numenius phaeopus (Whimbrel)	0	0	0	0.37	0.81	0.33	0.01	1.52	0.80	8:1	6.40
Tringa nebularia (Common greenshank)	0	0	0	0.37	0.81	0.33	0.01	1.52	0.80	8:1	6.40
Tringa brevipes (Grey-tailed tattler)	0	0	0	0.37	0.81	0.33	0.01	1.52	0.80	8:1	6.40
Calidris tenuirostris (Great knot)	0	0	0	0.37	0.81	0.33	0.01	1.52	0.80	8:1	6.40
Calidris ruficollis (Red-necked stint)	0	0	0	0.37	0.81	0.33	0.01	1.52	0.80	8:1	6.40
Arenaria interpres (Ruddy turnstone)	0	0	0	0.37	0.81	0.33	0.01	1.52	0.80	8:1	6.40
Recurvirostra novaehollandiae (Red-necked avocet)	0	0	0	0.37	0.81	0.33	0.01	1.52	0.80	8:1	6.40
Calidris alba (Sanderling)	0	0	0	0.37	0.81	0.33	0.01	1.52	0.80	8:1	6.40

MNES Species	Species number or habitat area disturbed (ha)									Proposed offset ratio	Proposed number of species or habitat offset area (ha)
	KP0 to KP30	KP30 to KP40	KP40 to KP130	KP130 to KP312	KP312 to KP408.81	KP408.81 to KP409.04	KP413.57 to KP419.69	Total	Total offsetable habitat area (AIAM applied)		
Limicola falcinellus (Broad-billed sandpiper)	0	0	0	0.37	0.81	0.33	0.01	1.52	0.80	8:1	6.40
Himantopus himantopus (Black-winged stilt)	0	0	0	0.37	0.81	0.33	0.01	1.52	0.80	8:1	6.40
Calidris ferruginea (Curlew sandpiper)	0	0	0	0.37	0.81	0.33	0.01	1.52	0.80	8:1	6.40
Charadrius leschenaultii (Greater sand plover)	0	0	0	0.37	0.81	0.33	0.01	1.52	0.80	8:1	6.40
Gallinago hardwickii (Latham's snipe)	0	0	0	0.37	0.81	0.33	0.01	1.52	0.80	8:1	6.40
Pluvialis squatarola (Grey plover)	0	0	0	0.37	0.81	0.33	0.01	1.52	0.80	8:1	6.40
Sternula albifrons (Little tern)	0	0	0	0	0.05	0	0	0.05	0.05	8:1	0.40
Sterna caspia (Caspian tern)	0	0	0	0	0.05	0	0	0.05	0.05	8:1	0.40

Table note: ind = individual specimens

Offsets for disturbance of 11.232 ha to Brigalow TEC for the GTP will be undertaken pursuant to the proposed offset ratio referenced in Table 6.1.

Offsets for approved disturbance to 2.4 ha of SEVT TEC for the GTP will be addressed as part of the GLNG GTP EPBC Act approval (EPBC No. 2008/4096) conditions 15 to 22.

After clearing has been completed, GLNG will utilise the final recorded figures of clearing in these mapped habitat areas for determining the final unavoidable impacts to MNES fauna species habitat.

It is important to note that the majority of the 'general habitat' identified in this SSMP is contained within non remnant and highly disturbed environments that have extensive coverage of non-native flora species.

Given that the 'precautionary principal' has been used to map the 'general habitat' areas there is a likelihood that these areas are overestimated (ie worst case scenario) for the following fauna species habitat within KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69:

- Squatter pigeon
- Red goshawk
- Dunmall's snake
- Collared delma
- Rainbow bee-eater
- White-bellied sea-eagle
- Cattle egret

The remaining species within Part 2 of this SSMP as listed in Table 6.2, the mapping provided is considered to be a true reflection of habitat contained within the ROW and ancillary work areas.

The criteria to be used by GLNG to potentially refine 'general habitat' areas to 'unlikely habitat' include:

- New research findings by expert advisors on EPBC Act listed fauna species and migratory bird species habitat requirements
- Developing a new GIS habitat modelling procedure and additional targeted surveys that allows highly modified 'general habitat' to be mapped as 'unlikely habitat' for specific fauna species (eg Squatter pigeon does not utilise cleared agricultural areas dominated by exotic pasture species)
- Lack of sufficient micro-habitats for specific fauna species (eg bats)
- Non flowing permanent water bodies with topographic, water quality or ecological conditions that provide 'unlikely habitat' for specific fauna species (eg Squatter pigeon prefers not to utilise water bodies with steep sided banks which preclude easy access)

If GLNG refines the mapping of 'general habitat' areas contained within this SSMP (KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69) through additional studies and this change results in a revised unavoidable impact on MNES, GLNG will request a variation to the approved

SSMP in accordance with the EPBC Act controlled action conditions 41 to 43 (EPBC No 2008/4096).

6.3 Offset Plan

Santos GLNG will provide a revised Offset Plan for significant residual adverse impacts to MNES associated with the construction of the GTP. The GLNG Offset Plan (Document Number 0007-560-PLA-0014) will allow Santos GLNG to provide final acquittal of the offset obligations for the Gas Transmission Pipeline project (EPBC Act approval (2008/4096)). Specifically, this Offset Plan will provide acquittal of the offset obligations from the GTP project (EPBC Act approval (2008/4096)) not yet acquitted by Santos GLNG through the *Monte Christo Offset Proposal Document 3301-GLNG-4-1.3-0049.* The GLNG Offset Plan will include:

- Maps and site description for the two properties, known as “Kentucky” and “Bottle Tree”, used to acquit these obligations and the timing and arrangements for property acquisition
- Detailed acquittal tables showing where the offsets obligations for Gas Transmission Pipeline project (EPBC Act approval (2008/4096), including those listed in Table 6.2 below
- Offset values assessment reports for the properties known as “Kentucky” and “Bottle Tree”. These reports detail the TEC mapping as well as the extent of potential habitat for EVNT fauna species subject to offsets in Santos GLNG’s environmental approvals
- Offset property management plans for each of the properties known as “Kentucky” and “Bottle Tree”. The management plans detail how the offset values present on Bottle Tree and Kentucky are protected, maintained and enhanced for the purposes of providing environmental offsets for the Santos GLNG Project
- Measures to address threats to MNES, including but not limited to grazing pressure and damage by livestock and adverse impacts from feral animals and weeds
- Fire prevention measures and management regimes appropriate for the MNES
- Management of revegetation areas to the stage where habitat is established or improved for listed species and revegetation areas meet the criteria for ‘remnant status’ for that threatened ecological community
- An objective, that revegetation areas meet the criteria applicable at the time for ‘remnant status’ and measures to ensure application is made to have the revegetation areas reclassified as ‘remnant vegetation’ in accordance with the relevant Queensland legislation
- Monitoring including the undertaking of ecological surveys to assess the success of the management measures against identified milestones and objectives
- Performance measures and reporting requirements against identified objectives, including trigger levels for corrective actions and the actions to be taken to ensure performance measures and objectives are met

The GLNG Offset Plan will be submitted for approval in accordance with the EPBC Act approval 2008/4096 and will be implemented. If the approved GLNG Offset Plan cannot be implemented, an alternative Plan will be submitted for the Minister’s approval. The

alternative Plan will provide at least an equivalent environmental outcome and the approved alternative Plan will be implemented.

If any action within a proposed offset area is suggested, other than actions related to managing that area as an offset property, an approval will be obtained, in writing from DoEE. A detailed assessment will be provided of the proposed action, including a map identifying where the action is proposed to take place and an assessment of all associated adverse impacts on MNES. If DoEE agrees to the action within the proposed offset site, the area identified for the action will be excised from the proposed offset and alternative offsets secured of equal or greater environmental value in relation to the impacted MNES.

7 Common SSMP Procedures

7.1 Spotter catcher requirements

All spotter catchers will be licensed and experienced and hold a current Rehabilitation Permit under the *Nature Conservation Act 1992.* All spotter catchers will undertake the handling of native wildlife in accordance with the *Code of Practice – Care for Orphaned, Sick or Injured Protected Animals by Wildlife Care Volunteers* prepared by DEHP.

If clearing in a Koala habitat area, a Koala spotter catcher will undertake the work in accordance with the *Nature Conservation (Koala) Conservation Plan 2006 and Management Program 2006-2016.* A Koala spotter is a person who has demonstrated experience in locating koalas in koala habitats or conducting fauna surveys.

If handling bats, the spotter catcher will need to ensure they have had the appropriate vaccinations. DoEE will be consulted if Large-eared pied bat roosts are identified within or in close proximity to the GTP ROW and ancillary areas. Consultation must occur prior to any vegetation clearing or other construction activity in the relevant area.

Only spotter catchers that have been deemed competent after having completed a venomous snake handling course may handle venomous snakes.

Frog handling will be undertaken in accordance with the *Technical Manual: Hygiene Protocol for Handling Amphibians* prepared by DERM (now DEHP).

7.2 Monitoring, reporting and record keeping

Monitoring of the SSMP will be achieved through the compilation of incidental, weekly and monthly inspections and reporting. Reporting will be undertaken in accordance with the aims and objectives of the CEMP.

During the GTP Project the EO will regularly review the conservation status of flora and fauna species by keeping abreast of relevant literature and through consultation with DEHP, DNRM and DoEE.

The SSMP will be updated as required during the life of the Project to include changes to the conservation status of species identified on site, new species populations and changes to management measures.

From time to time legislation, standards and guidelines may be updated. GLNG commits to ensuring the most up to date information, including guidelines, conservation advice and recovery plans for surveying, rehabilitation and all other relevant activities will be adopted and form part of the SSMP.

GLNG will maintain accurate records substantiating all activities associated with or relevant to the EPBC Act controlled action conditions, including measures taken to implement this SSMP.

The records will also be made available to the DoEE, DNRM and DEHP upon request.

7.3 Species of Conservation Interest (SOCI) logbook

EPBC Act listed threatened fauna, migratory species and/or their habitat disturbed and encountered during pre-clearing, construction and operational works will be recorded in the SOCI logbook and mapped in the supporting ecological GIS database. The information collated in the SOCI will include:

- Location of the community or species
- Person reporting the sighting
- Status of active and inactive nests (eg Squatter pigeon)
- Habitat type the species inhabited
- Total area cleared and time of the clearing works
- Where necessary, where the species was relocated or translocated to
- Incidents
- Remedial actions

7.4 Annual Environmental Return

The SOCI logbook will support the Annual Environmental Return, which will be submitted to DoEE electronically, within 20 business days of each anniversary date from the date of the EPBC Act controlled action approval (ie 22 October 2010). The Annual Environmental Return will:

- Demonstrate compliance with the EPBC Act controlled action conditions
- Detail where there was any unavoidable adverse impacts on MNES, mitigation measures applied to avoid impacts on MNES; and any rehabilitation work undertaken in connection with any unavoidable impact on MNES
- Detail any non-compliances with the EPBC Act controlled action conditions
- Detail any amendments needed to plans to achieve compliance with these conditions

7.5 Fauna incidents

Any incident that results in the injury or fatality of an animal will be recorded on Accident, Injury and Incident Reporting template sheets. Details of the incident including time and date of incident, cause of injury/mortality and the species (if known) will be recorded and reported to DoEE and DEHP within 24 hours of its occurrence.

7.6 Non-conformance

For clarity, environmental non-conformances will be referred to as environmental issues to differentiate them from GTP Project non-conformances, which typically relate to quality defects in items of plant or materials. An environmental issue will be detected through verification processes such as monitoring, inspections, audits and receipt of complaints.

The process for managing environmental issues will be in accordance with GLNG Operations' Internal and Project Policies and Procedures. When an environmental issue is detected, the following actions will occur:

- The incident will recorded in the Incident Management System (IMS)
- The nature of the event will be investigated by the EO
- Advice may be sought from a specialist where the extent of the issue is beyond the expertise of the in-house resource
- Monitoring will be undertaken where the issue is complaint driven and the impact may be outside the project parameters
- The effectiveness or need for new/additional controls will be reviewed
- An appropriate preventative and corrective action will be entered into the environmental IMS and implemented
- Strategies will be identified to prevent reoccurrence
- The incident will be closed-out
- Environmental documentation (ie CEMP) will be reviewed and revised

Where the issue impacts on a third party (ie is outside the project area or in breach of regulatory conditions) the EO will also issue an Incident Report. In addition to the above, where an issue of a more serious nature has been identified, the following will apply:

- Stop work
- Implement an immediate action to rectify the incident and stop further damage
- Report the incident
- Identify corrective and preventative actions
- If the incident impacts upon Commonwealth or State interests, the Incident Report will also be forwarded to the relevant authority
- The incident will be reported in monthly GTP management reports
- Associated environmental issues and corrective actions will be tracked

Where non-compliance occurs with regard to the EPBC Act controlled action approval conditions, a report will be submitted to DoEE within five business days. The report will outline the type of non-compliance and the remedial actions taken to ensure that the matter is resolved within a reasonable timeframe. The timeframe will be specified in writing by DoEE.

7.7 Training and awareness

In accordance with GLNG Operations policy all personnel and visitors will be required to undertake appropriate environmental training and induction programmes.

As part of the training programme, all project personnel are required to complete site specific environmental awareness training which is to be conducted by the EO. As a minimum, the training will consist of a presentation and an assessment questionnaire. The site induction will address the following:

- Species targeted by the SSMP (awareness training)

- Location of sensitive areas (eg threatened species habitat areas, wetlands and habitat trees)
- Vegetation protection areas and 'No Go' Zones
- Procedures and actions associated with encountering fauna
- Weed identification and control
- Responses and reporting of environmental issues
- Speed limited in the GTP ROW (50 km/hr maximum)

This training will be delivered by the Environmental Construction Manager/Environmental Officer(s). This will be undertaken within the initial induction process, ongoing toolbox meetings and relevant Construction Method Statements.

Where possible, personnel will also be shown photographs and given general information on significant species and ecological communities identified within and adjacent the GTP ROW and ancillary work areas, this will enable them to identify these species should they be encountered.

7.8 Environmental health and safety management framework

7.8.1 Santos GLNG Environment Health, Safety and Management System (EHSMS)

This section provides an introduction to the EHSMS for operations. An overview of the Santos EHSMS is provided together with further information on key components of the system considered to be specifically relevant to the construction of the GTP.

The framework has been developed to ensure compliance with Australian Standard (AS) 4801:2000 Occupational Health and Safety Management Systems – Specification with guidance for use, and AS/NZS ISO 14001:1996 Environmental Management Systems – Specification with guidance for use. The Santos EHSMS applies to all Santos GLNG operations.

7.8.2 Overall EHSMS structure

The EHSMS framework consists of multiple layers, the key components being management and hazard standards.

The documents that make up each level of the EHSMS are maintained in electronic form on a central server (The Well) that is accessible to all Santos and GLNG sites and employees.

7.8.3 EHSMS management standards (1-80029)

Management Standards are documents which define the requirements necessary to ensure that environmental, health and safety risk is systematically managed. Management standards have been developed as part of the EHSMS.

7.8.4 EHSMS hazard standards (HSHS (0-19))

Hazard Standards detail the controls required to manage the risks of specific hazards to acceptable levels. These apply to all Santos operations. They contain specific requirements for planning and undertaking activities and include checklists and references to internal and external approvals and controls.

7.9 Prevention and correction

The EO will review any correction and preventative actions required if an event occurs. These will be approved and documented by the Construction Contractor.

7.9.1 Preventative actions

Preventative actions will be managed as follows:

- Environmental incidents along with their preventative and corrective actions will be recorded in the Incident Management System. Preventative and corrective actions will be updated into the CEMP. Future audits will check for compliance with the CEMP and that the necessary preventative actions are in place
- Reviews of environmental performance will be undertaken through consideration of key performance indicators, objectives and targets, and benchmark performance
- Where assessed by the EO (as necessary), a preventative action will be raised and action undertaken as a Corrective Action. Preventative actions may include changes to specific procedures or training requirements, or other management areas

7.9.2 Contingency measures

GLNG Operations recognises that contingency measures and adjustments to the management strategies may need to be considered in the event that a detrimental impact is recorded, and/or performance measures or targets are not met.

In the event that additional EPBC Act listed threatened species, migratory species and their habitat (other than those identified in this SSMP) are identified within the Project area during construction activities, a revised SSMP will be submitted to DoEE for approval in accordance with condition 10 of the EPBC Act controlled action approval. Work will not continue within the construction area where the MNES was encountered until the revised SSMP has been approved by DoEE.

In the event that fauna are injured or killed during works or where there is illegal clearing of vegetation communities or native flora, the current mitigation strategies will be reviewed in conjunction with the relevant specialist and any recommended changes implemented.

7.10 Emergency preparedness and response

An Incident Response Plan will be prepared for the GTP Project and will be outlined in the CEMP. This plan will document suitable incident procedures to ensure effective response in the event of an emergency (including environmental emergencies such as fire, flood and large fuel spills).

The emergency procedures shall be tested on a six-monthly basis. Records of all site emergencies will be maintained (eg results of emergency practice drills). The Emergency Response Controller for the GTP Project will be defined within the Incident Response Plan. This will also include the use contingency measures to check open trenches during and after rainfall events.

An up-to-date list of emergency response personnel and organisations will be maintained at each site office and compound.

8 Variations to the SSMP

Once the SSMP has been approved by the Minister (Commonwealth), any revisions will be submitted for Ministerial approval, if the works are to be undertaken other than in accordance with the approved plans and governing conditions. This will include any changes to the SSMP requested by the Commonwealth.

For any revision to the approved SSMP, the Minister will be provided at least 20 business days for review and consideration of the revised plan, unless otherwise agreed in writing between GLNG Operations and the Minister.

Until the revised SSMP is approved by the Minister, works must continue in accordance with the original approved SSMP. Once the revised SSMP is approved, this plan will supersede the original SSMP.

9 Compliance and evaluation

The compliance component of this SSMP will be developed in accordance with the CEMP and Commonwealth and State approval conditions.

9.1 Ecological performance auditing

The regulatory agencies associated with environmental matters may also conduct regular works inspections. The relevant EO shall attend these inspections.

GLNG Operations will conduct internal compliance audits of the implementation of Project environmental management commitments during the construction and operational phases, including:

- Onsite audits of compliance with this SSMP
- Audits of contractor's environmental management
- Work area inspections and monitoring

Non-conformances identified during inspections will be documented, addressed with appropriate corrective and preventive actions, and rectified within an agreed timeframe.

9.2 External audits

External audits will be undertaken on an annual basis by an independent auditor approved by the Minister (Commonwealth). The audits will be conducted in accordance with AZ/NZ ISO9011.2003 Guidelines for Quality and/or Environmental Systems Auditing and/or Section 458 of the EPBC Act and may be used to verify compliance with the EPBC Act controlled action conditions.

The external auditors report will document the following:

- The components of the GTP Project being audited
- The conditions that were activated during the period covered by the audit
- A compliance/non-compliance table
- A description of the evidence to support audit findings of compliance or non-compliance
- Recommendations on any non-compliance or other matter to improve compliance

- A response by the GLNG Operations to the recommendations in the report (or, if the GLNG Operations does not respond within 20 business days of a request to do so by the auditor, a statement by the auditor to that effect)
- Certification by the independent auditor of the findings of the audit report

Audits or summaries of audits carried out under the EPBC Act controlled action conditions, or under Section 458 of the EPBC Act, may be posted on the DoEE website. The results of such audits may also be publicised through the general media.

If during the auditing process, any non-compliance with the EPBC Act controlled action conditions is identified, DoEE will be provided with written advice within 20 business days of the audit report. The written advice will outline:

- Actions taken by the GLNG Operations to ensure compliance with these conditions
- Actions taken to prevent a recurrence of any non-compliance, or implement any other recommendation to improve compliance, identified in the audit report

Santos
GLNG Project

Part 2
Management Plans

Part 2 – Management Plans

1 Ooline Management Plan

1.1 EPBC Act legal status

Vulnerable - listed 16 July 2000

1.2 Biology and ecology

1.2.1 Characteristics

Cadellia pentastylis (Ooline) is a tree to 10 m (occasionally 25 m) high with a bushy crown and dark grey bark which is hard and fissured (Threatened Species Scientific Committee (TSSC) 2008; Santos 2007). Leaves are alternate, simple (undivided) on short hairy stalks (petioles) which are 2 to 7 mm long, glossy (including when juvenile), green on top, paler and dull underneath. The leaf blades are obovate (egg-shaped) to elliptical usually 1 cm to 7 cm long and 1.5 cm to 2 cm wide with broad rounded tips. Veins are prominent on both sides when dry (TSSC 2008; Harden 2012).

The flowers are single with five petals and approximately 20 mm in diameter. Flowers are usually white in colour, but may also appear greenish or reddish. The main flowering period is usually between October to November, but the timing of flower may vary depending on environmental factors (TSSC 2008; Santos 2007). Fruit is brownish in colour with a wrinkled surface. Fruit are presented in a cluster of 3 to 5 balls (drupes) at the centre of the old flower. Each segment is 3 to 5 mm long and contains a single, hard-coated seed (Santos 2007).

Form, bark, flower and fruiting body of *Cadellia pentastylis* (Source: Santos 2007; A. Wain n.d)

1.2.2 Known distribution

The range of Ooline extends from the western edge of the New South Wales north-west slopes, from Mt Black Jack near Gunnedah to west of Tenterfield into Queensland to the Carnarvon Range and Callide Valley, south-west of Rockhampton (TSSC 2008). Figure 1.1 is an indicative distribution map of the present distribution of Ooline.

Figure 1.1 Mapped distribution range of *Cadellia pentastylis* (Source: DSEWPaC 2012a)

1.2.3 Known species populations and their relationship with the GTP footprint

This species has been identified in predominantly cleared pastoral grazing paddocks between KP92 and KP108 of the GTP ROW and is considered to be locally common within the Arcadia Valley area.

Additionally, five individuals have been located within the Camp 1 site (Arcadia Valley).

Further pre-clearance survey work undertaken by Ausecology has identified additional seedling and juvenile regrowth Ooline plants within and in close proximity to the ROW between KP92 and KP107. These plants were not observed in the original survey likely due to the lack of vegetative matter associated with their seasonality and their early development as recent regrowth specimens.

Figure 1.2 shows the location of Ooline species between KP40 and KP130.

The additional Ooline plants identified by additional Ausecology pre-clearance surveys are as individual juvenile plants and are within seven discreet areas between KP92 and KP107 of the GTP ROW. Within each area, the juvenile Ooline plants are clustered within close proximity to each other and have been represented on Figure 1.2 as areas within the GTP ROW as they are not distinguishable on Figure 1.2 as individual points.

1.2.4 Habitat

Ooline occurs in a range of vegetation types, and often associates with *Acacia harpophylla* (Brigalow), *Casuarina cristata* (Belah), *Acacia catenulata* (Bendee) and *Lysiphyllum carronii* (Red bauhinia) species in dry rainforest, semi-evergreen vine thicket and sclerophyll communities. Ooline may be observed as the locally dominant species within such communities. This species is found on clay plains, sandstone slopes, and ridgelines between 200 and 500 m above sea level, often on the moderately fertile soils preferred for agriculture and pasture development (TSSC 2008; Santos 2007; DERM 2012).

1.2.5 Biology and reproduction

The primary flowering period for Ooline in Queensland is October through to November, although the intensity and timing of flowering often varies between years (Santos 2007). Fruiting has been recorded between November and December (DERM 2012). Dispersal of seed is likely to occur as a result of “passive fall” or from birds. Seeds show a high rate of

infertility, although they have been successfully germinated using heat application (TSSC 2008). Ooline has the capacity to resprout and coppice, hence the number of genetic individuals in some stands may be much lower than the number of stems present (DEH 2011).

1.3 Anticipated threats and potential impacts from GTP

The most significant threats to Ooline have been identified by the TSSC (2008) as:

- Clearing for agriculture
- Localised extinction due to small, fragmented and scattered populations
- Reduced genetic diversity or genetic depression resulting from inbreeding in small populations
- Low seed viability
- Grazing and soil compaction by domestic stock, feral goats and pigs – seedling recruitment is inhibited by soil compaction and grazing
- Fire – juvenile trees are sensitive to all fire, although adult trees appear able to withstand low-intensity fires
- Invasion of habitat by weeds
- Tunnel and sheet erosion
- Damage to roadside populations during roadwork
- High insect attack

The anticipated threats and potential impacts to Ooline from the GTP construction, operation and decommissioning include localised loss of scattered individuals, seeding recruitment inhibited by soil compaction, increase in dust from construction activities, and invasion by weeds or non-native pasture grasses increasing exposure to higher intensity fire impacts.

1.4 Unavoidable impact from GTP

Clearing for construction of the GTP footprint and ancillary work areas between KP40 and KP130 will result in the disturbance of 96 Ooline plants. No Ooline individuals have been identified within KP0 to KP30, KP30 to KP40, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69. Although 96 Ooline plants have now been identified within KP40 to KP130 of the GTP ROW, the actual Ooline clearance numbers is likely to be less as GLNG has initiated an alteration of the GTP ROW alignment to avoid clearing Ooline wherever practical. Figure 1.2 shows the general location of these plants.

1.5 Management practices and methods

1.5.1 Pre-construction mitigation measures

Measures to avoid impact

- To avoid a large stand of Ooline (>300 individuals), a ROW route change has been initiated for the ROW section between KP107 to KP108
- The ROW has been reduced from 40 m wide to 30 m wide where Ooline individuals have been confirmed in the vicinity of the ROW. This has occurred between KP98 and KP101
- Approximately five individuals have been observed within the vicinity of Camp 1. The configuration of the camp has been amended to avoid these plants, including their drip zones
- The siting of additional ancillary work areas, not covered by this SSMP, will be designed to avoid additional impacts on this species

Measures to minimise impacts

- Prior to the commencement of construction clearing, the limits of clearing will be clearly marked out by a suitably qualified and experienced EO. Each Ooline plant to be cleared will be clearly numbered, and no more than 96 Ooline individual plants will be marked for clearing between KP40 and KP130. Barricade webbing or similar will be used for the 'No Go' zones (ie Ooline species adjoining the ROW will not be cleared)
- Prior to site entry, all project personnel, including contractors will be appropriately trained and made aware of the sensitive environs in which they will be working (refer Part 1, Section 7.7)

1.5.2 Construction phase mitigation measures

Measures to minimise impacts

- All vegetation clearing will comply with the clearing approval conditions (eg NC Act, EPBC Act)
- 96 Ooline individual plants will be cleared within the GTP footprint and ancillary work areas between KP40 and KP130
- The Ooline present near Camp 1 have been mapped as a 'No Go' zone with an appropriate buffer
- If during construction it is identified that more than 96 Ooline plants need to be cleared within the ROW or other ancillary work areas, the EO will be notified and the area barricaded off until GLNG Operations obtains written approval from DotE to clear the additional individual(s) (refer Part 1, Section 8)
- To minimise the risk of weed and pest animal establishment within and adjacent to the GTP footprint and ancillary work areas, the PWMP will be implemented
- The EO will record each Ooline individual cleared and provide a report to GLNG Operations within one week of clearing the 96 Ooline individuals. GLNG Operations will use this information to ensure compliance with Ooline clearing numbers

- Weather permitting, rehabilitation of the GTP footprint will commence within three months from the completion of the pipeline construction. With the exception of operational constraints, revegetation will be consistent with the plant density, floristic composition and distribution of the adjacent communities. For the area in which Ooline was identified this will predominantly be grazing pastures

1.5.3 Operational phase mitigation measures

Measures to avoid impact

- No Ooline species will be cleared during the operational phase of the GTP
- To avoid impacting on regenerating Ooline populations, access to operational sections of the GTP corridor will be restricted to designated tracks only

Measures to minimise impacts

- The PWMP will be implemented to minimise the risk of weed establishment within and adjacent existing populations of Ooline in these areas
- The operational phase of the LRMP will be implemented. The LRMP has been developed with the aim of re-instating the landscape values impacted during the construction of the GTP ROW. Some of the key actions outlined within the plan include:
  - Habitat rehabilitation post construction phase may occur through the management of natural regeneration, in addition to planting of seedlings or tube stock. Species selected will be consistent with the pre-clearing (pre-construction phase) RE as determined from analogue site surveys
  - Top soil will be reinstated to disturbed areas to allow natural regeneration from the soil seed bank
  - Natural contours and drainage lines will be re-established immediately following construction activities, so as to minimise erosion and restore natural functions as far as possible
  - Disturbed communities such as woodlands and open forests will be graded and contoured to maintain their pre-construction profiles, so as to minimise erosion and restore natural functions as far as possible
  - Woodland vegetation will be allowed to naturally revegetate or will be directly seeded (seed mix for areas of remnant vegetation will be determined by the vegetation composition of the RE as determined by analogue surveys
  - Logs or other debris will be re-spread to provide shelter and stepping stones between habitats
- Through the implementation of the LRMP, ecological communities will be progressively restored according to the rehabilitation completion criteria. For Ooline, management measures outlined in the LRMP will be maintained until the rehabilitation completion criteria for this species habitat have been achieved. Key measures include:
  - The ongoing management of other introduced species (ie environmental weeds) in order to manage negative impacts associated with the quality and availability of habitat for this species

- The ongoing management of rehabilitation works including the monitoring and management of floristic density and inter species competition (in particular in the understorey) that may negatively impact on the ability for the species to naturally regenerate
- The ongoing management of fire in areas that may impact on habitat quality and availability within and adjacent the GTP ROW
- The ongoing monitoring of analogue sites to determine the success of rehabilitation measures

1.5.4 Decommissioning phase mitigation measures

Measures to minimise impacts

- A decommissioning plan will be developed by GLNG Operations and provided for approval. The plan will aim to address the requirements of AS2885 and also to ensure environmental harm is avoided, including:
  - The Project area no longer contains hazardous contaminants and is left in stable condition
  - All above ground infrastructure is removed
  - All areas disturbed by above ground infrastructure are rehabilitated in accordance with the relevant conditions
- For a minimum of five years after the completion of rehabilitation, rehabilitated areas will be monitored on a yearly basis
- The rehabilitation and associated monitoring programme will include:
  - Pest and weed controls
  - Methods to monitor subsidence and erosion rates at rehabilitated buried transmission pipeline corridors and buried flow lines
  - BioCondition assessment in accordance with the BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland: Assessment Manual: Version 2.1 (Eyre *et al* 2011)
  - Monitoring of indicators identified in the LRMP at analogue sites to measure progressive and final rehabilitation success relevant to the final land use(s)
  - The frequency and seasonality of monitoring of analogue sites and rehabilitated areas to assess rehabilitation success
  - Identification of the experimental design for analysing analogue and rehabilitated site data including statistical methods of analyses
- The final standard for rehabilitation of disturbance areas will be for impacted areas to as closely as possible match species composition, and structure for analogue sites for each community

1.6 Translocation and monitoring programme

There is currently no documented evidence of success for the translocation of Ooline by way of a salvage dig. Therefore it is expected that individuals within the GTP ROW that cannot be avoided will be destroyed during construction activities.

Although there is no documented evidence of successful Ooline translocation by salvage, a translocation and monitoring programme for the establishment of an Ooline population offsite (ie outside of the GTP ROW) will be established. There is some non documented information of successful translocation of Ooline in Queensland. As this has not been formerly documented, it is proposed that the translocation methods will be further explored during the offsetting and rehabilitation program. Findings of these works will be documented and published to contribute towards the knowledge for the conservation of this species. The programme will be developed for this species in consultation with relevant subject matter experts and in accordance with the principles established in Vallee *et al* (2004).Translocation is likely to include, but not be limited to, root material from cleared species which are likely to produce basal shoots (suckers).
Key information contained within this programme will include:

- Details of the establishment site
- Collection and propagation methodologies
- Details on the management, monitoring and reporting requirements including a minimum of five years monitoring post final planting
- Criteria for measuring success

Additionally, it is anticipated that research into the establishment and recruitment of individuals would be undertaken as part of this programme.

Due to operational constraints, it is expected that no Ooline will be able to re-colonise within the GTP footprint during the operational phase of the GTP Project. Ooline will be encouraged to re-establish during the decommissioning phase of the GTP Project.

2 *Xerothamnella herbacea*

2.1 EPBC Act legal status

Endangered – listed 16 July 2000

2.2 Biology and ecology

2.2.1 Characteristics

Xerothamnella herbacea, Family Acanthaceae, is a sparse, sprawling, perennial herb growing to a height of 30 cm (DSEWPaC 2012bi). Stems arise from a central point but can root at the nodes where they contact the soil. Leaves in opposite pairs are soft, linear to narrowly ovate in outline, dark green above and paler beneath. Flowers are small, bright pink to mauve, two lipped, to 6.5 mm long, and occur in the upper leaf axils (Barker 1986).

***Xerothamnella herbacea* (left), *Xerothamnella herbacea* habitat (right) (Source: Aurecon 2012b)**

2.2.2 Known distribution

Xerothamnella herbacea is known from a site north-west of Theodore Brigalow Research Station, a site south-east of Medlow, at Burraburri Creek, west of Durong, at two sites north east of Chinchilla, at a site on the Millmerran-Goondiwindi road, north-east of Kindon and at a site near Yelarbon, east of Goondiwindi, Queensland (Atlas of Living Australia 2012).

This species occurs within the Condamine, Border Rivers Maranoa–Balonne and Fitzroy (Queensland) Natural Resource Management Regions (Threatened Species Scientific Committee (TSSC) 2008c).

Figure 2.1 is an indicative distribution map of the present distribution of *Xerothamnella herbacea*.

This species is not known to occur in any conservation reserves. Some of the known populations occur in cleared areas or non- remnant vegetation that are not protected under the *Vegetation Management Act 1999* (Queensland) (TSSC 2008c).

This distribution of this species overlaps with the following EPBC Act-listed threatened ecological communities (TSSC 2008c):

- Brigalow (*Acacia harpophylla* dominant and co-dominant)

- Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland

In November 2011, *Xerothamnella herbacea* was identified at the Santos GLNG GTP ROW crossing location in Gratz Gully on Lonesome Holding, in the southern end of Arcadia Valley by Boobook Ecological Consulting (Boobook). Samples were sent to Queensland Herbarium for verification and the population at Gratz Gully represented a newly recorded and outlying location for the species in Queensland.

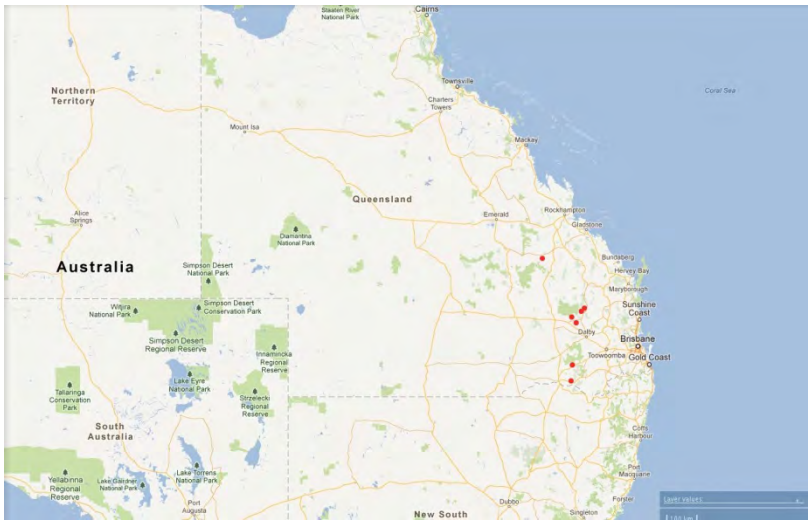


Figure 2.1 Mapped distribution range of *Xerothamnella herbacea* (Source: Atlas of Living Australia 2012)

2.2.3 Known species populations and their relationship with the GTP footprint

The Pre-Clearance Survey Report for KP0 to KP130 (Ecologica 2012) identified *Xerothamnella herbacea* as present within the southern extent of the Arcadia Valley between KP32 and KP35 of the GTP ROW which is outside of its current distribution range. Within this area, it was observed as either occasional and/or sparse specimens or as very dense clusters generally ranging no more than 4m^2 in size.

Boobook identified a total of 287 *Xerothamnella herbacea* plant locations recorded over a distance of approximately 5 km following the watercourse in Gratz Gully and the species was identified as occurring as individual plants, sparse ground covering plants to heavily matted patches.

Targeted *Xerothamnella herbacea* surveys, led by Dr Chris Schell of Aurecon (a Commonwealth approved ecologist), surveyed the population of *Xerothamnella herbacea* between KP30 and KP35 in September and November 2012.

As noted in Aurecon's field notes, it was found that the *Xerothamnella herbacea* distribution is ubiquitous and extends along the watercourse within Gratz Gully in an east-west direction for a considerable distance. The densities varied from relatively sparse within the GTP ROW to dense to the west of the GTP ROW with the population estimated to be in the thousands along the gully.

Xerothamnella herbacea was identified as sparse and non-flowering within KP30 to KP35 in September 2012 while the targeted survey in November 2012 identified *Xerothamnella*

herbacea as sparse to very dense matted clusters and flowering. The species was also identified in areas where it was not occurring in September 2012.

The previous non-detection of the species was possibly due to the seasonality of the species, prolonged dry conditions at the time of the survey, reduced canopy cover (due to seasonality of trees), major ground surface disturbance from cattle, wild pigs and kangaroos sheltering in the shaded areas along with the cryptic nature of the species.

Figure 2.2 shows the location of identified *Xerothamnella herbacea* individuals between KP30 and KP40.

2.2.4 Habitat

Xerothamnella herbacea occurs in Brigalow (*Acacia harpophylla*) dominated communities in shaded situations, often in leaf litter and is associated with gilgais (shallow ground depressions). Soils are heavy, grey to dark brown clays (Queensland Herbarium 2008a).

The preferred habitat of *Xerothamnella herbacea* at Gratz Gully (Boobook 2012) appeared to be:

- Floodplain flats, channel banks and beds, no greater than 0.5 m elevation above the channel; usually within 50 cm elevation of the top of the ditch/channel ie mounds, low ridges and rises between drainage ditches, gutters, rills and channels, and flood ponds
- Soils with high clay content
- Shade of greater than 40%
- Shade provided by Brigalow (*Acacia harpophylla*) and Wilga (*Geijera parviflora*) most often, and Poplar box (*Eucalyptus populnea*) to a lesser degree (more often on the southern side of small shade patches)
- Areas of notable leaf litter coverage
- Sometimes associated with gilgais (shallow ground depressions)

Associated herbaceous species most frequently detected with *Xerothamnella herbacea* included Blue trumpet (*Brunoniella australis*), Slender sedge (*Cyperus gracilis*), Curly windmill grass (*Enteropogon ramosus*), Creeping shade grass (*Oplismenus aemulus*) and Pink tongues (*Rostellularia adscendens*) (Boobook 2012).

Xerothamnella herbacea plants look similar to *Brunoniella australis* and *Rostellularia adscendens*, two very common forbs throughout the search area. *Xerothamnella herbacea* plants are distinguishable from a distance by a neater, more symmetrical leaf arrangement, more glabrous (smooth or hairless) foliage and stems, lighter and more consistent shade of green, a thinner more delicate appearance to leaves, fruit spade shaped (*B. australis* fruit rod shaped), flowers arising together in heads, corolla with distinct upper petals (*R. adscendens* upper petals absent or not obvious, flowers arranged along spikes 2 to 7 cm long) (Boobook 2012).

2.2.5 Biology and reproduction

There is no published information on the fruiting and flowering period for this species however it has been recorded flowering during the pre-clearance surveys in November/December (Ecologica 2012).

Based on visual observations, Aurecon noted that *Xerothamnella herbacea* could have the ability to propagate from cuttings and/or grown from seeds based on its ability to colonise recently disturbed areas as evident between the September and November 2012 survey periods.

Xerothamnella herbacea plants were suspected to be in the process of dying-off during a survey in March and April 2012 where soil moisture was declining. It is suspected that the species relies on available soil moisture in the top 30 cm of soil (Boobook 2012).

2.3 Anticipated threats and potential impacts from GTP

The main identified threat to *Xerothamnella herbacea* is competition from invasive plant species as it occurs in a niche with few other ground layer species. Green Panic (*Megathyrsus maximus* var. *pubiglumis*) and to a lesser extent Buffel Grass (*Pennisetum ciliare*) are species that tolerate shade and colonise these habitats. Both of these introduced grasses threaten *Xerothamnella herbacea* either by direct competition or by increasing the fuel load and altering fire regimes (TSSC 2008c).

The main potential threats to *Xerothamnella herbacea* include road widening and maintenance activities; surface erosion; and grazing and trampling by cattle and native macropods (McDonald 2010).

Further threats to *Xerothamnella herbacea* identified by Aurecon include grazing, foraging and rooting by feral pigs. *Xerothamnella herbacea* is restricted to Gratz Gully which appears to be preferred habitat for the feral pig providing a water point and dense cover.

2.4 Unavoidable impact from GTP

Reducing the GTP ROW from KP32.5 to KP32.595, within KP34.929 to KP35.003 and KP35.174 to KP35.182 will result in a construction corridor of approximately 15 m wide using a restricted trenching methodology. This clearing will impact an area of approximately 2,655 m^2 (0.2655 ha) where the species has been identified. Pre-clearance surveys indicate that within these areas there are 12 discrete patches where up to 42 individual plants have been recorded. Given the phenology of the species, there is the potential for the number of plants within these impact zones to increase with preferential growing conditions. GLNG has undertaken another survey prior to construction within the impact zones and reported to DotE on the total number or density of plants to be impacted. As part of the survey, a total of 70 *Xerothamnella herbacea* individuals were initially identified within the GTP ROW. A strategy to minimise the number of plants was then executed, involving the narrowing of the ROW from 30 metres to 15 metres in three locations. This strategy has seen the number of impacted *Xerothamnella herbacea* individuals reduced to 42.These impact figures will be used to calculate offset requirements in accordance with Part 1, Section 6.2 of this report. No *Xerothamnella herbacea* has been identified in KP0 to KP30, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 of the GTP RoW.

2.5 Management Measures

2.5.1 General

Xerothamnella herbacea has been identified and mapped during the pre-clearance survey of the GTP ROW within KP30 to KP40.The GTP corridor will be reduced from 30 m to 15 m within KP32.5 to KP32.595, KP34.929 to KP35.003 and KP35.174 to KP35.182 to avoid areas of *Xerothamnella herbacea*.

Despite investigating all measures to avoid *Xerothamnella herbacea* a degree of take is necessary due to the stoloniferous nature of the species. Where *Xerothamnella herbacea* clearing is unavoidable the construction of the GTP will be through the 'lowest density path' through the *Xerothamnella herbacea* populations. The clearing footprint and all 'No Go' zones are clearly identified in construction plans and all works will be restricted to this predetermined footprint.

If any additional *Xerothamnella herbacea* plants are identified elsewhere in the GTP RoW they will be managed in accordance with the provisions set out in Section 3.6 of this SSMP.

2.6 Management practices and methods

2.6.1 Pre-construction mitigation measures

Measures to avoid impact

- The width of the GTP ROW will be reduced from 30 m to 15 m in the vicinity of known occurrences of *Xerothamnella herbacea*
- Prior to the commencement of construction clearing, a suitably qualified and experienced EO will confirm the buffer zones ('No Go' zones) and where necessary barriers and signs will be erected. 'No Go' zones are areas where actual plants occur
- An appropriate fire management strategy will be implemented, to ensure that individuals and populations of *Xerothamnella herbacea* are not adversely impacted by fire
- The siting of construction camps, vehicle access tracks and pipe lay-down areas outside the ROW will be designed to ensure that there are no impacts to this species

Measures to minimise impacts

- Prior to the commencement of construction clearing, the limits of clearing will be clearly marked out by a suitably qualified and experienced EO. Each *Xerothamnella herbacea* plant to be cleared will be clearly numbered. Barricade webbing or similar will be used for the 'No Go' zones (ie *Xerothamnella herbacea* species adjoining the ROW will not be cleared)
- Prior to site entry, all project personnel, including contractors will be appropriately trained and made aware of the sensitive environs in which they will be working (refer Part 1, Section 7.7) This will include a familiarisation with *Xerothamnella herbacea*, ie how to identify the plant and what actions must be taken if a previously unmarked individual or population is discovered
- Collection of vegetative material suitable for propagation and if possible, seed will occur prior to clearance of any individual: seed will be stored using established protocols
- Maps of known occurrences will be provided to local and state Rural Fire Services for inclusion in mitigation measures in bush fire risk management plans, risk registers and/or operation maps
- Any new occurrences will be reported to the Queensland Herbarium for inclusion in current herbarium databases

2.6.2 Construction phase mitigation measures

Measures to minimise impacts

- Due to potential for trampling unidentified individuals, all vehicles and pedestrians will remain within the ROW on designated access tracks
- All vegetation clearing will comply with the clearing approval conditions (eg NC Act, EPBC Act)
- Recent surveys along the GTP ROW and adjacent areas indicate that the most suitable alignment will result in only 42 *Xerothamnella herbacea* individual plants will be cleared within the GTP footprint and ancillary work areas between KP30 and KP40. Given the phenology of the species and its ability to quickly propagate with rain and moisture, it is possible that this number will increase. The area of impact through Gratz Gully will however remain the same. GLNG will report on numbers of plants taken following construction works
- Affected plants will be relocated to suitable habitat nearby, following national translocation protocols
- If during construction it is identified that an increase in area is necessary and more habitat with *Xerothamnella herbacea* need to be cleared within the ROW or other ancillary work areas, the EO will be notified and the area barricaded off until GLNG Operations obtains written approval from DotE to clear the additional individual(s) (refer Part 1, Section 8)
- Any new occurrences will be reported to the Queensland Herbarium for inclusion in current herbarium databases
- To minimise the risk of weed and pest animal establishment within and adjacent to the GTP footprint and ancillary work areas, the PWMP will be implemented
- The EO will record each *Xerothamnella herbacea* individual cleared and provide a report to GLNG Operations within one week of clearing *Xerothamnella herbacea* individuals. GLNG Operations will use this information to ensure compliance with *Xerothamnella herbacea* clearing areas
- Weather permitting, rehabilitation of the GTP footprint will commence within three months from the completion of the pipeline construction. With the exception of operational constraints, revegetation will be consistent with the plant density, floristic composition and distribution of the adjacent communities. For the area in which *Xerothamnella herbacea* was identified this will predominantly be Brigalow and Eucalypt woodland with the re-establishment of gilgai/melanhole features as much as practicable
- Dust suppression mechanisms will be put in place to ensure excessive dust deposition does not occur on the foliage and affect the plants ability to photosynthesise
- As part of the 15 m GTP ROW, a 6 m wide access path will be constructed within KP32.5 to KP32.595, KP34.929 to KP35.003 and KP35.174 to KP35.182 such that it does not require stripping or clearing of *Xerothamnella herbacea*, although trees and shrubs within the access path will be required to be cut at ground level which is likely to reduce the level of canopy cover and shade that is required for the *Xerothamnella herbacea*
- The access path will be constructed using ‘swamp mats’ to distribute the load of the traversing equipment and protect the *Xerothamnella herbacea* root system allowing

for potential regrowth and or revegetation when the mats are removed and avoids the need to remove the *insitu* soil

- The remaining area of the GTP ROW will involve the removal of top soil and lower profiles of soil which will be stockpiled separately outside of Gratz Gully within designated areas
- The first 50 mm of topsoil (based on retention of seed stock, fertile material and plant rhizomes) within KP32.5 to KP32.595, KP34.929 to KP35.003 and KP35.174 to KP35.182 will be carefully salvaged, 'banked' and maintained for rehabilitation purposes as it is expected that this would carry significant viable seed and vegetative matter that will be re-layed onto the ROW during rehabilitation process
- The banked topsoil will be managed in accordance with the GLNG GTP Construction Environmental Management Plan
- The top soil will be held separately to avoid unintended impacts such as mixing with other soil profiles, compaction, hydro-mulching, further disturbances and herbicide spraying

2.6.3 Operational phase mitigation measures

Measures to avoid impact

- All vehicles and pedestrians will remain within the ROW and designated access tracks
- No *Xerothamnella herbacea* individuals will be cleared during the operational phase of the GTP

Measures to minimise impacts

- A suitable fire management strategy will be implemented
- Any new individuals that may emerge within the GTP ROW will be recorded and reported to a suitably qualified and experienced EO
- If deemed appropriate, new individuals will be relocated to suitable habitat nearby, following national translocation protocols. GLNG Operations will obtain written approval from DotE to clear the additional individual(s)
- Any new occurrences will be reported to the Queensland Herbarium for inclusion in current herbarium databases
- The PWMP will be implemented to minimise the risk of weed establishment within and adjacent existing populations of *Xerothamnella herbacea* in these areas
- The operational phase of the LRMP will be implemented. The LRMP has been developed with the aim of re-instating the landscape values impacted during the construction of the GTP ROW. Some of the key actions outlined within the plan include:
  - Habitat rehabilitation post construction phase may occur through the management of natural regeneration, in addition to planting of seedlings or tube stock. Species selected will be consistent with the pre-clearing (pre-construction phase) RE as determined from analogue site surveys
  - Top soil will be reinstated to disturbed areas to allow natural regeneration from the soil seed bank

  - Natural contours and drainage lines will be re-established immediately following construction activities, so as to minimise erosion and restore natural functions as far as possible
  - Disturbed communities such as woodlands and open forests will be graded and contoured to maintain their pre-construction profiles, so as to minimise erosion and restore natural functions as far as possible
  - Woodland vegetation will be allowed to naturally revegetate or will be directly seeded (seed mix for areas of remnant vegetation will be determined by the vegetation composition of the RE as determined by analogue surveys
  - Logs or other debris will be re-spread to provide shelter and stepping stones between habitats
- Through the implementation of the LRMP, ecological communities will be progressively restored according to the rehabilitation completion criteria. For *Xerothamnella herbacea*, management measures outlined in the LRMP will be maintained until the rehabilitation completion criteria for this species habitat have been achieved. Key measures include:
  - The ongoing management of other introduced species (ie non declared weeds) in order to manage negative impacts associated with the quality and availability of habitat for this species
  - The ongoing management of rehabilitation works including the monitoring and management of floristic density and inter species competition (in particular in the understorey) that may negatively impact on the ability for the species to naturally regenerate
  - The ongoing management of fire in areas that may impact on habitat quality and availability within and adjacent the GTP ROW
  - The ongoing monitoring of analogue sites to determine the success of rehabilitation measures

2.6.4 Decommissioning phase mitigation measures

Measures to minimise impacts

- A decommissioning plan will be developed by GLNG Operations and provided for approval. The plan will aim to address the requirements of AS2885 and also to ensure environmental harm is avoided, including:
  - The Project area no longer contains hazardous contaminants and is left in stable condition
  - All above ground infrastructure is removed
  - All areas disturbed by above ground infrastructure are rehabilitated in accordance with the relevant conditions
- For a minimum of five years after the completion of rehabilitation, rehabilitated areas will be monitored on a yearly basis
- The rehabilitation and associated monitoring programme will include:
  - Pest and weed controls
  - Methods to monitor subsidence and erosion rates at rehabilitated buried transmission pipeline corridors and buried flow lines

  - BioCondition assessment in accordance with the BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland: Assessment Manual: Version 2.1 (Eyre *et al* 2011)
  - Monitoring of indicators identified in the LRMP at analogue sites to measure progressive and final rehabilitation success relevant to the final land use(s)
  - The frequency and seasonality of monitoring of analogue sites and rehabilitated areas to assess rehabilitation success
  - Identification of the experimental design for analysing analogue and rehabilitated site data including statistical methods of analyses
- The final standard for rehabilitation of disturbance areas will be for impacted areas to as closely as possible match species composition, and structure for analogue sites for each community

2.7 Translocation and monitoring programme

A translocation and monitoring programme for the establishment of a *Xerothamnella herbacea* population offsite (ie outside of the GTP ROW) will be established in the event that *Xerothamnella herbacea* plants need to be cleared. The programme will be developed for this species in consultation with relevant subject matter experts and in accordance with the principles established in Vallee *et al* (2004).

Key information contained within this programme will include:

- Recording of GPS locations of original and relocated plants
- Number and size of plants
- Survival rates
- Details of horticultural applications such as pruning, watering, fertilising, seed collection and storage actions
- Details of the establishment site
- Collection and propagation methodologies
- Details on the management, monitoring and reporting requirements including a minimum of five years monitoring post final planting
- Criteria for measuring success

Additionally, it is anticipated that research into the establishment and recruitment of individuals would be undertaken as part of this programme.

It is expected that *Xerothamnella herbacea* will be able to re-colonise within the GTP footprint during the operational phase of the GTP Project as shrubs that provide suitable shady habitat for *Xerothamnella herbacea* are allowed to re-establish along the GTP ROW. *Xerothamnella herbacea* will also be encouraged to re-establish during the decommissioning phase of the GTP Project.

3 *Philotheca sporadica*

3.1 EPBC Act legal status

Vulnerable - listed 16 July 2000

3.2 Biology and ecology

3.2.1 Characteristics

Philotheca sporadica, commonly known as Kogan waxflower, is an open to compact shrub that grows to 150 cm high and has numerous branches (Halford 1995). Along its length, each branch has many small (1 to 4 mm long) hairless, club-shaped leaves. The white flowers are 6 to10 mm in diameter, solitary and occur on short stalks (up to 0.7 mm long) at the end of branchlets (Halford 1995).

***Philotheca sporadica* (left) and *Philotheca sporadica* flowers (right) (Source: Chinchilla Field Naturalist Group 2005; Moore 2007)**

3.2.2 Known distribution

Philotheca sporadica is known from south-east Queensland just north of Tara to approximately 12 km east of Kogan in the Darling Downs Pastoral District (Halford 1995). In 1995, Queensland Herbarium had recorded 11 populations (Halford 1995) and at least four have been subsequently reported (Powerlink Queensland 2005). Nine populations were comprehensively assessed by Halford (1995).

Figure 3.1 is an indicative distribution map of the present distribution of *Philotheca sporadica*.

Of the known populations the following land tenures of sites include seven on road verges (six of which extend onto freehold land); one within Braemar State Forest (State Forest 4); one in State Forest 155; one exclusively on freehold land; and three on and near the grounds of the Braemar Power Station (Halford 1995; DSEWPaC 2012bj). *Philotheca sporadica* was encountered from east of Kogan Creek to west of the Braemar Power Station during surveys in 2004 in the Darling Downs region (Powerlink Queensland 2005).

Figure 3.1 Mapped distribution range of *Philotheca sporadica* (Source: DSEWPaC 2012bj)

3.2.3 Known species populations and their relationship with the GTP footprint

This species has not been identified within the GTP ROW and ancillary areas during the pre-clearance surveys although this species is likely to occur along the GTP ROW. This management plan has been prepared in accordance with condition 12 of the EPBC Act controlled action approval for the GLNG GTP Project (EPBC No. 2008/4096).

3.2.4 Habitat

Philotheca sporadica occurs within the Condamine River catchment on soils derived from low fertility laterised Cretaceous sandstones (Kumbarilla Beds). Soils are shallow uniform sandy loams to clay loams or shallow texture contrast soils with loamy surfaces and medium clay subsoils (DSEWPaC 2012bj). Ironstone gravel is usually present within the soil column. Topography of these areas is undulating to flat with low dissected flat top or rounded hills (Dawson 1972; Halford 1995). Some sites have duricrust surfaces (Powerlink Queensland 2005).

The Darling Downs area, in which this species occurs, has a sub-humid and subtropical climate, with warm to hot, moist summers and cool to cold, dry winters (Halford 1995).

Vegetation associated with *Philotheca sporadica* has been described as open shrubland to closed shrubland to closed woodland (HLA-Envirosciences Pty Ltd 2005). Native flora identified in association with *Philotheca sporadica*, according to Kanowski (2005) and Halford (1995) include:

- Trees: Stringybark sheoak (*Allocasuarina inophloia*), Apple (*Angophora leiocarpa*), Black cypress (*Callistris endlicheri*), White cypress (*Callistris glaucophylla*), Narrow-leaved ironbark (*Eucalyptus crebra*), Yellow jacket (*Corymbia watsoniana*), Queensland peppermint (*Eucalyptus exserta*), Red ironbark (*Eucalyptus fibrosa*), Blue-leaved ironbark (*Eucalyptus fibrosa* subsp. *nubila*) and Tom russell mahogany (*Lysicarpus angustifolius*)
- Shrubs: Burrow's wattle (*Acacia burrowii*), Crowded-leaf wattle (*Acacia conferta*), *Acacia crassa*, *Acacia debilis*, *Acacia loroloba*, Umbrella wattle (*Acacia oswaldii*), *Acacia semilunata*, *Babingtonia jucunda*, *Daviesa* spp., Hop bush (*Dodonaea triangularis*) and Sticky hop bush (*Dodonaea viscosa*)

- Grasses: Three awn (*Aristilda* spp.), Wire grass (*Cleistochloa subjuncea*), Barbwire grass (*Cymbopogon refractus*), Sword grass (*Gahnia sieberiana*) and Lomandra (*Lomandra longifolia*)
- Other species: Galavanised burr (*Bassia birchii*), Bipinnate boronia (*Boronia bipinnate*), *Cryptandra armata*, Queensland black orchid (*Cymbidium canaliculatum*), *Homalocalyx polyandrus* and Grass-tree (*Xanthorrhoea johnsonii*)

3.2.5 Biology and reproduction

Philotheca sporadica is a perennial shrub (Halford 1995). The longevity of individual plants is unknown. It is estimated that individual shrubs can live for 20 years (Halford 1995).

Flowering has been recorded from August to October. Mature fruits have been observed in late November (Halford 1995). Flower petals are white and open during the day and nectar is produced from glands at the base of the ovary. Pollinators are unknown (Halford 1995). Flowers are borne in clusters at the ends of branchlets. These flowers have an ovary comprised of five carpels each with two ovules, usually only one seed develops per carpel. Seeds are sub-reniform, about 3 mm long and are forcibly ejected from the mature fruit (Halford 1995). Dry conditions may reduce the viability of seeds (Halford 1995).

Although little is known of the germination and viability of *Philotheca sporadica* seeds, other *Philotheca* are difficult to germinate but do respond positively to smoke water treatement (ANPSA 2009) and seed coat scouring (Halford 1995) while some related species have been propogated from cuttings (Halford 1995). No seedlings had been observed at a recently burnt site and a stable number of individuals had been maintained at a site where fire was excluded for approximately 60 years (Halford 1995).

3.3 Anticipated threats and potential impacts from GTP

The most significant threats to *Philotheca sporadica* have been identified by DSEWPaC (2012bk) as:

- Habitat loss
- Road works
- Habitat disturbance due to forestry practices and recreational use in State forests
- Introduced weeds
- Grazing
- Fire

3.4 Unavoidable impact from GTP

Clearing for construction of the GTP footprint and ancillary work areas between KP0 and KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 will result in the disturbance of zero *Philotheca sporadica* individuals.

3.5 Management practices and methods

3.5.1 Pre-construction mitigation measures

Measures to avoid impact

- The width of the GTP ROW will be reduced from 40 m to 30 m in the vicinity of known occurrences of *Philotheca sporadica*
- Prior to the commencement of construction clearing, a suitably qualified and experienced EO will confirm the buffer zones ('No Go' zones) and where necessary barriers and signs will be erected. 'No Go' zones are areas where actual plants occur
- An appropriate fire management strategy will be implemented, to ensure that individuals and populations of *Philotheca sporadica* are not adversely impacted by fire

Measures to minimise impacts

- Prior to the commencement of construction clearing, the limits of clearing will be clearly marked out by a suitably qualified and experienced EO. Barricade webbing or similar will be used for the 'No Go' zones (ie *Philotheca sporadica* species adjoining the ROW will not be cleared)
- If during pre-construction it is identified that *Philotheca sporadica* plants need to be cleared within the ROW or other ancillary work areas, the EO will be notified and the area barricaded off until GLNG Operations obtains written approval from DotE to clear the individual(s) (refer Part 1, Section 8)
- Prior to site entry, all project personnel, including contractors will be appropriately trained and made aware of the sensitive environs in which they will be working (refer Part 1, Section 7.7) This will include a familiarisation with *Philotheca sporadica*, ie how to identify the plant and what actions must be taken if a previously unmarked individual or population is discovered
- Where possible, appropriate seed collection and storage will occur prior to clearance of any individual
- Maps of known occurrences should be provided to local and state Rural Fire Services for inclusion in mitigation measures in bush fire risk management plans, risk registers and/or operation maps
- Any new occurrences will be reported to the Queensland Herbarium for inclusion in current herbarium databases

3.5.2 Construction phase mitigation measures

Measures to minimise impacts

- Due to potential for trampling unidentified individuals, all vehicles and pedestrians will remain within the ROW and designated access tracks
- All vegetation clearing will comply with the clearing approval conditions (eg NC Act, EPBC Act)
- If during construction it is identified that *Philotheca sporadica* plants need to be cleared within the ROW or other ancillary work areas, the EO will be notified and the area barricaded off until GLNG Operations obtains written approval from DotE to clear the individual(s) (refer Part 1, Section 8)

- Any new occurrences will be reported to the Queensland Herbarium for inclusion in current herbarium databases
- To minimise the risk of weed and pest animal establishment within and adjacent to the GTP footprint and ancillary work areas, the PWMP will be implemented
- The EO will record each *Philotheca sporadica* individual cleared and provide a report to GLNG Operations within one week of clearing *Philotheca sporadica* individuals. GLNG Operations will use this information to ensure compliance with *Philotheca sporadica* clearing numbers
- Weather permitting, rehabilitation of the GTP footprint will commence within three months from the completion of the pipeline construction. With the exception of operational constraints, revegetation will be consistent with the plant density, floristic composition and distribution of the adjacent communities

3.5.3 Operational phase mitigation measures

Measures to avoid impact

- Due to potential for trampling unidentified individuals, all vehicles and pedestrians will remain within the ROW and designated access tracks
- No *Philotheca sporadica* individuals will be cleared during the operational phase of the GTP

Measures to minimise impacts

- A suitable fire management strategy will be implemented
- Any new individuals that may emerge within the GTP ROW will be recorded and reported to a suitably qualified and experienced EO
- If deemed appropriate, new individuals will be relocated to suitable habitat nearby, following national translocation protocols. GLNG Operations will obtain written approval from DotE to clear the additional individual(s)
- Any new occurrences will be reported to the Queensland Herbarium for inclusion in current herbarium databases
- The PWMP will be implemented to minimise the risk of weed establishment within and adjacent existing populations of *Philotheca sporadica* in these areas
- The operational phase of the LRMP will be implemented. The LRMP has been developed with the aim of re-instating the landscape values impacted during the construction of the GTP ROW. Some of the key actions outlined within the plan include:
  - Habitat rehabilitation post construction phase may occur through the management of natural regeneration, in addition to planting of seedlings or tube stock. Species selected will be consistent with the pre-clearing (pre-construction phase) RE as determined from analogue site surveys
  - Top soil will be reinstated to disturbed areas to allow natural regeneration from the soil seed bank
  - Natural contours and drainage lines will be re-established immediately following construction activities, so as to minimise erosion and restore natural functions as far as possible

  - Disturbed communities such as woodlands and open forests will be graded and contoured to maintain their pre-construction profiles, so as to minimise erosion and restore natural functions as far as possible
  - Woodland vegetation will be allowed to naturally revegetate or will be directly seeded (seed mix for areas of remnant vegetation will be determined by the vegetation composition of the RE as determined by analogue surveys
  - Logs or other debris will be re-spread to provide shelter and stepping stones between habitats
- Through the implementation of the LRMP, ecological communities will be progressively restored according to the rehabilitation completion criteria. For *Philotheca sporadica*, management measures outlined in the LRMP will be maintained until the rehabilitation completion criteria for this species habitat have been achieved. Key measures include:
  - The ongoing management of other introduced species (ie non declared weeds) in order to manage negative impacts associated with the quality and availability of habitat for this species
  - The ongoing management of rehabilitation works including the monitoring and management of floristic density and inter species competition (in particular in the understorey) that may negatively impact on the ability for the species to naturally regenerate
  - The ongoing management of fire in areas that may impact on habitat quality and availability within and adjacent the GTP ROW
  - The ongoing monitoring of analogue sites to determine the success of rehabilitation measures

3.5.4 Decommissioning phase mitigation measures

Measures to minimise impacts

- A decommissioning plan will be developed by GLNG Operations and provided for approval. The plan will aim to address the requirements of AS2885 and also to ensure environmental harm is avoided, including:
  - The Project area no longer contains hazardous contaminants and is left in stable condition
  - All above ground infrastructure is removed
  - All areas disturbed by above ground infrastructure are rehabilitated in accordance with the relevant conditions
- For a minimum of five years after the completion of rehabilitation, rehabilitated areas will be monitored on a yearly basis
- The rehabilitation and associated monitoring programme will include:
  - Pest and weed controls
  - Methods to monitor subsidence and erosion rates at rehabilitated buried transmission pipeline corridors and buried flow lines
  - Biocondition assessment in accordance with the BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland: Assessment Manual: Version 2.1 (Eyre *et al* 2011)

  - Monitoring of indicators identified in the LRMP at analogue sites to measure progressive and final rehabilitation success relevant to the final land use(s)
  - The frequency and seasonality of monitoring of analogue sites and rehabilitated areas to assess rehabilitation success
  - Identification of the experimental design for analysing analogue and rehabilitated site data including statistical methods of analyses
- The final standard for rehabilitation of disturbance areas will be for impacted areas to as closely as possible match species composition, and structure for analogue sites for each community

3.6 Translocation and monitoring programme

A translocation and monitoring programme for the establishment of a *Philotheca sporadica* population offsite (ie outside of the GTP ROW) will be established in the event that *Philotheca sporadica* plants need to be cleared. The programme will be developed for this species in consultation with relevant subject matter experts and in accordance with the principles established in Vallee *et al* (2004).

Key information contained within this programme will include:

- Recording of GPS locations of original and relocated plants
- Number and size of plants
- Survival rates
- Details of horticultural applications such as pruning, watering, fertilising, seed collection and storage actions
- Details of the establishment site
- Collection and propagation methodologies
- Details on the management, monitoring and reporting requirements including a minimum of five years monitoring post final planting
- Criteria for measuring success

Additionally, it is anticipated that research into the establishment and recruitment of individuals would be undertaken as part of this programme.

It is expected that *Philotheca sporadica* will be able to re-colonise within the GTP footprint during the operational phase of the GTP Project as shrubs are allowed to re-stablish along the GTP ROW. *Philotheca sporadica* will also be encouraged to re-establish during the decommissioning phase of the GTP Project.

4 *Cycas megacarpa*

4.1 EPBC Act legal status

Endangered – listed 16 July 2000

4.2 Biology and ecology

4.2.1 Characterisitics

Cycas megacarpa (Large-fruited zamia) is a small to medium sized Cycad with an erect trunk standing around 3 m tall and approximately 15 cm wide (Hill 1992, Jones 2002). The leaves are 70 to 110 cm long and with 120 to 170 leaflets (Hill 1992, Jones 2002, Queensland Herbarium 2007). Young leaves are light green and densely covered in brown hairs while mature leaves are a glossy mid to dark green (Jones 2002). Mature leaves are shallowly keeled when viewed in cross section (Hill 1992; Jones 2002). All Cycads are unisexual with the female cones of *Cycas megacarpa* 15 cm wide and hairy and the male cones ovoid (egg-shaped), 18 cm long, 7 cm in diameter and coloured yellow to orange brown (Hill 1998a; Hill & Osbourne 2001, Jones 2002). The seeds are ovoid 38 to 50 mm long and 35 to 45 mm in diameter and are green in colour turning yellow (Hill 1992; Hill & Osbourne 2001; Jones 2002).

Cycas megacarpa is visually similar to *Cycas media* but *Cycas megacarpa* can be distinguished by the larger seeds, smaller leaves, as well as possessing a more slender trunk (Hill 1996; Hill 1998; Hill & Osbourne 2001).

***Cycas megacarpa* (Source: Aurecon 2013)**

4.2.2 Known distribution

Cycas megacarpa is endemic to south-east Queensland. It is found from as far south as Woolooga to Bouldercombe in the north (Queensland Herbarium 2007). Illegal collection of Cycad species is a major threat and, therefore, detailed distribution information is not available (DSEWPaC 2013).

Figure 4.1 is an indicative distribution map of the present distribution of *Cycas megacarpa*.

The extent of occurrence for *Cycas megacarpa* is 18,726 km². This has been calculated from detailed distribution information collected during the creation of the National Multi-species Recovery Plan for the Cycads (Queensland Herbarium 2007).

The area of occupancy for *Cycas megacarpa* is 46 km² (Queensland Herbarium 2007). The Queensland Herbarium (2007) has identified 46 populations of *Cycas megacarpa*.

Cycas megacarpa is known to have been cultivated for horticultural use and is generally propagated from seed (Hill & Osbourne 2001; Jones 2002).

Many populations of *Cycas megacarpa* are very small and greatly fragmented, with only a handful of adult plants (Forster 2007). Cycad species are known to have little genetic flow between fragmented populations and Cycads are not known to disperse far from the parent plant (Queensland Herbarium 2007). Forster (2007) highlights that the low levels of dispersal, recruitment, specialised pollination mechanisms and slow seedling growth create restricted occurrences of Cycads.

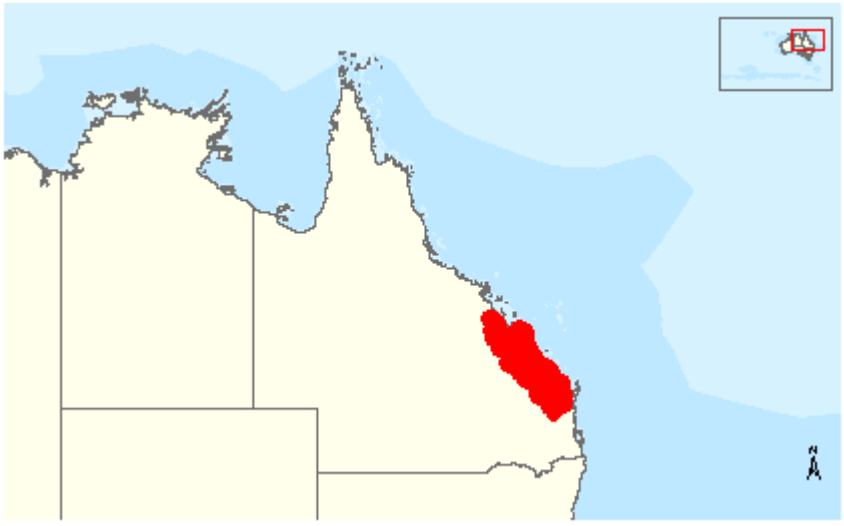


Figure 4.1 Mapped distribution range of *Cycas megacarpa* (Source: DSEWPaC 2013)

4.2.3 Known species populations and their relationship with the GTP footprint

The Pre-Clearance Survey Report for KP312 to KP408.81 (Santos GLNG 2013) identified *Cycas megacarpa* as present at nine sites within the Callide and Calliope Ranges from KP314.5 to KP344. Additional *Cycas megacarpa* individuals were identified within Larcom Range, although these plants will not be impacted. Within the Callide and Calliope Ranges, it was observed as either occasional and/or sparse specimens or as large, dense populations that numbered in the hundreds. It is estimated that up to 1,100 *Cycas megacarpa* individuals, including seedlings are within the GTP ROW and ancillary works disturbance footprint between KP312 and KP408.81.

Figure 4.2a and Figure 4.2b shows the location of identified *Cycas megacarpa* individuals between KP312 and KP408.81.

4.2.4 Habitat

Cycas megacarpa is found in woodland, open woodland and open forests, often in conjunction with a grassy understory (Queensland CRA/RFA Steering Committee 1998; Jones 2002; Queensland Herbarium 2007). This species is found in habitat dominated by *Eucalyptus crebra* and *Corymbia citriodora* as well as *Corymbia erythrophloia*, *Eucalyptus melanophloia* and *Lophostemon confertus* (Queensland Herbarium 2007). There are also reports that it can be found in or on the edge of rainforest habitat (Hill 1998; Jones 2002; Queensland CRA/RFA Steering Committee 1998).

Periodic fires of different intensities are a natural part of the habitat of *Cycas megacarpa*. Mature plants can survive most fires; however, fire is likely to kill small seedlings and juveniles (Queensland Herbarium 2007).

This species often grows on undulating to hilly terrain at an altitude of 40 to 680 m. The soil is typically well-draining rocky or shallow clay, clay/loam, derived from acid volcanic, ironstone or mudstone (Hill 1998; Queensland CRA/RFA Steering Committee 1998; Queensland Herbarium 2007).

Cycas megacarpa is not known to be part of any threatened ecological community listed under the EPBC Act (DSEWPaC 2013).

Endangered habitat types, under the Queensland *Vegetation Management Act 1999*, that *Cycas megacarpa* occurs in includes *Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains; *Acacia harpophylla* open forest on deformed and metamorphosed sediments and interbedded volcanics; and *Eucalyptus tereticornis* woodland to open forest on alluvial plains (Queensland Herbarium 2011).

4.2.5 Biology and reproduction

The exact age range of *Cycas megacarpa* is currently not known (Queensland Herbarium 2007). Cycads in general are considered to be long lived plants with Australian *Macrozamia* species ranging from 60 to 1,530 years (Benson & McDougall 1993; Pate 1993).

Cycads are unisexual with male pollen cones or female seed cones (Jones 2002). Female cones use a lot of the plant resources as the seeds develop (Jones 2002). The seeds of *Cycas megacarpa* become ripe from March onwards and will not be ready to germinate for nine months due to delayed fertilisation (Queensland Herbarium 2007).

Very little information is known about pollination in Cycad species (Queensland CRA/RFA Steering Committee 1998; Queensland Herbarium 2007). Previously it was believed that Cycads were pollinated via the wind, which may, in part, still take place (Forster *et al* 1994; Schneider *et al* 2002; Queensland Herbarium 2007). Insects may also be involved, including Coleoptera beetles, thrips and/or *Trigona carbonaria*, an ancient bee species observed collecting pollen from *Cycas media* (Forster *et al* 1994; Ornduff 1991, Queensland Herbarium 2007; Schneider *et al* 2002). Forster and colleagues (1994) found *Hapalips* sp. (beetle), an unidentifiable Cossoninae (weevil) and *Ulomoides australis* (beetle) on *Cycas megacarpa*. Cycad species also form symbiotic relationships with cyanobacteria and mycorrhiza (Forster 2004).

Seeds generally do not disperse far from the parent plant. A limited amount of dispersal may be carried out by mammals, rodents and fruit bats. The seeds are, however, toxic and relatively large (Queensland Herbarium 2007).

Fire is a natural component of habitats in which *Cycas megacarpa* is found (Forster 2007; Queensland Herbarium 2007). These fires vary greatly in intensity and frequency and most adult *Cycas megacarpa* individuals can survive fire, suffering only with varying degrees of foliage loss and stem scarring (Forster 2007; Queensland Herbarium 2007). Fire is likely to kill seeds on the plant as well as seedlings or dispersed seed (Forster 2007; Queensland Herbarium 2007).

4.3 Anticipated threats and potential impacts from the GTP

The National Multi-species Recovery Plan for the Cycads (Queensland Herbarium 2007) lists nine key threats to *Cycas megacarpa* including:

- Destruction due to land clearing
- Legal harvesting and commercial harvesting
- Illegal harvesting of the whole plant
- Illegal harvesting of seed
- Loss of genetic variation
- Loss of insect pollinators
- Land management practices including fire, timber harvesting and drought

4.4 Unavoidable impact from GTP

The GTP ROW will be reduced from 40 m to 30 m wide through the Callide and Calliope Ranges to minimise the impact on *Cycas megacarpa*. The *Cycas megacarpa* individuals identified in Larcom Range will not be impacted by the construction of the GTP. Pre-clearance surveys indicate that within the Callide and Calliope Ranges there are nine discrete patches where up to 1,100 individual plants, including seedlings have been recorded within the GTP ROW and ancillary areas. The number of individuals is likely to reduce as the total number of plants includes individuals that are located on the boundary of the ROW. These plants may be able to subsequently be avoided during the construction phase of the Project. It must also be noted that due to the current wet season, there is the likelihood that juvenile plants may emerge between the date of the pre-clearance surveys being undertaken and prior to construction commencing in early 2013. GLNG have undertaken pre-clearance surveys as part of the *Cycas megacarpa* Management Plan prior to construction within the impact zones and reported to DotE on the total number and density of plants to be impacted. These impact figures have been used to calculate offset requirements in accordance with EPBC approval 2008/4096 Condition 23 (a), where a minimum of 3,990 individual plants will be translocated and propagated. Further details are provided in the *Cycas megacarpa* Management Plan.

It must be noted that no *Cycas megacarpa* has been identified in other sections of the GTP ROW.

4.5 Management practices and methods

4.5.1 Pre-construction mitigation measures

Measures to avoid impact

- The width of the GTP ROW will be reduced from 40 m to 30 m in the vicinity of known occurrences of *Cycas megacarpa*

- Prior to the commencement of construction clearing, a suitably qualified and experienced EO will confirm the buffer zones ('No Go' zones) and where necessary barriers and signs will be erected. 'No Go' zones are areas where actual plants occur
- An appropriate fire management strategy will be implemented, to ensure that individuals and populations of *Cycas megacarpa* are not adversely impacted by fire
- The siting of construction camps, vehicle access tracks and pipe lay-down areas outside the ROW will be designed to ensure that there are no impacts to this species

Measures to minimise impacts

- Prior to the commencement of construction clearing, the limits of clearing will be clearly marked out by a suitably qualified and experienced EO. Each *Cycas megacarpa* plant to be translocated will be clearly numbered. Barricade webbing or similar will be used for the 'No Go' zones (ie *Cycas megacarpa* species adjoining the ROW will not be cleared)
- Prior to site entry, all project personnel, including contractors will be appropriately trained and made aware of the sensitive environs in which they will be working (refer Part 1, Section 7.7) This will include a familiarisation with *Cycas megacarpa*, ie how to identify the plant and what actions must be taken if a previously unmarked individual or population is discovered
- Where possible, collection of seed and vegetative material suitable for propagation and storage will occur prior to clearance of any individual
- Maps of known occurrences should be provided to local and state Rural Fire Services for inclusion in mitigation measures in bush fire risk management plans, risk registers and/or operation maps
- Any new occurrences will be reported to the Queensland Herbarium for inclusion in current herbarium databases

4.5.2 Construction phase mitigation measures

Measures to minimise impacts

- Due to potential for trampling unidentified individuals, all vehicles and pedestrians will remain within the ROW on designated access tracks
- All vegetation clearing will comply with the clearing approval conditions (eg NC Act, EPBC Act)
- Affected plants will be relocated to a temporary storage site before translocation to a suitable recipient site nearby, following national translocation protocols outlined in the *Cycas megacarpa* Management Plan
- Translocation of *Cycas megacarpa* individuals will be undertaken by a suitably qualified and experienced EO and overseen by an ecologist approved by DotE
- If during construction it is identified that an increase in area is necessary and more habitat with *Cycas megacarpa* need to be cleared within the ROW or other ancillary work areas, the EO will be notified and the area barricaded off until GLNG Operations obtains written approval from DotE to clear the additional individual(s) (refer Part 1, Section 8)

- Any new occurrences will be reported to the Queensland Herbarium for inclusion in current herbarium databases
- To minimise the risk of weed and pest animal establishment within and adjacent to the GTP footprint and ancillary work areas, the PWMP will be implemented
- The EO will record each *Cycas megacarpa* individual translocated and provide a report to GLNG Operations within one week of translocating *Cycas megacarpa* individuals. GLNG Operations will use this information to ensure compliance with *Cycas megacarpa* clearing areas
- Weather permitting, rehabilitation of the GTP footprint will commence within three months from the completion of the pipeline construction. With the exception of operational constraints, revegetation will be consistent with the plant density, floristic composition and distribution of the adjacent communities
- Dust suppression mechanisms will be put in place to ensure excessive dust deposition does not occur on the foliage and affect the plants ability to photosynthesise
- Topsoil will be carefully salvaged, 'banked' and maintained for rehabilitation purposes as it is expected that this would carry significant viable seed and vegetative matter that could be re-layed onto the ROW during the rehabilitation process
- The banked topsoil will be managed in accordance with the GLNG GTP Construction Environmental Management Plan
- The top soil will be held separately to avoid unintended impacts such as mixing with other soil profiles, compaction, hydro-mulching, further disturbances and herbicide spraying
- Clearance of the GTP ROW will be subject to comprehensive sediment and erosion control measures as detailed in the ESCP and Section 8.1 of the *Cycas megacarpa* Management Plan

4.5.3 Operational phase mitigation measures

Measures to avoid impact

- Due to potential for trampling unidentified individuals, all vehicles and pedestrians will remain within the ROW and designated access tracks
- No *Cycas megacarpa* individuals will be cleared during the operational phase of the GTP

Measures to minimise impacts

- A suitable fire management strategy will be implemented
- Any new individuals that may emerge within the GTP ROW will be recorded and reported to a suitably qualified and experienced EO
- If deemed appropriate, new individuals will be relocated to suitable habitat nearby, following national translocation protocols. GLNG Operations will obtain written approval from DotE to clear the additional individual(s)
- Any new occurrences will be reported to the Queensland Herbarium for inclusion in current herbarium databases

- The PWMP will be implemented to minimise the risk of weed establishment within and adjacent existing populations of *Cycas megacarpa* in these areas
- The operational phase of the LRMP will be implemented. The LRMP has been developed with the aim of re-instating the landscape values impacted during the construction of the GTP ROW. Some of the key actions outlined within the plan include:
  - Habitat rehabilitation post construction phase may occur through the management of natural regeneration, in addition to planting of seedlings or tube stock. Species selected will be consistent with the pre-clearing (pre-construction phase) RE as determined from analogue site surveys
  - Top soil will be reinstated to disturbed areas to allow natural regeneration from the soil seed bank
  - Natural contours and drainage lines will be re-established immediately following construction activities, so as to minimise erosion and restore natural functions as far as possible
  - Disturbed communities such as woodlands and open forests will be graded and contoured to maintain their pre-construction profiles, so as to minimise erosion and restore natural functions as far as possible
  - Woodland vegetation will be allowed to naturally revegetate or will be directly seeded (seed mix for areas of remnant vegetation will be determined by the vegetation composition of the RE as determined by analogue surveys
  - Logs or other debris will be re-spread to provide shelter and stepping stones between habitats
- Through the implementation of the LRMP, ecological communities will be progressively restored according to the rehabilitation completion criteria. For *Cycas megacarpa*, management measures outlined in the LRMP will be maintained until the rehabilitation completion criteria for this species habitat have been achieved. Key measures include:
  - The ongoing management of other introduced species (ie non declared weeds) in order to manage negative impacts associated with the quality and availability of habitat for this species
  - The ongoing management of rehabilitation works including the monitoring and management of floristic density and inter species competition (in particular in the understorey) that may negatively impact on the ability for the species to naturally regenerate
  - The ongoing management of fire in areas that may impact on habitat quality and availability within and adjacent the GTP ROW
  - The ongoing monitoring of analogue sites to determine the success of rehabilitation measures

4.5.4 Decomissioning phase mitigation measures

Measures to minimise impacts

- A decommissioning plan will be developed by GLNG Operations and provided for approval. The plan will aim to address the requirements of AS2885 and also to ensure environmental harm is avoided, including:

  - The Project area no longer contains hazardous contaminants and is left in a stable condition
  - All above ground infrastructure is removed
  - All areas disturbed by above ground infrastructure are rehabilitated in accordance with the relevant conditions
- For a minimum of five years after the completion of rehabilitation, rehabilitated areas will be monitored on a yearly basis
- The rehabilitation and associated monitoring programme will include:
  - Pest and weed controls
  - Methods to monitor subsidence and erosion rates at rehabilitated buried transmission pipeline corridors and buried flow lines
  - BioCondition assessment in accordance with the BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland: Assessment Manual: Version 2.1 (Eyre *et al* 2011)
  - Monitoring of indicators identified in the LRMP at analogue sites to measure progressive and final rehabilitation success relevant to the final land use(s)
  - The frequency and seasonality of monitoring of analogue sites and rehabilitated areas to assess rehabilitation success
  - Identification of the experimental design for analysing analogue and rehabilitated site data including statistical methods of analyses
- The final standard for rehabilitation of disturbance areas will be for impacted areas to as closely as possible match species composition, and structure for analogue sites for each community

4.6 Translocation and monitoring programme

In accordance with EPBC Act approval conditions, a minimum of 3,990 *Cycas megacarpa* individuals must be established and managed within the recipient site and offset area (transplanted individuals and seedlings combined). GLNG will secure an area of at least 166.8 ha as an offset for receiving the translocated and propagated *Cycas megacarpa* individuals.

A translocation and monitoring programme for the establishment of a *Cycas megacarpa* population offsite (ie outside of the GTP ROW) will be established. The programme will be developed for this species in consultation with relevant subject matter experts and in accordance with the principles established in Vallee *et al* (2004).

All *Cycas megacarpa* within the disturbance footprint will be tagged with a unique identification code (fire proof/resistant aluminium tag), marked with hi-visibility paint (non-toxic) and have the following information recorded against their new identification:

- Lat / Long co-ordinates
- Plant height
- Sex, including number of fruit present/presence of pollen cone
- Presence of insects/insect attack
- Presence of new growth

- Overall condition and other relevant observations
- Current height and crown condition photographed

Overarching management principles will be outlined within a *Cycas megacarpa* Offset Site Management Plan. Site specific preparation measures will be developed once the defined recipient site(s) area within the offset location has been confirmed.

