E3 | Nature Conservation

West of the Bruce Highway
Gladstone State Development Area
Curtis Island

Santos | PETRONAS

Report

GLNG EIS Supplement

Gas Transmission Pipeline, Nature Conservation

NOVEMBER 2009

Prepared for

Santos

32 Turbot Street,
Brisbane, Qld 4000

42626440

URS

Project Manager:

Jim Barker
Associate Environmental Scientist

URS Australia Pty Ltd

Level 16, 240 Queen Street
Brisbane, QLD 4000
GPO Box 302, QLD 4001
Australia
T: 61 7 3243 2111
F: 61 7 3243 2199

Project Director:

Chris Pigott
Senior Principal

Author:

Vanessa Wood
Project Ecologist

Reviewer:

Dan Simmons
Associate Environmental Scientist

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Abbreviations

Abbreviation	Description
APIA	Australian Pipeline Industry Association
BoM	Bureau of Meteorology
CICSDA	Callide Infrastructure Corridor State Development Area
CPIC	Common Pipeline Infrastructure Corridor
CRAR	Callide Range Alternative Route
CSG	Coal Seam Gas
Cwth.	Commonwealth
DEEDI	Queensland Department of Employment, Economic Development and Innovation
DERM	Queensland Department of Environment and Resource Management
DEWHA	Department of Environment, Water, Heritage and the Arts
DIP	Department of Infrastructure and Planning
DIWA	Directory of Important Wetlands in Australia
DNRW	Department of Natural Resources and Water
DPIF	Department of Primary Industry and Fisheries
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESA	Environmentally Sensitive Areas
EVR	Endangered Vulnerable and Rare
FPC	Foliage Projection Cover
GLNG	Gas Liquefied Natural Gas
GRT	Giant Rat's Tail
GSDA	Gladstone State Development Area
GTP	Gas Transmission Pipeline
ha	hectares
HERBRECS	A database maintained by the Queensland Herbarium that provides a list of specimens and collections for a specified search area.
LNG	Liquefied Natural Gas
LP Act	Queensland *Lands Protection (Pest and Stock Route Management) Act 2002*
m	metre
MNES database	Commonwealth Department of the Environment, Water, Heritage and the Arts (DEWHA) Matters of National Environmental Significance database
NC Act	*Queensland Nature Conservation Act 1992*
NDE	Non destructive examination
QCLNG	Queensland Curtis Liquefied Natural Gas
Qld.	Queensland
RE	Regional Ecosystems
REDD	Regional Ecosystems Description Database
ROW	Right of Way
SF	State Forest
SW	South-West
VM Act	Queensland *Vegetation Management Act 1999*
VM Status	Vegetation Management Status
WONS	Weeds of National Significance

Part 1 Introduction

The Gladstone Liquefied Natural Gas (GLNG) Environmental Impact Statement (EIS) investigated the environmental values, potential impacts and proposed mitigation measures for the gas transmission pipeline (GTP), LNG facility and Coal Seam Gas (CSG) field components of the GLNG Project.

Supplementary studies for the EIS, including those prepared for the GTP, were conducted following design changes stemming from engineering, geotechnical, social, environmental and other investigations and submissions received during the public exhibition of the EIS. For the purposes of the Supplementary EIS nature conservation component, the GTP has been separated into three portions:

- Part 2: West of the Bruce Highway (GLNG GTP September 2009, Callide Range Alternative Route and the CICSDA);
- Part 3: The Gladstone State Development Area (GSDA) (GLNG GTP (September 2009) and the CPIC Route); and
- Part 4: Curtis Island (GLNG GTP (September 2009) and the CPIC Route).

All of the GTP component studies listed above have been compiled into this single report. This section introduces each of the components.

1.1 West of the Bruce Highway (Part 2)

This Part details the findings of the ecological assessment of the GTP study area and its two alternative alignments west of the GSDA. A Common Pipeline Infrastructure Corridor (CPIC) has been designated in the Callide Infrastructure Corridor State Development Area (CICSDA) to the west of the Bruce Highway, however at the time of this investigation a decision had not yet been made regarding the CPIC in the GSDA.

This supplement to the EIS assesses the impact of alternative GTP route alignment options identified since completion of the EIS as a result of further technical, ecological, topographical and social investigations and information and submissions received during the public exhibition of the EIS. The alternative alignment options were divided into several sections and the assessment was conducted in stages according to these sections. These sections have been identified as:

- GLNG GTP (September 2009) - South-Western Section;
- GLNG GTP (September 2009) - Eastern Section;
- Callide Range Alternative Route (CRAR); and
- CPIC (CICSDA Section) Route.

1.2 Gladstone State Development Area (Part 3)

This Part discusses two GTP routes within the GSDA. The GSDA lies to the north and north-west of Gladstone and extends approximately 20 km from the Bruce Highway in a north-east direction across The Narrows to Curtis Island. The two options are:

- The CPIC (GSDA Section) Route; and
- The GLNG GTP (September 2009) within the GSDA.

Designation of the government preferred option known as the CPIC is still to be finally determined by the Department of Infrastructure and Planning (DIP). This corridor aims to provide a common use corridor for multiple pipelines through the GSDA. Santos' use of the CPIC is also dependent on the

government's resumption of the relevant underlying land interest and negotiation of access terms and conditions.

The GLNG GTP (September 2009) alignment differs in several locations from the CPIC and has been included to ensure that the study area covers the GTP deviation from the proposed CPIC. Throughout Part 3, a reference to the study area refers to both the GTP option routes within the GSDA area as designated above. A reference to the study corridor or GTP corridor refers to the area within each individual pipeline route; either the CPIC (GSDA Section) Route or the GLNG GTP (September 2009) route within the GSDA.

1.3 Curtis Island (Part 4)

This Part investigates the environmental conditions and potential impacts for the following alignments:

- The GLNG GTP (September 2009); and
- The CPIC (GSDA Section) Route on Curtis Island.

The GLNG GTP (September 2009) are route alternatives identified by Santos since March 2009 as the result of further engineering, geotechnical, environmental and other investigations and submissions received during the public exhibition of the EIS. The CPIC Route is the shared infrastructure corridor for multiple proponents proposed by the Queensland Government between Callide and the proposed LNG facility sites on Curtis Island.

This report includes details on:

- Background information to the study;
- Study scope, aims and objectives and approach;
- Environmental values present within the study area;
- Potential impacts to the environmental values ascertained during the study; and
- Proposed impact mitigation measures.

2

Part 2 West of Bruce Highway

Report

Part 2 - West of the Bruce Highway

Prepared for

Santos

32 Turbot Street
Brisbane Qld 4000

42626453

URS

Project Manager:

Dan Simmons
Associate Environmental Scientist

URS Australia Pty Ltd

Level 16, 240 Queen Street
Brisbane, QLD 4000
GPO Box 302, QLD 4001
Australia
T: 61 7 3243 2111
F: 61 7 3243 2199

Project Director:

Chris Pigott
Senior Principal

Author:

Angus McLeod
Senior Ecologist

Reviewer:

Dan Simmons
Associate Environmental Scientist

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Abbreviation	Description
BoM	Bureau of Meteorology
CICSDA	Callide Infrastructure Corridor State Development Area
CPIC	Common Pipeline Infrastructure Corridor
CRAR	Callide Range Alternative Route
CSG	Coal Seam Gas
Cwth.	Commonwealth
DERM	Queensland Department of Environment and Resources Management
GLNG	Gladstone Liquefied Natural Gas
GSDA	Gladstone State Development Area
GTP	Gas Transmission Pipeline
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EPA	Environmental Protection Agency
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
FPC	Foliage Projection Cover
LNG	Liquefied Natural Gas
NC Act	Queensland *Nature Conservation Act 1992*
NDE	Non destructive examination
Qld.	Queensland
RE	Regional Ecosystems
REDD	Regional Ecosystems Description Database
ROW	Right-of-way
SW	South-West
VM Act	Queensland *Vegetation Management Act 1999*
WONS	Weeds of National Significance

Executive Summary

This report details the findings of the ecological assessment of the Gladstone Liquefied Natural Gas (GLNG) Gas Transmission Pipeline (GTP) study area and its two alternative alignments west of the Gladstone State Development Area (GSDA). A Common Pipeline Infrastructure Corridor (CPIC) has been designated in the Callide Infrastructure Corridor State Development Area (CICSDA) (CPIC (CICSDA Section) Route) to the west of the Bruce Highway, however at the time of this investigation a decision had not yet been made regarding the CPIC in the GSDA (CPIC (GSDA Section) Route). Therefore, the GSDA component of the GTP has been assessed in a different document. EIS Appendix N2 detailed the findings of the assessment undertaken for the GTP route alignment proposed at the time of completion of the EIS. This supplement to the GLNG EIS assesses the impact of alternative GTP route alignment options identified since completion of the EIS as a result of further technical, ecological, topographical and social investigations and information.

Desktop assessment identified areas along the various alternative GTP route alignment options that required field investigation in addition to that undertaken for the EIS. Detailed analysis of the vegetation mapping has resulted in the identification of potential areas of remnant vegetation to be cleared throughout the study area. In addition, significant regional ecosystems, significant flora species and declared weeds have been identified and mapped.

A field survey of the relevant areas was undertaken. The field survey identified the presence of 27 Regional Ecosystems (REs) within the GLNG GTP (September 2009) corridor including 13 listed as 'Endangered' or 'Of Concern' under the *Vegetation Management Act 1999* (VM Act) and/or the *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act). This compares with 47 REs recorded during the studies for the EIS including 18 listed as 'Endangered' or 'Of Concern' under the VM Act and/or EPBC Act. This reduction in vegetation communities impacted stems mainly from the exclusion of the Curtis Island portion from this report.

An additional five weed species were recorded during the supplementary studies, bringing the total to 45 along the GLNG GTP (September 2009) route. No additional declared weeds listed under the Queensland *Land Protection (Pest and Stock Route Management) Act, 2002* were recorded.

The clearing of remnant vegetation within the GTP right-of-way (ROW) will provide the greatest impacts to flora and fauna. The pipeline ROW width will be a maximum of 40 m, or 30 m where the GTP intersects conservation significant vegetation communities. Three combinations of the GTP alignment options are investigated and potential areas of vegetation to be cleared are presented. The construction of the GTP will result in the partial clearing of REs listed as 'Endangered' and 'Of Concern' under the VM Act and EPBC Act. The vegetation clearing may also impact upon the two significant flora species recorded.

The potential impacts and mitigation actions section has been updated to incorporate innovative approaches to management of potential impacts to flora and fauna.

1

Introduction

1.1 Background

EIS Appendix N2 detailed the findings of the ecological assessment for the gas transmission pipeline (GTP) linking the coal seam gas (CSG) field and Liquefied Natural Gas (LNG) facility on Curtis Island. Subsequent to completion of the GLNG EIS, a number of alternative GTP route alignment options were identified as a result of further technical, topographical, social and ecological investigations and information. This chapter details the findings of further studies along the GTP in regard to these alternative alignment options west of the GSDA – i.e. west of the Bruce Highway. A full study of the GTP alignment through the GSDA is presented in Part 3 GSDA.

1.2 Study Scope

Following the completion of the GLNG EIS, a number of route changes or options were considered. This report assesses the environmental values and potential impacts of the alternative GTP route alignments individually and in combination. The alternative alignment options were broken up into several sections and the assessment was conducted in stages according to these sections.

These sections have been identified as:

- GLNG GTP (September 2009) South-West Section (SW);
- GLNG GTP (September 2009) Eastern Section;
- Callide Range Alternative Route (CRAR); and
- Common Pipeline Infrastructure Corridor (CPIC) in the Callide Infrastructure Corridor State Development Area (CICSDA) referred to as the CPIC (CICSDA Section) Route.

For the geographical representation of these pipeline sections, see Figure 1 and Figure 2.

The overall approach of this supplementary ecological assessment is the same as used during the EIS ecological assessment. This study builds on the previous EIS GTP study utilising the same desktop assessment, target species and field methodology. To this end, inclusion of the following sections in this report are omitted to avoid repetition, and can be referred to in the respective sections of EIS Appendix N2.

- Review of Existing Information (Section 2.2 of EIS Appendix N2);
- Target Species (Section 2.3);
- Legislative context (Section 2.4.4);
- Survey Limitations (Section 2.5.1);
- Nomenclature (Section 2.5.2);
- Regional Context (Section 3); and
- Study Site (Section 3.1.4).

This report provides results, vegetation mapping, potential impacts and mitigation for the values assessed for the alignment options outlined below.

1.2.1 GLNG GTP Alternative Alignment Study Sections

GLNG GTP (September 2009) South-West (SW) Section (~242.6 km)

This section originates at Fairview and tracks north through the Arcadia Valley on the western side of the Expedition Range. The alignment then continues in a north-east direction to its termination at Moura-Baralaba Road. The alternative alignment option generally follows the alignment presented in the GLNG EIS except for the Arcadia Valley and Fairview where it diverges.

GLNG GTP (September 2009) Eastern Section (~141.3 km)

This section originates at the Moura-Baralaba Road to the north of Moura, joining the South-West Section and continuing east to meet the Dawson Highway. It then follows the Dawson Highway and Mount Alma Road, terminating at the Bruce Highway adjacent to Mount Alma Road to the north-west of Gladstone. The alternative alignment option generally follows the alignment presented in the GLNG EIS.

Callide Range Alternative Route (CRAR) (~8.79 km)

The Callide Range Alternative Route alignment option essentially follows Bell's Creek through the Callide Range and Inverness Road to the north of the Dawson Highway.

Common Pipeline Infrastructure Corridor (CPIC) – CICSDA Section (CPIC (CICSDA Section) Route) (~45.3 km)

The CPIC (CICSDA Section) Route is located between the Calliope Range and the Bruce Highway. As the corridor has now been gazetted, it is intended that the GTP will follow this alignment.

Other GTP Components

It should be noted that the GLNG EIS GTP Nature Conservation Report (EIS Appendix N2) included the portion of the GTP on Curtis Island. This report does not cover the Curtis Island portion. Alternative alignment options on Curtis Island are detailed in the Part 4 Curtis Island. Similarly, the findings of the investigations into the GLNG GTP (September 2009) within the GSDA and the CPIC through the GSDA are presented in Part 3 GSDA.

1.3 Study Aims and Objectives

The aims of this supplementary investigation were to assess the environmental impact of route changes by mapping the vegetation communities of the GTP study area (within the alternative route alignment options), identify areas of vegetation or species of conservation significance and assess the impact of the GTP on these species. In meeting these aims, the objectives of the study were to:

- Provide baseline data on REs occurring in the study area;
- Identify ecologically sensitive areas;
- Identify the occurrence or expected occurrence of conservation significant species;
- Describe weed species and their distribution in the study area; and

- Determine the impacts of the GTP on the surrounding vegetation and habitats and develop appropriate management strategies.

It should be noted that a further assessment of fauna habitat has not been undertaken as part of this report as the alignment options investigated for this study did not present any significant variation of habitat or additional values and potential impacts to those assessed in the previous EIS study.

1.4 Study Approach

Alternative alignment options for portions of the pipeline between the Fairview CSG field and the Bruce Highway north-west of Gladstone (EIS Section 1.2.1, Figure 1 and Figure 2) were analysed for any potential changes in ecological values to those determined from the EIS study.

Where the alternative alignment option (GLNG GTP (September 2009)) deviated from the EIS GTP (March 2009) alignment, aerial photo analysis was employed to determine potential ecological values. Areas of potential ecological values (such as waterway crossings, large areas of contiguous bushland or significant ecological communities) were targeted as sites for field investigation. Sites were also identified and investigated at points along the EIS GTP (March 2009) alignment (and relevant to the current alignment) that were not accessible during previous EIS field studies, enabling refinement and improvement of the vegetation mapping previously presented in the GLNG EIS.

The flora survey employed an assessment of floral taxa and REs in keeping with the methodology employed by the Queensland Herbarium for the survey of REs and vegetation communities (Neldner *et al.,* 2005). The survey design was originally established in consultation with the Department of Environment and Resources Management (DERM).

Vegetation mapping was restricted to a 100 m buffer either side of the GTP (200 m wide survey corridor). Preliminary identification of the vegetation communities was conducted prior to the commencement of fieldwork using 1:100 000 REs coverage Version 5.0 for the region (EPA, 2009).

Fieldwork was conducted over seven days between 31 August and 6 September 2009. Twenty-eight sites were assessed during the field survey. A number of standard botanical assessment methods were employed including secondary transects, quaternary sample plots, and random meander searches. Vehicle traverses of the GTP study area and surrounds were also undertaken throughout the survey period to identify changes in landform and community boundaries. Community structural formation classes were assessed according to Neldner *et. al.*(2005). REs classification of communities was determined as per Sattler and Williams (1999) and in accordance with the Regional Ecosystems Description Database (REDD) Version 5.2 (EPA, 2007). Final vegetation mapping was undertaken by digitising field survey data directly into MapInfo. Full details on survey methodology employed can be found in EIS Appendix N2.

2

Environmental Values

2.1 Weather Conditions

Weather conditions for the survey period were typical for this season in the region, with temperatures ranging from 12.2 ^{o} C to 32.2 ^{o} C. Average relative humidity for this period was 56.0 %. Wind was variable in direction and generally calm to light. No rainfall was recorded in the survey area during the survey period (BoM, 2009).

2.2 Survey Results

Results from this study provide additional values to those previously detailed in EIS Appendix N2.

2.2.1 Additional Flora Species

Eighteen species not detected in previous EIS surveys were recorded during the supplementary studies. These are displayed in Table 2-1 below. All species listed are common. None of the additional exotic species are declared weeds listed under the Queensland *Land Protection (Pest and Stock Route Management) Act, 2002*.