The translocation and monitoring methodologies are outlined within the *Cycas megacarpa* Management Plan and have been developed in consultation with the Queensland Herbarium, by their *Cycas megacarpa* experts from the Tondoon Botanic Gardens.

5 Squatter pigeon

5.1 EPBC Act legal status

Vulnerable - listed 16 July 2000

5.2 Biology and ecology

5.2.1 Characteristics

The Squatter pigeon (southern) is a medium sized ground dwelling pigeon (approximately 30 cm long). Both sexes are of similar appearance. Adults are generally grey-brown in colour with black and white stripes on the face and throat, blue-grey skin around the eyes, dark brown (with some patches iridescent green or violet) wings, a blue-grey lower breast and white flanks and lower belly. The species has a black bill, dark brown iris, and dull purple feet and legs. Juveniles are duller in colour with patchy and less distinctive black and white facial stripes and paler facial skin. The Squatter pigeon (southern) is typically seen in pairs or small groups up to 20 or more individuals (DSEWPaC 2012b).

Squatter pigeon (Source: Aviceda 2006)

5.2.2 Known distribution

The total population of the Squatter pigeon (southern) is estimated to be 40,000 breeding birds, however this is considered to be of low reliability (DSEWPaC 2012b). Despite this the species is thought to occur as a single, contiguous and stable population (DSEWPaC 2012b).

The Squatter pigeon (southern) occurs on the inland slopes of the Great Dividing Range. The species distribution extends from the Burdekin-Lynd divide in central Queensland, west to Charleville and Longreach, east to the coastline between Proserpine and Port Curtis (near Gladstone), and south to scattered sites throughout south-eastern Queensland (eg south of the Carnarvon Range). The distribution extends from 19° 00’ S to 29° 00’S, and 141° 00’ E to 153° 30’ E. The extent of occurrence is estimated to be 440,000 km^2 while the area of occupancy is estimated to be 10,000 km^2 (DSEWPaC 2012b).

Figure 5.1 is an indicative distribution map of the present distribution of the Squatter pigeon.

Population decline is considered to have slowed and the Squatter pigeon remains locally abundant in parts of Queensland, for example, groups of up to 30 are still observed in Central Queensland (Curtis *et al* 2012).

No populations have been identified as being especially important to the long-term survival or recovery of the Squatter pigeon. It has been claimed that the southern and northern subspecies of the Squatter pigeon cross-breed in a hybrid zone centred around the Burdekin-Lynd Divide in central Queensland (DSEWPaC 2012b).

The Action Plan for Australian Birds 2010 also noted that the reasons for not including the Squatter pigeon was there were no recent declines between 2000 and 2010 and the species occurs across numerous sites within its broad distribution (Garnett *et al* 2011).

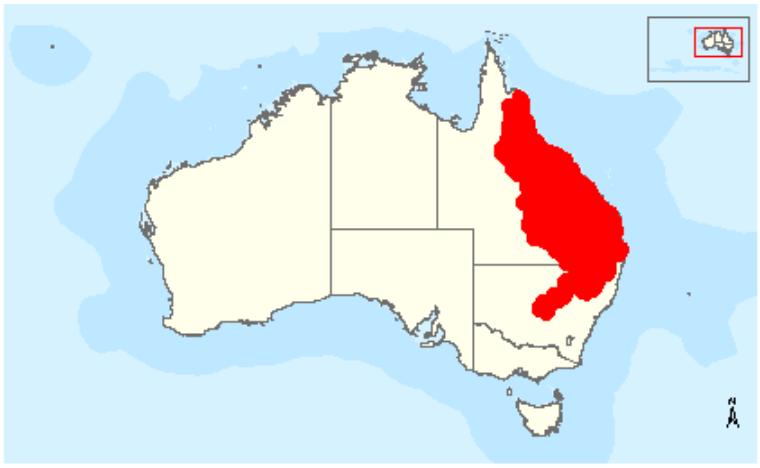


Figure 5.1 Distribution range of the Squatter pigeon (Source: DSEWPaC 2012b)

5.2.3 Known species populations and their relationship with the GTP footprint

During pre-clearing ecological surveys, Squatter pigeons were identified from KP30 to KP40, KP130 to KP312 and KP312 to KP408.81 of the GTP footprint (but outside KP0 to KP30 and KP40 to KP130). This included one location in the southern section of Arcadia Valley, as well as multiple locations in the Dawson Range, Mimosa Creek floodplain, the Callide and Calliope Ranges and Fairview CSG Fields. This species was also locally abundant in the GSDA and the CICSDA. Sightings generally involved small groups (two to six individuals) but in some instances sightings involved a solitary bird or groups in excess of six (maximum ~20 individuals). Sightings were primarily in cleared and thinned vegetation generally in close proximity to access tracks or other linear disturbances and also near watercourses or other water sources (Ecologica Consulting 2012; FEC 2012b).

This species is considered to be relatively common in central Queensland and is considered likely to occur anywhere within KP408.81 to KP409.04 and ancillary areas where suitable habitat exists.

5.2.4 Biology and reproduction

The Squatter pigeon (southern) is typically seen in pairs or small groups of up to 20 or more individuals (DSEWPaC 2012b). Whilst predominantly terrestrial (ie feeding, resting and nesting on the ground), this species is also known to roost in trees (Curtis *et al* 2012).

The squatter pigeon is a granivore but will supplement its diet with invertebrates subject to season resource availability (Curtis *et al* 2012).

This species will breed throughout the year, however breeding is influenced by heavy rainfall and most commonly occurs during the dry season between May to June (Pizzey & Knight 2007). The Squatter pigeon incubation period is approximately 17 days and chicks will remain in the nest for a further 2 to 3 weeks after hatching, however they appear capable of only short flights for up to four weeks after fledging and remain dependent on their parents during this period (DSEWPaC 2012b). Nests are usually shallow depressions in the ground lined with grass and leaves (NPWS 1999a; Pizzey & Knight 1997).

5.3 Habitat

The Squatter pigeon (southern) occurs mainly in grassy woodlands and open eucalypt forests. The species also inhabits sown grasslands with scattered remnant trees, disturbed areas (such as roads, railways, settlements and stockyards), scrubland, *Acacia* regrowth and is commonly found in heavily-grazed areas north of the Tropic of Capricorn. However, it is noted that this species is considered more common in ungrazed land (Curtis *et al* 2012).

The species is typically found in close proximity to bodies of water (DSEWPaC 2012b).

Habitat example for Squatter pigeon (Source: Wain 2012)

5.4 Habitat assessment

Information obtained from BPA (ie Brigalow Belt South Fauna Expert Panel Report (EPA 2006)), together with expert advice, site based species records and pre-clearance survey data have been used to define a set of assumptions that have been used to identify areas of habitat that are consistent with the definitions of 'core habitat', 'essential habitat' and 'general habitat' presented in Part 1 of this SSMP. The Squatter pigeon habitat assessment assumptions are presented below.

5.4.1 General assumptions

The following general habitat assumptions have been made based on current scientific knowledge of this species:

- Species is found within walking distance to a water source (ie within 3 km of a stream-order 3 or greater watercourse as indicated on DEHP's mapping and/or within 3 km of areas mapped as 'lacustrine' waterbodies on the Queensland Wetland Mapping (Version 3.0) and permanent farm dams etc)

5.4.2 Core habitat

'Core habitat' consists of 'essential habitat' in which the species is known and the habitat is recognised under relevant recovery plans or other relevant plans/policies/regulations. Also included within this category are populations that are limited geographically within the region.

For the Squatter pigeon all REs or Pre-REs that contain a specimen backed record, which overlap with areas identified in the BPA mapping that have been identified as containing a 'State' or 'Regional' 'Corridor' (J-Rating) and/or 'Core Habitat' (H-Rating) and/or 'Habitat for EVR Taxa' (A-Rating) have been mapped as 'core habitat'.

KP0 to KP30

Individuals of this species have been identified within the general vicinity of the KP0 to KP30 GTP ROW area (but outside of the ROW itself), and as these areas meet the criteria outlined above, 'core habitat' has been mapped within this section of the GTP ROW.

The location of the 'core habitat' for this species is shown in Figure 5.2a.

KP30 to KP40

Two individuals of this species have been identified on an access track at KP34.84, and as this area meets the criteria outlined above, 'core habitat' has been mapped within this section of the GTP ROW.

The location of the 'core habitat' for this species is shown in Figure 5.2b.

KP40 to KP130

No individuals of this species have been identified within KP40 to KP130; therefore no 'core habitat' exists within this section of the GTP.

KP130 to KP312

Three individuals of this species have been identified within the GTP ROW at KP280.42, and as this area meets the criteria outlined above, 'core habitat' has been mapped within this section of the GTP ROW.

The location of the 'core habitat' for this species is shown in Figure 5.2d and Figure 5.2e.

KP312 to KP408.81

Individuals of this species have been identified near KP354, KP365, KP366, KP383, KP384, KP397 and numerous sightings within KP405 to KP408.81 of the GTP ROW, and as these areas meet the criteria outlined above, 'core habitat' has been mapped within this section of the GTP ROW.

The location of the 'core habitat' for this species is shown in Figure 5.2f and Figure 5.2g.

KP408.81 to KP409.04

Individuals of this species have been identified within the general vicinity of the KP408.81 to KP409.04 GTP ROW area and within the proposed access road footprints and as these areas meet the criteria outlined above 'core habitat' has been mapped within this section of the GTP ROW.

The location of the 'core habitat' for this species is shown in Figure 5.2h.

KP413.57 to KP419.69

No individuals of this species have been identified within KP413.57 to KP419.69; therefore no 'core habitat' exists within this section of the GTP.

5.4.3 Essential habitat

'Essential habitat' is an area containing resources that are considered essential for the maintenance of populations of the species (eg potential habitat for breeding, roosting, foraging, shelter, for either migratory or non-migratory species). 'Essential habitat' is defined from known records and/or expert advice (including the findings of pre-clearance surveys).

The BPA expert panel (EPA 2006) states that as the Squatter Pigeon inhabits such a wide range of habitats within the Brigalow Belt South Bioregion, all habitats are defined as 'general habitat', although based on known records for the Squatter pigeon, all REs or Pre-REs that contain a specimen backed record have been mapped as 'essential habitat'. This mapping is restricted only to the relevant polygon in which the record falls (ie as per the DEHP certified RE or Pre RE mapping).

KP0 to KP30

As individuals of this species have been identified within the general vicinity of the KP0 to KP30 GTP ROW (but outside of the ROW), but these areas meet the criteria to be included as 'core habitat', no 'essential habitat' has been mapped within this section of the GTP.

KP30 to KP40

As individuals of this species have been identified within KP30 to KP40 of the GTP ROW, but these areas meet the criteria to be included as 'core habitat', no 'essential habitat' has been mapped within this section of the GTP.

KP40 to KP130

As no individuals of this species have been identified within KP40 to KP130, no 'essential habitat' exists within this section of the GTP.

KP130 to KP312

As three individuals of this species have been identified at KP280.42, but these areas meet the criteria to be included as 'core habitat', no 'essential habitat' has been mapped within this section of the GTP.

KP312 to KP408.81

As individuals of this species have been identified near KP350, KP358 and KP368 of the GTP ROW, and these areas meet the criteria outlined above, 'essential habitat' has been mapped within this section of the GTP.

The location of the 'essential habitat' for this species is shown in Figure 5.2f and Figure 5.2g.

KP408.81 to KP409.04

As individuals of this species have been identified within the general vicinity of the KP408.81 to KP409.04 GTP ROW (but outside of the ROW), but these areas meet the criteria to be included as 'core habitat', no 'essential habitat' has been mapped within this section of the GTP.

KP413.57 to KP419.69

As no individuals of this species have been identified within KP413.57 to KP419.69, no 'essential habitat' exists within this section of the GTP.

5.4.4 General habitat

'General habitat' consists of areas or locations that are used by transient individuals or where species have been recorded but there is insufficient information to assess the area as 'essential/core habitat'. 'General habitat' may be defined from known records or habitat that is considered to potential support a species according to expert knowledge of habitat relationships, despite the absence of specimen backed records. General habitat may include areas of suboptimal habitat for species.

For the Squatter pigeon all areas contained within a 3 km buffer from watercourses mapped as 'Stream order 3' and above as indicated on the DEHP certified mapping, that have REs or Pre-REs as identified above have been included within this category. Non-flowing permanent water bodies which might be utilised by the species (ie lacustrine wetlands, artificial ponds and billabongs) are also included within this category. Where records occur outside of this buffer zone, a 1 km buffer (ie radius) from the specimen's record has been established and this area is also included within the 'general habitat' category.

KP0 to KP30

The location of the 'general habitat' for this species within KP0 to KP30 is shown in Figure 5.2a.

KP30 to KP40

The location of the 'general habitat' for this species within KP30 to KP40 is shown in Figure 5.2b.

KP40 to KP130

The location of the 'general habitat' for this species within KP40 to KP130 is shown in Figure 5.2c.

KP130 to KP312

Cleared areas within Expedition Range (KP135.3 to KP136.5, KP146.8, KP148.8 to KP148.9), KP183 to KP190, Conciliation Creek area (KP207 to KP210) and KP224.25 to KP224.6 has been identified during the pre-clearance surveys as meeting the criteria of 'general habitat' for this species (Santos GLNG 2012).

The location of the 'general habitat' for this species within KP130 to KP312 is shown in Figure 5.2d and Figure 5.2e.

KP312 to KP408.81

Pre-clearance surveys identified 'general habitat' for this species throughout the Callide and Calliope Ranges, KP373 to KP380 and KP397 to KP404 (Santos GLNG 2013).

The location of the 'general habitat' for this species within KP312 to KP408.81 is shown in Figure 5.2f and Figure 5.2g.

KP408.81 to KP409.04

The location of the 'general habitat' for this species within KP408.81 to KP409.04 is shown in Figure 5.2h.

KP413.57 to KP409.69

Pre-clearance surveys did not identify 'general habitat' for this species within KP413.57 to KP419.69.

5.4.5 Unlikely habitat

'Unlikely habitat' areas are those areas that do not contain records of the particular species and contain no habitat values to support the presence or existence of resident or migratory individuals or populations of the species.

5.5 Anticipated threats and potential impacts as a result of the GTP

- Loss and degradation of 'general habitat'
- Changes to local foraging behaviour due to increased vehicle movement, noise, lighting, etc
- Stress, injury and mortality to animals due to increases in noise, vehicle movement, lighting and clearing during construction
- Destruction of nests
- Entrapment of individuals in the trench and barriers to movement

5.6 Unavoidable impact and unavoidable adverse (offsetable) impact from GTP

Areas of proposed disturbance and areas of adverse (offsetable) impact associated with clearing and construction activities for the GTP between KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 for the Squatter pigeon are presented in Table 5.1. It is important to note that this unavoidable impact is considered minor and temporary in the context of the wide spread extent of 'general habitat' in the region. The location of this habitat is shown in Figure 5.2a, Figure 5.2b, Figure 5.2c, Figure 5.2d, Figure 5.2e, Figure 5.2f, Figure 5.2g and Figure 5.2h.

A cumulative total of proposed clearing of habitat for the Squatter pigeon and the cumulative total of unavoidable adverse (offsetable) impact to the species habitat is provided in Table 5.1.

Table 5.1 Cumulative total of Squatter pigeon habitat to be cleared and area of habitat subject to unavoidable adverse (offsetable) impacts from the GTP

Location	'General habitat'	'Essential habitat'	'Core habitat'	Total habitat area per GTP section	Total habitat area adversely impacted per GTP section
KP0 to KP30	48.83 ha	0 ha	6.28 ha	55.11 ha	12.57 ha
KP30 to KP40	21.43 ha	0 ha	2.89 ha	24.32 ha	15.65 ha
KP40 to KP130	441.60 ha	0 ha	0.00 ha	441.60 ha	0.79 ha

Location	'General habitat'	'Essential habitat'	'Core habitat'	Total habitat area per GTP section	Total habitat area adversely impacted per GTP section
KP130 to KP312	438.77 ha	0 ha	38.23 ha	476.97 ha	38.23 ha
KP312 to KP408.81	199.23 ha	70.86 ha	123.33 ha	393.42 ha	146.89 ha
KP408.81 to KP409.04	1.27 ha	0 ha	11.02 ha	12.29 ha	11.02 ha
KP413.57 to KP419.69	0 ha	0 ha	0 ha	0 ha	0 ha
Total habitat area	**1,151.10 ha**	**70.86 ha**	**181.75 ha**	**1,403.71 ha**	**225.15 ha**

5.7 Management practices and methods

5.7.1 Pre-construction mitigation measures

Measures to avoid impact

- Prior to the commencement of construction clearing, a suitably qualified and experienced EO will confirm the buffer zones ('No Go' zones) and where necessary barriers and signs will be erected

Measures to minimise impacts

- Wherever practicable, signage will be erected to increase awareness of the Squatter pigeons in the area
- Prior to site entry, all site personnel will be appropriately trained and made aware of the sensitive environs in which they will be working (refer Part 1, Section 7.7). This will include understanding the responses of the Squatter pigeons to vehicle movement

5.7.2 Construction phase mitigation measures

Measures to avoid impact

- Due to the location of nests (on ground) and the ground dwelling nature of the birds, all vehicles and pedestrians will remain within the ROW and designated access tracks

Measures to minimise impacts

- Locate site offices, construction camps, stockpiling/laydown areas, plant and equipment storage areas away from Squatter pigeon core habitat (ie permanent water bodies)
- Implementation of the Fauna Handling Procedures (refer Appendix C)
- All vegetation clearing within known Squatter pigeon habitat will comply with clearing approval conditions (eg NC Act and other statutory approvals)
- A licensed and experienced spotter catcher(s) will be onsite during all clearing activities and will ensure any injured animals are given to an appropriate wildlife carer

group or vet (refer Appendix C). DotE and DEHP will be notified within 24 hours of any native animal injuries or deaths

- Due to the tendency for this species to utilise disturbed areas (such as access tracks and pastoral grasslands) vehicle and machinery speed limits will be restricted to 20 km/hr (maximum speed limit of 50 km/hr in the GTP footprint) within key areas where the Squatter pigeon has been identified with appropriate signage erected
- Clearing activities will be supervised by the relevant EO
- Clearing will be conducted in a sequential manner and in a way that directs escaping wildlife away from the clearing activities and into adjacent natural areas
- Measures to be adopted to prevent fauna entrapment within the pipeline trench, include:
  - Minimising the period of time the trench is open, particularly in ‘core habitat’ and ‘essential habitat’ areas
  - Constructing ramps with a non-slip surface with slopes less than 45° to provide exit ramps for fauna at intervals no greater than 500 m
  - Trench plugs will be installed in open trenches. These will be provided as a minimum every 500 m
  - Installing additional ramps at greater than normal frequencies (500 m) in areas identified as known or high value habitat
  - Branches, hessian sacks, ramped gangplanks or similar to be used to create 'ladders' to enable fauna to exit the trench. These structures will be placed every 250 to 500 m, depending on the surrounding landscapes
- The whole trench will be checked at least twice a day (early morning/late afternoon) and the removal of wildlife from the trench will be undertaken by an appropriately trained and licensed spotter catcher(s)
- Spotter catcher(s) will have access to the site (particularly the open trench) during all weather conditions to check for trapped fauna
- Where practicable, direct any lighting associated within night works away from sensitive areas or use engineering solutions to limit light spillage. This may include the use of light shades and low lighting being applied to construction and operational areas located adjacent to remnant native vegetation and known habitat areas for this species
- Prior to backfilling, the spotter catcher(s) will check the open trench for trapped fauna and where required move them to a safe location away from the trench
- Ensure equipment is regularly maintained and is good working order
- The construction phase component of the LRMP will be implemented
- Weather permitting, rehabilitation of all areas identified will commence immediately after the pipeline has been lowered in and backfilled (refer LRMP). With the exception of operational constraints, revegetation will be consistent with the plant density, floristic composition and distribution of the adjacent communities

5.7.3 Operational phase mitigation measures

Measures to avoid impact

- To avoid impacting on regenerating Squatter pigeon habitat, vehicle and pedestrian access will be restricted to the defined access tracks to and from the ROW and the defined access track within the ROW

Measures to minimise impacts

- Implementation of the Fauna Handling Procedures (refer Appendix C)
- The operational phase component of the LRMP will be implemented
- The operational phase of the PWMP will be implemented to minimise the risk of weed and pest animal establishment

5.7.4 Decommissioning phase mitigation measures

Measures to minimise impacts

- Implementation of the Fauna Handling Procedures (refer Appendix C)
- A decommissioning plan will be developed by GLNG operations and provided for approval. The plan will aim to address the requirements of AS2885 and also to ensure environmental harm is avoided, including:
  - The Project area no longer contains hazardous contaminants and Is left in stable condition
  - All the above ground infrastructure is removed
  - All areas disturbed by above ground infrastructure are rehabilitated in accordance with the relevant conditions
- For a minimum of five years after the completion of rehabilitation, rehabilitated areas will be monitored on a yearly basis
- The monitoring programme will include:
  - Methods to measure subsidence and erosion rates at rehabilitated buried transmission pipeline corridors and buried flow lines
  - BioCondition assessment in accordance with the BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland: Assessment Manual: Version 2.1 (Eyre *et al* 2011)
  - Monitoring of indicators identified in the LRMP at analogue sites to measure progressive and final rehabilitation success relevant to the final land use(s)
  - Frequency and seasonality of monitoring analogue sites and rehabilitated areas to assess rehabilitation success
  - Identification of the experimental design for analysing analogue and rehabilitated site data including statistical methods of analyses

6 Black-breasted button-quail

6.1 EPBC Act legal status

Vulnerable - listed 16 July 2000

6.2 Biology and ecology

6.2.1 Characteristics

The Black-breasted button-quail is a large, plump, pale-eyed button-quail. It is similar in size to the Painted button-quail. The male Black-breasted button-quails are about 18 cm long, with a wingspan of 32 to 35 cm, and weighing 65 g. The females are larger, weighing approximately 100 g. The sexes differ in plumage. No seasonal variation in plumage occurs in this species. Males have finely patterned backs and wings with brown, black, grey and white mottling. The face and throat are whitish and the breast is black with numerous white half-moon markings (DSEWPaC 2012c). The female is similar to the male in regards to colouration and patterning, except for the presence of a black face and throat, a larger dark area over the upper and lower breast and heavier white half-moon markings on the upper and lower breast. The bill is grey and the legs are pale yellow. Juveniles resemble males in colouration, but are duller (Marchant & Higgins 1993).

Black-breasted button-quail are commonly seen in pairs or occasionally in small groups. Being territorial, females are occasionally seen singly (Hughes & Hughes 1991; Marchant & Higgins 1993).

Black-breasted button-quail (Source: Aviceda 2005a)

6.2.2 Known distribution

The Black-breasted button-quail is endemic to eastern Australia. It is restricted to coastal and near-coastal regions of south-eastern Queensland and north-eastern New South Wales. The main populations occur within south-east Queensland (DSEWPaC 2012c).

Present-day known distribution in Queensland extends from near Byfield in the north, south to the New South Wales border and westwards to Palm Grove National Park and Barakula State Forest (Marchant & Higgins 1993; DSEWPaC 2012c). The most significant populations appear to be in the Yarraman-Nanango, Jimna-Conondale and Great Sandy regions (Bennett 1985; Hamley *et al* 1997; DSEWPaC 2012c).

Figure 6.1 is an indicative distribution map of the present distribution of the Black-breasted button-quail.

The extent of occurrence is estimated to be approximately 5,200 km², but this estimate is only of medium reliability (Garnett & Crowley 2000). Total area of occupancy is estimated to be approximately 750 km², but this estimate is of low reliability (Garnett & Crowley 2000).

Populations have become severely fragmented since European settlement, mostly due to clearance of forests and bushland for agriculture (Hamley *et al* 1997). There are approximately 25 sub-populations of this species and most of these are probably isolated in fragments (Garnett & Crowley 2000). A survey in south-eastern Queensland indicated that there were 14 discrete areas where this species occurs, and there is also some fragmentation within these areas (Hamley *et al* 1997 in Garnett & Crowley 2000).

The total population is estimated at 5,000 breeding birds. However, this estimate is of low reliability (Garnett & Crowley 2000).

Figure 6.1 Distribution range of the Black-breasted button-quail (Source: DSEWPaC 2012c)

6.2.3 Known species populations and their relationship with the GTP footprint

The Black-breasted button-quail has not been identified from the local area and was not identified during the pre-clearance surveys (Ecologica Consulting 2012).

Preferred habitat (eg vine thicket) is limited within the GTP ROW however, this species is also known to utilise woodlands and ecotone environments near vine thickets. As such there is the potential for the species to forage in the *Eucalyptus crebra* + *Corymbia Clarksoniana* and *Acacia leiocarpa* woodlands near KP7 (ie SEVT was identified from the adjacent sandstone cliffs) (Ecologica Consulting 2012).

Button-quail platelets were identified within Callide Range at approximately KP315 and KP315.25. Five *Turnix* ssp. distribution ranges overlap this site and as the Black-breasted button-quail can not be excluded, 'general habitat' occurs here. SEVT TEC was also identified within KP401.82 to KP401.93 which is preferred habitat for this species.

6.2.4 Biology and reproduction

The diet is mostly invertebrates, taken from litter on the forest floor (Hughes & Hughes 1991; Lees & Smith 1998; Marchant & Higgins 1993; McConnell & Hobson 1995), but seeds are also possibly taken (Smyth 1997).

There is no information concerning sexual maturity or life-span of birds in the wild (DSEWPaC 2012c).

The breeding season generally occurs from September to April-May (DSEWPaC 2012c). At one site in south-eastern Queensland, juveniles were observed in all except one month, suggesting that breeding can occur throughout the year at certain localities (Hughes & Hughes 1991; Smyth & Young 1996). The onset and finish of the breeding season may be affected by climatic factors such as minimum daily temperature and rainfall, eg a reduction in the amount of food available, caused by dropping temperatures, probably causes the breeding season to end (Smyth & Young 1996; DSEWPaC 2012c). However, the relationship between rainfall and breeding season is not clear (Smyth & Young 1996).

Between three and five eggs are laid, with a mean clutch-size of 3.88 (Smyth & Young 1996). Nests consist of a scrape in the ground, lined with leaves, grass or moss. Nests are well-concealed and placed in the buttress root of a tree or sapling, the base of a fern or under a low bush or grass tussock (Marchant & Higgins 1993, Smyth & Young 1996).

Nests are often in areas where the common understorey plants include species such as Bracken (*Pteridium esculentum*), Rasp fern (*Doodia aspera*) and Lantana (*Lantana camara*) (Smyth & Young 1996).

The incubation period in the wild is 18 to 21 days (Smyth & Young 1996). Only the male incubates (Marchant & Higgins 1993, Smyth & Young 1996). During the breeding season, females are territorial toward other females, but not males. Males possibly hold small temporary territories for courtship and mating, these being within a female's larger territory. The female apparently mates with several males in succession (Smyth & Young 1996). Mating takes place within the female's own territory and, on occasions, within the adjacent territories of other females (DSEWPaC 2012c). The female can lay two clutches 8 to 10 days apart (Smyth & Young 1996).

6.3 Habitat

The Black-breasted button-quail is restricted to rainforests and forests, mostly in areas with 770 to 1,200 mm rainfall per annum (Bennett 1985; Hughes & Hughes 1991; Marchant & Higgins 1993). They prefer drier low closed forests, particularly semi-evergreen vine thicket, low microphyll vine forest, araucarian microphyll vine forest and araucarian notophyll vine forest (Bennett 1985; Hughes & Hughes 1991; Marchant & Higgins 1993; Milledge 2000; Smyth *et al* 2001). They may also be found in low, dense acacia thickets and, in littoral area, in vegetation behind sand dunes (Smith & Mathieson 2004).

Many areas of optimum habitat are located on highly fertile soils. It is believed that the highly fertile soils promote rapid leaf growth on plants (DSEWPaC 2012c). During dry periods, much of the foliage then drops to the ground thus maintaining the deep leaf litter layer which is crucial to the foraging requirements of the species (Smith & Mathieson 2004).

Many reports are from dry forest described as Bottle tree scrub, comprising Brigalow (*Acacia harpophylla*), Belah (*Casuarina cristata*) and Bottle tree (*Brachychiton rupestris*), with or without emergent Hoop pine (*Araucaria cunninghamii*), with a shrub understorey and thick litter layer (Barnard 1925; Bennett 1985). Much of this vegetation type, especially in the Fitzroy and Dawson valleys has been grossly depleted (Hamley *et al* 1997).

In Googa State Forest, south-eastern Queensland, birds are most commonly associated with remnant microphyll vine forest with no lantana in the understorey, but lantana is often used for diurnal foraging and nocturnal roosting. This species has been recorded as far as 60 m into mature Hoop pine plantations. A mosaic of Lantana and emergent vine forest species appears to be important for cover (Smith *et al* 1998).

In littoral areas, the species associates with vegetation behind dunes, namely vine scrubs and thickets, acacia thickets and areas densely covered in shrubs, particularly Midgen berry (*Austromyrtus dulcis*) and Lantana (Smith & Mathieson 2004). In the Great Sandy region of south-east Queensland, Black-breasted button-quail occur in Brush box (*Lophostemon confertus*), Pink bloodwood (*Corymbia intermedia*) and Forest red gum (*Eucalyptus tereticornis*) forest, with an understorey of Black she-oak (*Allocasuarina littoralis*), Acacias, Lantana and berry-bearing shrubs (Bennett 1985).

In south-eastern Queensland, they are recorded on rare occasions in open eucalypt forest (Smyth *et al* 2001). An extensive dense leaf-litter layer is required for foraging (Hughes & Hughes 1991) and possibly also roosting (McConnell & Hobson 1995). Fallen logs and a dense, heterogeneously distributed shrub layers are also considered to be important habitat characteristics for shelter and breeding (Smith *et al* 1998; Smyth & Young 1996).

The species has also recorded from vine forest remnants between Hoop pine plantations and agricultural land (Smith *et al* 1998) and occasionally in areas of pasture grass adjacent to habitat areas (Hughes & Hughes 1991).

6.4 Habitat assessment

Information obtained from BPA (ie Brigalow Belt South Fauna Expert Panel Report (EPA 2006)), together with expert advice, site based species records and pre-clearance survey data have been used to define a set of assumptions that have been used to identify areas of habitat that are consistent with the definitions of ‘core habitat’, ‘essential habitat’ and ‘general habitat’ that have been presented in Part 1 of this SSMP. The Black-breasted button-quail habitat assumptions are presented below.

6.4.1 General assumptions

The following habitat assumptions have been made based on current scientific knowledge of this species:

- Preferred habitat of this species consists of drier low closed forests, particularly semi-evergreen vine thicket, low microphyll vine forest, araucarian microphyll vine forest and araucarian notophyll vine forest (DSEWPaC 2012c; BPA Expert Panel)

6.4.2 Core habitat

‘Core habitat’ consists of ‘essential habitat’ in which the species is known and the habitat is recognised under relevant recovery plans or other relevant plans/policies/regulations. Also included within this category are populations that are limited geographically within the region.

For the Black-breasted button-quail, all areas identified in the habitat assumptions above, which overlap with areas identified in the BPA mapping that have been identified as containing a ‘State’ or ‘Regional’ ‘Corridor’ (J-Rating) and/or ‘Core Habitat’ (H-Rating) and/or ‘Habitat for EVR Taxa’ (A-Rating) have been mapped as ‘core habitat’.

No individuals of this species have been identified within the general vicinity of KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to

KP409.04 and KP413.57 to KP419.69 of the GTP, therefore no 'core habitat' exists within these sections of the GTP.

6.4.3 Essential habitat

'Essential habitat' is an area containing resources that are considered essential for the maintenance of populations of the species (eg potential habitat for breeding, roosting, foraging, shelter, for either migratory or non-migratory species). 'Essential habitat' is defined from known records and/or expert advice (including the findings of pre-clearance surveys).

For the Black-breasted button-quail, all REs that contain a specimen backed record have been mapped as 'essential habitat'. This mapping is restricted only to the relevant polygon in which the record falls (ie as per the DEHP certified RE mapping).

As this species was not observed within KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 of the GTP during pre-clearance surveys, no 'essential habitat' for this species is considered to exist between these sections of the GTP.

6.4.4 General habitat

''General habitat' consists of areas or locations that are used by transient individuals or where species may have been recorded but where there is insufficient information to assess the area as essential/core habitat. 'General habitat' also includes areas defined from known records or habitat that is considered to potentially support a species according to expert knowledge of habitat relationships, despite the absence of specimen backed records. 'General habitat' may include areas of suboptimal habitat for species. As potential habitat for many species contained within this SSMP may include most of the regional ecosystems of the Brigalow Belt Bioregion, the 'general habitat' category restricts the habitat to a more limited and realistic set of environmental parameters that are supported by literature and field based observation.

For the Black-breasted button-quail, all areas that contain REs that have been identified by DotE or site based observations as containing habitat suitable for the occurrence of this species, are included within the 'general habitat' category.

KP0 to KP30

The location of the 'general habitat' for this species within this section of the GTP is shown in Figure 6.2a.

KP30 to KP40

No 'general habitat' for this species exists in this section of the GTP.

KP40 to KP130

No 'general habitat' for this species exists in this section of the GTP.

KP130 to KP312

No 'general habitat' for this species exists in this section of the GTP.

KP312 to KP408.81

Button-quail platlets were identified within Callide Range at approximately KP315 and KP315.25 and suitable habitat for this species was also identified at KP400.3 and within KP401.82 to KP401.93. These locations have been determined as 'general habitat' for this species.

The location of the 'general habitat' for this species within this section of the GTP is shown in Figure 6.2b and 6.2c.

KP408.81 to KP409.04

No 'general habitat' for this species exists in this section of the GTP.

KP413.57 to KP419.69

Pre-clearance surveys did not identify 'general habitat' for this species within this section of the GTP.

6.4.5 Unlikely habitat

'Unlikely habitat' areas are those areas that do not contain records of the particular species and contain no habitat values to support the presence or existence of resident or migratory individuals or populations of the species.

6.5 Anticipated threats and potential impacts as a result of the GTP

- Loss and degradation of 'general habitat'
- Changes to local foraging behaviour due to increased vehicle movement, noise, lighting, etc
- Stress, injury and mortality to animals due to increases in noise, vehicle movement, lighting and clearing during construction
- Destruction of nests
- Entrapment of individuals in the trench and barriers to movement

6.6 Unavoidable impact and unavoidable adverse (offsetable) impact from GTP

Areas of proposed disturbance and areas of adverse (offsetable) impact associated with clearing and construction activities for the GTP between KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 for the Black-breasted button-quail are presented in Table 6.1. The location of this habitat is shown in Figure 6.2a, Figure 6.2b and Figure 6.2c.

A cumulative total of proposed clearing of habitat for the Black-breasted button-quail and the cumulative total of unavoidable adverse (offsetable) impact to the species habitat is provided in Table 6.1.

Table 6.1 Cumulative total of Black-breasted button-quail habitat to be cleared and area of habitat subject to unavoidable adverse (offsetable) impacts from the GTP

Location	'General habitat'	Total habitat area per GTP section	Total habitat area adversely impacted per GTP section
KP0 to KP30	0.24 ha	0.24 ha	0.24 ha
KP30 to KP40	0 ha	0 ha	0 ha
KP40 to KP130	0 ha	0 ha	0 ha
KP130 to KP312	0 ha	0 ha	0 ha
KP312 to KP408.81	2.37 ha	2.37 ha	2.37 ha
KP408.81 to KP409.04	0 ha	0 ha	0 ha
KP413.57 to KP419.69	0 ha	0 ha	0 ha
Total habitat area	**2.61 ha**	**2.61 ha**	**2.61 ha**

6.7 Management practices and methods

6.7.1 Pre-construction mitigation measures

Measures to avoid impact

- Prior to the commencement of construction clearing, a suitably qualified and experienced EO will confirm the buffer zones ('No Go' zones) and where necessary barriers and signs will be erected

Measures to minimise impacts

- Wherever practicable, signage will be erected to increase awareness of the Black-breasted button-quail in the area
- Prior to site entry, all site personnel will be appropriately trained and made aware of the sensitive environs in which they will be working (refer Part 1, Section 7.7)

6.7.2 Construction phase mitigation measures

Measures to avoid impact

- Due to the location of nests (on ground) and the ground dwelling nature of the birds, all vehicles and pedestrians will remain within the ROW and designated access tracks

Measures to minimise impacts

- Locate site offices, construction camps, stockpiling/laydown areas, plant and equipment storage areas away from Black-breasted button-quail core habitat (ie permanent water bodies)
- Implementation of the Fauna Handling Procedures (refer Appendix C)
- All vegetation clearing within known Black-breasted button-quail habitat will comply with clearing approval conditions (eg NC Act and other statutory approvals)
- A licensed and experienced spotter catcher(s) will be onsite during all clearing activities and will ensure any injured animals are given to an appropriate wildlife carer

group or vet (refer Appendix C). DotE and DEHP will be notified within 24 hours of any native animal injuries or deaths

- Vehicle and machinery speed limits will be restricted to 20 km/hr (maximum speed limit of 50 km/hr in the GTP ROW footprint) within key areas where the Black-breasted button-quail has been identified with appropriate signage erected
- Clearing activities will be supervised by the relevant EO
- Clearing will be conducted in a sequential manner and in a way that directs escaping wildlife away from the clearing activities and into adjacent natural areas
- Measures to be adopted to prevent fauna entrapment within the pipeline trench, include:
  - Minimising the period of time the trench is open, particularly in ‘core habitat’ and ‘essential habitat’ areas
  - Constructing ramps with a non-slip surface with slopes less than 45° to provide exit ramps for fauna at intervals no greater than 500 m
  - Trench plugs will be installed in open trenches. These will be provided as a minimum every 500 m
  - Installing additional ramps at greater than normal frequencies (500 m) in areas identified as known or high value habitat
  - Branches, hessian sacks, ramped gangplanks or similar to be used to create 'ladders' to enable fauna to exit the trench. These structures will be placed every 250 to 500 m, depending on the surrounding landscapes
- The whole trench will be checked at least twice a day (early morning/late afternoon) and the removal of wildlife from the trench will be undertaken by an appropriately trained and licensed spotter catcher(s)
- Spotter catcher(s) will have access to the site (particularly the open trench) during all weather conditions to check for trapped fauna
- Where practicable, direct any lighting associated within night works away from sensitive areas or use engineering solutions to limit light spillage. This may include the use of light shades and low lighting being applied to construction and operational areas located adjacent to remnant native vegetation and known habitat areas for this species
- Prior to backfilling, the spotter catcher(s) will check the open trench for trapped fauna and where required move them to a safe location away from the trench
- Ensure equipment is regularly maintained and is good working order
- The construction phase component of the LRMP will be implemented
- Weather permitting, rehabilitation of all areas identified will commence immediately after the pipeline has been lowered in and backfilled (refer LRMP). With the exception of operational constraints, revegetation will be consistent with the plant density, floristic composition and distribution of the adjacent communities

6.7.3 Operational phase mitigation measures

Measures to avoid impact

- To avoid impacting on regenerating Black-breasted Button-quail habitat, vehicle and pedestrian access will be restricted to the defined access tracks to and from the ROW and the defined access track within the ROW

Measures to minimise impacts

- Implementation of the Fauna Handling Procedures (refer Appendix C)
- The operational phase component of the LRMP will be implemented
- The operational phase of the PWMP will be implemented to minimise the risk of weed and pest animal establishment

6.7.4 Decommissioning phase mitigation measures

Measures to minimise impacts

- Implementation of the Fauna Handling Procedures (refer Appendix C)
- A decommissioning plan will be developed by GLNG operations and provided for approval. The plan will aim to address the requirements of AS2885 and also to ensure environmental harm is avoided, including:
  - The Project area no longer contains hazardous contaminants and Is left in stable condition
  - All the above ground infrastructure is removed
  - All areas disturbed by above ground infrastructure are rehabilitated in accordance with the relevant conditions
- For a minimum of five years after the completion of rehabilitation, rehabilitated areas will be monitored on a yearly basis
- The monitoring programme will include:
  - Methods to measure subsidence and erosion rates at rehabilitated buried transmission pipeline corridors and buried flow lines
  - BioCondition assessment in accordance with the BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland: Assessment Manual: Version 2.1 (Eyre *et al* 2011)
  - Monitoring of indicators identified in the LRMP at analogue sites to measure progressive and final rehabilitation success relevant to the final land use(s)
  - Frequency and seasonality of monitoring analogue sites and rehabilitated areas to assess rehabilitation success
  - Identification of the experimental design for analysing analogue and rehabilitated site data including statistical methods of analyses

7 Red goshawk

7.1 EPBC Act legal status

Vulnerable - listed 16 July 2000

7.2 Biology and ecology

7.2.1 Characteristics

The Red goshawk (*Erythrotriorchis radiates*) is a large, swift and powerful rufous-brown hawk, growing to a length of 45 to 60 cm, with a wingspan of 100 to 135 cm (DSEWPaC 2012d). The two sexes of this species are quite different in size and appearance (NPWS 2002). The females weigh approximately 1.1 kg, the males approximately 0.63 kg. The Red goshawk is boldly mottled and streaked, with rufous scalloping on the back and upper wings, rufous underparts that are brightest and lack streaking on the thighs, and with massive yellowish legs and feet, and boldly barred underwings. Females are larger, more powerfully built, paler and more heavily streaked below, showing some white on the under body. Juveniles have redder upper-parts, and the head and underparts are rich rufous with fine dark streaks. The juvenile's rufous head distinguishes it from adults (DSEWPaC 2012d).

The Red goshawk can further be distinguished from other similar raptors by its broad 'six-fingered' wings that are held at slightly angled planes when soaring, the lack of pale markings on upperparts, the heavy and dark streaking on the head and chest, the flat head, the deep bill (female), the broad deep chest, and the long tail which is square-tipped to slightly rounded at the tip (DSEWPaC 2012d).

The Red goshawk is solitary and very thinly dispersed. It is usually observed singly, and occasionally in pairs or family groups (DSEWPaC 2012d). Red goshawk pairs are believed to remain within the nesting territory all year, but some may expand their home range when not breeding (Aumann & Baker-Gabb 1991; Debus & Czechura 1988).

Red goshawk (Source: Hansch 2008)

7.2.2 Known distribution

It was estimated that there were 1,000 breeding birds in 2000 and this estimate was made with medium reliability (Garnett & Crowley 2000).

The Red goshawk is endemic to Australia. It is very sparsely dispersed across approximately 15% of coastal and sub-coastal Australia, from western Kimberley Division (north of 19°S) to north-eastern NSW (north of 33°), and occasionally on continental islands (Aumann & Baker-Gabb 1991; Marchant & Higgins 1993).

Figure 7.1 is an indicative distribution map of the present distribution of the Red goshawk.

There appears to have been a recent coastal contraction of the range in parts of eastern Australia, and a northward contraction of about 500 km in NSW where it is now virtually extinct (Blakers *et al* 1984; Debus & Czechura 1988a; Debus 1991; Debus *et al* 1993; Marchant & Higgins 1993).

The estimated extent of occurrence is likely to be stable at 1,000,000 km and the estimated area of occupancy is suspected to be 200,000 km², though the reliability of this estimate is low (DSEWPaC 2012d).

The area of occupancy has declined since European settlement. While this decline cannot be quantified, the lack of any breeding records in NSW over the last 50 years, and the decline in sightings of Red goshawk further from the coast especially in Queensland suggest that fewer areas are now being used for breeding (Debus & Czechura 1988a; NPWS 2002). It is suggested that since European settlement, development and habitat alteration have rendered about 20% of the predicted Red goshawk's range unsuitable for breeding, especially in coastal Queensland (Aumann & Baker-Gabb 1991).

The distribution of the Red goshawk is not severely fragmented. It is suspected that there is some fragmentation (BirdLife International 2004), but there is no evidence that fragmentation in the Red goshawk distribution is severe. However, some fragmentation may have occurred in the more heavily settled and cleared regions of the species range, such as in the coastal lowlands of eastern Queensland (DSEWPaC 2012d).

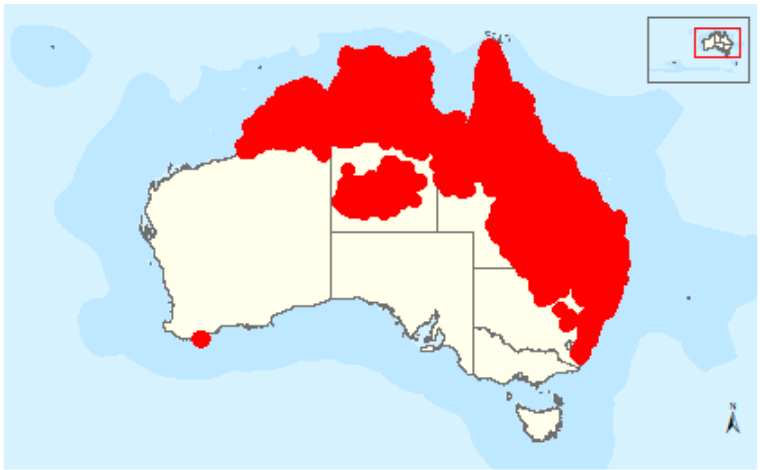


Figure 7.1 Distribution range of the Red goshawk (Source: DSEWPaC 2012d)

7.2.3 Known species populations and their relationship with the GTP footprint

There are no known records from the region and the species was not observed during the pre-clearance surveys (Ecologica 2012). However, potential habitat for this species (ie mosaic vegetation near permanent water) is present within the GTP ROW, including nesting habitat, in particular the area surrounding the Dawson River and Baffle Creek (KP25 to KP35) (Ecologica Consulting 2012).

It should be noted that no raptor nests were identified during the pre-clearance surveys in the KP0 to KP30 section of the ROW (Ecologica Consulting 2012).

FEC (2012b) did not identify any Red goshawk between KP350 and KP413 and no suitable habitat was supported in the GTP and ancillary areas. The potential occurrence of the Red goshawk is highly unlikely within KP350 to KP413 as there is unsuitable habitat within and adjacent to the GTP (FEC 2012b).

Further pre-clearance survey work undertaken by Aurecon and Footprints (Santos GLNG 2013) determined that 'general habitat' is present within the KP312 to KP408.81 section of the GTP ROW which could be utilised by individuals of this species.

7.2.4 Biology and reproduction

Ages of sexual maturity, life expectancy and natural mortality remain very poorly known (Marchant & Higgins 1993). The generation length was estimated at 10 years, but this estimate has low reliability as there is no reliable life history data to base it on. The estimate was made primarily based on data from other taxa (Garnett & Crowley 2000).

The breeding season for Red goshawks is long with courtship starting as early as April and young not leaving their natal territories until as late as the end of December (Aumann & Baker-Gabb 1991). Breeding occurs generally in the spring with eggs laid between May and October in the north (Aumann & Baker-Gabb 1991), and between August and October in the southeast of its range (Debus & Czechura 1988).

The Red goshawk breeds solitarily, in forested or wooded areas, within one kilometre of permanent water, and in a large (over 20 m tall) tree. They are probably monogamous (Aumann & Baker-Gabb 1991). The length of bonding is not known, but replacement may occur if one of the pair is lost (Hill 1911). Breeding pairs use the same nesting territories year after year, renovating the nest used in the previous year or nesting nearby (Aumann & Baker-Gabb 1991). Conspecific interactions have been observed with Wedge-tailed eagles and Black-breasted buzzards which appear to prey on goshawk nests (Aumann & Baker-Gabb 1991).

Courtship is first observed 110 to 120 days before egg-laying. Nest-building and refurbishment is done 50 to 70 days before eggs are laid. The nest is a large structure (0.6 to 1.2 m across) made of dead sticks with a saucer-shaped hollow at top, thickly lined with finer twigs and green eucalyptus leaves. There is no conclusive information about clutch size, but it is probably one or two eggs (DSEWPaC 2012d). The female carries out incubation exclusively, but the male may shelter a clutch when the female is off the nest. The male appears to bring all the food from about 25 days before egg-laying through the incubation period. The incubation period is 39 to 43 days. The male also provides most of the food for nestlings, with two to five deliveries per day, during the first 25 to 40 days. The female guards the chick(s) constantly for the first 10 to 14 days. The nestling period is 51 to 53 days, probably slightly longer for females (DSEWPaC 2012d). Fledglings depend on the parents and remain in natal territory for 25 to 30 days, frequently being fed by the nest, and continue to be at least partially food dependent for 70 to 80 days after fledging (Aumann & Baker-Gabb 1991).

7.3 Habitat

The Red goshawk occurs in coastal and sub-coastal areas in wooded and forested lands of tropical and warm-temperate Australia (Marchant & Higgins 1993). Riverine forests are also used frequently (Debus 1991 & 1993). Such habitats typically support high bird numbers and biodiversity, especially medium to large species which the goshawk requires for prey. The Red goshawk nests in large trees, frequently the tallest and most massive in a tall stand, and nest trees are invariably within one kilometre of permanent water (Aumann & Baker-Gabb 1991; Debus & Czechura 1988).

The Red goshawk occurs over wooded and forested lands of tropical and warm-temperate Australia, coastal and sub-coastal (Marchant & Higgins 1993).

This species prefers forest and woodland with a mosaic of vegetation types, large prey populations (birds), and permanent water. The vegetation types include eucalypt woodland, open forest, tall open forest, gallery rainforest, swamp sclerophyll forest, and rainforest margins (DSEWPaC 2012d).

Habitat has to be open enough for fast attack and manoeuvring in flight, but provide cover for ambushing of prey. Therefore, forests of intermediate density are favoured, or ecotones between habitats of differing densities, eg between rainforest and eucalypt forest, between gallery forest and woodland, or on edges of woodland and forest where they meet grassland, cleared land, roads or watercourses (DSEWPaC 2012d). They avoid very dense and very open habitats (Marchant & Higgins 1993). These habitats provide appropriate foraging conditions for the large Red goshawk, and a diversity and abundance of the medium to large birds taken as food (Aumann & Baker-Gabb 1991).

Immature birds have been reported from mangroves, open river floodplains, low open woodland, agricultural land and pasture, but such habitats are not used regularly (Marchant & Higgins 1993).

Nests are in tall trees within one kilometre of and often beside, permanent water (river, swamp, pool), usually in fairly open, biologically rich forest or woodland. The average distance of the nest tree to water was 164 m (n=18). Nest trees were significantly taller, with larger crown diameters, greater girth at breast height, and the height of the lowest live branch was higher than the tallest trees found in the immediate vicinity of random locations along rivers. Nest trees had an average height of 31.4 m, and an average girth at breast height of 2.9 m. Trees in 0.2 ha plots around the nest tree also had significantly higher canopy height, fewer small trees (girth less than 0.5 m), and more large trees (girth greater than 1 m) than random plots (Aumann & Baker-Gabb 1991). Nests tend to be placed on a substantial horizontal limb often against a vertical branch arising from it (DSEWPaC 2012d).

This species is a local migrant throughout Australia and inhabits coastal areas, islands, estuaries, inlets, rivers and inland lakes. The species will overfly a variety of terrestrial habitats (such as coastal dunes, tidal flats, grasslands, heathlands, woodland, eucalypt forests, rainforests and urban areas) but will also forage over wide expanses of open water (DSEWPaC 2012d).

7.4 Habitat assessment

Information from expert opinions obtained from BPA (ie Brigalow Belt South Fauna Expert Panel Report (EPA 2006)), together with expert advice, site based species records and pre-clearance survey data have been used to define a set of assumptions that have been used to identify areas of habitat that are consistent with the definitions of 'core habitat', 'essential habitat' and 'general habitat' that have been presented in Part 1 of this SSMP. The Red goshawk habitat assessment assumptions are presented below.

7.4.1 General assumptions

The following habitat assumptions have been made based on current scientific knowledge of this species:

- Preferred habitat consists of tall open forest/woodland, especially near rivers, wetlands and rainforest fringes (DSEWPaC 2012d, Pizzey & Knight 1997). Habitat has to be open enough for fast attack and manoeuvring in flight, but provide cover for ambushing of prey. Therefore, forests of intermediate density are favoured (DSEWPaC 2012d)
- Nests are located in tall trees within 1 km of and often beside, permanent water (river, swamp, pool), usually in fairly open, biologically rich forest or woodland (DSEWPaC 2012d). As such, it is assumed that the species will not utilise areas for breeding that are further than 1 km from a source of water. Therefore, any inland REs identified within the dot-point above, that are contained within 1 km of areas mapped as 'lacustrine' and pulstrine' Wetland Regional Ecosystems as well as lacustrine' and 'pulstrine' waterbodies on the Queensland Wetland Mapping (Version 3.0) and within 1 km of a stream-order 3 or greater watercourse as indicated on DNRM's watercourse mapping are considered to constitute potential habitat for this species
- Within the KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 sections, the suitable habitats have been mapped based upon their habitat structure being consistent with that required for nesting or hunting
- Vegetated areas within the GTP that are not mapped as suitable habitat, despite their proximity to the 'general habitat', are due to the vegetation community structure; being either very sparsely wooded (representing unlikely habitat) or too densely vegetated for nesting or hunting movements (also representing unlikely habitats) as verified during pre-clearance surveys
- Other unsuitable habitat based on the absence of structural requirements are the grassland pastures that have been extensively cleared of remnant vegetation through historic grazing land management practices which are currently in place as verified through pre-clearance surveys

7.4.2 Core habitat

'Core habitat' consists of 'essential habitat' in which the species is known and the habitat is recognised under relevant recovery plans or other relevant plans/policies/regulations. Also included within this category are populations that are limited geographically within the region.

For the Red goshawk, all REs that contain a specimen backed record, which overlap with areas identified in the BPA mapping that have been identified as containing a 'State' or

'Regional' 'Corridor' (J-Rating) and/or 'Core Habitat' (H-Rating) and/or 'Habitat for EVR Taxa' (A-Rating) have been mapped as 'core habitat'.

No individuals of this species have been identified within the general vicinity of KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 of the GTP; therefore no 'core habitat' exists within these sections of the GTP.

7.4.3 Essential habitat

'Essential habitat' is an area containing resources that are considered essential for the maintenance of populations of the species (eg potential habitat for breeding, roosting, foraging, shelter, for either migratory or non-migratory species). 'Essential habitat' is defined from known records and/or expert advice (including the findings of pre-clearance surveys).

KP0 to KP30

For the Red goshawk, no species records have been recorded during pre-clearance surveys. However, pre-clearance surveys identified area directly adjacent to Baffle Creek and the Dawson River as habitat for this species. These areas are therefore considered to constitute 'essential habitat' for this species.

The location of the 'essential habitat' for this species in this section of the GTP is shown in Figure 7.2a.

KP30 to KP40

Pre-clearance surveys identified no species records or 'essential habitat' for this species, therefore no 'essential habitat' for this species is considered to exist for this section of the GTP.

KP40 to KP130

Pre-clearance surveys identified no species records or 'essential habitat' for this species, therefore no 'essential habitat' for this species is considered to exist for this section of the GTP.

KP130 to KP312

Pre-clearance surveys identified no species records or 'essential habitat' for this species, therefore no 'essential habitat' for this species is considered to exist for this section of the GTP.

KP312 to KP408.81

Pre-clearance surveys identified no species records or 'essential habitat' for this species, therefore no 'essential habitat' for this species is considered to exist for this section of the GTP.

KP408.81 to KP409.04

Pre-clearance surveys identified no species records or 'essential habitat' for this species, therefore no 'essential habitat' for this species is considered to exist for this section of the GTP.

KP413.57 to KP419.69

Pre-clearance surveys identified no species records or 'essential habitat' for this species, therefore no 'essential habitat' for this species is considered to exist for this section of the GTP.

7.4.4 General habitat

''General habitat' consists of areas or locations that are used by transient individuals or where species may have been recorded but where there is insufficient information to assess the area as essential/core habitat. 'General habitat' also includes areas defined from known records or habitat that is considered to potentially support a species according to expert knowledge of habitat relationships, despite the absence of specimen backed records. 'General habitat' may include areas of suboptimal habitat for species. As potential habitat for many species contained within this SSMP may include most of the regional ecosystems of the Brigalow Belt Bioregion, the 'general habitat' category restricts the habitat to a more limited and realistic set of environmental parameters that are supported by literature and field based observation.

For the Red goshawk, all areas that contain REs that have been identified by DotE or site based observations as containing habitat suitable for the occurrence of this species, are included within the 'general habitat' category.

KP0 to KP30

The location of the 'general habitat' for this species within this section of the GTP is shown in Figure 7.2a.

KP30 to KP40

KP30 to KP32.25 has been identified during the pre-clearance surveys as meeting the criteria of 'general habitat' for this species.

The location of the 'general habitat' for this species within this section of the GTP is shown in Figure 7.2b.

KP40 to KP130

No 'general habitat' for this species exists in this section of the GTP.

KP130 to KP312

Conciliation Creek area (KP207 to KP210), Dawson River area (KP233 to KP235), KP249.5 and riparian vegetation within KP295.6 to KP300.2 has been identified during the pre-clearance surveys as meeting the criteria of 'general habitat' for this species (Santos GLNG 2012).

The location of the 'general habitat' for this species within this section of the GTP is shown in Figure 7.2c and Figure 7.2d.

KP312 to KP408.81

Pre-clearance surveys identified 'general habitat' for the Red goshawk within the Callide Range and between KP405.5 and KP407.5 (Santos GLNG 2013).

The location of the 'general habitat' for this species within this section of the GTP is shown in Figure 7.2e and Figure 7.2f.

KP408.81 to KP409.04

No 'general habitat' for this species exists in this section of the GTP.

KP413.57 to KP419.69

Pre-clearance surveys did not identify 'general habitat' for this species within this section of the GTP.

7.4.5 Unlikely habitat

Unlikely habitat areas are those areas that do not contain records of the particular species and do not contain habitat features to support the species such as vegetation structures that are either to dense or to open for this species to nest or hunt (ie areas that do not meet the habitat and general assumptions identified above).

7.5 Anticipated threats and potential impacts as a result of the GTP

- Loss and degradation of potential foraging habitat for this species
- Changes to foraging patterns as a result of increases in noise, vibration, movement and dust, stress, injury and death to animals due to anthropogenic activities
- Removal of potential nesting habitat due to clearing of large remnant trees near watercourses (however no nests have been identified within or adjacent to the GTP ROW)

7.6 Unavoidable impact and unavoidable adverse (offsetable) impact from GTP

Areas of proposed disturbance and areas of adverse (offsetable) impact associated with clearing and construction activities for the GTP between KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 for the Red goshawk are presented in Table 7.1. It is important to note that this unavoidable impact is considered minor and temporary in the context of the wide spread extent of 'general habitat' in the region. The location of this habitat is shown in Figure 7.2a, Figure 7.2b, Figure 7.2c, Figure 7.2d, Figure 7.2e and Figure 7.2f.

A cumulative total of proposed clearing of habitat for the Red goshawk and the cumulative total of unavoidable adverse (offsetable) impact to the species habitat is provided in Table 7.1.

Table 7.1 Cumulative total of Red goshawk habitat to be cleared and area of habitat subject to unavoidable adverse (offsetable) impacts from the GTP

Location	'General habitat'	'Essential habitat'	Total habitat area per GTP section	Total habitat area adversely impacted per GTP section
KP0 to KP30	8.22 ha	0.81 ha	9.03 ha	9.03 ha
KP30 to KP40	6.94 ha	0 ha	6.94 ha	6.94 ha
KP40 to KP130	0 ha	0 ha	0 ha	0 ha
KP130 to KP312	9.24 ha	0 ha	9.24 ha	9.24 ha
KP312 to KP408.81	43.7 ha	0 ha	43.7 ha	43.7 ha
KP408.81 to KP409.04	0 ha	0 ha	0 ha	0 ha

Location	'General habitat'	'Essential habitat'	Total habitat area per GTP section	Total habitat area adversely impacted per GTP section
KP413.57 to KP419.69	0 ha	0 ha	0 ha	0 ha
Total habitat area	**68.1 ha**	**0.81 ha**	**68.91 ha**	**68.91 ha**

7.7 Management practices and methods

7.7.1 Pre-construction mitigation measures

Measures to minimise impacts

- As part of the pre-clearing surveys migratory species have been identified and recorded. This includes nesting sites and associated habitat in which the species was observed
- Prior to site entry, all site personnel will be appropriately trained and made aware of the sensitive environs in which they will be working (refer Part 1, Section 7.7). This includes the likelihood of the Red goshawk being present or describing known areas
- Where appropriate, signage will be erected to increase personnel awareness of the species nesting locations and/or 'No Go' zones within and adjacent the GTP footprint
- Nests will be declared temporary 'No Go' zones (200 m radius around tree) and potential actions such as avoidance or relocation will be determined in consultation with DotE
- Approximately 1 to 2 weeks prior to the commencement of construction clearing, a licensed and experienced spotter catcher(s) will undertake a targeted survey to ensure there is no nesting Red goshawk present within the ROW

7.7.2 Construction phase mitigation measures

Measures to avoid impact

- No nests will be disturbed or destroyed
- Unless otherwise agreed by DEHP and DotE, active nests, roosting and/or foraging habitat will be declared temporary 'No Go' zones with the establishment of an exclusion zone until the area is no longer occupied by this species. The status of active nests will be regularly checked in a way that does not risk the nest being abandoned by the breeding pair (adult birds)

Measures to minimise impacts

- All works will be undertaken in accordance with the conditions of any applicable statutory approvals
- Disturbance to remnant vegetation and applicable palustrine, riverine and lacustrine wetlands, creek lines and river banks will be minimised to a width of 30 m or less
- All waste/rubbish will be correctly disposed of so as to not pose a risk to local fauna
- Implementation of the Fauna Handling Procedures (refer Appendix C)

- Temporary exclusion zones around active nests will be regularly checked to ensure they are clearly marked out
- Direct temporary lighting away from light-sensitive areas such as roost areas. Light shades and low lighting will be applied to construction and operational areas located adjacent to remnant native vegetation and other environmentally sensitive areas
- Noise and vibration measures such as regular maintenance of equipment will be adopted
- Clearing activities within these areas will be supervised by the EO
- Clearing will be conducted in a sequential manner and in a way that directs escaping wildlife away from the clearing activities and into adjacent natural areas. With the exception of the spotter catcher, no birds will be physically moved on at any time
- A licensed and experienced spotter catcher(s) will be onsite during all clearing activities and must ensure any injured animals are given to an appropriate wildlife carer group or vet (refer Appendix C)
- Weather permitting, rehabilitation of all habitats impacted as a result of construction works, will commence immediately after the pipeline has been lowered in and backfilled (refer LRMP)

7.7.3 Operational phase mitigation measures

Measures to minimise impacts

- Implementation of the relevant operational and decommissioning phases of the LRMP and PWMP (refer Appendix A and B)
- Implementation of the Fauna Handling Procedures (refer Appendix C)

7.7.4 Decommissioning phase mitigation measures

- Implementation of the Fauna Handling Procedures (refer Appendix C)
- A decommissioning plan will be developed by GLNG operations and provided for approval. The plan will aim to address the requirements of AS2885 and also to ensure environmental harm is avoided, including:
  - The Project area no longer contains hazardous contaminants and Is left in stable condition
  - All the above ground infrastructure is removed
  - All areas disturbed by above ground infrastructure are rehabilitated in accordance with the relevant conditions
- For a minimum of five years after the completion of rehabilitation, rehabilitated areas will be monitored on a yearly basis
- The monitoring programme will include:
  - Methods to measure subsidence and erosion rates at rehabilitated buried transmission pipeline corridors and buried flow lines
  - BioCondition assessment in accordance with the BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland: Assessment Manual: Version 2.1 (Eyre *et al* 2011)

- Monitoring of indicators identified in the LRMP at analogue sites to measure progressive and final rehabilitation success relevant to the final land use(s)
- Frequency and seasonality of monitoring analogue sites and rehabilitated areas to assess rehabilitation success
- Identification of the experimental design for analysing analogue and rehabilitated site data including statistical methods of analyses

8 Australasian bittern

8.1 EPBC Act legal status

Endangered – listed 3 March 2011

8.2 Biology and ecology

8.2.1 Characteristics

The Australasian bittern (*Botaurus poiciloptilus*) is a large, stocky, thick-necked heron-like bird with camouflage-like plumage growing to a length of 66 to 76 cm, with a wingspan of 1,050 to 1,180 cm. The male weighs 1,400 g and the female weighs 900 g (Marchant & Higgins 1990). The upperparts are brown and dark brown to black, mottled buff in complex patterns that aid the bird's concealment in swamp vegetation; the underparts are streaked and scalloped brown and buff. The bird has a prominent black-brown stripe running down the side of the neck, the eyebrow is pale, and the chin and upper throat are white. The bill is straight and pointed, straw yellow to buff in colour, with a dark grey culmen (dorsal ridge of the bill); the legs and feet are pale green to olive; and the iris orange-brown or yellow (Marchant & Higgins 1990; Pizzey & Knight 1997; DSEWPaC 2012t). Dark and pale variants of the plumage have been observed in adults, but the variations are not understood. The sexes appear similar, but females are smaller (Marchant & Higgins 1990). Juveniles are generally paler than adults (Marchant & Higgins 1990; Pizzey & Knight 1997), with heavier buff flecking on the back; adults and juveniles are probably not separable in the field (Marchant & Higgins 1990).

Australasian bittern (Source: Turner 2008)

8.2.2 Known distribution

The Australasian bittern occurs from south-east Queensland to south-east South Australia, Tasmania and in the southwest of Western Australia (Marchant & Higgins 1990).

In Queensland, the bittern occurs in the far south-east; it has been reported north to Baralaba and west to Wyandra, although in most years it is probably confined to a few coastal swamps (Marchant & Higgins 1990; DSEWPaC 2012t). Today, it is rarely recorded in Queensland, and possibly survives only in protected areas such as the Cooloola and Fraser regions (DSEWPaC 2012t).

Figure 8.1 is an indicative distribution map of the present distribution of the Australasian bittern.

The extent of occurrence is stable at an estimated 1,000,000 km^2 (DSEWPaC 2012t). The estimate is considered to be of high reliability.

The estimated area of occupancy is 1,200 km^2 but is considered to be of low reliability (Garnett & Crowley 2000). Documented data shows that the area of occupancy is decreasing (Garnett & Crowley 2000).

The Australian population of the Australasian bittern is estimated at 2,500 breeding birds. This estimate is considered to be of low reliability (Garnett & Crowley 2000).

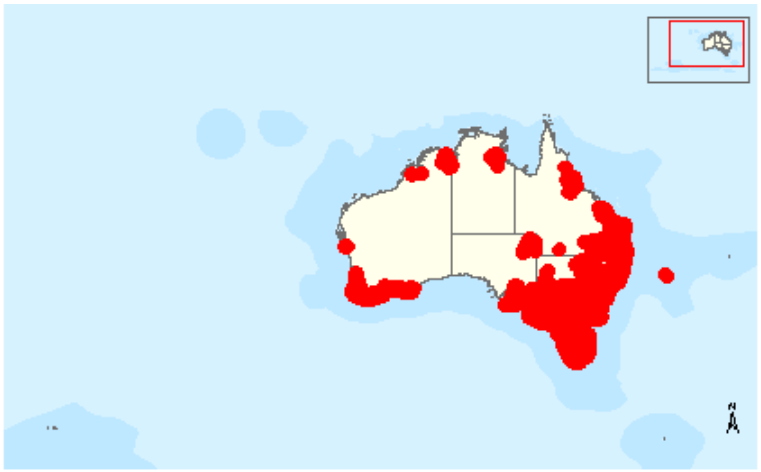


Figure 8.1 Distribution range of the Australasian bittern (Source: DSEWPaC 2012t)

8.2.3 Known species populations and their relationship with the GTP footprint

This species was not identified during the pre-clearance survey although potential habitat has been identified within KP312 to KP408.81 of the GTP ROW and to the north of the GTP ROW (KP408.81 to KP409.04) and ancillary areas.

8.2.4 Biology and reproduction

The Australasian bittern feeds mostly on animals taken from or around pools and waterways. It forages in still shallow water up to 0.3 m in depth, often at the water's edge, or from platforms or mats of flattened vegetation over deeper water (Heather & Robertson 2000; Marchant & Higgins 1990).

In Australia, the bittern has been recorded feeding on freshwater crayfish, fish (including goldfish), weevils, snakes, leaves and fruit (Marchant & Higgins 1990), and frogs and tadpoles are also likely to be eaten (DSEWPaC 2012t).

Little information is available on the breeding biology of the Australasian bittern. It breeds in single solitary pairs, but sometimes several nests may be placed quite close together. In Australia, breeding is said to occur from October to February (Marchant & Higgins 1990).

The nest is a well-constructed saucer of flat pieces of reeds or rushes that are laid across one another; it measures about 35 to 40 cm across and 20 to 22 cm thick, and may be sheltered above by stems of the surrounding vegetation. The eggs are oval, smooth and glossy, and pure olive in colour; they measure 49.0 to 53.8 mm (Marchant & Higgins 1990). Clutch-size is usually four or five, but can range from three to six (Marchant & Higgins 1990; Serventy & Whittell 1976).

8.3 Habitat

The Australasian bittern occurs mainly in densely vegetated freshwater wetlands and, rarely, in estuaries or tidal wetlands (Marchant & Higgins 1990).

In Australia, this species occurs in terrestrial wetlands and, rarely, estuarine habitats, mainly in the temperate southeast and southwest. It favours wetlands with tall dense vegetation, where it forages in still, shallow water up to 0.3 m deep, often at the edges of pools or waterways, or from platforms or mats of vegetation over deep water. It favours permanent and seasonal freshwater habitats, particularly those dominated by sedges, rushes and/or reeds (eg *Phragmites*, *Cyperus*, *Eleocharis*, *Juncus*, *Typha*, *Baumea*, *Bolboschoenus*) or Cutting grass (*Gahnia*) growing over muddy or peaty substrate (Marchant & Higgins 1990).

Knowledge of the breeding ecology of the Australasian bittern is poor. Available data indicate that the bittern breeds in relatively deep, densely vegetated freshwater swamps and pools, building its nests in deep cover over shallow water (Marchant & Higgins 1990). In rushland, it may avoid breeding in the densest areas (Marchant & Higgins 1990); alternatively, this may simply reflect the accessibility of the few nests that have been found (DSEWPaC 2012t). If population density is high, it may resort to open wetlands for nesting, eg in stunted Acacia swamps (Marchant & Higgins 1990).

The bittern appears to be capable of moving between habitats as suitability changes. It can occur in high densities in temporary or infrequently filled wetlands during exceptionally wet years, and will also use ephemeral wetlands when irrupting from drying floods (Garnett 1992).

8.4 Habitat assessment

Information obtained from BPA (ie Brigalow Belt South Fauna Expert Panel Report (EPA 2006)), together with expert advice, site based species records and pre-clearance survey data has been used to define a set of assumptions that have been used to identify areas of habitat that are consistent with the definitions of ‘core habitat’, ‘essential habitat’ and ‘general habitat’ that have been presented in Part 1 of this SSMP. These assumptions are presented in this section.

8.4.1 General Assumptions

The following general habitat assumptions have been made based on current scientific knowledge of this species:

- Species is most often associated with freshwater terrestrial wetlands (DSEWPaC 2012t). As such, areas mapped as ‘riverine’, ‘lacustrine’ and pulstrine’ Wetland Regional Ecosystems as well as ‘lacustrine’ and ‘pulstrine’ waterbodies on the Queensland Wetland Mapping wetlands on the Queensland Wetland Mapping (Version 3.0) are considered habitat for this species along with some anthropogenic permanent water sources (such as large farm dams)

8.4.2 Core habitat

'Core habitat' consists of 'essential habitat' in which the species is known and the habitat is recognised under relevant recovery plans or other relevant plans/policies/regulations. Also included within this category are populations that are limited geographically within the region.

For the Australian bittern, all wetlands that are indicated on the Queensland Wetland Mapping (Version 3.0), which overlap with areas identified in the BPA mapping that have been identified as containing a 'State' or 'Regional' 'Corridor' (J-Rating) and/or 'Core habitat' (H-Rating) and/or 'Habitat for EVR Taxa' (A-Rating) have been mapped as 'Core habitat'.

No individuals of this species have been identified within the general vicinity of KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 of the GTP; therefore no 'core habitat' exists within these sections of the GTP.

8.4.3 Essential habitat

'Essential habitat' is an area containing resources that are considered essential for the maintenance of populations of the species (eg potential habitat for breeding, roosting, foraging, shelter, for either migratory or non-migratory species). 'Essential habitat' is defined from known records and/or expert advice (including the findings of pre-clearance surveys).

No individuals of this species have been identified within the general vicinity of KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 of the GTP; therefore no 'essential habitat' exists within these sections of the GTP.

8.4.4 General habitat

'General habitat' consists of areas or locations that are used by transient individuals or where species may have been recorded but where there is insufficient information to assess the area as essential/core habitat. 'General habitat' also includes areas defined from known records or habitat that is considered to potentially support a species according to expert knowledge of habitat relationships, despite the absence of specimen backed records. 'General habitat' may include areas of suboptimal habitat for species. As potential habitat for many species contained within this SSMP may include most of the regional ecosystems of the Brigalow Belt Bioregion, the 'general habitat' category restricts the habitat to a more limited and realistic set of environmental parameters that are supported by literature and field based observation.

For the Australian bittern all areas that are mapped as 'riverine', 'lacustrine' and pulstrine' Wetland Regional Ecosystems as well as estuarine, 'riverine', lacustrine' and 'pulstrine' waterbodies on the Queensland Wetland Mapping wetlands on the Queensland Wetland Mapping (Version 3.0) are considered to constitute 'General habitat' for this species.

KP0 to KP30

No 'general habitat' for this species exists in this section of the GTP.

KP30 to KP40

No 'general habitat' for this species exists in this section of the GTP.

KP40 to KP130

No 'general habitat' for this species exists in this section of the GTP.

KP130 to KP312

No 'general habitat' for this species exists in this section of the GTP.

KP312 to KP408.81

Pre-clearance surveys identified 'general habitat' for this species at Calliope River (KP352.3) and Harper Creek (KP360.3) (Santos GLNG 2013).

The location of the 'general habitat' for this species within the GTP is shown in Figure 8.2a and Figure 8.2b.

KP408.81 to KP409.04

The location of the 'general habitat' for this species adjoining the GTP is shown in Figure 8.2c.

KP413.57 to KP419.69

Pre-clearance surveys did not identify 'general habitat' for this species within this section of the GTP although 'general habitat' was identified within close proximity to the GTP and is shown in Figure 8.2d.

8.4.5 Unlikely habitat

'Unlikely habitat' areas are those areas that do not contain records of the particular species and contain no habitat values to support the presence or existence of resident or migratory individuals or populations of the species.

8.5 Anticipated threats and potential impacts as a result of the GTP

- Loss and degradation of 'general habitat'
- Changes to local foraging behaviour due to increased vehicle movement, noise, lighting etc
- Stress, injury and mortality to animals due to increases in noise, vehicle movement, lighting and clearing during construction
- Destruction of nests
- Entrapment of individuals in the trench and barriers to movement

8.6 Unavoidable impact and unavoidable adverse (offsetable) impact from GTP

Areas of proposed disturbance and areas of adverse (offsetable) impact associated with clearing and construction activities for the GTP between KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 for the Australasian bittern are presented in Table 8.1. The location of this habitat is shown in Figure 8.2a, Figure 8.2b, Figure 8.2c and Figure 8.2d.

A cumulative total of proposed clearing of habitat for the Australasian bittern and the cumulative total of unavoidable adverse (offsetable) impact to the species habitat is provided in Table 8.1.

Table 8.1 Cumulative total of Australasian bittern habitat to be cleared and area of habitat subject to unavoidable adverse (offsetable) impacts from the GTP

Location	'General habitat'	Total habitat area per GTP section	Total habitat area adversely impacted per GTP section
KP0 to KP30	0 ha	0 ha	0 ha
KP30 to KP40	0 ha	0 ha	0 ha
KP40 to KP130	0 ha	0 ha	0 ha
KP130 to KP312	0.37 ha	0.37 ha	0.37 ha
KP312 to KP408.81	1.15 ha	1.15 ha	0.43 ha
KP408.81 to KP409.04	0 ha	0 ha	0 ha
KP413.57 to KP419.69	0 ha	0 ha	0 ha
Total habitat area	**1.52 ha**	**1.52 ha**	**0.80 ha**

8.7 Management practices and methods

8.7.1 Pre-construction mitigation measures

Measures to avoid impact

- Prior to the commencement of construction clearing, a suitably qualified and experienced EO will confirm the buffer zones ('No Go' zones) and where necessary barriers and signs will be erected

Measures to minimise impacts

- Pre-clearing ecological surveys have been undertaken by a suitably qualified Ecologist(s) in accordance with the Survey Guidelines for Australia's Threatened Birds
- Wherever practicable, signage will be erected to increase awareness of the Australasian bittern in the area
- Prior to site entry, all site personnel will be appropriately trained and made aware of the sensitive environs in which they will be working (refer Part 1, Section 7.7)

8.7.2 Construction phase mitigation measures

Measures to avoid impact

- Due to the location of nests (on ground), all vehicles and pedestrians will remain within the designated access tracks in the GTP ROW

Measures to minimise impacts

- Locate site offices, construction camps, stockpiling/laydown areas, plant and equipment storage areas away from Australasian bittern core habitat (ie permanent water bodies)
- Implementation of the Fauna Handling Procedures (refer Appendix C)

- All vegetation clearing within known Australasian bittern habitat will comply with clearing approval conditions (eg NC Act and other statutory approvals)
- A licensed and experienced spotter catcher(s) will be onsite during all clearing activities and will ensure any injured animals are given to an appropriate wildlife carer group or vet (refer Appendix C). DotE and DEHP will be notified within 24 hours of any native animal injuries or deaths
- Clearing activities will be supervised by the relevant EO
- Clearing will be conducted in a sequential manner and in a way that directs escaping wildlife away from the clearing activities and into adjacent natural areas
- Measures to be adopted to prevent fauna entrapment within the pipeline trench, include:
  - Minimising the period of time the trench is open, particularly in 'core habitat' and 'essential habitat' areas
  - Constructing ramps with a non-slip surface with slopes less than 45° to provide exit ramps for fauna at intervals no greater than 500 m
  - Trench plugs will be installed in open trenches. These will be provided as a minimum every 500 m
  - Installing additional ramps at greater than normal frequencies (500 m) in areas identified as known or high value habitat
  - Branches, hessian sacks, ramped gangplanks or similar to be used to create 'ladders' to enable fauna to exit the trench. These structures will be placed every 250 to 500 m, depending on the surrounding landscapes
- The whole trench will be checked at least twice a day (early morning/late afternoon) and the removal of wildlife from the trench will be undertaken by an appropriately trained and licensed spotter catcher(s)
- Spotter catcher(s) will have access to the site (particularly the open trench) during all weather conditions to check for trapped fauna
- Where practicable, direct any lighting associated within night works away from sensitive areas or use engineering solutions to limit light spillage. This may include the use of light shades and low lighting being applied to construction and operational areas located adjacent to remnant native vegetation and known habitat areas for this species
- Prior to backfilling, the spotter catcher(s) will check the open trench for trapped fauna and where required move them to a safe location away from the trench
- Ensure equipment is regularly maintained and is good working order
- The construction phase component of the LRMP will be implemented
- Weather permitting, rehabilitation of all areas identified will commence immediately after the pipeline has been lowered in and backfilled (refer LRMP). With the exception of operational constraints, revegetation will be consistent with the plant density, floristic composition and distribution of the adjacent communities

8.7.3 Operational phase mitigation measures

Measures to avoid impact

- To avoid impacting on regenerating Australasian bittern habitat, vehicle and pedestrian access will be restricted to the defined access tracks to and from the ROW and the defined access track within the ROW

Measures to minimise impacts

- Implementation of the Fauna Handling Procedures (refer Appendix C)
- The operational phase component of the LRMP will be implemented
- The operational phase of the PWMP will be implemented to minimise the risk of weed and pest animal establishment

8.7.4 Decommissioning phase mitigation measures

Measures to minimise impacts

- Implementation of the Fauna Handling Procedures (refer Appendix C)
- A decommissioning plan will be developed by GLNG operations and provided for approval. The plan will aim to address the requirements of AS2885 and also to ensure environmental harm is avoided, including:
  - The Project area no longer contains hazardous contaminants and Is left in stable condition
  - All the above ground infrastructure is removed
  - All areas disturbed by above ground infrastructure are rehabilitated in accordance with the relevant conditions
- For a minimum of five years after the completion of rehabilitation, rehabilitated areas will be monitored on a yearly basis
- The monitoring programme will include:
  - Methods to measure subsidence and erosion rates at rehabilitated buried transmission pipeline corridors and buried flow lines
  - BioCondition assessment in accordance with the BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland: Assessment Manual: Version 2.1 (Eyre *et al* 2011)
  - Monitoring of indicators identified in the LRMP at analogue sites to measure progressive and final rehabilitation success relevant to the final land use(s)
  - Frequency and seasonality of monitoring analogue sites and rehabilitated areas to assess rehabilitation success
  - Identification of the experimental design for analysing analogue and rehabilitated site data including statistical methods of analyses

9 Large-eared pied bat

9.1 EPBC Act legal status

Vulnerable - listed 4 April 2001

9.2 Biology and ecology

9.2.1 Characteristics

The Large-eared pied bat (*Chalinolobus dwyeri*) is a medium-sized insectivorous bat measuring a total length of approximately 100 mm and weighing 7 to 12 g (DSEWPaC 2012e). It has a shiny black coat with a white stripe on the flank (underside) of each wing. The ears are large and their facial lobes are located on the lower lip and between the corner of the mouth and the bottom of the ear (Hoye & Dwyer 1995; Ryan 1966). Its relatively short, broad wings suggest it flies slowly and with considerable manoeuvrability (DERM 2011a).

Large-eared pied bat (Source: Boobook Consulting 2011)

9.2.2 Known distribution

The former and current distribution of the Large-eared pied bat is poorly known (DSEWPaC 2012e). Large declines since the species was first described in northern NSW during 1966 have been suggested however it is not possible to evaluate these declines (DSEWPaC 2012e). Records for current distribution exist from Shoalwater Bay, north of Rockhampton in Queensland through to near Ulladulla in NSW. Despite this large range it is thought the species is uncommon and patchy within this area (DSEWPaC 2012e). The majority of the known distribution exists in NSW with the largest populations found within the sandstone escarpments and northern slopes of the Sydney basin (DSEWPaC 2012e).

Figure 9.1 is an indicative distribution map of the present distribution of the Large-eared pied bat.

Populations occur where suitable roosts are present. In particular, the populations in north-eastern NSW and south-east Queensland, Shoalwater Bay and Blackdown Tablelands are likely to be isolated with little interaction with their nearest populations (DSEWPaC 2012e).

Important populations supporting higher numbers of individuals include those present in the sandstone escarpments of Carnarvon, Expedition Ranges and Blackdown Tablelands Queensland (DSEWPaC 2012e). It is likely that these areas support a high proportion of the Queensland populations; however population estimates and distribution in these areas has not been established (DSEWPaC 2012e).

No maternity roost sites are known in Queensland (TSSC 2010)

The species extent of occurrence is approximately 570,000 km² based on the distribution range (Hoye and Dwyer 1995). The area of occupancy is approximately 9,120 km² (TSSC 2010).

Figure 9.1 Distribution range of the Large-eared pied bat (Source: DSEWPaC 2012e)

9.2.3 Known species populations and their relationship with the GTP footprint

The largest known populations of the Large-eared pied bat occur in those areas dominated by sandstone escarpments (DERM 2011a).

The combination of the sandstone cliffs and fertile wooded valley habitat is considered to be habitat critical to the survival of this species under the National recovery plan for the Large-eared pied bat *Chalinolobus dwyeri* (Ecologica Consulting 2012).

During the pre-clearance surveys this species was identified from two locations along the KP0 to KP130 section of the GTP ROW with one individual captured during harp trapping in Brigalow near KP34. The other recored is from Baffle Creek and may be attributed to foraging activities along Baffle Creek or from the species roosting in the area (Ecologica Consulting 2012).

No roosts were confirmed within the GTP ROW, however suitable roosting habitat (eg caves, crevices and pock-holes) are present within the project area, in particular the sandstone cliffs associated with Baffle Creek (Ecologica Consulting 2012).

9.2.4 Biology and reproduction

The diet and foraging behaviour of the Large-eared pied bat has not been well studied. The relatively short broad wings of this bat suggest that it is manoeuvrable and forages below the canopy (DERM 2011a). The species has been known to forage for insects at night around roost sites for a distance of up to several kilometres. However, it is not known if it targets particular groups of insects, such as moths (DERM 2011a).

Females can give birth at one year of age and males also appear capable of breeding at this age (DSEWPaC 2012e). Life expectancy and natural mortality have not been determined. Females have low fecundity giving birth to only one or two young per year (Hoye & Dwyer 1995).

Mating appears to occur in early winter. During autumn and early winter, males had enlarged testes and the muzzle glands of both sexes were swollen indicating that scent secreted from these glands may be a secondary sexual attractant during the mating period (Dwyer 1966). Females are pregnant in October and by early December they have all given birth and are lactating. Females most often have two young (average litter size of 1.8) with a juvenile sex ratio of males to females being 12:11. The nursery colony is established in September by both adult females and males with the majority of adult males leaving by the time the young are born in early summer. In late February and during March the juveniles have left the roost. The adult females leave the roost after the juveniles and the site is abandoned during the winter months (Dwyer 1966).

The generation life span has not been determined for the Large-eared pied bat. Based on the life expectancy of other bat species it is likely to be between two and ten years (DSEWPaC 2012e).

9.3 Habitat

Natural roosts may depend heavily on sandstone outcrops/escarpments and this species has been observed in disused mine shafts, caves, overhangs and disused Fairy martin (*Hirundo ariel*) nests for shelter and to raise young. The species also possibly roosts in the hollows of trees, dry and wet sclerophyll forest, Cyprus-pine dominated forest, tall open eucalypt forest with a rainforest sub-canopy, sub-alpine woodland and sandstone outcrop country. In South-east Queensland, the species has primarily been recorded from higher altitude among moist tall open forest adjacent to rainforest (DSEWPaC 2012e).

Recent habitat modelling based on surveys in the southern Sydney region suggests that the Large-eared pied bat is largely restricted to the interface of sandstone escarpment for roost habitat and relatively fertile valleys for foraging habitat. Recent survey work in the Brigalow Belt South region of NSW supports this modelling (DSEWPaC 2012e).

It is considered that some populations of this species would rely in part on Brigalow (*Acacia harpophylla* dominant and co-dominant) communities (DSEWPaC 2012e).

The Large-eared pied bat feeds on insects and usually flies at mid canopy level (6 to 10m) from the ground but have also been documented flying low along creek lines (Curtis *et al* 2012).

9.4 Habitat assessment

Information obtained from BPA (ie Brigalow Belt South Fauna Expert Panel Report (EPA 2006)), together with expert advice and relevant supporting literature (such as DSEWPaC 2012e) have been used to define a set of assumptions that have been used to identify areas of habitat that are consistent with the definitions of ‘core habitat’, ‘essential habitat’ and ‘general habitat’ that have been presented in Part 1 of this SSMP. The Large-eared pied bat habitat assessment assumptions were used to support pre-clearance surveys for the GTP ROW.

Pre-clearance surveys were undertaken along the GTP ROW and areas immediately adjacent. Mapping within the GTP ROW indicates where general, core and essential habitats were validated by pre-clearance surveys within the survey area.

9.4.1 Core habitat

'Core habitat' consists of 'essential habitat' in which the species is known and the habitat is recognised under relevant recovery plans or other relevant plans/policies/regulations. Also included within this category are populations that are limited geographically within the region.

For the Large-eared pied bat all REs that contain a specimen backed record, which overlap with areas identified in the BPA mapping that have been identified as containing a 'State' or 'Regional' 'Corridor' (J-Rating) and/or 'Core Habitat' (H-Rating) and/or 'Habitat for EVR Taxa' (A-Rating) have been mapped as 'core habitat'.

KP0 to KP30

Individuals of this species have been identified within the general vicinity of KP0 to KP30 of the GTP within a 'non-remnant' area which did not overlap with the BPA mapping, therefore no 'core habitat' exists within this section of the GTP.

KP30 to KP40

An individual of this species have been identified near KP34.51 of the GTP within an area which overlaps with the BPA mapping, therefore 'core habitat' exists within this section of the GTP.

The location of the 'core habitat' for this species within this section of the GTP is shown in Figure 9.2b.

KP40 to KP130

This species was not observed within KP40 to KP130; therefore no 'core habitat' exists within this section of the GTP.

KP130 to KP312

This species was not observed within KP130 to KP312; therefore no 'core habitat' exists within these sections of the GTP.

KP312 to KP408.81

This species was not observed within KP312 to KP408.81; therefore no 'core habitat' exists within this section of the GTP.

KP408.81 to KP409.04

This species was not observed within KP408.81 to KP409.04; therefore no 'core habitat' exists within this section of the GTP.

KP413.57 to KP419.69

This species was not observed within KP413.57 to KP419.69 during pre-clearance surveys; therefore no 'core habitat' exists within this section of the GTP.

9.4.2 Essential habitat

'Essential habitat' is an area containing resources that are considered essential for the maintenance of populations of the species (eg potential habitat for breeding, roosting, foraging, shelter, for either migratory or non-migratory species). 'Essential habitat' is defined from known records and/or expert advice (including the findings of pre-clearance surveys).

For the Large-eared pied bat, all REs that contain a specimen backed record have been mapped as 'essential habitat' in addition to the areas that have been validated during the pre-clearance surveys due to habitat and species recording. This mapping is restricted only to the relevant polygon in which the record falls (ie as per the DEHP certified RE mapping).

KP0 to KP30

This species was not observed within KP0 to KP30 of the GTP during pre-clearance surveys, although an individual of this species was identified outside of the GTP at Baffle Creek. As the specimen backed record and relevant polygon in which the record falls does not overlap with the GTP, no 'essential habitat' for this species is considered to exist for this section of the GTP.

KP30 to KP40

As an individual of this species has been identified within KP30 to KP40 of the GTP ROW, but this area meets the criteria to be included as 'core habitat', no 'essential habitat' has been mapped within this section of the GTP.

KP40 to KP130

As this species was not observed within KP40 to KP130 of the GTP during pre-clearance surveys, no 'essential habitat' for this species is considered to exist for this section of the GTP.

KP130 to KP312

As this species was not observed within KP130 to KP312 of the GTP during pre-clearance surveys, no 'essential habitat' for this species is considered to exist for this section of the GTP.

KP312 to KP408

As this species was not observed within KP312 to KP408.81 of the GTP during pre-clearance surveys, no 'essential habitat' for this species is considered to exist for this section of the GTP.

KP408.81 to KP409.04

As this species was not observed within KP408.81 to KP409.04 of the GTP during pre-clearance surveys, no 'essential habitat' for this species is considered to exist for this section of the GTP.

KP413.57 to KP419.69

As this species was not observed within KP413.57 to KP419.69 of the GTP during pre-clearance surveys, no 'essential habitat' for this species is considered to exist for this section of the GTP.

9.4.3 General habitat

'General habitat' consists of areas or locations that are used by transient individuals or where species may have been recorded but where there is insufficient information to assess the area as essential/core habitat. 'General habitat' also includes areas defined from known records or habitat that is considered to potentially support a species according to expert knowledge of habitat relationships, despite the absence of specimen backed records (ie forested areas adjacent to the identified 'essential habitat' area). 'General habitat' may include areas of suboptimal habitat for species. As potential habitat for many species contained within this SSMP may include most of the regional ecosystems of the Brigalow Belt Bioregion, the 'general habitat' category restricts the habitat to a more limited and realistic set of environmental parameters that are supported by literature and field based pre-clearance survey observations.

The range of these areas has been restricted to habitats that were identified during the pre-clearance surveys associated with either rocky outcrop terrains suitable for potential roosting sites or more complex structured habitat existing on fertile alluvial plains or sandy soils that provide a feeding and shelter resources consistent with those from habitats from which this species has been previously recorded, as described in Sections 9.3 and 9.4.

The other areas adjoining the majority of the GTP are omitted as potential habitat as they are grassland pastures containing no suitable habitat structure due to extensive clearing of remnant vegetation through historic grazing land management practices which are currently in place as verified through pre-clearance surveys.

KP0 to KP30

The location of the 'general habitat' for this species within this section of the GTP is shown in Figure 9.2a.

KP30 to KP40

The location of the 'general habitat' for this species within this section of the GTP is shown in Figure 9.2b.

KP40 to KP130

No 'general habitat' for this species exists in this section of the GTP.

KP130 to KP312

KP223.25 to KP224.25, Sellheim Creek area (KP280 to KP280.5), KP295.5 to KP295.75 and riparian vegetation within KP297.5 to KP300.2 has been identified during the pre-clearance surveys as meeting the criteria of 'general habitat' for this species (Santos GLNG 2012).

The location of the 'general habitat' for this species within this section of the GTP is shown in Figure 9.2c and Figure 9.2d.

KP312 to KP408.81

Pre-clearance surveys identified Calliope River (KP352.3), Harper Creek (KP360.3) and Larcom Creek (KP378) as potential corridors and 'general habitat' for this species (Santos GLNG 2013).

The location of the 'general habitat' for this species within this section of the GTP is shown in Figure 9.2e and Figure 9.2f.

KP408.81 to KP409.04

No 'general habitat' for this species exists in this section of the GTP.

KP413.57 to KP419.69

Pre-clearance surveys did not identify 'general habitat' for this species within this section of the GTP.

9.4.4 Unlikely habitat

'Unlikely habitat' areas are those areas that do not contain records of the particular species and do not contain habitat features to support the species such as simple structured and less fertile sedimentary rock, sandstone tableland associated habitats (ie that do not meet the habitat assumptions identified above).

9.5 Anticipated threats and potential impacts as a result of the GTP

- Clearing of vegetation associated with Baffle Creek
- Changes to foraging pattern as a result of loss of habitat and also due to lighting (eg light may result in the bat forging in a darker area, light near a roost access point will delay bats from appearing and may also result in bats abandoning the roost site)
- Removal of potential roosting sites (ie hollow bearing trees), however the habitats in this section are unlikely to support this species

9.6 Unavoidable impacts and unavoidable adverse (offsetable) impact from GTP

Areas of proposed disturbance and areas of adverse (offsetable) impact associated with clearing and construction activities for the GTP between KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 for the Large-eared pied bat are presented in Table 9.1. It is important to note that this unavoidable impact is considered minor and temporary in the context of the wide spread extent of 'general habitat' in the region. The location of this habitat is shown in Figure 9.2a, Figure 9.2b, Figure 9.2c, Figure 9.2d, Figure 9.2e and Figure 9.2f.

A cumulative total of proposed clearing of habitat for the Large-eared pied bat and the cumulative total of unavoidable adverse (offsetable) impact to the species habitat is provided in Table 9.1.

Table 9.1 Cumulative total of Large-eared pied bat habitat to be cleared and area of habitat subject to unavoidable adverse (offsetable) impacts from the GTP

Location	'General habitat'	'Core habitat'	Total habitat area per GTP section	Total habitat area adversely impacted per GTP section
KP0 to KP30	6.33 ha	0 ha	6.33 ha	6.33 ha
KP30 to KP40	13.78 ha	2.89 ha	16.67 ha	16.67 ha
KP40 to KP130	0 ha	0 ha	0 ha	0 ha
KP130 to KP312	24.52 ha	0 ha	24.52 ha	20.2 ha
KP312 to KP408.81	0.91 ha	0 ha	0.91 ha	0.91 ha

Location	'General habitat'	'Core habitat'	Total habitat area per GTP section	Total habitat area adversely impacted per GTP section
KP408.81 to KP409.04	0 ha	0 ha	0 ha	0 ha
KP413.57 to KP419.69	0 ha	0 ha	0 ha	0 ha
Total habitat area	**45.54 ha**	**2.89 ha**	**48.43 ha**	**44.11 ha**

9.7 Management practices and methods

9.7.1 Pre-construction mitigation measures

Measures to avoid impact

- All reasonable and practical measures will be taken to locate site offices, construction camps, stockpiling/lay down areas and plant and equipment storage areas (including heavy machinery) on existing cleared lands

Measures to minimise impacts

- Pre-clearing ecological surveys have been undertaken by a suitably qualified Ecologist(s) in accordance with the Survey Guidelines for Australia's Threatened Bats. These surveys included assessment within both remnant and non-remnant areas
- If a roost(s) is located within or within close proximity to the GTP footprint all practical and reasonable steps will be taken to avoid disturbing these sites. This will include consultation with DotE if roosts are identified within the GTP footprint or in close proximity to the GTP ROW and ancillary areas. Consultation will occur prior to any vegetation clearing or other construction activity in the GTP ROW and ancillary areas. This will also include the investigation of alternative construction measures near known roost areas that will not cause the bats to abandon the roost
- Where practically feasible, efforts will be made to co-locate the pipeline adjacent to existing cleared areas to minimise fragmentation and reduction of core habitat within remnant communities
- Prior to the commencement of construction clearing, the limits of clearing will be clearly marked out by a suitably qualified and experienced EO. Barricade webbing or similar should be used for temporary 'No Go' zones (where bats are found to be occupying tree hollows and loose bark, these areas should be barricaded off for 48 hrs or until the animal has moved on naturally)
- Wherever practicable, signage will be erected to increase awareness of the bat and their roosts in the area
- Prior to site entry, all site personnel will be appropriately trained and made aware of the sensitive environs in which they will be working (refer Part 1, Section 7.7)

9.7.2 Construction phase mitigation measures

Measures to avoid impact

- Vehicle and pedestrian access to and from the GTP ROW will be restricted to the defined access tracks

Measures to minimise impacts

- All vegetation clearing and/or construction activities will comply with the clearing approval conditions (eg EPBC Act, EP Act, NC Act and other statutory approvals) and be supervised by the relevant EO
- Implementation of the Fauna Handling Procedures (refer Appendix C)
- A licensed and experienced spotter catcher(s) that is able to handle bats will be onsite during all clearing activities and must ensure any injured animals are given to an appropriate wildlife carer group or vet (refer Appendix C). DEHP and DotE will be notified within 24 hours of any native animal injuries or deaths.
- Where habitat trees need to be removed the following measures will be implemented:
  - Non-hollow bearing trees will be removed before hollow-bearing (or potential habitat) trees, allowing fauna an opportunity to self-relocate from the potential habitat trees. This applies in the instance when the fauna cannot be relocated, and it is evident that an animal exists within the trees
  - Habitat trees will be left overnight from the time of the felling of the non-habitat trees nearby
  - Habitat trees will be inspected by a qualified spotter/catcher after at least one night has passed from the time that the surrounding vegetation has been cleared, to determine occupancy
  - In the case of the presence of bat species, the spotter/catcher will encourage the fauna to leave by reasonable means or capture and relocate it in the local environment prior to felling and trimming
  - Hollows identified as containing fauna will be plugged with a suitable material such as a towel, the section removed from the tree and gently lowered to the ground using ropes. Measures will be taken to avoid injuring animals
  - Habitat trees will be felled gently or lowered to the ground (by skilled plant operators), and trees will be left for a short period of time on the ground to give any fauna trapped in the trees an opportunity to escape before further processing of the trees. After this time the spotter catcher will thoroughly check the tree to ensure there are no injured animals
  - Displaced fauna will then be relocated (within their hollows) to a suitable, previously identified recipient site provided the animal did not sustain any injuries. Any injured animals (native or introduced) are to be taken to receive veterinary attention immediately. Once recovered, animals will be relocated to an area of similar habitat adjoining the project area
  - All removed hollows not containing fauna will be in rehabilitation works, unless artificial bat boxes have been put in place
- Clearing will be conducted in a sequential manner and in a way that directs escaping wildlife away from the clearing activities and into adjacent natural areas

- Clearing activities will be restricted to the maximum disturbance limits authorised for the GTP footprint activities
- All clearing activities within identified sensitive areas will be supervised by the relevant EO
- Any lighting associated within night works will be directed away from sensitive areas or use engineering solutions to limit light spillage. This may include the use of light shades and low lighting being applied to construction areas located adjacent to remnant native vegetation and known habitat areas for this species
- Avoid the use of barb wire when erecting any project related fencing. Where barb wire fencing is unavoidable the top strand will be high tensile steel (non-barbed wire) to avoid fauna getting caught and tangled in the barbs
- To minimise impact to potential maternity roosts, avoid the destruction of overhangs, caves and subterranean tunnels by using HDD and/or through micrositing. This includes:
  - Avoiding blasting in and adjacent ridges that contain caves, overhangs or old mine shafts
  - Avoiding the clearance of vegetation in and around cave structures (avoid destabilisation)
  - Avoiding the alteration of local hydrology of subterranean waters
- The construction phase component of the LRMP will be implemented
- Weather permitting, rehabilitation of all areas identified will commence immediately after the pipeline has been lowered in and backfilled (refer LRMP). With the exception of operational constraints, revegetation will be consistent with the plant density, floristic composition and distribution of the adjacent communities
- Where practically feasible, available hollows (empty) will be relocated into adjacent habitat outside the GTP ROW. The suitability of hollows for relocation will be determined on the basis of advice from a suitably qualified Ecologist or a licensed and experienced fauna handler
- Potential sightings of the species will be reported to the relevant EO, who will confirm the sightings and record them in a SOCI logbook
- The EO will record the extent of vegetation being cleared and provide a progressive report to GLNG. The EO Operations. The EO will use this information to ensure compliance with agreed disturbance of ‘general habitat’

9.7.3 Operational phase mitigation measures

Measures to avoid impact

- Vehicle and pedestrian access within and along the GTP footprint will be restricted to the defined access tracks

Measures to minimise impacts

- Implementation of the Fauna Handling Procedures (refer Appendix C)
- Adopt maintenance measures to minimise potential risk associated with wildfires

- The operational component of the LRMP will be implemented to encourage the re-establishment of ecological communities impacted as a result of construction works. In particular, associated habitat areas for the Large-eared pied bat
- The operational phase component of the PWMP will be implemented to minimise the risk of weed and pest animal establishment
- Where necessary, work with the landowner to exclude stock from known habitats to support this species along the GTP footprint

9.7.4 Decommissioning phase mitigation measures

Measures to minimise impacts

- Implementation of the Fauna Handling Procedures (refer Appendix C)
- A decommissioning plan will be developed by GLNG Operations and provided for approval. The plan will aim to address the requirements of AS2885 and also to ensure environmental harm is avoided, including:
  - The Project area no longer contains hazardous contaminants and is left in stable condition
  - All the above ground infrastructure is removed
  - All areas disturbed by above ground infrastructure are rehabilitated in accordance with the relevant conditions
- For a minimum of five years after the completion of rehabilitation, rehabilitated areas will be monitored on a yearly basis
- The monitoring programme will include:
  - Methods to monitor subsidence and erosion rates at rehabilitated buried transmission pipeline corridors and buried flow lines
  - Biocondition assessment in accordance with the Biocondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland: Assessment Manual: Version 2.1 (Eyre *et al* 2011)
  - Monitoring of indicators identified in the LRMP at analogue sites to measure progressive and final rehabilitation success relevant to the final land use(s)
  - Frequency and seasonality of monitoring analogue sites and rehabilitated areas to assess rehabilitation success
  - Identification of the experimental design for analysing analogue and rehabilitated site data including statistical methods of analyses

10 South-eastern long-eared bat

10.1 EPBC Act legal status

Vulnerable - listed 4 April 2001

10.2 Biology and ecology

10.2.1 Characteristics

The head and body length of the South-eastern long-eared bat (*Nyctophilus corbeni*) is approximately 50 to 75 mm in length and its tail length is approximately 35 to 50 mm. The weight varies between genders with females (14 to 21 g) being heavier than males (11 to 15 g).

The South-eastern long-eared bat is distinguishable from other long-eared bats by its larger size as well as a broader skull and jaw. It is also geographically separated from other long-eared bats (Van Dyck & Strahan 2008).

It should be noted that most of the data on this species is from studies undertaken outside of Queensland (Curtis *et al* 2012).

South-eastern long-eared bat (Source: Thomson 2006)

10.2.2 Known distribution

The South-eastern long-eared bat has a limited distribution restricted to the Murray-Darling Basin in south-eastern Australia (DSEWPaC 2012f). In Queensland, the majority of records for this species are from the Brigalow Belt South Bioregion, with the most easterly record from the Bunya Mountains National Park. The most northerly records are from the Expedition Range and Dawson River areas with the most westerly records from west of Bollon in the Mulga lands Bioregion (DSEWPaC 2012f; Schulz & Lumdsen 2010). The nearest records to the GTP footprint are from the Rundle Range, north of Gladstone and Expedition National Park on Melancholy Creek (DERM 2012; Atlas of Living Australia 2012).

Figure 10.1 is an indicative distribution map of the present distribution of the South-eastern long-eared bat.

Figure 10.1 South-eastern long-eared bat distribution range for the species (Source: DSEWPaC 2012f)

10.2.3 Known species populations and their relationship with the GTP footprint

There is no data on the population size for this species. The species is considered rare throughout most of its distribution range, including Queensland where there are relatively few records (less than 30 localities) despite the large distribution area (Curtis *et al* 2012; DSEWPaC 2012f).

No individuals have been positively identified from the GTP footprint during the pre-clearing surveys. However it should be noted that *Nyctophilus* calls were identified from a number of locations during the pre-clearing surveys. However these could not be reliably identified to the species level (Ecologica Consulting 2012). There are no known roosting and/or breeding places within and directly adjacent the GTP ROW (Ecologica Consulting 2012).This species is unlikely to occur in the GTP ROW due the highly attenuated nature of the area. However this species may turn up in better woodland remnants (eg riparian areas) that are attached to the extensive remnants on the eastern and western sides of Arcadia Valley. This includes Clematis Creek and Ironbark Creek which have been mapped as ‘general habitat’.

This species was not identified during the pre-clearance survey within KP312 to KP408.81 (FEC 2012b, Santos GLNG 2013). However, *Nyctophilus* species calls were identified at Bell Creek (1.14 km east of KP334.5) and Harper Creek (KP360.3). *Nyctophilus* species produce distinctive near-vertical linear pulses, which are indistinguishable from each other. Four *Nyctophilus* species occur within the range of the study area; *Nyctophilus bifax*, *Nyctophilus corbeni*, *Nyctophilus geoffroyi* and *Nyctophilus gouldi*. *Nyctophilus corbeni* (South-eastern long-eared bat) is listed as ‘vulnerable’ under the EPBC Act, while the others are not listed as threatened species under the EPBC Act. A total of ten calls attributable to *Nyctophilus*

species were recorded across both sites in this survey. Suitable habitat for *Nyctophilus corbeni* exists within Harper Creek, so this species can not be excluded from KP312 to KP408.81. Bell Creek within the GTP ROW has been cleared of riparian vegetation so suitable habitat is not present at this site.

Potential habitat has also been identified within and adjacent to KP408.81 to KP409.04.

10.2.4 Biology and reproduction

There is little information currently available on this species reproductive biology, although it is thought that mating takes place during autumn and winter. Females are thought to store sperm until spring, when fertilisation and gestation occurs. Up to two young are born during late spring/early summer with young not fully weaned until mid-summer (DEC 2005; Curtis *et al* 2012).

10.3 Habitat

Although commonly recorded in some areas such as the Brigalow Belt South and Nandewar Bioregions in north-eastern NSW, this species occurs in a range of inland woodland vegetation types, including Box, Ironbark, Cypress pine, Mallee, Bull-oak, Brigalow and Belah woodlands/forests and will roost in tree hollows, crevices and under loose bark within these communities (DEC 2005; DSEWPaC 2012f).The South-eastern long-eared bat forages within the understorey of the abovementioned communities, including the ground (DSEWPaC 2012f; Schulz & Lumdsen 2010).

'Essential habitat' is generally associated with large tracts of vegetation (100s to 1,000s of ha), including open forest with open to dense understorey (but also found in SEVT and Brigalow/ Belah); mixed *Eucalyptus*/ *Corymbia*/ *Angophora* +/- Cypress/ Bull-oak (pers comm. Greg Ford). 'General habitat' seems to be associated mainly with large tracts of relatively undisturbed woodland and forest, particularly on landzones 5, 7 and 10 (and landzone 3 within these), although it does venture into landzone 4 and 9 (pers comm. Greg Ford).

The species is known to fly large distances (greater than 7 km in a night) from roosts to foraging areas. There is limited information on species habitat in Queensland, with data based on capture records only (Curtis *et al* 2012).

Limited information is available regarding the roosting ecology of this species, however surveys undertaken by others suggest that these bats may change roosting sites as frequently as each day (most roosts used for just a single day) and are likely to travel across large distances between consecutive roosts (up to 2 km). No information is available on maternity roosts where larger groups may form (DSEWPaC 2012f; Schulz & Lumdsen 2010).

10.4 Habitat assessment

Information obtained from BPA (ie Brigalow Belt South Fauna Expert Panel Report (EPA 2006)), together with expert advice, site based species records and pre-clearance survey data have been used to define a set of assumptions that have been used to identify areas of habitat that are consistent with the definitions of 'core habitat', 'essential habitat' and 'general habitat' that have been presented in Part 1 of this SSMP. The South-eastern long-eared bat habitat assumptions are presented below.

10.4.1 General assumptions

The following habitat assumptions have been made based on current scientific knowledge of this species:

- Occurs in a range of inland woodland vegetation types, including Box, Ironbark and Cypress pine woodlands (DSEWPaC 2012f)
- Also occurs in Bull-oak woodland, Brigalow woodland, Belah woodland, Smooth-barked apple (*Angophora leiocarpa*), woodland; River red gum (*Eucalyptus camaldulensis*), forests lining watercourses and lakes, Black box (*Eucalyptus largiflorens*), woodland, dry sclerophyll forest (DSEWPaC 2012f)

10.4.2 Core habitat

'Core habitat' consists of 'essential habitat' in which the species is known and the habitat is recognised under relevant recovery plans or other relevant plans/policies/regulations. Also included within this category are populations that are limited geographically within the region.

For the South-eastern long-eared bat, all REs that are considered to be habitat for this species, which overlap with areas identified in the BPA mapping that have been identified as containing a 'State' or 'Regional' 'Corridor' (J-Rating) and/or 'Core Habitat' (H-Rating) and/or 'Habitat for EVR Taxa' (A-Rating) have been mapped as 'core habitat'.

KP0 to KP30

The location of the 'core habitat' for this species within KP0 to KP30 is shown in Figure 10.2a.

KP30 to KP40

No individuals of this species have been identified within the general vicinity of KP30 to KP40 although habitat identified during the pre-clearance surveys overlaps with areas identified in the BPA mapping as containing a 'State' or 'Regional' 'Corridor' (J-Rating) and/or 'Core Habitat' (H-Rating) and/or 'Habitat for EVR Taxa' (A-Rating); therefore 'core habitat' exists within this section of the GTP.

The location of the 'core habitat' for this species within KP30 to KP40 is shown in Figure 10.2b.

KP40 to KP130

The location of the 'core habitat' for this species within KP40 to KP130 is shown in Figure 10.2c.

KP130 to KP312

No individuals of this species have been identified within the general vicinity of KP130 to KP312 although habitat identified during the pre-clearance surveys overlaps with areas identified in the BPA mapping as containing a 'State' or 'Regional' 'Corridor' (J-Rating) and/or 'Core Habitat' (H-Rating) and/or 'Habitat for EVR Taxa' (A-Rating); therefore 'core habitat' exists within this section of the GTP.

The location of the 'core habitat' for this species within KP130 to KP312 is shown in Figure 10.2d and Figure 10.2e.

KP312 to KP408.81

No individuals of this species have been identified within the general vicinity of KP312 to KP408.81 although during the pre-clearance surveys, habitat was identified within the Callide and Calliope Ranges, at Calliope River (KP352.3), Larcom Creek (KP378) and within KP405.5 to KP407.5 (Santos GLNG 2013). This habitat overlaps with areas identified in the BPA mapping as containing a 'State' or 'Regional' 'Corridor' (J-Rating) and/or 'Core Habitat' (H-Rating) and/or 'Habitat for EVR Taxa' (A-Rating); therefore 'core habitat' exists within this section of the GTP.

The location of the 'core habitat' for this species within KP312 to KP408.81 is shown in Figure 10.2f and Figure 10.2g.

KP408.81 to KP409.04

The location of the 'core habitat' for this species within KP408.81 to KP409.04 is shown in Figure 10.2h.

KP413.57 to KP419.69

No individuals of this species have been identified within the general vicinity of KP413.57 to KP419.69 and no habitat identified during the pre-clearance surveys overlaps with areas identified in the BPA mapping as containing a 'State' or 'Regional' 'Corridor' (J-Rating) and/or 'Core Habitat' (H-Rating) and/or 'Habitat for EVR Taxa' (A-Rating); therefore no 'core habitat' exists within this section of the GTP.

10.4.3 Essential habitat

'Essential habitat' is an area containing resources that are considered essential for the maintenance of populations of the species (eg potential habitat for breeding, roosting, foraging, shelter, for either migratory or non-migratory species). 'Essential habitat' is defined from known records and/or expert advice (including the findings of pre-clearance surveys). As there are no current site based observation for the South-eastern long-eared bat, within or adjacent to (ie within 10 km) the proposed ROW, and pre-clearance surveys did not detect this species or identify areas of 'essential habitat', there is no 'essential habitat' considered to occur within the ROW and ancillary work areas.

10.4.4 General habitat

'General habitat' consists of areas or locations that are used by transient individuals or where species may have been recorded but where there is insufficient information to assess the area as essential/core habitat. 'General habitat' also includes areas defined from known records or habitat that is considered to potentially support a species according to expert knowledge of habitat relationships, despite the absence of specimen backed records. 'General habitat' may include areas of suboptimal habitat for species. As potential habitat for many species contained within this SSMP may include most of the regional ecosystems of the Brigalow Belt Bioregion, the 'general habitat' category restricts the habitat to a more limited and realistic set of environmental parameters that are supported by literature and field based observation.

For the South-eastern long-eared bat, all areas that contain REs that provide habitat as identified by DotE are included within the 'general habitat' category.

KP0 to KP30

The location of the 'general habitat' for this species within KP0 to KP30 is shown in Figure 10.2a.

KP30 to KP40

No 'general habitat' for this species exists in this section of the GTP.

KP40 to KP130

The location of the 'general habitat' for this species within KP40 to KP130 is shown in Figure 10.2c.

KP130 to KP312

Expedition Range (KP137 to KP143), Conciliation Creek (KP207.47), Dawson Range (KP223.2 to KP224.2), Sellheim Creek area (KP280 to KP280.5), KP295.5 to KP298.95, Callide Creek area (KP298.95 to KP300.2) and KP309.7 to KP312 has been identified during the pre-clearance surveys as meeting the criteria of 'general habitat' for this species (Santos GLNG 2012).

The location of the 'general habitat' for this species within this section of the GTP is shown in Figure 10.2d and Figure 10.2e.

KP312 to KP408.81

Pre-clearance surveys identified 'general habitat' for this species within the Callide Range (KP330 to KP333). 'General habitat' was also identified at Harper Creek (KP360.3) where *Nyctophilus* species calls were recorded (Santos GLNG 2013).

The location of the 'general habitat' for this species within this section of the GTP is shown in Figure 10.2f and Figure 10.2g.

KP408.81 to KP409.04

The location of the 'general habitat' for this species within KP408.81 to KP409.04 is shown in Figure 10.2h.

KP413.57 to KP419.69

Pre-clearance surveys did not identify 'general habitat' for this species within this section of the GTP.

10.4.5 Unlikely habitat

'Unlikely habitat' areas are those areas that do not contain records of the particular species and do not contain sufficient habitat features to support the species (ie areas that do not meet the habitat assumptions identified above).

10.5 Anticipated threats and potential impacts as a result of the GTP

- Clearing of vegetation associated with Clematis Creek and Ironbark Creek. However, these habitats are considered 'general habitat' as they are not known to support the species and are considered sub-optimal (ie impacts by anthropogenic activity)

- Changes to foraging pattern as a result of loss of habitat and also due to lighting (eg light may result in the bat forging in a darker area, light near a roost access point will delay bats from appearing and may also result in bats abandoning the roost site)
- Removal of potential roosting sites (ie hollow bearing trees), however the habitats in this section are unlikely to support this species

10.6 Unavoidable impacts and unavoidable adverse (offsetable) impact from GTP

Areas of proposed disturbance and areas of adverse (offsetable) impact associated with clearing and construction activities for the GTP between KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 for the South-eastern long-eared bat are presented in Table 10.1. The location of this habitat is shown in Figure 10.2a, Figure 10.2b, Figure 10.2c, Figure 10.2d, Figure 10.2e, Figure 10.2f, Figure 10.2g and Figure 10.2h.

A cumulative total of proposed clearing of habitat for the South-eastern long-eared bat and the cumulative total of unavoidable adverse (offsetable) impact to the species habitat is provided in Table 10.1.

Table 10.1 Cumulative total of South-eastern long-eared bat habitat to be cleared and area of habitat subject to unavoidable adverse (offsetable) impacts from the GTP

Location	'General habitat'	'Core habitat'	Total habitat area per GTP section	Total habitat area adversely impacted per GTP section
KP0 to KP30	0.61 ha	10.19 ha	10.80 ha	10.80 ha
KP30 to KP40	0 ha	16.67 ha	16.67 ha	16.67 ha
KP40 to KP130	0.45 ha	3.79 ha	4.24 ha	3.79 ha
KP130 to KP312	41.18 ha	38.64 ha	79.82 ha	51.64 ha
KP312 to KP408.81	8.05 ha	50.11 ha	58.16 ha	56.51 ha
KP408.81 to KP409.04	0.001 ha	3.50 ha	3.50 ha	3.50 ha
KP413.57 to KP419.69	0 ha	0 ha	0 ha	0 ha
Total habitat area	**50.29 ha**	**122.90 ha**	**173.19 ha**	**142.91 ha**

10.7 Management practices and methods

10.7.1 Pre-construction mitigation measures

Measures to avoid impact

- All reasonable and practical measures will be taken to locate site offices, construction camps, stockpiling/lay down areas and plant and equipment storage areas (including heavy machinery) on existing cleared lands

Measures to minimise impacts

- Pre-clearing ecological surveys have been undertaken by a suitably qualified Ecologist(s) in accordance with the Survey Guidelines for Australia's Threatened

Bats. These surveys included assessment within both remnant and non-remnant areas

- If a maternity roost(s) is located within or within close proximity to the GTP footprint all practical and reasonable steps will be taken to avoid disturbing these sites. This will include the investigation of alternative construction measures near known roost areas that will not cause the bats to abandon the roost
- Where practically feasible, efforts will be made to co-locate the pipeline adjacent to existing cleared areas to minimise fragmentation and reduction of core habitat within remnant communities
- Prior to the commencement of construction clearing, the limits of clearing will be clearly marked out by a suitably qualified and experienced EO. Barricade webbing or similar should be used for temporary 'No Go' zones (where bats are found to be occupying tree hollows and loose bark, these areas should be barricaded off for 48hrs or until the animal has moved on naturally)
- Wherever practicable, signage will be erected to increase awareness of the bat and their roosts in the area
- Prior to site entry, all site personnel will be appropriately trained and made aware of the sensitive environs in which they will be working (refer Part 1, Section 7.7)

10.7.2 Construction phase mitigation measures

Measures to avoid impact

- Vehicle and pedestrian access to and from the GTP ROW will be restricted to the defined access tracks

Measures to minimise impacts

- All vegetation clearing and/or construction activities will comply with the clearing approval conditions (eg EPBC Act, EP Act, NC Act and other statutory approvals) and be supervised by the relevant EO
- Implementation of the Fauna Handling Procedures (refer Appendix C)
- A licensed and experienced spotter catcher(s) that is able to handle bats will be onsite during all clearing activities and must ensure any injured animals are given to an appropriate wildlife carer group or vet (refer Appendix C). DEHP and DotE will be notified within 24 hours of any native animal injuries or deaths.
- Where habitat trees need to be removed the following measures will be implemented:
  - Non-hollow bearing trees will be removed before hollow-bearing (or potential habitat) trees, allowing fauna an opportunity to self-relocate from the potential habitat trees. This applies in the instance when the fauna cannot be relocated, and it is evident that an animal exists within the trees
  - Habitat trees will be left overnight from the time of the felling of the non-habitat trees nearby
  - Habitat trees will be inspected by a qualified spotter/catcher after at least one night has passed from the time that the surrounding vegetation has been cleared, to determine occupancy

  - In the case of the presence of bird species, the spotter/catcher will encourage the fauna to leave by reasonable means or capture and relocate it in the local environment prior to felling and trimming
  - Hollows identified as containing fauna will be plugged with a suitable material such as a towel, the section removed from the tree and gently lowered to the ground using ropes. Measures will be taken to avoid injuring animals
  - Habitat trees will be felled gently or lowered to the ground (by skilled plant operators), and trees will be left for a short period of time on the ground to give any fauna trapped in the trees an opportunity to escape before further processing of the trees. After this time the spotter catcher will thoroughly check the tree to ensure there are no injured animals
  - Displaced fauna will then be relocated (within their hollows) to a suitable, previously identified recipient site provided the animal did not sustain any injuries. Any injured animals (native or introduced) are to be taken to receive veterinary attention immediately. Once recovered, animals will be relocated to an area of similar habitat adjoining the project area
  - All removed hollows not containing fauna will be in rehabilitation works, unless artificial bat boxes have been put in place
- Clearing will be conducted in a sequential manner and in a way that directs escaping wildlife away from the clearing activities and into adjacent natural areas
- Clearing activities will be restricted to the maximum disturbance limits authorised for the GTP footprint activities
- All clearing activities within identified sensitive areas will be supervised by the relevant EO
- Where practicable, direct any lighting associated within night works away from sensitive areas or use engineering solutions to limit light spillage. This may include the use of light shades and low lighting being applied to construction areas located adjacent to remnant native vegetation and known habitat areas for this species
- Avoid the use of barb wire when erecting any project related fencing. Where barb wire fencing is unavoidable the top strand will be high tensile steel (non-barbed wire) to avoid fauna getting caught and tangled in the barbs
- To minimise impact to potential maternity roosts, avoid the destruction of overhangs, caves and subterranean tunnels by using HDD and/or through micrositing. This includes:
  - Avoiding blasting in and adjacent ridges that contain caves, overhangs or old mine shafts
  - Avoiding the clearance of vegetation in and around cave structures (avoid destabilisation)
  - Avoiding the alteration of local hydrology of subterranean waters
- The construction phase component of the LRMP will be implemented
- Weather permitting, rehabilitation of all areas identified will commence immediately after the pipeline has been lowered in and backfilled (refer LRMP). With the exception of operational constraints, revegetation will be consistent with the plant density, floristic composition and distribution of the adjacent communities
- Where practically feasible, available hollows (empty) will be relocated into adjacent habitat outside the GTP ROW. The suitability of hollows for relocation will be

determined on the basis of advice from a suitably qualified Ecologist or a licensed and experienced fauna handler

- Potential sightings of the species will be reported to the relevant EO, who will confirm the sightings and record them in a SOCI logbook
- The EO will record the extent of vegetation being cleared and provide a progressive report to GLNG. The EO Operations. The EO will use this information to ensure compliance with agreed disturbance of 'general habitat'

10.7.3 Operational phase mitigation measures

Measures to avoid impact

- Vehicle and pedestrian access within and along the GTP footprint will be restricted to the defined access tracks

Measures to minimise impacts

- Implementation of the Fauna Handling Procedures (refer Appendix C)
- Adopt maintenance measures to minimise potential risk associated with wildfires
- The operational component of the LRMP will be implemented to encourage the re-establishment of ecological communities impacted as a result of construction works. In particular, associated habitat areas for the South-eastern long-eared bat
- The operational phase component of the PWMP will be implemented to minimise the risk of weed and pest animal establishment
- Where necessary, work with the landowner to exclude stock from known habitats to support this species along the GTP footprint

10.7.4 Decommissioning phase mitigation measures

Measures to minimise impacts

- Implementation of the Fauna Handling Procedures (refer Appendix C)
- A decommissioning plan will be developed by GLNG Operations and provided for approval. The plan will aim to address the requirements of AS2885 and also to ensure environmental harm is avoided, including:
  - The Project area no longer contains hazardous contaminants and is left in stable condition
  - All the above ground infrastructure is removed
  - All areas disturbed by above ground infrastructure are rehabilitated in accordance with the relevant conditions
- For a minimum of five years after the completion of rehabilitation, rehabilitated areas will be monitored on a yearly basis
- The monitoring programme will include:
  - Methods to monitor subsidence and erosion rates at rehabilitated buried transmission pipeline corridors and buried flow lines

- Biocondition assessment in accordance with the Biocondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland: Assessment Manual: Version 2.1 (Eyre *et al* 2011)
- Monitoring of indicators identified in the LRMP at analogue sites to measure progressive and final rehabilitation success relevant to the final land use(s)
- Frequency and seasonality of monitoring analogue sites and rehabilitated areas to assess rehabilitation success
- Identification of the experimental design for analysing analogue and rehabilitated site data including statistical methods of analyses

11 Northern quoll

11.1 EPBC Act legal status

Endangered - listed 12 April 2005

11.2 Biology and ecology

11.2.1 Characteristics

The Northern quoll (*Dasyurus hallucatus*) is the smallest of the four Australian quoll species. This species is the most arboreal and aggressive of the four quoll species (DSEWPaC 2012g) It has reddish brown fur dorsally, with cream coloured fur on its ventral surface. White spots are present on its back and rump although the tails is unspotted. The Northern quoll has a pointy snout. The Northern quoll is a solitary carnivorous marsupial that makes its dens in rock crevices, tree holes or occasionally termite mounds. This species is primarily nocturnal or may be crepuscular under certain situations.

The Northern quoll can weigh up to 1.2 kg, with the males being larger than the females (Threatened Species Scientific Committee (TSSC) 2005). The body size for a male is approximately 270 to 370 mm and the female is approximately 249 to 310 mm (Van Dyck and Strahan 2008).

Northern quoll (Source: TSSC 2005)

11.2.2 Known distribution

The Northern quoll was historically common across northern Australia, occurring almost continuously from the Pilbara, Western Australia, to near Brisbane, Queensland (Braithwaite & Griffiths 1994). The Northern quoll is now restricted to five regional populations across Queensland, the Northern Territory and Western Australia both on the mainland and on offshore islands. Figure 11.1 is an indicative distribution map of the present distribution of the Northern quoll.

Within Queensland, extant populations are highly fragmented and have experienced significant range reductions when compared to the species former distribution (DSEWPaC 2012g).

The Northern quoll is known to occur as far south as Gracemere and Mt Morgan, south of Rockhampton, as far north as Cooktown in Queensland and extends as far west into central Queensland to the vicinity of Carnarvon Range National Park (Woinarski *et al* 2008). There are occasionally records as far south in Queensland as Maleny on the sunshine coast hinterland (DERM 2009).

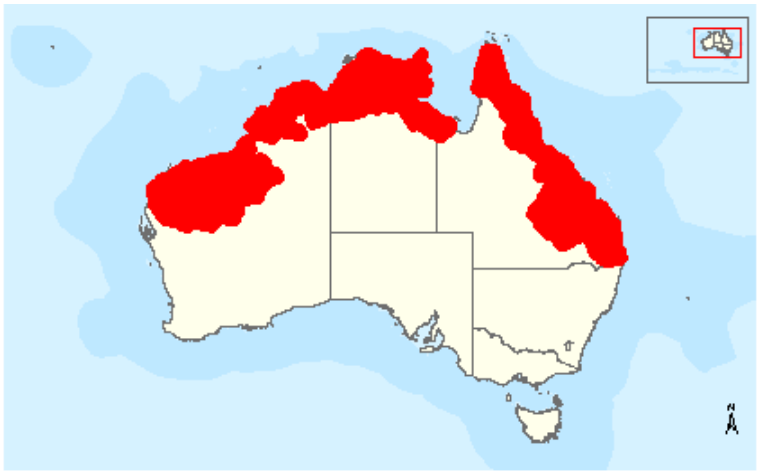


Figure 11.1 Distribution range of the Northern quoll (Source: DSEWPaC 2012g)

11.2.3 Known species populations and their relationship with the GTP footprint

No individuals of the Northern quoll were identified between KP0 to KP30 and KP40 to KP130 within the GTP ROW during any of the survey periods (Ecologica Consulting 2012). In addition, this species is now only known from the most rugged and remote parts of its former range from about Rockhampton north to Cape York (Curtis *et al* 2012).

However, pre-clearance surveys identified areas of habitat with suitable ground surface qualities for nesting, foraging and hunting and the required vegetation structure to provide cover from predation for this species associated woodland escarpment located at KP3.5 and KP400.3. This species is historically known from the Carnarvon Gorge area to the north (Ecologica Consulting 2012, Santos GLNG 2013).

11.2.4 Biology and reproduction

Northern quolls have short life spans, with males living for approximately one year and the oldest recorded female in the wild being three years of age (TSSC 2005).

Northern quolls breed once each year exhibiting synchronous reproduction within each year at each site (Nelson & Gemmell 2003; Oakwood 2008). Northern quolls produce on average seven young which are born after a gestation of 21 to 26 days. Females wean two to three young which become reproductively mature at 11 months (Oakwood 2008).

In the first year that females reproduce, the litters are larger and predominately male. If breeding occurs in the second year, litters are smaller and predominately female. As females rarely survive to reproduce in the third year, the breeding territory is probably inherited by one of her daughters, ensuring breeding success (Oakwood 2000).

Whilst still in the pouch, juveniles have a high rate of survival, but once they leave the pouch and are left in the den they are likely to suffer high mortality.

Young start to eat insects at four months old, and leave the den to forage at five months old, whilst still suckling from their mother. Juveniles are weaned at six months old, in November to early December. Once young are independent their survival is difficult to assess as they disperse to other areas. At this stage, they are in a size range that makes them vulnerable to a wide range of predators (Oakwood 2000).

The majority of male Northern quolls die after their first breeding season, which is unusual for a marsupial this large (Oakwood 2000).

The intense physical effort of male quolls (roving during the females onset of oestrus) appears to cause the physiological decline of males and subsequent die off at one year of age (Oakwood 2008). This male die-off in combination with the fact females usually breed only once makes local populations highly vulnerable to extinction.

11.3 Habitat

The Northern quoll lives in a range of open woodland and open forest types preferring rocky areas. Its greatest breeding success is known to occur at sites near water (DERM 2009).

During the day it hides in hollow logs, rock crevices, caves and hollow trees. In savannah landscapes, females maintain territories of about 35 ha, with males estimated to range over 150 ha.

11.4 Habitat assessment

Information obtained from BPA (ie Brigalow Belt South Fauna Expert Panel Report (EPA 2006)), together with expert advice, site based species records and pre-clearance survey data have been used to define a set of assumptions that have been used to identify areas of habitat that are consistent with the definitions of ‘core habitat’, ‘essential habitat’ and ‘general habitat’ that have been presented in Part 1 of this SSMP. The habitat assumptions for the Northern quoll are presented below.

11.4.1 General assumptions

The following habitat assumptions have been made based on current scientific knowledge of this species:

- This species prefers rocky habitats, including loose boulder-piles, rocky outcrops, steep rocky slopes, (DSEWPaC 2012g)
- The Northern quoll is now only known from the most rugged and remote parts of its former range (Curtis *et al* 2012). This could be attributed to the reduced occurrence and accessibility of the poisonous cane toads within these areas which has partly led to a decline in the species

- Research indicates that the species is more likely to be present in high relief areas that have shallower soils, greater cover of vegetation, boulders, less fire impact and were closer to permanent water (Woinarski *et al* 2008)
- It can also be assumed that the Northern quoll habitat would not extend into the surrounding un-wooded grasslands based on its habitat requirements such as cover from predators, height relief areas with a greater cover of boulders, rocky outcrops and less fire impact (Woinarski *et al* 2008; DSEWPaC 2012g; Curtis *et al* 2012). The change in the ecology within and adjoining the majority of the GTP to grasslands is largely due to the extensive clearing of remnant vegetation within these areas and historic grazing land management practices which are currently in place as verified through pre-clearance surveys
- Habitat for the Northern quoll has been mapped for this section of the GTP according to the habitat values and information gathered during pre-clearance surveys (refer Section 10.3 and 10.4)

11.4.2 Core habitat

'Core habitat' consists of 'essential habitat' in which the species is known and the habitat is recognised under relevant recovery plans or other relevant plans/policies/regulations. Also included within this category are populations that are limited geographically within the region.

For the Northern quoll, all REs that contain a specimen backed record (from any data source), which overlap with areas identified in the BPA mapping that have been identified as containing a 'State' or 'Regional' 'Corridor' (J-Rating) and/or 'Core Habitat' (H-Rating) and/or 'Habitat for EVR Taxa' (A-Rating) have been mapped as 'core habitat'.

No individuals of this species have been identified within the general vicinity of KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 of the GTP; therefore no 'core habitat' exists within these sections of the GTP.

11.4.3 Essential habitat

'Essential habitat' is an area containing resources that are considered essential for the maintenance of populations of the species (eg potential habitat for breeding, roosting, foraging, shelter, for either migratory or non-migratory species). 'Essential habitat' is defined from known records and/or expert advice (including the findings of pre-clearance surveys).

KP0 to KP30

For the Northern quoll, no individuals were identified during the pre-clearance surveys between KP0 to KP30. However, pre-clearance surveys have identified two areas as containing suitable habitat features for this species (ie at KP20). Although there are no species records and the areas are south of known populations, these areas are considered to constitute 'essential habitat'.

Figure 11.2a shows the location of 'essential habitat' within this section of the GTP.

KP30 to KP40

Pre-clearance surveys identified no species records or 'essential habitat' for this species, therefore no 'essential habitat' for this species is considered to exist for this section of the GTP.

KP40 to KP130

Pre-clearance surveys identified no species records or 'essential habitat' for this species, therefore no 'essential habitat' for this species is considered to exist for this section of the GTP.

KP130 to KP312

Pre-clearance surveys identified no species records or 'essential habitat' for this species, therefore no 'essential habitat' for this species is considered to exist for this section of the GTP.

KP312 to KP408.81

Pre-clearance surveys identified no species records or 'essential habitat' for this species, therefore no 'essential habitat' for this species is considered to exist for this section of the GTP.

KP408.81 to KP409.04

Pre-clearance surveys identified no species records or 'essential habitat' for this species, therefore no 'essential habitat' for this species is considered to exist for this section of the GTP.

KP413.57 to KP419.69

Pre-clearance surveys identified no species records or 'essential habitat' for this species, therefore no 'essential habitat' for this species is considered to exist for this section of the GTP.

11.4.4 General habitat

'General habitat' consists of areas or locations that are used by transient individuals or where species may have been recorded but where there is insufficient information to assess the area as essential/core habitat. 'General habitat' also includes areas defined from known records or habitat that is considered to potentially support a species according to expert knowledge of habitat relationships, despite the absence of specimen backed records. 'General habitat' may include areas of suboptimal habitat for species. As potential habitat for many species contained within this SSMP may include most of the regional ecosystems of the Brigalow Belt Bioregion, the 'general habitat' category restricts the habitat to a more limited and realistic set of environmental parameters that are supported by literature and field based observation.

KP0 to KP30

No 'general habitat' for this species exists in this section of the GTP.

KP30 to KP40

No 'general habitat' for this species exists in this section of the GTP.

KP40 to KP130

No 'general habitat' for this species exists in this section of the GTP.

KP130 to KP312

No 'general habitat' for this species exists in this section of the GTP.

KP312 to KP408.81

Pre-clearance surveys identified 'general habitat' for this species within Larcom Range at KP400.3 (Santos GLNG 2013).

The location of the 'general habitat' for this species within KP312 to KP408.81 is shown in Figure 11.2b and Figure 11.2c.

KP408.81 to KP409.04

No 'general habitat' for this species exists in this section of the GTP.

KP413.57 to KP419.69

Pre-clearance surveys did not identify 'general habitat' for this species within this section of the GTP ROW.

11.4.5 Unlikely habitat

'Unlikely habitat' areas are those areas that do not contain records of the particular species and do not contain habitat features to support the species (ie areas that do not meet the habitat assumptions identified above).

11.5 Anticipated threats and potential impacts as a result of the GTP

- Loss and degradation of potential habitat for the Northern quoll within the GTP ROW
- Predation caused by fragmentation and habitat degradation
- Changes to foraging behaviour due to increased vehicle movement, noise, lighting etc
- Stress, injury and mortality to animals due to increases in construction noise, vehicle movement, lighting and clearing
- Barriers to movement of individuals

The current identified threats include the continued degradation of habitat by livestock; ingestion of the introduced Cane Toad (*Rhinella marina*) as well as habitat disturbance and fragmentation (DSEWPaC 2012g).

11.6 Unavoidable impact and unavoidable adverse (offsetable) impact from GTP

Areas of proposed disturbance and areas of adverse (offsetable) impact associated with clearing and construction activities for the GTP between KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 for the Northern Quoll are presented in Table 11.1. It is important to note that this unavoidable impact is considered minor and temporary in the context of the wide spread extent of 'general habitat' in the region. The location of this habitat is shown in Figure 11.2a, Figure 11.2b and Figure 11.2c.

A cumulative total of proposed clearing of habitat for the Northern Quoll and the cumulative total of unavoidable adverse (offsetable) impact to the species habitat is provided in Table 11.1.

Table 11.1 Cumulative total of Northern Quoll habitat to be cleared and area of habitat subject to unavoidable adverse (offsetable) impacts from the GTP

Location	'General habitat'	'Essential habitat'	Total habitat area per GTP section	Total habitat area adversely impacted per GTP section
KP0 to KP30	0 ha	0.67 ha	0.67 ha	0.67 ha
KP30 to KP40	0 ha	0 ha	0 ha	0 ha
KP40 to KP130	0 ha	0 ha	0 ha	0 ha
KP130 to KP312	0 ha	0 ha	0 ha	0 ha
KP312 to KP408.81	0.86 ha	0 ha	0.86 ha	0.86 ha
KP408.81 to KP409.04	0 ha	0 ha	0 ha	0 ha
KP413.57 to KP419.69	0 ha	0 ha	0 ha	0 ha
Total habitat area	**0.86 ha**	**0.67 ha**	**1.53 ha**	**1.53 ha**

11.7 Management practices and methods

11.7.1 Pre-construction mitigation measures

Measures to avoid impact

- Prior to the commencement of construction clearing, a suitably qualified and experienced EO will confirm the buffer zones ('No Go' zones) and where necessary barriers and signs will be erected

Measures to minimise impacts

- Pre-clearing ecological surveys have been undertaken by a suitably qualified Ecologist(s) in accordance with the Survey Guidelines for Australia's Threatened Mammals
- Prior to site entry, all site personnel will be appropriately trained and made aware of the sensitive environs in which they will be working (refer Part 1, Section 7.7)

11.7.2 Construction phase mitigation measures

Measures to avoid impact

- All reasonable and practical measures will be taken to locate site offices, construction camps, stockpiling/lay down areas and plant and equipment storage areas (including heavy machinery) on existing cleared lands. As per other conditions these structures would be located at least 100 m away identified habitat areas

Measures to minimise impacts

- All vegetation clearing within known Northern quoll habitat will comply with clearing approval conditions (eg NC Act and other statutory approvals)
- Implementation of the Fauna Handling Procedures (refer Appendix C)

- A licensed and experienced spotter catcher(s) will be onsite during all clearing activities and will ensure any injured animals are given to an appropriate wildlife carer group or vet (refer Appendix C). DotE and DEHP will be notified within 24 hours of any native animal injuries or deaths
- Vehicle and machinery speed limits will be restricted to 20 km/hr (maximum speed limit of 50 km/hr in the GTP ROW footprint) within key areas where the Northern quoll has been identified with appropriate signage erected
- The clearing footprint within the above-listed locations and all 'No Go' zones will be adequately marked out for the clearing crew
- Clearing activities within these areas will be supervised by the relevant EO
- Clearing will be conducted in a sequential manner and in a way that directs escaping wildlife away from the clearing activities and into adjacent natural areas
- Measures will be in place to facilitate fauna movement, including gaps between stockpiles and pipe strings
- Ensure equipment is regularly maintained and is in good working order
- Where practicable, direct any lighting associated within night works away from sensitive areas or use engineering solutions to limit light spillage
- The construction phase component of the LRMP will be implemented
- Weather permitting, rehabilitation of all areas identified will commence immediately after the pipeline has been lowered in and backfilled (refer LRMP). With the exception of operational constraints, revegetation will be consistent with the plant density, floristic composition and distribution of the adjacent communities

11.7.3 Operational phase mitigation measures

Measures to avoid impact

- To avoid impacting on regenerating Northern quoll habitat, vehicle and pedestrian access will be restricted to the defined access tracks to and from the ROW and the defined access track within the ROW

Measures to minimise impacts

- Implementation of the Fauna Handling Procedures (refer Appendix C)
- The operational phase component of the LRMP will be implemented
- The operational phase of the PWMP will be implemented to minimise the risk of weed and pest animal establishment within the above-listed locations

11.7.4 Decommissioning phase mitigation measures

Measures to minimise impacts

- Implementation of the Fauna Handling Procedures (refer Appendix C)
- A decommissioning plan will be developed by GLNG Operations and provided for approval. The plan will aim to address the requirements of AS2885 and also to ensure environmental harm is avoided, including:

  - The Project area no longer contains hazardous contaminants and is left in stable condition
  - All the above ground infrastructure is removed
  - All areas disturbed by above ground infrastructure are rehabilitated in accordance with the relevant conditions
- For a minimum of five years after the completion of rehabilitation, rehabilitated areas will be monitored on a yearly basis
- The monitoring programme will include:
  - Methods to monitor subsidence and erosion rates at rehabilitated buried transmission pipeline corridors and buried flow lines
  - BioCondition assessment in accordance with the BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland: Assessment Manual: Version 2.1 (Eyre *et al* 2011)
  - Monitoring of indicators identified in the LRMP at analogue sites to measure progressive and final rehabilitation success relevant to the final land use(s)
  - Frequency and seasonality of monitoring analogue sites and rehabilitated areas to assess rehabilitation success
  - Identification of the experimental design for analysing analogue and rehabilitated site data including statistical methods of analyses

12 Water mouse

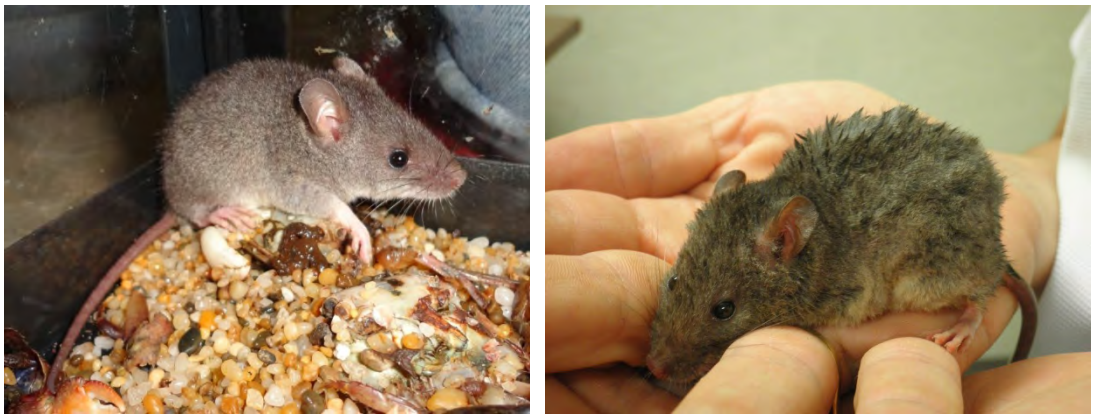
12.1 EPBC Act legal status

Vulnerable – listed 16 July 2000

12.2 Biology and ecology

12.2.1 Characteristics

The Water mouse (*Xeromys myoides*) is a small native rodent with a maximum head-body length of 126 mm and maximum weight of 64 g. Its fur is short and silky, and dark grey above with a white belly. Both the hands and feet are covered in fine white hair and the hindfeet are between 23 to 26 mm long. The tail is 85 to 100 mm in length, very finely ringed and covered in thin hairs (Gynther & Janetzki 2008). While the species is specialised to aquatic habitats, the feet are not webbed. The ears are short and rounded and the eyes are small. It has a distinctive hunched posture and often a 'mousy' odour.



Sub-adult male Water mouse (left) and adult female Water mouse, both collected in the Gladstone region (Walters 2011)

12.2.2 Known distribution

The Water mouse occurs in three discrete populations in Australia; the coastline of the Northern Territory, central south Queensland, and south-east Queensland. The central south Queensland population is relevant to the GLNG GTP Project in Gladstone, as this population extends from Cannonvale (Whitsunday Coast) in the north to Agnes Water in the south.

A number of recent surveys (GHD 2011; GHD 2012; Queensland Museum 2012; Aurecon 2012a; Worley Parsons 2011) have confirmed the presence of the Water mouse in the Gladstone region, and in close proximity to KP408.81 to KP409.04 of the GTP.

Within Queensland, the population size of the Water mouse is thought to be between 1,001 and 10,000 individuals, occupying an area of between 101 to 1,000 km^2 (Dickman *et al* 2000).

Figure 12.1 is an indicative distribution map of the present distribution of the Water mouse.

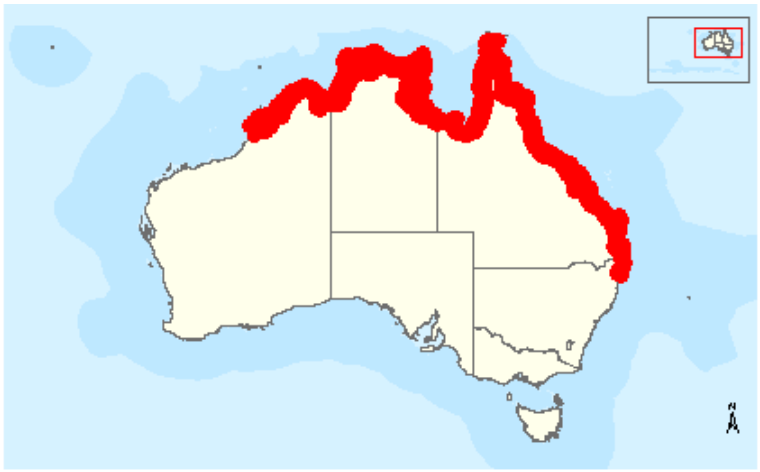


Figure 12.1 Distribution range of the Water mouse (Source: DSEWPaC 2012u)

12.2.3 Known species populations and their relationship with the GTP footprint

This species was identified during the pre-clearance survey in close proximity to KP408.81to KP409.04 of the GTP and ancillary areas, and potential habitat has also been identified in close proximity to the site.

12.2.4 Biology and reproduction

The diet of the Water mouse has been well surveyed. Van Dyck (1996) investigated the diet of the Water mouse on North Stradbroke Island in south-east Queensland. The composition of the diet included a variety of crustaceans (*Parasesarma erythrodactyla*, *Helice leachi* and *Australoplax tridentata*), Marine polyclads, Marine pulmonates (*Salinator solida*, *Ophicardelus quoyi* and *Ochidina australis*) and Marine bivalves (*Glauconome sp*.). Investigations of middens within and outside tree hollows also revealed the remains of the Mud lobster (*Laomedia healyi)* and Mottled shore crab (*Peragrapsis laevis)* (Van Dyck 1996). This suite of species is common on intertidal saltmarsh habitats in south-east Queensland (Breitfuss *et al* 2004).

The dietary preferences in central south Queensland appear to be similar and include grapsid crabs (Ball 2004). Plant foods to date have not been reported in the diet of the Water mouse, however gut morphology suggests that the diet of the Water mouse should not be totally carnivorous (Van Dyck 1996).

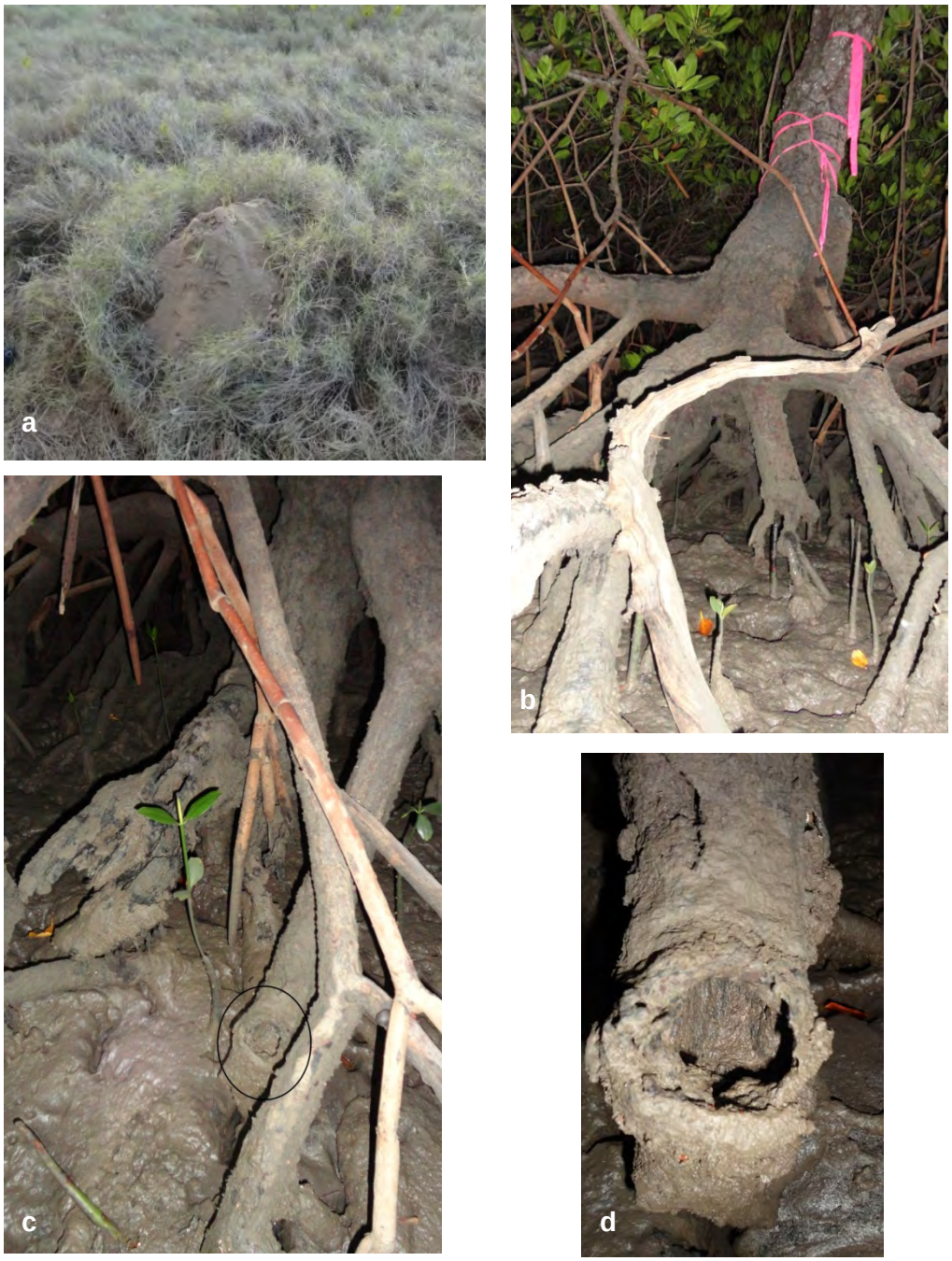
The Water mouse creates nests which are important for breeding and refuge from high tide and predators. Five types of nests have been identified (Van Dyck & Gynther 2003):

- Free-standing mound nests or mounds at the base of mangrove trees
- Mound nests on small elevated ‘islands’ within the tidal zone
- Mound nests or holes in supralittoral banks
- Nests inside hollow tree trunks
- Nests in spoil heaps created as a result of human activity

Recent surveys by Aurecon in the Gladstone region have detected:

- A free-standing mound nest above the high-tide mark, in a supralittoral bank vegetated with Saltwater couch (*Sporobolus virginicus*)

- A sub-adult male Water mouse that was radio-tracked to its daytime shelter inside a hollow stag of White-flowered black mangrove (*Lumnitzera racemosa*), below the high-tide mark, and approximately 100 m in to a dense forest of *Rhizophora stylosa*
- A second sub-adult male Water mouse that was radio-tracked to its daytime shelter beneath a rock pile adjacent to a dense mangrove forest of Yellow mangrove (*Ceriops tagal*)
- An apparent nest within a hollow mangrove tree containing four individuals, including one sub-adult male which was captured and subsequently released



Water mouse nest structures recently observed in the Gladstone region: a) a free-standing mound nest in the supralittoral bank, b) a hollow stag c) location of the entrance hole within the mangrove roots of the hollow stag d) close image of the entrance hole

12.3 Habitat

The Water mouse requires mangrove communities and associated saltmarsh, sedgelands, clay pans, heathlands and freshwater wetlands with intact hydrology that provide adequate nest sites and prey resources.

In central south Queensland, the Water mouse has been captured in the high inter-tidal zone in tall, closed fringing mangrove forest containing *Ceriops tagal* and/or *Bruguiera* sp and in saline grassland adjacent to this type of forest (Ball 2004; DSEWPaC 2012u). The Water mouse was also recorded in closed forest of *Avicennia marina* and a supralittoral bank is generally absent in the south central Queensland subregion (Ball 2004). Typical Water mouse habitat in this subregion has been described as the distinct ecotones between mangroves and dry sclerophyll woodlands and/or saltpan. However, very little research of the species has been completed, and recent surveys in the Gladstone region have added to the body of knowledge of Water mouse habitat use. This animal has recently been detected in the following habitats:

- Closed *Rhizophora stylosa* forest bordered by closed *Ceriops tagal* (Aurecon 2012a)
- Open *Avicennia marina* forest with supralittoral bank bordered by saline grassland (Aurecon 2012a)
- Closed *Ceriops tagal* forest (FEC 2012b)
- Closed *Avicennia marina*/*Ceriops tagal* forest bordered by closed *Rhizophora stylosa* (GHD 2011)

Very little is known about the dispersal and movement activities of the Water mouse. Only one published study has involved radio-tracking of individuals (Van Dyck 1996), which provided the following information:

- Animals may travel up to 3 km in a night
- The average home range is 0.7 ha
- Males generally have a larger home range than females (male average 0.77 ha, female 0.53 ha)
- Microhabitat complexity and width of mangrove strip influence the size of home range (ie animals will range further when the microhabitat is less complex and the mangrove strip is narrower)

The Water mouse is known to nest communally, and exhibit territorial behaviour (Gynther & Janetzki 2008). Van Dyck (1996) found that a nest usually contained only one sexually active male. It is reasonable to assume that animals and in particular sub-adult males will disperse from the original nest to establish new territories. Thus, areas that are not considered core habitat in terms of food or nesting resources however may still provide important dispersal pathways.

12.4 Habitat assessment

Information obtained from Biodiversity Planning Assessment (BPA) (ie Brigalow Belt South Fauna Expert Panel Report (EPA 2006)), together with expert advice, site based species records and pre-clearance survey data has been used to define a set of assumptions that have been used to identify areas of habitat that are consistent with the definitions of 'core habitat', 'essential habitat' and 'general habitat' presented in Part 1 of this SSMP. The habitat assessment assumptions for the Water mouse are presented below.

12.4.1 General assumptions

The following general habitat assumptions have been made based on current scientific knowledge of this species:

- Species is associated the upper inter-tidal zone in tall, closed fringing mangrove forest containing only *Ceriops tagal* and/or *Bruguiera* sp (Ball 2004; DSEWPaC 2012u)
- Species is associated with saline grassland on the landward side of closed forest of *Ceriops tagal* and *Bruguiera* sp and within closed forest of *Avicennia marina* (DSEWPaC 2012u)
- Species is associated with open mangrove communities that support invertebrate prey (DSEWPaC 2012u)
- Areas with corresponding habitat features to that of RE 11.1.2a and RE 12.1.2 which are described as bare mud flats on Quaternary estuarine deposits, with very isolated individual stunted mangroves and very sparse saltpan vegetation including grassland and herbland on marine clay plains, are not considered to be habitat as they are lacking the required structural attributes of cover for foraging and structure/resources for nesting that have been referenced in literature and points above in addition to the increased risk and exposure of predation in the open areas
- An allowance has been made to accommodate Water mouse movements across and within these areas to reach adjacent suitable habitats, assuming the species will move no more than 50 m from cover (based on current scientific knowledge and pre-clearance survey and trapping programs and habitat assessments)

12.4.2 Core habitat

'Core habitat' consists of 'essential habitat' in which the species is known and the habitat is recognised under relevant recovery plans or other relevant plans/policies/regulations. Also included within this category are populations that are limited geographically within the region.

For the Water mouse, all REs or Pre-REs that contain a specimen backed record, which overlap with areas identified in the BPA mapping that have been identified as containing a 'State' or 'Regional' 'Corridor' (J-Rating) and/or 'Core habitat' (H-Rating) and/or 'Habitat for EVR Taxa' (A-Rating) have been mapped as 'Core habitat'.

No 'core habitat' for this species exists within KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 of the GTP.

12.4.3 Essential habitat

'Essential habitat' is an area containing resources that are considered essential for the maintenance of populations of the species (eg potential habitat for breeding, roosting,

foraging, shelter, for either migratory or non-migratory species). 'Essential habitat' is defined from known records and/or expert advice (including the findings of pre-clearance surveys).

For the Water mouse, 'essential habitat' is defined as the RE polygon in which Water mouse individuals have been found during pre-clearing surveys.

No 'essential habitat' for this species exists within KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 of the GTP.

12.4.4 General habitat

'General habitat' consists of areas or locations that are used by transient individuals or where species may have been recorded but where there is insufficient information to assess the area as essential/core habitat. 'General habitat' also includes areas defined from known records or habitat that is considered to potentially support a species according to expert knowledge of habitat relationships, despite the absence of specimen backed records. 'General habitat' may include areas of suboptimal habitat for species. As potential habitat for many species contained within this SSMP may include most of the regional ecosystems of the Brigalow Belt Bioregion, the 'general habitat' category restricts the habitat to a more limited and realistic set of environmental parameters that are supported by literature and field based observation.

KP0 to KP30

No 'general habitat' for this species exists within KP0 to KP30 of the GTP.

KP30 to KP40

No 'general habitat' for this species exists within KP30 to KP40 of the GTP.

KP40 to KP130

No 'general habitat' for this species exists within KP40 to KP130 of the GTP.

KP130 to KP312

No 'general habitat' for this species exists within KP130 to KP312 of the GTP.

KP312 to KP408.81

Pre-clearance surveys identified 'general habitat' for this species within KP408.3 to KP408.7 (Santos GLNG 2013).

The location of the 'general habitat' for this species within KP312 to KP408.81 is shown in Figure 12.2a and Figure 12.2b.

KP408.81 to KP409.04

No 'general habitat' for this species exists within KP408.81 to KP409.04 of the GTP although 'general habitat' for this species exists in close proximity to the ROW and ancillary areas and is shown in Figure 12.2c.

KP413.57 to KP419.69

Pre-clearance surveys did not identify 'general habitat' for this species within this section of the GTP although 'general habitat' was identified within close proximity to the GTP and is shown in Figure 12.2d. It is important to note that the GLNG GTP ROW and ancillary

activities do not interfere with the tidal zone and therefore the hydrology of the habitat areas will not be altered.

12.4.5 Unlikely habitat

'Unlikely habitat' areas are those areas that do not contain records of the particular species and contain no habitat values to support the presence or existence of resident or migratory individuals or populations of the species.

12.5 Anticipated threats and potential impacts as a result of the GTP

- Habitat loss and fragmentation
- Habitat degradation due to altered hydrology
- Entrapment in trenches
- Reduction in nesting and foraging opportunities
- Acid sulfate soil exposure
- Increased anthropogenic disturbance
- Chemical, oil and/or fuel spills
- Increase in weed impacts
- Increase in impacts from predators

12.6 Unavoidable impact and unavoidable adverse (offsetable) impact from the GTP

Areas of proposed disturbance and areas of adverse (offsetable) impact associated with clearing and construction activities for the GTP between KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 for the Water mouse are presented in Table 12.1. The location of this habitat is shown in Figure 12.2a, Figure 12.2b, Figure 12.2c and Figure 12.2d.

A cumulative total of proposed clearing of habitat for the Water mouse and the cumulative total of unavoidable adverse (offsetable) impact to the species habitat is provided in Table 12.1.

Table 12.1 Cumulative total of Water mouse habitat to be cleared and area of habitat subject to unavoidable adverse (offsetable) impacts from the GTP

Location	'General habitat'	Total habitat area per GTP section	Total habitat area adversely impacted per GTP section
KP0 to KP30	0 ha	0 ha	0 ha
KP30 to KP40	0 ha	0 ha	0 ha
KP40 to KP130	0 ha	0 ha	0 ha
KP130 to KP312	0 ha	0 ha	0 ha
KP312 to KP408.81	0 ha	0 ha	0 ha
KP408.81 to KP409.04	0.33 ha	0.33 ha	0 ha
KP413.57 to KP419.69	0.01 ha	0.01 ha	0.01 ha

Location	'General habitat'	Total habitat area per GTP section	Total habitat area adversely impacted per GTP section
Total habitat area	**0.34 ha**	**0.34 ha**	**0.01 ha**

12.7 Management practices and methods

12.7.1 Pre-construction mitigation measures

Measures to avoid impact

- All reasonable and practical measures will be taken to locate site offices, construction camps, stockpiling/lay down areas and plant and equipment storage areas (including heavy machinery) on existing cleared lands
- Where the Water mouse and its breeding site is located within or within close proximity of the GTP and ancillary work areas, the location will be recorded and checked again for activity prior to construction clearing. All practical and reasonable steps will be taken to avoid disturbing these areas including the investigation of alternative construction measures near known habitats. The establishment of a 100 m buffer around breeding site(s) will also be applied if there are no applicable alternative GTP construction methods
- Where practically feasible, efforts should be made to co-locate the pipeline adjacent to existing cleared areas to minimise fragmentation and reduction of core habitat within remnant communities

Measures to minimise impacts

- Pre-clearing ecological surveys have been undertaken by a suitably qualified Ecologist(s) in accordance with the Survey Guidelines for Australia's Threatened Mammals
- Prior to the commencement of construction clearing, the limits of clearing will be clearly marked out by a suitably qualified and experienced EO. Barricade webbing or similar should be used for 'No Go' zones
- Wherever practicable, signage will be erected to increase awareness of this species and its habitat in the area
- Prior to site entry, all site personnel will be appropriately trained and made aware of the sensitive environs in which they will be working (refer Part 1, Section 7.7)

12.7.2 Construction phase mitigation measures

Measures to avoid impact

- Vehicle and pedestrian access to and from the GTP will be restricted to the defined access tracks
- The limits of clearing will be clearly marked out by a suitably qualified and experienced EO. Barricade webbing or similar will be present highlighting all temporary and permanent 'No Go' zones relevant to the Water mouse

Measures to minimise impacts

- All site personnel will be educated in not harming any animals. All native animals are protected under legislation and it is illegal to harm them
- All vegetation clearing and/or construction activities within known Water mouse habitat will comply with the clearing approval conditions (eg EPBC Act, EP Act, NC Act and other statutory approvals) and be supervised by the relevant EO
- Implement the Fauna Handling Procedures (refer Appendix C)
- Clearing will be conducted in a sequential manner and in a way that directs escaping wildlife away from the clearing activities and into adjacent natural areas
- Clearing activities will be restricted to the maximum disturbance limits authorised for the GTP and ancillary areas
- All clearing activities within identified sensitive areas will be supervised by the relevant EO
- Surveillance of the open trench in all areas and the removal of wildlife from the trench by appropriately trained personnel (the whole trench will be checked at least twice a day (early morning/late afternoon)
- The spotter catcher(s) will have access to the site (particularly the open trench) during all weather conditions to check for trapped fauna
- Measures will be adopted to prevent fauna entrapment within the pipeline trench, such as:
  - Minimising the period of time the trench is open
  - Constructing ramps with a non-slip surface with slopes less than 45° to provide exit ramps for fauna at intervals no greater than 500 m
  - Trench plugs shall be installed in open trenches. These will be provided as a minimum every 500 m
  - Installing additional ramps at greater than normal frequencies (500 m) in areas identified as known or high value habitat
  - Branches, hessian sacks, ramped gangplanks or similar to be used to create ‘ladders’ to enable fauna to exit the trench. These structures will be placed every 250 to 500 m, depending on the surrounding landscapes
- Direct temporary lighting away from light-sensitive areas such as intertidal zones. Light shades and low lighting will be applied to construction and operational areas located adjacent to intertidal areas. This includes remnant native vegetation and other environmentally sensitive areas within and adjacent to intertidal zones
- Prior to backfilling, the spotter catcher(s) will check the open trench in all areas for trapped fauna and where required move them to a safe location away from the trench. This may include disturbing the top layer of soil to ensure no reptiles are camouflaged under the soil
- The construction phase component of the LRMP will be implemented
- Weather permitting, rehabilitation of all areas identified will commence immediately after the pipeline has been lowered in and backfilled (refer LRMP). With the exception of operational constraints, revegetation will be consistent with the plant density, floristic composition and distribution of the adjacent communities (particularly ground cover). Rehabilitation will also incorporate the re-establishment of Water

mouse habitat and landscape connectivity within 'core habitat' and 'essential habitat' areas

- Clearance of the GTP ROW and ancillary areas will be subject to comprehensive stormwater management and sediment and erosion control measures as detailed in the SMESCP to ensure that there is no sediment runoff from construction areas into the habitat
- All construction phase activities will be in accordance with the noise and vibration management measures outlined in the Marine Crossing EMP with construction operations reducing or ceasing at night within close proximity to the Water mouse habitat. It is important to note however that no night works are planned within close proximity to the potential habitat areas

Observations from construction activities associated with the Gladstone Wiggins Island Coal Terminal project indicate that the Water mouse is still active and forages within its habitat during construction activities and that mitigation measures contained within this document are sound for reducing potential impacts for this species. However, these are observations only as very little published research of the species has been completed.

Importantly, as the ROW and ancillary works area construction footprint does not impact on the intertidal zone and night works are not planned for the ROW activities, it is considered that the potential impacts to this species will be minimised by the documented management measures.

12.7.3 Operational phase mitigation measures

Measures to avoid impact

- Vehicle and pedestrian access within the GTP and ancillary areas will be restricted to the defined access tracks

Measures to minimise impacts

- Implementation of the Fauna Handling Procedures (refer Appendix C)
- Appropriate maintenance measures will be adopted in the GTP to minimise potential risk to recolonising species. This includes ensuring that appropriate fire regimes are adopted (where necessary) as well as minimising the disturbance to rocky outcrops, woody debris and rehabilitating vegetation
- The operational phase component of the LRMP will be implemented to encourage the re-establishment of ecological communities impacted as a result of construction works. In particular, associated habitat areas for the Water mouse
- The PWMP will be implemented to minimise the risk of weed and pest animal establishment within known and/or potential Water mouse habitat

12.7.4 Decommissioning phase mitigation measures

Measures to minimise impacts

- Implementation of the Fauna Handling Procedures (refer Appendix C)
- A decommissioning plan will be developed by GLNG and provided for approval. The plan will aim to address the requirements of AS2885 and also to ensure environmental harm is avoided, including:

  - The Project area no longer contains hazardous contaminants and is in stable condition
  - All above ground infrastructure is removed
  - All areas disturbed by above ground infrastructure are rehabilitated in accordance with the relevant conditions
- For a minimum of five years after the completion of rehabilitation, rehabilitated areas will be monitored on a yearly basis
- The monitoring programme will include:
  - Methods to measure subsidence and erosion rates at rehabilitated buried transmission pipeline corridors and buried flow lines
  - BioCondition assessment in accordance with the BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland: Assessment Manual: Version 2.1 (Eyre *et al* 2011)
  - Monitoring of indicators identified in the LRMP at analogue sites to measure progressive and final rehabilitation success relevant to the final land use(s)
  - Frequency and seasonality of monitoring analogue sites and rehabilitated areas to assess rehabilitation success
  - Identification of the experimental design for analysing analogue and rehabilitated site data including statistical methods of analyses

13 Ornamental snake

13.1 EPBC Act legal status

Vulnerable - listed 16 July 2000

13.2 Biology and ecology

13.2.1 Characteristics

The Ornamental snake (*Denisonia maculata*) is a stout-bodied snake which grows to a total length of about 50 cm. The overall body colour is brown, greyish brown or almost black, under surfaces are cream, often with darker streaks or flecks on the outer edges of the belly. The skin between the scales is black. The entire head, and at least the fore body, is very finely peppered with dark brown or black markings. Lips distinctly barred. Scales are smooth and are arranged in 17 rows at mid-body (Cogger 2000; Richardson 2006).

Important populations occur in remnant vegetation in close proximity to Gilgai mounds and depressions (DSEWPaC 2012h). No known important populations occur within the GTP footprint and ancillary work areas or are contiguous with habitats intersected by the GTP Project (DERM 2012; Queensland Museum 2011; Atlas of Living Australia 2012). As such the relationship of populations on a regional scale cannot be outlined.

Ornamental snake (Source: Macdonald 2007)

13.2.2 Known distribution

The species is endemic to Queensland and mostly occurs in the Brigalow Belt from Inglewood, north to Emerald and east to Gladstone (Cogger 2000; DEHP 2006b). The centre of the species distribution lies within the drainage system of the Fitzroy and Dawson Rivers (DSEWPaC 2012h).

Known localities occur in Blackwater; Dysart, Peak Downs; Moranbah; Coppabella; Rockhampton region; east of Midgee; Yeppoon Crossing; Emerald; near Moura; the Dawson Valley; Charters Towers; Biloela; Duaringa; St Lawrence; St George; Goondiwindi; Dipperu National Park; and adjacent to South Walker Creek near Nebo (DSEWPaC 2012h).

Figure 13.1 is an indicative distribution map of the present distribution of the Ornamental snake.