Table 2-1 Additional flora species recorded during the supplementary field studies

Family	Scientific Name[1]	Common Name	Locality	Field Site Number[2]
Adiantaceae	*Cheilanthes distans*	Bristly cloak fern	Fairview CSG field	S6
Capparaceae	*Capparis canescens*	Wild orange	Calliope Range	Q8
Casuarinaceae	*Allocasuarina inophloia*	Thready-barked she-oak	Fairview CSG field	S5
Celastraceae	*Denhamia oleaster*	Stiff denhamia	Fairview CSG field	S6
Celastraceae	*Maytenus silvestris*	Narrow-leaved orangebark	Fairview CSG field	S1
Chenopodiaceae	*Maireana microphylla*	Small-leaf bluebush	Arcadia Valley	Q19
Euphorbiaceae	*Croton insularis*	Silver croton	Fairview CSG field	S6
Fabaceae	*Leucaena leucocephala**	Leucaena	Kaluda Road (Mt Alma Crossing)	Q2
Fabaceae	*Macroptilium atropurpureum**	Siratro	Kaluda Road (Mt Alma Crossing) East of Calliope Range	Q2, Q6
Malvaceae	*Sida subspicata*	Spiked sida	Mimosa Creek	S3
Mimosaceae	*Acacia catenulata*	Bendee	Fairview CSG field	S5
Moraceae	*Ficus rubiginosa*	Rock fig	Bells Creek	Q13
Myrtaceae	*Angophora leiocarpa*	Rusty gum	Harper Creek	Q4
Myrtaceae	*Corymbia watsoniana* subsp. *watsoniana*	Large-fruited yellow jacket	Callide Range	Q17
Myrtaceae	*Melaleuca fluviatilis*	Teatree	Kaluda Road (Mt Alma Crossing), Harper Creek, Calliope River, East of Calliope Range, Bells Creek	Q2, Q4, Q5, Q6, Q11
Poaceae	*Themeda quadrivalvis**	Grader grass	Kaluda Road (Mt Alma Crossing)	Q2

Family	Scientific Name[1]	Common Name	Locality	Field Site Number[2]
Polypodiaceae	*Platycerium bifurcatum*	Elkhorn fern	Fairview CSG field	S6
Solanaceae	*Solanum torvum**	Devils' fig	Harper Creek, East of Calliope Range	Q4, Q6

[1] * indicates exotic species.

[2] 'Q' and 'S' refer to quaternary and secondary level vegetation assessments respectively.

2.2.2 Regional Ecosystems

Twenty-seven REs were described and mapped within a 200 m wide corridor along the GTP alignment options, based upon the field survey results and interpretation of aerial photo stereo images (Figure 3 to Figure 21). Tables 2-2 to 2-5 detail the total area of each community found within the 200 m wide corridor of each of the study sections of the GTP:

- Table 2-2, REs recorded within the GLNG GTP (September 2009) SW Section;
- Table 2-3, REs recorded within the GLNG GTP (September 2009) Eastern Section;
- Table 2-4, REs recorded within the CRAR; and
- Table 2-5, REs recorded within the CPIC (CICSDA Section) Route.

These tables also present the area for each RE as a percentage of the extent of that vegetation community within the Brigalow Belt bioregion. Descriptions of communities surveyed at secondary transects (including floristics, structure, location, ecological integrity and disturbance notes) are presented in Appendix A.

Table 2-2 Regional Ecosystems recorded within a 200 m survey corridor of the GLNG GTP (September 2009) SW Section

RE	Community Description	Area within 200 m survey corridor (~ha)	Area within bioregion (~ha)[1]	% of bioregional extent[2]
11.3.2	*Eucalyptus populnea* woodland on alluvial plains	29.765	528,081	0.0056
11.3.3	*Eucalyptus coolabah* woodland on alluvial plains	26.344	282,541	0.0093
11.3.4	*Eucalyptus tereticornis* and/or *Eucalyptus* spp.	6.007	186,652	0.0032
11.3.17	*Eucalyptus populnea* woodland with *Acacia harpophylla* and/or *Casuarina cristata* on alluvial plains	29.276	36,294	0.0807
11.3.25	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	30.717	515,948	0.0060
11.4.9	*Acacia harpophylla* shrubby open forest to woodland with Terminalia oblongata on Cainozoic clay plains	7.855	96,425	0.0081
11.5.2	*Eucalyptus crebra*, *Corymbia* spp., with *E. moluccana* on lower slopes of Cainozoic sand plains/remnant surfaces	42.285	193,278	0.0219

RE	Community Description	Area within 200 m survey corridor (~ha)	Area within bioregion (~ha)[1]	% of bioregional extent[2]
11.5.9[3]	*Eucalyptus crebra* and other *Eucalyptus* spp. and *Corymbia* spp. woodland on Cainozoic sand plains/remnant surfaces. Plateaus and broad crests	13.785	240,914	0.0057
11.8.4	*Eucalyptus melanophloia* woodland on Cainozoic igneous rocks. Occurs on hillsides.	12.160	152,231	0.0080
11.8.5	*Eucalyptus orgadophila* open woodland on Cainozoic igneous rocks	26.612	350,390	0.0076
11.8.11	*Dichanthium sericeum* grassland on Cainozoic igneous rocks	2.447	176,127	0.0014
11.9.4b	Semi-evergreen vine thicket on fine grained sedimentary rocks	14.163	33,883	0.0418
11.9.5	*Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks	23.269	168,841	0.0138
11.10.1	*Corymbia citriodora* open forest on coarse-grained sedimentary rocks	138.856	881,416	0.0158
11.10.3	*Acacia catenulata* or *A. shirleyi* open forest on coarse-grained sedimentary rocks.	55.814	338,750	0.0016
11.10.4	*Eucalyptus decorticans, Lysicarpus angustifolius* ± *Eucalyptus* spp., *Corymbia* spp., *Acacia* spp. woodland on coarse-grained sedimentary rocks, crests and scarps.	28.236	474,820	0.0059
11.10.7	*Eucalyptus crebra* woodland on coarse-grained sedimentary rocks	134.4	285,759	0.0470
11.10.8	Semi-evergreen vine thicket in sheltered habitats on medium to coarse-grained sedimentary rocks	2.494	8,375	0.0298
11.10.13	*Eucalyptus* spp. and/or *Corymbia* spp. open forest on scarps and sandstone tablelands	104.813	391,782	0.0268
11.10.13a	*Eucalyptus cloeziana* ± *E. melanoleuca* ± *Corymbia bunites* ± *E. sphaerocarpa* woodland to open-forest.	3.322	391,782	0.00085
n/a	Cleared areas (e.g. improved pastures, cropping land or non-remnant regrowth vegetation)	4116.4	n/a	n/a
TOTAL		4849.02		

[1] Indicates extent of the vegetation community within the Brigalow Belt bioregion as per Accad *et. al.* (2008).

[2] Indicates % of vegetation community within the Brigalow Belt bioregion as per Accad *et. al.* (2008).

[3] RE 11.5.9 was not recorded during the GLNG EIS study.

Table 2-3 Regional Ecosystems recorded within a 200 m survey corridor of the GLNG GTP (September 2009) Eastern Section

RE	Community Description	Area within 200 m survey corridor (~ha)	Area within Bioregion (~ha)[1]	% of bioregional extent[2]
11.3.3	*Eucalyptus coolabah* woodland on alluvial plains	3.843	282,541	0.0014
11.3.4	*Eucalyptus tereticornis* and/or *Eucalyptus* spp.	9.523	186,652	0.0051
11.3.25	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	51.678	515,948	0.0100
11.3.26	*Eucalyptus moluccana* or *E. microcarpa* woodland to open forest on margins of alluvial plains	25.712	45,235	0.0568
11.4.8	*Eucalyptus cambageana* woodland to open forest with *Acacia harpophylla* or *A. argyrodendron* on Cainozoic clay plains	0.172	71,909	0.00024
11.4.9a	*Acacia harpophylla, Lysiphyllum carronii* ± *Casuarina cristata* open-forest to woodland.	0.074	96,425	0.000076
11.9.9	*Eucalyptus crebra* woodland on fine-grained sedimentary rocks	0.884	121,526	0.0073
11.10.1	*Corymbia citriodora* open forest on coarse-grained sedimentary rocks	37.245	881,416	0.0042
11.10.4	*Eucalyptus decorticans, Lysicarpus angustifolius* ± *Eucalyptus* spp., *Corymbia* spp., *Acacia* spp. woodland on coarse-grained sedimentary rocks, crests and scarps.	1.519	474,820	0.0003
11.10.8	Semi-evergreen vine thicket in sheltered habitats on medium to coarse-grained sedimentary rocks	1.321	8,375	0.0158
11.10.13	*Eucalyptus* spp. and/or *Corymbia* spp. open forest on scarps and sandstone tablelands	28.861	391,782	0.0074
11.11.3	*Corymbia citriodora, Eucalyptus crebra, E. acmenoides* open forest on old sedimentary rocks with varying degrees of metamorphism and folding.	17.065	97,063	0.0176
11.11.15	*Eucalyptus crebra* woodland on deformed and metamorphosed sediments and interbedded volcanics. Undulating plains.	168.895	531,316	0.0318
11.12.1	*Eucalyptus crebra* woodland on igneous rocks	83.011	850,431	0.0098
11.12.3[3]	*Eucalyptus crebra, E. tereticornis*, *Angophora leiocarpa* woodland on igneous rocks especially granite	8.804	54,088	0.0162

RE	Community Description	Area within 200 m survey corridor (~ha)	Area within Bioregion (~ha)[1]	% of bioregional extent[2]
11.12.6	*Corymbia citriodora* open forest on igneous rocks (granite)	11.526	156,251	0.0074
n/a	Cleared areas (e.g. improved pastures, cropping land or non-remnant regrowth vegetation)	2379.3	n/a	n/a
TOTAL		**2829.433**	n/a	n/a

[1] Indicates extent of the vegetation community within the Brigalow Belt bioregion as per Accad *et. al.* (2008).

[2] Indicates % of vegetation community within the Brigalow Belt bioregion as per Accad *et. al.* (2008).

[3] RE 11.12.3 was not recorded during the EIS study.

Table 2-4 Regional Ecosystems recorded within a 200 m survey corridor of the CRAR

RE	Community Description	Area within 200 m survey corridor (~ha)	Area within Bioregion (~ha)[1]	% of bioregional extent[2]
11.3.25	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	27.35	515,948	0.0053
11.11.15	*Eucalyptus crebra* woodland on deformed and metamorphosed sediments and interbedded volcanics. Undulating plains.	104.68	531,316	0.0197
n/a	Cleared areas (e.g. improved pastures, cropping land or non-remnant regrowth vegetation)	259.3	n/a	n/a
TOTAL		**391.33**	n/a	n/a

[1] Indicates extent of the vegetation community within the Brigalow Belt bioregion as per Accad *et. al.* (2008).

[2] Indicates % of vegetation community within the Brigalow Belt bioregion as per Accad *et. al.* (2008).

Table 2-5 Regional Ecosystems recorded within the CPIC (CICSDA Section) Route

RE	Community Description	Area within the CPIC-CICSDA[1] (~ha)	Area within Bioregion (~ha)[2]	% of bioregional extent[3]
11.3.4	*Eucalyptus tereticornis* and/or *Eucalyptus* spp.	6.43	186,652	0.0034
11.3.25	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	23.97	515,948	0.0046
11.3.26	*Eucalyptus moluccana* or *E. microcarpa* woodland to open forest on margins of alluvial plains	8.938	45,235	0.0198
11.12.1	*Eucalyptus crebra* woodland on igneous rocks	50.17	850,431	0.0059
11.12.3[4]	*Eucalyptus crebra, E. tereticornis*, *Angophora leiocarpa* woodland on igneous rocks especially granite	4.953	54,088	0.0092

RE	Community Description	Area within the CPIC-CICSDA[1] (~ha)	Area within Bioregion (~ha)[2]	% of bioregional extent[3]
11.12.6	*Corymbia citriodora* open forest on igneous rocks (granite)	3.849	156,251	0.0025
n/a	Cleared areas (e.g. improved pastures, cropping land or non-remnant regrowth vegetation)	1,316.6	n/a	n/a
TOTAL		**1,414.91**	n/a	n/a

[1] As the CPIC (CICSDA Section) Route is in corridor format, a centreline was not available and areas were calculated for the full width of the corridor.
[2] Indicates extent of the vegetation community within the Brigalow Belt bioregion as per Accad *et. al.* (2008).
[3] Indicates % of vegetation community within the Brigalow Belt bioregion as per Accad *et. al.* (2008).
[4] RE 11.12.3 was not recorded during the EIS study.

2.2.3 Conservation Significant Regional Ecosystems

13 REs of conservation significance were recorded along the GTP alignment for this supplementary study, as detailed below in Table 2-6. It should be noted that these have been recorded from a 200 m wide survey corridor and may not correlate to the conservation significant REs located within the 40/30 m ROW (EIS Section 3.1.3) that is considerably narrower.

Table 2-6 Significant Vegetation Communities recorded within a 200 m survey corridor along all GTP options west of the GSDA

RE	Community Description	VM Status	Biodiversity Status	EPBC Act Status
11.3.2	*Eucalyptus populnea* woodland on alluvial plains	Of Concern	Of Concern	-
11.3.3	*Eucalyptus coolabah* woodland on alluvial plains	Of Concern	Of Concern	-
11.3.4	*Eucalyptus tereticornis* and/or Eucalyptus spp.	Of Concern	Of Concern	-
11.3.17	*Eucalyptus populnea* woodland with *Acacia harpophylla* and/or *Casuarina cristata* on alluvial plains	Of Concern	Endangered	-
11.3.25	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	Not of Concern	Of Concern	-
11.4.8	*Eucalyptus cambageana* woodland to open forest with *Acacia harpophylla* or *A. argyrodendron* on Cainozoic clay plains	Endangered	Endangered	Endangered
11.4.9a	*Acacia harpophylla, Lysiphyllum carronii* ± *Casuarina cristata* open-forest to woodland.	Endangered	Endangered	Endangered
11.4.9	*Acacia harpophylla* shrubby open forest to woodland with Terminalia oblongata on Cainozoic clay plains	Endangered	Endangered	Endangered

RE	Community Description	VM Status	Biodiversity Status	EPBC Act Status
11.5.9	*Eucalyptus crebra* and other *Eucalyptus* spp. and *Corymbia* spp. woodland on Cainozoic sand plains/remnant surfaces. Plateaus and broad crests	Endangered	Endangered	-
11.8.11	*Dichanthium sericeum* grassland on Cainozoic igneous rocks	Of Concern	Of Concern	Endangered
11.9.4	Semi-evergreen vine thicket on fine grained sedimentary rocks	Endangered	Endangered	Endangered
11.9.5	*Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks	Endangered	Endangered	Endangered
11.10.8	Semi-evergreen vine thicket in sheltered habitats on medium to coarse-grained sedimentary rocks	Of Concern	Of Concern	-
11.12.3	*Eucalyptus crebra, E. tereticornis*, *Angophora leiocarpa* woodland on igneous rocks especially granite	Not of Concern	Of Concern	-

2.2.4 Additional Regional Ecosystems Not Previously Recorded

Two REs were encountered in this supplementary survey that were not recorded during the previous EIS field studies; RE 11.5.9 and RE 11.12.3.

RE 11.5.9

RE 11.5.9 (*Eucalyptus crebra* and other *Eucalyptus* spp. and *Corymbia* spp. woodland on Cainozoic sand plains/remnant surfaces. Plateaus and broad crests) was encountered within the GLNG GTP (September 2009) SW Section of the alignment. It is listed as 'Endangered' (VM and biodiversity status) under the NC Act but is not listed under the EPBC Act.

RE 11.12.3

RE 11.12.3 (*Eucalyptus crebra*, *E. tereticornis*, *Angophora leiocarpa* woodland on igneous rocks especially granite) was recorded from the CPIC (CICSDA Section) Route. It is listed as 'Of Concern' (biodiversity status) under the VM Act but is not listed under the EPBC Act.

2.2.5 Additional Weeds of Concern

The GLNG EIS noted 40 exotic weed species were recorded during the survey of the GTP (EIS Appendix N2 (Flora),Section 3.2.3), of which 10 are declared species under the Queensland *Land Protection (Pest and Stock Route Management) Act, 2002* (EIS Appendix N2, Table 3-2). Three of these species (rubber vine, lantana and parthenium) are also listed as Weeds of National Significance (WONS).

The EIS supplementary field studies determined the presence of an additional five weed species: *Leucaena leucocephala** (Leucaena), *Themeda quadrivalvis** (grader grass), *Solanum torvum** (devil's fig) *Cascabela thevetia** (yellow oleander) and *Macroptilium atropurpureum** (siratro). None of these species are declared or listed as WONS (Thorp and Lynch, 2000).

A number of declared/WONS species, already described in the GLNG EIS, were recorded at the supplementary study sites. These are shown in Table 2-7, below. *Cascabela thevetia* (yellow

oleander) is described following Table 2-7. Locations for weeds encountered during the field survey are shown on Figure 3 to Figure 21.

Table 2-7 Declared weeds present along the survey corridors of the GTP

Species	Common Name	Status[1]	Site
*Cascabela thevetia**	yellow oleander	Class 3	Q5
*Celtis sinensis**	Chinese elm	Class 3	Q3
*Cryptostegia grandiflora**	rubber vine	Class 2/WONS	Q3, Q4, Q5
*Lantana camara**	lantana	Class 3/WONS	S1, S2, Q2, Q6, Q8, Q11, Q13
*Lantana montevidensis**	creeping lantana	Class 3	Q9, Q10, Q11
*Macfadenya unguis-cati**	cat's-law creeper	Class 3	Q11, Q13
*Opuntia stricta**	prickly pear	Class 2	Q9
*Opuntia tomentosa**	velvety tree pear	Class 2	S1, S2, S3, S6, Q8, Q20
*Parthenium hysterophorus**	parthenium	Class 2/WONS	Q15

[1] Status under the Queensland *Land Protection (Pest and Stock Route Management) Act, 2002* and Weeds of National Significance.

Yellow Oleander

A single specimen of *Cascabela thevetia** (yellow oleander) was found at one site within RE 11.3.25 along the Calliope River at Duckholes Road. It is a popular ornamental plant that has escaped cultivation. All parts of the plant are toxic to humans and stock. All other WONS listed species outlined above are described in further detail in the EIS Section 7.4.4.2.

2.2.6 Potentially Occurring Species of Conservation Significance

The 'Endangered' (NC Act and EPBC Act) cycad *Cycas megacarpa* was again encountered within the Calliope and Callide Ranges along the proposed GLNG GTP (September 2009) Eastern section and CPIC (CICSDA Section) Route of the GTP alignment (Figures 14, 15 and 16). Numerous specimens were observed in these locations. It forms a patchy distribution throughout REs 11.11.15 and 11.12.1. It is estimated that densities of this species are similar to those observed for the EIS GTP (March 2009), resulting in no net change in environmental value as a result of route changes. The assessment of the CRAR did not determine the presence of *Cycas megacarpa* along this alignment. Given that the alignment is generally restricted to the alluvial floodplain of Bell's Creek, it is unlikely that there will be impacts to *Cycas megacarpa* by this option.

Isolated specimens of the Vulnerable (NC Act and EPBC Act) *Cadellia pentastylis* (online) were noted at numerous locations in the Arcadia Valley. This species will not be impacted by the proposed pipeline because all specimens observed are quite remote from the GLNG GTP (September 2009) SW Section of the alignment and are a significant distance from any potential disturbance. No other conservation significant species were recorded during the supplementary surveys.