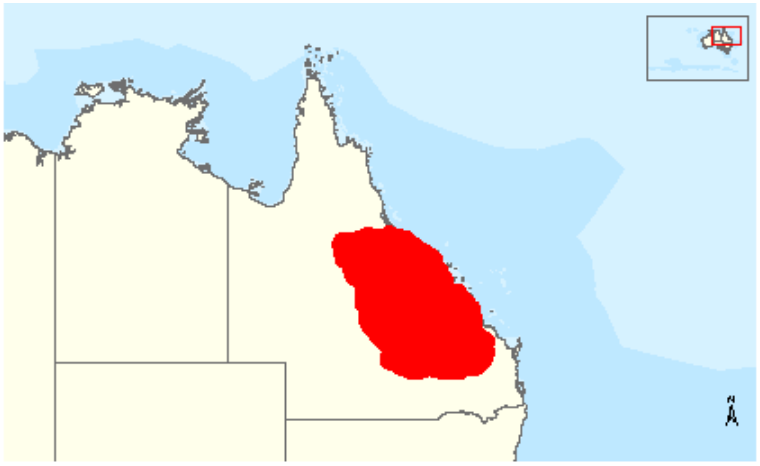


Figure 13.1 Distribution range of the Ornamental snake (Source: DSEWPaC 2012h)

13.2.3 Known species populations and their relationship with the GTP footprint

According to DotE's habitat modelling, the majority of the GTP footprint intersects potential habitat for this species. The exception is the Calliope River catchment area.

No individuals are known in the upper reaches of the Comet River and Dawson River; however habitat is present in the GTP footprint within Arcadia Valley (Ecologica Consulting 2012; Queensland Museum 2011; DERM 2012). This is generally consistent within known distribution in which the species has not been recorded south of Lake Nuga Nuga (Curtis *et al* 2012) or other observations (pers comm. Craig Eddie, Boobook Consulting).

This species tolerates relatively simple habitat structure (ie grasslands and cleared paddocks) where shelter and frogs are present (Curtis *et al* 2012).

13.2.4 Biology and reproduction

This species is nocturnal and feeds almost exclusively on frogs. The species is more active during the summer months, but may be encountered throughout the year. Activity peaks generally correlate to heavy rains when frogs congregate to breed, and later when young frog emerge (Curtis *et al* 2012).

The Ornamental snake is a live-bearing species with an average of three to 11 young per litter produced between September to November (Cogger 2000; Curtis *et al* 2012).

13.3 Habitat

The species is associated with moist or ephemeral areas (eg floodplains, clay pans and water bodies), with appropriate resources in the form of shelter (eg fallen timber, deep cracking soils) and prey species (ie frogs) (Curtis *et al* 2012).

This species is known only within the Fitzroy and Dawson River drainage systems in the Brigalow Belt region of Queensland where it has been found to be most abundant in heavily gilgaied (melonhole) Brigalow (DSEWPaC 2012h). However, this species is also known from habitats without Brigalow.

This species tolerates relatively simple habitat structure (ie grasslands and cleared paddocks) and as such may be encountered within unmapped sections of project footprint

where shelter and frogs are present (Curtis *et al* 2012). During dry periods, the species seeks refuge within soil cracks on gilgai mounds (DSEWPaC 2012h).

Important microhabitats for this species are likely to include cracking soils and ground cover (including perennial grass clumps, leaf litter, rocks, fallen timber etc) (Richardson 2006).

Photo of habitat example (Source: Wain 2012)

13.4 Habitat assessment

Information obtained from BPA (ie Brigalow Belt South Fauna Expert Panel Report (EPA 2006)), together with expert advice, site based species records and pre-clearance survey data have been used to define a set of assumptions that have been used to identify areas of habitat that are consistent with the definitions of 'core habitat', 'essential habitat' and 'general habitat' that have been presented in Part 1 of this SSMP.

13.4.1 Core habitat

'Core habitat' consists of 'essential habitat' in which the species is known and the habitat is recognised under relevant recovery plans or other relevant plans/policies/regulations. Also included within this category are populations that are limited geographically within the region.

For the Ornamental snake, all REs that have been identified by DotE to support the species (primary habitat areas), which overlap with areas identified in the BPA mapping that have been identified as containing a 'State' or 'Regional' 'Corridor' (J-Rating) and/or 'Core Habitat' (H-Rating) and/or 'Habitat for EVR Taxa' (A-Rating) have been mapped as 'core habitat'.

No individuals of this species have been identified within the general vicinity of KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 of the GTP; therefore no 'core habitat' exists within these sections of the GTP.

13.4.2 Essential habitat

'Essential habitat' is an area containing resources that are considered essential for the maintenance of populations of the species (eg potential habitat for breeding, roosting, foraging, shelter, for either migratory or non-migratory species). 'Essential habitat' is defined from known records and/or expert advice (including the findings of pre-clearance surveys).

For the Ornamental snake, there have been no confirmed records for this species within KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 of the GTP as a result of pre-clearance surveys. Pre-clearance surveys did not identify 'essential habitat' for this species within these sections of the ROW and ancillary work areas. Therefore, no 'essential habitat' is present within the GTP footprint.

13.4.3 General habitat

'General habitat' consists of areas or locations that are used by transient individuals or where species may have been recorded but where there is insufficient information to assess the area as essential/core habitat. 'General habitat' also includes areas defined from known records or habitat that is considered to potentially support a species according to expert knowledge of habitat relationships, despite the absence of specimen backed records. 'General habitat' may include areas of suboptimal habitat for species. As potential habitat for many species contained within this SSMP may include most of the regional ecosystems of the Brigalow Belt Bioregion, the 'general habitat' category restricts the habitat to a more limited and realistic set of environmental parameters that are supported by literature and field based observation.For the Ornamental snake, all areas that contain REs that have been identified by DSEWPaC (2012l) as containing habitat suitable for the occurrence of Ornamental snake are included within the 'general habitat' category.

KP0 to KP30

The location of the 'general habitat' for this species within KP0 to KP30 is shown in Figure 13.2a.

KP30 to KP40

KP30 to KP35.2 has been identified during the pre-clearance surveys as meeting the criteria of 'general habitat' for this species.

The location of the 'general habitat' for this species within KP0 to KP30 is shown in Figure 13.2b.

KP40 to KP130

The location of the 'general habitat' for this species within KP40 to KP130 is shown in Figure 13.2c.

KP130 to KP312

KP183.75 to KP184.25, KP188.25, KP252.25 to KP253, Sellheim Creek area (KP280 to KP280.5) and Kroombit Creek area (KP295.5) has been identified during the pre-clearance surveys as meeting the criteria of 'general habitat' for this species (Santos GLNG 2012).

The location of the 'general habitat' for this species within KP130 to KP312 is shown in Figure 13.2d and Figure 13.2e.

KP312 to KP408.81

No 'general habitat' for this species exists in this section of the GTP.

KP408.81 to KP409.04

No 'general habitat' for this species exists in this section of the GTP.

KP413.57 to KP419.69

Pre-clearance surveys did not identify 'general habitat' for this species within this section of the GTP.

13.4.4 Unlikely habitat

'Unlikely habitat' areas are those areas that do not contain records of the particular species and do not contain sufficient habitat features to support the species (ie areas that do not meet the habitat assumptions identified above).

13.5 Anticipated threats and potential impacts as a result of the GTP

- Loss, fragmentation and degradation of 'general habitat'
- Removal and destruction of key microhabitats, including potential breeding places
- The potential proliferation of Cane toads in some areas as a result construction disturbance creating habitat which may favour Cane toad reproduction
- Changes to local hydrology impacting on pooling and frog assemblages
- Changes to foraging behaviour due to artificial lighting
- Entrapment in trenches and other excavations
- Mortality due to equipment and vehicle movement

13.6 Unavoidable impact and unavoidable adverse (offsetable) impact from GTP

Areas of proposed disturbance and areas of adverse (offsetable) impact associated with clearing and construction activities for the GTP between KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 for the Ornamental snake are presented in Table 13.1. The location of the 'general habitat' for this species is shown in Figure 13.2a, Figure 13.2b, Figure 13.2c, Figure 13.2d and Figure 13.2e.

The proposed clearing of habitat for the Ornamental snake and the cumulative total of unavoidable adverse (offsetable) impact to the species habitat is provided in Table 13.1.

Table 13.1 Cumulative total of Ornamental snake habitat to be cleared and area of habitat subject to unavoidable adverse (offsetable) impacts from the GTP

Location	'General habitat'	Total habitat area per GTP section	Total habitat area adversely impacted per GTP section
KP0 to KP30	0.93 ha	0.93 ha	0.93 ha
KP30 to KP40	16.12 ha	16.12 ha	15.52 ha
KP40 to KP130	0.01 ha	0.01 ha	0 ha
KP130 to KP312	9.16 ha	9.16 ha	9.01 ha
KP312 to KP408.81	0 ha	0 ha	0 ha
KP408.81 to KP409.04	0 ha	0 ha	0 ha
KP413.57 to KP419.69	0 ha	0 ha	0 ha
Total habitat area	**26.22 ha**	**26.22 ha**	**25.46 ha**

13.7 Management practices and methods

13.7.1 Pre-construction mitigation measures

Measures to avoid impact

- All reasonable and practical measures will be taken to locate site offices, construction camps, stockpiling/lay down areas and plant and equipment storage areas (including heavy machinery) on existing cleared lands
- Where the Ornamental snake and its breeding site is located within or within close proximity to the GTP footprint and ancillary work areas, the location will be recorded and checked again for activity prior to construction clearing. All practical and reasonable steps must be taken to avoid disturbing these sites including the investigation of alternative construction measures near known habitats. The establishment of 50 m buffer around breeding site(s) may also be applied
- Where practically feasible, efforts should be made to co-locate the pipeline adjacent to existing. Cleared areas to minimise fragmentation and reduction of core habitat within remnant communities

Measures to minimise impacts

- Pre-clearing ecological surveys have been undertaken by a suitably qualified Ecologist(s) in accordance with the Survey Guidelines for Australia's Threatened Reptiles
- Prior to the commencement of construction clearing, the limits of clearing will be clearly marked out by a suitably qualified and experienced EO. Barricade webbing or similar should be used for 'No Go' zones
- Wherever practicable, signage will be erected to increase awareness of these snakes and their habitat in the area
- Prior to site entry, all site personnel will be appropriately trained and made aware of the sensitive environs in which they will be working (refer Part 1, Section 7.7)

13.7.2 Construction phase mitigation measures

Measures to avoid impact

- Vehicle and pedestrian access to and from the GTP footprint will be restricted to the defined access tracks
- The limits of clearing will be clearly marked out by a suitably qualified and experienced EO. Barricade webbing or similar will be present highlighting all temporary and permanent 'No Go' zones relevant to the Ornamental snake

Measures to minimise impacts

- All site personnel will be educated in not harming any animals, including snakes. All native animals are protected under legislation and it is illegal to harm them
- All vegetation clearing and/or construction activities within known Ornamental snake habitat will comply with the clearing approval conditions (eg EPBC Act, EP Act, NC Act and other statutory approvals) and be supervised by the relevant EO
- Implement the Fauna Handling Procedures (refer Appendix C)

- Areas of reptile habitat (ie rock features, areas with coarse woody debris) will be subject to mild active disturbance by the fauna handler prior to clearing, to encourage natural relocation of resident fauna
- Clearing will be conducted in a sequential manner and in a way that directs escaping wildlife away from the clearing activities and into adjacent natural areas
- Areas of reptile habitat (eg logs, rocks) that require removal will be relocated as soon as practical to adjacent habitat areas
- Clearing activities will be restricted to the maximum disturbance limits authorised for the GTP footprint activities. This will include reducing the ROW width to 30 m in known habitat for the Ornamental snake. Key locations include Brigalow and Coolibah woodlands
- All clearing activities within identified sensitive areas will be supervised by the relevant EO
- Surveillance of the open trench in all areas and the removal of wildlife from the trench by appropriately trained personnel (the whole trench will be checked at least twice a day (early morning/late afternoon)
- The spotter catcher(s) will have access to the site (particularly the open trench) during all weather conditions to check for trapped fauna
- Measures will be adopted to prevent fauna entrapment within the pipeline trench, such as:
  - Minimising the period of time the trench is open, particularly in ‘core habitat’ and ‘essential habitat’ areas
  - Constructing ramps with a non-slip surface with slopes less than 45° to provide exit ramps for fauna at intervals no greater than 500 m
  - Trench plugs shall be installed in open trenches. These will be provided as a minimum every 500 m
  - Installing additional ramps at greater than normal frequencies (500 m) in areas identified as known or high value habitat
  - Branches, hessian sacks, ramped gangplanks or similar to be used to create ‘ladders’ to enable fauna to exit the trench. These structures will be placed every 250 to 500 m, depending on the surrounding landscapes
- Direct temporary lighting away from light-sensitive areas such as roost areas. Light shades and low lighting will be applied to construction and operational areas located adjacent to remnant native vegetation and other environmentally sensitive areas
- Prior to backfilling, the spotter catcher(s) will check the open trench in all areas for trapped fauna and where required move them to a safe location away from the trench. This may include disturbing the top layer of soil to ensure no reptiles are camouflaged under the soil
- Cleared vegetation will be stick raked into piles to provide fauna habitat
- Minimise the double handling of stockpiled vegetation and rocky areas as cleared vegetation is likely to be used by native fauna, especially if not used for an extended period
- The construction phase component of the LRMP will be implemented

- Weather permitting, rehabilitation of all areas identified will commence immediately after the pipeline has been lowered in and backfilled (refer LRMP). With the exception of operational constraints, revegetation will be consistent with the plant density, floristic composition and distribution of the adjacent communities (particularly ground cover). Rehabilitation will also incorporate the re-establishment of Ornamental snake habitat and landscape connectivity within 'core habitat' and 'essential habitat' areas

13.7.3 Operational phase mitigation measures

Measures to avoid impact

- Vehicle and pedestrian access within the GTP footprint will be restricted to the defined access tracks

Measures to minimise impacts

- Implementation of the Fauna Handling Procedures (refer Appendix C)
- Appropriate maintenance measures will be adopted along the GTP ROW to minimise potential risk to recolonising species. This includes ensuring that appropriate fire regimes are adopted (where necessary) as well as minimising the disturbance to rocky outcrops, woody debris and rehabilitating vegetation
- The operational phase component of the LRMP will be implemented to encourage the re-establishment of ecological communities impacted as a result of construction works. In particular, associated habitat areas for the Ornamental snake
- The PWMP will be implemented to minimise the risk of weed and pest animal establishment within known and/or potential Ornamental snake habitat
- A reasonable effort will be made to work with the landowner to exclude stock from known habitat locations within and adjacent the GTP ROW

13.7.4 Decommissioning phase mitigation measures

Measures to minimise impacts

- Implementation of the Fauna Handling Procedures (refer Appendix C)
- A decommissioning plan will be developed by GLNG and provided for approval. The plan will aim to address the requirements of AS2885 and also to ensure environmental harm is avoided, including:
  - The Project area no longer contains hazardous contaminants and is in stable condition
  - All above ground infrastructure is removed
  - All areas disturbed by above ground infrastructure are rehabilitated in accordance with the relevant conditions
- For a minimum of five years after the completion of rehabilitation, rehabilitated areas will be monitored on a yearly basis
- The monitoring programme will include:

- Methods to measure subsidence and erosion rates at rehabilitated buried transmission pipeline corridors and buried flow lines
- BioCondition assessment in accordance with the Biocondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland: Assessment Manual: Version 2.1 (Eyre *et al* 2011)
- Monitoring of indicators identified in the LRMP at analogue sites to measure progressive and final rehabilitation success relevant to the final land use(s)
- Frequency and seasonality of monitoring analogue sites and rehabilitated areas to assess rehabilitation success
- Identification of the experimental design for analysing analogue and rehabilitated site data including statistical methods of analyses

14 Dunmall's snake

14.1 EPBC Act legal status

Vulnerable - listed 16 July 2000

14.2 Biology and ecology

14.2.1 Characteristics

Dunmall's snake (*Furina dunmalli*) is a venomous snake that belongs to the Elapidae family. Dunmall's snake is found only in Australia (Cogger 2000; Ehmann 1992).

Dunmall's snake has a uniform dark grey-brown colour above that fades to white at the lower flanks. The scales are smooth and light edged, with most of the scales near the upper lip having pale blotches (Cogger 2000; Ehmann 1992). The snake is small to medium sized, growing to a length to 60 cm. The head is large and distinct from the neck (Cogger 2000; Ehmann 1992).

Observations of a captive specimen suggest it is nocturnal, docile and terrestrial. It appears to favour dark places (Queensland CRA/RFA Steering Committee 1997).

Dunmall's snake (Source: Boobook Consulting 2011)

14.2.2 Known distribution

Given the rarity and difficulty of detecting this declining species, all suitable habitats (remnant or non-remnant vegetation) that are coincident with the known locations of the species are considered important habitats (DSEWPaC 2012i). Similarly, any suitable remnant vegetation or vegetation corridors within the range of Dunmall's snake is considered important habitat for the species (Brigalow Belt Reptiles Workshop 2010).

Whilst Dunmall's snake has been recorded in Expedition National Park and Lake Broadwater Conservation Park, the species is not actively managed in these reserves (Cogger *et al* 1993; Covacevich *et al* 1996; Covacevich *et al* 1988; McDonald *et al* 1991).

The distribution of Dunmall's snake extends from near the Queensland border throughout the Brigalow Belt South and Nandewar bioregions, as far south as Ashford in New South Wales (NSW) (DSEWPaC 2012i).

Figure 14.1 is an indicative distribution map of the present distribution of Dunmall's snake.

Dunmall's snake occurs primarily in the Brigalow Belt region in the south-eastern interior of Queensland. Records indicate sites at elevations between 200 to 500 m above sea level. The snake is very rare or secretive with limited records existing (DSEWPaC 2012i). It has been recorded at Archokoora, Oakey, Miles, Glenmorgan, Wallaville, Gladstone, Lake Broadwater, Mount Archer, Exhibition Range National Park, roadside reserves between Inglewood and Texas, Rosedale, Yeppoon and Lake Broadwater Conservation Park (Cogger *et al* 1993; Covacevich *et al* 1988; Covacevich *et al* 1996; McDonald *et al* 1991).

The distribution of Dunmall's snake is highly fragmented due to cropping and grazing, especially in the Darling Downs. As a result, the species has declined dramatically and is considered to be of particular conservation significance (Covacevich 1995).

Figure 14.1 Distribution range of Dunmall's snake (Source: DSEWPaC 2012i)

14.2.3 Known species populations and their relationship with the GTP footprint

Based on the modelled distribution range for this species (DSEWPaC 2011a), the Dunmall's snake was not likely to occur within the GTP ROW between KP0 to KP30 (Ecologica Consulting 2012).

However, during the 2011 survey period, a Dunmall's snake was encountered during nocturnal searches outside the KP0 to KP30 section (Ecologica Consulting 2012)

This species is highly cryptic and is likely to occur in other sections of the GTP ROW, with suitable habitat being forests to woodlands within the range of the species especially where microhabitats are present (eg cracking soils and ground cover (including perennial grass clumps, leaf litter, rocks, fallen timber etc)). Based on habitat assessments, this includes areas in the vicinity of (Ecologica Consulting 2012):

- KP5 to KP6.5
- KP8
- KP9
- KP22

- KP33 to KP35

Suitable habitat for this species has also been identified within Larcom Range at KP400.3, KP401.3 and KP414.3 (Curtis Island) during pre-clearance surveys (Santos GLNG 2013 & 2013b).

14.2.4 Biology and reproduction

The diet of Dunmall's snake consists of small skinks and geckos. Specific studies have found the gut contents of one specimen containing the remains of the Tree skink, *Egernia striolata* (Shine 1981).

Little is known about the life cycle or reproduction behaviour of Dunmall's snake (Queensland CRA/RFA Steering Committee 1997). While there is no information on the breeding season or clutch size of the species (Forests Taskforce 1997), it is known that the species lays eggs rather than live young (Threatened Species Network (TSN) 2008).

14.3 Habitat

Dunmall's snake has been found in a broad range of habitats, including:

- Forests and woodlands on black alluvial cracking clay and clay loams dominated by Brigalow (*Acacia harpophylla*), other Wattles (*Acacia burowii, Acacia deanii, Acacia leioclyx*), native Cypress (*Callitris* spp.) or Bull-oak (*Allocasuarina luehmannii*) (Brigalow Belt Reptiles Workshop 2010; Covacevich *et al* 1988; Stephenson & Schmida 2008)
- Various Blue spotted gum (*Corymbia citriodora*), Ironbark (*Eucalyptus crebra and Eucalyptus melanophloia*), White cypress pine (*Callitris glaucophylla*) and Bull-oak open forest and woodland associations on sandstone derived soils (Brigalow Belt Reptiles Workshop 2010; Stephenson & Schmida 2008; TSN 2008)

In other environments, one specimen was found on the edge of dry vine scrub near Tarong Power Station, Queensland, whilst another was found in hard ironstone country (Queensland Regional Ecosystem Land Zone 7) at Lake Broadwater near Dalby, Queensland (DSEWPaC 2012i).

Little is known about the ecological requirements of Dunmall's snake, however, the species has been found sheltering under fallen timber and ground litter (Brigalow Belt Reptiles Workshop 2010, Cogger *et al* 1993) and may use cracks in alluvial clay soils (DERM 2010b; Richardson 2006).

Records indicate the species prefers habitats between 200 to 500 m above sea level (DSEWPaC 2012i).

14.4 Habitat assessment

Information obtained from BPA (ie Brigalow Belt South Fauna Expert Panel Report (EPA 2006)), together with expert advice, site based species records and pre-clearance survey data have been used to define a set of assumptions that have been used to identify areas of habitat that are consistent with the definitions of ‘core habitat’, ‘essential habitat’ and ‘general habitat’ that have been presented in Part 1 of this SSMP. The habitat assumptions for Dunmall’s snake are presented below.

14.4.1 General assumptions

The following general habitat assumptions have been made based on current scientific knowledge of this species:

- Forests and woodlands on black alluvial cracking clay (ie Land zones 3 and 8) and clay loams (ie Land zone 4) dominated by Brigalow (*Acacia harpophylla*), other Wattles (*Acacia burrowii, Acacia deanei, Acacia leiocalyx*), native Cypress (*Callitris* spp.) or Bull-oak (*Allocasuarina luehmannii*) (Brigalow Belt Reptiles Workshop 2010; Covacevich *et al* 1988; Stephenson & Schmida 2008)
- Various Spotted gum (*Corymbia citriodora*), Ironbark (*Eucalyptus crebra* and *Eucalyptus melanophloia*), White cypress pine (*Callitris glaucophylla*) and Bull-oak open forest and woodland associations on sandstone derived soils (Brigalow Belt Reptiles Workshop 2010; Stephenson & Schmida 2008; Threatened Species Network 2008)

14.4.2 Core habitat

'Core habitat' consists of 'essential habitat' in which the species is known and the habitat is recognised under relevant recovery plans or other relevant plans/policies/regulations. Also included within this category are populations that are limited geographically within the region.

For Dunmall's snake, all REs that contain a specimen backed record (from any data source), which overlap with areas identified in the BPA mapping that have been identified as containing a 'State' or 'Regional' 'Corridor' (J-Rating) and/or 'Core Habitat' (H-Rating) and/or 'Habitat for EVR Taxa' (A-Rating) have been mapped as 'core habitat'.

KP0 to KP30

No individuals of this species have been identified within the general vicinity of KP0 to KP30; therefore no 'core habitat' exists within this section of the GTP.

KP30 to KP40

An individual of this species has been identified at KP34.71 of the GTP ROW, and as this area meets the criteria outlined above, 'core habitat' exists within this section of the GTP.

The location of the 'core habitat' for this species within KP30 to KP40 is shown in Figure 14.2b.

KP40 to KP130

No individuals of this species have been identified within the general vicinity of KP40 to KP130; therefore no 'core habitat' exists within this section of the GTP.

KP130 to KP312

No individuals of this species have been identified within the general vicinity of KP130 to KP312; therefore no 'core habitat' exists within this section of the GTP.

KP312 to KP408.81

No individuals of this species have been identified within the general vicinity of KP312 to KP408.81; therefore no 'core habitat' exists within this section of the GTP.

KP408.81 to KP409.04

No individuals of this species have been identified within the general vicinity of KP408.81 to KP409.04; therefore no 'core habitat' exists within this section of the GTP.

KP413.57 to KP419.69

No individuals of this species have been identified within the general vicinity of KP413.57 to KP419.69; therefore no 'core habitat' exists within this section of the GTP.

14.4.3 Essential habitat

'Essential habitat' is an area containing resources that are considered essential for the maintenance of populations of the species (eg potential habitat for breeding, roosting, foraging, shelter, for either migratory or non-migratory species). 'Essential habitat' is defined from known records and/or expert advice (including the findings of pre-clearance surveys).

KP0 to KP30

No individuals of this species have been identified within the general vicinity of KP0 to KP30; therefore no 'essential habitat' exists within this section of the GTP.

KP30 to KP40

As an individual of this species has been identified within KP30 to KP40 of the GTP ROW, but this area meets the criteria to be included as 'core habitat', no 'essential habitat' has been mapped within this section of the GTP.

KP40 to KP130

No individuals of this species have been identified within the general vicinity of KP40 to KP130; therefore no 'essential habitat' exists within this section of the GTP.

KP130 to KP312

No individuals of this species have been identified within the general vicinity of KP130 to KP312; therefore no 'essential habitat' exists within this section of the GTP.

KP312 to KP408.81

No individuals of this species have been identified within the general vicinity of KP312 to KP408.81; therefore no 'essential habitat' exists within this section of the GTP.

KP408.81 to KP409.04

No individuals of this species have been identified within the general vicinity of KP408.81 to KP409.04; therefore no 'essential habitat' exists within this section of the GTP.

KP413.57 to KP419.69

No individuals of this species have been identified within the general vicinity of KP413.57 to KP419.69; therefore no 'essential habitat' exists within this section of the GTP.

14.4.4 General habitat

'General habitat' consists of areas or locations that are used by transient individuals or where species may have been recorded but where there is insufficient information to assess the area as essential/core habitat. 'General habitat' also includes areas defined from known

records or habitat that is considered to potentially support a species according to expert knowledge of habitat relationships, despite the absence of specimen backed records. 'General habitat' may include areas of suboptimal habitat for species. As potential habitat for many species contained within this SSMP may include most of the regional ecosystems of the Brigalow Belt Bioregion, the 'general habitat' category restricts the habitat to a more limited and realistic set of environmental parameters that are supported by literature and field based observation.

For Dunmall's snake, all areas that do not contain a specimen backed record, and do not fulfil the requirements of 'core' and 'essential habitat' are considered to be 'general habitat'. These include areas noted as potential habitat within the pre-clearance survey.

KP0 to KP30

Figure 14.2a shows the location of 'general habitat' for Dunmall's snake within this section of the GTP.

KP30 to KP40

Figure 14.2b shows the location of 'general habitat' for Dunmall's snake within this section of the GTP.

KP40 to KP130

No 'general habitat' for this species exists in this section of the GTP.

KP130 to KP312

KP184, KP223.25 to KP224.25, Dawson River area (KP233 to KP235), KP249.5 to KP252, Sellheim Creek area (KP280 to KP280.5) and a small patch of vegetation at KP297.5 has been identified during the pre-clearance surveys as meeting the criteria of 'general habitat' for this species (Santos GLNG 2012).

Figure 14.2c and Figure 14.2d shows the location of 'general habitat' for Dunmall's snake within this section of the GTP.

KP312 to KP408.81

Pre-clearance surveys identified habitat for this species within Larcom Range at KP400.3 and KP401.2 (Santos GLNG 2013).

Figure 14.2e and Figure 14.2f shows the location of 'general habitat' for Dunmall's snake within this section of the GTP.

KP408.81 to KP409.04

No 'general habitat' for this species exists in this section of the GTP.

KP413.57 to KP419.69

Pre-clearance surveys have identified 'general habitat' at KP414.3 on Curtis Island for this species.

Figure 14.2g shows the location of 'general habitat' for Dunmall's snake within this section of the GTP.

14.4.5 Unlikely habitat

'Unlikely habitat' areas are those areas that do not contain records of the particular species and do not contain habitat features to support the species (ie areas that do not meet the habitat assumptions identified above).

14.5 Anticipated threats and potential impacts as a result of the GTP

- Loss, fragmentation and degradation of 'general habitat'
- Removal and destruction of key microhabitats, including potential breeding places
- Changes to foraging behaviour due to artificial lighting
- Entrapment in trenches and other excavations
- Mortality due to equipment and vehicle movement

14.6 Unavoidable impact and unavoidable adverse (offsetable) impact from GTP

Areas of proposed disturbance and areas of adverse (offsetable) impact associated with clearing and construction activities for the GTP between KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 for Dunmall's snake are presented in Table 14.1. It is important to note that this unavoidable impact is considered minor and temporary in the context of the wide spread extent of 'general habitat' in the region. The location of this habitat is shown in Figure 14.2a, Figure 14.2b, Figure 14.2c, Figure 14.2d, Figure 14.2e, Figure 14.2f and Figure 14.2g.

A cumulative total of proposed clearing of habitat for the Dunmall's snake and the cumulative total of unavoidable adverse (offsetable) impact to the species habitat is provided in Table 14.1.

Table 14.1 Cumulative total of Dunmall's snake habitat to be cleared and area of habitat subject to unavoidable adverse (offsetable) impacts from the GTP

Location	'General habitat'	'Core habitat'	Total habitat area per GTP section	Total habitat area adversely impacted per GTP section
KP0 to KP30	28.65 ha	0 ha	28.65 ha	28.65 ha
KP30 to KP40	9.32 ha	2.89 ha	12.21 ha	12.21 ha
KP40 to KP130	0 ha	0 ha	0 ha	0 ha
KP130 to KP312	52.53 ha	0 ha	52.53 ha	36.14 ha
KP312 to KP408.81	2.36 ha	0 ha	2.36 ha	2.36 ha
KP408.81 to KP409.04	0 ha	0 ha	0 ha	0 ha
KP413.57 to KP419.69	0.42 ha	0 ha	0.42 ha	0.42 ha
Total habitat area	**93.28 ha**	**2.89 ha**	**96.17 ha**	**79.78 ha**

14.7 Management practices and methods

14.7.1 Pre-construction mitigation measures

Measures to avoid impact

- All reasonable and practical measures will be taken to locate site offices, construction camps, stockpiling/lay down areas and plant and equipment storage areas (including heavy machinery) on existing cleared lands
- Where Dunmall's snake and its breeding site is located within or within close proximity to the GTP footprint and ancillary work areas, the location will be recorded and checked again for activity prior to construction clearing. All practical and reasonable steps must be taken to avoid disturbing these sites including the investigation of alternative construction measures near known habitats. The establishment of 50 m buffer around breeding site(s) may also be applied
- Where practically feasible, efforts should be made to co-locate the pipeline adjacent to existing. Cleared areas to minimise fragmentation and reduction of core habitat within remnant communities

Measures to minimise impacts

- Pre-clearing ecological surveys have been undertaken by a suitably qualified Ecologist(s) in accordance with the Survey Guidelines for Australia's Threatened Reptiles
- Prior to the commencement of construction clearing, the limits of clearing will be clearly marked out by a suitably qualified and experienced EO. Barricade webbing or similar should be used for 'No Go' zones
- Wherever practicable, signage will be erected to increase awareness of these snakes and their habitat in the area
- Prior to site entry, all site personnel will be appropriately trained and made aware of the sensitive environs in which they will be working (refer Part 1, Section 7.7)

14.7.2 Construction phase mitigation measures

Measures to avoid impact

- Vehicle and pedestrian access to and from the GTP footprint will be restricted to the defined access tracks
- The limits of clearing will be clearly marked out by a suitably qualified and experienced EO. Barricade webbing or similar will be present highlighting all temporary and permanent 'No Go' zones relevant to Dunmall's snake

Measures to minimise impacts

- All site personnel will be educated in not harming any animals. All native animals are protected under legislation and it is illegal to harm them
- All vegetation clearing and/or construction activities within known Dunmall's snake habitat will comply with the clearing approval conditions (eg EPBC Act, EP Act, NC Act and other statutory approvals) and be supervised by the relevant EO

- Implement the Fauna Handling Procedures (refer Appendix C)
- Areas of reptile habitat (ie rock features, areas with coarse woody debris) will be subject to mild active disturbance by the fauna handler prior to clearing, to encourage natural relocation of resident fauna
- Clearing will be conducted in a sequential manner and in a way that directs escaping wildlife away from the clearing activities and into adjacent natural areas
- Areas of reptile habitat (eg logs, rocks) that require removal will be relocated as soon as practical to adjacent habitat areas
- Clearing activities will be restricted to the maximum disturbance limits authorised for the GTP footprint activities. This will include reducing the ROW width to 30 m in known habitat for Dunmall's snake
- All clearing activities within identified sensitive areas will be supervised by the relevant EO
- Surveillance of the open trench in all areas and the removal of wildlife from the trench by appropriately trained personnel (the whole trench will be checked at least twice a day (early morning/late afternoon)
- The spotter catcher(s) will have access to the site (particularly the open trench) during all weather conditions to check for trapped fauna
- Measures will be adopted to prevent fauna entrapment within the pipeline trench, such as:
  - Minimising the period of time the trench is open, particularly in 'core habitat' and 'essential habitat' areas
  - Constructing ramps with a non-slip surface with slopes less than 45° to provide exit ramps for fauna at intervals no greater than 500 m
  - Trench plugs shall be installed in open trenches. These will be provided as a minimum every 500 m
  - Installing additional ramps at greater than normal frequencies (500 m) in areas identified as known or high value habitat
  - Branches, hessian sacks, ramped gangplanks or similar to be used to create 'ladders' to enable fauna to exit the trench. These structures will be placed every 250 to 500 m, depending on the surrounding landscapes
- Direct temporary lighting away from light-sensitive areas such as roost areas. Light shades and low lighting will be applied to construction and operational areas located adjacent to remnant native vegetation and other environmentally sensitive areas
- Prior to backfilling, the spotter catcher(s) will check the open trench in all areas for trapped fauna and where required move them to a safe location away from the trench. This may include disturbing the top layer of soil to ensure no reptiles are camouflaged under the soil
- Cleared vegetation will be stick raked into piles to provide fauna habitat
- Minimise the double handling of stockpiled vegetation and rocky areas as cleared vegetation is likely to be used by native fauna, especially if not used for an extended period
- The construction phase component of the LRMP will be implemented

- Weather permitting, rehabilitation of all areas identified will commence immediately after the pipeline has been lowered in and backfilled (refer LRMP). With the exception of operational constraints, revegetation will be consistent with the plant density, floristic composition and distribution of the adjacent communities (particularly ground cover). Rehabilitation will also incorporate the re-establishment of Dunmall's snake habitat and landscape connectivity within 'core habitat' and 'essential habitat' areas

14.7.3 Operational phase mitigation measures

Measures to avoid impact

- Vehicle and pedestrian access within the GTP footprint will be restricted to the defined access tracks

Measures to minimise impacts

- Implementation of the Fauna Handling Procedures (refer Appendix C)
- Appropriate maintenance measures will be adopted along the GTP ROW to minimise potential risk to recolonising species. This includes ensuring that appropriate fire regimes are adopted (where necessary) as well as minimising the disturbance to rocky outcrops, woody debris and rehabilitating vegetation
- The operational phase component of the LRMP will be implemented to encourage the re-establishment of ecological communities impacted as a result of construction works. In particular, associated habitat areas for Dunmall's snake

The PWMP will be implemented to minimise the risk of weed and pest animal establishment within known and/or potential Dunmall's snake habitat

14.7.4 Decommissioning phase mitigation measures

Measures to minimise impacts

- Implementation of the Fauna Handling Procedures (refer Appendix C)
- A decommissioning plan will be developed by GLNG and provided for approval. The plan will aim to address the requirements of AS2885 and also to ensure environmental harm is avoided, including:
  - The project area no longer contains hazardous contaminants and is in stable condition
  - All above ground infrastructure is removed
  - All areas disturbed by above ground infrastructure are rehabilitated in accordance with the relevant conditions
- For a minimum of five years after the completion of rehabilitation, rehabilitated areas will be monitored on a yearly basis
- The monitoring programme will include:
  - Methods to measure subsidence and erosion rates at rehabilitated buried transmission pipeline corridors and buried flow lines

- BioCondition assessment in accordance with the BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland: Assessment Manual: Version 2.1 (Eyre *et al* 2011)
- Monitoring of indicators identified in the LRMP at analogue sites to measure progressive and final rehabilitation success relevant to the final land use(s)
- Frequency and seasonality of monitoring analogue sites and rehabilitated areas to assess rehabilitation success
- Identification of the experimental design for analysing analogue and rehabilitated site data including statistical methods of analyses

15 Yakka skink

15.1 EPBC Act legal status

Vulnerable - listed 16 July 2000

15.2 Biology and ecology

15.2.1 Characteristics

The Yakka skink (*Egernia rugosa*) is a large, robustly built skink with a notably thick tail and grows to a total length of about 40 cm with short legs and claws. A broad, dark brown to black stripe extends along the back from the nape to the tail. Individual scales within this stripe can be variegated with dark and medium brown. This dark stripe is bordered on either side by a narrow, pale fawn stripe. The upper lips are whitish to reddish brown, contrasting with darker adjacent scales. The belly and ventral surfaces are cream to yellowish orange and the throat often with blackish flecks. Scales are in 26 to 30 rows at mid-body (Cogger 2000; DEHP 2012b; Richardson 2006).

Yakka skink (Source: DSEWPaC 2008)

15.2.2 Known distribution

Important Yakka skink populations occur where colonies are identified or are within 5 km of known records of the species. Any contiguous patch of vegetation which is suitable for the long-term persistence of a population, or for maintaining genetic diversity across the landscape, is important habitat for the species (Brigalow Belt Reptiles Workshop 2010).

The distribution of the Yakka skink is highly fragmented and spans from the coast to the hinterland of sub-humid to semi-arid eastern Queensland. Included in this range are sections of the Brigalow Belt (North and South), Mulga Lands, South-east Queensland, Einasleigh Uplands, Wet Tropics and Cape York Peninsula Biogeographical Regions (DSEWPaC 2012i).

This species is known from Fairview and Arcadia CSG Fields and has been recorded from Arcadia Valley, Lonesome Holding and Mt. Hutton (DEHP 2012b; Queensland Museum 2011). The Yakka skink is also known from remnant vegetation communities which are contiguous with the communities within the gas fields, including Expedition National Park (URS 2009), unprotected lands near the Dawson Highway and Leichardt Highway junction, a number of unprotected areas in Arcadia Valley and also from the Burnett Highway to the north of Biloela (Richardson 2006).

Figure 15.1 is an indicative distribution map of the present distribution of the Yakka skink.

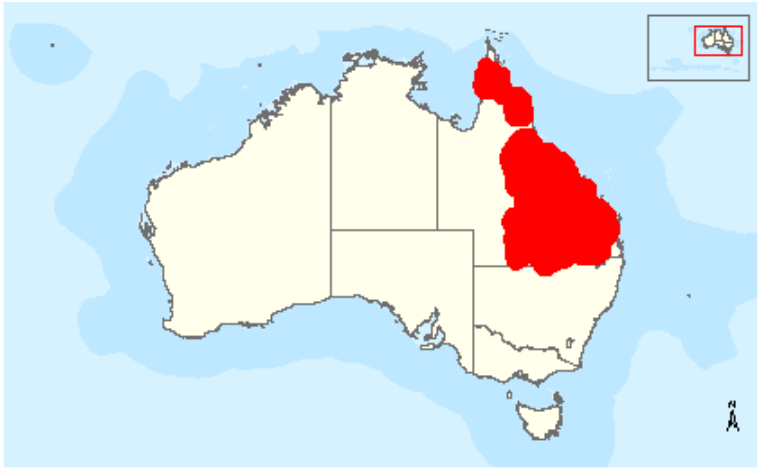


Figure 15.1 Distribution range of the Yakka skink (Source: DSEWPaC 2012j)

15.2.3 Known species populations and their relationship with the GTP footprint

No individuals or burrows were observed during the pre-clearance surveys however, this species is known from the local area, having been recorded from habitat contiguous with the area between KP28 and KP35 (DERM 2012). This record is from habitat contiguous with and similar to the habitat within the GTP ROW (Queensland Museum 2011).

Under the criteria for important habitats for Brigalow Belt reptiles (DSEWPaC 2011o), the area between KP28 and KP37 may be described as an important habitat for this species. That is:

- Any contiguous patch of suitable habitat, particularly remnant vegetation, where a colony is known or identified
- Any microhabitat where colonies are likely to be found

Suitable habitat may also include Hutton Creek, the area around KP1 and between KP4 and KP6.5 (Ecologica Consulting 2012).

Suitable habitat has also been identified within KP130 to KP312 and KP312 to KP408.81 (Santos GLNG 2012 & 2013)

15.2.4 Biology and reproduction

The Yakka skink is a gregarious terrestrial species which is active during the morning, and from dusk through the early evening. The colony/group consists of both adults and juveniles and a wide variety of body sizes (Curtis *et al* 2012; DSEWPaC 2012j).

The species is omnivorous feeding on plant material (including fruits) and a wide variety of invertebrates (eg beetles, grasshoppers and spiders). The species also uses a regular defecation site and is known to retreat quickly to shelter (Curtis *et al* 2012; DSEWPaC 2012j).

The species shows a high site-fidelity and limited capacity to disperse from a colony site (DSEWPaC 2012j).

The Yakka skink produces live young and rarely bears more than six per litter. The breeding season for this poorly known species has not been recorded (DEHP 2012b; Richardson 2006).

15.3 Habitat

Yakka skink habitat is amongst dense ground vegetation, fallen timber or rock outcrops in open dry sclerophyll forest (ironbark) or woodland, Brigalow forest, open shrub land, and lancewood forest on coarse gritty soils in the vicinity of low ranges, foothills and undulating terrain with good drainage (Cogger 2000; DEHP 2012b; Richardson 2006).

Important microhabitats for this species include rocky outcrops, hollow logs, animal burrows and ground cover (including perennial grass clumps, leaf litter, rocks, fallen timber etc) (Richardson 2006).

Colonies have been found in large hollow logs, cavities or burrows under large fallen trees, tree stumps, logs, stick-raked piles, large rocks and rock piles, dense ground-covering vegetation, and deeply eroded gullies, tunnels and sinkholes. However, the species is not generally found in trees or rocky habitats (DSEWPaC 2012j).

This species can occur in Brigalow communities as listed under the EPBC Act (DSEWPaC 2012j).

15.4 Habitat assessment

Information obtained from BPA (ie Brigalow Belt South Fauna Expert Panel Report (EPA 2006)), together with expert advice, site based species records and pre-clearance survey data have been used to define a set of assumptions that have been used to identify areas of habitat that are consistent with the definitions of ‘core habitat’, ‘essential habitat’ and ‘general habitat’ that have been presented in Part 1 of this SSMP. The Yakka skink habitat assumptions are presented below.

15.4.1 General assumptions

The following general habitat assumptions have been made based on current scientific knowledge of this species:

- The species has been observed to utilise the following six land zones: 3 - Alluvium (river and creek flats); 4 - Clay plains not associated with current alluvium; 5 - Old loamy and sandy plains; 7 - Ironstone jump-ups; 9 - Undulating country on fine-grained sedimentary rocks; and 10 - Sandstone ranges. (DSEWPaC 2012j)
- The species has been observed associating in habitats with the following flora species: Brigalow (*Acacia harpophylla*); Mulga (*Acacia aneura*); Bendee (*Acacia catenulata*); Lancewood (*Acacia shirleyi*); Belah (*Casuarina cristata*); Poplar box (*Eucalyptus populnea*); Ironbark (*Eucalyptus* spp.); and White cypress pine (*Callitris glaucophylla*) (DSEWPaC 2012j)

15.4.2 Core habitat

'Core habitat' consists of 'essential habitat' in which the species is known and the habitat is recognised under relevant recovery plans or other relevant plans/policies/regulations. Also included within this category are populations that are limited geographically within the region.

For the Yakka skink, all REs that contain a specimen backed record (from any data source), which overlap with areas identified in the BPA mapping that have been identified as containing a 'State' or 'Regional' 'Corridor' (J-Rating) and/or 'Core Habitat' (H-Rating) and/or 'Habitat for EVR Taxa' (A-Rating) have been mapped as 'core habitat'.

No individuals of this species have been identified within the general vicinity of KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 of the GTP, therefore no 'core habitat' exists within these sections of the GTP.

15.4.3 Essential habitat

'Essential habitat' is an area containing resources that are considered essential for the maintenance of populations of the species (eg potential habitat for breeding, roosting, foraging, shelter, for either migratory or non-migratory species). 'Essential habitat' is defined from known records and/or expert advice (including the findings of pre-clearance surveys).

For the Yakka skink, as no individuals or 'essential habitat' areas were identified during the pre-clearance surveys, no 'essential habitat' for this species is considered to occur within KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 of the GTP.

15.4.4 General habitat

'General habitat' consists of areas or locations that are used by transient individuals or where species may have been recorded but where there is insufficient information to assess the area as essential/core habitat. 'General habitat' also includes areas defined from known records or habitat that is considered to potentially support a species according to expert knowledge of habitat relationships, despite the absence of specimen backed records. 'General habitat' may include areas of suboptimal habitat for species. As potential habitat for many species contained within this SSMP may include most of the regional ecosystems of the Brigalow Belt Bioregion, the 'general habitat' category restricts the habitat to a more limited and realistic set of environmental parameters that are supported by literature and field based observation.

For the Yakka skink, all areas that do not contain a specimen backed record, and do not fulfil the requirements of 'core' and 'essential habitat' are considered to be 'general habitat'. Areas identified as potential habitat for this species in the pre-clearance survey have been included into this habitat category.

KP0 to KP30

Figure 15.2a shows the location of 'general habitat' for Yakka skink within this section of the GTP.

KP30 to KP40

KP30 to KP35.2 has been identified during the pre-clearance surveys as meeting the criteria of 'general habitat' for this species.

Figure 15.2b shows the location of 'general habitat' for Yakka skink within this section of the GTP.

KP40 to KP130

No 'general habitat' for this species exists in this section of the GTP.

KP130 to KP312

Dawson Range (KP223.2 to KP224.2), Sellheim Creek area (KP280 to KP280.5) and KP311.5 to KP312 has been identified during the pre-clearance surveys as meeting the criteria of 'general habitat' for this species (Santos GLNG 2012).

Figure 15.2c and Figure 15.2d shows the location of 'general habitat' for Yakka skink within this section of the GTP.

KP312 to KP408.81

Pre-clearance surveys identified 'general habitat' for this species within Larcom Range (KP400.3) and between KP405.5 and KP407.5 (Santos GLNG 2013).

Figure 15.2e and Figure 15.2f shows the location of 'general habitat' for Yakka skink within this section of the GTP.

KP408.81 to KP409.04

No 'general habitat' for this species exists in this section of the GTP.

KP413.57 to KP419.69

Pre-clearance surveys did not identify 'general habitat' for this species within this section of the GTP.

15.4.5 Unlikely habitat

'Unlikely habitat' areas are those areas that do not contain records of the particular species and do not contain habitat features to support the species (ie areas that do not meet the habitat assumptions identified above).

15.5 Anticipated threats and potential impacts as a result of the GTP

- Loss, fragmentation and degradation of 'general habitat'
- Removal and destruction of key microhabitats, including potential breeding places
- Changes to foraging behaviour due to artificial lighting, noise and movement
- Entrapment in trenches and other excavations
- Mortality due to equipment and vehicle movement

15.6 Unavoidable impact and unavoidable adverse (offsetable) impact from GTP

Areas of proposed disturbance and areas of adverse (offsetable) impact associated with clearing and construction activities for the GTP between KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 for the Yakka skink are presented in Table 15.1. It is important to note that this

unavoidable impact is considered minor and temporary in the context of the wide spread extent of 'general habitat' in the region. The location of this habitat is shown in Figure 15.2a, Figure 15.2b, Figure 15.2c, Figure 15.2d, Figure 15.2e and Figure 15.2f.

A cumulative total of proposed clearing of habitat for the Yakka skink and the cumulative total of unavoidable adverse (offsetable) impact to the species habitat is provided in Table 15.1.

Table 15.1 Cumulative total of Yakka skink habitat to be cleared and area of habitat subject to unavoidable adverse (offsetable) impacts from the GTP

Location	'General habitat'	Total habitat area per GTP section	Total habitat area adversely impacted per GTP section
KP0 to KP30	10.80 ha	10.80 ha	10.80 ha
KP30 to KP40	15.34 ha	15.34 ha	15.28 ha
KP40 to KP130	0 ha	0 ha	0 ha
KP130 to KP312	37.48 ha	37.48 ha	23.58 ha
KP312 to KP408.81	13.45 ha	13.45 ha	13.45 ha
KP408.81 to KP409.04	0 ha	0 ha	0.00 ha
KP413.57 to KP419.69	0 ha	0 ha	0.00 ha
Total habitat area	**77.07 ha**	**77.07 ha**	**63.11 ha**

15.7 Management practices and methods

15.7.1 Pre-construction mitigation measures

Measures to avoid impact

- All reasonable and practical measures will be taken to locate site offices, construction camps, stockpiling/lay down areas and plant and equipment storage areas (including heavy machinery) on existing cleared lands
- Where the Yakka skink and its breeding site is located within or within close proximity to the GTP footprint and ancillary work areas, the location will be recorded and checked again for activity prior to construction clearing. All practical and reasonable steps must be taken to avoid disturbing these sites including the investigation of alternative construction measures near known habitats. The establishment of 50 m buffer around breeding site(s) may also be applied
- Where practically feasible, efforts should be made to co-locate the pipeline adjacent to existing. Cleared areas to minimise fragmentation and reduction of core habitat within remnant communities

Measures to minimise impacts

- Pre-clearing ecological surveys have been undertaken by a suitably qualified Ecologist(s) in accordance with the Survey Guidelines for Australia's Threatened Reptiles
- Prior to the commencement of construction clearing, the limits of clearing will be clearly marked out by a suitably qualified and experienced EO. Barricade webbing or similar should be used for 'No Go' zones

- Wherever practicable, signage will be erected to increase awareness of this species and its habitat in the area
- Prior to site entry, all site personnel will be appropriately trained and made aware of the sensitive environs in which they will be working (refer Part 1, Section 7.7)

15.7.2 Construction phase mitigation measures

Measures to avoid impact

- Vehicle and pedestrian access to and from the GTP footprint will be restricted to the defined access tracks
- The limits of clearing will be clearly marked out by a suitably qualified and experienced EO. Barricade webbing or similar will be present highlighting all temporary and permanent 'No Go' zones relevant to the Yakka skink

Measures to minimise impacts

- All site personnel will be educated in not harming any animals. All native animals are protected under legislation and it is illegal to harm them
- All vegetation clearing and/or construction activities within known Yakka skink habitat will comply with the clearing approval conditions (eg EPBC Act, EP Act, NC Act and other statutory approvals) and be supervised by the relevant EO
- Implement the Fauna Handling Procedures (refer Appendix C)
- Areas of reptile habitat (ie rock features, areas with coarse woody debris) will be subject to mild active disturbance by the fauna handler prior to clearing, to encourage natural relocation of resident fauna
- Clearing will be conducted in a sequential manner and in a way that directs escaping wildlife away from the clearing activities and into adjacent natural areas
- Areas of reptile habitat (eg logs, rocks) that require removal will be relocated as soon as practical to adjacent habitat areas
- Clearing activities will be restricted to the maximum disturbance limits authorised for the GTP footprint activities. This will include reducing the ROW width to 30 m in known habitat for the Yakka skink
- All clearing activities within identified sensitive areas will be supervised by the relevant EO
- Surveillance of the open trench in all areas and the removal of wildlife from the trench by appropriately trained personnel (the whole trench will be checked at least twice a day (early morning/late afternoon)
- The spotter catcher(s) will have access to the site (particularly the open trench) during all weather conditions to check for trapped fauna
- Measures will be adopted to prevent fauna entrapment within the pipeline trench, such as:
  - Minimising the period of time the trench is open, particularly in 'core habitat' and 'essential habitat' areas
  - Constructing ramps with a non-slip surface with slopes less than 45° to provide exit ramps for fauna at intervals no greater than 500 m

  - Trench plugs shall be installed in open trenches. These will be provided as a minimum every 500 m
  - Installing additional ramps at greater than normal frequencies (500 m) in areas identified as known or high value habitat
  - Branches, hessian sacks, ramped gangplanks or similar to be used to create 'ladders' to enable fauna to exit the trench. These structures will be placed every 250 to 500 m, depending on the surrounding landscapes
- Direct temporary lighting away from light-sensitive areas such as roost areas. Light shades and low lighting will be applied to construction and operational areas located adjacent to remnant native vegetation and other environmentally sensitive areas
- Prior to backfilling, the spotter catcher(s) will check the open trench in all areas for trapped fauna and where required move them to a safe location away from the trench. This may include disturbing the top layer of soil to ensure no reptiles are camouflaged under the soil
- Cleared vegetation will be stick raked into piles to provide fauna habitat
- Minimise the double handling of stockpiled vegetation and rocky areas as cleared vegetation is likely to be used by native fauna, especially if not used for an extended period
- The construction phase component of the LRMP will be implemented
- Weather permitting, rehabilitation of all areas identified will commence immediately after the pipeline has been lowered in and backfilled (refer LRMP). With the exception of operational constraints, revegetation will be consistent with the plant density, floristic composition and distribution of the adjacent communities (particularly ground cover). Rehabilitation will also incorporate the re-establishment of Yakka skink habitat and landscape connectivity within 'core habitat' and 'essential habitat' areas

15.7.3 Operational phase mitigation measures

Measures to avoid impact

- Vehicle and pedestrian access within the GTP footprint will be restricted to the defined access tracks

Measures to minimise impacts

- Implementation of the Fauna Handling Procedures (refer Appendix C)
- Appropriate maintenance measures will be adopted along the GTP ROW to minimise potential risk to recolonising species. This includes ensuring that appropriate fire regimes are adopted (where necessary) as well as minimising the disturbance to rocky outcrops, woody debris and rehabilitating vegetation
- The operational phase component of the LRMP will be implemented to encourage the re-establishment of ecological communities impacted as a result of construction works. In particular, associated habitat areas for the Yakka skink
- The PWMP will be implemented to minimise the risk of weed and pest animal establishment within known and/or potential Yakka skink habitat

15.7.4 Decommissioning phase mitigation measures

Measures to minimise impacts

- Implementation of the Fauna Handling Procedures (refer Appendix C)
- A decommissioning plan will be developed by GLNG and provided for approval. The plan will aim to address the requirements of AS2885 and also to ensure environmental harm is avoided, including:
  - The Project area no longer contains hazardous contaminants and is in stable condition
  - All above ground infrastructure is removed
  - All areas disturbed by above ground infrastructure are rehabilitated in accordance with the relevant conditions
- For a minimum of five years after the completion of rehabilitation, rehabilitated areas will be monitored on a yearly basis
- The monitoring programme will include:
  - Methods to measure subsidence and erosion rates at rehabilitated buried transmission pipeline corridors and buried flow lines
  - BioCondition assessment in accordance with the Biocondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland: Assessment Manual: Version 2.1 (Eyre *et al* 2011)
  - Monitoring of indicators identified in the LRMP at analogue sites to measure progressive and final rehabilitation success relevant to the final land use(s)
  - Frequency and seasonality of monitoring analogue sites and rehabilitated areas to assess rehabilitation success
  - Identification of the experimental design for analysing analogue and rehabilitated site data including statistical methods of analyses

16 Collared delma

16.1 EPBC Act legal status

Vulnerable - listed 16 July 2000

16.2 Biology and ecology

16.2.1 Characteristics

The Collared delma (*Delma torquata*) is endemic to Queensland and is the smallest member of the family Pygopodidae. This small legless lizard is generally uniform brown; but with belly shields that are darker at the margins, and a dark-brown banded head and neck with cream-yellow interspaces (DSEWPaC 2012k). The species has a maximum snout-vent length of 7 cm and maximum total length of approximately 19 cm (Peck & Hobson 2007). The species average weight is about 2 g and the mid-body scales are in 16 rows. The snout is relatively short and blunt (Cogger 2000).

Collared delma (Source: Wilson 2008)

16.2.2 Known distribution

Despite difficulties in estimating the Collared delma population size, it is known that the the species occurs in small isolated populations throughout its distribution (DSEWPaC 2012k). Important populations include Mt Crosby, the Toowoomba Range, stock route areas (especially the Donnybrook Stock Route region) and the Brisbane area (DSEWPaC 2012k).

The species has been recorded at the Bunya Mountains (approximately 200 km northwest of Brisbane), the Blackdown Tablelands National Park (approximately 200 km west of Rockhampton), Expedition National Park (Central Queensland), Western Creek (approximately 200 km south-west of Brisbane) and the Toowoomba Range. A large concentration or records come from the western suburbs of Brisbane (DSEWPaC 2012k).

Figure 16.1 is an indicative distribution map of the present distribution of the Collared delma.

Due to specific habitat requirements of Collared delma, the species distribution is highly fragmented and restricted to only a few locations within the area that is defined by the habitat boundary (Peck 2003).

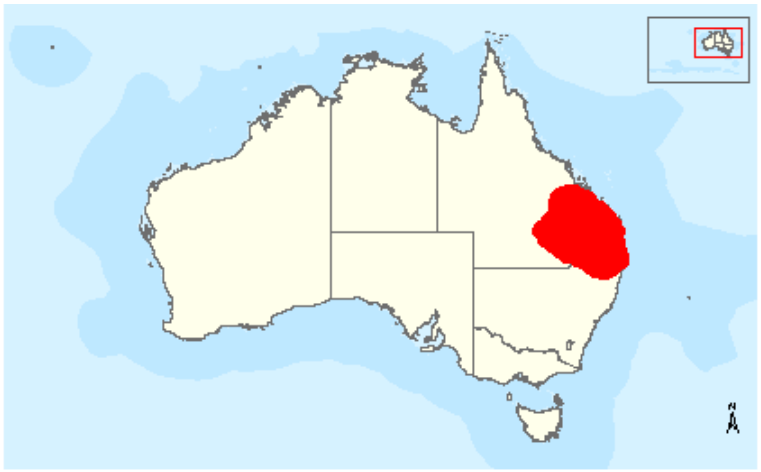


Figure 16.1 Distribution range of the Collared delma (Source: DSEWPaC 2012k)

16.2.3 Known species populations and their relationship with the GTP footprint

During the pre-clearing surveys one individual was identified within the KP30 to KP40 section of the GTP ROW. Suitable habitat is considered present in the areas around Baffle Creek (KP20 to KP22) and the cliffs south of Dawson River (KP28). Additionally the area between KP24 and KP28 may also be suitable habitat for this species. Under the criteria for important habitats for Brigalow Belt reptiles, these areas may be described as an important habitat for this species (Ecologica Consulting 2012).

Suitable habitat was also identified within the KP312 to KP408.81 section of the GTP ROW within Larcom Range and within KP413.57 to KP419.69 of the GTP ROW on Curtis Island.

16.2.4 Biology and reproduction

The Collared delma feeds on insects and spiders, with small cockroaches the most common prey item. Some individuals have been captured in subterranean termite colonies (Davidson 1993, Porter 1998).

As with all members of the Pygopodidae family, the Collared delma produces two small white, elongated eggs in December. These then hatch in February to March (Peck & Hobson 2007).

16.3 Habitat

The Collared delma normally inhabits eucalypt-dominated woodlands and open-forests in Queensland Regional Ecosystem Land Zones (LZ) 3, 9 and 10 (Brigalow Belt Reptiles Workshop 2010).

The Collared delma has been recorded from rocky areas associated with dry open forests. This species occurs in open eucalypt and acacia woodland with an understorey of native grasses and loose rocks. The Collared delma has also been recorded from eucalypt woodland adjacent to semi-evergreen vine thicket. This species shelters under rocks, fallen timber, leaf litter and in soil cracks (Richardson 2006).

The presence of rocks, logs, bark and other coarse woody debris, and mats of leaf litter (typically 30 to 100 mm thick) appears to be an essential characteristic of the Collared delma microhabitat and is always present where the species occurs (Brigalow Belt Reptiles Workshop 2010, Davidson 1993).

16.4 Habitat assessment

Information obtained from BPA (ie Brigalow Belt South Fauna Expert Panel Report (EPA 2006)), together with expert advice, site based species records and pre-clearance survey data have been used to define a set of assumptions that have been used to identify areas of habitat that are consistent with the definitions of 'core habitat', 'essential habitat' and 'general habitat' that have been presented in Part 1 of this SSMP. The habitat assumptions for the Collared delma are presented below.

16.4.1 Core habitat

'Core habitat' consists of 'essential habitat' in which the species is known and the habitat is recognised under relevant recovery plans or other relevant plans/policies/regulations. Also included within this category are populations that are limited geographically within the region.

For the Collared delma, all REs that contain a specimen backed record (from any data source), which overlap with areas identified in the BPA mapping that have been identified as containing a 'State' or 'Regional' 'Corridor' (J-Rating) and/or 'Core Habitat' (H-Rating) and/or 'Habitat for EVR Taxa' (A-Rating) have been mapped as 'core habitat'.

KP0 to KP30

No individuals of this species have been identified within the general vicinity of KP0 to KP30; therefore no 'core habitat' exists within this section of the GTP.

KP30 to KP40

An individual of this species has been identified near KP34.40 of the GTP ROW; therefore 'core habitat' exists within this section of the GTP.

The location of the 'core habitat' for this species within KP30 to KP40 is shown in Figure 16.2b.

KP40 to KP130

No individuals of this species have been identified within the general vicinity of KP40 to KP130; therefore no 'core habitat' exists within this section of the GTP.

KP130 to KP312

No individuals of this species have been identified within the general vicinity of KP130 to KP312; therefore no 'core habitat' exists within this section of the GTP.

KP312 to KP408.81

No individuals of this species have been identified within the general vicinity of KP312 to KP408.81; therefore no 'core habitat' exists within this section of the GTP.

KP408.81 to KP409.04

No individuals of this species have been identified within the general vicinity of KP408.81 to KP409.04; therefore no 'core habitat' exists within this section of the GTP.

KP413.57 to KP419.69

No individuals of this species have been identified within the general vicinity of KP413.57 to KP419.69; therefore no 'core habitat' exists within this section of the GTP.

16.4.2 Essential habitat

'Essential habitat' is an area containing resources that are considered essential for the maintenance of populations of the species (eg potential habitat for breeding, roosting, foraging, shelter, for either migratory or non-migratory species). 'Essential habitat' is defined from known records and/or expert advice (including the findings of pre-clearance surveys).

KP0 to KP30

For the Collared delma, no individuals were identified during the pre-clearance surveys between KP0 to KP30. However, habitat as a result of pre-clearance surveys has been identified around KP20 to KP22 and KP28. These areas are considered to constitute 'essential habitat' for this species.

The location of the 'essential habitat' for this species is shown in Figure 16.2a.

KP30 to KP40

As an individual of this species has been identified within KP30 to KP40 of the GTP ROW, but as this area meets the criteria to be included as 'core habitat', no 'essential habitat' has been mapped within this section of the GTP.

KP40 to KP130

Pre-clearance surveys identified no species records or 'essential habitat' for this species, therefore no 'essential habitat' for this species is considered to exist within this section of the GTP.

KP130 to KP312

Pre-clearance surveys identified no species records or 'essential habitat' for this species, therefore no 'essential habitat' for this species is considered to exist within this section of the GTP.

KP312 to KP408.81

Pre-clearance surveys identified no species records or 'essential habitat' for this species, therefore no 'essential habitat' for this species is considered to exist within this section of the GTP.

KP408.81 to KP409.04

Pre-clearance surveys identified no species records or 'essential habitat' for this species, therefore no 'essential habitat' for this species is considered to exist within this section of the GTP.

KP413.57 to KP419.69

Pre-clearance surveys identified no species records or 'essential habitat' for this species, therefore no 'essential habitat' for this species is considered to exist within this section of the GTP.

16.4.3 General habitat

'General habitat' consists of areas or locations that are used by transient individuals or where species may have been recorded but where there is insufficient information to assess the area as essential/core habitat. 'General habitat' also includes areas defined from known records or habitat that is considered to potentially support a species according to expert knowledge of habitat relationships, despite the absence of specimen backed records. 'General habitat' may include areas of suboptimal habitat for species. As potential habitat for many species contained within this SSMP may include most of the regional ecosystems of the Brigalow Belt Bioregion, the 'general habitat' category restricts the habitat to a more limited and realistic set of environmental parameters that are supported by literature and field based observation.

For the Collared delma, all areas that do not contain a specimen backed record, and do not fulfil the requirements of 'core' and 'essential habitat' are considered to be 'general habitat'.

KP0 to KP30

The location of the 'general habitat' for this species between KP0 and KP30 is shown in Figure 16.2a.

KP30 to KP40

The location of the 'general habitat' for this species between KP0 and KP30 is shown in Figure 16.2b.

KP40 to KP130

No 'general habitat' for this species exists in this section of the GTP.

KP130 to KP312

Expedition Range (KP135.3 to KP136.5, KP148.8 to KP148.9), Dawson Range (KP223.25 to KP225) and Dawson River area (KP233 to KP235) has been identified during the pre-clearance surveys as meeting the criteria of 'general habitat' for this species (Santos GLNG 2012).

Figure 16.2c and Figure 16.2d shows the location of 'general habitat' for Collared delma within this section of the GTP.

KP312 to KP408.81

Pre-clearance surveys identified 'general habitat' for this species within Larcom Range at KP400.3 (Santos GLNG 2013).

Figure 16.2e and Figure 16.2f shows the location of 'general habitat' for Collared delma within this section of the GTP.

KP408.81 to KP409.04

No 'general habitat' for this species exists in this section of the GTP.

KP413.57 to KP419.69

Pre-clearance surveys identified 'general habitat' for this species at KP414.3 on Curtis Island.

Figure 16.2g shows the location of 'general habitat' for Collared delma within this section of the GTP.

16.4.4 Unlikely habitat

'Unlikely habitat' areas are those areas that do not contain records of the particular species and do not contain habitat features to support the species (ie areas that do not meet the habitat assumptions identified above).

16.5 Anticipated threats and potential impacts as a result of the GTP

- Loss, fragmentation and degradation of 'general habitat'
- Removal and destruction of key microhabitats, including potential breeding places
- Changes to foraging behaviour due to artificial lighting, noise and movement
- Entrapment in trenches and other excavations
- Mortality due to equipment and vehicle movement

16.6 Unavoidable impact and unavoidable adverse (offsetable) impact from GTP

Areas of proposed disturbance and areas of adverse (offsetable) impact associated with clearing and construction activities for the GTP between KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 for the Collared delma are presented in Table 16.1. It is important to note that this unavoidable impact is considered minor and temporary in the context of the wide spread extent of 'general habitat' in the region. The location of this habitat is shown in Figure 16.2a, Figure 16.2b, Figure 16.2c, Figure 16.2d, Figure 16.2e, Figure 16.2f and Figure 16.2g.

A cumulative total of proposed clearing of habitat for the Collared delma and the cumulative total of unavoidable adverse (offsetable) impact to the species habitat is provided in Table 16.1.

Table 16.1 Cumulative total of Collared delma habitat to be cleared and area of habitat subject to unavoidable adverse (offsetable) impacts from the GTP

Location	'General habitat'	'Essential habitat'	'Core habitat'	Total habitat area per GTP section	Total habitat area adversely impacted per GTP section
KP0 to KP30	39.12 ha	0.97 ha	0 ha	40.09 ha	38.95 ha
KP30 to KP40	13.20 ha	0 ha	2.92 ha	16.12 ha	16.12 ha
KP40 to KP130	0 ha	0 ha	0 ha	0 ha	0 ha
KP130 to KP312	44.98 ha	0 ha	0 ha	44.98 ha	29.85 ha
KP312 to KP408.81	0.88 ha	0 ha	0 ha	0.88 ha	0.88 ha
KP408.81 to KP409.04	0 ha	0 ha	0 ha	0 ha	0 ha
KP413.57 to KP419.69	0.42 ha	0 ha	0 ha	0.42 ha	0.42 ha
Total habitat area	**98.60 ha**	**0.97 ha**	**2.92 ha**	**102.49 ha**	**86.22 ha**

16.7 Management practices and methods

16.7.1 Pre-construction mitigation measures

Measures to avoid impact

- All reasonable and practical measures will be taken to locate site offices, construction camps, stockpiling/lay down areas and plant and equipment storage areas (including heavy machinery) on existing cleared lands
- Where the Collared delma and its breeding site is located within or within close proximity to the GTP footprint and ancillary work areas, the location will be recorded and checked again for activity prior to construction clearing. All practical and reasonable steps must be taken to avoid disturbing these sites including the investigation of alternative construction measures near known habitats. The establishment of 50 m buffer around breeding site(s) may also be applied
- Where practically feasible, efforts should be made to co-locate the pipeline adjacent to existing. Cleared areas to minimise fragmentation and reduction of core habitat within remnant communities

Measures to minimise impacts

- Pre-clearing ecological surveys have been undertaken by a suitably qualified Ecologist(s) in accordance with the Survey Guidelines for Australia's Threatened Reptiles
- Prior to the commencement of construction clearing, the limits of clearing will be clearly marked out by a suitably qualified and experienced EO. Barricade webbing or similar should be used for 'No Go' zones
- Wherever practicable, signage will be erected to increase awareness of this species and its habitat in the area
- Prior to site entry, all site personnel will be appropriately trained and made aware of the sensitive environs in which they will be working (refer Part 1, Section 7.7)

16.7.2 Construction phase mitigation measures

Measures to avoid impact

- Vehicle and pedestrian access to and from the GTP footprint will be restricted to the defined access tracks
- The limits of clearing will be clearly marked out by a suitably qualified and experienced EO. Barricade webbing or similar will be present highlighting all temporary and permanent 'No Go' zones relevant to the Collared delma

Measures to minimise impacts

- All site personnel will be educated in not harming any animals. All native animals are protected under legislation and it is illegal to harm them
- All vegetation clearing and/or construction activities within known Collared delma habitat will comply with the clearing approval conditions (eg EPBC Act, EP Act, NC Act and other statutory approvals) and be supervised by the relevant EO
- Implement the Fauna Handling Procedures (refer Appendix C)

- Areas of reptile habitat (ie rock features, areas with coarse woody debris) will be subject to mild active disturbance by the fauna handler prior to clearing, to encourage natural relocation of resident fauna
- Clearing will be conducted in a sequential manner and in a way that directs escaping wildlife away from the clearing activities and into adjacent natural areas
- Areas of reptile habitat (eg logs, rocks) that require removal will be relocated as soon as practical to adjacent habitat areas
- Clearing activities will be restricted to the maximum disturbance limits authorised for the GTP footprint activities. This will include reducing the ROW width to 30 m in known habitat for the Collared delma
- All clearing activities within identified sensitive areas will be supervised by the relevant EO
- Surveillance of the open trench in all areas and the removal of wildlife from the trench by appropriately trained personnel (the whole trench will be checked at least twice a day (early morning/late afternoon)
- The spotter catcher(s) will have access to the site (particularly the open trench) during all weather conditions to check for trapped fauna
- Measures will be adopted to prevent fauna entrapment within the pipeline trench, such as:
  - Minimising the period of time the trench is open, particularly in 'core habitat' and 'essential habitat' areas
  - Constructing ramps with a non-slip surface with slopes less than 45° to provide exit ramps for fauna at intervals no greater than 500 m
  - Trench plugs shall be installed in open trenches. These will be provided as a minimum every 500 m
  - Installing additional ramps at greater than normal frequencies (500 m) in areas identified as known or high value habitat
  - Branches, hessian sacks, ramped gangplanks or similar to be used to create 'ladders' to enable fauna to exit the trench. These structures will be placed every 250 to 500 m, depending on the surrounding landscapes
- Direct temporary lighting away from light-sensitive areas such as roost areas. Light shades and low lighting will be applied to construction and operational areas located adjacent to remnant native vegetation and other environmentally sensitive areas
- Prior to backfilling, the spotter catcher(s) will check the open trench in all areas for trapped fauna and where required move them to a safe location away from the trench. This may include disturbing the top layer of soil to ensure no reptiles are camouflaged under the soil
- Cleared vegetation will be stick raked into piles to provide fauna habitat
- Minimise the double handling of stockpiled vegetation and rocky areas as cleared vegetation is likely to be used by native fauna, especially if not used for an extended period
- The construction phase component of the LRMP will be implemented
- Weather permitting, rehabilitation of all areas identified will commence immediately after the pipeline has been lowered in and backfilled (refer LRMP). With the

exception of operational constraints, revegetation will be consistent with the plant density, floristic composition and distribution of the adjacent communities (particularly ground cover). Rehabilitation will also incorporate the re-establishment of Collared delma habitat and landscape connectivity within 'core habitat' and 'essential habitat' areas

16.7.3 Operational phase mitigation measures

Measures to avoid impact

- Vehicle and pedestrian access within the GTP footprint will be restricted to the defined access tracks

Measures to minimise impacts

- Implementation of the Fauna Handling Procedures (refer Appendix C)
- Appropriate maintenance measures will be adopted along the GTP ROW to minimise potential risk to recolonising species. This includes ensuring that appropriate fire regimes are adopted (where necessary) as well as minimising the disturbance to rocky outcrops, woody debris and rehabilitating vegetation
- The operational phase component of the LRMP will be implemented to encourage the re-establishment of ecological communities impacted as a result of construction works. In particular, associated habitat areas for the Collared delma
- The PWMP will be implemented to minimise the risk of weed and pest animal establishment within known and/or potential Collared delma habitat

16.7.4 Decommissioning phase mitigation measures

Measures to minimise impacts

- Implementation of the Fauna Handling Procedures (refer Appendix C)
- A decommissioning plan will be developed by GLNG and provided for approval. The plan will aim to address the requirements of AS2885 and also to ensure environmental harm is avoided, including:
  - The Project area no longer contains hazardous contaminants and is in stable condition
  - All above ground infrastructure is removed
  - All areas disturbed by above ground infrastructure are rehabilitated in accordance with the relevant conditions
- For a minimum of five years after the completion of rehabilitation, rehabilitated areas will be monitored on a yearly basis
- The monitoring programme will include:
  - Methods to measure subsidence and erosion rates at rehabilitated buried transmission pipeline corridors and buried flow lines
  - BioCondition assessment in accordance with the Biocondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland: Assessment Manual: Version 2.1 (Eyre *et al* 2011)

- Monitoring of indicators identified in the LRMP at analogue sites to measure progressive and final rehabilitation success relevant to the final land use(s)
- Frequency and seasonality of monitoring analogue sites and rehabilitated areas to assess rehabilitation success
- Identification of the experimental design for analysing analogue and rehabilitated site data including statistical methods of analyses

17 Fitzroy river turtle

17.1 EPBC legal status

Vulnerable – listed 16 July 2000

17.2 Biology and Ecology

17.2.1 Characteristics

The Fitzroy river turtle (*Rheodytes leukops*) is a medium to dark brown turtle growing to 25 cm shell length (SL) with scattered darker spots and blotches on the upper shell surface (DSEWPaC 2012bh). It has a pale yellow or cream belly and dull olive-grey exposed fleshy parts. The shell is broadly oval and the neck is covered with large, pointed conical tubercles (Cogger 2000). The back edge of the shell on hatchlings is serrated (Cogger 2000, Latta & Latta 2005, Wilson & Swan 2003). The Fitzroy river turtle has distinctive eyes with black pupils surrounded by a narrow white inner ring (adults) or a metallic silvery-blue iris (hatchlings) (Cogger 2000, Limpus 2007). The Fitzroy river turtle has relatively long forelimbs with five long claws and a large cloacal bursae which has a respiratory function (Cogger 2000, Wilson & Swan 2003).

Fitzroy river turtle adult, nest and turtle tracks from waterline (Source: DERM 2007, Greening Australia 2010)

17.2.2 Known distribution

The Fitzroy river turtle is only found in the drainage system of the Fitzroy River, Queensland (DSEWPaC 2012bh). It is estimated that this species occurs in a total area of less than 10,000 km^2 (Cogger *et al* 1993, McDonald *et al* 1991). Known sites include Boolburra, Gainsford, Glenroy Crossing, Theodore, Baralba, the Mackenzie River, the Connors River, Duaringa, Marlborough Creek, and Gogango (Cogger *et al* 1993, Covacevich *et al* 1996, Tucker *et al* 2001, Venz 2002).

Figure 17.1 is an indicative distribution map of the present distribution of the Fitzroy river turtle.

No population information is available for this species.

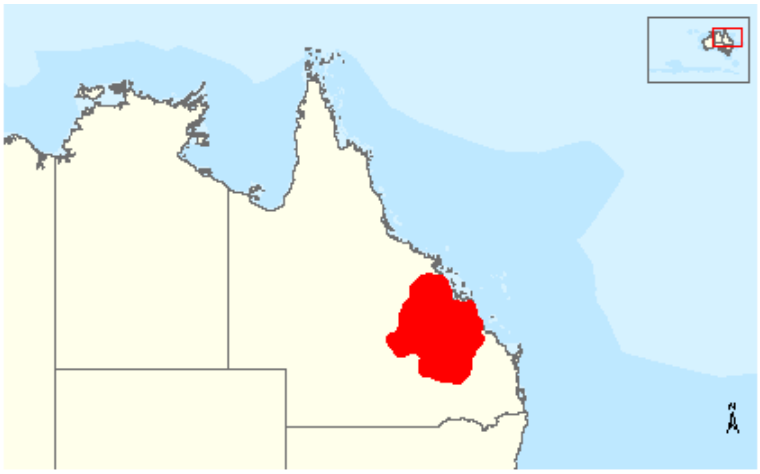


Figure 17.1 Distribution range of the Fitzroy river turtle (Source: DSEWPaC 2012bh)

17.2.3 Known species populations and their relationship with the GTP footprint

No individuals were encountered during the pre-clearance survey. However, the Fitzroy river turtle is likely to be associated with the deep pools located in Hutton Creek, Baffle Creek and the Dawson River which are intercepted by the GTP ROW. These pools provide refugia habitat during periods of low or no flow, while riffles and runs were identified within the local reach in relatively close proximity to the GTP ROW (Ecologica Consulting 2012).

Harper Creek at KP360.3 was also identified as suitable habitat for the Fitzroy river turtle.

17.2.4 Biology and reproduction

The Fitzroy river turtle forages on the river bottom (Cann 1998) and is known to consume a variety of foods, including Ribbonweed (*Vallisneria* sp.), freshwater sponge, aquatic insect larvae, algae, small snails, terrestrial insects and terrestrial plant material such as leaves and bark (Cann 1998, Tucker *et al* 2001).

Nesting occurs between September and October (Legler 1985). All located nests have been on river sandbanks 1 to 4 m above water level (Cann 1998, Cogger *et al* 1993). Nests have been found up to 15 m from water on flat sandbanks (Cann 1998).

Annual reproductive potential of females is 46 to 59 eggs laid in three to five clutches (Cann 1998). Eggs can take up to 90 days to hatch (Legler 1985). Eggs are deposited in nesting chambers 170 mm deep, containing between 12 and 20 eggs (Latta & Latta 2005). The eggs are approximately 29 mm long and 21 mm wide (Limpus 2007).

This species can take between 15 to 20 years to reach sexual maturity (Limpus 2007).

17.3 Habitat

The Fitzroy river turtle is found in rivers with large deep pools with rocky, gravelly or sandy substrates, connected by shallow riffles (DSEWPaC 2012bh). Preferred areas have high water clarity, and are often associated with Ribbonweed (*Vallisneria* sp.) beds (Cogger *et al* 1993). Common riparian vegetation associated with the Fitzroy river turtle includes Blue gums (*Eucalyptus tereticornis*), River oaks (*Casuarina cunninghamiana*), Weeping bottlebrushes (*Callistemon viminalis*) and Paperbarks (*Melaleuca linariifolia*) (Tucker *et al* 2001).

Turtles often associate with logs in deeper water, and may sit on the downstream side or under rocks in fast flowing riffles (Cann 1998, Tucker *et al* 2001).

It is thought that the Fitzroy river turtle has an affinity for well-oxygenated riffle zones, moving into deeper pools as the riffle zones cease to flow (Tucker *et al* 2001). However, recent studies have captured several turtles from deep pools (Gordos *et al* 2003a, 2003b, 2004).

17.4 Habitat assessment

Information obtained from BPA (ie Brigalow Belt South Fauna Expert Panel Report (EPA 2006)), together with expert advice, site based species records and pre-clearance survey data have been used to define a set of assumptions that have been used to identify areas of habitat that are consistent with the definitions of 'core habitat', 'essential habitat' and 'general habitat' that have been presented in Part 1 of this SSMP. The habitat assumptions for the Fitzroy river turtle are presented below.

17.4.1 General assumptions

The following habitat assumption has been made based on current scientific knowledge of this species:

- The Fitzroy river turtle is found in rivers with large deep pools with rocky, gravelly or sandy substrates, connected by shallow riffles (DSEWPaC 2012bh)

17.4.2 Core habitat

'Core habitat' consists of 'essential habitat' in which the species is known and the habitat is recognised under relevant recovery plans or other relevant plans/policies/regulations. Also included within this category are populations that are limited geographically within the region.

For the Fitzroy river turtle, all REs that contain a specimen backed record (from any data source), which overlap with areas identified in the BPA mapping that have been identified as containing a 'State' or 'Regional' 'Corridor' (J-Rating) and/or 'Core Habitat' (H-Rating) and/or 'Habitat for EVR Taxa' (A-Rating) have been mapped as 'core habitat'.

No individuals of this species have been identified within the general vicinity of KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 of the GTP; therefore no 'core habitat' exists within these sections of the GTP.

17.4.3 Essential habitat

'Essential habitat' is an area containing resources that are considered essential for the maintenance of populations of the species (eg potential habitat for breeding, roosting, foraging, shelter, for either migratory or non-migratory species). 'Essential habitat' is defined from known records and/or expert advice (including the findings of pre-clearance surveys).

For the Fitzroy river turtle, as no individuals or 'essential habitat' areas were identified during the pre-clearance surveys, no 'essential habitat' for this species is considered to occur between KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 of the GTP.

17.4.4 General habitat

'General habitat' consists of areas or locations that are used by transient individuals or where species may have been recorded but where there is insufficient information to assess the area as essential/core habitat. 'General habitat' also includes areas defined from known records or habitat that is considered to potentially support a species according to expert knowledge of habitat relationships, despite the absence of specimen backed records. 'General habitat' may include areas of suboptimal habitat for species. As potential habitat for many species contained within this SSMP may include most of the regional ecosystems of the Brigalow Belt Bioregion, the 'general habitat' category restricts the habitat to a more limited and realistic set of environmental parameters that are supported by literature and field based observation.

For the Fitzroy river turtle, all areas with the required habitat structure and composition that do not contain a specimen backed record, and do not fulfil the requirements of 'core' and 'essential habitat' are considered to be 'general habitat'.

KP0 to KP30

The location of the 'general habitat' for this species within this section of the GTP is shown in Figure 17.2a.

KP30 to KP40

No 'general habitat' for this species exists in this section of the GTP.

KP40 to KP130

No 'general habitat' for this species exists in this section of the GTP.

KP130 to KP312

Dawson River (KP234) has been identified during the pre-clearance surveys as meeting the criteria of 'general habitat' for this species (Santos GLNG 2012).

The location of the 'general habitat' for this species within this section of the GTP is shown in Figure 17.2b.

KP312 to KP408.81

Harper Creek (KP360.30) has been identified during the pre-clearance surveys as meeting the criteria of 'general habitat' for this species (Santos GLNG 2013).

The location of the 'general habitat' for this species within this section of the GTP is shown in Figure 17.2c and Figure 17.2d.

KP408.81 to KP409.04

No 'general habitat' for this species exists in this section of the GTP.

KP413.57 to KP419.69

KP413.57 to KP419.69 of the GTP is outside the distribution range for the Fitzroy river turtle; therefore no 'general habitat' for this species exists within this section of the GTP.

17.4.5 Unlikely habitat

'Unlikely habitat' areas are those areas that do not contain records of the particular species and do not contain habitat features to support the species (ie areas that do not meet the habitat assumptions identified above).

17.5 Anticipated threats and potential impacts as a result of the GTP

- Loss, fragmentation and degradation of 'general habitat'
- Removal and destruction of key microhabitats, including potential breeding places
- Changes to foraging behaviour due to artificial lighting, noise and movement
- Entrapment in trenches and other excavations
- Mortality due to equipment and vehicle movement

17.6 Unavoidable impact and unavoidable adverse (offsetable) impact from GTP

Areas of proposed disturbance and areas of adverse (offsetable) impact associated with clearing and construction activities for the GTP between KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 for the Fitzroy river turtle are presented in Table 17.1. It is important to note that this unavoidable impact is considered minor and temporary in the context of the wide spread extent of 'general habitat' in the region. The location of this habitat is shown in Figure 17.2a, Figure 17.2b, Figure 17.2c and Figure 17.2d.

A cumulative total of proposed clearing of habitat for the Fitzroy river turtle and the cumulative total of unavoidable adverse (offsetable) impact to the species habitat is provided in Table 17.1.

Table 17.1 Cumulative total of Fitzroy river turtle habitat to be cleared

Location	'General habitat'	Total habitat area per GTP section	Total habitat area adversely impacted per GTP section
KP0 to KP30	0.49 ha	0.49 ha	0.49 ha
KP30 to KP40	0 ha	0 ha	0 ha
KP40 to KP130	0 ha	0 ha	0 ha
KP130 to KP312	1.93 ha	1.93 ha	0.44 ha
KP312 to KP408.81	0.17 ha	0.17 ha	0.12 ha
KP408.81 to KP409.04	0 ha	0 ha	0 ha
KP413.57 to KP419.69	0 ha	0 ha	0 ha
Total habitat area	**2.59 ha**	**2.59 ha**	**1.05 ha**

17.7 Management practices and methods

17.7.1 Pre-construction mitigation measures

Measures to avoid impact

- All reasonable and practical measures will be taken to locate site offices, construction camps, stockpiling/lay down areas and plant and equipment storage areas (including heavy machinery) on existing cleared lands
- Where the Fitzroy river turtle and its breeding site is located within or within close proximity to the GTP footprint and ancillary work areas, the location will be recorded and checked again for activity prior to construction clearing. All practical and reasonable steps must be taken to avoid disturbing these sites including the investigation of alternative construction measures near known habitats. The establishment of 50 m buffer around breeding site(s) may also be applied
- Where practically feasible, efforts should be made to co-locate the pipeline adjacent to existing cleared areas to minimise fragmentation and reduction of core habitat within remnant communities

Measures to minimise impacts

- Pre-clearing ecological surveys have been undertaken by a suitably qualified Ecologist(s) in accordance with the Survey Guidelines for Australia's Threatened Reptiles
- Prior to the commencement of construction clearing, the limits of clearing will be clearly marked out by a suitably qualified and experienced EO. Barricade webbing or similar should be used for 'No Go' zones
- Wherever practicable, signage will be erected to increase awareness of this species and its habitat in the area
- Prior to site entry, all site personnel will be appropriately trained and made aware of the sensitive environs in which they will be working (refer Part 1, Section 7.7)

17.7.2 Construction phase mitigation measures

Measures to avoid impact

- Vehicle and pedestrian access to and from the GTP footprint will be restricted to the defined access tracks
- The limits of clearing will be clearly marked out by a suitably qualified and experienced EO. Barricade webbing or similar will be present highlighting all temporary and permanent 'No Go' zones relevant to the Fitzroy river turtle

Measures to minimise impacts

- All site personnel will be educated in not harming any animals. All native animals are protected under legislation and it is illegal to harm them
- All riparian vegetation clearing and/or construction activities within known Fitzroy river turtle habitat will comply with the clearing approval conditions (eg EPBC Act, EP Act, NC Act and other statutory approvals) and be supervised by the relevant EO

- Clearing will be conducted in a sequential manner and in a way that directs escaping wildlife away from the clearing activities and into adjacent natural areas
- Unless otherwise agreed by DotE, horizontal directional drilling must be undertaken at all waterway crossings within the Fitzroy and Calliope River catchments where the Fitzroy river turtle is known to occur. The minimum buffer width must be >15 m from the waterway (maximum recorded nest distance from a waterway)
- Pipeline construction activities across these waterways must not take place during the known nesting and breeding season of this species
- The crossing(s) will be designed to ensure that construction time will be minimised and rehabilitation completed straight away
- For minor waterway crossings where HDD is not the agreed construction method, the watercourse bed and bank material and trench spoil will be stockpiled separately outside the buffer zone (15 m) to reduce any potential impacts to the turtle nest areas (where applicable). These measures will also reduce the likelihood of sedimentation build-up in the waterway from surface runoff
- Implement the Fauna Handling Procedures (refer Appendix C)
- Clearing activities will be restricted to the maximum disturbance limits authorised for the GTP footprint activities. This will include reducing the ROW width to 30 m in known habitat for the Fitzroy river turtle
- All clearing activities within identified sensitive areas will be supervised by the relevant EO
- Surveillance of the open trench in all areas and the removal of wildlife from the trench by appropriately trained personnel (the whole trench will be checked at least twice a day (early morning/late afternoon)
- The spotter catcher(s) will have access to the site (particularly the open trench) during all weather conditions to check for trapped fauna
- Measures will be adopted to prevent fauna entrapment within the pipeline trench, such as:
  - Minimising the period of time the trench is open, particularly in ‘core habitat’ and ‘essential habitat’ areas
  - Constructing ramps with a non-slip surface with slopes less than 45° to provide exit ramps for fauna at intervals no greater than 500 m
  - Trench plugs shall be installed in open trenches. These will be provided as a minimum every 500 m
  - Installing additional ramps at greater than normal frequencies (500 m) in areas identified as known or high value habitat
  - Branches, hessian sacks, ramped gangplanks or similar to be used to create ‘ladders’ to enable fauna to exit the trench. These structures will be placed every 250 to 500 m, depending on the surrounding landscapes
- Direct temporary lighting away from light-sensitive areas. Light shades and low lighting will be applied to construction and operational areas located adjacent to remnant native riparian vegetation and other environmentally sensitive areas
- Prior to backfilling, the spotter catcher(s) will check the open trench in all areas for trapped fauna and where required move them to a safe location away from the trench

- Minimise the double handling of stockpiled vegetation and rocky areas as cleared vegetation is likely to be used by native fauna, especially if not used for an extended period
- The construction phase component of the LRMP will be implemented
- Weather permitting, rehabilitation of all areas identified will commence immediately after the pipeline has been lowered in and backfilled (refer LRMP). With the exception of operational constraints, revegetation will be consistent with the plant density, floristic composition and distribution of the adjacent communities (particularly ground cover). Rehabilitation will also incorporate the re-establishment of Fitzroy river turtle habitat and landscape connectivity within 'core habitat', 'essential habitat' and 'general habitat' areas

17.7.3 Operational phase mitigation measures

Measures to avoid impact

- To avoid impacting on regenerating riparian zone and associated turtle nesting habitat, vehicle and pedestrian access within the GTP footprint will be restricted to the defined access tracks

Measures to minimise impacts

- Implementation of the Fauna Handling Procedures (refer Appendix C)
- Appropriate maintenance measures will be adopted along the GTP ROW to minimise potential risk to recolonising species. This includes ensuring that appropriate fire regimes are adopted (where necessary) as well as minimising the disturbance rehabilitating riparian vegetation
- The operational phase component of the LRMP will be implemented to encourage the re-establishment of ecological communities impacted as a result of construction works. In particular, associated habitat areas for the Fitzroy river turtle
- The PWMP will be implemented to minimise the risk of weed and pest animal establishment within known and/or potential Fitzroy river turtle habitat

17.7.4 Decommissioning phase mitigation measures

Measures to minimise impacts

- Implementation of the Fauna Handling Procedures (refer Appendix C)
- A decommissioning plan will be developed by GLNG and provided for approval. The plan will aim to address the requirements of AS2885 and also to ensure environmental harm is avoided, including:
  - The Project area no longer contains hazardous contaminants and is in stable condition
  - All above ground infrastructure is removed
  - All areas disturbed by above ground infrastructure are rehabilitated in accordance with the relevant conditions
- For a minimum of five years after the completion of rehabilitation, rehabilitated areas will be monitored on a yearly basis

- The monitoring programme will include:
  - Methods to measure subsidence and erosion rates at rehabilitated buried transmission pipeline corridors and buried flow lines
  - BioCondition assessment in accordance with the Biocondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland: Assessment Manual: Version 2.1 (Eyre *et al* 2011)
  - Monitoring of indicators identified in the LRMP at analogue sites to measure progressive and final rehabilitation success relevant to the final land use(s)
  - Frequency and seasonality of monitoring analogue sites and rehabilitated areas to assess rehabilitation success
  - Identification of the experimental design for analysing analogue and rehabilitated site data including statistical methods of analyses

18 General migratory species

18.1 Rainbow bee-eater

18.1.1 EPBC Act legal status

Migratory (JAMBA)

18.1.2 Biology and ecology

Characteristics

The Rainbow bee-eater (*Merops ornatus*) is the only species of bee-eater in Australia. The males measure 25 cm in length and the females 22 cm, including the central tail-streamers, which project 2 to 6 cm beyond the rest of the tail in the male and 1 to 2 cm in the female. The wingspan is 34 cm in the male and 31 cm in the female (DSEWPaC 2012l).

Rainbow bee-eaters have a long, slender and decurved black bill, a red iris, dark grey skin around the eye and blackish legs and feet. The adults have green or blue-green colouring on the forehead and chestnut on the back of the head. There is a bold black stripe across the eye that is bordered below by a narrower blue stripe and bright yellow colouring on the chin and cheeks that changes to chestnut around the throat and that is bordered by a conspicuous, crescent-shaped black patch on the front of the neck. The upper part of the back is bright green, merging to light blue on the lower part of the back to the base of the tail. There is bright green and light blue colouring on the upper surface of the wings, with chestnut colouring on the secondary feathers and dark brown primary feathers, light green colouring on the breast that becomes paler on the belly and that changes to light or pale blue from the lower belly to the base of the tail (DSEWPaC 2012l).

The tail is black with blue edging on the upper surface and two long, wire-like central feathers (termed streamers) that project beyond the tip of the tail. There is some slight seasonal variation in the appearance of the plumage (DSEWPaC 2012l).

Rainbow bee-eater (Source: Aviceda 2007)

Known distribution

It is not known if the total population of the Rainbow bee-eater is divided into a series of discrete sub-populations. Analyses have indicated that there has been little or no change in the total population size of the Rainbow bee-eater, but that there have been shifts in local abundances and, possibly, in local distributions. The mobility of the species suggests that it is unlikely that any local or regional population would be genetically isolated from the remainder of the Australian population (DSEWPaC 2012l).

The Rainbow bee-eater can be found throughout much of mainland Australia and near-shore islands. The occurrence and occupancy of the species within Australia have not been estimated (DSEWPaC 2012l).

Figure 18.1 is an indicative distribution map of the present distribution of the Rainbow bee-eater.

Figure 18.1 Distribution range of the Rainbow bee-eater (Source: DSEWPaC 2012l)

Known species populations and their relationship with the GTP footprint

This species has been identified from a number of locations and habitats throughout the GTP footprint, including the Calliope Range, Dawson River, Fairview Gas Fields, Arcadia Valley and the GSDA. Records were primarily species foraging within the ecotone between the existing remnant vegetation and the adjoining cleared areas (including the existing gas pipelines).

No nests sites were identified within or adjacent the GTP footprint. However a nest site was identified from an access track into the Dawson River (at least 500 m upstream of the GTP footprint crossing).

Suitable habitat for this species within KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 of the GTP and ancillary areas is considered to be limited and to areas used during migration.

Biology and reproduction

The movement patterns of the Rainbow bee-eater are complex, and are not fully understood. Populations that breed in southern Australia are migratory (ie after breeding, they move north and remain there for the winter). However, populations that breed in northern Australia are considered to be resident, and in many northern localities the Rainbow bee-eater is present throughout the year (DSEWPaC 2012l).

The Rainbow bee-eater is primarily insectivorous usually foraging from open perches. The species may also feed on the ground, preying on worms and tadpoles (DSEWPaC 2012l).

The Rainbow bee-eater is capable of living for up to 24 years; however there is no information on the ages of sexual maturity. The breeding season extends from August to January. Nests are located in a chamber at the end of a burrow or tunnel in flat or sloping ground, in the banks of rivers, creeks or dams, in roadside cuttings, in the walls of gravel pits or quarries, in mounds of gravel or cliff faces (DSEWPaC 2012l).

The species breeds in socially monogamous pairs that are sometimes assisted by a varying number of auxiliary birds or 'helpers'. The female lays a clutch of two to eight, but normally four or five, eggs which are incubated by both sexes. Incubation is for a period of 22 to 31 days. The young remain in their burrows for a period of 23 to 36 days and will continue to be fed by the adults for another two to four weeks after their first departure from the nest (DSEWPaC 2012l). The species breeding period is detailed in Table 18.1.

Table 18.1 Breeding periods (Orange indicates breeding period)

Species name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Merops ornatus (Rainbow bee-eater)												

18.1.3 Habitat

This species inhabits open woodlands with sandy/loamy soils, sand ridges, sandpits, riverbanks, road cuttings, beaches, dunes, cliffs, mangroves and rainforest communities. On migration, the Rainbow bee-eater may also fly over the top of non-preferred habitats such as rainforest or treeless plains (DSEWPaC 2012l; Pizzey & Knight 1997).

18.1.4 Habitat assessment

Information obtained from BPA (ie Brigalow Belt South Fauna Expert Panel Report (EPA 2006)), together with expert advice, site based species records and pre-clearance survey data have been used to define a set of assumptions that have been used to identify areas of habitat that are consistent with the definitions of ‘core habitat’, ‘essential habitat’ and ‘general habitat’ that have been presented in Part 1 of this SSMP. The Rainbow bee-eater habitat assumptions are presented below.

General assumptions

The following habitat assumptions have been made based on current scientific knowledge of this species:

- Occurs mainly in open forests and woodlands, shrub lands, and in various cleared or semi-cleared habitats, including farmland and areas of human habitation (DSEWPaC 2012l). These areas are considered to constitute habitat for this species
- It usually occurs in open, cleared or lightly-timbered areas that are often, but not always, located in close proximity to permanent water (DSEWPaC 2012l). It is assumed that areas that are located within but not necessarily limited to 3 km of a stream-order 3 or greater watercourse (as indicated on DEHP’s mapping) provide potential habitat for this species

Core habitat

'Core habitat' consists of 'essential habitat' in which the species is known and the habitat is recognised under relevant recovery plans or other relevant plans/policies/regulations. Also included within this category are populations that are limited geographically within the region.

For the Rainbow bee-eater, all REs that contain a specimen backed record (from any data source), which overlap with areas identified in the BPA mapping that have been identified as containing a 'State' or 'Regional' 'Corridor' (J-Rating) and/or 'Core Habitat' (H-Rating) and/or 'Habitat for EVR Taxa' (A-Rating) have been mapped as 'core habitat'.

As the Rainbow bee-eater is a ubiquitous species with an extensive distribution both within, and outside of Australia, it is not considered that 'core habitat' exists for this species within the GTP footprint.

Essential habitat

'Essential habitat' is an area containing resources that are considered essential for the maintenance of populations of the species (eg potential habitat for breeding, roosting, foraging, shelter, for either migratory or non-migratory species). 'Essential habitat' is defined from known records and/or expert advice (including the findings of pre-clearance surveys).

As the Rainbow bee-eater is a ubiquitous species with an extensive distribution both within, and outside of Australia, it is not considered that 'essential habitat' exists for this species within the GTP footprint.

General habitat

'General habitat' consists of areas or locations that are used by transient individuals or where species have been recorded but there is insufficient information to assess the area as essential/core habitat. 'General habitat' may be defined from known records or habitat that is considered to potential support a species according to expert knowledge of habitat relationships, despite the absence of specimen backed records. 'General habitat' may include areas of suboptimal habitat for species.

For the Rainbow bee-eater, all areas that meet the assumptions presented above are included within the 'general habitat' category.

KP0 to KP30

The location of the 'general habitat' for this species within KP0 to KP30 is shown in Figure 18.2a.

KP30 to KP40

The location of the 'general habitat' for this species within KP0 to KP30 is shown in Figure 18.2b.

KP40 to KP130

The location of the 'general habitat' for this species within KP40 to KP130 is shown in Figure 18.2c.

KP130 to KP312

An individual of this species was identified at KP184, Conciliation Creek (KP207.47) and Callide Creek (KP298.94) during the Aurecon and Ausecology pre-clearance surveys.

Multiple Rainbow bee-eater nests and an individual were observed in a sandy bank near KP233, approximately 230 m south-east of alignment (Santos GLNG 2012).

Nesting habitat is restricted within the ROW, with potential nesting sites at Callide Creek (KP298.95 to KP300.2) based on exposed sandy banks. In addition, the creek banks of the ROW at Sellheim Creek (KP280.21) could provide nesting habitat (Santos GLNG 2012).

Expedition Range (KP130 to KP150), KP206 to KP212, Dawson River area (KP233 to KP235), Sellheim Creek area (KP280 to KP280.5), KP295.5 to KP300.2 and KP311 to KP312 has been identified during the pre-clearance surveys as meeting the criteria of 'general habitat' for this species (Santos GLNG 2012).

The location of the 'general habitat' for this species within KP130 to KP312 is shown in Figure 18.2d and 18.2e.

KP312 to KP408.81

The location of the 'general habitat' for this species within KP312 to KP408.81 is shown in Figure 18.2f and 18.2g.

KP408.81 to KP409.04

The location of the 'general habitat' for this species within KP408.81 to KP409.04 is shown in Figure 18.2h.

KP413.57 to KP419.69

Pre-clearance surveys identified 'general habitat' for this species within this section of the GTP.

The location of the 'general habitat' for this species within KP413.57 to KP419.69 of the GTP is shown in Figure 18.2i.

Unlikely habitat

'Unlikely habitat' areas are those areas that do not contain records of the particular species and do not contain sufficient habitat features to support the species (ie areas that do not meet the habitat assumptions identified above).

18.1.5 Anticipated threats and potential impacts as a result of the GTP

- Loss and degradation of 'general habitat' for these species
- Direct impacts to nest sites, with walls of trenches potentially providing desirable nesting opportunities for individuals
- Changes to foraging patterns as a result of increases in noise, vibration, vehicle movement and dust
- Stress, injury and death to animals due to anthropogenic activities

18.1.6 Unavoidable impact and unavoidable adverse (offsetable) impact from GTP

Areas of proposed disturbance and areas of adverse (offsetable) impact associated with construction activities for the GTP between KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 for the Rainbow bee-eater are presented in Table 18.2. It is important to note that this unavoidable impact is considered minor and temporary in the context of the wide spread

extent of 'general habitat' in the region. The location of this 'general habitat' for this species is shown in Figure 18.2a, Figure 18.2b, Figure 18.2c, Figure 18.2d, Figure 18.2e, Figure 18.2f, Figure 18.2g, Figure 18.2h and Figure 18.2i.

A cumulative total of proposed clearing of habitat for the Rainbow bee-eater and the cumulative total of unavoidable adverse (offsetable) impact to the species habitat is provided in Table 18.2.

Table 18.2 Cumulative total of Rainbow bee-eater habitat to be cleared and area of habitat subject to unavoidable adverse (offsetable) impacts from the GTP

Location	'General habitat'	Total habitat area per GTP section	Total habitat area adversely impacted per GTP section
KP0 to KP30	118.84 ha	118.84 ha	46.90 ha
KP30 to KP40	42.58 ha	42.58 ha	13.91 ha
KP40 to KP130	397.39 ha	397.39 ha	1.26 ha
KP130 to KP312	872.52 ha	872.52 ha	82.95 ha
KP312 to KP408.81	405.78	405.78	64.77 ha
KP408.81 to KP409.04	2.71 ha	2.71 ha	2.71 ha
KP413.57 to KP419.69	12.89 ha	12.89 ha	12.89 ha
Total habitat area	**1,852.71 ha**	**1,852.71 ha**	**225.39 ha**

18.1.7 Management practices and methods

Pre-construction mitigation measures

Measures to avoid impact

- All reasonable and practical measures will be taken to locate site offices, construction camps, stockpiling/lay down areas and plant and equipment storage areas (including heavy machinery) on existing cleared lands

Measures to minimise impacts

- Pre-clearing surveys have been undertaken have been undertaken by a suitably qualified Ecologist(s) in accordance with the Survey Guidelines for Australia's Threatened Birds
- Prior to site entry, all site personnel will be appropriately trained and made aware of the sensitive environs in which they will be working (refer Part 1, Section 7.7). This includes the likelihood of migratory species being present or describing known areas
- Where appropriate, signage will be erected to increase personnel awareness of the migratory nesting locations and/or 'No Go' zones within and adjacent the GTP footprint
- Approximately 1 to 2 weeks prior to the commencement of construction clearing, a licensed and experienced spotter catcher(s) will undertake a targeted survey to ensure there are no nesting migratory species present within the ROW. There will be a key focus on checking hollows and nests of key species listed above to reduce the overall risk of injury or fatality to local inhabitants during clearing activities
- If an active nest is identified, a temporary exclusion zone of 50 m (radius) will be established until young have fledged. The status of active nests will be regularly

checked in a way that does not risk the nest being abandoned by the breeding pair (adult birds)

Construction phase mitigation measures

Measures to avoid impact

- Disturbance to remnant vegetation and applicable palustrine, riverine and lacustrine wetlands creek lines and river banks will be minimised to a width of 30 m or less

Measures to minimise impacts

- All works will be undertaken in accordance with the conditions of any applicable statutory approvals
- Implementation of the Fauna Handling Procedures (refer Appendix C)
- All waste/rubbish will be correctly disposed of so as to not pose a risk to local fauna
- Temporary exclusion zones around active nests will be regularly checked to ensure they are clearly marked out
- All reasonable efforts will be made to minimise night work, wherever possible. Wherever constructability allows, night lighting associated with the construction phase of the project shall be directed landwards and facing away from the coastline. In addition, measures to limit light pollution spilling onto mapped roosting area will be implemented (eg light guards, etc)
- Noise and vibration measures such as regular maintenance of equipment will be adopted
- Clearing activities within these areas will be supervised by the EO
- Clearing will be conducted in a sequential manner and in a way that directs escaping wildlife away from the clearing activities and into adjacent natural areas. With the exception of the spotter catcher, no migratory birds will physically be moved on at any time
- A licensed and experienced spotter catcher(s) will be onsite during all clearing activities and will ensure any injured animals are given to an appropriate wildlife carer group or vet (refer Appendix C)
- Prior to backfilling trenches, the spotter catcher will check trench walls in all areas to ensure no Rainbow bee-eater nests have been constructed
- Weather permitting, rehabilitation of all habitats impacted as a result of construction works, will commence immediately after the pipeline has been lowered in and backfilled (refer LRMP)

Operational and decommissioning phase mitigation measures

Measures to minimise impacts

- Implementation of the Fauna Handling Procedures (refer Appendix C)
- Implement the relevant operational and decommissioning phases of the LRMP and PWMP

18.2 Fork-tailed swift

18.2.1 EPBC Act legal status

Migratory (CAMBA, JAMBA and ROKAMBA)

18.2.2 Biology and ecology

Characteristics

The Fork-tailed swift (*Apus pacificus*) is a medium-sized Swift with a length of 18 to 21 cm, a wingspan of 40 to 42 cm and weighs around 30 to 40 g. The body is slim, with long scythe-shaped wings that taper to finely pointed tips. It is characterised by a long and deeply forked tail. The species is mainly blackish with a white band across the rump and a white patch on the chin and throat. The sexes are alike, with juveniles also indistinguishable in the field (DSEWPaC 2012m).

Fork-tailed swift (Source: Francksan, date unknown)

Known distribution

This species occurs throughout the majority of Australian except for south-eastern Western Australian and western South Australia.

Figure 18.3 is an indicative distribution map of the present distribution of the Fork-tailed swift.

Within Queensland this species is normally found in higher abundance west of the Great Dividing Range, while east of the range records are more scattered. There is limited information on the population size (DSEWPaC 2012m).

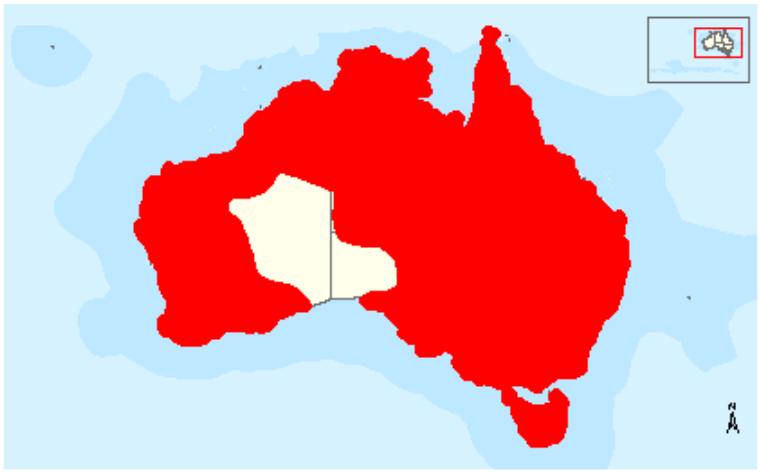


Figure 18.3 Distribution range of the Fork-tailed swift (Source: DSEWPaC 2012m)

Known species populations and their relationship with the GTP footprint

Likely to over-fly the entire Project area (during migration period) and was observed from Arcadia Valley during the pre-clearing surveys. This species is highly mobile and is likely to overfly the entire GTP and as such habitat mapping is not included.

Biology and reproduction

This species flies anywhere between 1 and 300 m above the ground, with the species highly mobile in Australia. The species forages for insects generally in flocks (10 to 1,000) along the edge of low pressure.

The Fork-tailed swift is a non-breeding migrant to Australia usually in the summer (October to April) (DSEWPaC 2012m, Pizzey & Knight 2007).

The species migration period is detailed in Table 18.3.

Table 18.3 Migration period to Australia (Pizzey & Knight 2007)

Australian Migrants	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Apus pacificus (Fork-tailed swift)												

18.2.3 Habitat

This species is usually observed flying over open country (from semi-arid to coastal zones and islands), however occasionally observed flying over forests and cities (Pizzey & Knight 2007).

18.2.4 Habitat assessment

Information obtained from BPA (ie Brigalow Belt South Fauna Expert Panel Report (EPA 2006)), together with expert advice, site based species records and pre-clearance survey data have been used to define a set of assumptions that have been used to identify areas of habitat that are consistent with the definitions of ‘core habitat’, ‘essential habitat’ and ‘general habitat’ that have been presented in Part 1 of this SSMP. The Fork-tailed swift habitat assessment assumptions are presented below.

General assumptions

The following habitat assumptions have been made based on current scientific knowledge of this species:

- This species is aerial and hunts and courts in flight. Is reported to roost on cliffs and large trees, but also known to sleep whilst in flight (Pizzey & Knight 1997)
- This species does not breed in Australia. Breeding occurs in Siberia and the Himalayas (Pizzey & Knight 1997)

Core habitat

Core habitat consists of 'essential habitat' in which the species is known and the habitat is recognised under relevant recovery plans or other relevant plans/policies/regulations. Also included within this category are populations that are limited geographically within the region.

As the Fork-tailed swift is a ubiquitous species with an extensive distribution both within, and outside of Australia, it is not considered that 'core habitat' exists for this species within the GTP footprint.

Essential habitat

'Essential habitat' is an area containing resources that are considered essential for the maintenance of populations of the species (eg potential habitat for breeding, roosting, foraging, shelter, for either migratory or non-migratory species). 'Essential habitat' is defined from known records and/or expert advice (including the findings of pre-clearance surveys).

As the Fork-tailed swift is a ubiquitous species with an extensive distribution both within, and outside of Australia, it is not considered that 'essential habitat' exists for this species within the GTP footprint. Pre-clearance surveys confirm this assumption.

General habitat

'General habitat' consists of areas or locations that are used by transient individuals or where species may have been recorded but where there is insufficient information to assess the area as essential/core habitat. 'General habitat' also includes areas defined from known records or habitat that is considered to potentially support a species according to expert knowledge of habitat relationships, despite the absence of specimen backed records. 'General habitat' may include areas of suboptimal habitat for species. As potential habitat for many species contained within this SSMP may include most of the regional ecosystems of the Brigalow Belt Bioregion, the 'general habitat' category restricts the habitat to a more limited and realistic set of environmental parameters that are supported by literature and field based observation. As the Fork-tailed swift is highly mobile, there is potential for it to utilise airspace above the entire alignment. However, as this species does not utilise terrestrial based habitats, it is considered that no general 'land based' habitat occurs within the GTP footprint.

Unlikely habitat

'Unlikely habitat' areas are those areas that do not contain records of the particular species and do not contain habitat features to support the species (ie areas that do not meet the habitat assumptions identified above).

18.2.5 Anticipated threats and potential impacts as a result of the GTP

- Changes to foraging patterns as a result anthropogenic activities (eg dust and noise)

18.2.6 Unavoidable impact and unavoidable adverse (offsetable) impact from GTP

No unavoidable impacts or unavoidable adverse (offsetable) impacts are anticipated for this species.

18.2.7 Management practices and methods

Pre-construction mitigation measures

Measures to minimise impacts

- As part of the pre-clearing surveys migratory species are identified and recorded. This includes nesting sites and associated habitat in which the species was observed
- Prior to site entry, all site personnel shall be appropriately trained and made aware of the sensitive environs in which they will be working (refer Part 1, Section 7.7). This includes the likelihood of migratory species being present or describing known areas

Construction phase mitigation measures

Measures to minimise impacts

- All works will be undertaken in accordance with the conditions of any applicable statutory approvals
- Implementation of the Fauna Handling Procedures (refer Appendix C)
- All reasonable effort will be made to minimise night work, whereever possible. Wherever constructability allows, any night lighting associated with the construction phase of the project will be directed landwards and facing away from the coastline. In addition, measures to limit light pollution spilling onto mapped roosting area shall be implemented (eg light guards, etc)
- Noise and vibration measures such as regular maintenance of equipment will be adopted
- Clearing will be conducted in a sequential manner and in a way that directs escaping wildlife away from the clearing activities and into adjacent natural areas. With the exception of the spotter catcher, no migratory birds will be physically moved on at any time
- A licensed and experienced spotter catcher(s) will be onsite during all clearing activities and will ensure any injured animals are given to an appropriate wildlife carer group or vet (refer Appendix C)
- Weather permitting, rehabilitation of all habitats impacted as a result of construction works, will commence immediately after the pipeline has been lowered in and backfilled (refer LRMP)

Operational and decommissioning phase mitigation measures

Measures to minimise impacts

- Implementation of the relevant operational and decommissioning phases of the LRMP and PWMP (refer Appendix A and B)
- Implementation of the Fauna Handling Procedures (refer Appendix C)

18.3 White-bellied sea-eagle

18.3.1 EPBC Act legal status

Migratory (CAMBA)

18.3.2 Biology and ecology

Characteristics

The White-bellied sea-eagle (*Haliaeetus leucogaster*) is a large raptor that has long, broad wings and a short, wedge-shaped tail. The species measures 75 to 85 cm in length, and has a wingspan of 180 to 220 cm (DSEWPaC 2012n).

The plumage of adult birds is predominantly white and grey. The head, breast and belly, and the feathering on the legs, are white, while the back and upper surfaces of the wings are grey, with black tips. The undersides of the wings are greyish-black around the distal edges, with a smaller area of white along the leading edge. The tail is grey at the base, and has a white tip.

Juveniles differ from the adults in appearance, with juveniles having predominantly dark brown plumage on the upper parts, except for the creamy colouring on the head, and creamy markings over the rest of the upper parts. The underside of the body is a similar colour to the upper parts, but becomes paler with wear. The underside of the wing is patterned with a mixture of orange-buff, white, dark brown and dark grey. There is a gradual transition (several moults over several years) from the brown and cream plumage of juvenile birds to the white and grey plumage of the adults (DSEWPaC 2012n).

White-bellied sea-eagle (Source: Department of Sustainability & Environment, date unknown)

Known distribution

The species is distributed along the coastline (including offshore islands) of mainland Australia and Tasmania. The species also occurs inland along some of the larger waterways, especially in eastern Australia. Analysis indicates that distribution may shift in response to climatic conditions, with an apparent decreased occupancy of inland sites (and increased occupancy of coastal sites) during drought conditions (DSEWPaC 2012n).

Figure 18.4 is an indicative distribution map of the present distribution of the White-bellied sea-eagle.

The total population size of is estimated at more than 500 pairs (DSEWPaC 2012n). No specific information is available on the number of subpopulations. Some populations are geographically isolated, for example, the Tasmanian population; however such populations are not genetically isolated. No specific populations have been identified as being critical to the long-term survival and recovery of the species (DSEWPaC 2012n). There is limited published data available on the population dynamics of the central Queensland populations.

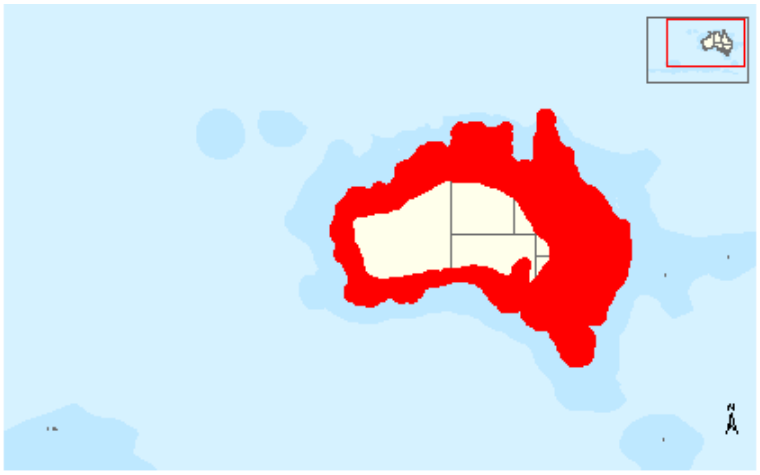


Figure 18.4 Distribution range of the White-bellied sea-eagle (Source: DSEWPaC 2012n)

Known species populations and their relationship with the GTP footprint

This species was identified from a wetland area within Arcadia Valley, approximately 5 km west of the GTP footprint. The species is likely to overfly sections of the GTP footprint in this area as it is known to forage over terrestrial habitats and this species has a large home range.

The species was also identified from other areas of the GTP footprint in particular the sections of the GSDA near Larcom Creek, Kangaroo Island and Curtis Island. This species has a large foraging area and will overfly other sections of the GTP footprint, including non-remnant areas.

Biology and reproduction

The White-bellied sea-eagle is described as a breeding resident throughout much of its distribution. The species home range, which is generally close to water bodies can be up to 100 km^2 (DSEWPaC 2012n).

The White-bellied sea-eagle is generally seen singularly or in pairs, though it may occasionally congregate around sites where food is abundant. The White-bellied sea-eagle

hunts its prey from a perch or whilst in flight, including fish, birds, reptiles, mammals and crustaceans. This species also feeds on carrion and offal feeds (DSEWPaC 2012n).

The species first breeds at approximately six years old, with a high mortality rate in newly-independent young birds. If juveniles survive to breeding age they may live for up to 30 years (DSEWPaC 2012n).

Breeding has been recorded from only a relatively small area of the total distribution, with patchy distribution along the coastline, and especially the eastern coast. However, the species could potentially breed throughout much of its range (DSEWPaC 2012n).

The start of nesting season is when the species is most vulnerable, with a risk that a breeding pair could desert the nest. This species is a breeding resident throughout much of its range, with breeding adult birds generally sedentary and monogamous (DSEWPaC 2012n). In Northern Australia, the breeding period for this species is between May and August. The nest of the White-bellied sea-eagle is quite large and often found in tall trees near water, remote coastal cliffs or on the ground on islands, bushes, mangroves, rocky outcrops, caves, crevices, on the ground and on artificial structures (Pizzey & Knight 2007, DSEWPaC 2012n).

The species breeding period is detailed in Table 18.4.

Table 18.4 Breeding period for the White-bellied sea-eagle (Orange indicates breeding period)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Clutches for this species usually consist of two eggs, with the eggs incubated for approximately six weeks. The nestlings remain in the nest for 65 to 70 days or more, while the fledged young may be fed by the adults for up to three months after leaving the nest. Fledglings are driven out of their parents breeding territory approximately four months after fledging (DSEWPaC 2012n).

18.3.3 Habitat

This species is a local migrant throughout Australia and inhabits coastal areas, islands, estuaries, inlets, rivers and inland lakes. The species will overfly a variety of terrestrial habitats (such as coastal dunes, tidal flats, grasslands, heathlands, woodland, eucalypt forests, rainforests and urban areas) but will also forage over wide expanses of open water (DSEWPaC 2012n).

18.3.4 Habitat assessment

Information obtained from BPA (ie Brigalow Belt South Fauna Expert Panel Report (EPA 2006)), together with expert advice, site based species records and pre-clearance survey data have been used to define a set of assumptions that have been used to identify areas of habitat that are consistent with the definitions of ‘core habitat’, ‘essential habitat’ and ‘general habitat’ that have been presented in Part 1 of this SSMP. The White-bellied sea-eagle habitat assessment assumptions are presented below.

General assumptions

The following habitat assumptions have been made based on current scientific knowledge of this species:

- Species is associated with freshwater and/or saline wetlands (DSEWPaC 2012n). As such, areas mapped as 'marine', estuarine' and lacustrine' Wetland Regional Ecosystems as well as 'marine', estuarine, lacustrine' waterbodies on the Queensland Wetland Mapping wetlands on the Queensland Wetland Mapping (Version 3.0) are considered to contain the required habitat attributes for this species

Core habitat

Core habitat consists of 'essential habitat' in which the species is known and the habitat is recognised under relevant recovery plans or other relevant plans/policies/regulations. Also included within this category are populations that are limited geographically within the region.

As the White-bellied sea-eagle is a ubiquitous species with an extensive distribution within Australia, it is not considered that 'core habitat' exists for this species within the GTP footprint.

Essential habitat

'Essential habitat' is an area containing resources that are considered essential for the maintenance of populations of the species (eg potential habitat for breeding, roosting, foraging, shelter, for either migratory or non-migratory species). 'Essential habitat' is defined from known records and/or expert advice (including the findings of pre-clearance surveys).

As the White-bellied sea-eagle is a ubiquitous species with an extensive distribution within Australia, it is not considered that 'essential habitat' exists for this species within the GTP footprint. Pre-clearance surveys confirm this assumption.

General habitat

'General habitat' consists of areas or locations that are used by transient individuals or where species have been recorded but there is insufficient information to assess the area as essential/core habitat. 'General habitat' may be defined from known records or habitat that is considered to potential support a species according to expert knowledge of habitat relationships, despite the absence of specimen backed records. 'General habitat' may include areas of suboptimal habitat for species.

For the White-bellied sea-eagle all areas that are mapped as 'marine', estuarine', 'lacustrine' and pulstrine' Wetland Regional Ecosystems as well as 'marine', estuarine' and 'lacustrine' waterbodies on the Queensland Wetland Mapping wetlands (Version 3.0) and areas with a 'stream order' of '4' and above as indicated on DEHP's watercourse mapping (Version 2.1) are considered to constitute 'general habitat' for this species.

KP0 to KP30

The location of the 'general habitat' for this species within KP0 to KP30 is shown in Figure 18.5a.

KP30 to KP40

KP30 to KP32.25 has been identified during the pre-clearance surveys as meeting the criteria of 'general habitat' for this species.

The location of the 'general habitat' for this species within KP30 to KP40 is shown in Figure 18.5b.

KP40 to KP130

The location of the 'general habitat' for this species within KP40 to KP130 is shown in Figure 18.5c.

KP130 to KP312

Conciliation Creek (KP207.47), Dawson River area (KP233 to KP235), KP249.5, KP295.6 to KP297.4 and Callide Creek (KP298.95) has been identified during the pre-clearance surveys as meeting the criteria of 'general habitat' for this species (Santos GLNG 2012).

The location of the 'general habitat' for this species within KP130 to KP312 is shown in Figure 18.5d and Figure 18.5e.

KP312 to KP408.81

Pre-clearance surveys identified 'general habitat' at Calliope River (KP352.3), Harper Creek (KP360.3), Larcom Creek (KP378) and a wetland located within KP407.87 to KP407.89 (Santos GLNG 2013).

The location of the 'general habitat' for this species within KP312 to KP408.81 is shown in Figure 18.5f and Figure 18.5g.

KP408.81 to KP409.04

No 'general habitat' for this species exists in this section of the GTP although 'general habitat' for this species exists outside of KP408.81 to KP409.04 and is shown in Figure 18.5h.

KP413.57 to KP419.69

Pre-clearance surveys identified 'general habitat' for this species within this section of the GTP. A raptor nest, possibly a White-bellied sea-eagle nest was identified outside of the ROW (approximately 50 m to the south of KP414.2, adjacent to the QCLNG GTP ROW). Further investigation of the QCLNG Narrows Crossing Project Pre-clearance Survey Report (GHD 2011) identified the same nest as an active White-bellied sea-eagle nest occupied by two individuals.

The location of the 'general habitat' for this species within KP413.57 to KP419.69 is shown in Figure 18.5i.

Unlikely habitat

'Unlikely habitat' areas are those areas that do not contain records of the particular species and do not contain habitat features to support the species (ie areas that do not meet the habitat assumptions identified above).

18.3.5 Anticipated threats and potential impacts as a result of the GTP

- Degradation of potential foraging habitat for this species (ie attenuated grasslands within Arcadia Valley)
- Changes to foraging patterns as a result of increases in noise, vibration, movement and dust, stress, injury and death to animals due to anthropogenic activities

No impacts on breeding areas as a result of this GTP Project are anticipated as no breeding sites have been identified within the GTP footprint as part of pre-clearance surveys.

18.3.6 Unavoidable impact and unavoidable adverse (offsetable) impact from GTP

Areas of proposed disturbance and areas of adverse (offsetable) impact associated with clearing and construction activities for the GTP between KP0 to 30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 of White-bellied sea-eagle habitat is presented in Table 18.5. It is important to note that this unavoidable impact is considered minor and temporary in the context of the wide spread extent of 'general habitat' in the region. The location of the 'general habitat' is shown in Figure 18.5a, Figure 18.5b, Figure 18.5c, Figure 18.5d, Figure 18.5e, Figure 18.5f, Figure 18.5g, Figure 18.5h and Figure 18.5i.

A cumulative total of proposed clearing of habitat for the White-bellied sea-eagle and the cumulative total of unavoidable adverse (offsetable) impact to the species habitat is provided in Table 18.5.

Table 18.5 Cumulative total of White-bellied sea-eagle habitat to be cleared and area of habitat subject to unavoidable adverse (offsetable) impacts from the GTP

Location	'General habitat'	Total habitat area per GTP section	Total habitat area adversely impacted per GTP section
KP0 to KP30	25.73 ha	25.73 ha	8.93 ha
KP30 to KP40	6.94 ha	6.94 ha	4.50 ha
KP40 to KP130	10.38 ha	10.38 ha	0.34 ha
KP130 to KP312	129.49 ha	129.49 ha	7.08 ha
KP312 to KP408.81	34.81 ha	34.81 ha	1.04 ha
KP408.81 to KP409.04	0 ha	0 ha	0 ha
KP413.57 to KP419.69	3.20 ha	3.20 ha	3.20 ha
Total habitat area	**210.55 ha**	**210.55 ha**	**25.09 ha**

18.3.7 Management practices and methods

Pre-construction mitigation measures

Measures to minimise impacts

- As part of the pre-clearing surveys migratory species have been identified and recorded. This includes nesting sites and associated habitat in which the species was observed
- Prior to site entry, all site personnel will be appropriately trained and made aware of the sensitive environs in which they will be working (refer Part 1, Section 7.7). This includes the likelihood of migratory species being present or describing known areas
- Where appropriate, signage will be erected to increase personnel awareness of the migratory nesting locations and/or 'No Go' zones within and adjacent the GTP footprint
- No nests will be disturbed or destroyed
- Active nests will be declared temporary 'No Go' zones (where the GLNG ROW and ancillary works areas are within a 200 m radius around tree) and potential actions such as avoidance or relocation will be determined in consultation with DotE
- Approximately 1 to 2 weeks prior to the commencement of construction clearing, a licensed and experienced spotter catcher(s) will undertake a targeted survey to

ensure there are no nesting White-bellied sea-eagles present within the ROW. There will be a key focus on checking the known nest site listed above to reduce the overall risk of injury, fatality or significant disturbance to local inhabitants during clearing activities

Construction phase mitigation measures

Measures to avoid impact

- No nests will be disturbed or destroyed

Measures to minimise impacts

- All works will be undertaken in accordance with the conditions of any applicable statutory approvals
- Disturbance to remnant vegetation and applicable palustrine, riverine and lacustrine wetlands creek lines and river banks will be minimised to a width of 30 m or less
- All waste/rubbish will be correctly disposed of so as to not pose a risk to local fauna
- Implementation of the Fauna Handling Procedures (refer Appendix C)
- Temporary exclusion zones where the ROW and ancillary works areas are within 200 m of active nests will be regularly checked to ensure they are clearly marked out
- If nests become active during the construction phase, no construction activities will be undertaken within the GLNG GTP ROW and ancilary works areas where they are located within the 200 m exclusion zone until the nest becomes inactive or mitigation measures are implemented in consultation with DotE
- All reasonable effort will be made to minimise night work, wherever possible. Wherever constructability allows, any night lighting associated with the construction phase of the project will be directed landwards and facing away from the coastline. In addition, measures to limit light pollution spilling onto mapped roosting area will be implemented (eg light guards, etc)
- Noise and vibration measures such as regular maintenance of equipment will be adopted
- Clearing activities within these areas will be supervised by the EO
- Clearing will be conducted in a sequential manner and in a way that directs escaping wildlife away from the clearing activities and into adjacent natural areas. With the exception of the spotter catcher, no migratory birds will be physically moved on at any time
- A licensed and experienced spotter catcher(s) will be onsite during all clearing activities and must ensure any injured animals are given to an appropriate wildlife carer group or vet (refer Appendix C)
- Weather permitting, rehabilitation of all habitats impacted as a result of construction works, will commence immediately after the pipeline has been lowered in and backfilled (refer LRMP)

Operational and decommissioning phase mitigation measures

Measures to minimise impacts

- Implementation of the relevant operational and decommissioning phases of the LRMP and PWMP (refer Appendix A and B)
- Implementation of the Fauna Handling Procedures (refer Appendix C)
- No nests will be disturbed or destroyed

18.4 Great egret

18.4.1 EPBC Act legal status

Migratory (CAMBA and JAMBA)

18.4.2 Biology and ecology

Characteristics

The Great egret (*Ardea alba*) is a moderately large bird (83 to 103 cm in length, 700 to 1,200 g in weight) with white plumage, a black or yellow bill and long reddish and black legs. During the breeding season the colour of the bare parts change (DSEWPaC 2012o).

Great egret (Source: Baird 2009)

Known distribution

The species is a widespread throughout southern and eastern Asia and Australasia. The species occur throughout the majority of Australia. There are no published estimates of the extent of occurrence of this species in Australia, however the area of occupancy is estimated at 408,400 km² (DSEWPaC 2012o).

Figure 18.6 is an indicative distribution map of the present distribution of the Great egret.

It is estimated that there are between 25,000 and 100,000 individuals within Australia. The most important populations, based on the capacity for recruitment and abundance, are the breeding populations that occur at the Top End, in the Channel Country and in the Darling Riverine Plains and Riverina regions. It should be noted that minor breeding sites are scatted across this species range, including the central Queensland Coast (DSEWPaC 2012o). However, no known breeding sites have been documented within the Port Curtis area.

Figure 18.6 Distribution range of the Great egret (Source: DSEWPaC 2012o)

Known species populations and their relationship with the GTP footprint

No individuals were observed from the Project area during pre-clearing surveys. However, this species is highly mobile and may occur within the Project area in a wide range of habitats, including roadside depressions, subject to rainfall or water. The species was observed from ephemeral and permanent wetlands (including dams) in Arcadia Valley (Ecologica Consulting 2012).

Individuals were observed at several creeks within the KP130 to KP312 section of the GTP ROW during the pre-clearance surveys (Santos GLNG 2012).

Given the location of the project footprint no breeding or roosting habitat is likely to occur within or near the project area (ie Central Queensland and no major wetland systems).

Suitable habitat for this species within KP312 to KP408.81 and KP408.81 to KP409.04 of the GTP and ancillary areas is considered to be limited and to areas used during migration.

Biology and reproduction

This species is dispersive and, in parts of its range, migratory and is often observed as a solitarily individual, or in small groups when feeding. They roost in large flocks that may consist of hundreds of birds (DSEWPaC 2012o).

The species exhibits a diverse array of complex foraging behaviours, including foraging by wading through shallow to moderately deep water, by standing in water and capturing prey that wanders nearby, or by walking over shore or dry ground. Prey is taken from water and vegetation but not from sediments. Prey species include fish, insects, crustaceans, molluscs, frogs, lizards, snakes and small birds and mammals (DSEWPaC 2012o).

The breeding season is variable and depends to some extent on rainfall, but generally extends from November to April. The Great egret usually nests in colonies and builds its nest as a platform of sticks in treetops over water in swampy woodlands and mangrove communities (DSEWPaC 2012o, Pizzey & Knight 2007). These colonies can be mono-specific or more commonly mixed with other wader/waterbird species. Two to six, but usually three to five eggs are laid, with both parents incubating the eggs (23 to 29 days). Fledglings depart the nest or colony between 55 to 88 days of age (DSEWPaC 2012o).

18.4.3 Habitat

This species is a local migrant throughout Australia and inhabits shallow points of rivers, estuaries, mudflats, freshwater wetlands, irrigated pastures, dams and sewerage ponds (Pizzey & Knight 2007).

18.4.4 Habitat assessment

Information obtained from BPA (ie Brigalow Belt South Fauna Expert Panel Report (EPA 2006)), together with expert advice, site based species records and pre-clearance survey data have been used to define a set of assumptions that have been used to identify areas of habitat that are consistent with the definitions of 'core habitat', 'essential habitat' and 'general habitat' that have been presented in Part 1 of this SSMP. The Great egret habitat assumptions are presented below.

General assumption

The following general habitat assumption has been made based on current scientific knowledge of this species:

- Species is often associated with freshwater and/or saline wetlands (DSEWPaC 2012o). As such, areas mapped as 'marine', 'estuarine', 'riverine', 'lacustrine' and 'pulstrine' Wetland REs as well as 'marine', estuarine, 'riverine', lacustrine' and 'pulstrine' waterbodies on the Queensland Wetland Mapping wetlands on the Queensland Wetland Mapping (Version 3.0) are considered suitable habitat for this species along with permanent anthropogenic water sources such as farm dams

Core habitat

Core habitat consists of 'essential habitat' in which the species is known and the habitat is recognised under relevant recovery plans or other relevant plans/policies/regulations. Also included within this category are populations that are limited geographically within the region.

As the Great egret is a ubiquitous species with an extensive distribution both within, and outside of Australia, it is not considered that 'core habitat' exists for this species within the GTP footprint.

Essential habitat

'Essential habitat' is an area containing resources that are considered essential for the maintenance of populations of the species (eg potential habitat for breeding, roosting, foraging, shelter, for either migratory or non-migratory species). 'Essential habitat' is defined from known records and/or expert advice (including the findings of pre-clearance surveys).

As the Great egret is a ubiquitous species with an extensive distribution both within and outside of Australia, it is not considered that 'essential habitat' exists for this species within the GTP footprint. Pre-clearance surveys confirm this assumption.

General habitat

'General habitat' consists of areas or locations that are used by transient individuals or where species may have been recorded but where there is insufficient information to assess the area as essential/core habitat. 'General habitat' also includes areas defined from known records or habitat that is considered to potentially support a species according to expert knowledge of habitat relationships, despite the absence of specimen backed records. 'General habitat' may include areas of suboptimal habitat for species. As potential habitat for many species contained within this SSMP may include most of the regional ecosystems of the Brigalow Belt Bioregion, the 'general habitat' category restricts the habitat to a more limited and realistic set of environmental parameters that are supported by literature and field based observation For the Great egret all areas that are mapped as 'marine', estuarine', 'riverine', 'lacustrine' and pulstrine' Wetland REs as well as 'marine', estuarine, 'riverine', lacustrine' and 'pulstrine' waterbodies on the Queensland Wetland Mapping wetlands (Version 3.0) are considered to constitute 'general habitat' for this species.

KP0 to KP30

No 'general habitat' for this species exists within this section of the GTP.

KP30 to KP40

No 'general habitat' for this species exists within this section of the GTP.

KP40 to KP130

Figure 18.7a shows the location of 'general habitat' for the Great egret within this section of the GTP.

KP130 to KP312

Individuals of this species were sighted within KP177.24 to KP177.76, KP184, Mimosa Creek (KP220.13) and a dam to the west of the ROW at KP288.14 (Santos GLNG 2012).

KP183.7 to KP184.25, Conciliation Creek (KP207.47), Dawson River area (KP233.75 to KP234.5), Sellheim Creek area (KP280 to KP280.75), wetland areas within KP295.6 to KP298.95 and the riparian zone at KP300 has been identified during the pre-clearance surveys as meeting the criteria of 'general habitat' for this species (Santos GLNG 2012).

The location of the 'general habitat' for this species within KP130 to KP312 is shown in Figure 18.7b and Figure 18.7c.

KP312 to KP408.81

Pre-clearance surveys identified 'general habitat' for this species at Calliope River (KP352.3), Harper Creek (KP360.3) and wetlands located within KP362.54 to KP362.75 and KP407.87 to KP407.89 (Santos GLNG 2013).

The location of the 'general habitat' for this species within KP312 to KP408.81 is shown in Figure 18.7d and Figure 18.7e.

KP408.81 to KP409.04

No 'general habitat' for this species exists within KP408.81 to KP409.04 of the GTP although 'general habitat' for this species exists in close proximity to the ROW and ancillary areas and is shown in Figure 18.7f.

KP413.57 to KP419.69

Pre-clearance surveys did not identify ‘general habitat’ for this species within this section of the GTP although ‘general habitat’ was identified within close proximity to the GTP and is shown in Figure 18.7g.

Unlikely habitat

‘Unlikely habitat’ areas are those areas that do not contain records of the particular species and do not contain sufficient habitat features to support the species (ie areas that do not meet the habitat assumptions identified above).

18.5 Cattle egret

18.5.1 EPBC Act legal status

Migratory (CAMBA and JAMBA)

18.5.2 Biology and ecology

Characteristics

The Cattle egret (*Ardea ibis*) is about 70 cm in length, while the wingspan and weight vary between sexes; males have a wingspan of 91 cm and weight of 390 g, while the females have a wingspan of 88 cm and weight of 340 g (DSEWPaC 2012p).

The species is small, stocky and mostly white with a short neck and stout yellow-red bill. During breeding and courtship the species has a heavy jowl, orange-buff crown, neck, breast and mantle. There is a marked seasonal variation in plumages during the breeding and non-breeding seasons. The juveniles are indistinguishable from non-breeding adults until the end of their first year when they may develop coloration during the breeding season (DSEWPaC 2012p).

Cattle egret (Non breeding and breeding colours) (Source: Burns 2011, Burnett 2006)

Known distribution

In Australian the species is a partial migrant. Two major distributions have been located: from north-east Western Australia to the Top End of the Northern Territory and around south-east Australia. The south-east distribution occurs from Bundaberg, inland to Roma, Thargominda, and then down through Inverell, Walgett, Nyngan, Cobar, Ivanhoe, Balranald to Swan Hill, and then west to Pinnaroo and Port Augusta (DSEWPaC 2012p).

Figure 18.8 is an indicative distribution map of the present distribution of the Cattle egret.

It is estimated that there are over 100,000 individuals inhabiting Australia and New Zealand.

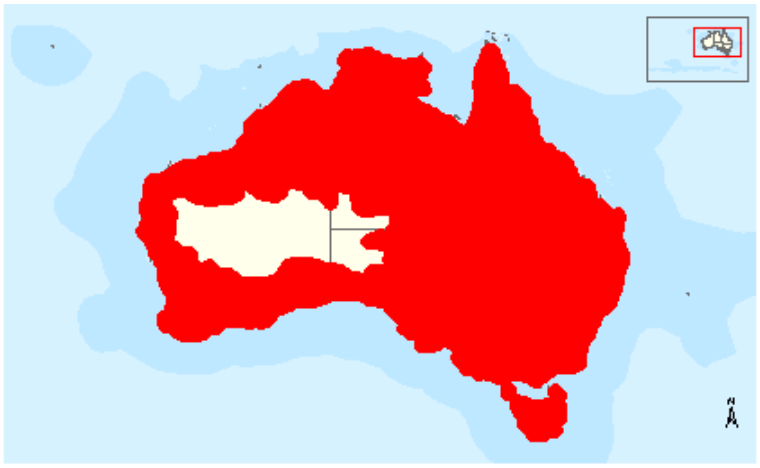


Figure 18.8 Distribution range of the Cattle egret (Source: DSEWPaC, 2012u)

Known species populations and their relationship with the GTP footprint

There is the potential for the species to be found throughout the Project area, in particular grazing areas with cattle and wetlands.

No individuals were observed from the GTP footprint during pre-clearing surveys. However, this species is highly mobile and may occur within the GTP footprint in a wide range of habitats, including roadside depressions, subject to rainfall or water.

Given the location of the project footprint no breeding or roosting habitat is likely to occur within or near the Project area (ie Central Queensland and no major wetland systems).

Suitable habitat for this species within KP312 to KP408.81 and KP408.81 to KP409.04 of the GTP and ancillary areas is considered to be limited and to areas used during migration.

Biology and reproduction

The Cattle egret derives its name from its habit of associating with cattle (eg eating ticks and flies off the backs of livestock). The species also preys on other insects, frogs, lizards, snakes and small mammals (DSEWPaC 2012p). Foraging normally occurs away from water on low lying grasslands, improved pastures and croplands (DSEWPaC 2012p).

Breeding in the eastern colonies usually occurs in a well-defined period from October to January, occasionally extending by a month either side. Breeding generally occurs close to the coast from Bundaberg south (DSEWPaC 2012p). The Cattle egret usually nests in colonies and builds its nest as a small, untidy platform of sticks in foliage in swampy woodlands (Pizzey & Knight 2007). Nests are sited usually in middle to upper branches (DSEWPaC 2012p).

18.5.3 Habitat

This species is a local migrant throughout Australia and inhabits paddocks, pastures, croplands, garbage tips, wetlands, mudflats and drainage areas and is frequently associated with cattle (Pizzey & Knight 2007).

The species breeds in colonies in wooded swamps such as mangrove forests (eg the lower Adelaide River, Northern Territory), *Melaleuca* swamps (eg Shortland, NSW) and the eucalypt/lignum swamps of the Murray-Darling Basin. They may breed in artificial situations or close to urban areas; generally the nesting trees are inundated except where breeding on small islands (DSEWPaC 2012p).

18.5.4 Habitat assessment

Information obtained from BPA (ie Brigalow Belt South Fauna Expert Panel Report (EPA 2006)), together with expert advice, site based species records and pre-clearance surveys have been used to define a set of assumptions used to identify areas of habitat that are consistent with the definitions of 'core habitat', 'essential habitat' and 'general habitat' that have been presented in Part 1 of this SSMP. The Cattle egret habitat assumptions are presented below.

General assumptions

The following general habitat assumptions have been made based on current scientific knowledge of this species:

- Species is often associated with freshwater wetlands. As such, areas mapped as 'riverine', 'lacustrine' and 'palustrine' Wetland REs as well as 'riverine', 'lacustrine' and 'palustrine' waterbodies on the Queensland Wetland Mapping (Version 3.0) are considered suitable habitat for this species along with permanent anthropogenic water sources such as farm dams
- The species has been identified as utilising low-lying grasslands, improved pasture and cropland as foraging habitat (DSEWPaC 2012p). As a result of this, areas mapped as 'non-remnant' contained within 3 km of a wetland are considered habitat for this species

Core habitat

Core habitat consists of 'essential habitat' in which the species is known and the habitat is recognised under relevant recovery plans or other relevant plans/policies/regulations. Also included within this category are populations that are limited geographically within the region.

As the Cattle egret is a ubiquitous species with an extensive distribution both within, and outside of Australia, it is not considered that 'core habitat' exists for this species within the GTP footprint.

Essential habitat

'Essential habitat' is an area containing resources that are considered essential for the maintenance of populations of the species (eg potential habitat for breeding, roosting, foraging, shelter, for either migratory or non-migratory species). 'Essential habitat' is defined from known records and/or expert advice (including the findings of pre-clearance surveys).

As the Cattle egret is a ubiquitous species with a distribution both within and outside of Australia, it is not considered that 'essential habitat' exists for this species within the GTP footprint. Pre-clearance surveys confirm this assumption.

General habitat

'General habitat' consists of areas or locations that are used by transient individuals or where species have been recorded but there is insufficient information to assess the area as essential/core habitat. 'General habitat' may be defined from known records or habitat that is considered to potential support a species according to expert knowledge of habitat relationships, despite the absence of specimen backed records. 'General habitat' may include areas of suboptimal habitat for species.

For the Cattle egret 'riverine', 'lacustrine' and pulstrine' Wetland REs as well as 'riverine', lacustrine' and 'pulstrine' waterbodies on the Queensland Wetland Mapping (Version 3.0) and the associated buffer are considered to constitute 'general habitat' for this species.

KP0 to KP30

The location of the 'general habitat' for this species within KP0 to KP30 is shown in Figure 18.9a.

KP30 to KP40

KP36.5 to KP40 has been identified during the pre-clearance surveys as meeting the criteria of 'general habitat' for this species.

The location of the 'general habitat' for this species within KP0 to KP30 is shown in Figure 18.9b.

KP40 to KP130

The location of the 'general habitat' for this species within KP40 to KP130 is shown in Figure 18.9c.

KP130 to KP312

KP149.75 to KP152.75, KP183 to KP190, KP249.5 to KP252, Sellheim Creek area (KP280 to KP280.5), KP294.7 to KP295.5, KP297.5 to KP298.95 and Callide Creek area (KP298.95 to KP300.2) has been identified during the pre-clearance surveys as meeting the criteria of 'general habitat' for this species (Santos GLNG 2012).

The location of the 'general habitat' for this species within KP130 to KP312 is shown in Figure 18.9d and Figure 18.9e.

KP312 to KP408.81

Pre-clearance surveys identified 'general habitat' throughout this section of the GTP ROW, particularly within the non-remnant pasture and cropland areas (Santos GLNG 2013).

The location of the 'general habitat' for this species within KP312 to KP408.81 is shown in Figure 18.9f and Figure 18.9g.

KP408.81 to KP409.04

The location of the 'general habitat' for this species within KP408.81 to KP409.04 is shown in Figure 18.9h.

KP413.57 to KP419.69

Pre-clearance surveys did not identify 'general habitat' for this species within this section of the GTP.

Unlikely habitat

'Unlikely habitat' areas are those areas that do not contain records of the particular species and do not contain sufficient habitat features to support the species (ie areas that do not meet the habitat assumptions identified above).

18.6 Australian painted snipe

18.6.1 EPBC Act legal status

Vulnerable – listed 15 August 2003
Migratory (CAMBA)

18.6.2 Biology and ecology

Characteristics

The Australian painted snipe (*Rostratula australis*) is a stocky wading bird around 220 to 250 mm in length with a long pinkish bill. The adult female, more colourful than the male, has a chestnut-coloured head, with white around the eye and a white crown stripe, and metallic green back and wings, barred with black and chestnut. There is a pale stripe extending from the shoulder into a V down its upper back The adult female is slightly larger and more brightly coloured than the male (DSEWPaC 2012q).

This species is generally seen singly or in pairs, or less often in small flocks (Marchant & Higgins 1993). Flocking occurs during the breeding season, when adults sometimes form loose gatherings around a group of nests. Flocks can also form after the breeding season, and at some locations small groups regularly occur (DSEWPaC 2012q).

Painted snipe (Source: Aviceda 2002a)

Known distribution

The Australian painted snipe has been recorded at wetlands in all states of Australia (Barrett *et al* 2003, Blakers *et al* 1984, Hall 1910b). It is most common in eastern Australia, where it has been recorded at scattered locations throughout much of Queensland, New South Wales, Victoria and south-eastern South Australia (DSEWPaC 2012q).

Figure 18.10 is an indicative distribution map of the present distribution of the Australian painted snipe.

The extent of occurrence of the Australian painted snipe is estimated, with low reliability, to be 4,500,000 km² (Garnett & Crowley 2000).

The total population size of the Australian painted snipe is effectively unknown, but tentative estimates range from a few hundred individuals to 5,000 breeding adults (Garnett & Crowley 2000; Lane & Rogers 2000; Oring *et al* 2004; Watkins 1993).

The Australian painted snipe is considered to occur in a single, contiguous breeding population (Garnett & Crowley 2000).

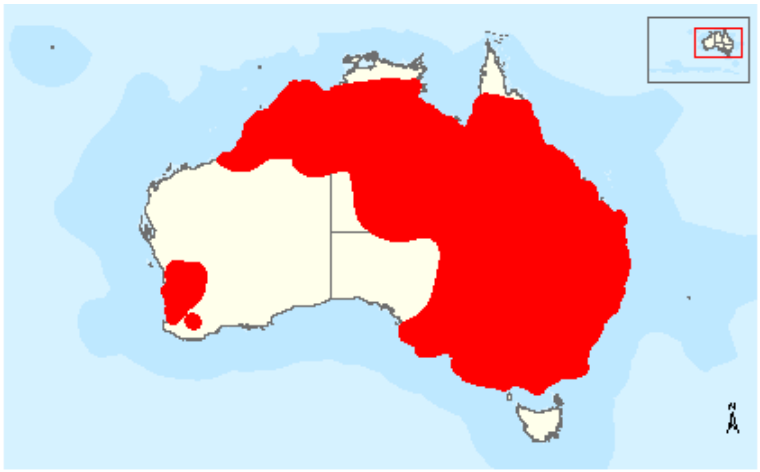


Figure 18.10 Distribution range of the Australian painted snipe (DSEWPaC 2012q)

Known species populations and their relationship with the GTP footprint

Suitable habitat for this species within the Project area is considered to be severely limited and consequently, no individuals were identified during the pre-clearing survey period (Ecologica Consulting 2012).

However, potential habitat is considered to be present adjacent the GTP footprint within palustrine wetlands such as those near KP29 and KP101 (Ecologica Consulting 2012).

Suitable habitat for this species within KP312 to KP408.81 and KP408.81 to KP409.04 of the GTP and ancillary areas is considered to be limited and to areas used during movement from one area of habitat to another.

18.6.3 Biology and reproduction

The Australian painted snipe may breed in response to wetland conditions rather than during a particular season. It has been recorded breeding in all months in Australia. In southern Australia most records have been from August to February. Eggs have been recorded from mid-August to March, with breeding in northern Queensland also recorded between May and October (Marchant & Higgins 1993).

Australian painted snipe breeding habitat requires shallow wetlands with areas of bare wet mud and both upper and canopy cover nearby and nests usually occur on or near small islands in freshwater habitats (DSEWPaC 2012q).

The Australian painted snipe loafs on the ground under clumps of lignum, tea-tree and similar dense bushes (Marchant & Higgins 1993).

In some situations this species is loosely colonial, although nests are widely separated (Lowe 1963). The Australian painted snipe often breeds near nesting Red-necked avocets (*Recurvirostra novaehollandiae*), Banded stilts (*Cladorhynchus leucocephalus*), Red-kneed dotterels (*Erythrogonys cinctus*) and Black-tailed native-hens (*Gallinula ventralis*) (Lowe 1963).

The Australian painted snipe has also been recorded nesting in and near swamps, canegrass swamps, flooded areas including samphire, grazing land, among Cumbungi, sedges, grasses, Salt water couch (*Paspalum*), Saltbush (*Halosarcia*) and grass, also in ground cover of water-buttons and grasses, at the base of tussocks and under low saltbush (Marchant & Higgins 1993).

The nest is usually placed in a scrape in the ground (Pringle 1987), and either has scant lining or is a shallow bowl-shaped nest of dry grass or other plant material (Marchant & Higgins 1993). The Australian painted snipe can also use modified habitats, such as low-lying woodlands converted to grazing pasture, sewage farms, dams, bores and irrigation schemes (Marchant & Higgins 1993).

Rostratula benghalensis and the Australian painted snipe are known to lay two to six (usually three or four) eggs and females may lay up to four clutches in a year. Incubation takes 15 to 21 days (DSEWPaC 2012q).

The female Australian painted snipe mostly breed every two years (del Hoyo *et al* 1996; Marchant & Higgins 1993).

18.6.4 Habitat

The Australian painted snipe generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire; often with scattered clumps of lignum *Muehlenbeckia* or canegrass or sometimes tea-tree (*Melaleuca*) (DSEWPaC 2012q). The Australian painted snipe sometimes utilises areas that are lined with trees, or that have some scattered fallen or washed-up timber (Marchant & Higgins 1993).

This species requires suitable wetland areas even in drought conditions. The species can move to suitable habitat if necessary (Marchant & Higgins 1993).

The Australian painted snipe is not known to associate with any other species or subspecies of fauna or flora that are listed as threatened under the EPBC Act (DSEWPaC 2012q).

18.6.5 Habitat assessment

Information obtained from BPA (ie Brigalow Belt South Fauna Expert Panel Report (EPA 2006)), together with expert advice, site based species records and pre-clearance survey data have been used to define a set of assumptions that have been used to identify areas of habitat that are consistent with the definitions of ‘core habitat’, ‘essential habitat’ and ‘general habitat’ that have been presented in Part 1 of this SSMP. The Australian painted snipe habitat assumptions are presented below.

General assumption

The following general habitat assumption has been made based on current scientific knowledge of this species:

- Species is often associated with freshwater and/or saline wetlands (DSEWPaC 2012q). As such, areas mapped as 'marine', estuarine', 'riverine', 'lacustrine' and pulstrine' Wetland Regional Ecosystems as well as 'marine', estuarine, 'riverine', lacustrine' and 'pulstrine' waterbodies on the Queensland Wetland Mapping wetlands on the Queensland Wetland Mapping (Version 3.0) are considered suitable habitat for this species along with permanent anthropogenic water sources such as farm dams

Core habitat

'Core habitat' consists of 'essential habitat' in which the species is known and the habitat is recognised under relevant recovery plans or other relevant plans/policies/regulations. Also included within this category are populations that are limited geographically within the region.

For the Australian painted snipe all wetlands that are indicated on the Queensland Wetland Mapping (Version 3.0), which overlap with areas identified in the BPA mapping that have been identified as containing a 'State' or 'Regional' 'Corridor' (J-Rating) and/or 'Core Habitat' (H-Rating) and/or 'Habitat for EVR Taxa' (A-Rating) have been mapped as 'core habitat'.

KP0 to KP30

No individuals of this species have been identified within the general vicinity of the KP0 to KP30 section of the GTP; therefore no 'core habitat' exists within this section of the GTP.

KP30 to KP40

No individuals of this species have been identified within the general vicinity of the KP30 to KP40 section of the GTP; therefore no 'core habitat' exists within this section of the GTP.

KP40 to KP130

Individuals of this species have been identified within the general vicinity of the KP40 to KP130 section of the GTP (but outside of the ROW itself), and as these areas meet the criteria outlined above, 'core habitat' has been mapped within this section of the GTP.

Figure 18.11a shows the location of the 'core habitat' for the Australian painted snipe.

KP130 to KP312

Wetlands within KP130 to KP312 overlap with areas identified in the BPA mapping as containing a 'State' or 'Regional' 'Corridor' (J-Rating) and/or 'Core Habitat' (H-Rating) and/or 'Habitat for EVR Taxa' (A-Rating); therefore 'core habitat' exists within this section of the GTP.

Figure 18.11b and Figure 18.11c shows the location of the 'core habitat' for the Australian painted snipe.

KP312 to KP408.81

No individuals of this species have been identified within the general vicinity of KP312 to KP408.81 although pre-clearance surveys identified habitat at Calliope River (KP352.3)

(Santos GLNG 2013). This habitat overlaps with BPA mapping identified as containing a 'State' or 'Regional' 'Corridor' (J-Rating) and/or 'Core Habitat' (H-Rating) and/or 'Habitat for EVR Taxa' (A-Rating); therefore 'core habitat' exists within this section of the GTP. Figure 18.11d and Figure 18.11e shows the location of the 'core habitat' for the Australian painted snipe.

KP408.81 to KP409.04

No 'core habitat' for this species exists within KP408.81 to KP409.04 of the GTP although 'core habitat' for this species exists in close proximity to the ROW and ancillary areas and is shown in Figure 18.11f.

KP413.57 to KP419.69

No individuals of this species have been identified within the general vicinity of the KP413.57 to KP419.69 section of the GTP; therefore no 'core habitat' exists within this section of the GTP.

Essential habitat

'Essential habitat' is an area containing resources that are considered essential for the maintenance of populations of the species (eg potential habitat for breeding, roosting, foraging, shelter, for either migratory or non-migratory species). 'Essential habitat' is defined from known records and/or expert advice (including the findings of pre-clearance surveys).

There are no confirmed records of this species within and in close proximity to KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 of the GTP and ancillary areas.

General habitat

'General habitat' consists of areas or locations that are used by transient individuals or where species may have been recorded but where there is insufficient information to assess the area as essential/core habitat. 'General habitat' also includes areas defined from known records or habitat that is considered to potentially support a species according to expert knowledge of habitat relationships, despite the absence of specimen backed records. 'General habitat' may include areas of suboptimal habitat for species. As potential habitat for many species contained within this SSMP may include most of the regional ecosystems of the Brigalow Belt Bioregion, the 'general habitat' category restricts the habitat to a more limited and realistic set of environmental parameters that are supported by literature and field based observation For the Australian painted snipe all areas that are mapped as wetlands on the Queensland Wetland Mapping (Version 3.0) are considered to constitute 'general habitat' for this species.

KP0 to KP30

No 'general habitat' for this species exists in this section of the GTP.

KP30 to KP40

No 'general habitat' for this species exists in this section of the GTP.

KP40 to KP130

Figure 18.11a shows the location of the 'general habitat' for the Australian painted snipe.

KP130 to KP312

Water course areas identified at KP207.47 (Conciliation Creek) and KP297.5 to KP300.2 has been identified during the pre-clearance surveys as meeting the criteria of 'general habitat' for this species (Santos GLNG 2012).

Figure 18.11b and Figure 18.11c shows the location of the 'general habitat' for the Australian painted snipe.

KP312 to KP408.81

Pre-clearance surveys identified 'general habitat' at Harper Creek (KP360.3) and wetlands located within KP362.54 to KP362.75 and KP407.87 to KP407.89 (Santos GLNG 2013).

Figure 18.11d and Figure 18.11e shows the location of the 'general habitat' for the Australian painted snipe.

KP408.81 to KP409.04

No 'general habitat' for this species exists within KP408.81 to KP409.04 of the GTP although 'general habitat' for this species exists in close proximity to the ROW and ancillary areas and is shown in Figure 18.11f.

KP413.57 to KP419.69

Pre-clearance surveys did not identify 'general habitat' for this species within this section of the GTP although 'general habitat' was identified within close proximity to the GTP and is shown in Figure 18.11g.

Unlikely habitat

'Unlikely habitat' areas are those areas that do not contain records of the particular species and do not contain sufficient habitat features to support the species (ie areas that do not meet the habitat assumptions identified above).

18.7 Eastern osprey

18.7.1 EPBC Act legal status

Marine
Migratory (Bonn)

18.7.2 Biology and ecology

Characteristics

The Eastern osprey (*Pandion cristatus*) is a medium-sized raptor (length 50 to 65 cm, wingspan 145 to 170 cm, weight 1.0 to 1.1 kg in adult males and 1.2 to 1.9 kg in adult females) (DSEWPaC 2012aa). Adults are mainly dark-brown to blackish-brown above and white below with a white head and neck, streaked blackish-brown, a dark-brown to blackish-brown crest, a black stripe across the eye and ear, a band of reddish-brown, brown or dark-brown streaking across the breast (sparse or absent in males), a white and pale greyish-brown underwing with black carpal patches and black trim, a white to pale greyish-brown undertail, yellow irides, a black bill and white to pale grey legs and feet (Johnstone & Storr 1998; Marchant & Higgins 1993). The sexes are similar in appearance but can be distinguished when together by differences in size and plumage (females are typically larger than males and usually have darker and more distinct streaking on the breast). Juveniles are similar in appearance to adults, but can be distinguished by multiple differences in plumage and their darker, yellow-orange irides (Marchant & Higgins 1993).

Eastern osprey (Source: Psylexic 2007)

Known distribution

The total range (breeding plus non-breeding) around the northern coast is more widespread, extending from Esperance in Western Australia to NSW, where records become scarcer towards the south, and into Victoria and Tasmania, where the species is a rare vagrant (Barrett *et al* 2003; Blakers *et al* 1984; Johnstone & Storr 1998; Marchant & Higgins 1993; Morris *et al* 1981). The distribution of the species around the northern coast (south-western Western Australia to south-eastern NSW) appears continuous except for a possible gap at Eighty Mile Beach (Barrett *et al* 2003; Blakers *et al* 1984).

Figure 18.12 is an indicative distribution map of the present distribution of the Eastern osprey.

There are no published estimates of the extent of occurrence of the Eastern osprey within Australia (DSEWPaC 2012aa) although the area of occupancy for this species in Australia is estimated at 117,400 km^2 (DSEWPaC 2012aa).

The Eastern osprey is considered to be moderately common in Australia (Olsen 1998). The species is most abundant in northern Australia, where high population densities occur in remote areas (Garnett 1992; Johnstone & Storr 1998).

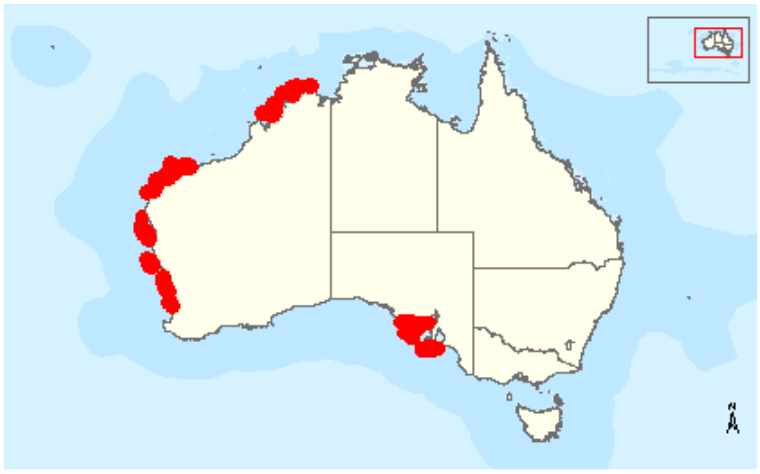


Figure 18.12 Distribution range of the Eastern osprey (DSEWPaC 2012aa)

Known species populations and their relationship with the GTP footprint

Suitable habitat for this species within KP312 to KP408.81 and KP408.81 to KP409.04 of the GTP and ancillary areas is considered to be limited and to areas used during migration/flyover.

Biology and reproduction

In Australia, Eastern ospreys mainly feed on fish, especially mullet where available, and rarely take molluscs, crustaceans, insects, reptiles, birds and mammals (DSEWPaC 2012aa).

Eastern ospreys typically breed in monogamous pairs (Marchant & Higgins 1993; Olsen 1995). The Eastern osprey breeds from April to February in Australia (DSEWPaC 2012aa).

Eastern osprey nests vary in size and shape but they are generally large and are mostly composed of sticks (Bischoff 2001; Clancy 2006; Johnstone & Storr 1998; Kennard & Kennard 2006; Marchant & Higgins 1993; Rose 2000). They are constructed in a variety of natural and artificial sites including in dead or partly dead trees or bushes, on cliffs, rocks, rock stacks or islets, on the ground on rocky headlands, coral cays, deserted beaches, sandhills or saltmarshes and on artificial nest platforms, pylons, jetties, lighthouses, navigation towers, cranes, exposed shipwrecks and offshore drilling rigs (Bischoff 2001; Clancy 2006; Dennis 2007a; Dennis & Baxter 2006; Johnstone & Storr 1998; Marchant & Higgins 1993; Olsen 1995; Rose 2000). Nest sites may be used over many years by one or more pairs (DSEWPaC 2012aa).

Females lay clutches of one to four (but typically two or three) eggs (Hollands 2003; Johnstone & Storr 1998; Marchant & Higgins 1993; Olsen 1995). The eggs are white to buff with brownish (and sometimes also underlying purple or grey) spots and blotches (Hollands 2003; Johnstone & Storr 1998; North 1912). They are incubated by both sexes, but mainly by the female, for a period of 33 to 38 days (Clancy 2006; Hollands 2003; Johnstone & Storr 1998; Kennard & Kennard 2006; Rose 2000).

The nestlings are brooded by the female and by the male when the female is absent from the nest. To begin with they are mainly fed by the female on food delivered by the male, but later both parents gather and supply food (Hollands 2003; Kennard & Kennard 2006; Marchant & Higgins 1993; Rose 2000). The young fledge approximately seven to eleven weeks after hatching (Dennis 2007b; Holsworth 1965; Kennard & Kennard 2006; Maciejewski 1993; Rose 2000) but continue to return to the nest for some time thereafter to be fed. The period of post-fledging dependence probably ranges from about one to two months in duration (Dennis 2007b; Hollands 2003; Kennard & Kennard 2006; Marchant & Higgins 1993; Rose 2000). Pairs usually rear one brood but are capable of rearing two broods per season (Clancy 2006; Marchant & Higgins 1993). Pairs tend not to breed each year; breeding attempts may be separated by periods of up to three years (Dennis 2007a).

18.7.3 Habitat

Eastern ospreys occur in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. They are mostly found in coastal areas but occasionally travel inland along major rivers, particularly in northern Australia (Johnstone & Storr 1998; Marchant & Higgins 1993; Olsen 1995). They require extensive areas of open fresh, brackish or saline water for foraging (Marchant & Higgins 1993). They frequent a variety of wetland habitats including inshore waters, reefs, bays, coastal cliffs, beaches, estuaries, mangrove swamps, broad rivers, reservoirs and large lakes and waterholes (DSEWPaC 2012aa). They exhibit a preference for coastal cliffs and elevated islands in some parts of their range (Boekel 1976; Domm 1977), but may also occur on low sandy, muddy or rocky shores and over coral cays (Marchant & Higgins 1993). They may occur over atypical habitats such as heath, woodland or forest when travelling to and from foraging sites (DSEWPaC 2012aa).

Eastern ospreys occur sympatrically and sometimes interact with White-bellied sea-eagles (Barrett *et al* 2003; Clancy 2006; Dennis & Baxter 2006; Kennard & Kennard 2006), which is also listed as Marine and Migratory under the EPBC Act.

18.7.4 Habitat assessment

Information obtained from BPA (ie Brigalow Belt South Fauna Expert Panel Report (EPA 2006)), together with expert advice, site based species records and pre-clearance survey data has been used to define a set of assumptions that have been used to identify areas of habitat that are consistent with the definitions of 'core habitat', 'essential habitat' and 'general habitat' that have been presented in Part 1 of this SSMP. These assumptions are presented in this section.

General assumptions

The following general habitat assumptions have been made based on current scientific knowledge of this species:

- Species inhabits coasts, estuaries, bays, inlets, islands and surrounding waters, coral atolls, reefs, lagoons, rock cliffs and stacks (Pizzey & Knight 1997)
- The species also ventures far inland and ascends larger rivers, large permanent waterbodies (such as larger farm dams) (Pizzey & Knight 1997)

Core habitat

'Core habitat' consists of 'essential habitat' in which the species is known and the habitat is recognised under relevant recovery plans or other relevant plans/policies/regulations. Also included within this category are populations that are limited geographically within the region.

As the Eastern osprey is a ubiquitous species with an extensive distribution within Australia, it is not considered that 'core habitat' exists for this species within the proposed alignment.

Essential habitat

'Essential habitat' is an area containing resources that are considered essential for the maintenance of populations of the species (eg potential habitat for breeding, roosting, foraging, shelter, for either migratory or non-migratory species). 'Essential habitat' is defined from known records and/or expert advice (including the findings of pre-clearance surveys).

As the Eastern osprey is a ubiquitous species with an extensive distribution within Australia, it is not considered that 'essential habitat' exists for this species within the proposed alignment.

General habitat

'General habitat' consists of areas or locations that are used by transient individuals or where species have been recorded but there is insufficient information to assess the area as essential/core habitat. 'General habitat' may be defined from known records or habitat that is considered to potential support a species according to expert knowledge of habitat relationships, despite the absence of specimen backed records. General habitat may include areas of suboptimal habitat for species. As potential habitat for many species contained within this SSMP may include most of the regional ecosystems of the Brigalow Belt Bioregion, the 'general habitat' category restricts the habitat to a more limited and realistic set of environmental parameters that are supported by literature that field based observation.

For the Eastern osprey all areas that are mapped as 'marine', estuarine', 'lacustrine' and pulstrine' Wetland Regional Ecosystems as well as 'marine', estuarine' and 'lacustrine' waterbodies, on the Queensland Wetland Mapping wetlands (Version 3.0) and areas with a 'stream order' of '4' and above as indicated on DEHP's watercourse mapping (Version 2.1) are considered to constitute 'general habitat' for this species along with other permanent water resources with suitable feeding attrbutes.

KP0 to KP30

No 'general habitat' for this species exists within this section of the GTP.

KP30 to KP40

No 'general habitat' for this species exists within this section of the GTP.

KP40 to KP130

No 'general habitat' for this species exists within this section of the GTP.

KP130 to KP312

No 'general habitat' for this species exists within this section of the GTP.

KP312 to KP408.81

Pre-clearance surveys identified 'general habitat' for this species at Calliope River (KP352.3), Harper Creek (KP360.3), Larcom Creek (KP378) and a wetland within KP407.87 to KP407.89 (Santos GLNG 2013).

Figure 18.13a and Figure 18.13b shows the location of the 'general habitat' for the Eastern osprey.

KP408.81 to KP409.04

No 'general habitat' for this species exists within KP408.81 to KP409.04 of the GTP although 'general habitat' for this species exists in close proximity to the ROW and ancillary areas and is shown in Figure 18.13c.