2.2.7 Terrestrial Fauna

A detailed description of fauna and habitat values for the GTP (EIS GTP (March 2009)) alignment are presented in EIS Appendix N2. The alignment options investigated for this study did not present any significant variation of habitat or additional values and potential impacts as assessed in the EIS. However, further recommendations for mitigation of potential impacts to fauna habitat and minimisation of potential harm to fauna species are detailed below in EIS Section 3.2.

Potential Impacts and Mitigation Measures

3.1 Potential Impacts

3.1.1 Proposed Development

Subsequent to the GLNG EIS, a number of alignment options, varying from that originally studied, were considered based on topographical, social and ecological grounds. For all route alignments the GTP development will involve:

- Survey of the pipeline route;
- Provision of access tracks and temporary facilities;
- Clear and grade of the right-of-way (ROW) including vegetation removal;
- Trenching;
- Pipe stringing and bending;
- Pipe welding and Non destructive examination (NDE);
- Pipe placement in the trench (lowering in and laying);
- Backfilling;
- Hydro-testing; and
- Restoration.

A standard ROW width of 40 m has been specified. However, to reduce impacts to ecological communities, the ROW will be reduced to 30 m wide where the alignment traverses 'Endangered' and 'Of Concern' REs as well as riparian corridors.

Aspects of the proposed development considered to have the potential to impact upon fauna and flora include creation of access tracks, clearing of the ROW and trenching. These are detailed throughout this chapter.

3.1.2 Vegetation Disturbance

The construction of the pipeline will involve the clearing of remnant and non-remnant vegetation. For each alignment, areas of vegetation proposed to be cleared have been calculated for a 40 m wide ROW or, where the ROW intersects 'Endangered' or 'Of Concern' REs, 30 m wide. The areas of vegetation clearing are displayed in Tables 3-1 to 3-4. The tables also show the disturbance to each community as a percentage of the RE within the bioregion. The four sections are:

- GLNG GTP (September 2009) SW Section (Table 3-1);
- GLNG GTP (September 2009) Eastern Section (Table 3-2);
- CRAR (Table 3-3); and
- CPIC (CICSDA Section) Route (Table 3-4).

As a single alignment has not yet been decided, it is not possible to provide a single figure for clearing along the GTP. Table 3-5 compares areas of clearing between the various alignment combinations.

Table 3-1 Potential vegetation clearing for the GLNG GTP (September 2009) SW Section

RE	Community Description	VM Status	Biodiversity Status	EPBC Act Status	Disturbance (~ha) [1]	% of Bioregion Extent [2]
11.3.2	*Eucalyptus populnea* woodland on alluvial plains	Of Concern	Of Concern	-	4.45	0.0008
11.3.3	*Eucalyptus coolabah* woodland on alluvial plains	Of Concern	Of Concern	-	2.05	0.0007
11.3.4	*Eucalyptus tereticornis* and/or Eucalyptus spp.	Of Concern	Of Concern	-	0.92	0.0005
11.3.17	*Eucalyptus populnea* woodland with *Acacia harpophylla* and/or *Casuarina cristata* on alluvial plains	Of Concern	Endangered	-	4.17	0.01
11.3.25	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	Not of Concern	Of Concern	-	5.81	0.001
11.4.9	*Acacia harpophylla* shrubby open forest to woodland with Terminalia oblongata on Cainozoic clay plains	Endangered	Endangered	Endangered	1.23	0.001
11.5.2	*Eucalyptus crebra*, *Corymbia* spp., with *E. moluccana* on lower slopes of Cainozoic sand plains/remnant surfaces	Not of Concern	No concern at present	-	9.90	0.005
11.5.9	*Eucalyptus crebra* and other *Eucalyptus* spp. and *Corymbia* spp. woodland on Cainozoic sand plains/remnant surfaces. Plateaus and broad crests	Not of Concern	No concern at present	-	2.18	0.0009
11.8.4	*Eucalyptus melanophloia* woodland on Cainozoic igneous rocks. Occurs on hillsides.	Not of Concern	No concern at present	-	0.81	0.0005
11.8.5	*Eucalyptus orgadophila* open woodland on Cainozoic igneous rocks	Not of Concern	No concern at present	-	5.37	0.002
11.9.4b	Semi-evergreen vine thicket on fine grained sedimentary rocks	Endangered	Endangered	Endangered	2.13	0.006

RE	Community Description	VM Status	Biodiversity Status	EPBC Act Status	Disturbance (~ha) [1]	% of Bioregion Extent [2]
11.9.5	*Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks	Endangered	Endangered	Endangered	3.20	0.002
11.10.1	*Corymbia citriodora* open forest on coarse-grained sedimentary rocks	Not of Concern	No concern at present	-	27.04	0.003
11.10.3	*Acacia catenulata* or *A. shirleyi* open forest on coarse-grained sedimentary rocks	Not of Concern	No concern at present	-	10.76	0.003
11.10.4	*Eucalyptus decorticans, Lysicarpus angustifolius* ± *Eucalyptus* spp., *Corymbia* spp., *Acacia* spp. woodland on coarse-grained sedimentary rocks, crests and scarps	Not of Concern	No concern at present	-	5.97	0.001
11.10.7	*Eucalyptus crebra* woodland on coarse-grained sedimentary rocks	Not of Concern	No concern at present	-	25.75	0.009
11.10.8	Semi-evergreen vine thicket in sheltered habitats on medium to coarse-grained sedimentary rocks	Of Concern	Of Concern	-	0.31	0.004
11.10.13	*Eucalyptus* spp. and/or *Corymbia* spp. open forest on scarps and sandstone tablelands	Not of Concern	No concern at present	-	20.36	0.005
11.10.13 a	*Eucalyptus cloeziana* ± *E. melanoleuca* ± *Corymbia bunites* ± *E. sphaerocarpa* woodland to open-forest.	Not of Concern	No concern at present	-	0.81	0.0002
n/a	Cleared areas (e.g. improved pastures, cropping land or non-remnant regrowth vegetation).	n/a	n/a	n/a	830.59	n/a
TOTAL					963.81	-

[1] Approximate area cleared based upon a standard 40 m ROW or, where the alignment traverses 'Endangered' or 'Of Concern' REs, 30 m.

[2] Indicates disturbed % of vegetation community within the Brigalow Belt bioregion as per Accad *et. al.* (2008)

As outlined in Table 3-1 above, Non-remnant areas including improved pastures, cropping land and regrowth vegetation are to be subjected to the majority of proposed disturbance (~830.59 ha). This

represents approximately 86 % of the total area of disturbance within the ROW for the GLNG GTP (September 2009) South-West Section alignment.

Of the remnant vegetation to be cleared, the vegetation community of *Corymbia citriodora* open forest on coarse-grained sedimentary rocks (RE 11.10.1) is to be subjected to the majority of proposed disturbance (~27.04 ha). This disturbance represents 0.003 % of this community within the bioregion. This vegetation community has no current conservation significance under state or commonwealth legislation.

Vegetation communities representing the second and third greatest area of clearance are *Eucalyptus crebra* woodland on coarse-grained sedimentary rocks (RE 11.10.7) and *Eucalyptus* spp. and/or *Corymbia* spp. open forest on scarps and sandstone tablelands (RE 11.10.13). It is estimated that ~25.75 ha and ~20.36 ha of these REs is proposed to be cleared respectively. This disturbance represents 0.009 % and 0.005 % of these REs within the bioregion respectively. These communities have no current conservation significance under state or commonwealth legislation.

The vegetation community of *Eucalyptus populnea woodland with Acacia harpophylla and/or Casuarina cristata on alluvial plains* (RE 11.3.17) is subject to the greatest disturbance when viewed as a percentage of the bioregional extent (0.01%). Approximately 4.17 ha of this RE is proposed to be cleared. This vegetation community is listed as 'Of Concern (VM status) and 'Endangered (biodiversity status) under the VM Act. It is not listed under commonwealth legislation.

GLNG GTP (September 2009) Eastern Section

Table 3-2 Potential vegetation clearing for the GLNG GTP (September 2009) Eastern Section

RE	Community Description	VM Status	Biodiversity Status	EPBC Act Status	Disturbance (~ha)[1]	% of Bioregion Extent [2]
11.3.3	*Eucalyptus coolabah* woodland on alluvial plains	Of Concern	Of Concern	-	0.75	0.0004
11.3.4	*Eucalyptus tereticornis* and/or Eucalyptus spp.	Of Concern	Of Concern	-	1.07	0.0000005
11.3.25	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	Not of Concern	Of Concern	-	8.18	0.003
11.3.26	*Eucalyptus moluccana* or *E. microcarpa* woodland to open forest on margins of alluvial plains	Not of Concern	No concern at present	-	5.97	0.03
11.9.9	*Eucalyptus crebra* woodland on fine-grained sedimentary rocks	Not of Concern	No concern at present	-	0.5	0.0007
11.10.1	*Corymbia citriodora* open forest on coarse-grained sedimentary rocks	Not of Concern	No concern at present	-	8.28	0.001
11.10.4	*Eucalyptus decorticans, Lysicarpus angustifolius* ± *Eucalyptus* spp., *Corymbia* spp., *Acacia* spp. woodland on coarse-grained sedimentary rocks, crests and scarps	Not of Concern	No concern at present	-	0.31	0.0001

RE	Community Description	VM Status	Biodiversity Status	EPBC Act Status	Disturbance (~ha)[1]	% of Bioregion Extent [2]
11.10.13	*Eucalyptus* spp. and/or *Corymbia* spp. open forest on scarps and sandstone tablelands	Not of Concern	No concern at present	-	5.83	0.003
11.11.3	*Corymbia citriodora, Eucalyptus crebra, E. acmenoides* open forest on old sedimentary rocks with varying degrees of metamorphism and folding.	Not of Concern	No concern at present	-	3.42	0.007
11.11.15	*Eucalyptus crebra* woodland on deformed and metamorphosed sediments and interbedded volcanics. Undulating plains.	Not of Concern	No concern at present	-	34.05	0.001
11.12.1	*Eucalyptus crebra* woodland on igneous rocks	Not of Concern	No concern at present	-	16.50	0.002
11.12.3	*Eucalyptus crebra, E. tereticornis, Angophora leiocarpa* woodland on igneous rocks especially granite	Not of Concern	Of Concern	-	0.92	0.002
11.12.6	*Corymbia citriodora* open forest on igneous rocks (granite)	Not of Concern	No concern at present	-	1.90	0.002
n/a	Cleared areas (e.g. improved pastures, cropping land or non-remnant regrowth vegetation).	n/a	n/a	n/a	476.75	n/a
TOTAL					564.43	-

[1] Approximate area cleared based upon a standard 40 m ROW or, where the alignment traverses 'Endangered' or 'Of Concern' REs, 30 m.
[2] Indicates disturbed % of vegetation community within the Brigalow Belt bioregion as per Accad *et. al.* (2008)

Table 3-2 (above) details the areas of each vegetation community proposed for clearing. Within the GLNG GTP (September 2009) Eastern Section alignment, non-remnant areas such as improved pastures, cropping land and regrowth vegetation are to be subjected to the majority of proposed disturbance (~476.75 ha). This represents 84 % of the total area of disturbance. Of the remnant vegetation to be cleared, the vegetation community of *Eucalyptus crebra* woodland on deformed and metamorphosed sediments and interbedded volcanics. Undulating plains (RE 11.11.15) is to be subjected to the majority of proposed disturbance (~34.05 ha). This disturbance represents 0.001 % of this community within the bioregion. This community has no current conservation significance under state or commonwealth legislation.

Vegetation communities representing the second and third greatest area of clearance are *Corymbia citriodora* open forest on coarse-grained sedimentary rocks (RE 11.10.1) and *Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines (RE 11.3.25). It is estimated that approximately

8.28 ha and 8.18 ha of these REs is proposed to be cleared respectively. This disturbance represents 0.001 % and 0.003 % of these REs within the bioregion respectively. These communities have no current conservation significance under state or commonwealth legislation.

The vegetation community of *Eucalyptus moluccana* or *E. microcarpa* woodland to open forest on margins of alluvial plains (RE 11.3.26) is subject to the greatest disturbance when viewed as a percentage of the bioregional extent (0.03 %). Approximately 5.97 ha of this RE is proposed to be cleared. This vegetation community has no current conservation significance under state or commonwealth legislation.

Callide Range Alternative Route

Table 3-3 Potential vegetation clearing for the CRAR

RE	Community Description	VM Status	Biodiversity Status	EPBC Act Status	~ha Cleared[1]	% of Bioregion Extent [2]
11.3.25	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	Not of Concern	Of Concern	-	3.58	0.002
11.11.15	*Eucalyptus crebra* woodland on deformed and metamorphosed sediments and interbedded volcanics. Undulating plains.	Not of Concern	No concern at present	-	19.81	0.008
n/a	Cleared areas (e.g. improved pastures, cropping land or non-remnant regrowth vegetation).	n/a	n/a	n/a	54.68	n/a
TOTAL					78.07	

[1] Approximate area cleared based upon a standard 40 m ROW or, where the alignment traverses 'Endangered' or 'Of Concern' REs, 30 m.
[2] Indicates disturbed % of vegetation community within the Brigalow Belt bioregion as per Accad *et. al.* (2008)

As displayed in Table 3-3 above, non-remnant areas such as improved pastures, cropping land and regrowth vegetation are to be subjected to the majority of proposed disturbance (approximately 54.68 ha or 70 % of the entire CRAR). Only two REs are impacted which account for approximately 23.39 ha, or 30 % of the total area, RE 11.3.25 is listed as 'Of Concern' (biodiversity status). RE 11.11.15 has no current conservation significance under state or commonwealth legislation.

CPIC (CICSDA Section) Route

The CPIC (CICSDA Section) Route has been assessed for potential disturbance to vegetation communities and was provided in corridor format. The entire CPIC has not been assessed here as the GSDA and Curtis Island portions of the CPIC have been investigated in separate reports (Part 3 and Part 4 respectively). In addition, where the CPIC overlaps with the EIS GTP (March 2009) Route, an assessment has not been undertaken. For the purposes of impact assessment, an arbitrary centreline alignment has been used to calculate an estimate for vegetation clearing along the corridor and is presented in Table 3-4 below. The ROW is calculated as 40 m wide or is reduced to 30 m width where it traverses 'Endangered' or 'Of Concern' REs.

Table 3-4 Potential vegetation clearing for the CPIC (CICSDA Section) Route

RE	Community Description	VM Status	Biodiversity Status	EPBC Act Status	~ha Cleared [1]	% of Bioregion Extent [2]
11.3.4	*Eucalyptus tereticornis* and/or Eucalyptus spp.	Of Concern	Of Concern	-	0.00019	0.000005
11.3.25	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	Not of Concern	Of Concern	-	1.98	0.0008
11.3.26	*Eucalyptus moluccana* or *E. microcarpa* woodland to open forest on margins of alluvial plains	Not of Concern	No concern at present	-	0.49	0.002
11.12.1	*Eucalyptus crebra* woodland on igneous rocks	Not of Concern	No concern at present	-	9.76	0.002
11.12.3	*Eucalyptus crebra, E. tereticornis*, *Angophora leiocarpa* woodland on igneous rocks especially granite	Not of Concern	Of Concern	-	1.21	0.004
11.12.6	*Corymbia citriodora* open forest on igneous rocks (granite)	Not of Concern	No concern at present	-	0.72	0.0009
n/a	Cleared areas (e.g. improved pastures, cropping land or non-remnant regrowth vegetation).	n/a	n/a	n/a	165.32	n/a
TOTAL					179.48	-

[1] Approximate area cleared based upon a standard 40 m ROW or, where the alignment traverses 'Endangered' or 'Of Concern' REs, 30 m.
[2] Indicates disturbed % of vegetation community within the Brigalow Belt bioregion as per Accad *et. al.* (2008)

As indicated above in Table 3-4, non-remnant areas including improved pastures, cropping land and regrowth vegetation are to be subjected to the majority of proposed disturbance (~165.32 ha). This represents 92 % of the total area of disturbance.

Of the remnant vegetation to be cleared, the vegetation community of *Eucalyptus crebra* woodland on igneous rocks (RE 11.12.1) is to be subjected to the majority of proposed disturbance (~9.76 ha). This disturbance represents 0.002 % of this community within the bioregion. This vegetation community has no current conservation significance under state or commonwealth legislation.

Vegetation communities representing the second and third greatest area of clearance are *Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines (RE 11.3.25) and *Eucalyptus crebra, E. tereticornis*, *Angophora leiocarpa* woodland on igneous rocks especially granite (RE 11.12.3). It is estimated that approximately 1.98 ha and 1.21 ha of these REs is proposed to be cleared respectively. This disturbance represents 0.0008 % and 0.004 % of these REs within the bioregion respectively. Both RE 11.3.25 and RE 11.12.3 are listed as 'Of Concern' (biodiversity status) and have no current conservation significance commonwealth legislation.

The vegetation communities of *Eucalyptus moluccana* or *E. microcarpa* woodland to open forest on margins of alluvial plains (RE 11.3.26) and *Eucalyptus crebra* woodland on igneous rocks (RE 11.12.1) are equally subject to the greatest disturbance when viewed as a percentage of the

bioregional extent (0.002 %). Approximately 0.49 ha and 9.76 ha of these REs are proposed to be cleared respectively. Regional Ecosystem 11.3.26 has no current conservation significance under state or commonwealth legislation.

Alignment Combinations

There are three potential combinations of the designated alignments. As a final single alignment has not yet been decided, Table 3-5 below has been provided to indicate potential vegetation clearing areas for the different alignment combinations.

Table 3-5 Comparison of clearing areas between the various alignment combinations

Number	Combination	Length (~km)	Remnant Vegetation to be cleared (~ha) (40/30m ROW)	Non-remnant Vegetation to be cleared (~ha) (40/30m ROW)	Total vegetation to be cleared (~ha) (40/30m ROW)
1	GLNG GTP (September 2009) SW Section and GLNG GTP (September 2009) Eastern Section	383.9	220.9	1,307.34	1,528.24
2	GLNG GTP (September 2009) SW and GLNG GTP (September 2009) Eastern Sections with CRAR substitute; CPIC (CICSDA Section) Route replaces north-eastern part of GLNG GTP (September 2009)Eastern Section	381.9	197.57	1,321.15	1,518.72
3	GLNG GTP (September 2009) SW and GLNG GTP (September 2009) Eastern Sections with no CRAR substitute, CPIC (CICSDA Section) Route replaces north-eastern part of GLNG GTP (September 2009) Eastern Section	382.2	220.18	1,298.37	1,518.56

All combinations are of a similar length. Alignment combination two results in the least remnant vegetation potentially cleared (~197.57 ha). Alignment option three results in the least vegetation cleared in total (~1518.56 ha). The CRAR is less vegetated than the portion of the GLNG GTP (September 2009) Eastern Section to the south it replaces and thus will result in less clearing of remnant vegetation. The CRAR is the preferred alignment.

3.1.3 Conservation Significant Regional Ecosystems within the ROW

Table 3-6, below details areas of conservation significant REs to be potentially cleared within the ROW (30 m wide in these locations). Ten conservation significant REs were recorded.

Table 3-6 Significant Regional Ecosystems within the 30 m ROW

RE	Community Description	VM Status	Biodiversity Status	EPBC Act Status	Area Impacted (~ha)	Alignment in which RE is present
11.3.2	*Eucalyptus populnea* woodland on alluvial plains	Of Concern	Of Concern	-	4.45	GLNG GTP (September 2009) SW Section
11.3.3	*Eucalyptus coolabah* woodland on alluvial plains	Of Concern	Of Concern	-	2.80	GLNG GTP (September 2009) Eastern Section GLNG GTP (September 2009) SW Section
11.3.4	*Eucalyptus tereticornis* and/or Eucalyptus spp.	Of Concern	Of Concern	-	1.99	GLNG GTP (September 2009) Eastern Section GLNG GTP (September 2009) SW Section CPIC (CICSDA Section) Route
11.3.17	*Eucalyptus populnea* woodland with *Acacia harpophylla* and/or *Casuarina cristata* on alluvial plains	Of Concern	Endangered	-	4.17	GLNG GTP (September 2009) SW Section
11.3.25	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	Not of Concern	Of Concern	-	15.97	GLNG GTP (September 2009) Eastern Section GLNG GTP (September 2009) SW Section CRAR
11.4.9	*Acacia harpophylla* shrubby open forest to woodland with *Terminalia oblongata* on Cainozoic clay plains	Endangered	Endangered	Endangered	1.23	GLNG GTP (September 2009) SW Section
11.9.4b	Semi-evergreen vine thicket on fine grained sedimentary rocks	Endangered	Endangered	Endangered	2.13	GLNG GTP (September 2009) SW Section

RE	Community Description	VM Status	Biodiversity Status	EPBC Act Status	Area Impacted (~ha)	Alignment in which RE is present
11.9.5	*Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks	Endangered	Endangered	Endangered	3.20	GLNG GTP (September 2009) SW Section
11.10.8	Semi-evergreen vine thicket in sheltered habitats on medium to coarse-grained sedimentary rocks	Of Concern	Of Concern	-	0.31	GLNG GTP (September 2009) SW Section
11.12.3	*Eucalyptus crebra, E. tereticornis*, *Angophora leiocarpa* woodland on igneous rocks especially granite	Not of Concern	Of Concern	-	2.13	CPIC (CICSDA Section) Route

The conservation significant RE subject to the greatest area of clearing is *Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines (RE 11.3.25) with approximately 15.97 ha. Riparian woodlands comprised of this RE are often the most discernible vegetation community within highly altered landscapes such as is found for the majority of the alignments. These communities, because of the linear nature, also act as significant fauna corridors. In a bioregional context, only 0.003 % of this community will be affected across the length of all alignments.

The second greatest area of clearance of a significant RE will be *Eucalyptus populnea* woodland on alluvial plains (RE 11.3.2). This community is listed as 'Of Concern under the VM Act (VM and biodiversity status). Approximately 4.45 ha of this community will potentially be cleared. This disturbance represents 0.0008 % of this community found within the bioregion.

REs 11.4.9 and 11.9.5, and 11.9.4b are analogous to the 'Endangered' EPBC communities of Brigalow (*Acacia harpophylla* dominant and co-dominant) and Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions respectively. Approximate areas proposed for clearing of these communities are 1.23 ha, 3.20 ha and 2.13 ha respectively. When comparing the clearing areas of the ten conservation significant communities listed above, these rank comparatively low with the 9th, 4th and 6th greatest areas of clearing respectively.

3.1.4 Ecological Integrity of Impacted Communities

The supplementary studies confirmed the appraisal regarding the ecological integrity of impacted communities. The GLNG EIS noted that most vegetation communities have been impacted by grazing, thinning and exotic weed invasion. Further studies have highlighted the impact of fire. Again, the steep terrain of the range crossings afforded the highest levels of ecological integrity. However, weeds such as *Opuntia tomentosa*,* and in places, *Lantana montevidensis** have invaded some isolated areas thereby reducing ecological functionality.

3.1.5 Impacts to Conservation Significant Species

EIS Appendix N2 details the potential impacts and recommendations for future actions with regard to conservation significant species. *Cycas megacarpa* was confirmed during this supplementary study in the vicinity of previous sightings. *Acacia pedleyi* was not observed during the supplementary studies.

The alignment has not varied markedly in the vicinity of these species, and so approaches to mitigating impacts to both significant species have not altered.

3.2 Impact Mitigation

3.2.1 Pipeline Route Selection

The original alignment (EIS GTP (March 2009)) studied in the GLNG EIS has been refined through further on-ground studies and community consultation. Reports including Route Change Requests (RCRs) have been submitted by field staff to optimise the route so as to minimise impacts to (among others) ecologically sensitive areas.

3.2.2 Further Surveys

A commitment has been added to the GTP Environmental Management Plan (EMP) for a Significant Species Management Plan to be developed prior to the disturbance of any EVR species. The Significant Species Management Plan will include a pre-clearing survey in targeted areas to confirm the specific location of populations of conservation significant species (particularly *Cycas megacarpa* and *Acacia pedleyi*) and the location of 'Endangered' grassland communities (e.g. RE 11.8.11) to enable mitigation measures to be employed to minimise impact on these species (e.g. adjustment of the GTP route within the corridor to minimise impact on particular species). Specific measures for the mitigation of any disturbed EVR flora species including potential options for propagation or translocation will be detailed in the Significant Species Management Plan.

3.2.3 Clearing Scheme

The ROW for the GTP alignments has been defined as 40 m wide except within 'Endangered' and 'Of Concern' REs which is set at 30 m wide. Where possible, this will be reduced further in identified corridors (e.g. riparian corridors). Further prescriptions, consistent with the GLNG EIS, include:

- Pre-clearing surveys will be undertaken in targeted areas such as within known and potential locations for *Cycas megacarpa* and *Acacia pedleyi* and RE 11.8.11;
- Clearing of areas in proximity to 'Endangered' and 'Of Concern' REs areas will be supervised by a qualified ecologist;
- Clearing of all remnant REs and particularly 'Of concern' and 'Endangered' will be avoided for ancillary areas including construction camps vehicle tracks, and lay down areas;
- Any clearing involving the removal of expansive stands of woodland vegetation will be undertaken in stages to retain opportunities for fauna dispersal; and
- Where local land practices permit, large scale burning of cleared vegetation will be avoided and timber should be stacked in piles to provide fauna habitat and assist revegetation.

All vegetation clearance will be undertaken in accordance with Section 12.16.2 (Clearing and Grading) and Section 12.15.8 (Flora and Fauna Management) of the Gas Transmission Pipeline EMP. These include measures such as maintaining soil and surface stability, placing stockpiles away from the beds or banks of watercourses, and the use of containment devices (e.g. silt fences) to preserve stockpiled soils and prevent siltation of any land surface water.

Management of Conservation Significant Species

The species of conservation significance recorded along the alignments will require appropriate management actions. The management priority will be avoidance of impact to these areas where practicable following the actions described below.

The pre-construction surveys (EIS Section 12.16.8) will include surveys for specific locations conservation significant species to enable the mitigation measures for the final location of the GTP within the corridor to be employed. This will target areas of known habitat for *Cycas megacarpa* and *Acacia pedleyi* in addition to areas considered potential habitat for conservation significant species identified as 'likely' or 'possibly' present. These detailed surveys will allow for avoidance of conservation significant species where practicable.

Prior to vegetation clearing, all individuals of *Cycas megacarpa* and *Acacia pedleyi* will be flagged by a qualified botanist to provide an accurate number of individuals to be removed. To offset any net loss of this species, relocation of individual specimens and the planting of seed will be considered as part of the project's restoration program (EIS Section 3.2.5). The National Multi-species Recovery Plan for the cycads *Cycas megacarpa*, *Cycas ophiolitica*, *Macrozamia cranei, Macrozamia lomandroides, Macrozamia pauli-guilielmi* and *Macrozamia platyrhachis* will be used as the primary document guiding recovery actions (Queensland Herbarium, 2007).

Additional management strategies will include:

- Reduce ROW width where possible near areas of conservation significant species;
- Awareness presentation of conservation significant species to pipeline construction crews;
- Increased monitoring of dust, water movement, and weeds around areas supporting conservation significant species; and
- A Significant Species Management Plan (as outlined above in EIS Section 3.2.2).

Management of Impacts to Fauna

Mitigation measures to reduce impacts to fauna were outlined in the GLNG EIS. Additional strategies include:

- If fencing of the ROW or other facilities is to occur outside of grazing country, non-barbed wire will be used to reduce the mortality of gliders and fruit bats. There is evidence to suggest that greater than 95 % of entanglements and subsequent death of native fauna on barbed wire fences occurs on standard height farm fencing (van der Ree, 1999). This is a priority in well-vegetated areas and vegetated creek crossings where gliders will be required to volplane across the ROW;
- Research has shown that most fauna entanglements with barbed wire fences occur on the top strand of barbed wire (van der Ree, 1999). Thus, within grazing country, the top strand of fencing will be replaced by non-barbed wire where possible in consultation with respective landholders; The use of non-barbed wire as a fencing style has proven to be of equal or greater benefit for stock management and plain high-tensile fencing wire can contain most stock (van der Ree, 1999); and
- Where possible, arrangements are to be made with wildlife carers to receive injured or displaced fauna in case this eventuates. Contact details are to be made known at all staging camps and site offices.

Management of Impacts at Waterway Crossings

Where clearing of vegetation is within or in close proximity to riparian communities, adequate erosion and sedimentation mitigation measures will be utilised to ensure waterways are not impacted and

riparian vegetation is not unduly affected as per EIS Section 12.16.10 and EIS Section 12.16.11 of the GTP EMP.

Additional strategies to reduce impacts include:

- Habitat trees (live or dead trees with hollows) will be avoided where possible. Pre-clearing surveys, including diurnal and nocturnal observations, will be undertaken by a qualified ecologist. Their role will be to investigate the usage of habitat trees by arboreal mammals and birds, and identify potential risks to fauna and significant flora species. During clearing of these areas, an accredited fauna spotter/catcher will be present to remove individuals from the danger zone, or rescue any injured animals;
- Potential habitat trees (where hollows are suspected but not evident) will be shaken with the blade of the machine to allow fauna to escape. Such trees will also be lowered to the ground slowly where practicable; and
- An ecologist or qualified spotter/catcher will be employed during these events to ensure fauna is not harmed, or if harmed, can be treated in a proper manner.

3.2.4 Weed Control

Weed control has been specified previously within the EIS and GTP EMP (EIS Section 12.16.9). Appropriate weed management strategies will be implemented for controlling the spread of weeds, including continued weed monitoring as per EIS Section 12.16.9 of the GTP EMP. A separate Weed Management Plan has also been developed and implemented for the GTP. Management Strategies in the Weed Management Plan include, but are not limited to:

- Effective management strategies to control the spread of declared weed species in keeping with Santos Standards (including Santos EHS09 Weeds and Pest Animal Control), regional management practice or Department of Natural Resources and Water (DNR&W) pest control fact sheets;
- Ongoing monitoring of the project site to identify any new incidence of weed infestation;
- Provision of information for project staff on the identification of declared weeds and their dispersal methods;
- Regular targeted spraying of the project area to minimise the risk of vehicles driving over a mature weed plant in seed or flower;
- Wash down protocols for any vehicles or machinery entering and leaving site, and when moving from weed zones to clean zones;
- Implementing vehicle movement protocols to limit the movement of vehicles from a weed zone to a clean zone (e.g. having a clean and dirty construction spread and strategic placement of camps);
- Implementing a sticker identification program to enable easy identification as to whether a vehicle is certified to be in that area;
- Authorised weed inspectors at vehicle washdown bays; and
- Recording of all vehicle movements in washdown registers and vehicle logs.

Additional species such as the Hudson pear (*Cylindropuntia rosea*) (declared Class 1 plant under the *Land Protection (Pest and Stock Route Management) Act 2002*), found at Mundubbera (154 km south-east of Biloela), have the capacity to be translocated by clinging tenaciously to tyres and other vehicle parts. This is an example of a potential weed hazard that may be encountered during the construction of the GTP. Other potential weed species (beyond those noted in this report) such as the Hudson pear will also be included in weed management planning.

3.2.5 Restoration of Disturbed Areas

A restoration strategy developed for the areas to be disturbed is outlined in the GTP Restoration Plan Section 12.16.7 of the GTP EMP. This features approaches such as:

- The rapid re-establishment of ground cover along the GTP ROW following construction to reduce losses of soil from the action of wind and water;
- Restoration methods will be in keeping with current best practice and will employ techniques involving natural regeneration, direct seeding and / or tube stock to ensure a viable success rate of re-established vegetation. In addition, watering may be required periodically to promote growth; and
- Monitoring of the rehabilitated areas will be undertaken to ensure long term viability and allow adaptive management of restoration strategies where necessary.

Further strategies that may be utilised include:

- Selection of species suitable for the climate and endemic to vegetation communities present;
- Graziers may request that the ROW is sown with buffel grass (*Pennisetum ciliare*) for cattle forage. The use of native grass species suitable for grazing will be investigated with the cooperation of the grazier in an attempt to provide superior habitat for native fauna; and
- The tolerance or promotion of shrubby plant species within the ROW will be investigated as an additional means of providing cover for fauna.

3.2.6 Environmental Offsetting

EIS Appendix N2 outlines legislative and corporate requirements for biodiversity offsetting. These are currently valid.

Subsequent to this a biodiversity offsets package is being developed by Santos in conjunction with Ecofund Queensland (a Queensland government advisory service) as a Environmental Offset Strategy to address the objectives of both the current State & Commonwealth legislative biodiversity offsetting requirements. An analysis has been undertaken to identify the offset requirements for proposed impacts for the CSG field, GTP and LNG facility components of the GLNG Project. Analysis requirements being undertaken for offsets include:

- Extent and size of offsets required to be secured for the GTP;
- Ecological values required to be offset;
- Options available for pooling or consolidation offset requirements;
- Options for securing offsets;
- Offset assessment and analysis includes the co-ordination of multiple offset requirements and is being carried out under the following policies;

- Vegetation management offsets under the *Vegetation Management Act, 1999* (Qld);
- Fish habitat offsets under the *Fisheries Act, 1992*;
- Protected plants offsets under the NC Act;
- Biodiversity offsets under the *Draft Policy for Biodiversity Offsets 2008* (Qld); and
- Environmental offsets under the *Environmental Protection & Biodiversity Conservation Act, 1999* (Cwth).

Further steps to be undertaken within a suitable timeframe as part of the process include:

- Identification of suitable offset options;
- Assessment of properties;
- Landholder liaison and negotiation to secure required offsets;
- Offset validation and preparation of specific Biodiversity Offset Management Plan(s); and
- Liaison to finalise contractual arrangements and covenants.

In addition to the objectives outlined above and those previously stated within the EIS (EIS Sections 6.4, 7.4, 8.4 and EIS Appendices N1, N2 and N3). The Environmental Offset Strategy will be implemented over an appropriate time frame to accomplish the following specific aims:

- Identification of suitable potential offset areas with ecological values analogous to impacted ecological communities;
- Assessment of the ecological value and equivalence of offsets to ensure suitable offset extent, species assemblage, floristic structure and ecological integrity utilising an appropriate biometric field methodology;
- Development of appropriate management prescriptions to ensure long term viability of offsets (such as pest control, livestock management, access exclusion, ameliorative plantings and fire regime management);
- Placement of appropriate covenants for future conservation and management of offsets; and
- Development of appropriate monitoring and maintenance activities and performance review processes to ensure long term viability of the offsets.

The process of developing a suitable Environmental Offset Strategy is an iterative process with State and Commonwealth regulatory bodies and the outcome will be coordinated with the other Santos components.

3.2.7 Impacts and Mitigation Previously Documented for the GTP

EIS Appendix N2 comprehensively covers potential impacts from the following sources:

- Dust (EIS Appendix Section 4.1.4);
- Fragmentation (Section 4.1.5);
- Weeds (Section 4.1.7);
- Edge effects (Section 4.1.8);

- Changes to fire regimes (Section 4.1.9);
- Erosion and sedimentation (Section 4.1.10); and
- Restoration of Disturbed Areas (Section 4.2.5).

These impacts and associated mitigation and management measures are relevant to the current alignment options addressed in the study.