KP413.57 to KP419.69

Pre-clearance surveys did not identify 'general habitat' for this species within this section of the GTP although 'general habitat' was identified within close proximity to the GTP and is shown in Figure 18.13d.

Unlikely habitat

'Unlikely habitat' areas are those areas that do not contain records of the particular species and do not contain sufficient habitat features to support the species (ie areas that do not meet the habitat assumptions identified above).

18.8 Anticipated threats and potential impacts as a result of the GTP

Anticipated threats and potential impacts to migratory wetland species as a result of the GTP Project include:

- Loss and degradation of 'essential habitat' and 'general habitat' for migratory wetland species
- Changes to local foraging, roosting and nesting behaviour due to increased vehicle movement, noise, lighting etc
- Stress, injury and mortality to animals due to increases in noise, vehicle movement, lighting and clearing
- Destruction of nests
- Possible impacts causing a reduction of water quality (due to siltation, changes in chemistry, contamination by petroleum, sediment and erosion impacts, and salinity) on large water bodies (including artificial habitats)
- Potential alterations to groundwater and surface water hydrology due to excavations associated with trenches

18.9 Unavoidable impact and unavoidable adverse (offsetable) impact from GTP

Table 18.6 summarises the direct disturbance of 'essential habitat' and 'general habitat' for general migratory species and areas of adverse (offsetable) impact from clearing and construction activities for the GTP between KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69. It is important to note that these unavoidable impacts for the Great egret, Cattle egret, Australian painted snipe and Eastern osprey are considered to be minor and temporary in the context of the wide spread extent of 'general habitat' in the region. The location of this 'general habitat' and 'essential habitat' is shown in Figures 18.7a, 18.7b, 18.7c, 18.7d, 18.7e, 18.7f, 18.7g, 18.9a, 18.9b, 18.9c, 18.9d, 18.9e, 18.9f, 18.9g, 18.9h, 18.11a, 18.11b, 18.11c, 18.11d, 18.11e, 18.11f, 18.11g, 18.13a, 18.13b, 18.13c, 18.13d, 18.13e, 18.13f, 18.13a, 18.13b, 18.13c and 18.13d.

A cumulative total of proposed clearing of habitat for general migratory species and the cumulative total of unavoidable adverse (offsetable) impact to the species habitat is provided in Table 18.6.

Table 18.6 Cumulative total of general migratory species habitat to be cleared and area of habitat subject to unavoidable adverse (offsetable) impacts from the GTP

Species	'General habitat'							'Essential habitat'			'Core habitat'		Total habitat area impacted per species	Total habitat area adversely impacted per GTP section
	KP0 to KP30	KP30 to KP40	KP40 to KP130	KP130 to KP312	KP312 to KP408.81	KP408.81 to KP409.04	KP413.57 to KP419.69	KP40 to KP130	KP312 to KP408.81	KP408.81 to KP409.04	KP130 to KP312	KP312 to KP408.81	-	
Great egret	0.00 ha	0.00 ha	0.06 ha	11.18 ha	1.52 ha	0.00 ha	0.00 ha	0.00 ha	0.00 ha	0.00 ha	0.00 ha	0.00 ha	**12.76 ha**	**3.83 ha**
Cattle egret	4.79 ha	21.79 ha	447.04 ha	774.82 ha	315.15 ha	4.73 ha	0.00 ha	0.00 ha	0.00 ha	0.00 ha	0.00 ha	0.00 ha	**1,568.32 ha**	**1.67 ha**
Australian painted snipe	0.00 ha	0.00 ha	0.06 ha	2.30 ha	1.09 ha	0.00 ha	0.00 ha	0.00 ha	0.00 ha	0.00 ha	1.82 ha	0.43 ha	**5.70 ha**	**4.79 ha**
Eastern osprey	0.00 ha	0.00 ha	0.00 ha	0.00 ha	30.96 ha	0.00 ha	0.00 ha	0.00 ha	0.00 ha	0.00 ha	0.00 ha	0.00 ha	**30.96 ha**	**1.40 ha**

18.10 Management practices and methods

18.10.1 Pre-construction mitigation measures

Measures to avoid impact

- Prior to the commencement of construction clearing, a suitably qualified and experienced EO will confirm the presence of active roosting and/or foraging habitat and establish an exclusion zone where necessary

Measures to minimise impacts

- Pre-clearing ecological surveys have been undertaken by a suitably qualified Ecologist(s) in accordance with the Survey Guidelines for Australia's Threatened Birds. The surveys included carrying out a habitat assessment for these species and confirming their presence/absence within and adjacent the GTP ROW and ancillary areas
- Prior to site entry, all site personnel will be appropriately trained and made aware of the sensitive environs in which they will be working (refer Part 1, Section 7.7)

18.10.2 Construction phase mitigation measures

Measures to avoid impact

- Unless otherwise agreed by DEHP and DotE, active nests, roosting and/or foraging habitat will be declared temporary 'No Go' zones with the establishment of an exclusion zone until the area is no longer occupied by this species. The status of active nests will be regularly checked in a way that does not risk the nest being abandoned by the breeding pair (adult birds)
- All vehicles and pedestrians are to remain within the ROW throughout the above listed areas or on designated access tracks
- All reasonable and practical measures will be taken to locate site offices, construction camps, stockpiling/lay down areas and plant and equipment storage areas (including heavy machinery) on existing cleared lands. As per other conditions these structures would be located at least 100 m away from a watercourse

Measures to minimise impacts

- All vegetation clearing within known general migratory species habitat must comply with clearing approval conditions (eg NC Act and other statutory approvals)
- Implementation of the Fauna Handling Procedures (refer Appendix C)
- A licensed and experienced spotter catcher(s) will be onsite during all clearing activities and will ensure any injured animals are given to an appropriate wildlife carer group or vet (refer Appendix C). DotE and DEHP will be notified within 24 hours of any native animal injuries or deaths
- Clearing activities within these areas will be supervised by the relevant EO
- Clearing will be conducted in a sequential manner and in a way that directs escaping wildlife away from the clearing activities and into adjacent natural areas

- Measures will be in place to facilitate fauna movement, including gaps between stockpiles and pipe strings
- Ensure equipment is regularly maintained and is good working order
- Wherever practicable, direct any lighting associated within night works away from sensitive areas or use engineering solutions to limit light spillage
- The construction phase component of the LRMP will be implemented
- Weather permitting, rehabilitation of all areas identified will commence immediately after the pipeline has been lowered in and backfilled (refer LRMP). With the exception of operational constraints, revegetation will be consistent with the plant density, floristic composition and distribution of the adjacent communities

18.10.3 Operational phase mitigation measures

Measures to avoid impact

- To avoid impacting on regenerating 'general habitat' for general migratory species, vehicle and pedestrian access will be restricted to the defined access tracks to and from the ROW and the defined access track within the GTP ROW

Measures to minimise impacts

- Implementation of the Fauna Handling Procedures (refer Appendix C)
- The operational phase component of the LRMP will be implemented
- The operational phase of the PWMP will be implemented to minimise the risk of weed and pest animal establishment within the above-listed locations

18.10.4 Decommissioning phase mitigation measures

Measures to minimise impacts

- Implementation of the Fauna Handling Procedures (refer Appendix C)
- A decommissioning plan will be developed by GLNG Operations and provided for approval. The plan will aim to address the requirements of AS2885 and also to ensure environmental harm is avoided, including:
  - The Project area no longer contains hazardous contaminants and is left in stable condition
  - All the above ground infrastructure is removed
  - All areas disturbed by above ground infrastructure are rehabilitated in accordance with the relevant conditions
- For a minimum of five years after the completion of rehabilitation, rehabilitated areas will be monitored on a yearly basis
- The monitoring programme will include, but not necessarily be limited to:
  - Methods to monitor subsidence and erosion rates at rehabilitated buried transmission pipeline corridors and buried flow lines

- BioCondition assessment in accordance with the BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland: Assessment Manual: Version 2.1 (Eyre *et al* 2011)
- Monitoring of indicators identified in the LRMP at analogue sites to measure progressive and final rehabilitation success relevant to the final land use(s)
- Frequency and seasonality of monitoring analogue sites and rehabilitated areas to assess rehabilitation success
- Identification of the experimental design for analysing analogue and rehabilitated site data including statistical methods of analyses

19 Migratory woodland species

19.1 Black-faced monarch

19.1.1 EPBC Act legal status

Migratory (Bonn)

19.1.2 Biology and ecology

Characteristics

The Black-faced monarch (*Monarcha melanopsis*) ranges in size from 16 to 19 cm and has a distinctive black face that does not extend across the eyes. The dorsal parts, wings and upper breast are grey and with a rufous coloured belly. The blue-grey bill is hooked at the tip and eye is dark in colour. Young birds are similar but lack the black face, have a black bill and tend to have a brownish body and wings. The Black-faced monarch is one of the monarch flycatchers, a forest and woodland-dwelling group of small insect-eating birds, and is strictly arboreal (Pizzey & Knight 1997).

Black-faced Monarch (Source: Ilyas 2012)

Known distribution

The Black-faced monarch occurs along the east coast of Australia. This species is located primarily on the eastern side of the Great Dividing Range, between Cape York Peninsula (Queensland) to Glendale National Park in eastern Victoria. This species is more abundant within the northern portion of its range (Pizzey & Knight 1997).

Figure 19.1 is an indicative distribution map of the present distribution of the Black-faced monarch.

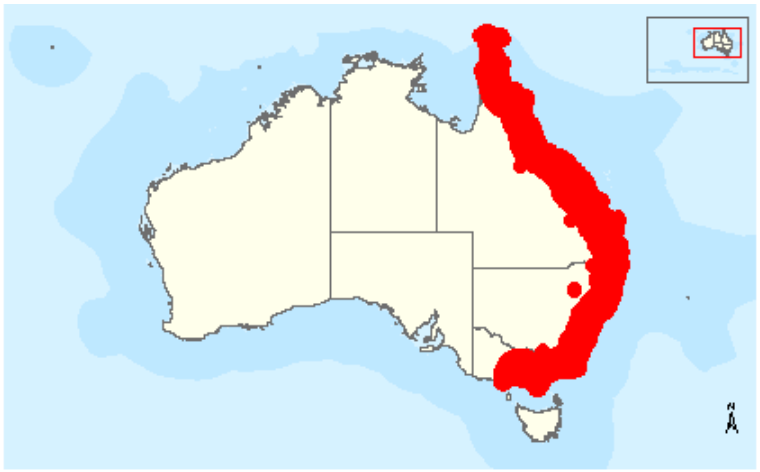


Figure 19.1 Distribution range of the Black-faced Monarch (DSEWPaC 2012ab)

Known species populations and their relationship with the GTP footprint

Suitable habitat for this species within KP312 to KP408.81, KP408.81 and KP409.04 and KP413.57 to KP419.69 of the GTP and ancillary areas is considered to be limited and to areas used during migration.

Biology and reproduction

The Black-faced monarch is a resident in the north of its range, but is a summer breeding migrant to coastal south-eastern Australia, arriving in September and returning northwards in March. It may also migrate to Papua New Guinea in autumn and winter (Pizzey & Knight 1997).

The Black-faced monarch forages for insects among foliage, or catches flying insects on the wing (Pizzey & Knight 1997).

The Black-faced monarch builds a deep cup nest of Casuarina needles, bark, roots, moss and spider web in the fork of a tree, about 3 to 6 m above the ground. Only the female builds the nest, but both sexes incubate the eggs and feed the young. Clutch size ranges from two to three and reproduction occurs between October and January (Pizzey & Knight 1997).

19.1.3 Habitat

The Black-faced monarch is known to inhabit rainforests, eucalypt-dominated woodlands and forests and coastal scrubs in addition to damp gullies in rainforests and eucalypt forests (Pizzey & Knight 1997).

On migration, this species occurs in coastal forests, woodlands, mangroves and drier woodlands and open forests (Blakers *et al* 1984; Emison *et al* 1987; Officer 1969; Pizzey & Knight 1997).

19.2 Spectacled monarch

19.2.1 EPBC Act legal status

Migratory (Bonn)

19.2.2 Biology and ecology

Characteristics

The Spectacled monarch (*Monarcha trivirgatus*) ranges in size from 14 to 16 cm. This species is blue-grey above, with a black face mask that extends across both eyes. The breast is rufous in colour and the underparts are white. The tail is black with white outer tips. Immature birds lack the black face and have a grey throat. The north Queensland subspecies *albiventris* has a rufous upper breast sharply defined from more extensive white underparts (Pizzey & Knight 1997).

Spectacled Monarch (nominate race) (Source: Harrison 2011i)

Known distribution

The Spectacled monarch is found in coastal north-eastern and eastern Australia, including coastal islands, from Cape York, Queensland to Port Stephens, New South Wales. It is much less common in the south. It is also found in Papua New Guinea, the Moluccas and Timor (Blakers *et al* 1984; Pizzey & Knight 1997).

Figure 19.2 is an indicative distribution map of the present distribution of the Spectacled monarch.

Figure 19.2 Distribution range of the Spectacled Monarch (Birdlife International 2012)

Known species populations and their relationship with the GTP footprint

Suitable habitat for this species within KP312 to KP408.81, KP408.81 and KP409.04 and KP413.57 to KP419.69 of the GTP and ancillary areas is considered to be limited and to areas used during migration.

Biology and reproduction

The Spectacled monarch is a resident in the north of its range (ie from Rockhampton in QLD northward), but is a summer breeding migrant to coastal south-eastern Australia, arriving in September and returning northwards in March. It may also migrate to Papua New Guinea in autumn and winter (Pizzey & Knight 1997).

The Spectacled monarch forages for insects among foliage, or catches flying insects on the wing (Pizzey & Knight 1997).

The Spectacled monarch builds a small cup nest of fine bark, plant fibres, moss and spider web in a tree fork or in hanging vines 1 to 6 m above the ground, often near water. Only the female builds the nest, but both sexes incubate the eggs and feed the young. Clutch size consists of two eggs. Reproduction occurs between October and February (Pizzey & Knight 1997).

19.2.3 Habitat

The Spectacled monarch inhabit both dense low vegetation and habitats with fairly open understoreys (Bravery 1970; Huggett 2000) and prefers understorey of mountain and lowland rainforests, thickly wooded gullies and waterside vegetation; mostly well below the canopy (Pizzey & Knight 1997).

The spectacled monarch forages at most levels in the forest, though most often at low or middle levels, within 6 m of the ground (Crome 1978; Hughes & Hughes 1980).

19.3 Satin flycatcher

19.3.1 EPBC Act legal status

Migratory (Bonn)

19.3.2 Biology and ecology

Characteristics

The Satin flycatcher (*Myiagra cyanoleuca*) ranges in size from 15 to 17 cm. This species is blue-black and white bird with a small crest. The sexes are dimorphic. Males are glossy blue-black dorsally, with a blue-black chest and white below. Females are duskier blue-black dorsally, with an orange-red chin, throat and breast, and white underparts and pale-edged wing and tail feathers. Young birds are dark brown-grey above, with pale streaks and buff edges to the wing feathers, and a mottled brown-orange throat and chest (Pizzey & Knight 1997).

Satin Flycatcher (Female above, Male below & right) (Source: Australian National Botanic Gardens 2012; Aviceda 2008)

Known distribution

The Satin flycatcher occurs along the east coast of Australia from far northern Queensland to Tasmania, including south-eastern South Australia. It is also found in New Guinea. The Satin flycatcher is not a commonly seen species, especially in the far south of its range, where it is a summer breeding migrant (Birdlife Australia 2012e).

Figure 19.3 is an indicative distribution map of the present distribution of the Satin flycatcher.

The Satin flycatcher is a migratory species, moving northwards in winter to northern Queensland and Papua New Guinea, returning south to breed in spring (Pizzey & Knight 1997).

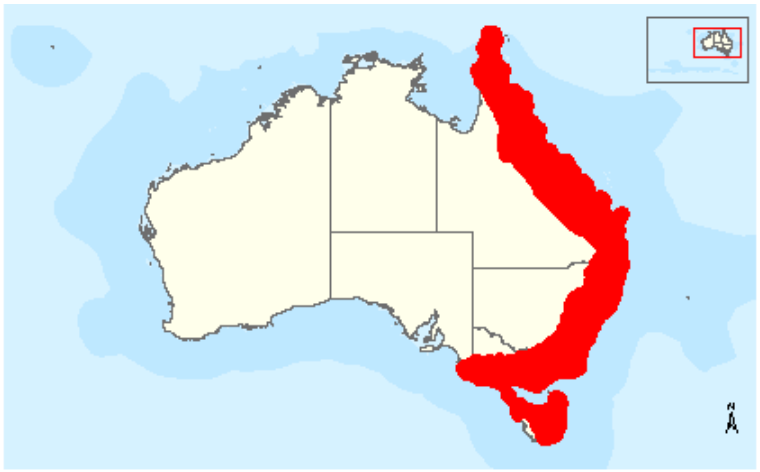


Figure 19.3 Distribution range of the Satin flycatcher (DSEWPaC 2012ac)

Known species populations and their relationship with the GTP footprint

Suitable habitat for this species within KP312 to KP408.81, KP408.81 and KP409.04 and KP413.57 to KP419.69 of the GTP and ancillary areas is considered to be limited and to areas used during migration.

Biology and reproduction

The Satin flycatcher is a resident in the north of its range, but is a migrant to coastal south-eastern Australia, arriving in August to October and returning northwards in February to April (Pizzey & Knight 1997).

The Satin flycatcher forages for insects among foliage, or catches flying insects on the wing (Pizzey & Knight 1997).

The Satin flycatcher builds a neat cup of bark strips, moss, spiders webs on a horizontal dead branch located 5 to 25 m above the ground under living foliage (Pizzey & Knight 1997). This species has been reported to nest in lose groups with each individual pair spaced between 20 to 50 m apart. Both sexes build the nest, incubate the eggs and feed the young (Pizzey & Knight 1997).

Clutch size ranges from two to three eggs and breeding occurs between October and February (Pizzey & Knight 1997).

19.3.3 Habitat

The Satin flycatcher is found in tall forests, preferring wetter habitats such as heavily forested gullies, but not rainforests (Birdlife Australia 2012e).

- This species is known to inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands (cited in DSEWPaC 2012ac) usually above the shrub layer (Pizzey & Knight 1997)
- On migration, this species occur in coastal forests, woodlands, mangroves and drier woodlands and open forests (Blakers *et al* 1984; Emison *et al* 1987; Officer 1969) as well as trees in open country and gardens (Pizzey & Knight 1997)

19.4 Rufous fantail

19.4.1 EPBC Act legal status

Migratory (Bonn)

19.4.2 Biology and ecology

Characteristics

The Rufous fantail (*Rhipidura rufifrons*) is a small, active bird which has a distinctive orange/rufous rump and continuously fanned tail. This species ranges in size from 15 to 16.5 cm. The crown, face, neck and shoulders are grey-brown, shading to orange/rufous on the lower back, rump and upper tail. The eyebrow is reddish-brown, the chin and throat are white, grading into a dappled black and white breast, and the rest of the underparts are white tinged red-brown. The wings are grey-brown and the tail feathers have red-brown bases, but are otherwise dark grey, tipped white. Young birds are similar, but duller, with less distinct markings on the breast (Pizzey & Knight 1997).

Rufous fantail (Source: Donald 2005)

Known distribution

The Rufous fantail is found in northern and eastern coastal Australia, being more common in the north. It is also found in New Guinea, the Solomon Islands, Sulawesi and Guam (Pizzey & Knight 1997).

Figure 19.4 is an indicative distribution map of the present distribution of the Rufous fantail.

This species is a breeding migrant (October to April) within south-eastern Australia, primarily east of the Great Dividing Range. The species is vagrant in Tasmania. This species is strongly migratory in the south of its range and it moves northwards in winter, and virtually disappears from Victoria and New South Wales during the winter months. In north-eastern New South Wales, this species is an altitudinal migrant (Pizzey & Knight 1997).

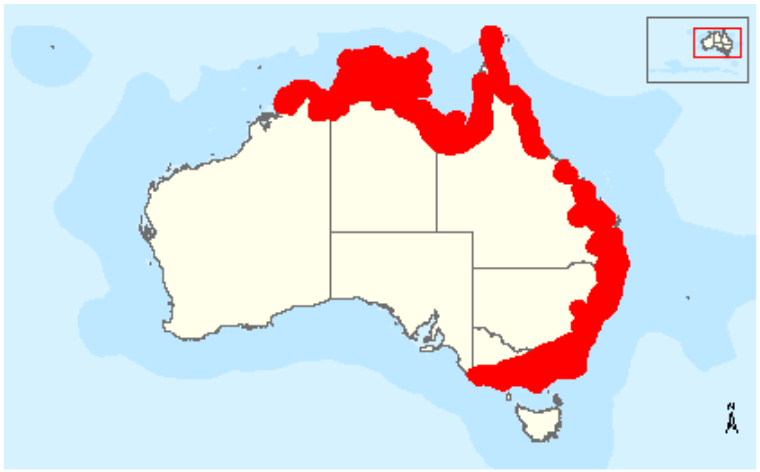


Figure 19.4 Distribution range of the Rufous fantail (DSEWPaC 2012ad)

Known species populations and their relationship with the GTP footprint

Suitable habitat for this species within KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 of the GTP and ancillary areas is considered to be limited and to areas used during migration.

Biology and reproduction

The Rufous fantail is a resident in the north of its range, but is a migrant to coastal south-eastern Australia, arriving in September to October and returning northwards in March to April (Pizzey & Knight 1997).

The Rufous fantail forages for insects among foliage, or catches flying insects on the wing (Pizzey & Knight 1997).

The Rufous fantail builds a neat, fawn coloured tailed cup of bark strips, moss, spider's webs in a shaded fork, low in tress/shrubs (ie less than 5 m from the ground) (Pizzey & Knight 1997).

Clutch size ranges from two to three glossy, stone coloured eggs. Breeding occurs between October and February (Pizzey & Knight 1997).

19.4.3 Habitat

The Rufous fantail is found in the undergrowth of rainforest and wetter eucalypt forests/gullies, monsoon forests, paperbark and sub-inland/coastal scrub, mangroves, watercourses, parks and gardens. During migration, it may be found in more open habitats or urban areas such as farms, suburban streets and building structures (Pizzey & Knight 1997).

19.5 Oriental cuckoo

19.5.1 EPBC Act legal status

Migratory (CAMBA, JAMBA, ROKAMBA)

19.5.2 Biology and ecology

Characteristics

The Oriental cuckoo (*Cuculus optatus*) is a large cuckoo of 28 to 33 cm. The bill is part-yellow and the eye, eye-ring and feet are yellow. The underparts are whitish and boldly barred black. The female is similar with the upperbreast washed buff. Some 'hepatic' females are red-brown above, whitish below, barred black on the upperparts, rump and tail and barred finer below, from the throat down. Immature birds are barred as the female with the upperparts grey-brown or red-brown with buff scalloping. The bill and legs are grey-yellow (Pizzey & Knight 1997).

Oriental cuckoo (Source: Aviceda 2005b)

Known distribution

The Oriental cuckoo is a regular non-breeding migrant from September to May to coastal north and east Australia and islands from Kimberley in Western Australia to north-east and eastern Queensland and eastern New South Wales. Some remain through the Australian winter (Pizzey & Knight 1997).

Figure 19.5 is an indicative distribution map of the present distribution of the Oriental cuckoo.

Figure 19.5 Distribution range of the Oriental cuckoo (Birdlife International 2013)

Known species populations and their relationship with the GTP footprint

Suitable habitat for this species within KP413.57 and KP419.69 of the GTP and ancillary areas is considered to be limited and to areas used during migration.

Biology and reproduction

The Oriental cuckoo's diet consists of insects and their larvae, with a particular preference for caterpillars. The Oriental cuckoo forages for prey on the ground and in trees and bushes.

The Oriental cuckoo breeds in Mongolia, China and Japan and is a regular non-breeding resident to Australia (Pizzey & Knight 1997).

19.5.3 Habitat

The Oriental cuckoo inhabits rainforest margins, monsoon forest, vine scrub, riverine thickets, wetter, densely canopied eucalypt forest, paperbark swamp and mangroves (Morcombe 2003).

19.6 Dollarbird

19.6.1 EPBC Act legal status

Marine

19.6.2 Biology and ecology

Characteristics

The Dollarbird (*Eurystomus orientalis*) is the sole Australian representative of the Roller family, so named because of their rolling courtship display flight. The Dollarbird visits Australia each year to breed. It has mostly dark brown upperparts, washed heavily with blue-green on the back and wing coverts. The breast is brown, while the belly and undertail coverts are light, and the throat and undertail glossed with bright blue (Birdlife Australia 2013). The flight feathers of the wing and tail are dark blue. The short, thick-set bill is orange-red, tipped with black. In flight, the pale blue coin-shaped patches towards the tips of its wings, that gave the bird its name, are clearly visible. Both sexes are similar, although the female is slightly duller. Young Dollarbirds are duller than the adults and lack the bright blue gloss on the throat. The bill and feet are brownish in colour instead of red (Birdlife Australia 2013).

Dollarbird (Source: Aviceda 2002b)

Known distribution

The Dollarbird arrives in northern and eastern Australia from Papua New Guinea and east Indonesia in September each year to breed. In March or April the birds return to Papua New Guinea and east Indonesia to spend the winter (Birdlife Australia 2013; Pizzey & Knight 1997).

Figure 19.6 is an indicative distribution map of the present distribution of the Dollarbird.

The global population size has not been quantified, but the species is reported to be frequent to common throughout most of its range (del Hoyo *et al* 2001).

Figure 19.6 Distribution range of the Dollarbird (Birdlife International 2013)

Known species populations and their relationship with the GTP footprint

Suitable habitat for this species within KP312 to KP408.81 and KP408.81 to KP409.04 of the GTP and ancillary areas is considered to be limited and to areas used during migration.

Biology and reproduction

Dollarbirds feed almost exclusively on flying insects. They search for food from a conspicuous perch and then capture it in skilful aerial pursuits, before returning to the same perch. Occasionally, Dollarbirds have been seen feeding on grasshoppers on the ground, although this practice is uncommon (Birdlife Australia 2013).

During breeding season, pairs of Dollarbirds are often seen flying in characteristic rolling flights. These flights are more common in the evening, and are accompanied by cackling calls. The white eggs are laid in an unlined tree hollow and are incubated by both adults. The young birds are also cared for by both parents. The same nesting site may be used for several years (Birdlife Australia 2013).

19.6.3 Habitat

In Australia, the Dollarbird inhabits open wooded areas, normally with mature, hollow-bearing trees suitable for nesting (Birdlife Australia 2013).

Dollarbirds are often seen flying around in forests and woodlands, especially near wetlands and watercourses, particularly where bare branches extend above the forest canopy or over water (Birdlife Australia 2013).

19.7 Habitat assessment of Migratory Woodland Species

Species included:

- Black faced monarch (*Monarcha melanopsis*)
- Spectacled monarch (*Monarcha trivirgatus*)
- Satin flycatcher (*Myiagra cyanoleuca*)
- Rufus fantail (*Rhipidura rufifrons*)
- Oriental cuckoo (*Cuculus optatus*)
- Dollarbird (*Eurystomus orientalis*)

Information obtained from Brigalow Belt South Fauna Expert Panel Report, South-east Queensland Biodiversity Planning Assessment (EPA 2006) together with expert advice, site based species records and pre-clearance survey data has been used to define a set of assumptions that have been used to identify areas of habitat that are consistent with the definitions of 'core habitat', 'essential habitat' and 'general habitat' that have been presented in Part 1 of this SSMP. These assumptions are presented in this section.

General assumptions

The habitat assumptions for the four identified species are very similar in terms of structural and resource requirements, and have been combined and developed based on current scientific knowledge of these species with reference to the individual species habitat descriptions in sections 24.1.3, 24.2.3, 24.3.3, 24.4.3, 24.5.3 and 24.6.3 of this SSMP.

Core habitat

'Core habitat' consists of 'essential habitat' in which the species is known and the habitat is recognised under relevant recovery plans or other relevant plans/policies/regulations. Also included within this category are populations that are limited geographically within the region.

As these species are ubiquitous with extensive distributions within Australia, 'core habitat' is not considered to exist for these species within the proposed alignment.

Essential habitat

'Essential habitat' is an area containing resources that are considered essential for the maintenance of populations of the species (eg potential habitat for breeding, roosting, foraging, shelter, for either migratory or non-migratory species). 'Essential habitat' is defined from known records and/or expert advice (including the findings of pre-clearance surveys).

As these species are ubiquitous with extensive distributions within Australia, 'essential habitat' is not considered to exist for these species within the proposed alignment.

General habitat

'General habitat' consists of areas or locations that are used by transient individuals or where species have been recorded but there is insufficient information to assess the area as 'essential habitat' or 'core habitat'. 'General habitat' may be defined from known records or habitat that is considered to potential support a species according to expert knowledge of habitat relationships, despite the absence of specimen backed records. 'General habitat' may include areas of suboptimal habitat for species. As potential habitat for many species contained within this SSMP may include most of the regional ecosystems of the Brigalow

Belt Bioregion, the 'General habitat' category restricts the habitat to a more limited and realistic set of environmental parameters that are supported by literature that field based observation.

For these species, all areas that meet the habitat assumptions presented above are considered to constitute 'general habitat'.

KP0 to KP30

No 'general habitat' exists for these species within this section of the GTP.

KP30 to KP40

No 'general habitat' exists for these species within this section of the GTP.

KP40 to KP130

No 'general habitat' exists for these species within this section of the GTP.

KP130 to KP312

No 'general habitat' exists for these species within this section of the GTP.

KP312 to KP408.81

Pre-clearance surveys identified 'general habitat' for migratory woodland species at Calliope River (KP352.3), Harper Creek (KP360.3), Larcom Creek (KP378) and KP405.5 to KP407.5 (Santos GLNG 2013).

Figure 19.7a and Figure 19.7b shows the location of the 'general habitat' for these species within KP312 to KP408.81.

KP408.81 to KP409.04

Figure 19.7c shows the location of the 'general habitat' for these species within KP408.81 to KP409.04.

KP413.57 to KP419.69

Pre-clearance surveys identified 'general habitat' for these species within KP413.6 to KP414.34 of the GTP.

Figure 19.7d shows the location of the 'general habitat' for these species within this section of the GTP.

Unlikely habitat

'Unlikely habitat' areas are those areas that do not contain records of the particular species and contain no habitat values to support the presence or existence of resident or migratory individuals or populations of the species.

19.8 Anticipated threats and potential impacts as a result of the GTP upon migratory woodland species

- Loss and degradation of 'general habitat'
- Changes to local foraging behaviour due to increased vehicle movement, noise, lighting, etc

- Stress, injury and mortality to animals due to increases in noise, vehicle movement, lighting and clearing during construction
- Destruction of nests
- Entrapment of individuals in the trench and barriers to movement

19.9 Unavoidable impact and unavoidable adverse (offsetable) impact from the GTP

Areas of proposed disturbance and areas of adverse (offsetable) impact associated with clearing and construction activities for the GTP between KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 for migratory woodland species are presented in Table 19.1. It is important to note that this unavoidable impact is considered minor and temporary in the context of the wide spread extent of 'general habitat' in the region. The location of this habitat is shown in Figure 19.7a, Figure 19.7b, Figure 19.7c and Figure 19.7d.

A cumulative total of proposed clearing of habitat for migratory woodland species and the cumulative total of unavoidable adverse (offsetable) impact to the species habitat is provided in Table 19.1.

Table 19.1 Cumulative total of migratory woodland species habitat to be cleared and area of habitat subject to unavoidable adverse (offsetable) impacts from the GTP

Location	'General habitat'	Total habitat area per GTP section	Total habitat area adversely impacted per GTP section
KP0 to KP30	0 ha	0 ha	0 ha
KP30 to KP40	0 ha	0 ha	0 ha
KP40 to KP130	0 ha	0 ha	0 ha
KP130 to KP312	0 ha	0 ha	0 ha
KP312 to KP408.81	9.63 ha	9.63 ha	8.60 ha
KP408.81 to KP409.04	2.79 ha	2.79 ha	2.79 ha
KP413.57 to KP419.69	3.29 ha	3.29 ha	3.29 ha
Total habitat area	**15.71 ha**	**15.71 ha**	**14.68 ha**

19.10 Management practices and methods

19.10.1 Pre-construction mitigation measures

Measures to avoid impact

- Prior to the commencement of construction clearing, a suitably qualified and experienced EO will confirm the buffer zones ('No Go' zones) and where necessary barriers and signs will be erected

Measures to minimise impacts

- Wherever practicable, signage will be erected to increase awareness of migratory woodland species in the area
- Prior to site entry, all site personnel will be appropriately trained and made aware of the sensitive environs in which they will be working (refer Part 1, Section 7.7)

19.10.2 Construction phase mitigation measures

Measures to avoid impacts

- Unless otherwise agreed by DEHP and DotE, active nests, roosting and/or foraging habitat will be declared temporary 'No Go' zones with the establishment of an exclusion zone until the area is no longer occupied by this species. The status of active nests will be regularly checked in a way that does not risk the nest being abandoned by the breeding pair (adult birds)
- All vehicles and pedestrians are to remain within the ROW throughout the above listed areas or on designated access tracks
- All reasonable and practical measures will be taken to locate site offices, construction camps, stockpiling/lay down areas and plant and equipment storage areas (including heavy machinery) on existing cleared lands. As per other conditions these structures would be located at least 100 m away from a watercourse

Measures to minimise impacts

- Locate site offices, construction camps, stockpiling/laydown areas, plant and equipment storage areas away from migratory woodland species core habitat
- Implementation of the Fauna Handling Procedures (refer Appendix C)
- All vegetation clearing within known migratory woodland species habitat will comply with clearing approval conditions (eg NC Act and other statutory approvals)
- A licensed and experienced spotter catcher(s) will be onsite during all clearing activities and will ensure any injured animals are given to an appropriate wildlife carer group or vet (refer Appendix C). DotE and DEHP will be notified within 24 hours of any native animal injuries or deaths
- Clearing activities will be supervised by the relevant EO
- Clearing will be conducted in a sequential manner and in a way that directs escaping wildlife away from the clearing activities and into adjacent natural areas
- Measures to be adopted to prevent fauna entrapment within the pipeline trench, include:
  - Minimising the period of time the trench is open, particularly in 'core habitat' and 'essential habitat' areas
  - Constructing ramps with a non-slip surface with slopes less than 45° to provide exit ramps for fauna at intervals no greater than 500 m
  - Trench plugs will be installed in open trenches. These will be provided as a minimum every 500 m
  - Installing additional ramps at greater than normal frequencies (500 m) in areas identified as known or high value habitat
  - Branches, hessian sacks, ramped gangplanks or similar to be used to create 'ladders' to enable fauna to exit the trench These structures will be placed every 250 to 500 m, depending on the surrounding landscapes
- The whole trench will be checked at least twice a day (early morning/late afternoon) and the removal of wildlife from the trench will be undertaken by an appropriately trained and licensed spotter catcher(s)

- Spotter catcher(s) will have access to the site (particularly the open trench) during all weather conditions to check for trapped fauna
- Where practicable, direct any lighting associated within night works away from sensitive areas or use engineering solutions to limit light spillage. This may include the use of light shades and low lighting being applied to construction and operational areas located adjacent to remnant native vegetation and known habitat areas for this species
- Prior to backfilling, the spotter catcher(s) will check the open trench for trapped fauna and where required move them to a safe location away from the trench
- Ensure equipment is regularly maintained and is good working order
- The construction phase component of the LRMP will be implemented
- Weather permitting, rehabilitation of all areas identified will commence immediately after the pipeline has been lowered in and backfilled (refer LRMP). With the exception of operational constraints, revegetation will be consistent with the plant density, floristic composition and distribution of the adjacent communities

19.10.3 Operational phase mitigation measures

Measures to avoid impact

- To avoid impacting on regenerating migratory woodland species habitat, vehicle and pedestrian access will be restricted to the defined access tracks to and from the GTP and ancillary areas and the defined access track within the GTP and ancillary areas

Measures to minimise impacts

- Implementation of the Fauna Handling Procedures (refer Appendix C)
- The operational phase component of the LRMP will be implemented
- The operational phase of the PWMP will be implemented to minimise the risk of weed and pest animal establishment

19.10.4 Decommissioning phase mitigation measures

Measures to minimise impacts

- Implementation of the Fauna Handling Procedures (refer Appendix C)
- A decommissioning plan will be developed by GLNG operations and provided for approval. The plan will aim to address the requirements of AS2885 and also to ensure environmental harm is avoided, including:
  - The Project area no longer contains hazardous contaminants and Is left in stable condition
  - All the above ground infrastructure is removed
  - All areas disturbed by above ground infrastructure are rehabilitated in accordance with the relevant conditions
- For a minimum of five years after the completion of rehabilitation, rehabilitated areas will be monitored on a yearly basis

- The monitoring programme will include:
  - Methods to measure subsidence and erosion rates at rehabilitated buried transmission pipeline corridors and buried flow lines
  - BioCondition assessment in accordance with the BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland: Assessment Manual: Version 2.1 (Eyre *et al* 2011)
  - Monitoring of indicators identified in the LRMP at analogue sites to measure progressive and final rehabilitation success relevant to the final land use(s)
  - Frequency and seasonality of monitoring analogue sites and rehabilitated areas to assess rehabilitation success
  - Identification of the experimental design for analysing analogue and rehabilitated site data including statistical methods of analyses

20 Migratory marine species

20.1 Eastern reef egret

20.1.1 EPBC Act legal status

Marine
Migratory (CAMBA)

20.1.2 Biology and ecology

Characteristics

There are two colour forms of the Eastern reef egret (*Egretta sacra*). The white form has a white body and wings, a yellow and grey bill, a bare face that is green-yellow, and dull yellow-grey legs. The dark form has a slate-grey body and wings, with a small white streak on the throat, the bill is slate-brown, and the legs are grey. The eyes of both forms are yellow. The Eastern reef egret is also called the Eastern reef heron, and the dark form the Blue heron or Blue reef heron (Birdlife Australia 2012b).

Eastern Reef Egret (Source: Dark colour form (Fergus 2007), light colour form (Fergus 2006))

Known distribution

The Eastern reef egret is found on the coast and islands of most of Australia, but is more common on the Queensland coast and Great Barrier Reef than elsewhere. It is now rare on Victorian and Tasmanian coasts. The dark form predominates in temperate areas, the white form in the tropics (Birdlife Australia 2012b).

Figure 20.1 is an indicative distribution map of the present distribution of the Eastern reef egret.

Figure 20.1 Distribution range of the Eastern Reef Egret (Birdlife International 2012)

Known species populations and their relationship with the GTP footprint

Suitable habitat for this species within KP312 to KP408.81 and KP408.81 and KP409.04 of the GTP and ancillary areas is considered to be limited and to areas used during migration/flyover.

Biology and reproduction

Eastern reef egrets hunt by both day and night for small fish, crustaceans and insects. They also invade colonies of nesting terns and steal fish brought in to feed to the young. It is often recognised by its feeding behaviour: it feeds in clear water and hunts its prey by stealth, by crouching low as it moves through shallow water or over rocks and coral (Birdlife Australia 2012b).

The Eastern reef egret breeds throughout the year. The nests can be in trees in island woodlands, or on the ground under shrubs or rock ledges. The stick nest platform is lined with seaweed. Nesting occurs in single pairs or in small colonies. Both sexes incubate the eggs and the young remain in the nest for up to six weeks (Birdlife Australia 2012b).

20.1.3 Habitat

The Eastern reef egret lives on Australian coasts and islands, beaches, rocky shores, tidal rivers and inlets, mangroves and exposed coral reefs (Pizzey & Knight 1997; Birdlife Australia 2012b).

20.2 Lesser sand plover

20.2.1 EPBC Act legal status

Marine
Migratory (Bonn, CAMBA, JAMBA, ROKAMBA)

20.2.2 Biology and ecology

Characteristics

The Lesser sand plover (*Charadrius mongolus*) is a small to medium-sized grey-brown and white plover which has a dark eye-stripe and which reaches 18 to 21 cm in length and 56 to 71 g in weight. Sexes differ when in breeding plumage, but are inseparable when in non-breeding plumage. Juveniles are distinguishable (Marchant & Higgins 1993).

In breeding plumage, the male has a grey-brown crown and nape with a chestnut tinge, with the hindneck and sides of the neck chestnut; the rest of the upperparts are grey-brown. The face has a broad black mask which extends from the base of the bill, through the eye, to the ear-coverts, with a second black stripe above it, on the lower forehead, separated by a white patch. The eyebrow is pale and the chin and throat are white. The breast is chestnut and merges into the hindneck and the sides of the neck. It is demarcated from the throat by a narrow black band, with a narrow black line which extends down from the mask. The rest of the underbody is white. The upperwings are generally grey-brown, though in flight the primary coverts and flight feathers are blackish, with thin white trailing edges on the secondaries and there is a prominent but narrow white wing-bar. The underwing is white with a narrow dusky trailing edge. The bill is black, the eyes dark brown, and the legs and feet are dark grey, sometimes with a greenish tinge (Marchant & Higgins 1993).

The female appears similar except her mask is dark grey-brown or rufous, not black; there is no second dark stripe on the lower forehead; the crown, hindneck, sides of the neck and the breast-band are duller chestnut; and there is no black line bordering the breast-band (Marchant & Higgins 1993).

In non-breeding plumage, both species appear similar, with all black or chestnut markings of the breeding plumage now grey-brown. Juvenile birds are similar to non-breeding birds, but have buff fringes to their feathers, and the breast-band is indistinct (Marchant & Higgins 1993).

Lesser sand plover (Source: Harrison 2011a)

Known distribution

Within Australia, the Lesser sand plover is widespread in coastal regions, and has been recorded in all states. It mainly occurs in northern and eastern Australia, in south-eastern parts of the Gulf of Carpentaria, western Cape York Peninsula and islands in Torres Strait, and along the entire east coast, though it occasionally also occurs inland. It is most numerous in Queensland and NSW (Barrett *et al* 2003; Blakers *et al* 1984; Marchant & Higgins 1993; Milton & Driscoll 2006; Minton *et al* 2006; Watkins 1993).

Figure 20.2 is an indicative distribution map of the present distribution of the Lesser sand plover.

The total population is estimated to be in excess of 330,000 birds (Wiersma 1996). Of these, around 130,000 to 140,000 birds are estimated to be present in the East Asian-Australasian Flyway (Bamford *et al* 2006; Stewart *et al* 2007).

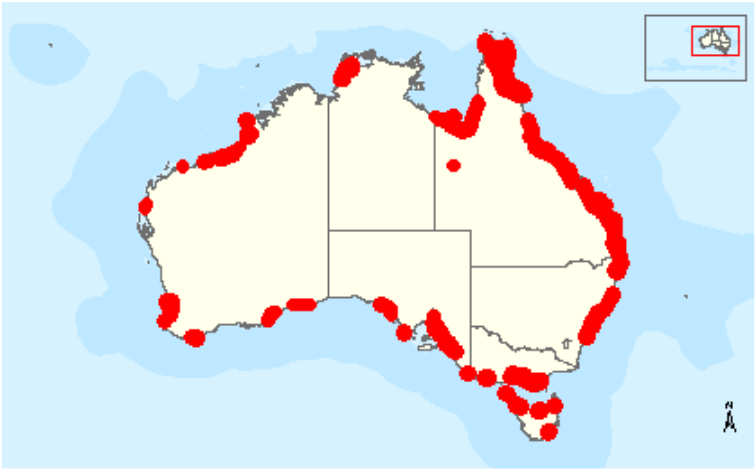


Figure 20.2 Distribution range of the Lesser sand plover (DSEWPaC 2012ae)

Known species populations and their relationship with the GTP footprint

Suitable habitat for this species within KP312 to KP408.81 and KP408.81 and KP409.04 of the GTP and ancillary areas is considered to be limited and to areas used during migration/flyover.

Biology and reproduction

During the non-breeding season the Lesser sand plovers eat invertebrates, such as molluscs (especially bivalves), worms, crustaceans (especially crabs) and insects (Domm & Recher 1973; Lane 1987). On the breeding grounds, they mostly eat beetles and fly larvae (Dement'ev & Gladkov 1951; Wiersma 1996).

This species does not breed in Australia (Marchant & Higgins 1993).

20.2.3 Habitat

In non-breeding grounds in Australia, this species usually occurs in coastal littoral and estuarine environments. It inhabits large intertidal sandflats or mudflats in sheltered bays, harbours and estuaries, and occasionally sandy ocean beaches, coral reefs, wave-cut rock platforms and rocky outcrops (DSEWPaC 2012ae). It also sometimes occurs in short saltmarsh or among mangroves. The species also inhabits saltworks and near-coastal saltpans, brackish swamps and sandy or silt islands in river beds (Marchant & Higgins 1993). Other areas also include sloping sandy and shelly beaches and airfields (Pizzey & Knight 1997). The species is seldom recorded away from the coast, at margins of lakes, soaks and swamps associated with artesian bores (Marchant & Higgins 1993).

20.3 Red-capped plover

20.3.1 EPBC Act legal status

Marine
Migratory - Bonn (Family Charadriidae)

20.3.2 Biology and ecology

Characteristics

The adult male Red-capped plover (*Charadrius ruficapillus*) has a bright reddish chestnut crown (centre of crown can be grey brown) and nape, and grey brown mantle. There is a black incomplete band running down from the chestnut nape to the sides of the breast and a black line from the bill through and past the eye. The legs and short fine bill are black. In flight there is a clear white wing bar and white outer tail. The female is duller in colour, missing the dark breast patches. Young birds are similar but paler than the adults (Birdlife Australia 2012a).

Red-capped plover breeding plumage (Source: Male (Harrison 2010a), Female (Harrison 2010b))

Known distribution

The Red-capped plover is the most common and widespread of Australia's beach-nesting shorebirds. They occur along virtually the entire Australian coastline, but they also occur in great numbers inland, especially around salt lakes (Birdlife Australia 2012a).

Figure 20.3 is an indicative distribution map of the present distribution of the Red-capped plover.

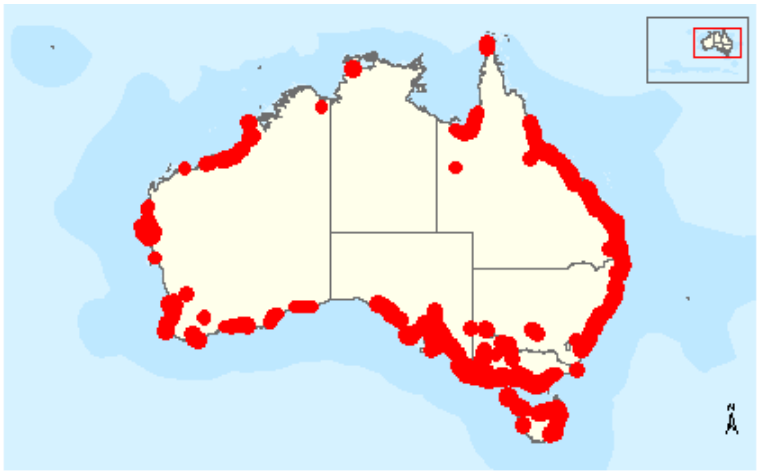


Figure 20.3 Distribution range of the Red-capped Plover (DSEWPaC 2012af)

Known species populations and their relationship with the GTP footprint

Suitable habitat for this species within KP312 to KP408.81 and KP408.81 and KP409.04 of the GTP and ancillary areas is considered to be limited and to areas used during migration/flyover.

Biology and reproduction

The Red-capped plover may be seen foraging for molluscs, small crustaceans and some vegetation, on mudflats, sandy beaches and salt-marsh (Birdlife Australia 2012a).

The nest site of the Red-capped plover is a shallow scrape on a beach or stony area, nearly always close to water. Sometimes the nest is protected by a small plant or some rubbish. The eggs are usually well camouflaged (Birdlife Australia 2012a).

20.3.3 Habitat

The Red-capped plover is found in wetlands, especially in arid areas, and prefers saline and brackish waters (Birdlife Australia 2012a). In addition, this species has known from broad sandy, shelly beaches, bare margins of saline wetlands and lakes, inland and coastal saltmarsh tidal mudflats and sandflats and occasionally freshwater wetland areas (Pizzey & Knight 1997).

20.4 Pacific golden plover

20.4.1 EPBC Act legal status

Marine
Migratory (Bonn, CAMBA, JAMBA, ROKAMBA)

20.4.2 Biology and ecology

Characteristics

The Pacific golden plover (*Pluvialis fulva*) is a medium-sized (length 23 to 26 cm, weight 120 to 175 g) plover with long legs and an upright stance. Sexes are generally inseparable, but juveniles are separable from adults in the field (DSEWPaC 2012ag).

In breeding plumage, adults have bold golden spots on the crown and hindneck; a white forehead, which extends as a broad supercilium that curves behind the ear coverts to the sides of the neck; and the rest of the face is black. The upperparts are blackish, boldly spotted with gold, with the tail dark brown with golden-buff bars. The underparts are black, with a broad white stripe (which continues from the sides of the neck) extending down along the sides of the breast to the flanks, where they are spotted black. The underwings are uniform brownish-grey. The bill is black, the eyes are dark brown, and the legs and feet are greyish black (Marchant & Higgins 1993).

In non-breeding plumage, the crown is dark brown with golden streaks; the nape and hindneck are similar, though slightly paler; the forehead, lores, supercilium, chin, throat and sides of the head are all golden or creamy buff. The upperparts are dark brown, heavily marked with bright golden scaly-shaped spots, while the secondary coverts are spotted white, which contrasts with the golden spots of the mantle and scapulars. The foreneck and breast are golden-buff, with grey-brown streaks, and the belly, flanks and undertail are all white with a buff tinge, and the flanks have fine grey-brown streaks. The underwings appear uniform brownish-grey (Marchant & Higgins 1993).

Juvenile birds are similar to non-breeding birds, but the patterning is neater, bolder and more even, with more golden-buff tones to the face and underparts, distinct streaking on the foreneck and barring or marbling on the breast and flanks (Marchant & Higgins 1993).

Pacific golden plover (Source: Harrison 2013)

Known distribution

Within Australia, the Pacific golden plover is widespread in coastal regions, though there are also a number of inland records (in all states), sometimes far inland and usually along major river systems, especially the Murray and Darling Rivers and their tributaries. Most Pacific golden plovers occur along the east coast, and are especially widespread along the Queensland and NSW coastlines (DSEWPaC 2012ag).

Figure 20.4 is an indicative distribution map of the present distribution of the Pacific golden plover.

There are no published estimates of the extent of occurrence of the Pacific golden plover in Australia. The estimated global extent of occurrence is 100,000 to 1,000,000 km^2 (Birdlife International 2007). The area of occupancy of the Pacific golden plover in Australia has been estimated at 46,700 km^2 (DSEWPaC 2012ag).

The distribution of the Pacific golden plover is not fragmented, either in its breeding grounds or in its non-breeding areas (DSEWPaC 2012ag).

The world population of Pacific golden plover has been estimated at about 209,500 (Wiersma 1996) or 170,000 to 220,000 (Birdlife International 2007).

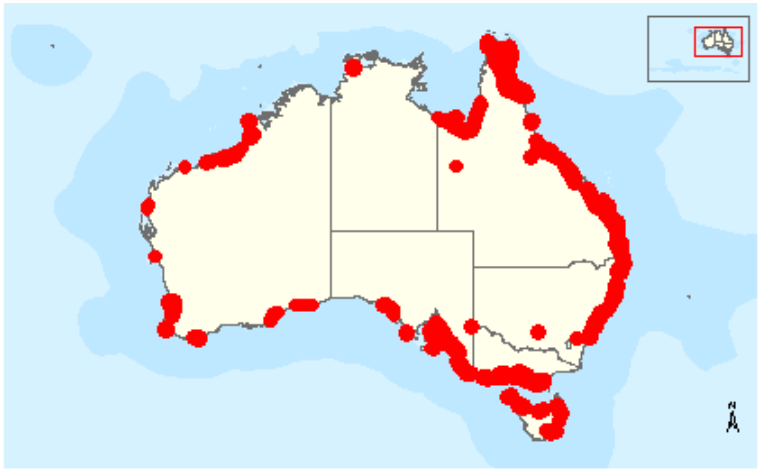


Figure 20.4 Distribution range of the Pacific golden plover (DSEWPaC 2012ag)

Known species populations and their relationship with the GTP footprint

Suitable habitat for this species within KP312 to KP408.81 and KP408.81 and KP409.04 of the GTP and ancillary areas is considered to be limited and to areas used during migration/flyover.

Biology and reproduction

During the non-breeding season, Pacific golden plovers mainly eat molluscs, polychaete worms, insects and insect larvae, spiders and crustaceans (Domm & Recher 1973; Evans 1975; Frith & Calaby 1974; Vestjens 1977c). They are also said to very occasionally eat seeds, leaves, lizards, birds eggs and small fish (Marchant & Higgins 1993).

The species does not breed in Australia (Marchant & Higgins 1993; Wiersma 1996).

20.4.3 Habitat

In non-breeding grounds in Australia this species usually inhabits coastal habitats, though it occasionally occurs around inland wetlands. Pacific golden plovers usually occur on beaches, mudflats and sandflats (sometimes in vegetation such as mangroves, low saltmarsh such as Sarcocornia or beds of seagrass) in sheltered areas including harbours, estuaries and lagoons, and also in evaporation ponds in saltworks. The species is also sometimes recorded on islands, sand and coral cays and exposed reefs and rocks. They are less often recorded in terrestrial habitats, usually wetlands such as fresh, brackish or saline lakes, billabongs, pools, swamps and wet claypans, especially those with muddy margins and often with submerged vegetation or short emergent grass. Other terrestrial habitats inhabited include short (or, occasionally, long) grass in paddocks, crops or airstrips, sewage ponds, sports feilds or ploughed or recently burnt areas, and they are very occasionally recorded well away from water (Marchant & Higgins 1993; Pizzey & Knight 1997).

This species usually forages on sandy or muddy shores (including mudflats and sandflats) or margins of sheltered areas such as estuaries and lagoons, though it also feeds on rocky shores, islands or reefs. In addition, Pacific golden plovers occasionally forage among vegetation, such as saltmarsh, mangroves or in pasture or crops (Bransbury 1985; Evans 1975; Ewart 1973; Pegler 1983; Smith 1966; Thomas 1968).

They usually roost near foraging areas, on sandy beaches and spits or rocky points, islets or exposed reefs, occasionally among or beneath vegetation including mangroves or low saltmarsh, or among beachcast seaweed. They sometimes also roost on levee banks and islands in evaporation ponds in saltworks (Bransbury 1985; Ewart 1973; Smith 1966; Thomas 1968; Patterson 1982; Pegler 1983; Prendergast *et al* 1985).

20.5 Double-banded plover

20.5.1 EPBC Act legal status

Marine
Migratory (Bonn)

20.5.2 Biology and ecology

Characteristics

The Double-banded plover (*Charadrius bicinctus*) is a medium sized dotterel, growing to approximately 20 cm and weighing 60 g. This species has a range of plumages according to age, sex and time of year. The breeding adult has white underparts except for two bands, a thin black band on the lower neck and a broad chestnut band on the breast (DSEWPaC 2012ah). All have a short dark grey bill, black eye and yellowish, grey, green legs (New Zealand Birds 2005).

Adults in breeding plumage are unmistakable, being the only plover in the Australian region with two breast-bands. Non-breeding adults and juveniles can be confused with corresponding plumages of the Lesser sand plover and Large sand plover. The Double-banded plover is characteristically smaller and has a finer bill, shorter legs, darker upperparts and characteristic double breast-tabs (Marchant & Higgins 1993).

Double-banded plover (Source: Harrison 2011b)

Known distribution

The Double-banded plover can be found in both coastal and inland areas. During the non-breeding season, it is common in eastern and southern Australia, mainly between the Tropic of Capricorn and western Eyre Peninsula, with occasional records in northern Queensland and Western Australia (Marchant & Higgins 1993). The greatest numbers are found in Tasmania and Victoria (DSEWPaC 2012ah).

Figure 20.5 is an indicative distribution map of the present distribution of the Double-banded plover.

Population estimates for the Double-banded plover in the East Asian-Australasian Flyway is 50,000 and Australia is 30,000 (Bamford *et al* 2008; Pierce 1999; Sagar *et al* 1999; Watkins 1993).

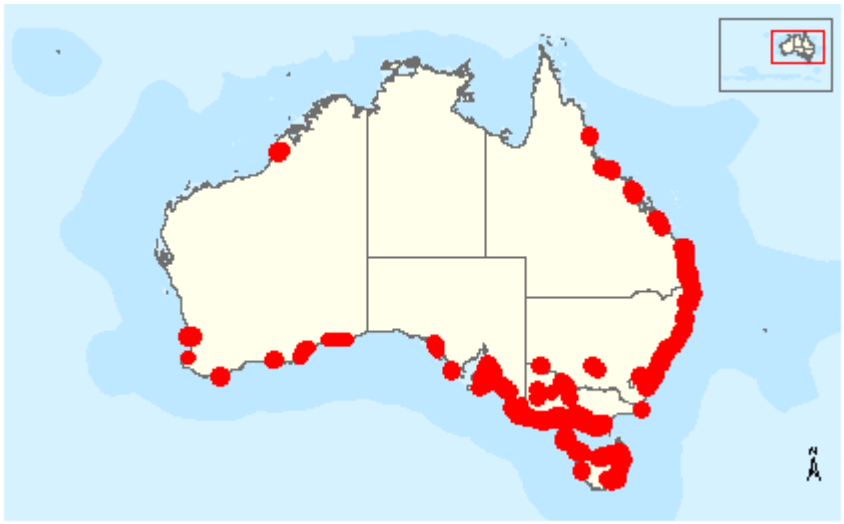


Figure 20.5 Distribution range of the Double-banded plover (DSEWPaC 2012ah)

Known species populations and their relationship with the GTP footprint

Suitable habitat for this species within KP312 to KP408.81 and KP408.81 and KP409.04 of the GTP and ancillary areas is considered to be limited and to areas used during migration/flyover.

Biology and reproduction

The Double-banded plover eats molluscs, insects, worms, crustaceans and spiders and sometimes seeds and fruits (Marchant & Higgins 1993).

This species does not breed in Australia (DSEWPaC 2012ah).

20.5.3 Habitat

The Double-banded plover is found on littoral, estuarine and fresh or saline terrestrial wetlands and also saltmarsh, grasslands and pasture. It occurs on wide muddy, sandy, shingled or sometimes rocky beaches, bays and inlets, harbours and margins of fresh or saline terrestrial wetlands such as lakes, lagoons and swamps, shallow estuaries and rivers (Marchant & Higgins 1993; Pizzey & Knight 1997). The species is sometimes associated with coastal lagoons, inland saltlakes and saltworks. It is also found on seagrass beds, especially *Zostera*, which, when exposed at low tide, remain heavily saturated or have numerous water-filled depressions. This species sometimes utilises kelp beds (Marchant & Higgins 1993).

The Double-banded plover is found on open grassy areas including short pasture, ploughed or newly cropped paddocks, swards, airstrips, and sports grounds such as golf courses or race-tracks near the coast and further inland (Marchant & Higgins 1993).

The species is sometimes found on exposed reefs and rock platforms with shallow rock pools and also on coastal sand dunes. It sometimes takes advantage of floodwaters, drowned river valleys and occasionally areas of bare pumice or scoria (Marchant & Higgins 1993).

Occasionally the species wades into belly-deep water (Marchant & Higgins 1993).

The Double-banded plover roosts on bare open areas or among vegetation and also on offshore islets. Roosting sites may be near feeding areas or hundreds of metres away (Marchant & Higgins 1993).

During strong winds the Double-banded plover may shelter behind rocks, small clods of earth, clumps of vegetation or seaweed or in depressions in the ground (Marchant & Higgins 1993).

20.6 Common sandpiper

20.6.1 EPBC Act legal status

Marine
Migratory (Bonn, CAMBA, JAMBA, ROKAMBA)

20.6.2 Biology and ecology

Characteristics

The Common sandpiper (*Actitis hypoleucos*) is a small sandpiper of 19 to 21 cm in length with a wingspan of 32 to 35 cm. Breeding plumage of the Common sandpiper is dark brown above, with a greenish gloss to feathers of cap, hindneck and mantle. Brown colouring is interspersed with irregular barring. Feathers are white underneath. The species has a prominent white eye-ring and indistinct dark eye-stripe from the bill to the rear of the ear coverts. White patches amongst darker feathers on the sides of the breast area are also notable. The species has a long tail that extends behind the wings when at rest, short legs, and a medium length bill (Higgins & Davies 1996).

Non-breeding plumage of the species is duller and more uniform in colouration. The sexes are similar and juveniles are distinguishable only when close enough to identify faint buff-spotted fringes to the feathers of head, neck, breast, mantle and scapulars (Hayman *et al* 1986; Higgins & Davies 1996).

Common sandpiper (Source: Harrison 2012b)

Known distribution

Found along all coastlines of Australia and in many areas inland, the Common sandpiper is widespread in small numbers. The population when in Australia is concentrated in northern and western Australia (Blakers *et al* 1984; Higgins & Davies 1996).

Figure 20.6 is an indicative distribution map of the present distribution of the Common sandpiper.

The total population of the Common sandpiper is in the order of 2,455,000 to 4,030,000 individuals (Bamford *et al* 2008). The East Asian-Australasian Flyway population is

estimated to be between 25,000 to 100,000 in east and south-east Asia, New Guinea, Australia and New Zealand (Rose & Scott 1997).

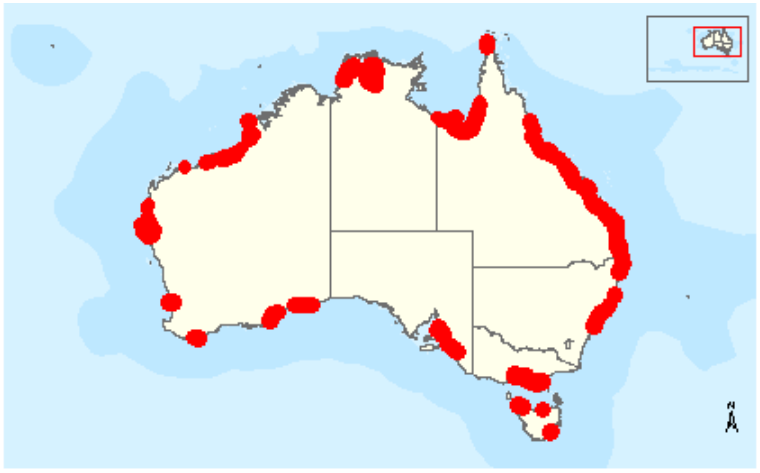


Figure 20.6 Distribution range of the Common sandpiper (DSEWPaC 2012ai)

Known species populations and their relationship with the GTP footprint

Suitable habitat for this species within KP312 to KP408.81 and KP408.81 and KP409.04 of the GTP and ancillary areas is considered to be limited and to areas used during migration/flyover.

Biology and reproduction

The Common sandpiper is typically carnivorous and eats molluscs such as bivalves, crustaceans such as amphipods and crabs and a variety of insects such as Gryllidae, Myrmeleontidae, Cafius, Dicax, Scarabaeidae, Tenebrionidae, Chrysomelidae, Timareta, Coelopidae, Tabanidae, Camponotus and Iridomyrmex (Higgins & Davies 1996).

This species does not breed in Australia (DSEWPaC 2012ai).

20.6.3 Habitat

The species utilises a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around muddy margins or rocky shores and rarely on mudflats (DSEWPaC 2012n). The Common sandpiper has been recorded in estuaries and deltas of streams, as well as on banks farther upstream; around lakes, pools, billabongs, reservoirs, dams and claypans, and occasionally piers and jetties. The muddy margins utilised by the species are often narrow, and may be steep. The species is often associated with mangroves, and sometimes found in areas of mud littered with rocks or snags (Geering *et al* 2007; Higgins & Davies 1996).

Generally the species forages in shallow water and on bare soft mud at the edges of wetlands; often where obstacles project from substrate, eg rocks or mangrove roots. Birds sometimes venture into grassy areas adjoining wetlands (Higgins & Davies 1996).

Roost sites are typically on rocks or in roots or branches of vegetation, especially mangroves. The species is known to perch on posts, jetties, moored boats and other artificial structures, and to sometimes rest on mud or 'loaf' on rocks (Higgins & Davies 1996).

20.7 Little curlew

20.7.1 EPBC Act legal status

Marine
Migratory (Bonn, CAMBA, JAMBA, ROKAMBA)

20.7.2 Biology and ecology

Characteristics

The Little curlew (*Numenius minutus*) is the smallest curlew with an average length of 28 to 31 cm, wingspan of 68 to 71 cm and weight of 175 g (Birds Australia 2010a; Higgins & Davies 1996).

Breeding and non-breeding plumage of adults is similar in the Little curlew. Adult birds have strongly patterned heads, with a blackish crown, a narrow buff coloured median crown stripe, and a broad pale supercilium (eyebrow). A short blackish-brown eyestripe which is broader at the front but does not reach the bill also distinguishes the species. Lores are buff and ear coverts pale buff with fine brown streaking. The neck and breast is off white and streaked with dark brown, while the remaining underparts are white with dark brown bars noticable on the flanks. The mantle feathers, scapulars and underwing coverts are blackish-brown fringed and notched in buff. The tertial feathers are barred brown to light brown with buff notches. The bill is black-brown with a pink base to the lower mandible. The Little curlew has a dark brown iris, and bluish-grey legs and feet (Geering *et al* 2007).

Juveniles are similar to adults in plumage; however the crown appears more black-brown with an indistinct median crown stripe. Scapulars, wing coverts and mantle feathers are notched and fringed in off white instead of buff, and the streaking on the breast and flanks is less extensive and paler (Geering *et al* 2007).

Little curlew (Source: Cheng 2007)

Known distribution

Little curlews generally spend the non-breeding season in northern Australia from Port Hedland in Western Australia to the Queensland coast (DSEWPaC 2012aj). There are records of the species from inland Australia, and widespread but scattered records on the east coast. The species has also been recorded on Lord Howe Island, Cocos-Keeling Island and Christmas Island (Higgins & Davies 1996). The species is recorded in Australia between September and April and there are few winter records (Blakers *et al* 1984).

Figure 20.7 is an indicative distribution map of the present distribution of the Little curlew.

In Queensland, the Little curlew is generally widespread in coastal regions with some inland records (Higgins & Davies 1996).

The estimated total population of the Little curlew is 180,000 (Birdlife International 2010a) with 175,000 spending the non-breeding period within Australia (Geering *et al* 2007).

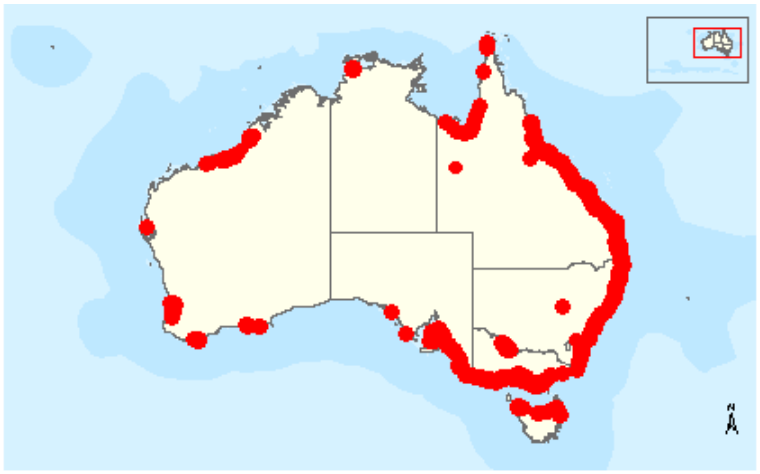


Figure 20.7 Distribution range of the Little curlew (DSEWPaC 2012aj)

Known species populations and their relationship with the GTP footprint

Suitable habitat for this species within KP312 to KP408.81 and KP408.81 and KP409.04 of the GTP and ancillary areas is considered to be limited and to areas used during migration/flyover.

Biology and reproduction

The Little curlew is omnivorous, mainly eating insects, but also seeds and berries (Higgins & Davies 1996).

This species does not breed in Australia; instead it breeds in central and north-east Russia (DSEWPaC 2012aj).

20.7.3 Habitat

The Little curlew is most often found feeding in short, dry grassland and sedgeland, including dry floodplains and blacksoil plains, which have scattered, shallow freshwater pools or areas seasonally inundated. Open woodlands with a grassy or burnt understorey, dry saltmarshes, coastal swamps, mudflats or sandflats of estuaries or beaches on sheltered coasts, mown lawns, gardens, recreational areas, ovals, racecourses and verges of roads and airstrips are also used (Higgins & Davies 1996).

Generally, foraging is in relatively short grass (around 20 cm tall) as the birds avoid dense tall grasses (Higgins & Davies 1996). Foraging sites are usually within 5 km of daytime roosting sites, as birds move between grassland and wetland, most feeding in drier grassland occurring during the first few hours after dawn and the late afternoon (DSEWPaC 2012aj). The Little curlew is known to fly up to 10 km for available water then return to feeding grounds; therefore the availability of drinking water is an important habitat requirement (Bamford *et al* 2008; Barter *et al* 1999; Higgins & Davies 1996; DSEWPaC 2012aj).

When resting during the heat of day, the Little curlew congregates around pools, river beds and water-filled tidal channels, and shallow water at edges of billabongs. The species prefers pools with bare dry mud (including mudbanks in shallow water) and they do not use pools if they are totally dry, flooded or heavily vegetated (Higgins & Davies 1996).

Birds may also rest in grassy, open woodlands and on bare blacksoil plains, or on dry or recently burnt grasslands on floodplains, which may be without vegetation for hundreds of metres, and occasionally on mudflats when nearby grasslands are unburnt, or around swamps. Resting has also been recorded under partly submerged vegetation. After freshwater pools dry up, roosting may occur in the shallows of reservoirs and the sea (Higgins & Davies 1996).

20.8 Marsh sandpiper

20.8.1 EPBC Act legal status

Marine
Migratory (Bonn, CAMBA, JAMBA, ROKAMBA)

20.8.2 Biology and ecology

Characteristics

The Marsh sandpiper (*Tringa stagnatilis*) is a medium sized member of the Tringinae family. It has a length of 22 to 26 cm, a wingspan of 40 to 45 cm and a weight of 70 g. In all plumages the species shows a contrasting outerwing, a very pale whitish tail and a bold white wedge up the back (Higgins & Davies 1996).

Marsh sandpiper (Source: Girvan 2006)

Known distribution

The Marsh sandpiper is found on coastal and inland wetlands throughout Australia. The species is widespread in coastal Queensland, but few records exist north of Cooktown (DSEWPaC 2012ak).

Figure 20.8 is an indicative distribution map of the present distribution of the Marsh sandpiper.

In Queensland, the south-east Gulf of Carpentaria is an internationally important site, while sites of national importance in Queensland include Buffalo Lake area in Normanton, Lake Namulla in Cunnamulla and Alva Beach in Ayr (Watkins 1993).

The Marsh sandpiper has an estimated East Asian-Australasian Flyway population of 100,000 to 1,000,000. The global population is estimated at 186,000 to 1,242,000 (Bamford *et al* 2008).

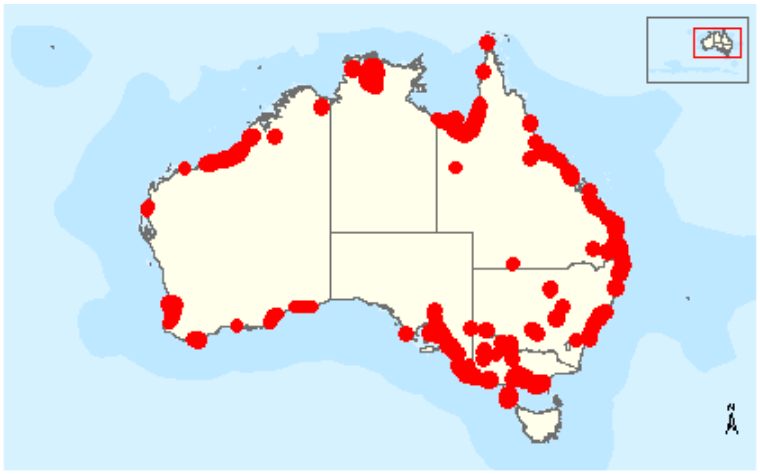


Figure 20.8 Distribution range of the Marsh sandpiper (DSEWPaC 2012ak)

Known species populations and their relationship with the GTP footprint

Suitable habitat for this species within KP312 to KP408.81 and KP408.81 and KP409.04 of the GTP and ancillary areas is considered to be limited and to areas used during migration/flyover.

Biology and reproduction

The Marsh sandpiper is carnivorous and has been recorded eating insects, molluscs and (internationally) crustaceans. Plant material has been found in stomachs but this may have been ingested incidentally (Higgins & Davies 1996).

The Marsh sandpiper does not breed in Australia (DSEWPaC 2012ak).

20.8.3 Habitat

The Marsh sandpiper lives in permanent or ephemeral wetlands of varying salinity, including swamps, lagoons, billabongs, saltpans, saltmarshes, estuaries, pools on inundated floodplains and intertidal mudflats and also regularly at sewage farms and saltworks (DSEWPaC 2012ak). They are recorded less often at reservoirs, waterholes, soaks, bore-drain swamps and flooded inland lakes (Pizzey & Knight 1997). They are found infrequently around mangroves (Higgins & Davies 1996).

The Marsh sandpiper usually forages in shallow water at the edge of wetlands. They probe wet mud of mudflats or feed among marshy vegetation (Higgins & Davies 1996).

The Marsh sandpiper has been recorded roosting or loafing on tidal mudflats, near low saltmarsh, and around inland swamps (Higgins & Davies 1996).

20.9 Red knot

20.9.1 EPBC Act legal status

Marine
Migratory (Bonn, CAMBA, JAMBA, ROKAMBA)

20.9.2 Biology and ecology

Characteristics

The Red knot (*Calidris canutus*) is a small to medium member of the Calidridinae family. It has a length of 23 to 25 cm, a wingspan of 45 to 54 cm and a weight of 120 g. The species is robust, short-necked, rather dumpy but long bodied wader with a short straight bill, long wings extending beyond the tail and short legs. The Red knot is similar in shape and proportions to the Great knot (*Calidris tenuirostris*) but smaller and less bulky, with shorter bill, and the breeding plumage differs markedly. In all plumages the species has a clear narrow white wing bar and off-white patch on the rump and uppertail-coverts. It is obscured by narrow dark barring and appears pale grey at a distance (Higgins & Davies 1996).

Red knot (Source: Straw n.d)

Known distribution

The Red knot is common in all the main suitable habitats around the coast of Australia, but is less numerous in south-west Australia than elsewhere (DSEWPaC 2012al).

In Queensland, the Red knot migrates along the coast north of 19°S, sometimes in large numbers; it is widespread along the coast south of Townsville and along the coasts of NSW and Victoria (DSEWPaC 2012al).

Figure 20.9 is an indicative distribution map of the present distribution of the Red knot.

In Queensland, the south-east of the Gulf of Carpentaria is a site of international importance (Bamford *et al* 2008). The global population of Red knot is estimated at 1,090,000. The population in the East Asian Australasian Flyway is estimated at 220,000 (Bamford *et al* 2008). The population in Australia is estimated at 135,000 (DSEWPaC 2012al).

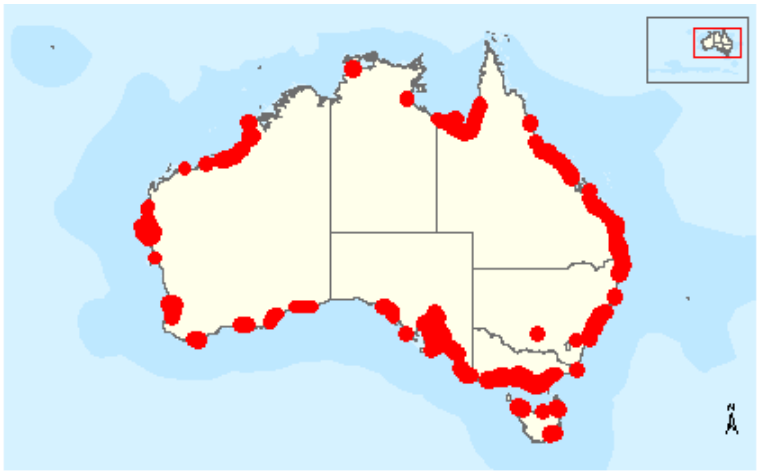


Figure 20.9 Distribution range of the Red knot (DSEWPaC 2012al)

Known species populations and their relationship with the GTP footprint

Suitable habitat for this species within KP312 to KP408.81 and KP408.81 and KP409.04 of the GTP and ancillary areas is considered to be limited and to areas used during migration/flyover.

Biology and reproduction

The Red knot is omnivorous. In Australia the species eats mostly worms, bivalves, gastropods, crustaceans and echinoderms. Internationally they also take shoots, bulbs and roots, especially early in the breeding season, as well as hydrozoans, arachnids, insects, fish and kitchen scraps (Higgins & Davies 1996).

The species does not breed in Australia (DSEWPaC 2012al).

20.9.3 Habitat

In Australasia, the Red knot mainly inhabit intertidal mudflats, sandflats and sandy beaches of sheltered coasts, in estuaries, bays, inlets, lagoons and harbours; sometimes on sandy ocean beaches or shallow pools on exposed wave-cut rock platforms or coral reefs. They are occasionally seen on terrestrial saline wetlands near the coast, such as lakes, lagoons, pools and pans, and recorded on sewage ponds and saltworks, but rarely use freshwater swamps. They rarely use inland lakes or swamps (Higgins & Davies 1996). They are also known to forage in ploughed lands and flooded pastures along the coastal margins (Pizzey & Knight 1997).

The Red knot usually forages in soft substrate near the edge of water on intertidal mudflats or sandflats exposed by low tide. At high tide the may feed at nearby lakes, sewage ponds and floodwaters (Higgins & Davies 1996). They have also been recorded foraging on beds of eelgrass on tidal sandflats (Higgins & Davies 1996), on a thick algal mat in shallow water (Dann 1983), and in shallow pools on crest of coral reef (Domm & Recher 1973).

The Red knot roosts on sandy beaches, spits and islets, and mudflats; also in shallow saline ponds of saltworks (DSEWPaC 2012al). They like to roost in open areas far away from potential cover for predators, but close to feeding grounds (Rogers 2001). In hot conditions, waders prefer to roost where a damp substrate lowers the local temperature (Rogers 1999).

20.10 Terek sandpiper

20.10.1 EPBC Act legal status

Marine
Migratory (Bonn, CAMBA, JAMBA, ROKAMBA)

20.10.2 Biology and ecology

Characteristics

The Terek sandpiper (*Xenus cinereus*) is pale brownish-grey with finer dark streaking on the upper body, head and sides of breast. Body length is approximately 22 to 24 cm, with a wing span of 36 to 45 cm and an average weight of 95 g (Marchant & Higgins 1993). The feet are orange to orange-yellow, the eye is brown and the bill black with a dirty range base and evenly-upcurved (Geering *et al* 2007; Hayman *et al* 1986). The underparts are white with a greyish wash forming an incomplete breast-band. On each scapular, a blackish band of feathers forms an irregular line down the centre (Hayman *et al* 1986).

Sexes are similar, and in breeding season, the main difference is stronger and increased streaking across the head. Juveniles appear similar to breeding adults, but with less pronounced streaking on the head, and with fringing of pale buff-brown on upper feathers. The black shoulder stripe on juveniles can appear more as dashes than a line (Geering *et al* 2007).

Terek sandpiper (Source: Alnus 2008a)

Known distribution

In Australia, the Terek sandpiper has a primarily coastal distribution, with occasional records inland. It is more widespread and common in northern and eastern Australia than southern Australia (DSEWPaC 2012am).

It is widespread in coastal Queensland, from south-east of the Gulf of Carpentaria, north to Torres Strait and along the eastern coast to south-east Australia (DSEWPaC 2012am).

Figure 20.10 is an indicative distribution map of the present distribution of the Terek sandpiper.

The Terek sandpiper non-breeding population in Australia is 23,000 (Geering *et al* 2007).

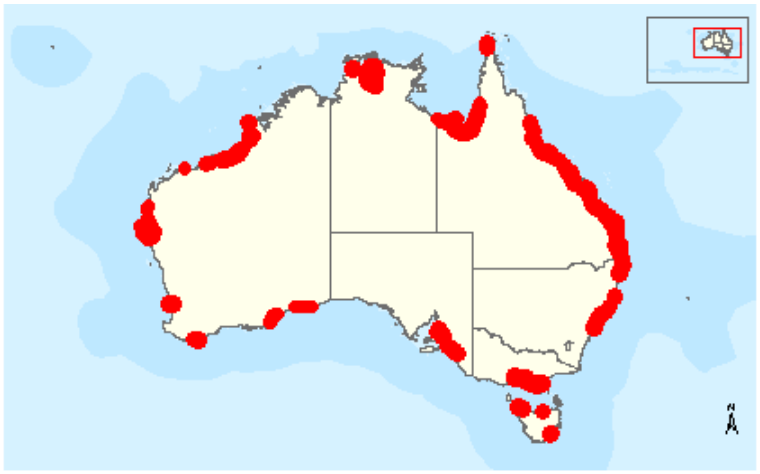


Figure 20.10 Distribution range of the Terek sandpiper (DSEWPaC 2012am)

Known species populations and their relationship with the GTP footprint

Suitable habitat for this species within KP312 to KP408.81 and KP408.81 and KP409.04 of the GTP and ancillary areas is considered to be limited and to areas used during migration/flyover.

Biology and reproduction

Terek sandpipers have been recorded eating crustaceans, insects, seeds, molluscs and arachnids (Marchant & Higgins 1993).

This species does not breed in Australia. It is a semi-colonial breeder from northern Russia, Finland, Siberia and the Arctic tundra (Pringle 1987).

20.10.3 Habitat

The Terek sandpiper mostly forages in the open, on soft wet intertidal mudflats or in sheltered estuaries, embayments, harbours or lagoons. The species has also been recorded on islets, mudbanks, sandbanks and spits, and near mangroves and occasionally in samphire (*Halosarcia* spp.). Birds are seldom near the edge of water; however, birds may wade into the water (Marchant & Higgins 1993).

Occasionally, on sandy beaches, among seaweed and other debris and in rocky areas, Terek sandpipers will use the supralittoral or upper littoral zone, where a film of water covers the sand. However, on exposed rock platforms, the species forages in the lower littoral zone and not the supralittoral or upper littoral zones (Marchant & Higgins 1993).

Less often seen on sandy or shingle beaches, or on rock or coral reefs or platforms, Terek sandpipers are occasionally sighted around drying sewage ponds and saltpans if surrounded by mudflats. The species is also found around brackish coastal swamps, lagoons and dune-lakes; and also on gravel or rocky edges of estuarine pools and freshwater river-pools (Marchant & Higgins 1993). Very occasionally, birds use swampy, grassy or cultivated paddocks near the coast (Marchant & Higgins 1993).

Preferring to roost in or among mangroves, birds may perch in branches or roots up to 2 m from the ground, or beneath them in the shade on hot days. Occasionally, they roost in dead trees or among tangled driftwood. Elsewhere, they may roost with other waders on flat shores, on muddy spits, islets or banks, and sometimes on sandy and pebbly beaches (Marchant & Higgins 1993).

20.11 Sharp-tailed sandpiper

20.11.1 EPBC Act legal status

Marine
Migratory (Bonn, CAMBA, JAMBA, ROKAMBA)

20.11.2 Biology and ecology

Characteristics

The Sharp-tailed sandpiper (*Calidris acuminata*) is a small-medium wader. The bird has a length of 17 to 22 cm, a wingspan of 36 to 43 cm and a weight of 65 g (DSEWPaC 2012an). It is a portly sandpiper with a flat back, pot belly and somewhat drawn-out rear end. It has a small flat head on a short neck with a short and slightly decurved bill. The species has medium length legs. At rest, the primaries are level with or slightly short of the tip of the tail. The primary projection is short in adults and moderately long in juveniles. The sexes are similar and there is marked seasonal variation (Higgins & Davies 1996).

Sharp-tailed sandpiper (Source: Alnus 2007)

Known distribution

The Sharp-tailed sandpiper spends the non-breeding season in Australia with small numbers occurring regularly in New Zealand. Most of the population migrates to Australia, mostly to the south-east and are widespread in both inland and coastal locations and in both freshwater and saline habitats. Many inland records are of birds on passage (Cramp 1985; Higgins & Davies 1996).

In Queensland, they are recorded in most regions, being widespread along much of the coast and are very sparsely scattered inland, particularly in central and south-western regions (Higgins & Davies 1996).

Figure 20.11 is an indicative distribution map of the present distribution of the Sharp-tailed sandpiper.

An estimated 160,000 Sharp-tailed sandpipers occupy the East Asian-Australasian Flyway with 91% of the non-breeding population occurring in Australia and New Zealand (DSEWPaC 2012an).