3.2.8 Cumulative Impacts

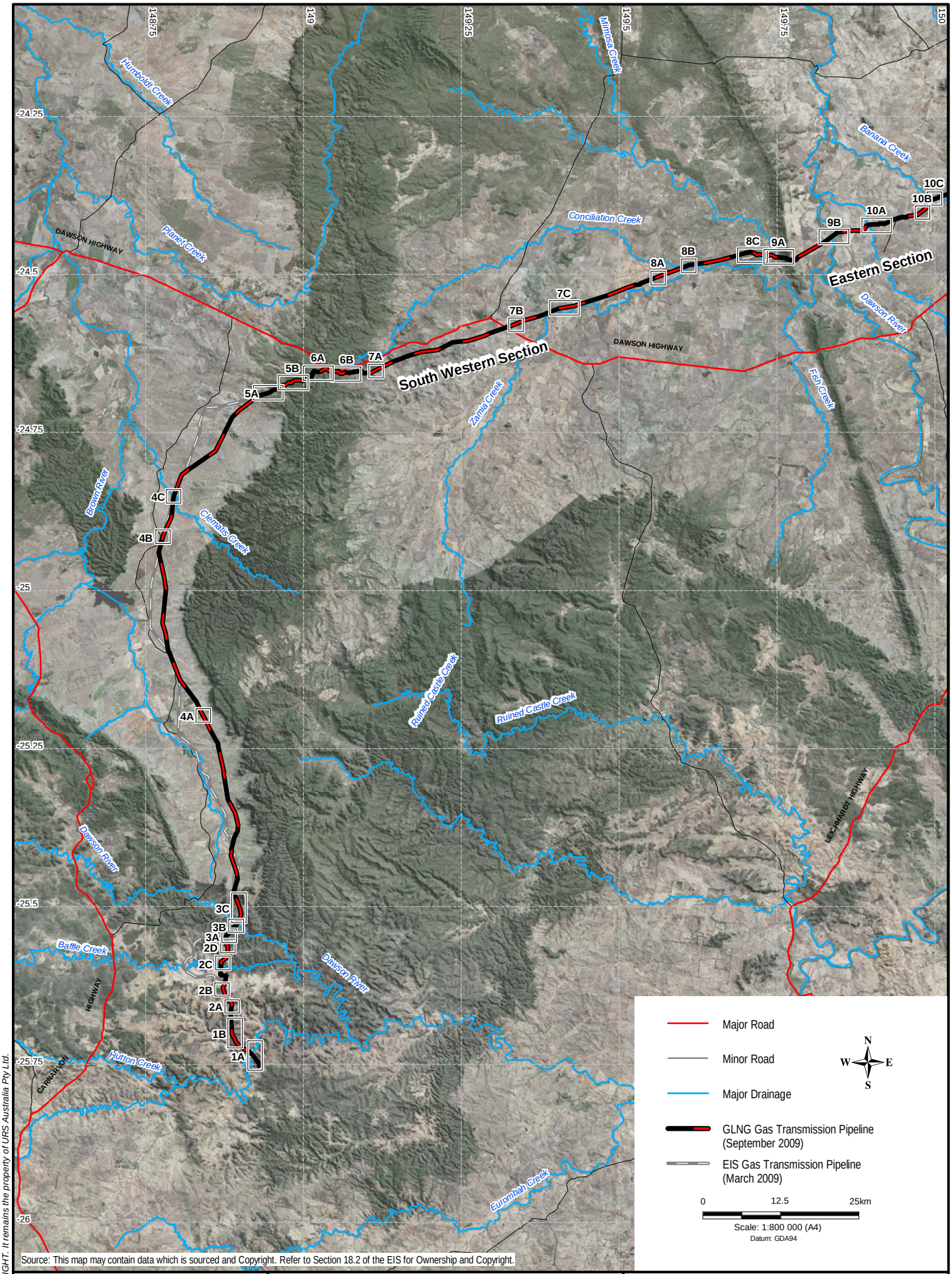
Clearing for pastoral and agricultural activities has historically altered the regions of central Queensland in which the pipeline traverses. In addition, forestry, road development, mining and existing pipeline easements have further reduced the amount of remnant vegetation. In this context, the construction of the GTP will not significantly reduce the overall conservation values of central Queensland. Route selection and planning from the commencement of the project has aimed to minimise impacts on remnant vegetation and fauna habitat through the avoidance of these areas wherever practicable. This is emphasised by the findings from this study that, on average, 83 % of the GTP alignments ROWs traverse cleared or non-remnant vegetation. Field studies have determined that areas of remnant vegetation impacted by the ROW have often experienced historical disturbance from forestry and grazing activities (Section 3.1.3). It is not anticipated that the proposed works will significantly further reduce the current ecological values of the proposed disturbance areas.

Co-locating multiple pipelines within the CICSDA and the GSDA could lead to cumulative impacts on nature conservation values. Management plans have been prepared by the GLNG Project to minimise such impacts and it is expected that similar plans will be implemented by the other pipeline projects. Use of the CICSDA will ensure that such cumulative impacts are generally restricted to a defined area within the corridor and are not more widely dispersed throughout the region where the pipeline alignments coincide.

The remnant vegetation present within the GLNG GTP corridor (includes all alternatives studied in this report) is largely restricted to the range crossings of the Calliope Range, Callide Range, Dawson Range, Expedition Range and Carnarvon Range. Of these, the Calliope and Callide Ranges will be most susceptible to cumulative impacts as that is where the multiple pipelines will begin to coincide. Flora species of conservation value in these areas include the Cycas megacarpa which was recorded from three locations within the Callide and Calliope Ranges and Acacia pedleyi which was identified within the Callide Range.

The adherence to sound environmental policy and planning frameworks will assist in ensuring that additional pipelines will not significantly impact on natural ecosystems.

Figures



Client

Project
GLADSTONE LNG PROJECT
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT
TERRESTRIAL FLORA ASSESSMENT
GAS TRANSMISSION PIPELINE

Title
REGIONAL ECOSYSTEMS
GTP WEST OF BRUCE HIGHWAY
KEY MAP 1 OF 2

Drawn: RG	Approved: JB	Date: 16-10-2009
Job No: **4262 6440/6220**	File No: 42626440-g-2031.wor	

Figure: **1**

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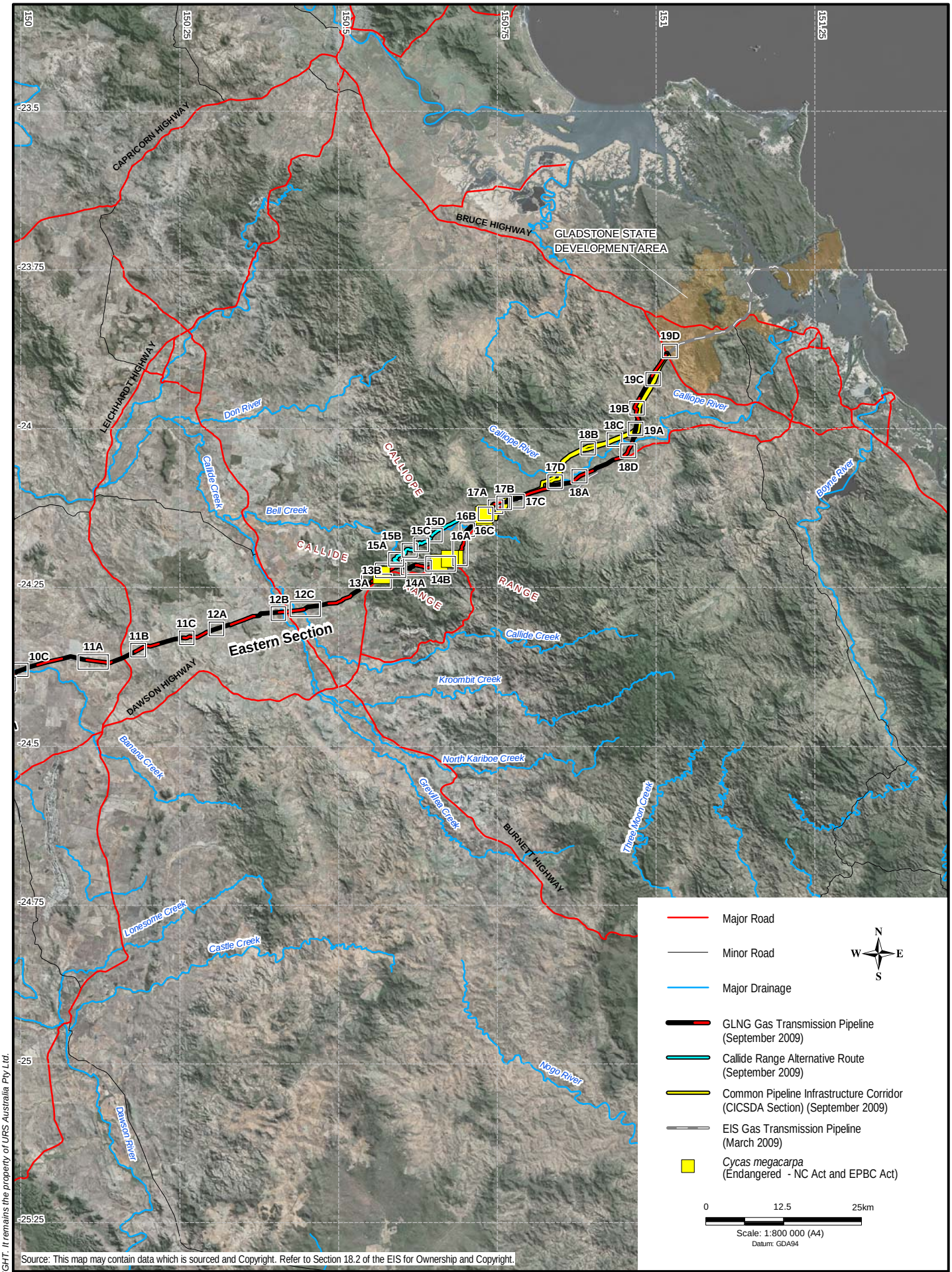

Client

Project
GLADSTONE LNG PROJECT
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT
TERRESTRIAL FLORA ASSESSMENT
GAS TRANSMISSION PIPELINE

Title
REGIONAL ECOSYSTEMS
GTP WEST OF BRUCE HIGHWAY
KEY MAP 2 OF 2

Drawn: RG	Approved: JB	Date: 09-11-2009
Job No: **4262 6440/**6220	File No: 42626440-g-2032.wor	

Figure: **2**

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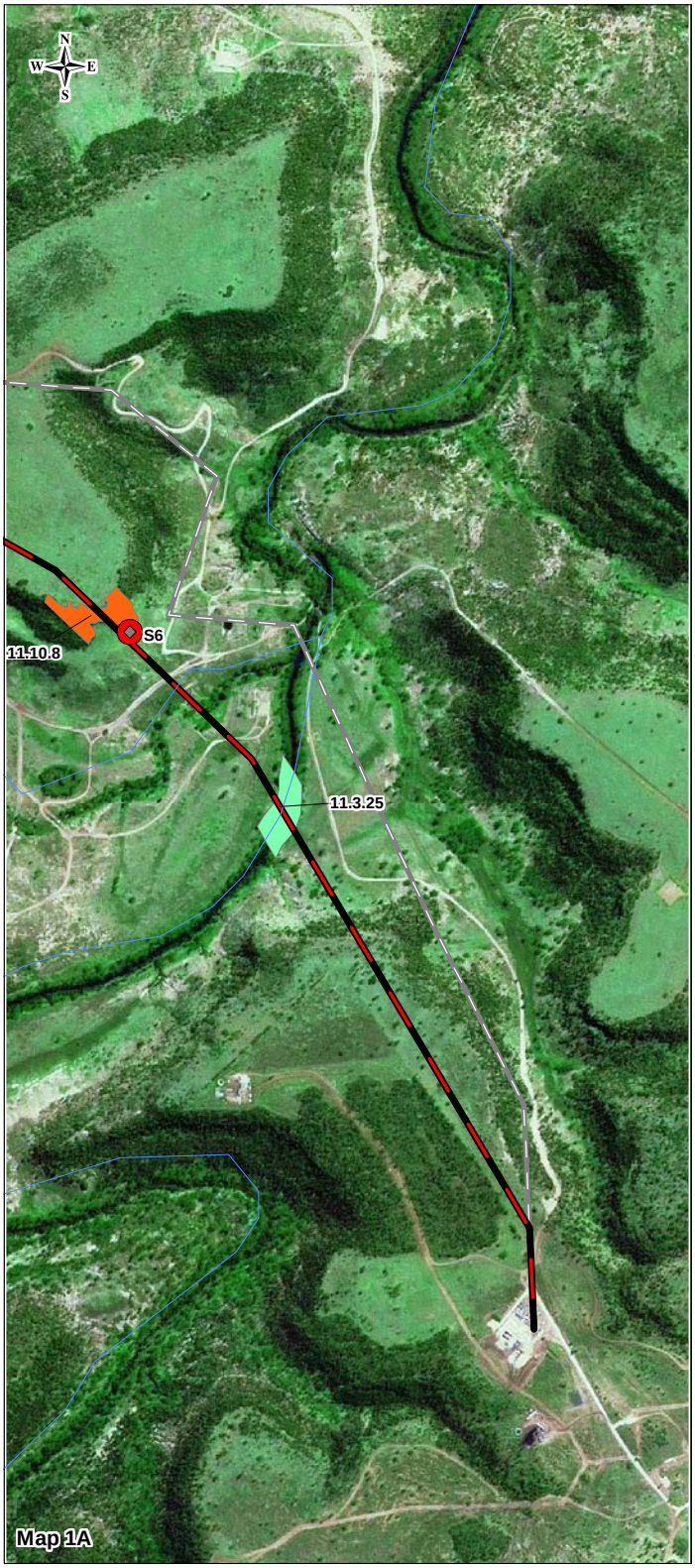

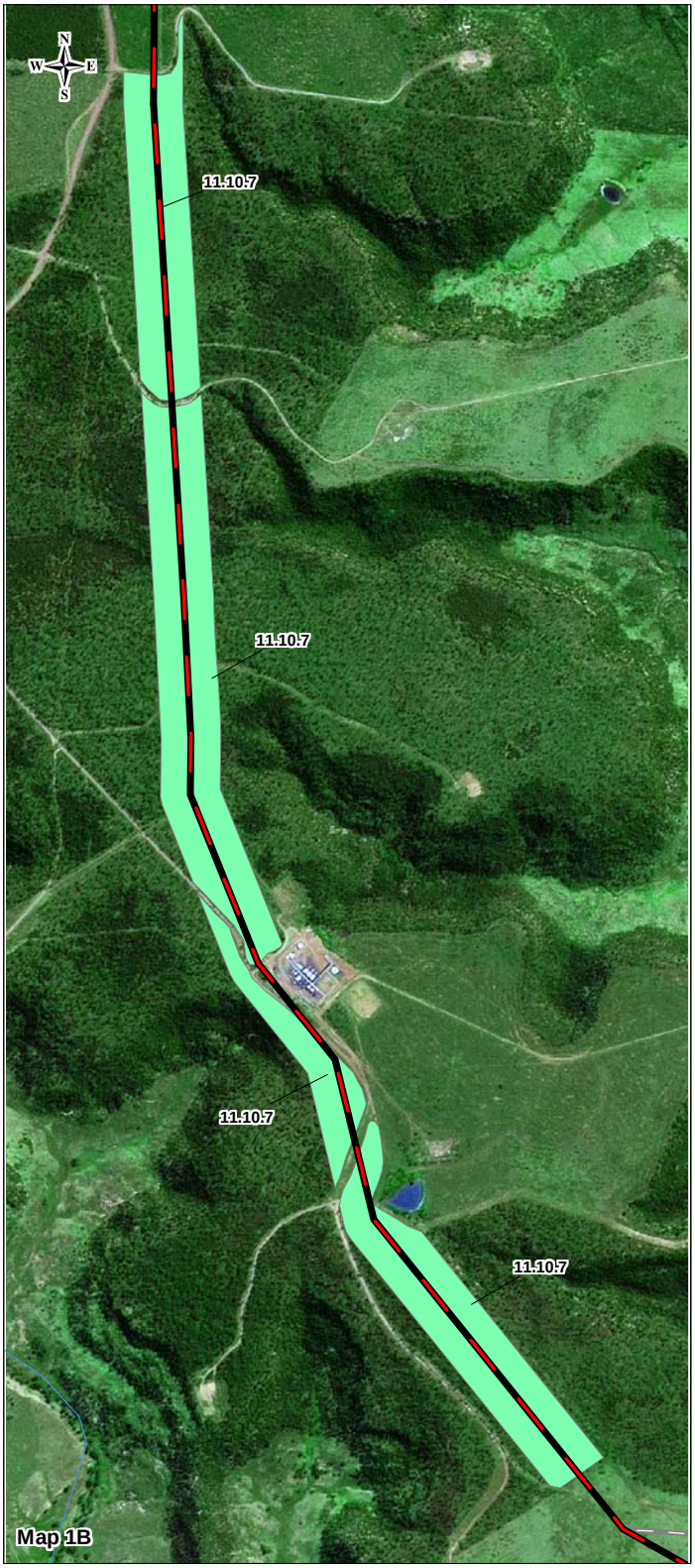

Major Road
Minor Road
Major Drainage
Minor Drainage

GLNG Gas Transmission Pipeline (September 2009)
EIS Gas Transmission Pipeline (March 2009)

Secondary Sites
Quaternary Sites
Presence of Exotic Species (Refer Figure 22 for details)

Not of concern RE
Of concern dominant RE
Endangered dominant RE

0 500 1000m

Scale: 1:25,000 (A4)
Projection: Geographic (GDA94)

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Client: LNG	Project: GLADSTONE LNG PROJECT ENVIRONMENTAL IMPACT STATEMENT SUPPLEMENT TERRESTRIAL FLORA ASSESSMENT GAS TRANSMISSION PIPELINE	Title: **REGIONAL ECOSYSTEMS GTP WEST OF BRUCE HIGHWAY MAP 1 OF 19**	
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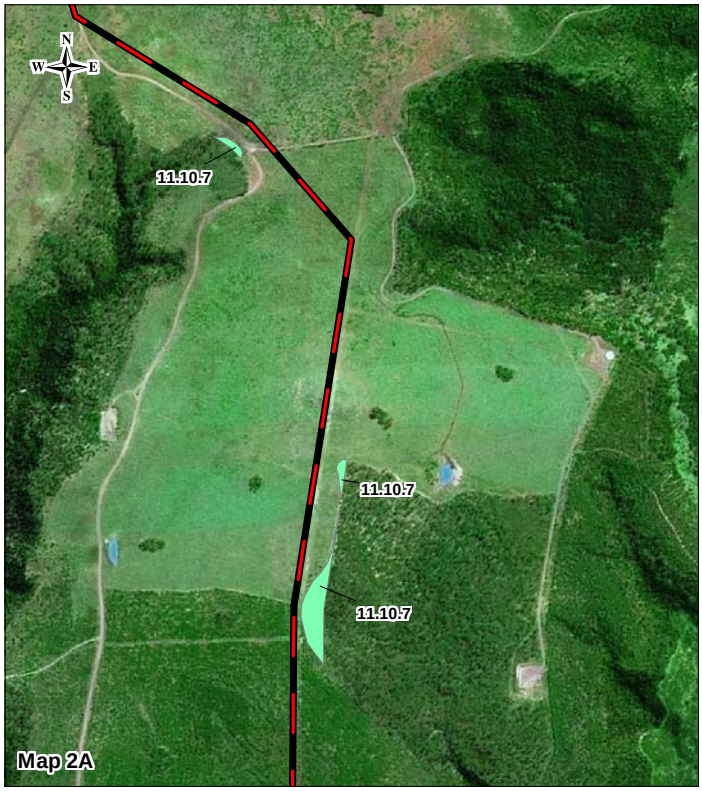

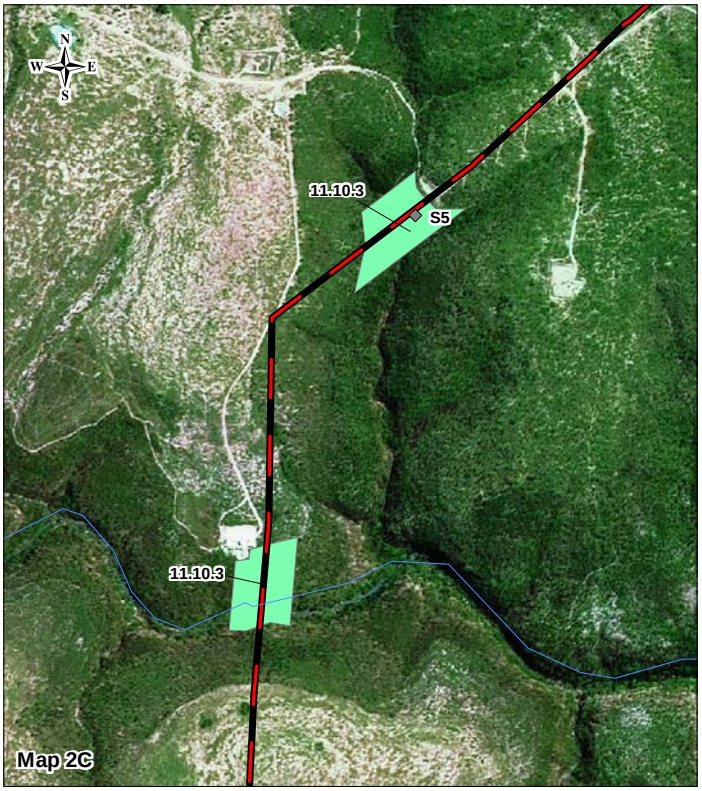

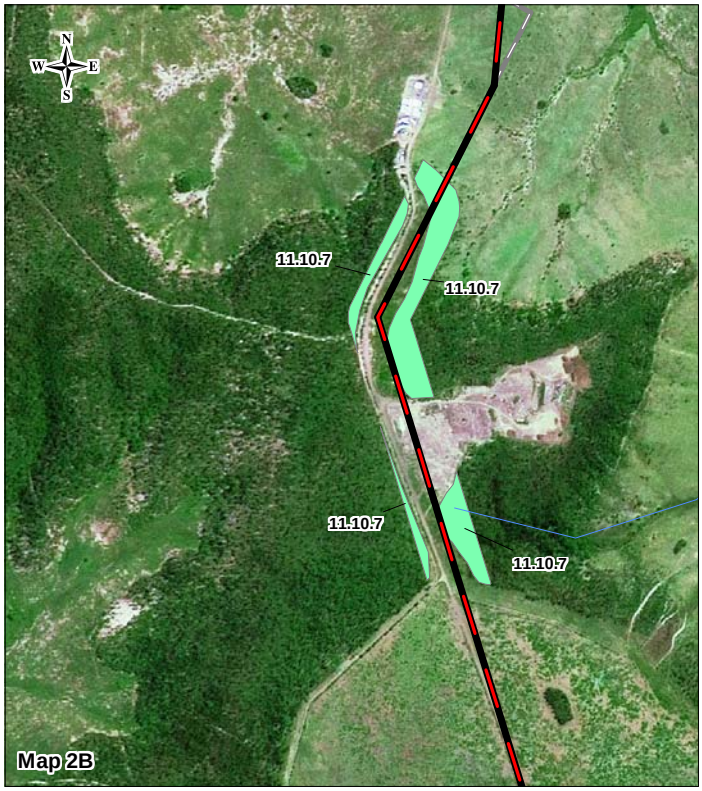

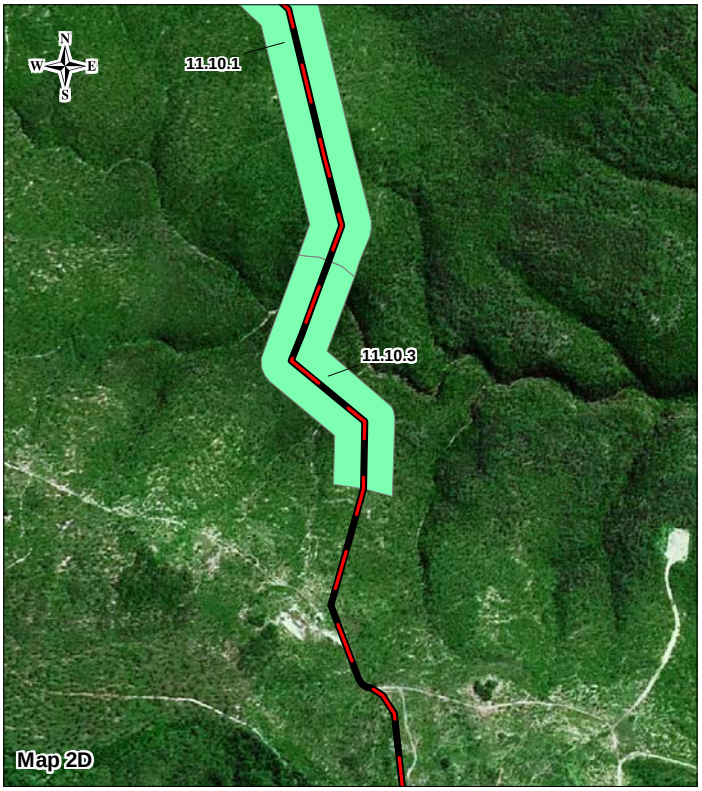

Major Road
Minor Road
Major Drainage
Minor Drainage
GLNG Gas Transmission Pipeline (September 2009)
EIS Gas Transmission Pipeline (March 2009)
Secondary Sites
Quaternary Sites
Presence of Exotic Species (Refer Figure 22 for details)
Not of concern RE
Of concern dominant RE
Endangered dominant RE

0 500 1000m

Scale: 1:25,000 (A4)
Projection: Geographic (GDA94)

Client

Project
GLADSTONE LNG PROJECT
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT
TERRESTRIAL FLORA ASSESSMENT
GAS TRANSMISSION PIPELINE

Title
REGIONAL ECOSYSTEMS
GTP WEST OF BRUCE HIGHWAY
MAP 2 OF 19

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Figure: **4**

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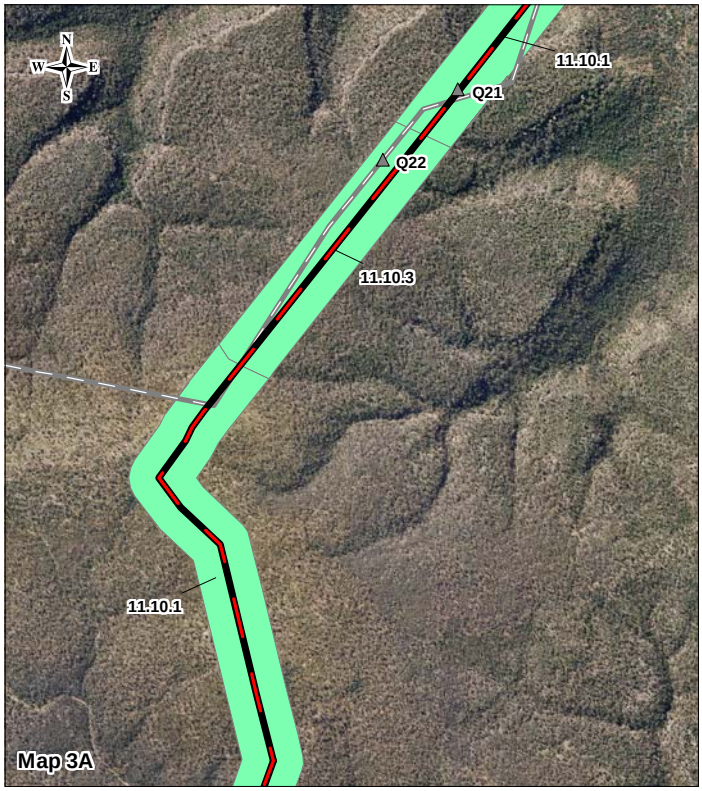
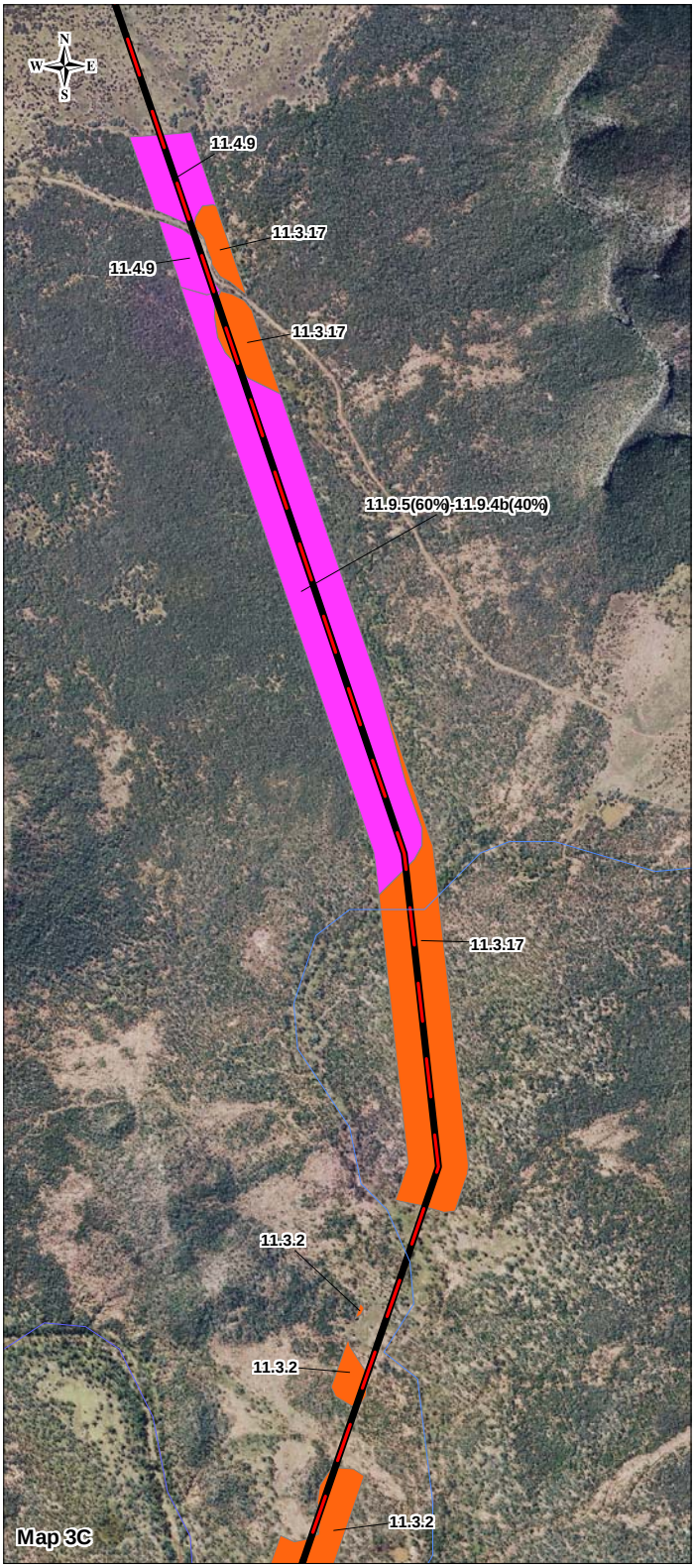
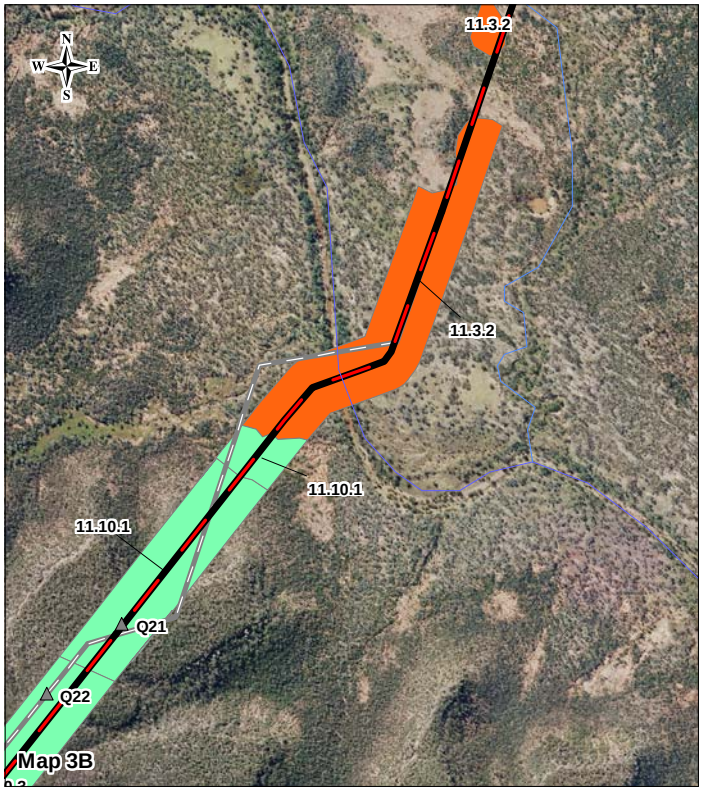






Major Road
Minor Road
Major Drainage
Minor Drainage

GLNG Gas Transmission Pipeline (September 2009)
EIS Gas Transmission Pipeline (March 2009)

Secondary Sites
Quaternary Sites
Presence of Exotic Species (Refer Figure 22 for details)

Not of concern RE
Of concern dominant RE
Endangered dominant RE

0 500 1000m

Scale: 1:25,000 (A4)
Projection: Geographic (GDA94)

Source:This map may contain data which is sourced and Copyright. Refer to Section 18.2 of the EIS for Ownership and Copyright.

Client

Project
GLADSTONE LNG PROJECT
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT
TERRESTRIAL FLORA ASSESSMENT
GAS TRANSMISSION PIPELINE

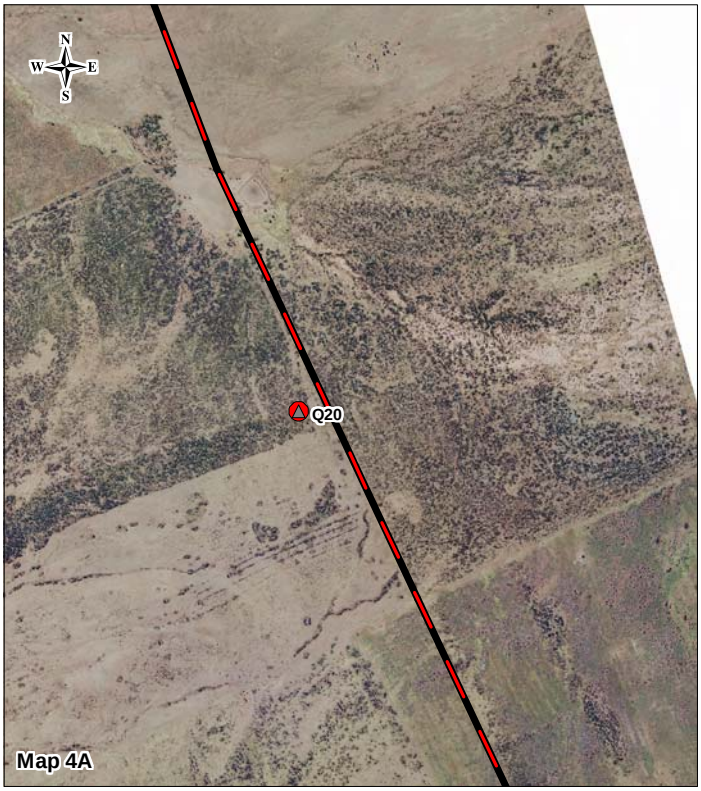
Title
REGIONAL ECOSYSTEMS
GTP WEST OF BRUCE HIGHWAY
MAP 3 OF 19

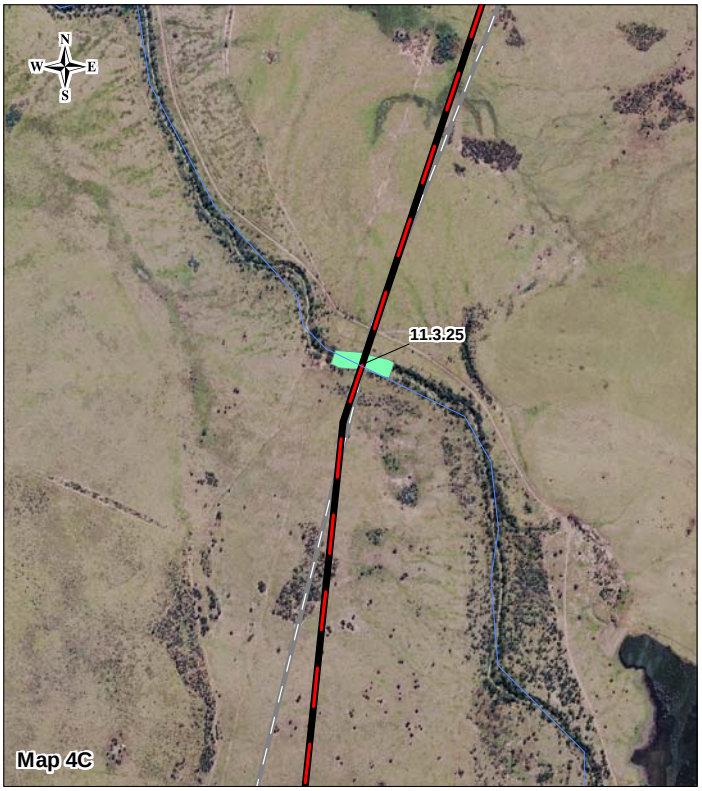
Drawn: RG	Approved: JB	Date: 16-10-2009
Job No: **42626440/**6220	File No: 42626440-g-2035.wor	

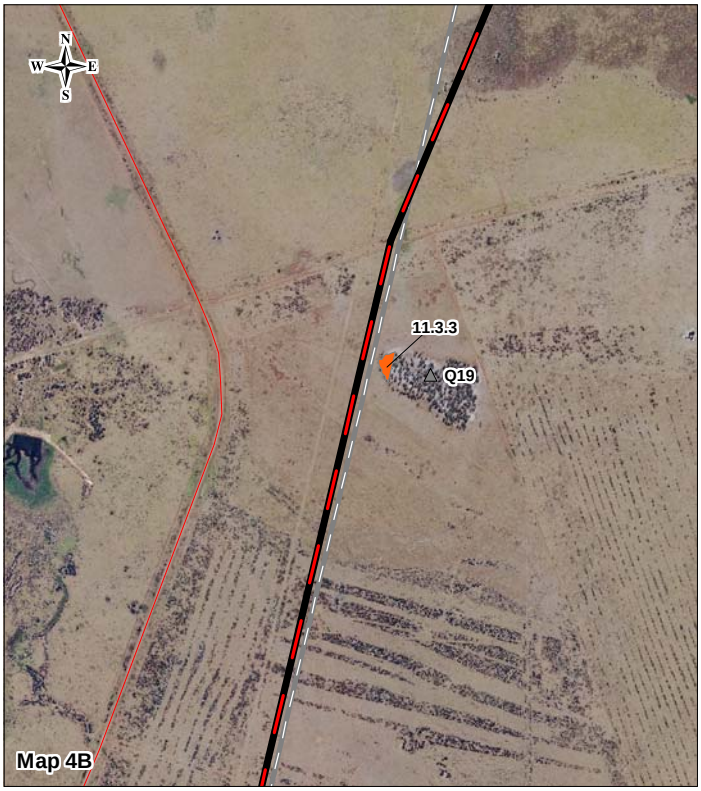
Figure: **5**

Rev:B

A4







Major Road
Minor Road
Major Drainage
Minor Drainage
GLNG Gas Transmission Pipeline (September 2009)
EIS Gas Transmission Pipeline (March 2009)
Secondary Sites
Quaternary Sites
Presence of Exotic Species (Refer Figure 22 for details)
Not of concern RE
Of concern dominant RE
Endangered dominant RE