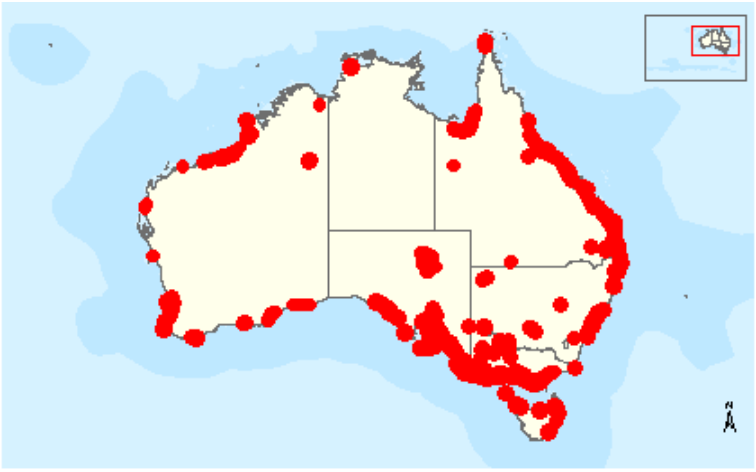


Figure 20.11 Distribution range of the Sharp-tailed sandpiper (DSEWPaC 2012an)

Known species populations and their relationship with the GTP footprint

Suitable habitat for this species within KP312 to KP408.81 and KP408.81 and KP409.04 of the GTP and ancillary areas is considered to be limited and to areas used during migration/flyover.

Biology and reproduction

The Sharp-tailed sandpiper forages on seeds, worms, molluscs, crustaceans and insects (Higgins & Davies 1996).

This species does not breed in Australia (DSEWPaC 2012an).

20.11.3 Habitat

In Australasia, the Sharp-tailed sandpiper prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. This includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, saltpans and hypersaline saltlakes inland. They also occur in saltworks and sewage farms. They use flooded paddocks, sedgelands and other ephemeral wetlands, but leave when they dry. They use intertidal mudflats in sheltered bays, inlets, estuaries or seashores, and also swamps and creeks lined with mangroves. They tend to occupy coastal mudflats mainly after ephemeral terrestrial wetlands have dried out, moving back during the wet season. They may be attracted to mats of algae and water weed either floating or washed up around terrestrial wetlands, and coastal areas with much beachcast seaweed. Sometimes they occur on rocky shores and rarely on exposed reefs (Higgins & Davies 1996).

They forage at the edge of the water of wetlands or intertidal mudflats, either on bare wet mud or sand, or in shallow water. They also forage among inundated vegetation of saltmarsh, grass or sedges. They forage in sewage ponds, and often in hypersaline environments. After rain, they may forage in paddocks of short grass, well away from water. They may forage on coastal mudflats at low tide, and move to freshwater wetlands near the coast to feed at high tide. Occasionally they forage on wet or dry mats of algae and among rotting beachcast seagrass or seaweed, and sometimes they are recorded foraging around

the edges of stony wetlands or among rocks in water, and rarely on exposed reef (Higgins & Davies 1996).

Roosting occurs at the edges of wetlands, on wet open mud or sand, in shallow water, or in short sparse vegetation, such as grass or saltmarsh. Occasionally, they roost on sandy beaches, stony shores or on rocks in water (Higgins & Davies 1996). They have also been recorded roosting in mangroves (Minton & Whitelaw 2000).

20.12 Black-tailed godwit

20.12.1 EPBC Act legal status

Marine
Migratory (Bonn, CAMBA, JAMBA, ROKAMBA)

20.12.2 Biology and ecology

Characteristics

The Black-tailed godwit (*Limosa limosa*) is a large wader and member of the Tringinae family. The species has a length of 40 to 44 cm, a wingspan of 63 to 75 cm and a weight of 200 to 300 g (DSEWPaC 2012ao). The species is described as being large and graceful with a rather small head, long neck, very long straight or slightly curved bill and very long legs. The species is slightly smaller than the Bar-tailed godwit (*Limosa lapponica*) with a straighter and slightly blunter bill, longer neck, shallower forehead, slimmer body and longer legs. Females have a slightly larger and longer bill, but a duller breeding plumage as compared to males (DSEWPaC 2012ao).

Black-tailed godwit (Source: Garg 2009)

Known distribution

The Black-tailed godwit is found in all states and territories of Australia, however, it prefers coastal regions and the largest populations are found on the north coast between Darwin and Weipa. It is generally found in small numbers elsewhere and there are scattered inland records (Watkins 1993).

Figure 20.12 is an indicative distribution map of the present distribution of the Black-tailed godwit.

The world population of the Black-tailed godwit is estimated to be between 561,000 to 750,000 pairs. In Australia there are an estimated 81,000 pairs (Watkins 1993).

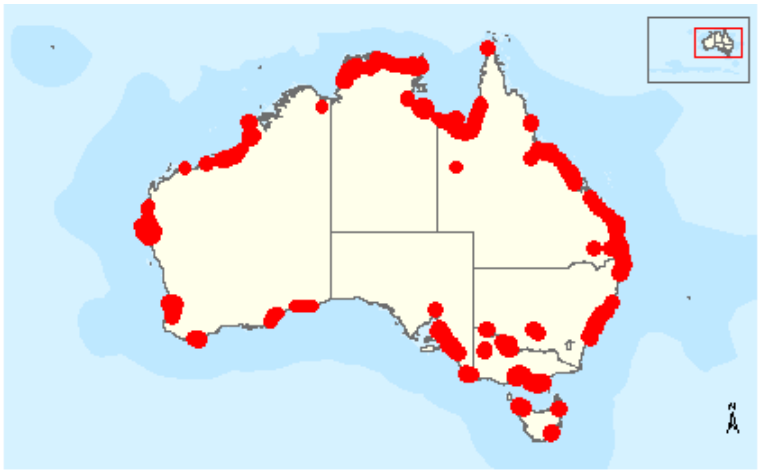


Figure 20.12 Distribution range of the Black-tailed godwit (DSEWPaC 2012ao)

Known species populations and their relationship with the GTP footprint

Suitable habitat for this species within KP312 to KP408.81 and KP408.81 and KP409.04 of the GTP and ancillary areas is considered to be limited and to areas used during migration/flyover.

Biology and reproduction

The Black-tailed godwit is omnivorous. There is little information on feeding habits in the Australian and New Zealand region; however, records from observers provide some insight into the species dietary requirements. The species has been recorded eating annelids, crustaceans, arachnids, fish eggs and spawn and tadpoles of frogs, and occasionally seeds (Higgins & Davies 1996).

The Black-tailed godwit does not breed in Australia (DSEWPaC 2012ao).

20.12.3 Habitat

In Australia the Black-tailed godwit has a primarily coastal habitat environment. The species is commonly found in sheltered bays, estuaries and lagoons with large intertidal mudflats or sandflats, or spits and banks of mud, sand or shell-grit; occasionally recorded on rocky coasts or coral islets. The use of habitat often depends on the stage of the tide. It is also found in shallow and sparsely vegetated, near-coastal, wetlands; such as saltmarsh, saltflats, river pools, swamps, lagoons and floodplains. There are a few inland records, around shallow, freshwater and saline lakes, swamps, dams and bore-overflows. They also use lagoons in sewage farms and saltworks (Higgins & Davies 1996).

The Black-tailed godwit forages on wide intertidal mudflats or sandflats, in soft mud or shallow water and occasionally in shallow estuaries. They use similar habitats on shores of inland lakes and other wetlands. They are found in muddy areas often open and unvegetated, but commonly use drying marshy wetlands preferred by Pectoral sandpipers (*Calidris melanotus*) and Long-toed stints (*C. subminuta*); sometimes they forage among mangroves (Higgins & Davies 1996). They roost and loaf on low banks of mud, sand or shell, bars, islets and beaches in sheltered areas; also on saltflats behind mangroves. They may occur in non-vegetated areas, or among low vegetation, such as samphire (Higgins & Davies 1996).

The claypan may be an important roost site for this species at least during the non-breeding season (Collins *et al* 2001).

20.13 Bar-tailed godwit

20.13.1 EPBC Act legal status

Marine
Migratory (Bonn, CAMBA, JAMBA, ROKAMBA)

20.13.2 Biology and ecology

Characteristics

The Bar-tailed godwit (*Limosa lapponica*) is a large wader and member of the Tringinae family. The bird has a length around 37 to 39 cm, a wingspan of 62 to 75 cm and a weight between 250 to 450 g. The bird has a long neck with a very long upturned bill. The bill is characterized by a dark tip and pinkish base. The Bar-tailed godwit is slightly larger and stockier than the Black-tailed godwit (*Limosa limosa*) with a shorter neck and legs, steeper forehead, and a more upturned and pointed bill. All plumages have a uniform upper pattern, with a dark back and upper rump. It is distinguishable from other godwits by the dark barring on the lower white rump, uppertail and lining of the underwing. The sexes differ, with females being larger with longer bills than males and a duller breeding plumage. Both sexes exhibit marked variation in plumages, with juveniles also having distinct plumages (Marchant & Higgins 1993).

Bar-tailed godwit (Source: Daniels 2009b)

Known distribution

The Bar-tailed godwit has been recorded in the coastal areas of all Australian states. It is widespread in the Torres Strait and along the east and south-east coasts of Queensland, NSW and Victoria, including the offshore islands (DSEWPaC 2012ap).

Figure 20.13 is an indicative distribution map of the present distribution of the Bar-tailed godwit.

The most recent estimate of the Bar-tailed godwit population was between 1,060,000 and 1,110,000. An estimated 325,000 Bar-tailed godwits occupy the East Asian-Australasian

Flyway. During the non-breeding season 88% of the East Asian-Australasian Flyway population occurs in Australia and New Zealand (Bamford *et al* 2008).

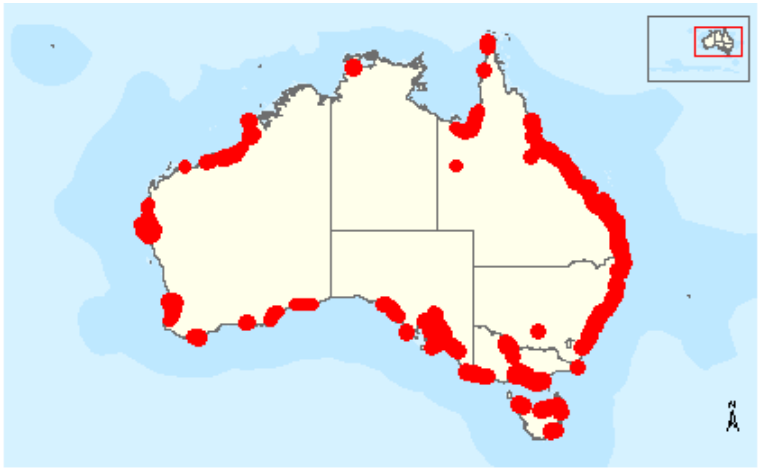


Figure 20.13 Distribution range of the Bar-tailed godwit (DSEWPaC 2012ap)

Known species populations and their relationship with the GTP footprint

Suitable habitat for this species within KP312 to KP408.81 and KP408.81 and KP409.04 of the GTP and ancillary areas is considered to be limited and to areas used during migration/flyover.

Biology and reproduction

The Bar-tailed godwit is mainly carnivorous with a diet consisting of worms, molluscs, crustaceans, insects and some plant material. It has also been recorded eating fruits, fish and tadpoles. While it is in breeding grounds it eats mainly ground dwelling insects (Marchant & Higgins 1993).

The Bar-tailed godwit does not breed in Australia; instead it nests in the Northern Hemisphere summer (DSEWPaC 2012ap).

20.13.3 Habitat

The Bar-tailed godwit is found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. It is found often around beds of seagrass and, sometimes, in nearby saltmarsh. It has been sighted in coastal sewage farms and saltworks, saltlakes and brackish wetlands near coasts, sandy ocean beaches, rock platforms, and coral reef-flats. It is rarely found on inland wetlands or in areas of short grass, such as farmland, paddocks and airstrips, although it is commonly recorded in paddocks at some locations overseas (Marchant & Higgins 1993).

The Bar-tailed godwit usually forages near the edge of water or in shallow water, mainly in tidal estuaries and harbours. They appear not to forage at high tide and prefer exposed sandy substrates on intertidal flats, banks and beaches. The also prefer soft mud; often with beds of eelgrass (*Zostera*) or other seagrasses. Occasionally they have been known to forage among mangroves, or on coral reefs or rock platforms among rubble, crevices and holes. They rarely forage in grassy or vegetated areas. On Heron Island they have been seen feeding on insect larvae among the roots of Casuarina (Marchant & Higgins 1993).

The Bar-tailed godwit usually roosts on sandy beaches, sandbars, spits and also in near-coastal saltmarsh. In some conditions, waders may choose roost sites where a damp substrate lowers the local temperature (DSEWPaC 2012ap).

20.14 Eastern curlew

20.14.1 EPBC Act legal status

Marine
Migratory (Bonn, CAMBA, JAMBA, ROKAMBA)

20.14.2 Biology and ecology

Characteristics

The Eastern curlew (*Numenius madagascariensis*) is a large wader with a long neck, long legs, and a heavy bill that curves downwards. The wingspan is 110 cm and the birds weigh approximately 900 g. The head and neck are dark brown, streaked with darker brown. The chin and throat are whitish and there is a prominent white eye-ring; the iris is dark brown. The feathers of the upper parts of the body are brown, with blackish centres, and have broad pale rufous or olive-brown edges or notches. The tail is grey-brown with narrow dark banding on the feathers. The underside of the bird is dark brownish-buff, becoming paler on the rear belly. There is fine dark-brown streaking on the foreneck and breast, which becomes thicker arrow-shaped streaks and barring on the foreflanks. The upper belly and rear flanks have finer and sparser dark streaking. The underneath of the wing is whitish, but appears darker due to fine dark barring. The bill is dark brown with a pinkish base and the legs and feet are blue-grey. The sexes are similar, but the female is slightly larger and has a longer bill (Higgins & Davies 1996).

Eastern curlew (Source: Daniels 2009a)

Known distribution

Within Australia, the Eastern curlew has a primarily coastal distribution. The species is found in all states, particularly the north, east, and south-east regions including Tasmania. Eastern curlews are rarely recorded inland. They have a continuous distribution from Barrow Island

and Dampier Archipelago, Western Australia, through the Kimberley Division and along Northern Territory, Queensland, and NSW coasts and the islands of Torres Strait. They are patchily distributed elsewhere (DSEWPaC 2012aq).

Figure 20.14 is an indicative distribution map of the present distribution of the Eastern curlew.

During the non-breeding season it is estimated that 28,000 Eastern curlews occur in Australia (Barter 2002, Birdlife International 2001).

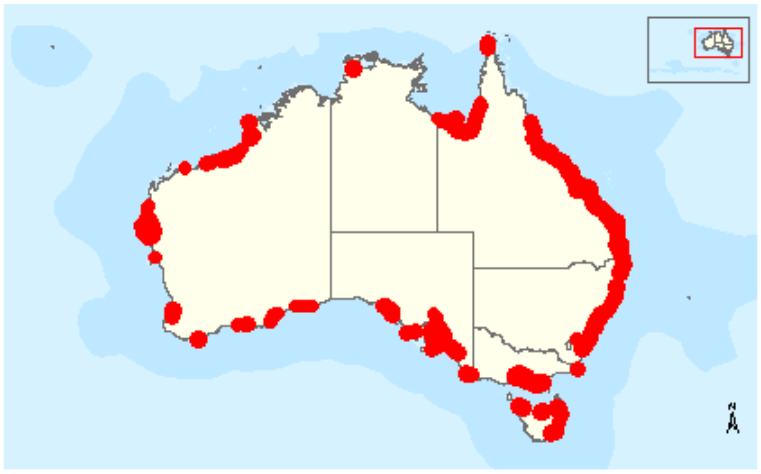


Figure 20.14 Distribution range of the Eastern curlew (DSEWPaC 2012aq)

Known species populations and their relationship with the GTP footprint

Suitable habitat for this species within KP312 to KP408.81 and KP408.81 and KP409.04 of the GTP and ancillary areas is considered to be limited and to areas used during migration/flyover.

Biology and reproduction

The Eastern curlew is carnivorous, mainly eating crustaceans (including crabs, shrimps and prawns), small molluscs, as well as some insects. There are no detailed studies of this species diet in Australia. In Roebuck Bay, Western Australia, the birds feed mainly on large crabs, but will also catch mantis shrimps and chase mudskippers (Rogers 1999).

The Eastern curlew does not breed in Australia (DSEWPaC 2012aq).

20.14.3 Habitat

The Eastern curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass. Occasionally, the species occurs on ocean beaches (often near estuaries), and coral reefs, rock platforms, or rocky islets. The birds are often recorded among saltmarsh and on mudflats fringed by mangroves, and sometimes use the mangroves. The birds are also found in saltworks and sewage farms (Marchant & Higgins 1993).

The Eastern curlew mainly forages on soft sheltered intertidal sandflats or mudflats, open and without vegetation or covered with seagrass, often near mangroves, on saltflats and in saltmarsh, rockpools and among rubble on coral reefs, and on ocean beaches near the

tideline. The birds are rarely seen on near-coastal lakes and in grassy areas (Marchant & Higgins 1993).

The Eastern curlew roosts on sandy spits and islets, especially on dry beach sand near the high-water mark, and among coastal vegetation including low saltmarsh or mangroves. It occasionally roosts on reef-flats, in the shallow water of lagoons and other near-coastal wetlands. Eastern curlews are also recorded roosting in trees and on the upright stakes of oyster-racks. Eastern curlews typically roost in large flocks, separate from other waders (Marchant & Higgins 1993).

20.15 Whimbrel

20.15.1 EPBC Act legal status

Marine
Migratory (Bonn, CAMBA, JAMBA, ROKAMBA)

20.15.2 Biology and ecology

Characteristics

The Whimbrel (*Numenius phaeopus*) is a medium sized curlew, with a length of around 40 to 45 cm, weight of approximately 350 g and wingspan of 76 to 89 cm (Higgins & Davies 1996).

The Whimbrel is dark brown on the upper half of its body, varyingly spotted with pale fringes. The underside is predominately white with dark coarse brown streaks. Its legs are dull bluish-grey in colour, sometimes with a tinge of green. Adult Whimbrels have a strongly patterned head with a dark brown crown and eye-stripe (Higgins & Davies 1996).

Whimbrels exhibit no seasonal variation; however, juveniles and immatures are separable at close range. Of the two subspecies commonly occurring in the Southern Hemisphere, *Numenius phaeopus* variegates is the only one occurring in the East Asian-Australasian Flyway (Higgins & Davies 1996).

Whimbrel (Source: Trepte 2011)

Known distribution

The Whimbrel is a regular migrant to Australia and New Zealand, with a primarily coastal distribution. There are also scattered inland records of Whimbrels in all regions. It is found in all states but is more common in the north (DSEWPaC 2012ar).

It is found along almost the entire coast of Queensland and NSW and regularly at some places in Victoria, Tasmania, and South Australia (DSEWPaC 2012ar).

According to Delany and Scott (2002), the global population of the Whimbrel was estimated between 1,007,000 and 2,132,000. An estimated 100,000 Whimbrels use the East Asian-Australasian Flyway (DSEWPaC 2012ar).

Figure 20.15 is an indicative distribution map of the present distribution of the Whimbrel.

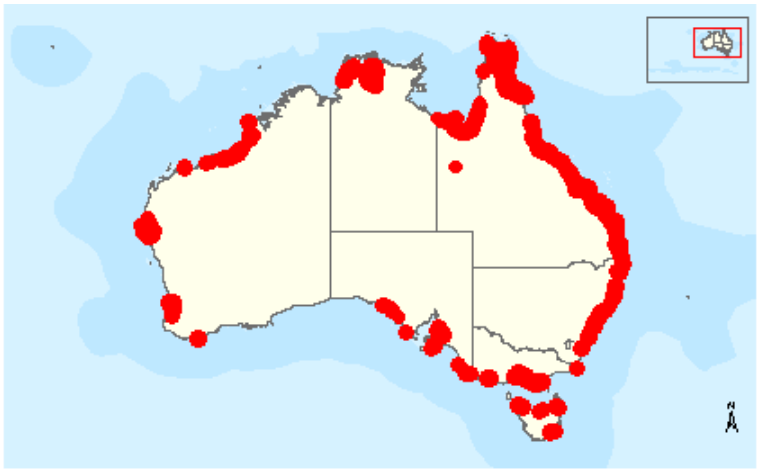


Figure 20.15 Distribution range of the Whimbrel (DSEWPaC 2012ar)

Known species populations and their relationship with the GTP footprint

Suitable habitat for this species within KP312 to KP408.81 and KP408.81 and KP409.04 of the GTP and ancillary areas is considered to be limited and to areas used during migration/flyover.

Biology and reproduction

In non-breeding areas the Whimbrel is mainly carnivorous, taking annelids, crustaceans (including crabs and shrimps), and, rarely, vertebrates (eg small fish, Little tern (*Sterna albifrons*) nestlings). Outside Australia, it is also known to take berries, molluscs, arachnids, insects and reptiles (Higgins & Davies 1996).

The Whimbrel does not breed in Australia (del Hoyo *et al* 1996).

20.15.3 Habitat

The Whimbrel is often found on the intertidal mudflats of sheltered coasts. It is also found in harbours, lagoons, estuaries and river deltas, often those with mangroves, but also open, unvegetated mudflats. It is occasionally found on sandy or rocky beaches, on coral or rocky islets, or on intertidal reefs and platforms. It has been infrequently recorded using saline or brackish lakes near coastal areas. It also used saltflats with saltmarsh, or saline grasslands with standing water left after high spring-tides, and in similar habitats in sewage farms and saltfields (Higgins & Davies 1996). There are a small number of inland records from saline lakes and canegrass swamps (Jarman 1978). It has also been recorded in coastal dunes and on a football field (Smith & Chafer 1987).

The Whimbrel generally forages on intertidal mudflats, along the muddy banks of estuaries and in coastal lagoons, either in open unvegetated areas or among mangroves. They sometimes forage on sandy beaches or among rocks. It has occasionally been sighted feeding on exposed coral or rocky reefs and rock platforms. It is known to probe holes and crevices among rubble and on reef flats, but not on reef crests (Higgins & Davies 1996). It was once recorded feeding on a grassy football field (Smith & Chafer 1987).

The Whimbrel is one of a small group of shorebird species that regularly roost in mangroves and other structures flooded at high tide. They often roost in the branches of mangroves around mudflats and in estuaries and occasionally in tall coastal trees. They have also been observed to roost on the ground (sometimes under mangroves or in shallow water), on muddy, sandy or rocky beaches; rocky islets and coral cays (Higgins & Davies 1996).

20.16 Common greenshank

20.16.1 EPBC Act legal status

Marine
Migratory (Bonn, CAMBA, JAMBA, ROKAMBA)

20.16.2 Biology and ecology

Characteristics

The Common greenshank (*Tringa nebularia*) is a heavily built, elegant wader, 30 to 35 cm in length, with a wingspan of 55 to 65 cm and weight up to 190 g for both males and females. The bill is long and slightly upturned and the legs are long and yellowish-green. In flight, all plumages show uniformly dark upperwing and constrasting white rump extending in a white wedge up the back, whitish tail and tips of toes projecting slightly beyond the tip of the tail. The sexes are alike (Higgins & Davies 1996).

The head and neck are white with heavy black streaking, the interwing coverts are mostly brownish-grey with white fringes. The underbody is white with fine black streaks on chin and throat and there are bold black chevrons on breast and flank. The underwing is white with faint brownish barring on covers and the bill is bluish grey or greenish grey, legs and feet are pale greyish-green (Higgins & Davies 1996).

The juveniles are like non-breeding adults but head and neck are slightly darker with heavier, darker streaking. Bare parts are similar to the adult, but juvenile legs and feet are occasionally bright pale-yellow, dull yellow or dull slate-grey (Higgins & Davies 1996).

Common greenshank (Source: Aviceda 2009)

Known distribution

The Common greenshank does not breed in Australia, however, the species occurs in all types of wetlands and has the widest distribution of any shorebird in Australia (Higgins & Davies 1996).

In Queensland, the species is widespread in the Gulf country and eastern Gulf of Carpentaria. It has been recorded in most coastal regions, possibly with a gap between north Cape York Peninsula and Cooktown. Inland, there have been a few records south of a line from near Dalby to Mt Guide, and sparsely scattered records elsewhere (Higgins & Davies 1996).

Figure 20.16 is an indicative distribution map of the present distribution of the Common greenshank.

The global population is estimated to be 440,000 to 1,500,000 (BirdLife International 2009). The East Asian-Australasian Flyway population of the Common greenshank is thought to be approximately 60,000, of which 18,000 to 19,000 spend the non-breeding season in Australia (Bamford *et al* 2008; Clemens *et al* 2008).

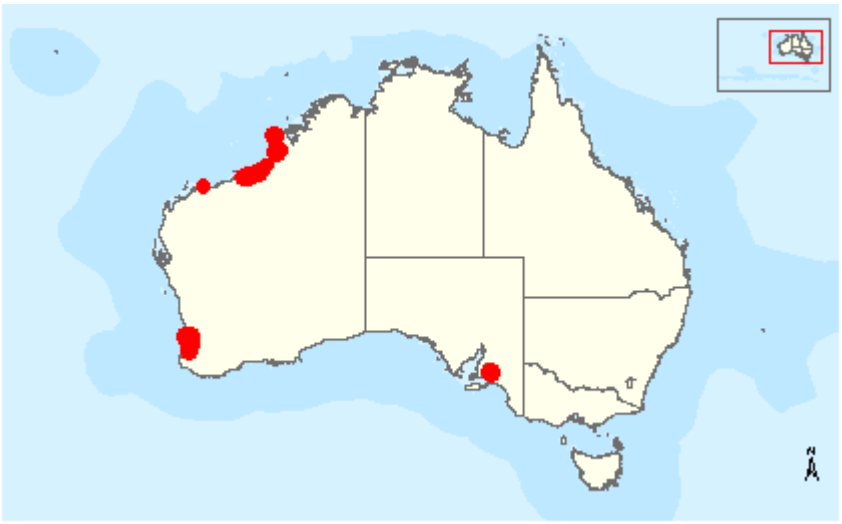


Figure 20.16 Distribution range of the Common greenshank (DSEWPaC 2012as)

Known species populations and their relationship with the GTP footprint

Suitable habitat for this species within KP312 to KP408.81 and KP408.81 and KP409.04 of the GTP and ancillary areas is considered to be limited and to areas used during migration/flyover.

Biology and reproduction

The Common greenshank is carnivorous. In Australia is has been recorded eating molluscs, crustaceans, insects, and occasionally fish and frogs. Elsewhere, it has also been recorded eating annelids, lizards, and rodents (Higgins & Davies 1996).

The Common greenshank does not breed in Australia (DSEWPaC 2012as).

20.16.3 Habitat

The Common greenshank is found in a wide variety of inland wetlands and sheltered coastal habitats of varying salinity. It occurs in sheltered coastal habitats, typically with large mudflats and saltmarsh, mangroves or seagrass. Habitats include embayments, harbours, river estuaries, deltas and lagoons and are recorded less often in round tidal pools, rock-flats and rock platforms. The species uses both permanent and ephemeral terrestrial wetlands, including swamps, lakes, dams, rivers, creeks, billabongs, waterholes and inundated floodplains, claypans and saltflats. It will also use artificial wetlands, including sewage farms and saltworks dams, inundated rice crops and bores. The edges of the wetlands used are generally of mud or clay, occasionally of sand, and may be bare or with emergent or fringing vegetation, including short sedges and saltmarsh, mangroves, thickets of rushes, and dead or live trees. It was once recorded with Black-winged stilts (*Himantopus himantopus*) in pasture, but are generally not found in dry grassland (Higgins & Davies 1996).

The species is known to forage at edges of wetlands, in soft mud on mudflats, in channels, or in shallows around the edges of water often among pneumatophores of mangroves or other sparse, emergent or fringing vegetation, such as sedges or saltmarsh. It will occasionally feed on exposed seagrass beds (Higgins & Davies 1996).

The Common greenshank roosts and loafs round wetlands, in shallow pools and puddles, or slightly elevated on rocks, sandbanks or small muddy islets. Occasionally the species will perch and roost on stakes (Higgins & Davies 1996).

20.17 Grey-tailed tattler

20.17.1 EPBC Act legal status

Marine
Migratory (Bonn, CAMBA, JAMBA, ROKAMBA)

20.17.2 Biology and ecology

Characteristics

The Grey-tailed tattler (*Tringa brevipes*) is a medium sized wader and member of the Tringinae family. It has a length of 25 cm, wingspan of 51 cm and an average weight of 125 g. Compared to other waders is has rather long wings and tail. It has a medium length straight bill and short yellow legs. It is very similar to the Wandering tattler, however it can be distinguished by its shorter wings and slightly smaller build. In all plumages, the Grey-tailed tattler is plain grey above with a white supercilium and a dark loral stripe. It has slate-grey under wings and yellow legs. There is a marked seasonal variation between breeding and non-breeding adults, the sexes are alike and juveniles are separable from adults (Higgins & Davies 1996).

Grey-tailed tattler (Source: Harrison 2011d)

Known distribution

Within Australia, the Grey-tailed tattler has a primarily northern coastal distribution and is found in most coastal regions (Higgins & Davies 1996).

In Queensland, the Grey-tailed tattler is found along the entire coast, with small numbers located in the Gulf of Carpentaria. It is widespread along the east coast and the Torres Strait. There is a continuous population along the entire east coast of Cape York Peninsula. Inland records include Burdekin Weir, Charters Towers and Mount Isa; however these are rare, with the species preferring coastal locations (Higgins & Davies 1996).

Figure 20.17 is an indicative distribution map of the present distribution of the Grey-tailed tattler.

Previous population estimates suggested a world population less than 100,000 (del Hoyo *et al* 1996). A recent review of the species indicated an East Asian-Australasian Flyway population of 50,000 (DSEWPaC 2012at).

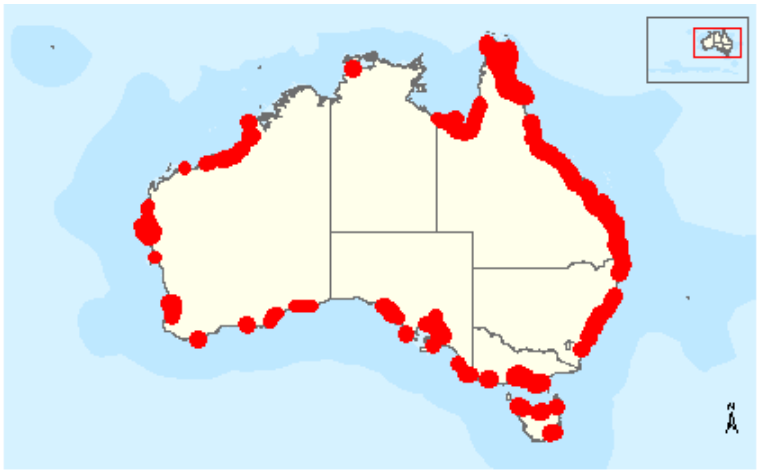


Figure 20.17 Distribution range of the Grey-tailed tattler (DSEWPaC 2012at)

Known species populations and their relationship with the GTP footprint

Suitable habitat for this species within KP312 to KP408.81 and KP408.81 and KP409.04 of the GTP and ancillary areas is considered to be limited and to areas used during migration.

Biology and reproduction

The diet of the Grey-tailed tattler consists primarily of Polychaetes, molluscs, crustaceans, insects and, occasionally, fish. It is believed that crabs are possibly a more important food source before migration. Crustaceans eaten include amphipods, isopods and crabs (Higgins & Davies 1996).

The Grey-tailed tattler does not breed in Australia; instead it breeds in north Siberia (DSEWPaC 2012at).

20.17.3 Habitat

The Grey-tailed tattler is often found on sheltered coasts with reefs and rock platforms or with intertidal mudflats. It can also be found at intertidal rocky, coral or stony reefs as well as platforms and islets that are exposed at low tide. It has been found around shores of rock, shingle, gravel or shells and also on intertidal mudflats in embayments, estuaries and coastal lagoons, especially fringed with mangroves. In Moreton Bay, Queensland, it is most abundant in areas with dense beds of seagrass. It is less often on open flat sandy beaches or sandbanks, especially around accumulated seaweed or isolated clumps of dead coral. It is occasionally found around near-coastal wetlands, such as lagoons and lakes and ponds in sewage farms and saltworks. Inland records for the species are rare with sightings on river banks and the edges of rock pools (Higgins & Davies 1996).

The Grey-tailed tattler usually forages in shallow water, on hard intertidal substrates, such as reefs and rock platforms, in rock pools and among rocks and coral rubble, over which water may surge. It has also been recorded foraging on exposed intertidal mudflats, especially with mangroves and possibly seagrass nearby. Occasionally it forages on intertidal sandflats, around banks of seaweed or protruding rocks or lumps of coral (Higgins & Davies 1996).

The Grey-tailed tattler usually roosts in the branches of mangroves or, rarely, in dense stands of other shrubs, or on snags or driftwood. Where mangroves are not present, it roosts on rocks that are sometimes partly submerged. It is also known to roost on beaches and reefs; however, it is rarely reported roosting on bare sandy beaches or sandbanks. It occasionally roosts among beds of *Samolus*. Sightings also indicate it roosts on sand-dunes. It often perches on artificial structures. It is occasionally found in near-coastal saltworks and sewage ponds and once recorded at a bore-drain. It may roost on or feed among oyster-racks and other artificial structures, such as seawalls, rocky causeways and boats (Higgins & Davies 1996; Rogers 1999).

20.18 Great knot

20.18.1 EPBC Act legal status

Marine
Migratory (Bonn, CAMBA, JAMBA and ROCKAMBA)

20.18.2 Biology and ecology

Characteristics

The Great knot (*Calidris tenuirostris*) is medium sized member of the family Scolopacidae. It has a length of 26 to 28 cm, wingspan of 57 to 59 cm and an average weight of 155 g. It has a greyish appearance, dark above, light underneath with chestnut above in breeding plumage. Distinguishing features include; the head and neck are heavily streaked and the sides scalloped grey and white. The head has a white eye brow stripe. The bill is up to 5 cm, slightly down curved. Legs are dark grey to olive green. It has a narrow white wing-bar, and observable white patch on the rump and upper tail-coverts (Higgins & Davies 1996).

Great knot (Source: Harrison 2011e)

Known distribution

The Great knot has been recorded predominately in coastal areas throughout Australia, including the coastal islands of Tasmania (Pizzey 1991; Higgins & Davies 1996). The species is common and abundant in the north of the continent and uncommon to rare further south (NPWS 1999b).

Occasionally individuals have been observed venturing inland into north-western Queensland, north-western Victoria and inland NSW (Pizzey 1991).

Figure 20.18 is an indicative distribution map of the present distribution of the Great knot.

The global population for the Great knot is estimated at 380,000 individuals (Wetlands International 2006).

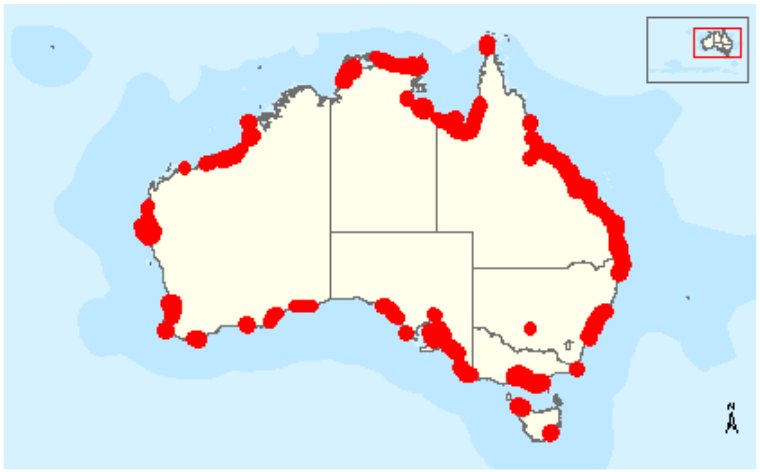


Figure 20.18 Distribution range of the Great knot (DSEWPaC 2012au)

Known species populations and their relationship with the GTP footprint

Suitable habitat for this species within KP312 to KP408.81 and KP408.81 and KP409.04 of the GTP and ancillary areas is considered to be limited and to areas used during migration.

Biology and reproduction

The diet of the Great knot is mainly bivalve molluscs, gastropods, invertebrates, polychaete worms, crabs, shrimps and sea-cucumbers, they have also been found to eat seeds and berries (Higgins & Davies 1996; Tomkovich 1996).

The Great knot does not breed in Australia; instead it breeds in Siberia (NPWS 1999b).

20.18.3 Habitat

In Australia, the Great knot occurs within sheltered, coastal habitats containing large, intertidal mudflats or sandflats, including inlets, bays, harbours, estuaries and lagoons. Individuals have often been recorded on sandy beaches with mudflats nearby, sandy spits and islets and sometimes on exposed reefs or rock platforms (Morris 1989; Higgins & Davies 1996). A small proportion of individuals have also been sighted in swallow inland freshwater and saline lakes (Pizzey & Knight 1997; Higgins & Davies 1996).

20.19 Red-necked stint

20.19.1 EPBC Act legal status

Marine
Migratory (Bonn, CAMBA, JAMBA, ROKAMBA)

20.19.2 Biology and ecology

Characteristics

The Red-necked stint (*Calidris ruficollis*) is a small Calidridinae approximately 13 to 16 cm in length and is the smallest shorebird in Australia (Geering *et al* 2007). It weighs 25 g and has a wingspan between 29 and 33 cm. The species is characterised by a small head, steep rounded forehead, and long thickset body with an attenuated rear end. Other distinguishing features include short legs, a short, straight (or slightly decurved) bill with a slight bulbous or finely pointed tip. At rest the folded primaries reach slightly over the tip of the tail (rarely short of the tip). In flight all plumages show typical patterns of Stints, with white wing bars, white sides to a black centered rump and upper tail colours. The species has a variety of plumages depending on age, sex and time or year. Sexes are similar; however, breeding adults are distinct from non-breeding adults as well as from juveniles (Higgins & Davies 1996).

Red-necked stint (Source: Harrison 2011f)

Known distribution

The Red-necked stint is distributed along most of the Australian coastline with large densities on the Victorian and Tasmanian coasts. The Red-necked stint has been recorded in all coastal regions, and found inland in all states when conditions are suitable (DSEWPaC 2012av).

Figure 20.19 is an indicative distribution map of the present distribution of the Red-necked stint.

The Red-necked stint has a global population estimate of between 315,000 and 353,000 (Watkins 1993). During the non-breeding season, 260,000 of the global population reside in Australia (DSEWPaC 2012av).

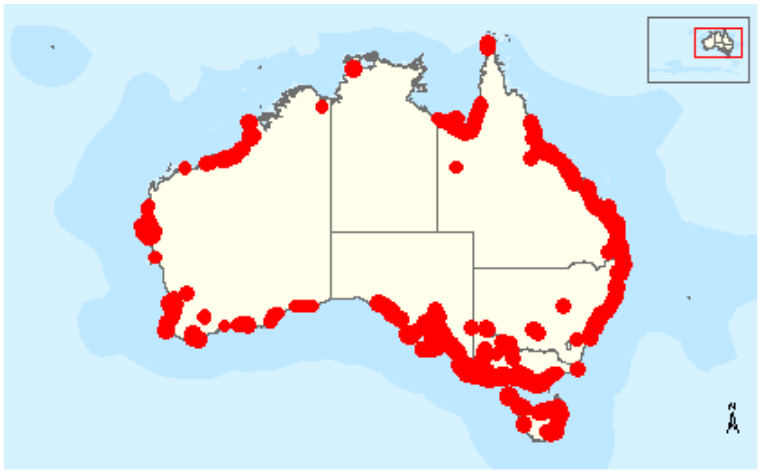


Figure 20.19 Distribution range of the Red-necked stint (DSEWPaC 2012av)

Known species populations and their relationship with the GTP footprint

Suitable habitat for this species within KP312 to KP408.81 and KP408.81 and KP409.04 of the GTP and ancillary areas is considered to be limited and to areas used during migration.

Biology and reproduction

The Red-necked stint is omnivorous. In Australia it is known to forage on intertidal and near-coastal wetlands. It jabs and probes with its bill into the soft mud for small invertebrates. It also gleans from plants in saltmarsh and water (Higgins & Davies 1996).

The Red-necked stint does not breed in Australia; instead it breeds in Siberia and occasionally in Alaska (DSEWPaC 2012av).

20.19.3 Habitat

In Australasia, the Red-necked stint is mostly found in coastal areas, including in sheltered inlets, bays, lagoons and estuaries with intertidal mudflats, often near spits, islets and banks and, sometimes, on protected sandy or coralline shores. Occasionally they have been recorded on exposed or ocean beaches, and sometimes on stony or rocky shores, reefs or shoals. They also occur in saltworks and sewage farms; saltmarsh; ephemeral or permanent shallow wetlands near the coast or inland, including lagoons, lakes, swamps, riverbanks, waterholes, bore drains, dams, soaks and pools in saltflats. They sometimes use flooded paddocks or damp grasslands. They have occasionally been recorded on dry gibber plains, with little or no perennial vegetation (Higgins & Davies 1996).

The Red-necked stint mostly forages on bare wet mud on intertidal mudflats or sandflats, or in very shallow water; mostly in areas with a film of surface water and mostly close to edge of water. During high tides they sometimes forage in non-tidal wetlands. Red-necked stints may also forage in samphire, generally avoid beds of seagrass, but may feed along edges (Higgins & Davies 1996).

The Red-necked stint roosts on sheltered beaches, spits, banks or islets, of sand, mud, coral or shingle, sometimes in saltmarsh or other vegetation. They occasionally roost on exposed reefs or shoals (Higgins & Davies 1996). Large numbers sometimes roost on ocean beaches

and they also roost among beachcast seaweed or clods of mud or dried cow-pats (Hobbs 1961). During very high tides they may use sand dunes or claypans (DSEWPaC 2012av).

20.20 Ruddy turnstone

20.20.1 EPBC Act legal status

Marine
Migratory (Bonn, CAMBA, JAMBA, ROKAMBA)

20.20.2 Biology and ecology

Characteristics

The Ruddy turnstone (*Arenaria Interpres*) is a medium sized member of the subfamily Arenariinae. It has a length between 22 to 24 cm, wingspan of 50 to 57 cm and a weight of approximately 115 g (DSWEPaC 2012aw).

Compared to other waders it has a stocky, medium build with a short, slightly uplifted, wedge shaped bill. Its distinct features include a black or dark brown chest with pale patches and a striking, dark-white, flight pattern. The bird also has orange-red legs and a bustling gait. The Ruddy Turnstone's common name is derived from its habit of turning stones with its bill. The sexes are similar in appearance however some breeding pairs are sometimes separable and juveniles are separable from immatures (Higgins & Davies 1996).

Ruddy turnstones exhibit marked seasonal variations. The males are brighter than females in breeding plumage, with non-breeding plumages being somewhat duller. Juveniles have distinctly duller plumages than breeding adults (Higgins & Davies 1996).

Ruddy turnstone (Source: Trepte 2006)

Known distribution

The Ruddy turnstone is widespread within Australia during its non-breeding period of the year (Bamford *et al* 2008), including from Tasmania in the south to Darwin in the north and many coastal areas in between. It is found in most coastal regions, with occasional records of inland populations (Higgins & Davies 1996).

Figure 20.20 is an indicative distribution map of the present distribution of the Ruddy turnstone.

The Australian population is estimated at 14,000 (Watkins 1993), however, 35,000 birds use the East Asian-Australasian Flyway annually (DSEWPaC 2012aw).

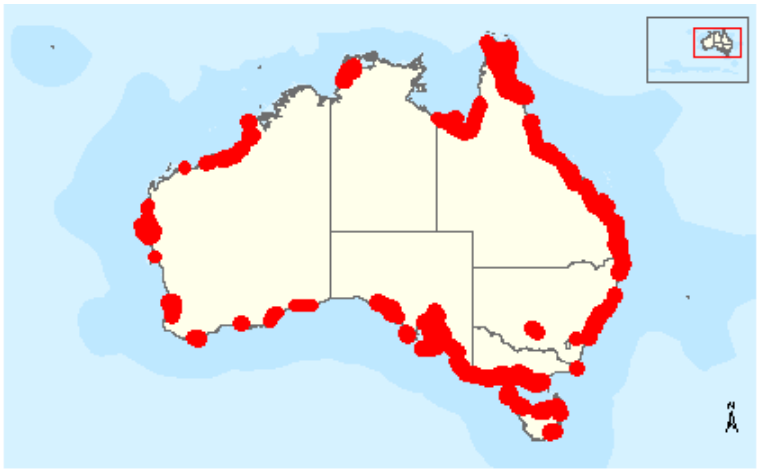


Figure 20.20 Distribution range of the Ruddy turnstone (DSEWPaC 2012aw)

Known species populations and their relationship with the GTP footprint

Suitable habitat for this species within KP312 to KP408.81 and KP408.81 and KP409.04 of the GTP and ancillary areas is considered to be limited and to areas used during migration.

Biology and reproduction

The Ruddy turnstone is carnivorous, eating insects, worms, crustaceans, molluscs, and spiders. It has occasionally been known to eat fish, birds eggs and carrion and human food scraps. It is capable of ingesting grit (Higgins & Davies 1996).

The Ruddy turnstone does not breed in Australia; instead it breeds in Europe, Asia and North America (DSEWPaC 2012aw).

20.20.3 Habitat

In Australasia, the Ruddy turnstone is mainly found on coastal regions with exposed rock coast lines or coral reefs. It also lives near platforms and shelves, often with shallow tidal pools and rocky, shingle or gravel beaches. It can, however, be found on sand, coral or shell beaches, shoals, cays and dry ridges of sand or coral. It has occasionally been sighted in estuaries, harbours, bays and coastal lagoons, among low saltmarsh or on exposed beds of seagrass, around sewage ponds and on mudflats. In north Australia it is known to occur in a wide variety of habitats, and may prefer wide mudflats. Surveys demonstrate that the Ruddy turnstone can live away from coastal areas in habitats such river beds, and on inland lakes and adjacent farmland (Higgins & Davies 1996).

The Ruddy turnstone mainly forages between lower supralittoral and lower littoral zones of foreshores, from strand-line to wave-zone. They often forage among banks of stranded seaweed or other tide-wrack. They are also known to forage on exposed rocky platforms, coral reefs and mudflats (Higgins & Davies 1996). In the south-east Gulf of Carpentaria they feed only on mangrove mudflats, especially those near shingle beaches (Garnett 1989). Sometimes they feed around coastal lagoons and sewage treatment ponds, occasionally among low vegetation in saltmarsh, on exposed beds of seagrass, or among dunes on coral

cays. The have sometimes been known to forage in grassy areas above the tideline, in short pasture, or in ploughed paddocks (Higgins & Davies 1996).

The Ruddy turnstone roosts on beaches, above the tideline, among rocks, shells, beachcast seaweed or other debris. They have also been observed roosting on rocky islets among grassy tussocks, and on mudflats and sandflats (Higgins & Davies 1996).

20.21 Red-necked avocet

20.21.1 EPBC Act legal status

Marine
Migratory – Bonn (Family Recurvirostridae)

20.21.2 Biology and ecology

Characteristics

The Red-necked avocet (*Recurvirostra novaehollandiae*) is 40 to 45 cm in size with an average weight of 310 g. It has a chestnut brown head and neck with a white eye-ring and a long, upturned, black bill. The rest of the body is white, except for two black streaks along the back. The wings are white, with black wing bars and tips. The relatively long legs are pale grey-blue. The sexes are similar, but the males have a more sharply upturned bill. This species is endemic (native) to Australia (Birdlife Australia 2012c).

Red-necked avocet (Source: Harrison 2012a)

Known distribution

The Red-necked avocet is found throughout mainland Australia, but breeds mainly in the south-western interior including southern inland areas of New South Wales, northern Victoria and souther eastern Sout Australia (Pizzey & Knight 1997). Out of breeding season, it visits most of the rest of Australia, but is only an accidental visitor to Tasmania or the Cape York Peninsula (Birdlife Australia 2012c). The Red-necked is nomadic and dispersive in nature and is also known to move towards the coast summer in southern Australia and the dry season in northern Australia (Pizzey & Knight 1997).

Figure 20.21 is an indicative distribution map of the present distribution of the Red-necked avocet.

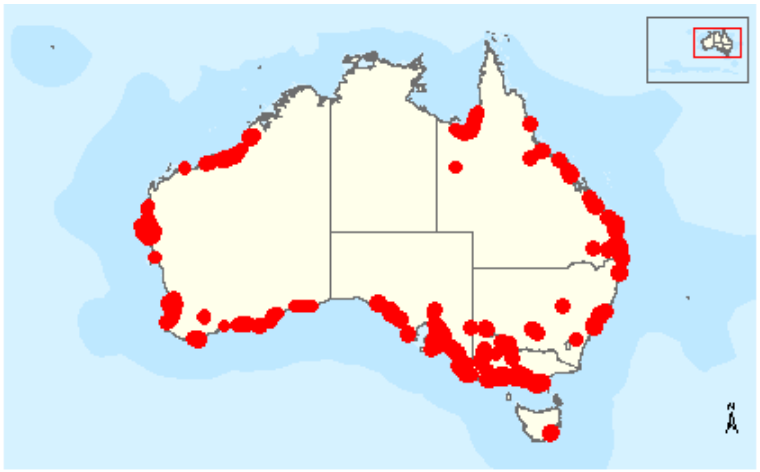


Figure 20.21 Distribution range of the Red-necked avocet (DSEWPaC 2012ax)

Known species populations and their relationship with the GTP footprint

Suitable habitat for this species within KP312 to KP408.81 and KP408.81 and KP409.04 of the GTP and ancillary areas is considered to be limited and to areas used during migration.

Biology and reproduction

The Red-necked avocet feeds on aquatic insects and their larvae, crustaceans and seeds (Birdlife Australia 2012c).

The Red-necked avocet breeds in loose colonies. Nests are shallow scrapes lined with water vegetation with a clutch size of three to four eggs and a single brood is raised per season (Birdlife Australia 2012c).

20.21.3 Habitat

The Red-necked avocet is found in large shallow freshwater or saltwater wetlands and estuarine tidal mudflats (Birdlife Australia 2012c). This species is also known to frequent fresh, brackish and salt swamps and lakes, claypans, commercial saltfields and sewage ponds (Pizzey & Knight 1997). The red-necked avocet is also known to roost and forage in the same habitats as that of stilts (Pizzey & Knight 1997).

20.22 Sanderling

20.22.1 EPBC Act legal status

Marine
Migratory (Bonn, CAMBA, JAMBA, ROKAMBA)

20.22.2 Biology and ecology

Characteristics

The Sanderling (*Calidris alba*) is an active, pale wader reaching 20 cm long, with a wingspan of approximately 40 cm and a weight of approximately 50 to 60 g. Females are slightly larger than males. The non-breeding adult is pale grey above and white below, with a black patch at the angle of the wing. It has a short, straight, broad-based black bill, blackish-brown wings with broad, white wing-stripes, and short, black legs that only have three toes (no hind toe as in other sandpipers). In flight, it shows the widest white wing-bar of any sandpiper, on a very dark wing. The forehead and eyebrows are white; iris is dark brown. The rump and tail have a brown centre and white sides. Elements of the rufous breeding plumage may be visible in some birds just after their spring arrival or before their autumn departure, and in some overwintering birds (Geering *et al* 2007; Higgins & Davies 1996; NSW DECCW 2005; Pringle 1987).

When breeding in the Northern Hemisphere, the Sanderling's plumage changes to a brick-red and grey-black pattern dominating the head, neck, back and wings of the bird (NPWS 1999d).

Juveniles have similar plumage to non-breeding adults, though more pronounced streaking occurs on the crown and a buff fringing may be seen on wing coverts. The underparts and other areas of white can have a buff wash or creamy appearance (Geering *et al* 2007).

Sanderling (Source: Harrison 2011g)

Known distribution

The Sanderling occurs in coastal areas around Australia. Inland records have occurred in most states of singles or small groups, birds probably on migration (Higgins & Davis 1996).

In Queensland, they are occasional in the Gulf of Carpentaria and Torres Strait. Scattered records occur in mid-east and south-east Queensland from Townsville and Alva Beach, south to Fraser Island, and around Moreton Bay and Point Danger, including on offshore islands (Higgins & Davis 1996).

Figure 20.22 is an indicative distribution map of the present distribution of the Sanderling.

The estimated extent of occurrence for the Sanderling is 1,260,000 km^2 (Birdlife International 2010b).

The worldwide population estimate for the Sanderling is 620,000 to 700,000 (Birdlife International 2010b). The number that spend the non-breeding time in Australia is estimated to be 10,000, approximately half of the estimated East-Asian Flyway population of 22,000 (Bamford *et al* 2008; Geering *et al* 2007).

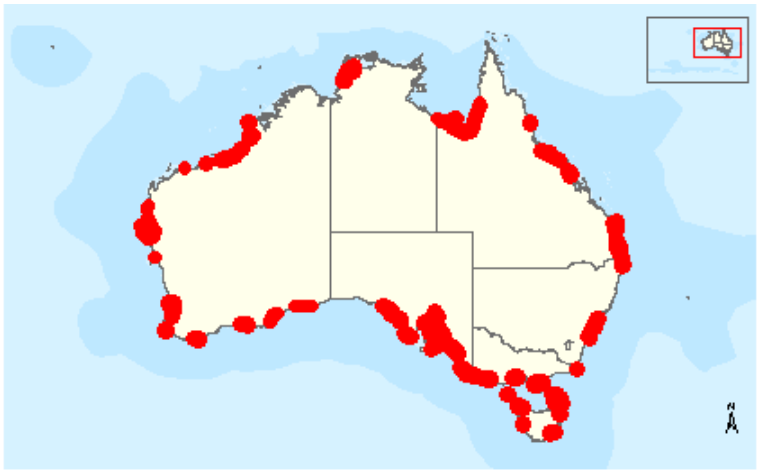


Figure 20.22 Distribution range of the Sanderling (DSEWPaC 2012ay)

Known species populations and their relationship with the GTP footprint

Suitable habitat for this species within KP312 to KP408.81 and KP408.81 and KP409.04 of the GTP and ancillary areas is considered to be limited and to areas used during migration.

Biology and reproduction

The Sanderling is omnivorous, foraging on plants, seeds, worms, crustaceans, spiders, insects, and occasionally on medusae, fish and larger molluscs and crustaceans taken as carrion (DSEWPaC 2012ay).

The Sanderling does not breed in Australia; instead it breeds in Russia, North America and the Arctic Ocean (DSEWPaC 2012ay).

20.22.3 Habitat

In Australia, the species is almost always found on the coast, mostly on open sandy beaches exposed to open sea-swell, and also on exposed sandbars and spits, and shingle banks, where they forage in the wave-wash zone and amongst rotting seaweed. Sanderlings also occur on beaches that may contain wave-washed rocky outcrops. Less often the species occurs on more sheltered sandy shorelines of estuaries, inlets and harbours. Rarely, they are recorded in near-coastal wetlands, such as lagoons, hypersaline lakes, saltponds and samphire flats. There are rare inland records from sandy shores of ephemeral brackish lakes and brackish river-pools (Higgins & Davies 1996).

They roost on/behind bare sand high on the beach, clumps of washed-up kelp, coastal dunes and rocky reefs and ledges (Higgins & Davies 1996).

In south-east Queensland, they are occasionally recorded sheltering on tidal flats during storms (Roberts 1979).

20.23 Broad-billed sandpiper

20.23.1 EPBC Act legal status

Marine
Migratory (Bonn, CAMBA, JAMBA, ROKAMBA)

20.23.2 Biology and ecology

Characteristics

The Broad-billed sandpiper (*Limicola falcinellus*) is a small member of the Calidridinae family. It is 16 to 18 cm in size, has a wingspan of 34 to 37 cm and a weight of 40 g. It is a small, stint-like wader with short legs and a diagnostic long straight black bill that is flattened and kinked downwards at the tip. When viewed from above the bill appears broad with parallel sides, tapering sharply to a pointed tip. The wing tips project a short distance beyond the tail at rest. The species flight pattern is similiar to that of stints (Higgins & Davies 1996).

Broad-billed sandpiper (Source: Alnus 2008b)

Known distribution

In Australia, the Broad-billed sandpiper is most common on the north and north-west coasts and occur regularly at scattered localities in southern Australia, where they are usually seen singly (DSEWPaC 2012az).

In Queensland, there are scattered coastal records, including at the south and south-east Gulf of Carpentaria. They have been seen at Coen River, Eagle Island, Cairns, Innisfail, Townsville and Jerona. In the states north they have been seen at Mackay, Emu Park and Gladstone. In the mid-east they are known from North Stradbroke Island, south to Moreton Bay and west to Clontarf and Seven-Mile Lagoon, Lowood, in south-east Queensland (Higgins & Davies 1996).

Figure 20.23 is an indicative distribution map of the present distribution of the Broad-billed sandpiper.

An estimated 25,000 Broad-billed sandpipers occupy the East Asian-Australasian Flyway. During the non-breeding season approximately 40% of the Flyway population occurs in Australia (Bamford *et al* 2008).

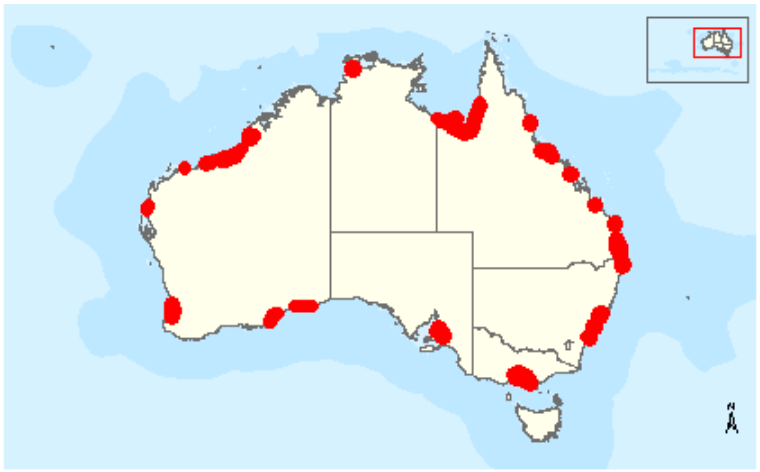


Figure 20.23 Distribution range of the Broad-billed sandpiper (DSEWPaC 2012az)

Known species populations and their relationship with the GTP footprint

Suitable habitat for this species within KP312 to KP408.81 and KP408.81 and KP409.04 of the GTP and ancillary areas is considered to be limited and to areas used during migration.

Biology and reproduction

The Broad-billed sandpiper is omnivorous, foraging on worms, including polychaetes, molluscs, crustaceans, insects, seeds and occasionally rootlets and other vegetation (DSEWPaC 2012az).

The Broad-billed sandpiper does not breed in Australia; instead it breeds in Siberia and Europe (DSEWPaC 2012az).

20.23.3 Habitat

The Broad-billed sandpiper occurs in sheltered parts of the coast, favouring estuarine mudflats but also occasionally occur on saltmarshes, shallow freshwater lagoons, saltworks and sewage farms, and in areas with large soft intertidal mudflats, which may have shell or sandbanks nearby. Occasionally they occur on reefs or rocky platforms. They have also been recorded in creeks, swamps and lakes near the coast, particularly those with bare mudflats or sand exposed by receding water. They often favour mud among, or fringed by, mangroves, particularly on the seaward side and sometimes occur in estuaries edged by saltmarsh. They are rarely recorded inland (Higgins & Davies 1996).

Foraging occurs on exposed flats of soft mud or wet sand at edges of coastal and near-coastal wetlands, often around channels on mudflats or in accumulated mud in swales between shell banks. In northern Australia, they forage in soft mud near mangroves, but may remain on same muddy section, even though fresher substrate may be exposed by the receding tide. They also forage in shallow water on muddy edges of ponds. They roost on the banks of sheltered sandy, shelly or shingly beaches (Higgins & Davies 1996). They nest on the ground, frequently in the top of a tussock (Cramp 1985).

20.24 Black-winged stilt

20.24.1 EPBC Act legal status

Marine
Migratory – Bonn (Family Recurvirostridae)

20.24.2 Biology and ecology

Characteristics

The Black-winged stilt (*Himantopus himantopus*) is 36 to 39 cm in size and is a large black and white wader with long orange-red legs and a straight black bill. It has black on the back of the neck, a white collar and a red iris. Both sexes are similar, and the plumage does not change during the year. Young Black-winged stilts lack black on the back of the neck and have grey-brown wings and back, speckled with white. They have a smudged grey crown, which extends down the back of the neck as the birds get older (Birdlife Australia 2012f).

Black-winged stilt (Source: Harrison 2011h)

Known distribution

The Black-winged stilt has a wide range, including Australia, Central and South America, Africa, southern and south-eastern Asia and parts of North America and Eurasia. More locally it also occurs through Indonesia, New Guinea, the Solomon Islands, the Philippines and New Zealand. Although widespread on the Australian mainland, it is an uncommon visitor to Tasmania (Birdlife Australia 2012f) and waterless deserts and the Nullarbor Plain (Pizzey & Knight 1997). This species is seasonally dispersive and moves according to rainfall.

Figure 20.24 is an indicative distribution map of the present distribution of the Black-winged stilt.

The Black-winged stilt breeds mostly between August and December in south eastern Australia, but almost any month following rain. It is also known to breed between autumn and winter in the tropics (Pizzey & Knight 1997).

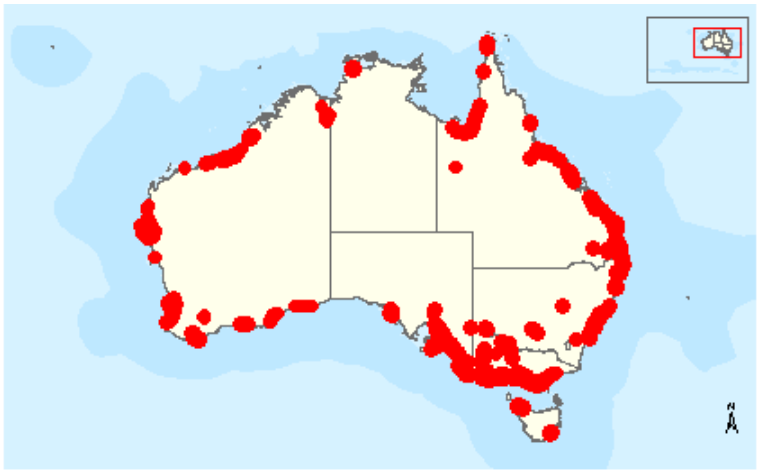


Figure 20.24 Distribution range of the Black-winged stilt (DSEWPaC 2012ba)

Known species populations and their relationship with the GTP footprint

Suitable habitat for this species within KP312 to KP408.81 and KP408.81 and KP409.04 of the GTP and ancillary areas is considered to be limited and to areas used during migration.

Biology and reproduction

Black-winged stilts feed mainly on aquatic insects, but will also take molluscs and crustaceans (Birdlife Australia 2012f).

As with other activities, Black-winged stilts nest in small colonies; within these, the mated pairs strongly defend their individual territories. The nest may be anything from a simple shallow scrape on the ground to a mound of vegetation placed in or near the water. Both sexes incubate the eggs and look after the young (Birdlife Australia 2012f).

20.24.3 Habitat

The Black-winged stilt is a social species, and is usually found in small groups. Black-winged stilts prefer freshwater and saltwater marshes, mudflats, and the shallow edges of lakes and rivers (Birdlife Australia 2012f). This species is also associated with flooded claypans, dams, sewage ponds and commercial saltfields (Pizzey & Knight 1997).

20.25 Curlew sandpiper

20.25.1 EPBC Act legal status

Marine
Migratory (Bonn, CAMBA, JAMBA, ROKAMBA)

20.25.2 Biology and ecology

Characteristics

The Curlew sandpiper (*Calidris ferruginea*) is a small, slim sandpiper 18 to 23 cm long and weighing 57 g, with a wingspan of 38 to 41 cm. The legs and neck are long. The bill is also long, and is decurved with a slender tip. The bill is black, sometimes with a brown or green tinge at the base. The head is small and round, and the iris is dark brown. The legs and feet are black or black-grey. When at rest, the wing-tips project beyond the tip of the tail. The sexes are similar, but females have a slightly larger and longer bill and a slightly paler underbelly in breeding plumage (Higgins & Davies 1996).

In breeding plumage, the head, neck and underbody to rear belly are a rich chestnut-red with narrow black bars on the belly and flanks. There are black streaks on the crown, a dusky loral stripe, and white around the base of the bill. The head, neck and underbody have a pale-streaked appearance due to white tips on the feathers. The feathers on the mantle and scapulars are black with large chestnut spots and grayish-white tips. The back and upper rump are dark brown, with a prominent square white patch across the lower rump and uppertail-covert (Higgins & Davies 1996).

The non-breeding plumage is similar to the breeding plumage. Differences are that the cap, ear-coverts, hindneck and sides of neck are pale brownish-grey with fine dark streaks, grading to off-white on the lower face, with white on the chin and throat. There is a narrow dark loral stripe and white supercilium from the bill to above the rear ear-coverts. The mantle, back, scapulars, tertials and innerwing-covert are pale brownish-grey with fine dark streaks. The underbody is white with a brownish-grey wash and fine dark streaks on the foreneck and breast (Higgins & Davies 1996).

Curlew sandpiper (Source: Szczepanek 2005)

Known distribution

In Australia, Curlew sandpipers occur around the coasts and are also quite widespread inland, though in smaller numbers. Records occur in all states during the non-breeding period, and also during the breeding season when many non-breeding one year old birds remain in Australia rather than migrating north (DSEWPaC 2012bb).

In Queensland, scattered records occur in the Gulf of Carpentaria, with widespread records along the coast south of Cairns. There are sparsely scattered records inland (DSEWPaC 2012bb).

Figure 20.25 is an indicative distribution map of the present distribution of the Curlew sandpiper.

The global population size of the Curlew Sandpiper is 1,350,000 (Bamford *et al* 2008) and the global extent of occurrence is estimated at 100,000 to 1,000,000 km^2 (BirdLife International 2008). The total population size of Curlew sandpipers in the East Asian-Australasian Flyway is 180,000 (DSEWPaC 2012bb).

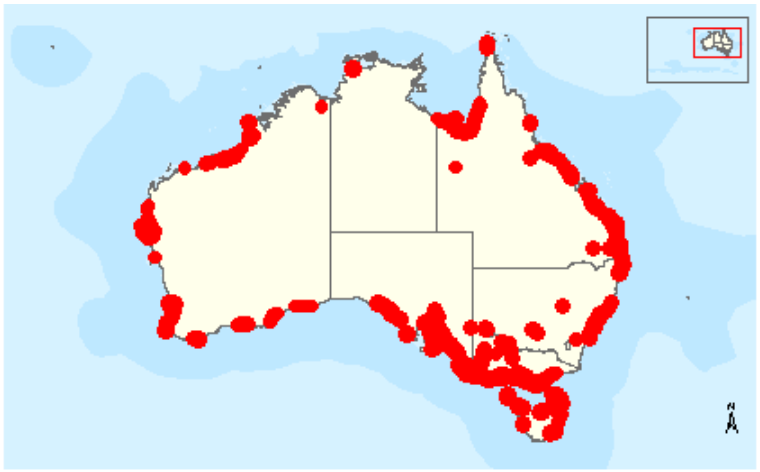


Figure 20.25 Distribution range of the Curlew sandpiper (DSEWPaC 2012bb)

Known species populations and their relationship with the GTP footprint

Suitable habitat for this species within KP312 to KP408.81 and KP408.81 and KP409.04 of the GTP and ancillary areas is considered to be limited and to areas used during migration.

Biology and reproduction

This species forages mainly on invertebrates, including worms, molluscs, crustaceans, and insects, as well as seeds (DSEWPaC 2012bb).

The Curlew sandpiper does not breed in Australia; instead it breeds in Siberia (DSEWPaC 2012bb).

20.25.3 Habitat

Curlew sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They are also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They occur in both fresh and brackish waters. Occasionally they are recorded around floodwaters (Higgins & Davies 1996).

Curlew sandpipers forage on mudflats and nearby shallow water. In non-tidal wetlands, they usually wade, mostly in water 15 to 30 mm, but up to 60 mm, deep. They forage at the edges of shallow pools and drains of intertidal mudflats and sandy shores. At high tide, they forage among low sparse emergent vegetation, such as saltmarsh, and sometimes forage in flooded paddocks or inundated saltflats. Occasionally they forage on wet mats of algae or waterweed, or on banks of beachcast seagrass or seaweed. They rarely forage on exposed reefs (Higgins & Davies 1996).

Curlew sandpipers generally roost on bare dry shingle, shell or sand beaches, sandspits and islets in or around coastal or near-coastal lagoons and other wetlands, occasionally roosting in dunes during very high tides and sometimes in saltmarsh (Higgins & Davies 1996).

20.26 Greater sand plover

20.26.1 EPBC Act legal status

Marine
Migratory (Bonn, CAMBA, JAMBA, ROKAMBA)

20.26.2 Biology and ecology

Characteristics

The Greater sand plover (*Charadrius leschenaultii*) is a medium-sized (length: 22 to 25 cm; weight 75 to 100 g) brown-and-white plover. Sexes differ when in breeding plumage, but are inseparable when in non-breeding plumage; juveniles are also separable from adults (Marchant & Higgins 1993; Stewart *et al* 2007).

In breeding plumage, the male has a grey-brown crown and nape with a pale chestnut tinge, and a chestnut hindneck and sides of neck; the rest of the upperparts are pale grey-brown, with rufous edges to the feathers which impart a slightly scaled appearance, white sides of the rump and uppertail-coverts, and the tail has a blackish-brown subterminal band. In flight the upperwings feature blackish flight feathers and primary coverts with a narrow white trailing edge to the innerwing and a prominent white wing-bar; the inner wing coverts are grey brown, concolorous with most of the upperparts. The face has a black band across the upper forehead, and is white on the lower forehead; a black stripe runs back from the bill, widening to form a black mask across the eyes and ear coverts, and joins the narrow black band on the upper forehead. The chin and throat are white, bordered by the chestnut of the sides of the neck; there is a broad chestnut band across the upper breast (concolorous with the sides of the neck), and this sometimes has a narrow dark band on its upper edge; the rest of the underparts are white. The underwing is white with a narrow, dusky trailing edge. The bill is black; the eyes dark brown; and the legs and feet are pale greenish grey. The female appears similar except that the mask and the frontal band is dark grey-brown, not black; the chestnut of the crown, nape and neck are paler than the male; and there is never a black margin to the breast band (Marchant & Higgins 1993; Stewart *et al* 2007).

In non-breeding plumage, birds differ from breeding plumage by lacking black and chestnut plumage, being replaced by grey-brown; and they develop a broad white supercilium, concolorous with the white forehead (Marchant & Higgins 1993; Stewart *et al* 2007).

Juvenile birds appear similar to non-breeding adults, but the feathers of the upperparts have narrow buff fringes and indistinct dark streaking and subterminal bands, and there may be a buff tinge to the face, and grey-brown patches at the sides of the breast, extending as a wash across the breast in some (Marchant & Higgins 1993).

Greater sand plover (Source: Cheng 2009)

Known distribution

In Australia, the Greater sand plover occurs in coastal areas in all states, though the greatest numbers occur in northern Australia, especially the north-west (Marchant & Higgins 1993; Minton *et al* 2006). It is abundant in south-eastern parts of the Gulf of Carpentaria in Queensland, and is widespread from the Torres Strait, along the eastern coast, into the Northern Rivers region of northern NSW, with occasional records south to about Shoalhaven Heads (Barrett *et al* 2003, Blakers *et al* 1984; Garnett 1986 & 1989; Lane 1987; Morris *et al* 1981).

Figure 20.26 is an indicative distribution map of the present distribution of the Greater sand plover.

There are no published estimates of the extent of occurrence of the Greater sand plover in Australia. The estimated global extent of occurrence is 100,000 to 1,000,000 km^2 (Birdlife International 2007).

The area of occupancy of the Greater sand plover in Australia has been estimated at 35,600 km^2 (DSEWPaC 2012bc).

The total population is estimated to be between approximately 200,000 and 275,000 birds (Wiersma 1996) or 190,000 to 360,000 birds (Birdlife International 2007). Of these, 110,000 birds are estimated to be present in the East Asian-Australasian Flyway (Stewart *et al* 2007).

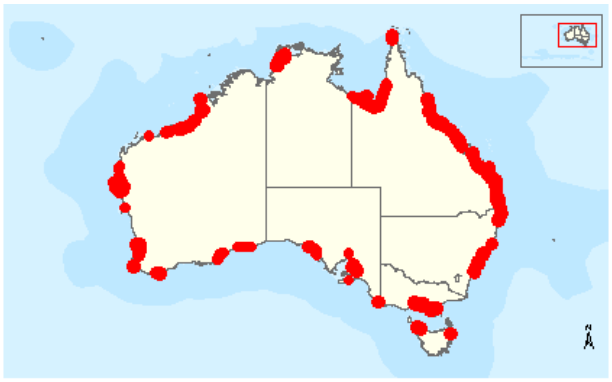


Figure 20.26 Distribution range of the Greater sand plover (DSEWPaC 2012bc)

Known species populations and their relationship with the GTP footprint

Suitable habitat for this species within the KP312 to KP408.81 and KP408.81 and KP409.04 of the GTP and ancillary areas is considered to be limited and to areas used during migration.

Biology and reproduction

During the non-breeding season, Greater sand plovers mostly eat molluscs, worms, crustaceans (especially small crabs and sometimes shrimps) and insects (including adults and larvae of termites, beetles, weevils, earwigs and ants) (DSEWPaC 2012bc). They are said to have been recorded eating lizards and plant material (Marchant & Higgins 1993); they may also eat shell grit (Hall 1974).

The Greater sand plover does not breed in Australia; instead it breeds in central Asia (DSEWPaC 2012bc).

20.26.3 Habitat

In the non-breeding grounds in Australasia, the species is almost entirely coastal, inhabiting littoral and estuarine habitats. They mainly occur on sheltered sandy, shelly or muddy beaches with large intertidal mudflats or sandbanks, as well as sandy estuarine lagoons (Bamford 1988; Blakers *et al* 1984; Lane 1987; Sibson 1948; Stewart *et al* 2007), and inshore reefs, rock platforms, small rocky islands or sand cays on coral reefs (Abbott 1982; Morris 1989; Sedgwick 1978). They are occasionally recorded on near-coastal saltworks and saltlakes, including marginal saltmarsh, and on brackish swamps (DSEWPaC 2012bc; Sibson 1953; Storr 1964 & 1977; Storr *et al* 1986). They seldom occur at shallow freshwater wetlands (Storr 1977).

Greater sand plovers usually feed from the surface of wet sand or mud on open intertidal flats of sheltered embayments, lagoons or estuaries (Ewart 1973; Sibson 1948; Marchant & Higgins 1993), more often on firm sandy flats than on soft muddy ones (Rogers 1999).

They usually roost on sand-spits and banks on beaches or in tidal lagoons, and occasionally on rocky points (Bamford 1988; Ewart 1973; Pegler 1983; Sibson 1948 & 1953), or in adjacent areas of saltmarsh (Gosper & Holmes 2002) or claypans (Collins *et al* 2001). They tend to roost further up the beach than other waders, sometimes well above high-tide mark (DSEWPaC 2012bc).

20.27 Latham's snipe

20.27.1 EPBC Act legal status

Marine
Migratory (Bonn, CAMBA, JAMBA, ROKAMBA)

20.27.2 Biology and ecology

Characteristics

Latham's snipe (*Gallinago hardwickii*) is a medium sized wader, and the largest snipe in Australia, with a length of 29 to 33 cm, a wingspan of 50 to 54 cm and a mass of 150 to 230 g. It has a long straight bill, rather short broad pointed wings, a long tail and short legs (Higgins & Davies 1996). The cryptic plumage is intricately marked with barring and chevrons of buff, black and various shades of brown, with blackish-brown stripes across the crown and cream streaks down the back. The belly and parts of the head are white, and the tail is rufous with a white tip. The eyes are large and blackish-brown in colour (Higgins & Davies 1996; Pizzey & Knight 1997). The colour of the bill varies from pale-brown to olive, becoming blackish at the distal third and olive-yellow at the base. The legs and feet are olive-grey to olive in colour. The sexes are similar in appearance, and there is no seasonal variation in the plumage. Juveniles in fresh plumage differ only slightly from adults, but can be distinguished by slight differences in the patterning on the upperwing. Adults and juveniles are indistinguishable after early November (Higgins & Davies 1996).

Latham's snipe (Source: Mdekool 2010)

Known distribution

Latham's snipe is a non-breeding visitor to south-eastern Australia, and is a passage migrant through northern Australia (ie it travels through northern Australia to reach non-breeding areas located further south) (Higgins & Davies 1996). The species has been recorded along the east coast of Australia from Cape York Peninsula through to south-eastern South Australia (including the Adelaide plains and Mount Lofty Ranges, and the Eyre Peninsula). The range extends inland over the eastern tablelands in south-eastern Queensland (and occasionally from Rockhampton in the north), and to west of the Great Dividing Range in New South Wales (Barrett *et al* 2003; Blakers *et al* 1984; Frith *et al* 1977).

Figure 20.27 is an indicative distribution map of the present distribution of the Latham's snipe.

The extent of occurrence is estimated at 3 000 000 km^2 and the area of occupancy is estimated at 3000 km^2 (Garnett & Crowley 2000).

The distribution of Latham's snipe is naturally fragmented (although, because of the mobility of the species, this is unlikely to have any effect on survival) (DSEWPaC 2012bd).

The size of the Latham's snipe population that visits Australia is estimated at 25,000 to 100,000 birds (Wetlands International 2002).

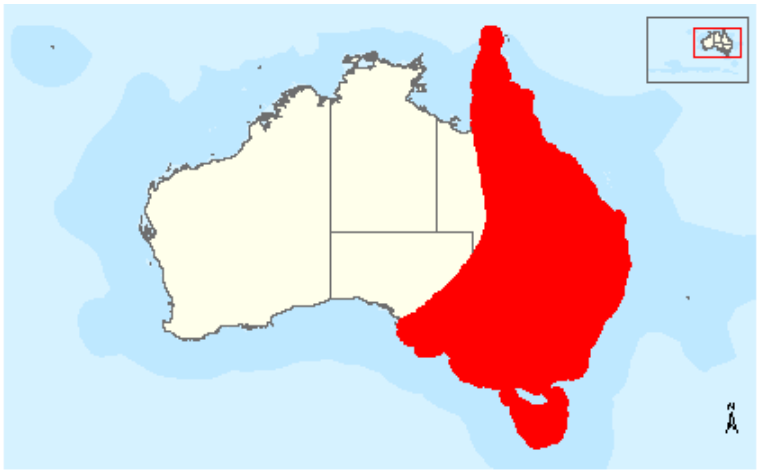


Figure 20.27 Distribution range of the Latham's snipe (DSEWPaC 2012bd)

Known species populations and their relationship with the GTP footprint

Suitable habitat for this species within KP312 to KP408.81 and KP408.81 and KP409.04 of the GTP and ancillary areas is considered to be limited and to areas used during migration.

Biology and reproduction

Latham's snipe is an omnivorous species that feeds on seeds and other plant material (mainly from species in families such as Cyperaceae, Poaceae, Juncaceae, Polygonaceae, Ranunculaceae and Fabaceae), and on invertebrates including insects (mainly flies and beetles), earthworms and spiders and occasionally molluscs, isopods and centipedes (Frith *et al* 1977; Todd 2000).

Latham's snipe does not breed in Australia; instead it breeds in Japan and eastern Russia (DSEWPaC 2012bd).

20.27.3 Habitat

In Australia, Latham's snipe occurs in permanent and ephemeral wetlands up to 2,000 m above sea-level (Chapman 1969; Naarding 1981). They usually inhabit open, freshwater wetlands with low, dense vegetation (eg swamps, flooded grasslands or heathlands, around bogs and other water bodies) (Frith *et al* 1977; Naarding 1983; DSEWPaC 2012bd). However, they can also occur in habitats with saline or brackish water, in modified or artificial habitats, and in habitats located close to humans or human activity (Frith *et al* 1977; Naarding 1983).

Latham's snipe occurs in temperate and tropical regions of Australia (Driscoll 1993). Its altitudinal range extends from sea-level (ie the coast) to approximately 2,000 m above sea-level (Chapman 1969; Driscoll 1993).

In Australia, Latham's snipe occurs in a wide variety of permanent and ephemeral wetlands (Naarding 1981). They usually occur in open, freshwater wetlands that have some form of shelter (usually low and dense vegetation) nearby (Frith *et al* 1977; Naarding 1983; DSEWPaC 2012bd). They generally occupy flooded meadows, seasonal or semi-permanent swamps, or open waters (Frith *et al* 1977; Naarding 1983), but various other freshwater habitats can be used including bogs, waterholes, billabongs, lagoons, lakes, creek or river margins, river pools and floodplains (Frith *et al* 1977; Naarding 1981 & 1983). The structure and composition of the vegetation that occurs around these wetlands is not important in determining the suitability of habitat (Naarding 1983). As such, snipe may be found in a variety of vegetation types or communities including tussock grasslands with rushes, reeds and sedges, coastal and alpine heathlands, lignum or tea-tree scrub, button-grass plains, alpine herbfields and open forest (Chapman 1969; Frith 1970; Frith *et al* 1977; Naarding 1983; Wall 1990).

Latham's snipe sometimes occur in habitats that have saline or brackish water, such as saltmarsh, mangrove creeks, around bays and beaches, and at tidal rivers (Frith *et al* 1977; Naarding 1983; Patterson 1991). These habitats are most commonly used when the birds are on migration (Frith *et al* 1977). They are regularly recorded in or around modified or artificial habitats including pasture, ploughed paddocks, irrigation channels and drainage ditches, ricefields, orchards, saltworks, and sewage and dairy farms (Fielding 1979; Frith *et al* 1977; Lane & Jessop 1985; Naarding 1982 & 1983). They can also occur in various sites close to humans or human activity (eg near roads, railways, airfields, commercial or industrial complexes) (Frith *et al* 1977; Naarding 1983).

The foraging habitats of Latham's snipe are characterised by areas of mud (either exposed or beneath a very shallow covering of water) and some form of cover (eg low, dense vegetation) (Frith *et al* 1977; Todd 2000). The snipe roost on the ground near (or sometimes in) their foraging areas, usually in sites that provide some degree of shelter, eg beside or under clumps of vegetation, among dense tea-tree, in forests, in drainage ditches or plough marks, among boulders, or in shallow water if cover is unavailable (Frith *et al* 1977; Naarding 1982 & 1983).

Latham's snipe could potentially occur in Bluegrass (*Dichanthium*) dominant grasslands of the Brigalow Belt Bioregions (North and South) if this community is subject to flooding (DSEWPaC 2012bd).

20.28 Grey plover

20.28.1 EPBC Act legal status

Marine
Migratory (Bonn, CAMBA, JAMBA, ROKAMBA)

20.28.2 Biology and ecology

Characteristics

The Grey plover (*Pluvialis squatarola*) is a medium-sized (length: 27 to 31 cm, weight: 250 g) plover with long legs and a short, stout bill. Sexes sometimes differ when in breeding plumage, but are inseparable when in non-breeding plumage; juveniles are separable from adults (DSEWPaC 2012be).

In breeding plumage, the male has a pale whitish crown and nape with fine black streaks or mottling; the hindneck is mostly white; and the rest of the upperparts are black with silvery-white blotches except for the rump, which is white, and the uppertail, which is white with black or dark-brown barring. The face is black except for a white forehead and supercilium which curves behind the ear coverts and down the sides of the neck. The underparts are black except for the vent and undertail coverts, which are white. In flight the upperwing is black with whitish mottling except for the flight feathers and primary coverts, which are black with a white wing-bar; the underwing is mostly whitish with black feathering in the 'arm pit'. The bill is black, the eyes are dark brown, and the legs and feet are dark grey or blackish. The female in breeding plumage appears similar to the male, but the areas which are black on the male may appear brown, and the underparts may have a little white flecking (Marchant & Higgins 1993; Stewart *et al* 2007).

In non-breeding plumage, both sexes have a brown crown and nape with fine white streaking. The rest of the upperparts are pale brownish-grey with white fringes to the feathers, giving a slightly mottled appearance, except for the rump and uppertail coverts, which are white. The forehead and lores are whitish, and there is an off-white supercilium with brown streaking above a brown eye-stripe. The rest of the face is whitish with fine grey-brown streaks. The chin and throat are white; the neck, breast and flanks are white with pale mottling and streaking, and the rest of the underparts are white. When in non-breeding plumage they retain the white wing-bar and black 'arm pit' (Marchant & Higgins 1993; Stewart *et al* 2007).

Juveniles are similar to non-breeding adults, but have distinct dusky-brown streaking on the face, throat and breast, and pale areas have a distinct pale-gold or yellow-buff tinge, including the spangling on the upperwings (Marchant & Higgins 1993; Stewart *et al* 2007).

Grey plover (Source: Buissart 2007)

Known distribution

The Grey plover breeds around the Arctic regions and migrates to the southern hemisphere, being a regular summer migrant to Australia, mostly to the west and south coasts. It is generally sparse but not uncommon in some areas. It is occasionally found inland (Birdlife Australia 2012d).

Figure 20.28 is an indicative distribution map of the present distribution of the Grey plover.

It is estimated that there are 16,000 to 125,000 Grey plovers in the East Asian-Australasian Flyway and of this, 12,000 occur in Australia (DSEWPaC 2012be).