0 500 1000m

Scale: 1:25,000 (A4)
Projection: Geographic (GDA94)

Client

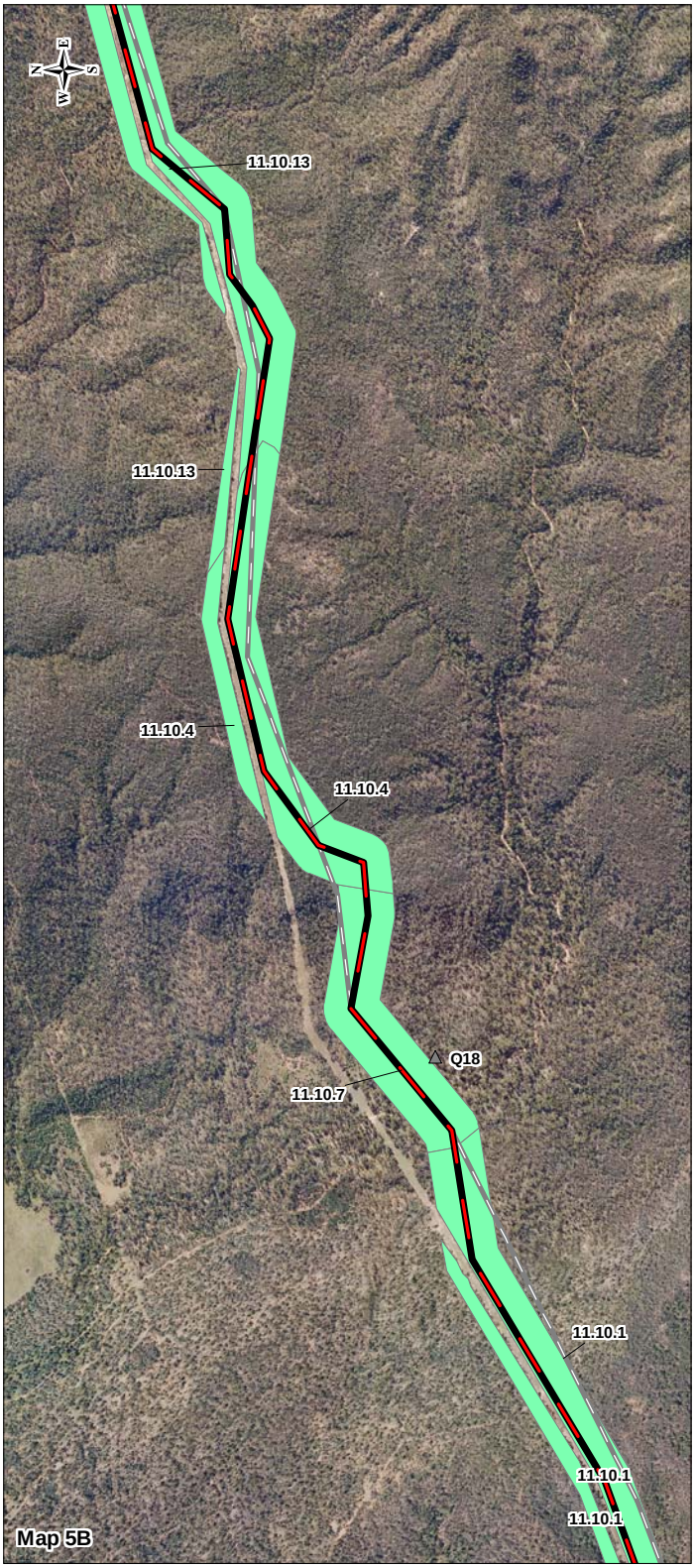
Project
GLADSTONE LNG PROJECT
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT
TERRESTRIAL FLORA ASSESSMENT
GAS TRANSMISSION PIPELINE

Title
REGIONAL ECOSYSTEMS
GTP WEST OF BRUCE HIGHWAY
MAP 4 OF 19

Drawn: RG	Approved: JB	Date: 16-10-2009
Job No: **42626440/**6220	File No: 42626440-g-2036.wor	

Figure: **6**

Rev:B
A4



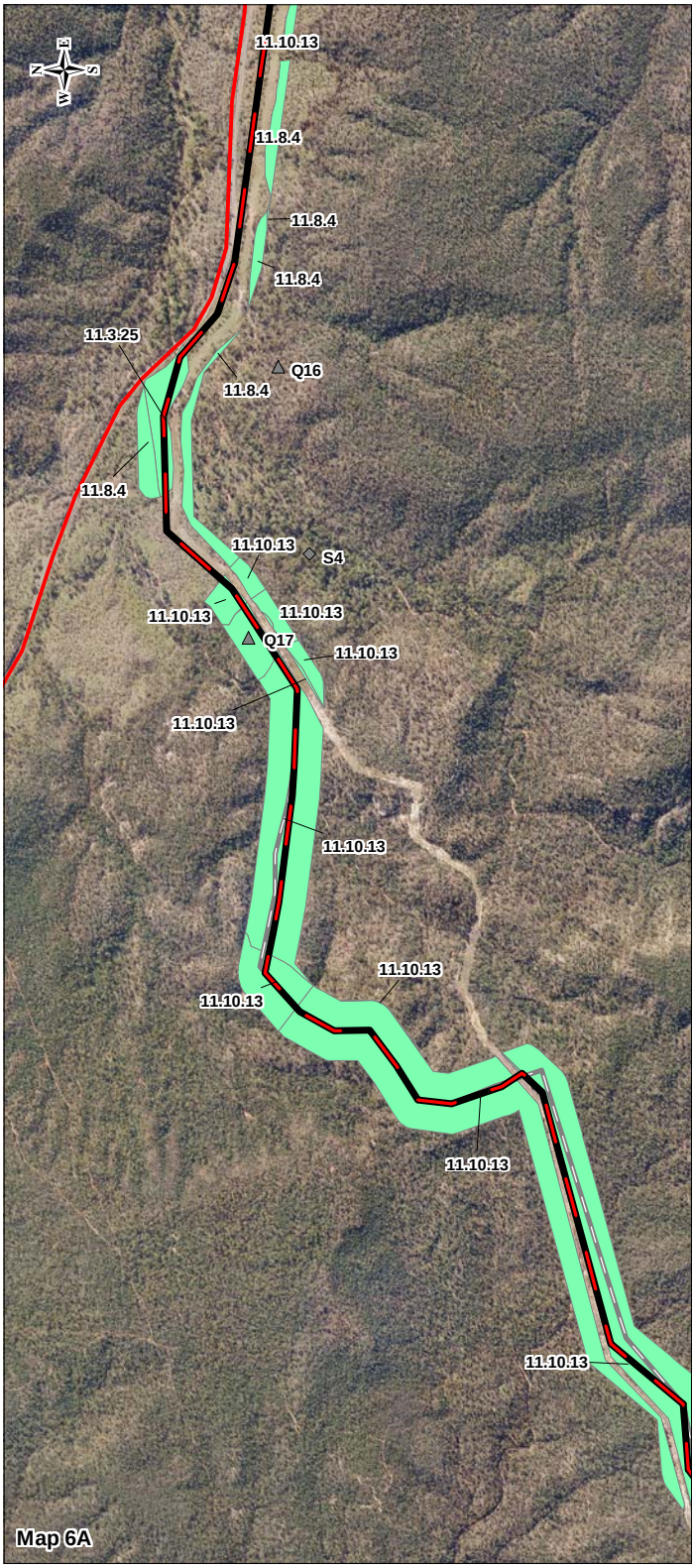
Major Road
Minor Road
Major Drainage
Minor Drainage
GLNG Gas Transmission Pipeline (September 2009)
EIS Gas Transmission Pipeline (March 2009)
Secondary Sites
Quaternary Sites
Presence of Exotic Species (Refer Figure 22 for details)
Not of concern RE
Of concern dominant RE
Endangered dominant RE

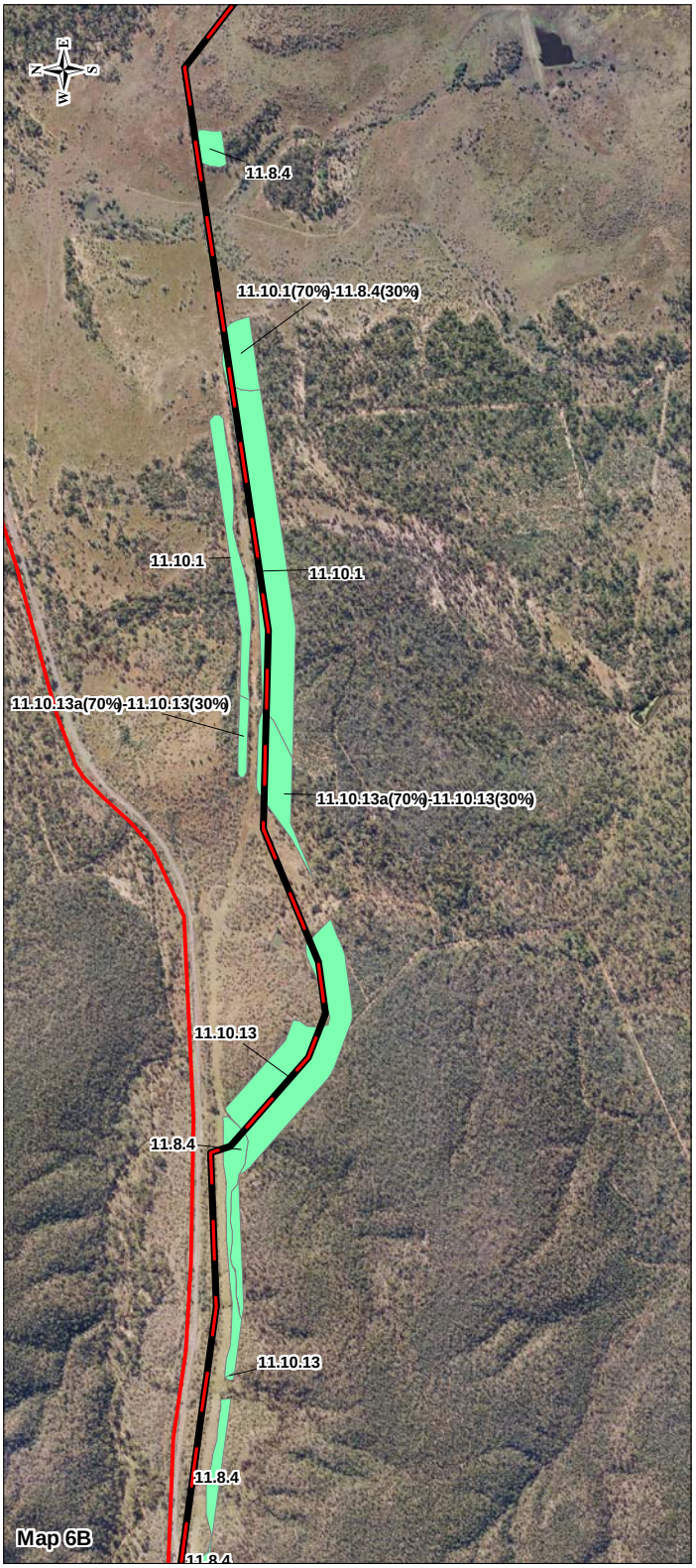
0 500 1000m

Scale: 1:25,000 (A4)
Projection: Geographic (GDA94)

Source:This map may contain data which is sourced and Copyright. Refer to Section 18.2 of the EIS for Ownership and Copyright.

Client: LNG	Project: GLADSTONE LNG PROJECT ENVIRONMENTAL IMPACT STATEMENT SUPPLEMENT TERRESTRIAL FLORA ASSESSMENT GAS TRANSMISSION PIPELINE	Title: **REGIONAL ECOSYSTEMS GTP WEST OF BRUCE HIGHWAY MAP 5 OF 19**	
URS	Drawn: RG | Approved: JB | Date: 16-10-2009	Figure: **7**	Rev:B
	Job No: **42626440/**6220 | File No: 42626440-g-2037.wor		**A4**





Major Road
Minor Road
Major Drainage
Minor Drainage

GLNG Gas Transmission Pipeline (September 2009)
EIS Gas Transmission Pipeline (March 2009)

Secondary Sites
Quaternary Sites
Presence of Exotic Species (Refer Figure 22 for details)

Not of concern RE
Of concern dominant RE
Endangered dominant RE

0 500 1000m

Scale: 1:25,000 (A4)
Projection: Geographic (GDA94)

Source:This map may contain data which is sourced and Copyright. Refer to Section 18.2 of the EIS for Ownership and Copyright.

Client

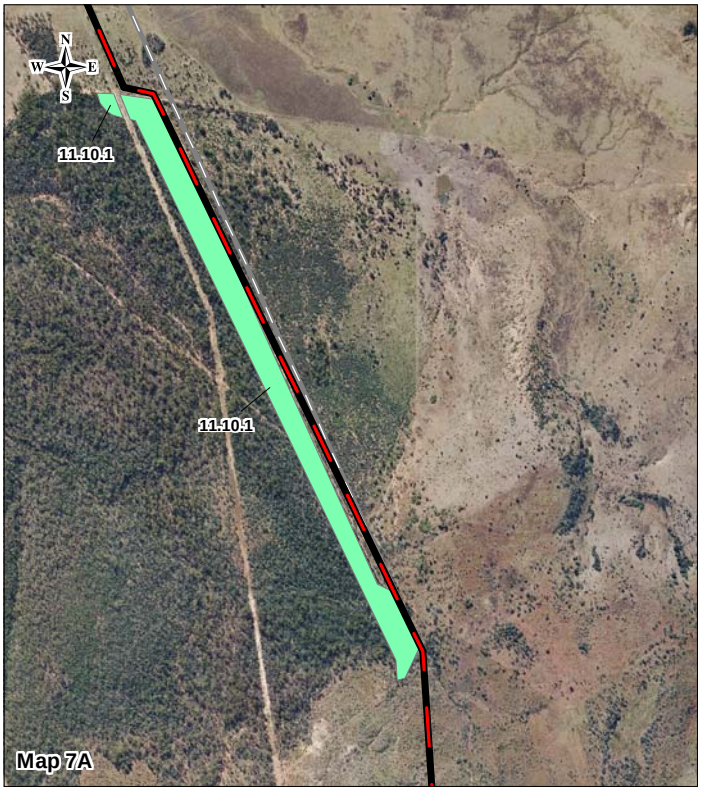
Project
GLADSTONE LNG PROJECT
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT
TERRESTRIAL FLORA ASSESSMENT
GAS TRANSMISSION PIPELINE

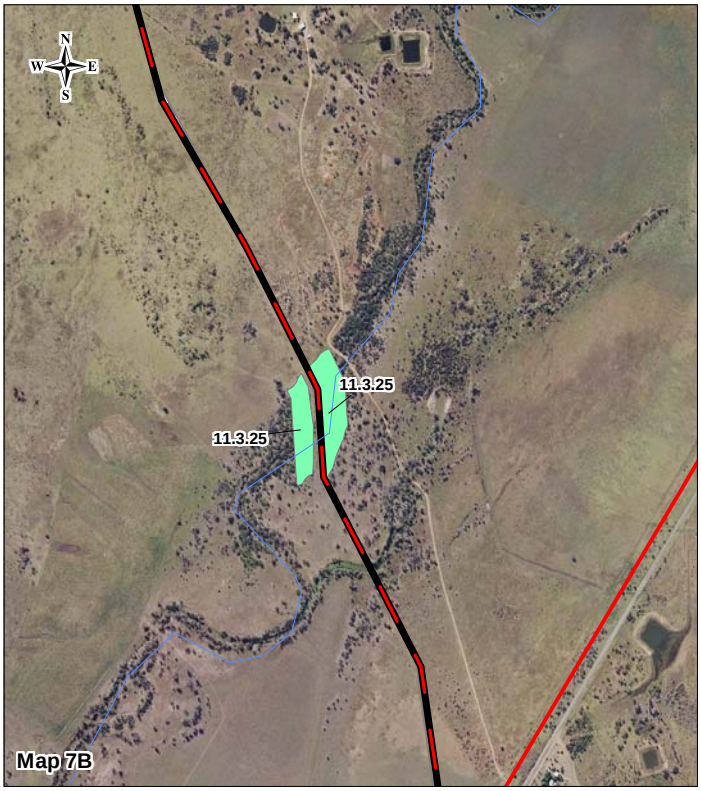
Title
REGIONAL ECOSYSTEMS
GTP WEST OF BRUCE HIGHWAY
MAP 6 OF 19

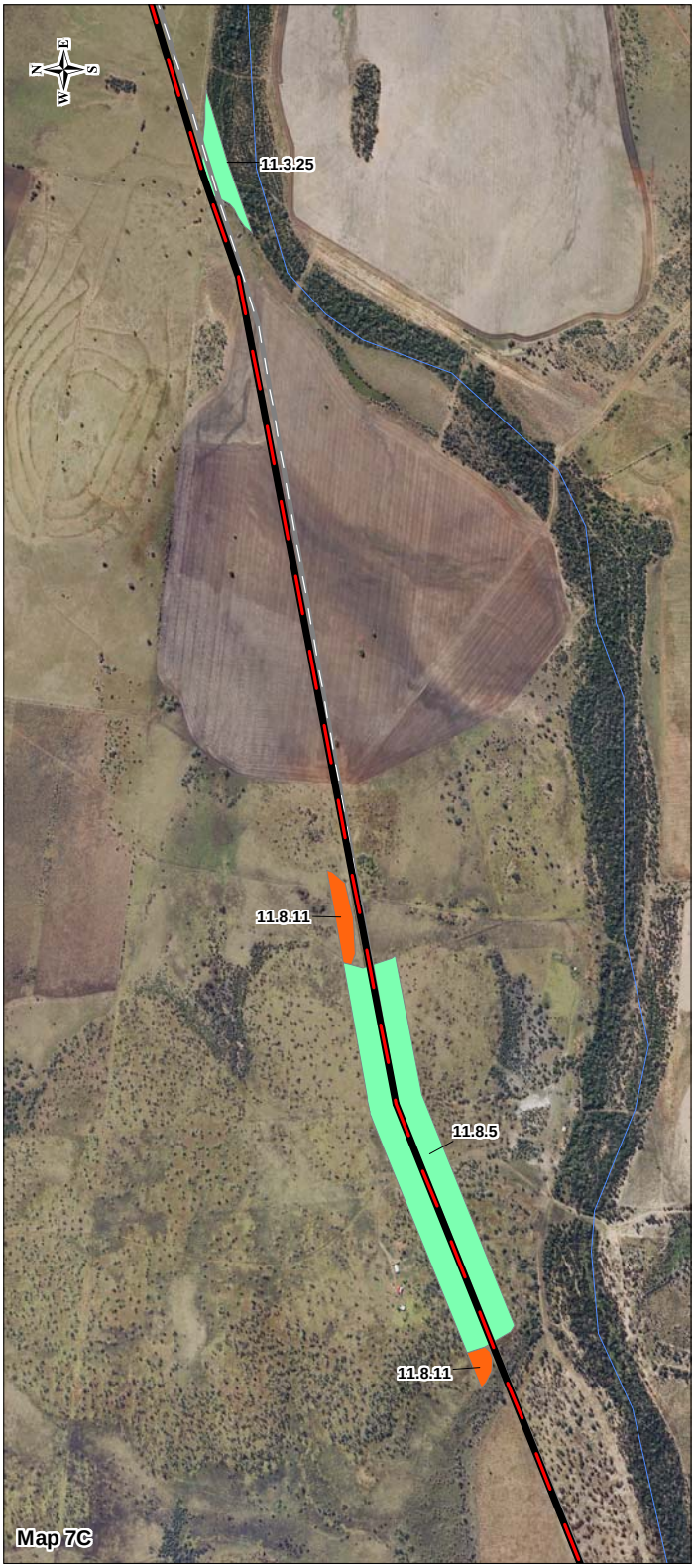
Drawn: RG	Approved: JB	Date: 16-10-2009
Job No: **42626440/**6220	File No: 42626440-g-2038.wor	

Figure: **8**

Rev:B
A4







Major Road
Minor Road
Major Drainage
Minor Drainage
GLNG Gas Transmission Pipeline (September 2009)
EIS Gas Transmission Pipeline (March 2009)
Secondary Sites
Quaternary Sites
Presence of Exotic Species (Refer Figure 22 for details)
Not of concern RE
Of concern dominant RE
Endangered dominant RE

0 500 1000m

Scale: 1:25,000 (A4)
Projection: Geographic (GDA94)

Source:This map may contain data which is sourced and Copyright. Refer to Section 18.2 of the EIS for Ownership and Copyright.