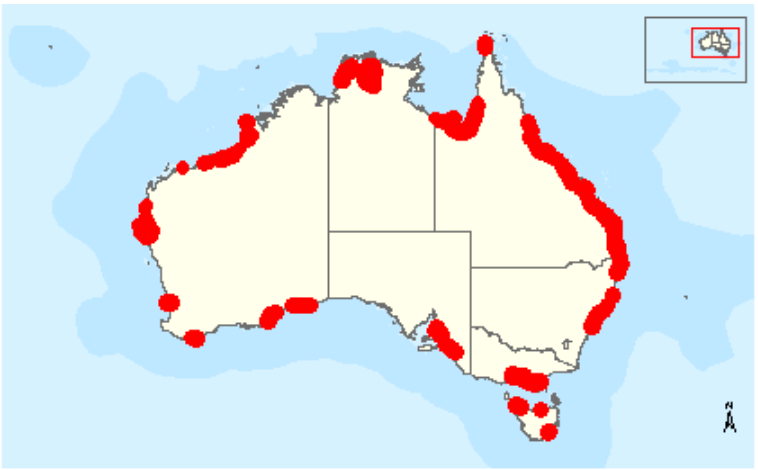


Figure 20.28 Distribution range of the Grey plover (DSEWPaC 2012be)

Known species populations and their relationship with the GTP footprint

Suitable habitat for this species within KP312 to KP408.81 and KP408.81 and KP409.04 of the GTP and ancillary areas is considered to be limited and to areas used during migration.

Biology and reproduction

During the non-breeding season, Grey plovers mostly eat molluscs (especially gastropods), insects and their larvae, crustaceans (especially crabs) and polychaete worms. Vegetation is very occasionally found in their stomachs (Barker & Vestjens 1989; Boehm 1964; Lea & Gray 1935; Marchant & Higgins 1993; Rogers 1999).

The Grey plover does not breed in Australia; instead it breeds in Siberia, Alaska and northern Canada (DSEWPaC 2012be).

20.28.3 Habitat

In non-breeding grounds in Australia, Grey plovers occur almost entirely in coastal areas, where they usually inhabit sheltered embayments, estuaries and lagoons with mudflats and sandflats, and occasionally on rocky coasts with wave-cut platforms or reef-flats, or on reefs within muddy lagoons. They also occur around terrestrial wetlands such as near-coastal lakes and swamps, or salt-lakes. The species is also very occasionally recorded further inland, where they occur around wetlands or salt-lakes (Marchant & Higgins 1993).

Grey plovers usually forage on large areas of exposed mudflats and beaches of sheltered coastal shores such as inlets, estuaries and lagoons. They also occasionally feed in pasture and at the muddy margins of inland wetlands such as lakes, swamps and bores (Marchant & Higgins 1993).

They usually roost in sandy areas, such as on unvegetated sandbanks or sand-spits on sheltered beaches or other sheltered environments such as estuaries or lagoons (Jaensch *et al* 1988; Pegler 1983). They less often roost on the muddy edges of estuaries or water storages such as reservoirs (Bravery 1964; Jaensch *et al* 1988) and salt-lakes (Storr 1964). The species has also been recorded roosting in claypans 2 km from the sea (Collins *et al* 2001).

20.29 Habitat assessment

For the purpose of habitat modelling, the following species have been considered collectively as migratory marine birds:

- Eastern reef egret (*Egretta sacra*)
- Lesser sand plover, mongolian plover (*Charadrius mongolus*)
- Red-capped plover (*Charadrius ruficapillus*)
- Pacific golden plover (*Pluvialis fulva*)
- Double-banded plover (*Charadrius bicinctus*)
- Common sandpiper (*Actitis hypoleucos*)
- Little curlew, little whimbrel (*Numenius minutus*)
- Marsh sandpiper (*Tringa stagnatilis*)
- Red knot (*Calidris canutus*)
- Terek sandpiper (*Xenus cinereus*)
- Sharp-tailed sandpiper (*Calidris acuminate*)
- Black-tailed godwit (*Limosa limosa*)
- Bar-tailed godwit (*Limosa lapponica*)
- Far eastern curlew (*Numenius madagascariensis*)
- Whimbrel (*Numenius phaeopus*)
- Common greenshank (*Tringa nebularia*)
- Grey-tailed tattler (*Tringa brevipes*)
- Great knot (*Calidris tenuirostris*)
- Red-necked stint (*Calidris ruficollis*)
- Ruddy turnstone (*Arenaria interpres*)
- Red-necked avocet (*Recurvirostra novaehollandiae*)
- Curlew sandpiper (*Calidris ferruginea*)
- Greater sand plover, Large sand plover (*Charadrius leschenaultia*)
- Sanderling (*Calidris alba*)
- Broad-billed sandpiper (*Limicola Falcinellus*)
- Black-winged stilt (*Himantopus himantopus*)
- Lathams snipe (*Gallinago hardwickii*)
- Grey plover (*Pluvialis squatarola*)

Information obtained from expert advice, data from pre clearing surveys and site based species records has been used to define a set of assumptions that have been used to identify areas of habitat that are consistent with the definitions of ‘core habitat’, ‘essential habitat’ and ‘general habitat’ that have been presented in Part 1 of this SSMP. These assumptions are presented in this section.

20.29.1 General assumptions

The following general habitat assumptions have been made based on current scientific knowledge of these species:

- Species are associated the inter-tidal zone (DSEWPaC 2012ae-be), and feeding patterns are generally restricted to less than wading depth (< 10 m below LAT) (Pizzey & Knight 1997)
- Species are associated with freshwater, brackish and marine riparian vegetation fringing waterways (Pizzey & Knight 1997) and are associated with the riparian vegetation (20 m either side) of tidal or stream order 3 or greater waterways within 5 km of the HAT
- Species rarely occur within mangrove forests (DSEWPaC 2012ae-be)
- Species are often associated with freshwater and/or saline wetlands (DSEWPaC 2012 (various)). As such, areas mapped as but not limited to estuarine', 'riverine', 'lacustrine' and pulstrine' Wetland Regional Ecosystems on the Queensland Wetland Mapping wetlands on the Queensland Wetland Mapping (Version 3.0) are considered potential habitat for these species
- All areas identified as shorebird habitat by 'Shorebird 2020' are considered 'essential habitat' for these species

20.29.2 Core habitat

Core habitat consists of 'essential habitat' in which the species is known and the habitat is recognised under relevant recovery plans or other relevant plans/policies/regulations). 'Essential habitat' also contains potential breeding habitat for resident species or areas that are identified as important for migratory species during migration (eg wetlands used for building fat reserves). Also included within this category are populations that are limited geographically within the region.

No 'core habitat' exists within these sections of the GTP. This has been confirmed during pre-clearance surveys.

20.29.3 Essential habitat

'Essential habitat' is an area containing resources that are considered essential for the maintenance of populations of the species (eg potential habitat for breeding, roosting, foraging, shelter, for either migratory or non-migratory species). 'Essential habitat' is defined from known records and/or expert advice (including the findings of pre-clearance surveys).

For the migratory marine species, essential habitat is defined as the RE polygon in which migratory/shorebirds were found roosting or feeding during pre-clearing surveys.

In addition, all areas identified as 'shore bird' habitat by 'Shorebirds 2020' are considered to provide 'essential habitat' for these species.

No 'essential habitat' exists within these sections of the GTP. This has been confirmed during pre-clearance surveys.

20.29.4 General habitat

'General habitat' consists of areas or locations that are used by transient individuals or where species have been recorded but there is insufficient information to assess the area as

essential/core habitat. 'General habitat' may be defined from known records or habitat that is considered to potential support a species according to expert knowledge of habitat relationships, despite the absence of specimen backed records. General habitat may include areas of suboptimal habitat for species. As potential habitat for many species contained within this SSMP may include most of the regional ecosystems of the Brigalow Belt Bioregion, the 'General habitat' category restricts the habitat to a more limited and realistic set of environmental parameters that are supported by literature that field based observation.

For the migratory shore birds, general habitat includes, but is not necessarily limited to, all areas identified above (excluding areas below LAT - lowest astronomical tide) and areas associated with the banks of coastal waterways are considered to constitute 'general habitat'.

KP0 to KP30

No 'general habitat' exists within this section of the GTP.

KP30 to KP40

No 'general habitat' exists within this section of the GTP.

KP40 to KP130

No 'general habitat' exists within this section of the GTP.

KP130 to KP312

No 'general habitat' exists within this section of the GTP.

KP312 to KP408.81

Pre-clearance surveys identified 'general habitat' for migratory marine species at Calliope River (KP352.5), Harper Creek (KP360.3) and wetlands within KP407.87 to KP407.89 (Santos GLNG 2013).

Figure 20.29a and Figure 20.29b shows the location of the 'general habitat' for the migratory marine species within this section of the GTP.

KP408.81 to KP409.04

No 'general habitat' exists within the direct disturbance footprint for the GTP between KP408.81 to KP409.04 and ancillary areas.

Figure 20.29c shows the location of the 'general habitat' for the migratory marine species adjoining the GTP.

KP413.57 to KP419.69

Pre-clearance surveys did not identify 'general habitat' for this species within this section of the GTP although 'general habitat' was identified within close proximity to the GTP and is shown in Figure 20.29d.

20.29.5 Unlikely habitat

'Unlikely habitat' areas are those areas that do not contain records of the particular species and contain no habitat values to support the presence or existence of resident or migratory individuals or populations of the species.

20.30 Anticipated threats and potential impacts as a result of the GTP upon migratory marine species

- Loss and degradation of 'general habitat'
- Changes to local foraging behaviour due to increased vehicle movement, noise, lighting, etc
- Stress, injury and mortality to animals due to increases in noise, vehicle movement, lighting and clearing during construction
- Destruction of nests
- Entrapment of individuals in the trench and barriers to movement

20.31 Unavoidable impact and unavoidable adverse (offsetable) impact from the GTP

Areas of proposed disturbance and areas of adverse (offsetable) impact associated with clearing and construction activities for the GTP between KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 for migratory marine species are presented in Table 20.1. It is important to note that this unavoidable impact is considered minor and temporary in the context of the wide spread extent of 'general habitat' in the region. The location of this habitat is shown in Figure 20.29a, Figure 20.29b, Figure 20.29c and Figure 20.29d.

A cumulative total of proposed clearing of habitat for migratory marine species and the cumulative total of unavoidable adverse (offsetable) impact to the species habitat is provided in Table 20.1.

Table 20.1 Cumulative total of migratory marine species habitat to be cleared and area of habitat subject to unavoidable adverse (offsetable) impacts from the GTP

Location	'General habitat'	Total habitat area per GTP section	Total habitat area adversely impacted per GTP section
KP0 to KP30	0 ha	0 ha	0 ha
KP30 to KP40	0 ha	0 ha	0 ha
KP40 to KP130	0 ha	0 ha	0 ha
KP130 to KP312	0.37 ha	0.37 ha	0.37 ha
KP312 to KP408.81	0.81 ha	0.81 ha	0.27 ha
KP408.81 to KP409.04	0.33 ha	0.33 ha	0.15 ha
KP413.57 to KP419.69	0.01 ha	0.01 ha	0.01 ha
Total habitat area	**1.52 ha**	**1.52 ha**	**0.80 ha**

20.32 Management practices and methods

20.32.1 Pre-construction mitigation measures

Measures to avoid impact

- Prior to the commencement of construction clearing, a suitably qualified and experienced EO will confirm the buffer zones ('No Go' zones) and where necessary barriers and signs will be erected

Measures to minimise impacts

- Wherever practicable, signage will be erected to increase awareness of migratory marine species in the area
- Prior to site entry, all site personnel will be appropriately trained and made aware of the sensitive environs in which they will be working (refer Part 1, Section 7.7)

20.32.2 Construction phase mitigation measures

Measures to avoid impact

- Due to the location of nests (on ground), all vehicles and pedestrians will remain within the designated access tracks within the GTP and ancillary areas

Measures to minimise impacts

- Locate site offices, construction camps, stockpiling/laydown areas, plant and equipment storage areas away from migratory marine species core habitat
- Implementation of the Fauna Handling Procedures (refer Appendix C)
- All vegetation clearing within known migratory marine species habitat will comply with clearing approval conditions (eg NC Act and other statutory approvals)
- A licensed and experienced spotter catcher(s) will be onsite during all clearing activities and will ensure any injured animals are given to an appropriate wildlife carer group or vet (refer Appendix C). DotE and DEHP will be notified within 24 hours of any native animal injuries or deaths
- Clearing activities will be supervised by the relevant EO
- Clearing will be conducted in a sequential manner and in a way that directs escaping wildlife away from the clearing activities and into adjacent natural areas
- Measures to be adopted to prevent fauna entrapment within the pipeline trench, include:
  - Minimising the period of time the trench is open, particularly in ‘core habitat’ and ‘essential habitat’ areas
  - Constructing ramps with a non-slip surface with slopes less than 45° to provide exit ramps for fauna at intervals no greater than 500 m
  - Trench plugs will be installed in open trenches. These will be provided as a minimum every 500 m
  - Installing additional ramps at greater than normal frequencies (500 m) in areas identified as known or high value habitat
  - Branches, hessian sacks, ramped gangplanks or similar to be used to create 'ladders' to enable fauna to exit the trench. These structures will be placed every 250 to 500 m, depending on the surrounding landscapes
- The whole trench will be checked at least twice a day (early morning/late afternoon) and the removal of wildlife from the trench will be undertaken by an appropriately trained and licensed spotter catcher(s)

- Spotter catcher(s) will have access to the site (particularly the open trench) during all weather conditions to check for trapped fauna
- Where practicable, direct any lighting associated within night works away from sensitive areas or use engineering solutions to limit light spillage. This may include the use of light shades and low lighting being applied to construction and operational areas located adjacent to remnant native vegetation and known habitat areas for these species
- Prior to backfilling, the spotter catcher(s) will check the open trench for trapped fauna and where required move them to a safe location away from the trench
- Ensure equipment is regularly maintained and is good working order
- The construction phase component of the LRMP will be implemented
- Weather permitting, rehabilitation of all areas identified will commence immediately after the pipeline has been lowered in and backfilled (refer LRMP). With the exception of operational constraints, revegetation will be consistent with the plant density, floristic composition and distribution of the adjacent communities

20.32.3 Operational phase mitigation measures

Measures to avoid impact

- To avoid impacting on regenerating migratory marine species habitat, vehicle and pedestrian access will be restricted to the defined access tracks to and from the GTP and ancillary areas and the defined access track within the GTP and ancillary areas

Measures to minimise impacts

- Implementation of the Fauna Handling Procedures (refer Appendix C)
- The operational phase component of the LRMP will be implemented
- The operational phase of the PWMP will be implemented to minimise the risk of weed and pest animal establishment

20.32.4 Decommissioning phase mitigation measures

Measures to minimise impacts

- Implementation of the Fauna Handling Procedures (refer Appendix C)
- A decommissioning plan will be developed by GLNG operations and provided for approval. The plan will aim to address the requirements of AS2885 and also to ensure environmental harm is avoided, including:
  - The Project area no longer contains hazardous contaminants and Is left in stable condition
  - All the above ground infrastructure is removed
  - All areas disturbed by above ground infrastructure are rehabilitated in accordance with the relevant conditions
- For a minimum of five years after the completion of rehabilitation, rehabilitated areas will be monitored on a yearly basis

- The monitoring programme will include:
  - Methods to measure subsidence and erosion rates at rehabilitated buried transmission pipeline corridors and buried flow lines
  - BioCondition assessment in accordance with the BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland: Assessment Manual: Version 2.1 (Eyre *et al* 2011)
  - Monitoring of indicators identified in the LRMP at analogue sites to measure progressive and final rehabilitation success relevant to the final land use(s)
  - Frequency and seasonality of monitoring analogue sites and rehabilitated areas to assess rehabilitation success
  - Identification of the experimental design for analysing analogue and rehabilitated site data including statistical methods of analyses

21 Migratory tern species

21.1 Little tern

21.1.1 EPBC Act legal status

Marine
Migratory (Bonn, CAMBA, JAMBA, ROKAMBA)

21.1.2 Biology and ecology

Characteristics

The Little tern (*Sternula albifrons*) is a small, slender and elegant marine tern (total length 20 to 28 cm; mean adult weight approximately 53 g for males, 49 g for females) with narrow wings and a fairly long and deeply forked tail. Sexes do not differ in plumage or size (DSEWPaC 2012bf).

Adults in breeding plumage have a diagnostic head-pattern, consisting of a neat black cap and tapering loral stripe isolating a triangular white patch on the forehead that tapers to a point above the rear of the eye, and with the rest of the head and neck white. The rest of the upperparts are largely pale grey, with a contrastingly white rump, uppertail-coverts and tail, and a white line along the upper edge, and a thin black line along the bottom edge, of the folded primaries, and with slightly darker grey outer primaries. In flight the upperwing appears pale grey with a white trailing edge and thin black leading edge to the outerwing. The underparts are wholly white. The bill is bright yellow with a small black tip, the eyes blackish, and the legs and feet bright orange (Gochfeld & Burger 1996; Higgins & Davies 1996).

Non-breeding adults are similar to breeding birds except the head-pattern differs, with the forehead, forecrown and anterior lores white-washed with grey, leaving a dark band extending from in front of the eyes to the nape, and that merges into dark spotting on the rear-crown. Non-breeding birds further differ by a pale-grey rump, uppertail-coverts and tail (concolorous with the rest of the upperbody), a less deeply forked tail, and a narrow dark cubital bar on the folded wing. The bill is also black, and the legs and feet duller, orange-brown (Gochfeld & Burger 1996; Higgins & Davies 1996).

Juveniles are like non-breeding adults but the black band on the head is narrower and duller; the white forehead, anterior lores and crown are washed brown; the mantle, back, scapulars and tertials are marked with narrow white scaling and bold brown U-shaped markings; there is a thin dark tail-band; and the upperwing-coverts are patterned much like the scapulars, and there is a dusky cubital bar on the upperwing. The bill is dark brown with a darker blackish tip and base, and the legs and feet are brownish orange (Gochfeld & Burger 1996; Higgins & Davies 1996).

Little tern (Source: Harrison 2011c)

Known distribution

The Little tern has a large global population and is variously estimated at some 140,000 to 410,000 individuals (Wetlands International 2002) or 70,000 to 100,000 birds (Gochfeld & Burger 1996). The estimated total breeding population in Australia is 3000 breeding pairs, but the reliability of this estimate is considered low (Garnett & Crowley 2000).

The Australian breeding population can be divided into two major subpopulations with a northern subpopulation that breeds across northern Australia, from about Broome in north-western Western Australia, through coastal Northern Territory to the Gulf of Carpentaria and eastern Cape York Peninsula (with an extended breeding season covering most of the year); and an eastern subpopulation that breeds on the eastern and south-eastern coast of the mainland and northern and eastern Tasmania, occasionally extending as far west as western Victoria and south-eastern South Australia (and breeding in the austral spring-summer) (DSEWPaC 2012bf).

In addition, a third population of Asian migrants that spend the northern non-breeding season (austral spring-autumn) in Australia, and leave for their northern breeding grounds in March-April is recognised (DSEWPaC 2012bf).

Non-breeding birds, of the Australian subpopulations and of extralimital populations, extend farther around the Australian coast than known breeding colonies, as well as overlapping extensively with the Australian breeding range (DSEWPaC 2012bf).

Figure 21.1 is an indicative distribution map of the present distribution of the Little tern.

The estimated area of occupancy of the Little tern in Australia is 500 km² (Garnett & Crowley 2000).

The distribution of the Little tern is not severely fragmented at large scales, though breeding colonies are patchily distributed at disjunct sites (DSEWPaC 2012bf).

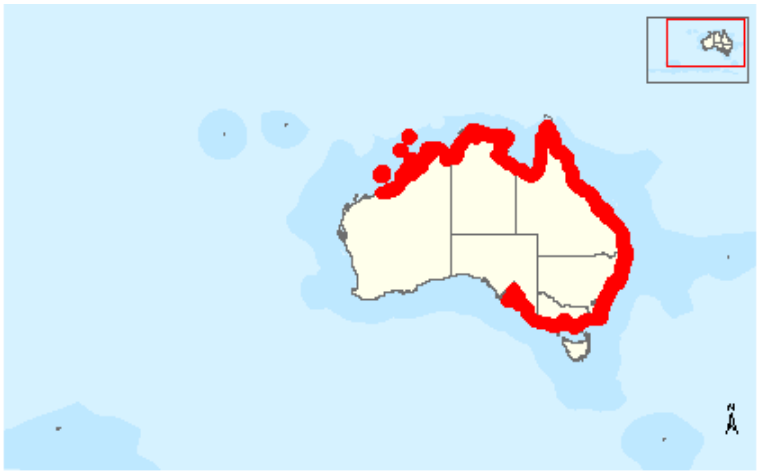


Figure 21.1 Distribution range of the Little tern (DSEWPaC 2012bf)

Known species populations and their relationship with the GTP footprint

Suitable habitat for this species within KP312 to KP408.81 and KP408.81 to KP409.04 of the GTP and ancillary areas is considered to be limited and to areas used during migration.

Biology and reproduction

Little terns feed mainly on small fish (<10 cm in length), but also eat crustaceans, insects, annelids and molluscs (Cramp 1985; Gochfeld & Burger 1996; Higgins & Davies 1996; Johnstone & Storr 1996; NPWS 2003; Urban *et al* 1986).

Little terns probably first breed at two to three years old, but possibly when one year old occasionally (Higgins & Davies 1996; Minton 1990; NPWS 2003; Owen 1991).

Little terns usually nest in small colonies, but solitary breeding has also been recorded. In Australia, colonies are typically up to 50 pairs, but colonies of up to 150 pairs or nests have been recorded (Chatto 2001; Higgins & Davies 1996; Morris 1979; Hill *et al* 1988; NPWS 2003; Reside *et al* 1989). Other species can be associated with colonies and Little terns sometimes nest in colonies of Fairy terns or vice versa; and plovers (*Charadrius*, *Thinornis* species) and oystercatchers (*Haematopus* species) sometimes nest within or at edge of colonies. Silver Gulls often nest close to or in Little tern colonies (Chatto 2001; Higgins & Davies 1996; Owen 1990 & 1991; Schipper & Weston 1998; Starks 1992).

The breeding season of the Little tern varies between the subpopulations of northern and eastern Australia. The eastern subpopulation breeds in the austral spring-summer, with laying from late August to January-February, more usually beginning late October and with peak laying in late November to mid-December. The nest of the Little tern is usually a simple, shallow scrape or depression in sand, sometimes placed close to driftwood, beachcast seaweed, other debris or vegetation. However, Little terns tend to avoid vegetated areas (DSEWPaC 2012bf). Little terns lay a clutch of between one and three eggs (DSEWPaC 2012bf).

21.1.3 Habitat

In Australia, Little terns inhabit sheltered coastal environments, including lagoons, estuaries, river mouths and deltas, lakes, bays, harbours and inlets, especially those with exposed sandbanks or sand-spits and also on exposed ocean beaches (DSEWPaC 2012bf).

Little Terns nest on sand-spits, banks, ridges or islets in sheltered coastal environments, such as coastal lakes, estuaries and inlets, and also on wide and flat or gently sloping sandy ocean beaches, and also, occasionally, in sand-dunes. Little terns also readily use artificial banks, islets, dunes or excavated areas created from dredge-spoil, gravel or shell (DSEWPaC 2012bf)

Chicks will hide in dunes, under vegetation and even in crab holes and artificial shelters (Neilly 2002).

Little terns forage in shallow waters of estuaries, coastal lagoons and lakes, frequently over channels next to spits and banks or entrances, and often close to breeding colonies. They also forage along open coasts, especially around bars off the entrances to rivers and lagoons, less often at sea, and usually within 50 m of shore (DSEWPaC 2012bf).

Little terns usually roost or loaf on sand-spits, banks and bars within sheltered estuarine or coastal environments, or on the sandy shores of lakes and ocean beaches (Bolger 1984; Chan & Dening 2007; Chan *et al* 2008; Chatto 2001; Dening 2003; Owen 1990 & 1991; Reside *et al* 1989; Vincent 1983). They prefer sheltered sand-spits that are surrounded by narrow shallow channels within lakes, to more exposed spits in large lakes, which are, in turn, preferred to ocean beaches (Reside *et al* 1989).

The species is not known to use refuge habitats (DSEWPaC 2012bf).

Little terns are not known to rely specifically on any threatened ecological community in Australia, nor are they specifically associated with any threatened species though they potentially share habitat with such species. The species is, however, associated with a number of Ramsar sites (DSEWPaC 2012bf).

21.2 Caspian tern

21.2.1 EPBC Act legal status

Marine
Migratory (CAMBA, JAMBA)

21.2.2 Biology and ecology

Characteristics

The largest tern in Australia, the Caspian tern (*Hydroprogne caspia*) has long, slender backswept wings and a slightly forked tail. The heavy bill is red with a dusky tip. The sexes are similar, with a body length between 53 and 60 cm long, and an average weight of 680 g (Higgins & Davies 1996).

The Caspian tern has a white body, with a black and white streaked crown from bill to nape and a short shaggy crest. The mantle and upperwings are grey and the flight feathers are darker. The eye is dark brown and legs are black (Higgins & Davis 1996). When breeding, the crown is black. Immature birds are similar to non-breeding adults. Younger birds are mottled grey and brown (Birds Australia 2010b).

Caspian tern (Source: Mdf 2007)

Known distribution

Within Australia, the Caspian tern has a widespread occurrence and can be found in both coastal and inland habitat (Higgins & Davies 1996).

In Queensland, the Caspian tern is widespread in coastal regions from the southern Gulf of Carpentaria to the Torres Strait, and along the eastern coast. The species has been recorded in the western districts, especially the Lake Eyre Drainage Basin, north-west to the Gulf Country north of Mt Isa and Cloncurry, there are also scattered records for central Queensland (Higgins & Davies 1996).

Breeding occurs on the Wellesley Islands in the south-east Gulf of Carpentaria, islands off the far north coast from Bird Island south to Three Isles and from islands around Shoalwater Bay including Pelican Rock south to Fairfax Island. Inland breeding records occur at Lake Bindegolly and Lake Moondarra (Chatto 2001; Higgins & Davies 1996).

Figure 21.2 is an indicative distribution map of the present distribution of the Caspian tern.

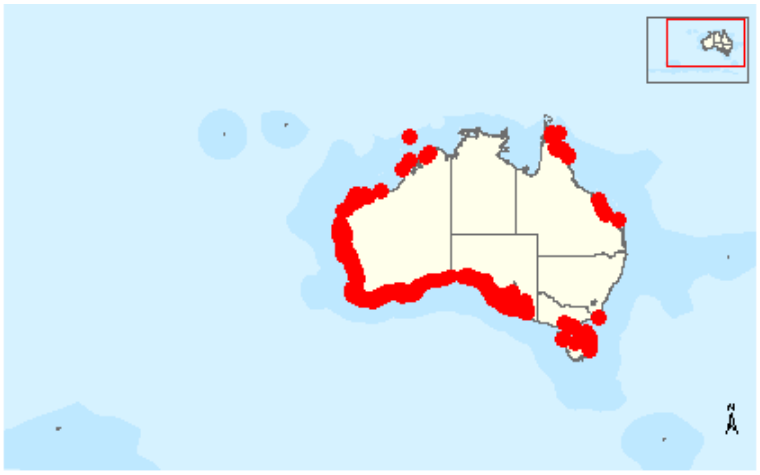


Figure 21.2 Distribution range of the Caspian tern (DSEWPaC 2012bg)

Known species populations and their relationship with the GTP footprint

Suitable habitat for this species within KP312 to KP408.81 and KP408.81 to KP409.04 of the GTP and ancillary areas is considered to be limited and to areas used during migration.

Biology and reproduction

The Caspian tern's diet consists predominantly of fish (5 to 25 cm in length) as well as the eggs and young of other birds, carrion, aquatic invertebrates (eg crayfish), flying insects and earthworms (Birdlife International 2010c).

The age of first breeding is four years old, or occasionally three years old (Barlow 1991). Caspian terns return to their natal areas to breed (Birds Australia 2010). The species breeds between September and December in the southern Hemisphere, though timing varies in different areas (Higgins & Davies 1996).

The nest is a deep scrape on the ground, usually unlined, but occasionally sparsely ringed with debris or scraps of local vegetation such as saltbush or Pigface (*Carpobrotus rossii*). Both sexes share nest-building, incubation and care of the young (Higgins & Davies 1996). Laying is asynchronous within colonies, with eggs and young at all stages being present in a colony at the one time (Higgins & Davies 1996). Colonies of Caspian terns can be large, dense and monospecific, or single pairs or small groups (two to three pairs) in large colonies of other bird species (Birdlife International 2010c; Chatto 2001; Fuller *et al* 1994).

The clutch size is one to three eggs, usually two, incubation takes 22 days and chicks fledge in approximately 35 days (Birds Australia 2010b).

21.2.3 Habitat

The Caspian tern is mostly found in sheltered coastal embayments (harbours, lagoons, inlets, bays, estuaries and river deltas) and those with sandy or muddy margins are preferred. They also occur on near-coastal or inland terrestrial wetlands that are either fresh or saline, especially lakes (including ephemeral lakes), waterholes, reservoirs, rivers and creeks. They also use artificial wetlands, including reservoirs, sewage ponds and saltworks. In offshore areas the species prefers sheltered situations, particularly near islands, and is rarely seen beyond reefs (Higgins & Davies 1996).

Large numbers may shelter along the coast, behind coastal sand-dunes or coastal lakes during rough weather, and have been recorded inland after storms (Higgins & Davies 1996).

The Caspian tern usually forages in open wetlands, including lakes and rivers. They often prefer sheltered shallow water near the margins, but can also be found in open coastal waters. In coastal inlets they may prefer to forage in tidal channels, or over submerged mudbanks (Higgins & Davies 1996).

The Caspian tern breeds on variable types of sites including low islands, cays, spits, banks, ridges, beaches of sand or shell, terrestrial wetlands and stony or rocky islets or banks. Nests may be in the open, or among low or sparse vegetation, including herbfield, tussocks, samphire or other prostrate sand-binding plants. They sometimes nest near bushes or other shelter such as large sticks, driftwood and piles of beachcast seagrass. Nests usually consist of a slight hollow scraped in the ground, and is left bare or is lined with grass, a few twigs, seaweed, feathers, small stones and shells. Generally roosting occurs on bare exposed sand or shell spits, banks or shores of coasts, lakes, estuaries, coastal lagoons and inlets. Occasionally they nest among beachcast debris above the high-water mark or at artificial sites, including islands in reservoirs, or on dredge-spoil (Higgins & Davies 1996).

21.3 Habitat assessment

For the purpose of habitat modelling, the following species have been considered collectively as Terns:

- Caspian tern (*Hydroprogne caspia*)
- Little tern (*Sternula albifrons*)

Information obtained from Brigalow Belt South Fauna Expert Panel Report, Southeast Queensland Biodiversity Planning Assessment together with expert advice, data from pre clearing surveys and site based species records has been used to define a set of assumptions that have been used to identify areas of habitat that are consistent with the definitions of 'Core habitat', 'Essential habitat' and 'General habitat' that have been presented in Part 1 of this SSMP. These assumptions are presented in this section.

21.3.1 General assumptions

The following general habitat assumptions have been made based on current scientific knowledge of this species:

- Species are associated with coastal and offshore waters, bays, inlets, saline or brackish lakes, saltfields, sewage ponds near the coast (Pizzey & Knight 1997)
- Species inhabit sheltered coastal environments, including lagoons, estuaries, river mouths and deltas, lakes, bays, harbours and inlets, especially those with exposed sandbanks or sand-spits, and also on exposed ocean beaches (DSEWPaC 2012bf & 2012bg)

21.3.2 Core habitat

Core habitat consists of 'essential habitat' in which the species is known and the habitat is recognised under relevant recovery plans or other relevant plans/policies/regulations. Also included within this category are populations that are limited geographically within the region.

As there are no current site based observations for the species within or adjacent to the GTP and ancillary areas, there is no 'core habitat'considered to occur within the GTP and ancillary areas.

21.3.3 Essential habitat

'Essential habitat' is an area containing resources that are considered essential for the maintenance of populations of the species (eg potential habitat for breeding, roosting, foraging, shelter, for either migratory or non-migratory species). 'Essential habitat' is defined from known records and/or expert advice (including the findings of pre-clearance surveys).

As there are no current site based observations for the species within or adjacent to (ie within 10 km) of the GTP and ancillary areas, there is no 'essential habitat'considered to occur within the GTP and ancillary areas.

21.3.4 General habitat

'General habitat' consists of areas or locations that are used by transient individuals or where species may have been recorded but where there is insufficient information to assess the area as essential/core habitat. 'General habitat' also includes areas defined from known records or habitat that is considered to potentially support a species according to expert knowledge of habitat relationships, despite the absence of specimen backed records. 'General habitat' may include areas of suboptimal habitat for species. As potential habitat for many species contained within this SSMP may include most of the regional ecosystems of the Brigalow Belt Bioregion, the 'general habitat' category restricts the habitat to a more limited and realistic set of environmental parameters that are supported by literature and field based observation.

For these species, all areas within the REs, marine areas and mapped wetlands identified above constitute 'general habitat'.

KP0 to KP30

No 'general habitat' exists for these species within this section of the GTP.

KP30 to KP40

No 'general habitat' exists for these species within this section of the GTP.

KP40 to KP130

No 'general habitat' exists for these species within this section of the GTP.

KP130 to KP312

No 'general habitat' exists for these species within this section of the GTP.

KP312 to KP408.81

Pre-clearance surveys identified 'general habitat' for migratory tern species at KP406.5 where the GTP crosses an estuarine area (Santos GLNG 2013).

Figure 21.3a and Figure 21.3b shows the location of the 'general habitat' for the migratory tern species within this section of the GTP.

KP408.81 to KP409.04

Figure 21.3c shows the location of the 'general habitat' for the migratory tern species adjacent to this section of the GTP.

KP413.57 to KP419.69

Pre-clearance surveys identified no 'general habitat' for the migratory tern species within this section of the GTP although 'general habitat' was identified within close proximity to the GTP.

Figure 21.3d shows the location of 'general habitat' for the migratory tern species.

21.3.5 Unlikely habitat

'Unlikely habitat' areas are those areas that do not contain records of the particular species and contain no habitat values to support the presence or existence of resident or migratory individuals or populations of the species.

21.4 Anticipated threats and potential impacts as a result of the GTP footprint

Anticipated threats and potential impacts to migratory tern species as a result of the GTP include:

- Loss and degradation of 'general habitat'
- Changes to local foraging, roosting and nesting behaviour due to increased vehicle movement, noise, lighting etc
- Stress, injury and mortality to animals due to increases in noise, vehicle movement, lighting and clearing
- Destruction of nests
- Possible impacts causing a reduction of water quality (due to siltation, changes in chemistry, contamination by petroleum, sediment and erosion impacts, and salinity) on large water bodies (including artificial habitats)

21.5 Unavoidable impact and unavoidable adverse (offsetable) impact from the GTP

Areas of proposed disturbance and areas of adverse (offsetable) impact associated with clearing and construction activities for the GTP between KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 for migratory tern species are presented in Table 21.1. It is important to note that this unavoidable impact is considered minor and temporary in the context of the wide spread extent of 'general habitat' in the region. The location of this habitat is shown in Figure 21.3a, Figure 21.3b, Figure 21.3c and Figure 21.3d.

A cumulative total of proposed clearing of habitat for migratory tern species and the cumulative total of unavoidable adverse (offsetable) impact to the species habitat is provided in Table 21.1.

Table 21.1 Cumulative total of migratory marine species habitat to be cleared and area of habitat subject to unavoidable adverse (offsetable) impacts from the GTP

Location	'General habitat'	Total habitat area per GTP section	Total habitat area adversely impacted per GTP section
KP0 to KP30	0 ha	0 ha	0 ha
KP30 to KP40	0 ha	0 ha	0 ha
KP40 to KP130	0 ha	0 ha	0 ha
KP130 to KP312	0 ha	0 ha	0 ha
KP312 to KP408.81	0.05 ha	0.05 ha	0.05 ha
KP408.81 to KP409.04	0 ha	0 ha	0 ha
KP413.57 to KP419.69	0 ha	0 ha	0 ha
Total habitat area	**0.05 ha**	**0.05 ha**	**0.05 ha**

21.6 Management practices and methods

21.6.1 Pre-construction mitigation measures

Measures to avoid impact

- Prior to the commencement of construction clearing, a suitably qualified and experienced EO will confirm the presence of active roosting and/or foraging habitat and establish an exclusion zone where necessary

Measures to minimise impacts

- Pre-clearing ecological surveys have been undertaken by a suitably qualified Ecologist(s) in accordance with the Survey Guidelines for Australia's Threatened Birds. The surveys included carrying out a habitat assessment for these species and confirming their presence/absence within and adjacent to the GTP and ancillary areas
- Prior to site entry, all site personnel will be appropriately trained and made aware of the sensitive environs in which they will be working (refer Part 1, Section 7.7)

21.6.2 Construction phase mitigation measures

Measures to avoid impact

- Unless otherwise agreed by DEHP and DotE, active nests, roosting and/or foraging habitat will be declared temporary 'No Go' zones with the establishment of an exclusion zone until the area is no longer occupied by this species. The status of active nests will be regularly checked in a way that does not risk the nest being abandoned by the breeding pair (adult birds)
- All vehicles and pedestrians are to remain within the GTP and ancillary areas or on designated access tracks
- All reasonable and practical measures will be taken to locate site offices, construction camps, stockpiling/lay down areas and plant and equipment storage areas (including heavy machinery) on existing cleared lands. As per other conditions these structures would be located at least 100 m away from a watercourse

Measures to minimise impacts

- All vegetation clearing within known migratory tern species habitat must comply with clearing approval conditions (eg NC Act and other statutory approvals)
- Implementation of the Fauna Handling Procedures (refer Appendix C)
- A licensed and experienced spotter catcher(s) will be onsite during all clearing activities and will ensure any injured animals are given to an appropriate wildlife carer group or vet (refer Appendix C). DotE and DEHP will be notified within 24 hours of any native animal injuries or deaths
- Clearing activities within these areas will be supervised by the relevant EO
- Clearing will be conducted in a sequential manner and in a way that directs escaping wildlife away from the clearing activities and into adjacent natural areas

- Measures will be in place to facilitate fauna movement, including gaps between stockpiles and pipe strings
- Ensure equipment is regularly maintained and is good working order
- Not withstanding Occupational Health and Safety requirements, lighting will be directed away from sensitive areas or engineering solutions will be implemented to limit light spillage
- The construction phase component of the LRMP will be implemented
- Weather permitting, rehabilitation of all areas identified will commence immediately after the pipeline has been lowered in and backfilled (refer LRMP). With the exception of operational constraints, revegetation will be consistent with the plant density, floristic composition and distribution of the adjacent communities

21.6.3 Operational phase mitigation measures

Measures to avoid impact

- To avoid impacting on regenerating 'general habitat' for migratory species, vehicle and pedestrian access will be restricted to the defined access tracks to and from the GTP and ancillary areas and the defined access track of the GTP and ancillary areas

Measures to minimise impacts

- Implementation of the Fauna Handling Procedures (refer Appendix C)
- The operational phase component of the LRMP will be implemented
- The operational phase of the PWMP will be implemented to minimise the risk of weed and pest animal establishment within the above-listed locations

21.6.4 Decommissioning phase mitigation measures

Measures to minimise impacts

- Implementation of the Fauna Handling Procedures (refer Appendix C)
- A decommissioning plan will be developed by GLNG Operations and provided for approval. The plan will aim to address the requirements of AS2885 and also to ensure environmental harm is avoided, including:
  - The Project area no longer contains hazardous contaminants and is left in stable condition
  - All the above ground infrastructure is removed
  - All areas disturbed by above ground infrastructure are rehabilitated in accordance with the relevant conditions
- For a minimum of five years after the completion of rehabilitation, rehabilitated areas will be monitored on a yearly basis
- The monitoring programme will include, but not necessarily be limited to:
  - Methods to monitor subsidence and erosion rates at rehabilitated buried transmission pipeline corridors and buried flow lines

- BioCondition assessment in accordance with the BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland: Assessment Manual: Version 2.1 (Eyre *et al* 2011)
- Monitoring of indicators identified in the LRMP at analogue sites to measure progressive and final rehabilitation success relevant to the final land use(s)
- Frequency and seasonality of monitoring analogue sites and rehabilitated areas to assess rehabilitation success
- Identification of the experimental design for analysing analogue and rehabilitated site data including statistical methods of analyses

Part 3 – Brigalow and SEVT TEC Management Plans

1 Brigalow Threatened Ecological Community (TEC) Management Plan

1.1 EPBC legal act status

Endangered - listed 4 April 2001

Brigalow community (Source: DERM 2010)

1.2 Ecology

1.2.1 Characteristics

The Brigalow 'threatened ecological community' (TEC) is characterised by either the dominance or co-dominance of *Acacia harpophylla* (Brigalow) as a canopy or sub-canopy species. Other canopy species that may be associated with this TEC include *Casuarina cristata* (Belah), other Acacia species and/or Eucalypt species. Structurally, the community may exist in a variety of forms from low open woodlands to open forests with dominant tree layers ranging between 9 m in height (in low rainfall regions) through to 25 m in height (in higher rainfall areas) (DSEWPaC 2012r).

The Brigalow TEC is commonly associated with heavy clay soils (ie deep gilgaied clays, sedentary clays, alluvial clays, miscellaneous deep clays and loamy), are relatively fertile and tend to have a high salt content. In Queensland, the soils are primarily cracking clays, but texture contrast soils are common where *Eucalyptus* species are co-dominant. 85% of listed Brigalow community remnants in Queensland occur on flat to gently undulating Cainozoic clay plains not associated with current alluvium, and on gently undulating landscapes. About 10% of remnants are associated with river and creek flats and the remainder are found on old loamy and sandy plains, basalt plains and hills or hills lowlands on metamorphic or granitic rocks. Cracking clay soils, which are characteristic of Brigalow TEC soils, provide shelter for various mammals and reptiles. Woody debris and other litter on the ground also provides important habitat for some faunal species, especially reptiles (cited in DSEWPaC 2012r).

Within Queensland, 16 REs have been identified as being analogous to the Brigalow TEC (DSEWPaC 2012r). Table 1.1 lists these REs and provides a brief description of each RE type. Figure 1 is a map showing the distribution of these REs using DEHP's RE mapping.

Table 1.1 REs analogous with Brigalow TECs in Queensland from DSEWPaC (2012w)

RE	Description
6.4.2	*Casuarina cristata* +/- *Acacia harpophylla* open forest on clay plains
11.3.1	*Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains
11.4.3	*Acacia harpophylla* and/or *Casuarina cristata* shrubby open forest on Cainozoic clay plains
11.4.7	Open forest of *Eucalyptus populnea* with *Acacia harpophylla* and/or *Casuarina cristata* on Cainozoic clay plains
11.4.8	*Eucalyptus cambageana* open forest with *Acacia harpophylla* or *Acacia argyrodendron* on Cainozoic clay plains
11.4.9	*Acacia harpophylla* shrubby open forest with *Terminalia oblongata* on Cainozoic clay plains
11.4.10	*Eucalyptus populnea* or *Eucalyptus pilligaensis*, *Acacia harpophylla*, *Casuarina cristata* open forest on margins of Cainozoic clay plains
11.5.16	*Acacia harpophylla* and/or *Casuarina cristata* open forest in depressions on Cainozoic sand plains/remnant surfaces
11.9.1	*Acacia harpophylla, Eucalyptus cambageana* open forest on Cainozoic fine grained sedimentary rocks
11.9.5	*Acacia harpophylla* and/or *Casuarina cristata* open forest on Cainozoic fine grained sedimentary rocks
11.9.6	*Acacia melvillei* +/- *Acacia harpophylla* open forest on Cainozoic fine grained sedimentary rocks
11.11.14	*Acacia harpophylla* open forest on deformed and metamorphosed sediments and interbedded volcanics
11.12.21	*Acacia harpophylla* open forest on igneous rocks; colluvial lower slopes
12.8.23	*Acacia harpophylla* open forest on Cainozoic igneous rocks
12.9-10.6	*Acacia harpophylla* open forest on sedimentary rocks
12.12.26	*Acacia harpophylla* open forest on Mesozoic to Proterozoic igneous rocks

1.2.2 Known distribution

The Brigalow TEC extends from south of Charters Towers in Queensland, in a broad swathe east of Blackall, Charleville and Cunnamulla and south to northern New South Wales near Narrabri and Bourke (DSEWPaC 2012r). Figure 1 outlines an indicative distribution of Brigalow TEC in Queensland.

In Queensland, it occurs predominantly within the Brigalow Belt North, Brigalow Belt South, Darling Riverine Plains and Southeast Queensland bioregions. It also occurs to a lesser extent in the Mitchell Grass Downs, Mulga Lands and Einasleigh Uplands bioregions. The original extent of the Brigalow ecological community in Queensland was estimated to be more than 7.3 million hectares. By 2003 about eight percent remained. Core areas of remnants are located in the Northern Bowen Basin, Belyando Downs, Issac-Comet Downs and Claude River Downs subregions of the Brigalow Belt North bioregion and in the Southern Downs and Moonie River-Commoron Creek Floodout subregions of the Brigalow Belt South Bioregion (cited in DSEWPaC 2012r).

1.2.3 Biology and reproduction

Acacia harpophylla and *Casuarina cristata* are generally the dominant species within most of the REs analogous to the Brigalow TEC. Therefore, the overall biology of the Brigalow TEC reflects patterns of seasonal growth and flowering as determined by these species. Brigalow flowers between April and October with the production of viable seed requiring cross-pollination between trees. Seeds normally mature in late spring, early summer and generally remain viable for less than a year. In Queensland germination and establishment require good rainfall following seed set. Where Brigalow has been initially cleared without further treatment, it will sucker from the root systems of the original plants, with this regrowth growing faster than Brigalow seedlings (cited in DSEWPaC 2012r). These areas of Brigalow regrowth have the ability to provide suitable offsets for the clearing of Brigalow TECs where these areas do not currently fulfil the definition of the Brigalow TEC.

1.2.4 Known species populations and their relationship with the GTP ROW

The Pre-Clearance Survey Reports for KP0 to KP130 (Ecologica Consulting 2012) and KP130 to KP312 (Santos GLNG 2012) identified the Brigalow TEC REs within KP0 to KP30, KP30 to KP40, KP40 to KP130 and KP130 to KP312 of the GTP ROW as REs 11.9.5, 11.9.5a, 11.4.8 and 11.4.9. The pre-clearance survey reports for KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 (Santos GLNG 2013 & 2013a; RPS 2012) identified no Brigalow TEC REs within these sections of the ROW. The full RE descriptions for 11.9.5, 11.9.5a, 11.4.8 and 11.4.9, as described in the Queensland Regional Ecosystem Description Database, Version 6.0b [REDD] (DEHP 2012), are:

- 11.9.5. Open forest dominated by *Acacia harpophylla* and/or *Casuarina cristata* to 20 m high +/- *Eucalyptus populnea, Eucalyptus orgadophila, Cadellia pentastylis* and *Brachychiton* spp. (these species may form part of the canopy or emerge above it). *Melaleuca bracteata* may be present along watercourses. A prominent/dense low tree or tall shrub layer dominated by species such as *Geijera parviflora* and *Eremophila mitchellii* and often with semi-evergreen vine thicket species is often present. The latter include *Flindersia dissosperma, Brachychiton rupestris, Excoecaria dallachyana, Macropteranthes leichhardtii* and *Acalypha eremorum* in eastern areas, and species such as *Carissa ovata, Owenia acidula, Croton insularis, Denhamia oleaster* and *Notelaea microcarpa* in south-western areas. Other species that may occur include *Apophyllum anomalum, Croton phebalioides, Alectryon diversifolius* and *Carissa ovata*. The ground layer is sparse and may be composed of *Ancistrachne uncinulata* and *Eragrostis megalosperma* and varies with the density of the shrub layers. Occurs on fine-grained sediments. The topography includes gently undulating plains (may be formed on shales), valley floors and undulating foot slopes and rarely on low hills. The soils are generally deep texture-contrast and cracking clays. The cracking clay soils may be strongly alkaline at or near the surface and acidic beneath, however, are usually black or grey to brown or reddish-brown in colour, often self-mulching and sometimes gilgaied in flatter areas. Some texture contrast soils are shallow to only moderately deep. May also be dark brown and grey-brown gradational soils, with a coarse-textured surface grading into alkaline, clayey subsoil
- 11.9.5a: *Acacia harpophylla* predominates and forms a fairly continuous canopy (10 m to 18 m high). Other tree species such as *Eucalyptus populnea, Casuarina cristata, Cadellia pentastylis* and *Brachychiton* spp. may also be present in some areas and form part of the canopy or emerge above it. Scattered *Eucalyptus orgadophila* may occur, especially on upper slopes and crests. A dense tall shrub layer dominated by a range of species is usually present, while a more open low shrub layer often occurs. Common species in these layers include *Croton insularis,*

Denhamia oleaster, Apophyllum anomalum, Croton phebalioides, Alectryon diversifolius and *Carissa ovata*. The ground layer is sparse, most frequently composed of *Ancistrachne uncinulata* and *Eragrostis megalosperma* and varies with the density of the shrub layers. Occurs on undulating plains and rises formed mainly on shales. The soils are predominantly cracking clay soils, which are strongly alkaline at or near the surface and acidic beneath, or dark brown and grey-brown gradational soils, with a coarse-textured surface grading into an alkaline, clayey subsoil

- 11.4.8: Woodland to open-forest dominated by *Eucalyptus cambageana* and *Acacia harpophylla* or, sometimes in the north, *Acacia argyrodendron*. *Eucalyptus thozetiana* is sometimes present on shallower soils. There is a moderately dense low tree layer (5 m high) layer dominated by species such as *Eremophila mitchellii* and a low shrub layer (2 m high) dominated by species such as *Carissa ovata* and *Geijera parviflora*. Occurs on level to gently undulating plains formed from Cainozoic deposits. Associated soils are usually deep texture contrast with thin loamy or sandy surface horizons overlying strongly alkaline clay subsoils. Surface or subsurface gravel is common
- 11.4.9: Open-forest, occasionally woodland, dominated by *Acacia harpophylla* usually with a low tree mid-storey of *Terminalia oblongata* and *Eremophila mitchellii*. *Casuarina cristata* sometimes replaces *Acacia harpophylla* in the overstorey and *Lysiphyllum cunninghamii* sometimes co-dominates. Other low tree or shrub species such as *Alectryon diversifolius*, *Carissa ovata*, *Pittosporum spinescens*, *Ehretia membranifolia*, *Geijera parviflora* and *Flindersia dissosperma* may occur in the mid-storey or low shrub layer. *Acacia harpophylla* trees have been recorded as 1 to 17 m high, the mid-storey layer 2 to 8 m high and the low shrub layer 1 to 2 m high. Occurs on level to gently undulating Cainozoic plains, including weathered basalt. Associated soils are predominantly moderately deep to deep cracking clays that may be brown, red-brown or grey-brown, and with much surface gravel in some areas

Endangered high value regrowth mapped within the GTP ROW may also be analogous with this community, as these areas have been determined not to have been cleared since 1989. Brigalow regrowth under the EPBC Act is classified as vegetation which has not been cleared in the last 15 years (in addition to meeting other threshold conditions such as 0.5 ha in size and understory is less than 50% introduced grasses and having a species composition that reflect the Brigalow TEC).

DNRM's RE and High Value Regrowth (HVR) mapping indicate that REs analogous with Brigalow TECs are located within and directly adjacent to the GTP ROW however, DNRM's High Value Regrowth (HVR) mapping indicates that no regrowth areas analogous with Brigalow TECs are located within the GTP ROW between KP0-KP30. Ecologica Consultants (2012) conducted a pre-clearance survey to confirm the presence of Brigalow TEC with the surveys have been restricted to the GTP disturbance areas (ie ROW and ancillary work areas) (refer Figure 2a for KP0 to KP30, Figure 2b for KP30 to KP40 and Figure 2c for KP40 to KP130). Brigalow areas shown in Figure 2a, Figure 2b and Figure 2c outside these disturbance areas represents the RE mapping of this TEC in Queensland.

Ausecology and Aurecon consultants (Santos GLNG 2012) conducted pre-clearance surveys of KP130 to KP312 to confirm the presence of Brigalow TEC with the surveys being restricted to the GTP disturbance areas (ie ROW and ancillary areas). The surveys involved a combination of desktop assessment of current aerial imagery along the ROW and ancillary areas and targeted ground truthing of areas identified as potential/probable Brigalow TEC (refer Figure 2d and Figure 2e for KP130 to KP312).

Brigalow areas shown in Figure 2d and Figure 2e outside these disturbance areas represents the RE mapping of this TEC in Queensland.

Table 1.2 outlines the RE mapping, determinations from ground truthing and the extent of clearing determined in the GTP ROW.

Table 1.2 Summary of Brigalow TEC ground truthed

Location	Mapped Remnant or HVR	Pre-clearance survey findings	Hectares of clearing of Brigalow TEC
KP0.52 to KP1.14	Remnant 11.10.1/11.9.5a	There is no Brigalow within or directly adjacent (200m either side) of the GTP ROW	Nil
KP1.73 to KP1.82	Remnant 11.10.1/11.9.5a	There is no Brigalow within or directly adjacent (200m either side) of the GTP ROW	Nil
KP28.77 to KP29.09	Remnant 11.9.5a	This RE has been confirmed as RE 11.9.5a and is analogous to the Brigalow TEC	0.817 ha
KP32.6 to KP33.05	Non-TEC remnant 11.3.17	This area is mapped as RE 11.3.17. However, ground truthing has identified this remnant community as consistent with RE 11.9.5 which is defined as Brigalow TEC under the EPBC Act	1.338 ha
KP33.05 to KP33.2	Remnant 11.9.5/11.9.5a	This area is mapped as RE 11.9.5/11.9.5a. However, ground truthing has identified this remnant community as consistent with RE 11.9.5 which is defined as Brigalow TEC under the EPBC Act	0.521 ha
KP33.2 to KP34.4	Remnant 11.9.5/11.9.5a	This area is mapped as RE 11.9.5/11.9.5a. However, ground truthing has identified this remnant community as consistent with RE 11.9.5 which is defined as Brigalow TEC under the EPBC Act	3.451 ha
KP34.4 to KP34.8	Non-TEC remnant 11.3.17	This area is mapped as RE 11.3.17. However, ground truthing has identified this remnant community as consistent with RE 11.9.5 which is defined as Brigalow TEC under the EPBC Act	1.399 ha
KP34.9 to KP35.2	Remnant 11.9.5/11.9.5a	This area is mapped as RE 11.9.5/11.9.5a. However, ground truthing has identified this remnant community as consistent with RE 11.9.5 which is defined as Brigalow TEC under the EPBC Act	1.032 ha
KP36.25 to KP36.5	HVR	This regrowth community is not consistent with the definition of Brigalow TEC under the EPBC Act	Nil
KP44 to KP45.5	HVR	Determined to meet the definition of Brigalow TEC under the EPBC Act	0.656 ha
KP45.88 to KP46.04	Remnant 11.9.5/11.9.5a	A small patch (~0.1 ha) of Brigalow (RE11.9.5) is present within the GTP ROW corridor where it intercepts Bully Frog Creek. However, the dominant vegetation in this area is *Eucalyptus melanophloia*	0.058 ha
KP54 to KP55	HVR	This regrowth community is not consistent with the definition of Brigalow TEC under the EPBC Act. The GTP ROW follows an existing fence line where vegetation is less than 10 years old	Nil

Location	Mapped Remnant or HVR	Pre-clearance survey findings	Hectares of clearing of Brigalow TEC
KP68 to KP69	HVR	This regrowth community is not consistent with the definition of Brigalow under the EPBC Act. The GTP ROW follows an existing fence line where vegetation is less than 10 years old	Nil
KP86 to KP87.5	HVR	Large patch of mapped regrowth follows a fence line. The GTP ROW avoids the vegetation in this area	Nil
KP92 to KP92.5	HVR	This regrowth community is not consistent with the definition of Brigalow under the EPBC Act. The GTP ROW follows an existing fence line where vegetation is less than 10 years old	Nil
KP98 to KP101	HVR	Determined to meet the definition of Brigalow TEC under the EPBC Act	0.761 ha
KP124.25 to KP124.5	HVR	Deep Creek. This regrowth community is not consistent with the definition of Brigalow under the EPBC Act. The GTP ROW follows an existing fence line where vegetation is less than 10 years old	Nil
KP188.18 to KP188.38	HVR	This regrowth community meets the definition of Brigalow TEC under the EPBC Act	0.149 ha
KP190.02 to KP190.40	HVR	This regrowth community is not consistent with the definition of Brigalow under the EPBC Act	Nil
KP246.19 to KP246.31	N/A	This area is mapped as non-remnant. However, ground truthing has identified this regrowth community as consistent with the definition of Brigalow under the EPBC Act	0.500 ha
KP252.42 to KP252.62	HVR	This mapped regrowth community meets the definition of Brigalow TEC under the EPBC Act	0.550 ha
KP252.70 to KP252.77	HVR	This regrowth community is not consistent with the definition of Brigalow under the EPBC Act	Nil
KP252.84 to KP253.30	HVR	This regrowth community is not consistent with the definition of Brigalow under the EPBC Act	Nil
KP258.84 to KP258.91	HVR	This regrowth community is not consistent with the definition of Brigalow under the EPBC Act	Nil
KP288.55 to KP288.90	HVR	This regrowth community is not consistent with the definition of Brigalow under the EPBC Act	Nil

The regrowth areas were not accurately depicted in the DNRM's mapping with a number of other communities (generally isolated or disjunct patches) identified during the pre-clearing surveys. *Acacia harpophylla* is scattered throughout the GTP ROW within KP0 to KP30, KP30 to KP40, KP40 to KP130 and KP130 to KP312 as individual trees or small clumps. Larger patches of Brigalow also occur as isolated patches, including areas along fence lines and some drainage lines. However, these areas generally deviate from the definition of the Brigalow TEC and the GTP ROW generally avoids these larger patches. Two large areas of Brigalow will be intersected, including sections of Clematis Creek upstream of the GTP ROW and a patch near KP101.

1.3 Anticipated threats and potential impacts as a result of the project

The most significant current threats to Brigalow TECs have been identified by DSEWPaC (2012w) as:

- Clearing – while Brigalow TECs are protected under Commonwealth and Queensland legislation, broadscale clearing for mining and smaller scale fragmentation for routine activities may result in further loss and fragmentation
- Fire – intense fire from extreme weather or increased fuel loads (particularly with an increase in exotic grass invasion) can alter the structure of Brigalow vegetation
- Plant and animal pests – pasture grasses increase fire risks while feral herbivores trample seedlings and reduce leaf litter and woody debris
- Fragmentation - which promotes weed invasion and overgrazing by native fauna
- Grazing pressures – many tree, shrub and grass species in Brigalow ecological communities are eaten by domestic stock, hence trampling and reduced leaf litter

The detailed design of the GTP ROW has aimed to avoid Brigalow TECs as much as possible (ie using DNRM's RE mapping and local knowledge).

Potential impacts as a result of the GTP ROW include:

- Fragmentation
- Edge effects introducing weeds
- Changes in fire intensity and frequency
- Changes to local hydrology and soil chemistry

1.4 Unavoidable impact of GTP

Clearing associated with the construction of the ROW and ancillary work areas within KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 will result in the disturbance of no more than 11.232 ha of EPBC Act listed Brigalow TEC as provided in Table 1.3.

Table 1.3 Cumulative total of Brigalow TEC to be cleared

Location	Ground-truthed Remnant or HVR	Hectares of clearing of Brigalow TEC
KP0 to KP30	Remnant 11.9.5a	0.817 ha
KP30 to KP40	Remnant 11.9.5	7.741 ha
KP40 to KP130	HVR / Remnant 11.9.5/11.9.5a	1.475 ha
KP130 to KP312	HVR 11.9.5/11.4.8/11.4.9	1.199 ha
KP312 to KP408.81	Not applicable	0 ha
KP408.81 to KP409.04	Not applicable	0 ha
KP413.57 to KP419.69	Not applicable	0 ha
Total clearing footprint		**11.232 ha**

1.5 Management measures

1.5.1 General

Brigalow TECs have been identified and mapped during the pre-clearance survey of the GTP ROW. To limit the clearing of Brigalow TECs, a key management strategy is to decrease the clearing in these areas to a maximum of 30 m in width and ensure the clearing footprint and all 'No Go' zones are clearing identified.

1.6 Management practices and methods

1.6.1 Pre-construction mitigation measures

Measures to minimise impacts

- Where the GTP ROW impacts on Brigalow TEC, the LRMP will include specific management measures and rehabilitation completion criteria associated with the re-establishment of the ground and shrub layers within approved areas of the GTP ROW[1]
- Where applicable, collection of local provenance seed from the Brigalow communities listed above will be carried out prior to the commencement of clearing activities. Refer to the LRMP for further information regarding seed collection and rehabilitation requirements
- Prior to site entry, all site personnel will be appropriately trained and made aware of the sensitive environs in which they will be working
- Prior to the commencement of construction clearing, the limits of clearing will be clearly marked out by a suitably qualified and experienced EO. Barricade webbing will be used for the 'No Go' zones for adjoining Brigalow communities

1.6.2 Construction phase mitigation measures

Measures to avoid impact

- All site offices, construction camps, stockpiling/lay down areas and plant and equipment storage areas (including heavy machinery) will be located on existing cleared lands at least 50 m away from the above-listed Brigalow communities
- Vehicle and pedestrian access within the above-listed Brigalow communities is to be restricted to within the ROW
- Access tracks to and from the work site areas will be designed to avoid impacts to these communities

1 Trees and deep rooted shrubs will not be allowed to re-establish within the GTP easement until the pipe is decommissioned.

Measures to minimise impacts

- All works will be undertaken in accordance with the conditions of any applicable statutory approvals
- The total clearing footprint within Brigalow TECs will be no wider than 30 m
- Clearing activities within these areas will be supervised by the relevant EO
- Clearing will be conducted in a sequential manner and in a way that directs escaping wildlife away from the clearing activities and into adjacent natural areas
- A licensed and experienced spotter catcher(s) will be onsite during all clearing activities and will ensure any injured animals are given to an appropriate wildlife carer group or vet (refer Appendix C)
- The clearing of Brigalow outside the approved GTP ROW will not be permitted. Refer to Part 1, Section 7 of the SSMP for the response protocol should this occur. If additional areas are required to be cleared, the relevant EO will seek approval from the Proponent PEM prior to the activity occurring
- Dust suppression mechanisms will be put in place to ensure excessive dust deposition does not occur on the foliage and affect their ability to photosynthesise (plants within the community)
- To minimise the risk of weed and pest animal establishment within and adjacent to these communities, the PWMP will be implemented
- The LRMP will be implemented
- Weather permitting, rehabilitation of all Brigalow communities will commence immediately after the pipeline has been lowered in and backfilled. Natural landscape features will be re-established/re-formed as much as practicable
- So as to minimise erosion and restore natural functions as far as possible, Brigalow areas cleared or impacted during construction will be graded and contoured to re-instate their pre-construction profiles. This will be particularly important for Brigalow identified on gilgai, alluvial plains and natural levees
- With the exception of operational constraints, revegetation will be consistent with the plant density and floristic composition of the adjacent Brigalow communities. The most efficient way to rehabilitate this community will be through the promotion of natural sucker growth from existing Brigalow adjacent the GTP ROW. However further augmentation with seeding and planting of tube stock may be required. This will be determined through the rehabilitation monitoring programme and will also be a feature of the decommissioning rehabilitation programme

1.6.3 Operational phase mitigation measures

Measures to avoid impact

- Vehicle access within the above-listed locations is to be restricted to the defined access tracks to and from the ROW and the defined access track within the ROW

Measures to minimise impacts

- The operational phase component of the PWMP will be implemented to minimise the risk of weed and pest animal establishment within and adjacent newly rehabilitated Brigalow communities
- The operational phase of the LRMP will be implemented. The LRMP has been developed with the aim of re-instating the landscape values impacted during the construction of the GTP ROW. Some of the key actions outlined within the plan include:
  - Habitat rehabilitation post construction phase may occur through the management of natural regeneration, in addition to planting of seedlings or tube stock. Species selected will be consistent with the pre-clearing (pre-construction phase) Regional Ecosystem as determined from analogue site surveys
  - Top soil will be reinstated to disturbed areas to allow natural regeneration from the soil seed bank
  - Natural contours and drainage lines will be re-established immediately following construction activities, so as to minimise erosion and restore natural functions as far as possible
  - Disturbed communities such as woodlands and open forests will be graded and contoured to maintain their pre-construction profiles, so as to minimise erosion and restore natural functions as far as possible
  - Vegetation will be allowed to naturally revegetate or will be directly seeded (seed mix for areas of remnant vegetation will be determined by the vegetation composition of the RE as determined by analogue surveys
  - Logs or other debris will be re-spread to provide shelter and stepping stones between habitats
- Through the implementation of the LRMP, ecological communities will be progressively restored according to the rehabilitation completion criteria. Management measures outlined in the LRMP will be maintained until the rehabilitation completion criteria for this community have been achieved. Such measures may include:
  - The ongoing management of other introduced species (ie non declared weeds) in order to manage negative impacts associated with the quality and availability of habitat
  - The ongoing management of fire in areas that may impact on habitat quality and availability within and adjacent the GTP ROW
  - The ongoing monitoring of analogue sites to determine the success of rehabilitation measures
- The final rehabilitation completion criteria will be for impacted areas to resemble their pre disturbance (pre-construction phase) condition as closely as possible through species composition and structure for each community. However, it should be noted that modelling (Bradley *et al* 2010) has projected that it would take at least 90 years to achieve this criteria

1.6.4 Decommissioning phase mitigation measures

Measures to minimise impacts

- A decommissioning plan will be developed by GLNG Operations and provided for approval. The plan will address the requirements of AS2885 and also to ensure environmental harm is avoided, including:
  - The Project area no longer contains hazardous contaminants and is left in stable condition
  - All above ground infrastructure is removed
  - All areas disturbed by above ground infrastructure are rehabilitated in accordance with the relevant conditions
- For a minimum of five years after the completion of rehabilitation, rehabilitated areas will be monitored on a yearly basis
- The rehabilitation and associated monitoring programme will include:
  - Pest and weed controls
  - Methods to monitor subsidence and erosion rates at rehabilitated buried transmission pipeline corridors and buried flow lines
  - BioCondition assessment in accordance with the BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland: Assessment Manual: Version 2.1 (Eyre *et al* 2011)
  - Monitoring of indicators identified in the LRMP at analogue sites to measure progressive and final rehabilitation success relevant to the final land use(s)
  - The frequency and seasonality of monitoring of analogue sites and rehabilitated areas to assess rehabilitation success
  - Identification of the experimental design for analysing analogue and rehabilitated site data including statistical methods of analyses
- During clearing activities, the EO will record the extent of vegetation being cleared and provide a progressive report to GLNG Operations. This will allow the EO to monitor the rate of clearance for threatened flora and ensure compliance with agreed disturbance limits
- The final standard for rehabilitation of disturbance areas will be for impacted areas to as closely as possible match species composition, and structure for analogue sites for each community

2 Semi-evergreen Vine Thicket (SEVT) of the Brigalow Belt North and South TEC Management Plan

2.1 EPBC Act legal status

Endangered – listed 4 April 2001

SEVT communities (Source: A Wain)

2.2 Ecology

2.2.1 Characteristics

The Central Semi-evergreen Vine Thicket (SEVT) 'threatened ecological community' (TEC) is also known as softwood scrub or bottle tree scrub. This TEC is characterised by a floristically diverse and heterogeneous assemblage of species, especially in the canopy and shrub layers (DSEWPaC 2012s). Typically, one patch of SEVT may contain over 40 vascular plant species, although the number of tree species is highly variable, ranging from one to 19 species (DSEWPaC 2012s).

Emergent species are composed of a range of evergreen, semi-evergreen and deciduous species, including *Brachychiton rupestris* (Narrow-leaved bottle tree) which is generally present within SEVT areas. Other species that may be locally present as emergent include *Acacia harpophylla* (Brigalow), *Brachychiton australis* (Broad-leaved bottle tree) and *Casuarina cristata* (Belah), or less often *Acacia fasciculifera*, *Archidendropsis thozetiana* (Grey boxwood), *Cadellia pentastylis* (Ooline), *Euroschinus falcata, Flindersia australis* (Crow's ash) and *Ventilago viminalis* (Vine tree) (DSEWPaC 2012s).

A wide range of species are generally present within the canopy stratum and generally include *Backhousia angustifolia, Backhousia kingii, Croton insularis, Denhamia oleaster, Ehretia membranifolia, Geijera parviflora, Macropteranthes leichhardtii, Notelaea microcarpa* and *Pouteria cotinifolia* (DSEWPaC 2012s).

A dense shrub understorey may be present. However where the canopy is very dense, shrubs may be absent as a result of competitive exclusion. Species common in the shrub layer include *Acalypha eremorum, Alectryon diversifolius, Everistia vacciniifolia, Carissa ovata, Croton phebalioides, Exocarpos latifolius, Geijera parviflora, Pittosporum spinescens* and *Triflorensia ixoroides* (DSEWPaC 2012s).

Within Queensland, 10 REs have been identified as being analogous to the SEVT TEC (DSEWPaC 2012s). Table 2.1 lists these REs and provides a brief description of each RE type. Figure 3 is a map showing the distribution of these REs using DEHP's RE mapping.

Table 2.1 REs analogous with SEVT TECs in Queensland from DSEWPaC (2012x)

RE	Description
11.2.3	Microphyll vine forest ("beach scrub") on sandy beach ridges
11.3.11	Semi-evergreen vine thicket on alluvial plains
11.4.1	Semi-evergreen vine thicket +/- *Casuarina cristata* on Cainozoic clay plains
11.5.15	Semi-evergreen vine thicket on Cainozoic sand plains/remnant surfaces
11.8.3	Semi-evergreen vine thicket on Cainozoic igneous rocks
11.8.6	*Macropteranthes leichhardtii* thicket on Cainozoic igneous rocks
11.8.13	Semi-evergreen vine thicket and microphyll vine forest on Cainozoic igneous rocks
11.9.4	Semi-evergreen vine thicket on Cainozoic fine-grained sedimentary rocks
11.9.8	*Macropteranthes leichhardtii* thicket on Cainozoic fine-grained sedimentary rocks
11.11.18	Semi-evergreen vine thicket on old sedimentary rocks with varying degrees of metamorphism and folding

2.2.2 Known distribution

The SEVT TEC extends from Townsville in Queensland south into northern New South Wales (NSW). It is primarily located within the Brigalow Belt Bioregion (ie Bioregion 11). Figure 3 outlines an indicative distribution of Brigalow TEC in Queensland based on current DEHP certified RE mapping.

In Queensland the remnant SEVT areas are scattered from coastal dunes and river deltas in the vicinity of Townsville and Ayr, through to the northern and central parts of the Brigalow Belt Bioregion and south into its south-eastern parts between Jandowae and Killarney on the Queensland/New South Wales border (Queensland Herbarium 2002a). In NSW, remnants usually occur as isolated patches scattered in other shrubby vegetation (Curran 2003) and are located on the North West Slopes east of Moree and north from the Liverpool Plains, with major occurrences in the vicinity of Gunnedah, Bingara and Narrabri (Benson *et al* 1996; Williams 1999; Curran 2003; Keith 2004).

The SEVT TEC occurs in the Brigalow Belt North, Brigalow Belt South and Nandewar bioregions (Threatened Species Scientific Committee 2001). In Queensland, more than 50% of remnants occur in the Arcadia, Buckland Basalts, Claude River Downs, Dawson River Downs, Northern Bowen Basin and Southern Downs sub regions (McDonald 2007).

2.2.3 Biology and reproduction

The SEVT TEC usually occurs as discrete patch within other vegetation types, including *Acacia harpophylla* forest. These TECs occupy the drier portion of the natural range of closed canopy vegetation communities, and the gradient from humid to sub-humid environments is reflected in the reduction of both canopy height and structural and floristic complexity. In rocky locations the canopy tends to be lower and more open. Adaptations to drier environments include smaller, thicker leaves, swollen roots and stems, and an optional deciduous habit.

SEVT TECs are generally fire sensitive and often rely on *Acacia harpophylla*, and other vegetation, to serve as a buffer to prevent the incursion of fires into the SEVT community.

SEVT ecosystems rely on a variety of dispersal modes for regeneration and recruitment.

The seeds of many canopy emergent species are dispersed by wind, while some seeds of the lower canopy and ground layer species are dispersed by frugivores (fruit-eating animals). SEVT ecosystems are known to be important habitat for numerous bird species and they provide a refuge for wildlife in times of fire and climate change (EPA 2007).

2.2.4 Known species populations and their relationship with the GTP ROW

The Pre-Clearance Survey Report for KP0 to KP130 (Ecologica Consulting 2012) and KP312 to KP408.81 (Santos GLNG 2013) identified SEVT TEC REs within KP0 to KP30 and KP312 to KP408.81 of the GTP ROW as REs 11.9.4 and 11.11.18. SEVT TEC was not identified within KP30 to KP40, KP40 to KP130, KP130 to KP312, KP408.81 to KP409.04 and KP413.57 to KP419.69 of the GTP ROW. The full RE descriptions for 11.9.4 and 11.11.18, as described in the Queensland Regional Ecosystem Description Database, Version 6.0b [REDD] (DEHP 2012d), are:

- 11.9.4. Semi-evergreen vine thicket (SEVT) which occurs on crests, mid-slopes, undulating plains and rises formed from fine-grained sediments
- 11.11.18. Semi-evergreen vine thicket on old sedimentary rocks with varying degrees of metamorphism and folding. Lowlands

DEHP's RE mapping indicates that Res analogous with SEVT TECs are not located within and directly adjacent to the GTP ROW. Ecologica Consultants (2012) and Santos GLNG (2013) conducted a pre-clearance survey to confirm the presence/absence of SEVT TECs within the ROW. The surveys were restricted to the GTP disturbance areas (ie ROW and ancillary work areas) (refer Figure 4a, Figure 4b and Figure 4c). SEVT TEC areas shown in Figure 4a, Figure 4b and Figure 4c outside these disturbance areas represents the current RE mapping of this TEC in Queensland.

Table 2.2 outlines the RE mapping, determinations from ground truthing and the extent of clearing determined in the GTP ROW and ancillary work areas.

Table 2.2 Summary of SEVT TEC ground truthed within KP0 to KP30 and KP312 to KP408.81

Location	Mapped Remnant or HVR	Pre-clearance survey findings	Hectares of clearing of SEVT TEC
KP3.25 to KP3.5	Remnant 11.10.1/11.10.13a	Area currently mapped as RE 11.10.1/11.10.13a. Area is analogous to SEVT TEC (ie RE 11.9.4)	0.238 ha
KP399.25 to KP399.50	Non-remnant / remnant 11.11.15/11.11.18	This site is mapped as containing non-remnant vegetation as well as 'Endangered' RE 11.11.15/11.11.18 on the DEHP certified RE mapping. Through aerial photograph interpretation it was thought this area may contain SEVT due to the reflective vegetation pattern. However, field investigations confirmed the vegetation composition present is considered to be analogous to remnant 'No concern at present' RE 11.11.3 and is therefore not SEVT TEC	Nil

Location	Mapped Remnant or HVR	Pre-clearance survey findings	Hectares of clearing of SEVT TEC
KP400.90 to KP401.30	Non-remnant / HVR	This site is currently mapped as containing non-remnant vegetation and 'Endangered' High Value Regrowth vegetation on the regrowth mapping. A review of aerial photography targeted this site for confirmation of the presence of SEVT due to the reflective vegetation pattern. However, field investigations confirmed the vegetation composition present is considered to be analogous to remnant 'No concern at present' RE 11.11.3 and therefore is not SEVT TEC, due to the presence of *Eucalyptus* woodland species	Nil
KP401.82 to KP401.93	HVR	This site is currently mapped as containing 'Endangered' High Value Regrowth vegetation on the regrowth mapping. However, the vegetation present is considered to be analogous to remnant 'Endangered' RE 11.11.18. This RE code is classified as a SEVT TEC which was confirmed during the on-ground field investigations	0.436 ha

2.3 Anticipated threats and potential impacts as a result of the project

The most significant current threats to SEVT TECs have been identified by DSEWPaC (2012x) as:

- Clearing – while SEVT TECs are protected under Commonwealth and Queensland legislation, broadscale clearing for mining purposes and smaller scale clearing for roads, fencelines and firebreaks will result in further loss and fragmentation through invasion of disturbed areas by shrubs and high biomass fuels such as buffel grass
- Fire – intense fire from extreme weather or increased fuel loads (particularly with an increase in exotic grass invasion) alters the structure of SEVT vegetation
- Plant and animal pests – pasture grasses naturally invade SEVT increasing fire risks, while feral herbivores create disturbed areas within SEVT that enhance exotic grass and other weed proliferation, further exacerbating the fire risk

The detailed design of the GTP ROW and ancillary work areas has aimed to avoid SEVT TECs as much as possible (ie using DEHP's RE mapping and local knowledge).

Potential impacts as a result of the GTP include:

- Fragmentation
- Edge effects introducing weeds
- Changes in fire intensity and frequency
- Changes to local hydrology and soil chemistry

2.4 Unavoidable impact of GTP

Clearing associated with the construction of the ROW and ancillary work areas within KP0 to KP30, KP30 to KP40, KP40 to KP130, KP130 to KP312, KP312 to KP408.81, KP408.81 to KP409.04 and KP413.57 to KP419.69 will result in the disturbance of no more than 0.674 ha of EPBC Act listed SEVT TEC as provided in Table 2.3.

Table 2.3 Cumulative total of SEVT TEC to be cleared

Location	Ground-truthed Remnant or HVR	Hectares of clearing of SEVT TEC
KP0 to KP30	Remnant 11.10.1/11.10.13a	0.238 ha
KP30 to KP40	Not applicable	0 ha
KP40 to KP130	Not applicable	0 ha
KP130 to KP312	Not applicable	0 ha
KP312 to KP408.81	Remnant 11.11.18	0.436 ha
KP408.81 to KP409.04	Not applicable	0 ha
KP413.57 to KP419.69	Not applicable	0 ha
Total clearing footprint		**0.674 ha**

2.5 Management measures

2.5.1 General

SEVT TECs has been identified and mapped during the pre-clearance survey of the GTP ROW. To limit the clearing of this SEVT TEC, a key management strategy is to decrease the clearing in this area to a maximum of 30 m in width and ensure the clearing footprint and all 'No Go' zones are clearing identified.

2.6 Management practices and methods

2.6.1 Pre-construction mitigation measures

Measures to minimise impacts

- Where the GTP ROW impacts on SEVT TEC, the LRMP will include specific management measures and rehabilitation completion criteria associated with the re-establishment of the ground and shrub layers within approved areas of the GTP ROW[2]
- Where applicable, collection of local provenance seed from the SEVT communities listed above will be carried out prior to the commencement of clearing activities. Refer to the LRMP for further information regarding seed collection and rehabilitation requirements
- Prior to site entry, all site personnel will be appropriately trained and made aware of the sensitive environs in which they will be working
- Prior to the commencement of construction clearing, the limits of clearing will be clearly marked out by a suitably qualified and experienced EO. Barricade webbing will be used for the 'No Go' zones for adjoining SEVT communities

2 Trees and deep rooted shrubs will not be allowed to re-establish within the GTP easement until the pipe is decommissioned.

2.6.2 Construction phase mitigation measures

Measures to avoid impact

- All site offices, construction camps, stockpiling/lay down areas and plant and equipment storage areas (incl. heavy machinery) will be located on existing cleared lands at least 50 m away from SEVT communities
- Vehicle and pedestrian access within SEVT communities is to be restricted to within the ROW and ancillary work areas
- Access tracks to and from the work site areas will be designed to avoid impacts to these communities

Measures to minimise impacts

- All works will be undertaken in accordance with the conditions of any applicable statutory approvals
- The total clearing footprint within SEVT TECs will be no wider than 30 m
- Clearing activities within these areas will be supervised by the relevant EO
- Clearing will be conducted in a sequential manner and in a way that directs escaping wildlife away from the clearing activities and into adjacent natural areas
- A licensed and experienced spotter catcher(s) will be onsite during all clearing activities and will ensure any injured animals are given to an appropriate wildlife carer group or vet (refer Appendix C)
- The clearing of SEVT TEC outside the approved GTP ROW will not be permitted. Refer to Part 1, Section 7 of the SSMP for the response protocol should this occur. If additional areas are required to be cleared, the relevant EO will seek approval from the Proponent PEM prior to the activity occurring
- Dust suppression mechanisms will be put in place to ensure excessive dust deposition does not occur on the foliage and affect their ability to photosynthesise (plants within the community)
- To minimise the risk of weed and pest animal establishment within and adjacent to these communities, the PWMP will be implemented
- The LRMP will be implemented
- Weather permitting, rehabilitation of all SEVT communities will commence immediately after the pipeline has been lowered in and backfilled. Natural landscape features will be re-established/re-formed as much as practicable
- So as to minimise erosion and restore natural functions as far as possible, SEVT areas cleared or impacted during construction will be graded and contoured to re-instate their pre-construction profiles
- With the exception of operational constraints, revegetation will be consistent with the plant density and floristic composition of the adjacent SEVT communities. The most efficient way to rehabilitate this community will be through the promotion of natural regeneration from existing SEVT adjacent the GTP ROW. However further augmentation with seeding and planting of tube stock may be required. This will be determined through the rehabilitation monitoring programme and will also be a feature of the decommissioning rehabilitation programme

2.6.3 Operational phase mitigation measures

Measures to avoid impact

- Vehicle access is to be restricted to the defined access tracks to the defined access track within the ROW and ancillary work areas

Measures to minimise impacts

- The operational phase component of the PWMP will be implemented to minimise the risk of weed and pest animal establishment within and adjacent newly rehabilitated SEVT communities
- The operational phase of the LRMP will be implemented. The LRMP has been developed with the aim of re-instating the landscape values impacted during the construction of the GTP ROW. Some of the key actions outlined within the plan include:
  - Habitat rehabilitation post construction phase may occur through the management of natural regeneration, in addition to planting of seedlings or tube stock. Species selected will be consistent with the pre-clearing (pre-construction phase) Regional Ecosystem as determined from analogue site surveys
  - Top soil will be reinstated to disturbed areas to allow natural regeneration from the soil seed bank
  - Natural contours and drainage lines will be re-established immediately following construction activities, so as to minimise erosion and restore natural functions as far as possible
  - Disturbed communities such as woodlands and open forests will be graded and contoured to maintain their pre-construction profiles, so as to minimise erosion and restore natural functions as far as possible
  - Vegetation will be allowed to naturally revegetate or will be directly seeded (seed mix for areas of remnant vegetation will be determined by the vegetation composition of the RE as determined by analogue surveys
  - Logs or other debris will be re-spread to provide shelter and stepping stones between habitats
- Through the implementation of the LRMP, ecological communities will be progressively restored according to the rehabilitation completion criteria. Management measures outlined in the LRMP will be maintained until the rehabilitation completion criteria for this community have been achieved. Such measures may include:
  - The ongoing management of other introduced species (ie non declared weeds) in order to manage negative impacts associated with the quality and availability of habitat
  - The ongoing management of fire in areas that may impact on habitat quality and availability within and adjacent the GTP ROW
  - The ongoing monitoring of analogue sites to determine the success of rehabilitation measures
- The final rehabilitation completion criteria will be for impacted areas to resemble their pre disturbance (pre-construction phase) condition as closely as possible through species composition and structure for each community

2.6.4 Decommissioning phase mitigation measures

Measures to minimise impacts

- A decommissioning plan will be developed by GLNG Operations and provided for approval. The plan will address the requirements of AS2885 and also to ensure environmental harm is avoided, including:
  - The Project area no longer contains hazardous contaminants and is left in stable condition
  - All above ground infrastructure is removed
  - All areas disturbed by above ground infrastructure are rehabilitated in accordance with the relevant conditions
- For a minimum of five years after the completion of rehabilitation, rehabilitated areas will be monitored on a yearly basis
- The rehabilitation and associated monitoring programme will include:
  - Pest and weed controls
  - Methods to monitor subsidence and erosion rates at rehabilitated buried transmission pipeline corridors and buried flow lines
  - BioCondition assessment in accordance with the BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland: Assessment Manual: Version 2.1 (Eyre *et al* 2011)
  - Monitoring of indicators identified in the LRMP at analogue sites to measure progressive and final rehabilitation success relevant to the final land use(s)
  - The frequency and seasonality of monitoring of analogue sites and rehabilitated areas to assess rehabilitation success
  - Identification of the experimental design for analysing analogue and rehabilitated site data including statistical methods of analyses
- During clearing activities, the EO will record the extent of vegetation being cleared and provide a progressive report to GLNG Operations. This will allow the EO to monitor the rate of clearance for threatened flora and ensure compliance with agreed disturbance limits
- The final standard for rehabilitation of disturbance areas will be for impacted areas to be rehabilitated to a level consistent with the pre-clearance condition

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APPENDIX A Landscape Rehabilitation Management Plan

APPENDIX B Pest and Weed Management Plan

APPENDIX C Fauna Handling Procedures