Client

Project
GLADSTONE LNG PROJECT
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT
TERRESTRIAL FLORA ASSESSMENT
GAS TRANSMISSION PIPELINE

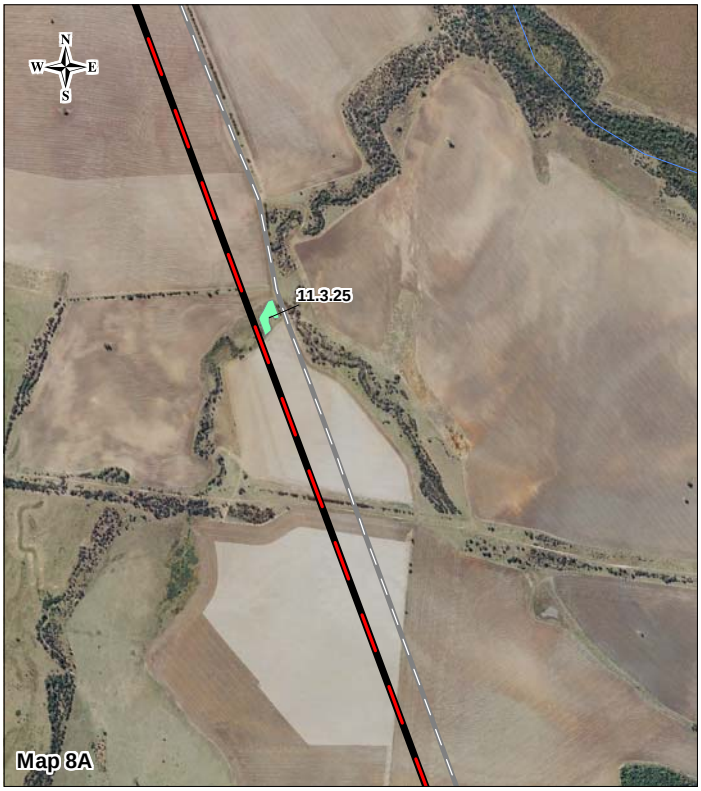
Title
REGIONAL ECOSYSTEMS
GTP WEST OF BRUCE HIGHWAY
MAP 7 OF 19

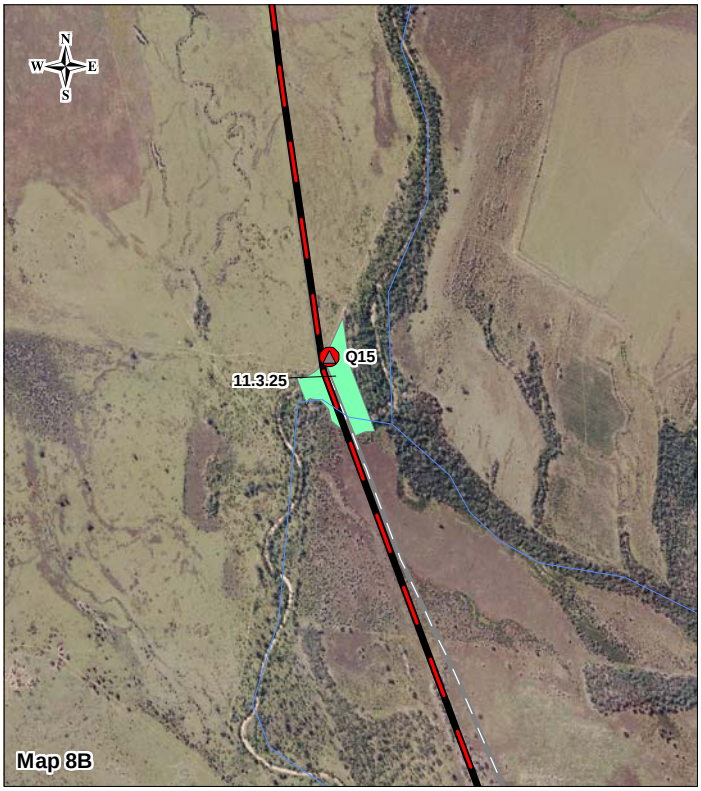
Drawn: RG	Approved: JB	Date: 16-10-2009
Job No: **42626440/**6220	File No: 42626440-g-2039.wor	

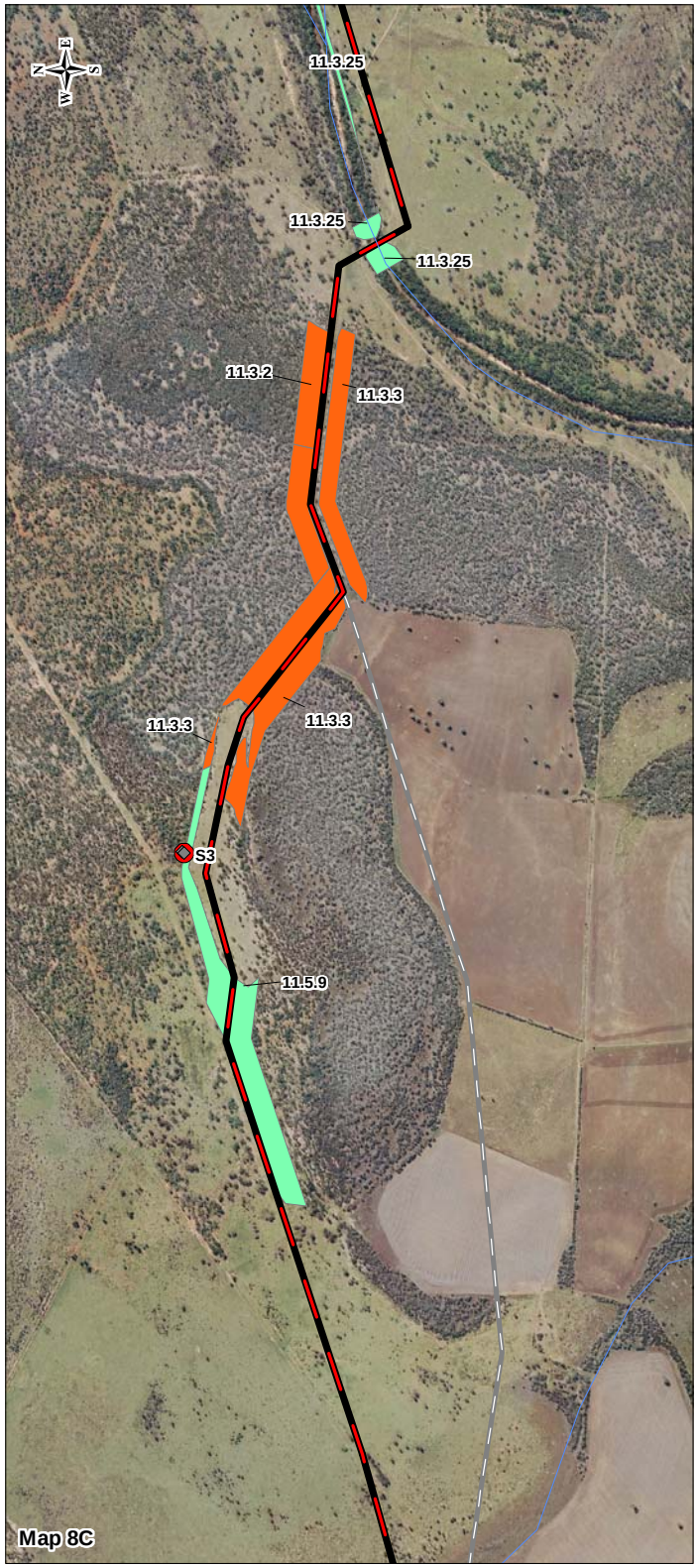
Figure: **9**

Rev:B

A4







Major Road
Minor Road
Major Drainage
Minor Drainage
GLNG Gas Transmission Pipeline (September 2009)
EIS Gas Transmission Pipeline (March 2009)
Secondary Sites
Quaternary Sites
Presence of Exotic Species (Refer Figure 22 for details)
Not of concern RE
Of concern dominant RE
Endangered dominant RE

0 500 1000m

Scale: 1:25,000 (A4)
Projection: Geographic (GDA94)

Client: LNG

URS

Project:
GLADSTONE LNG PROJECT
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT
TERRESTRIAL FLORA ASSESSMENT
GAS TRANSMISSION PIPELINE

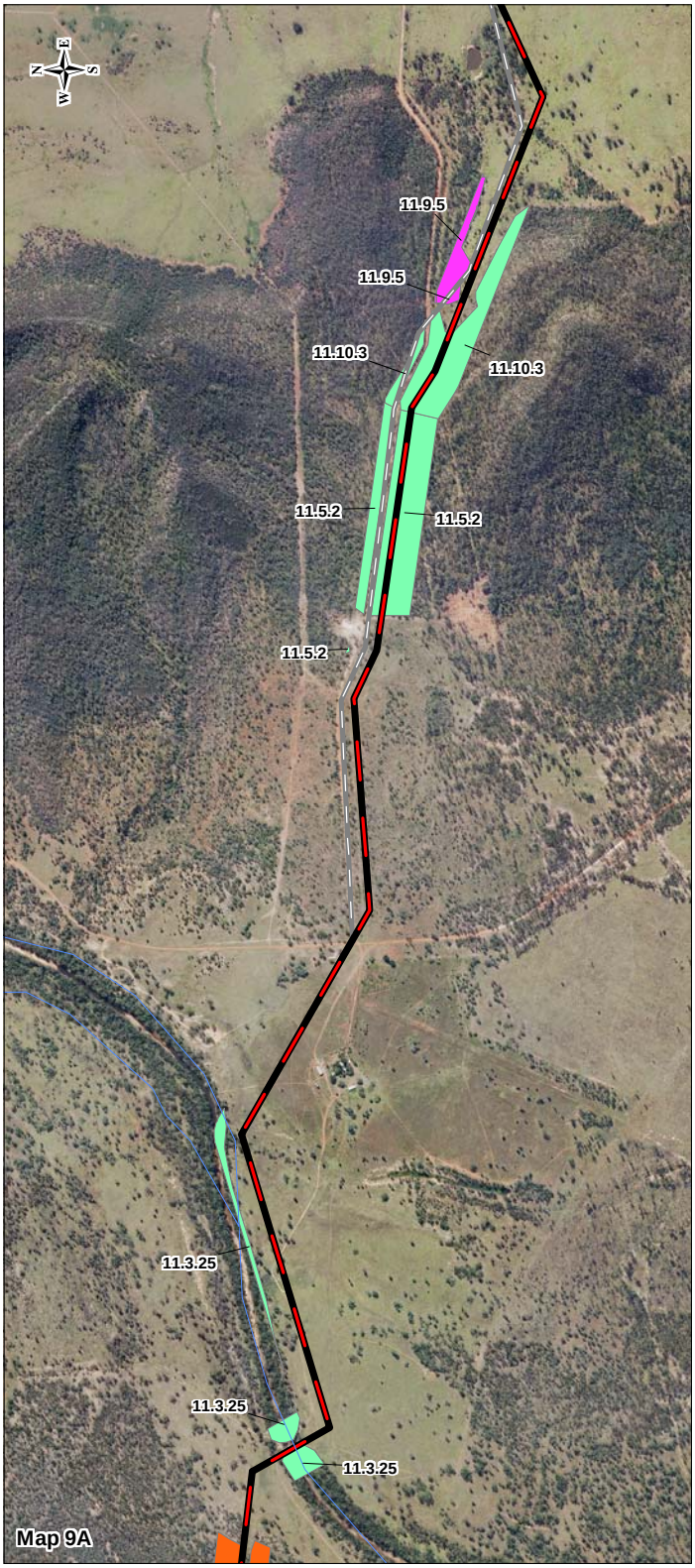
Title:
REGIONAL ECOSYSTEMS
GTP WEST OF BRUCE HIGHWAY
MAP 8 OF 19

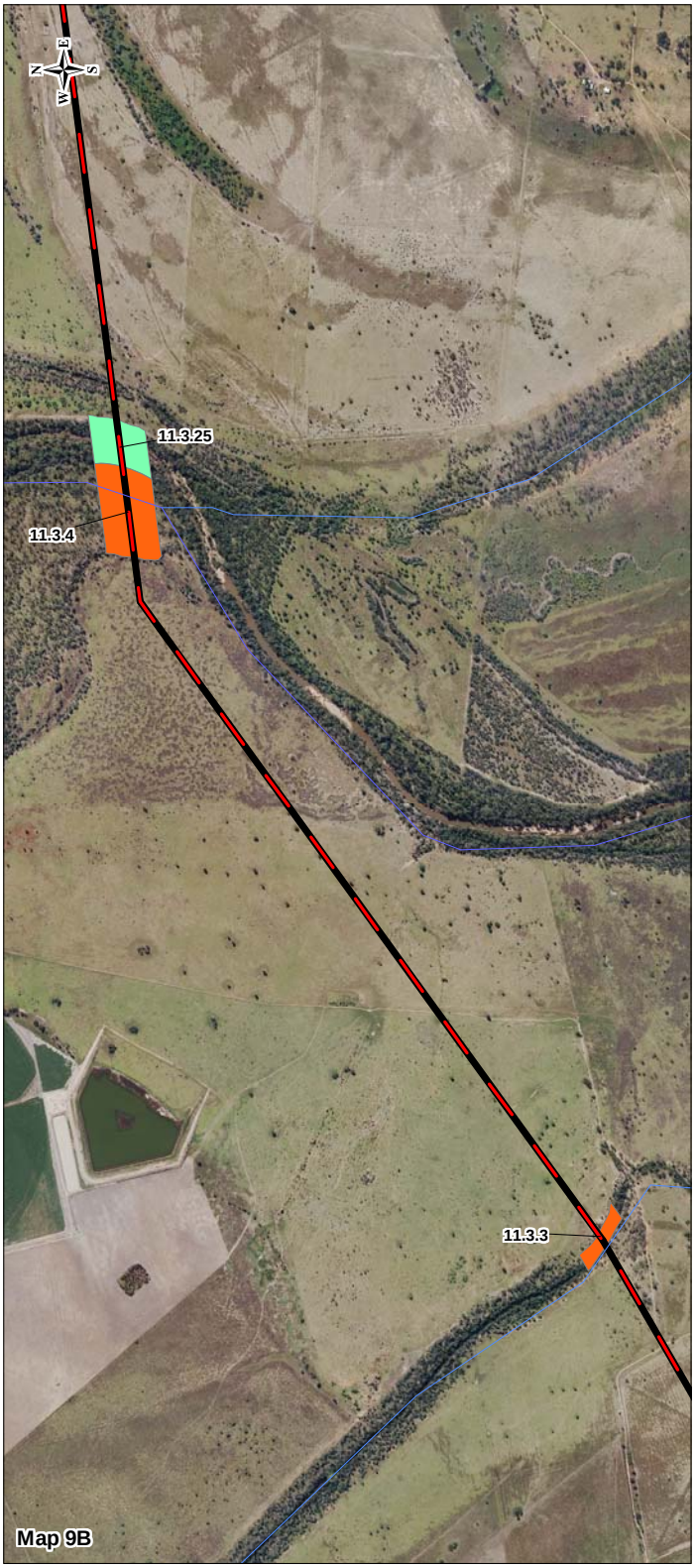
Drawn: RG	Approved: JB	Date: 09-11-2009
Job No: **42626440/**6220	File No: 42626440-g-2040.wor	

Figure: **10**

Rev:C

A4





Major Road
Minor Road
Major Drainage
Minor Drainage

GLNG Gas Transmission Pipeline (September 2009)
EIS Gas Transmission Pipeline (March 2009)

Secondary Sites
Quaternary Sites
Presence of Exotic Species (Refer Figure 22 for details)

Not of concern RE
Of concern dominant RE
Endangered dominant RE

0 500 1000m

Scale: 1:25,000 (A4)
Projection: Geographic (GDA94)

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Client: LNG

URS

Project:
GLADSTONE LNG PROJECT
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT
TERRESTRIAL FLORA ASSESSMENT
GAS TRANSMISSION PIPELINE

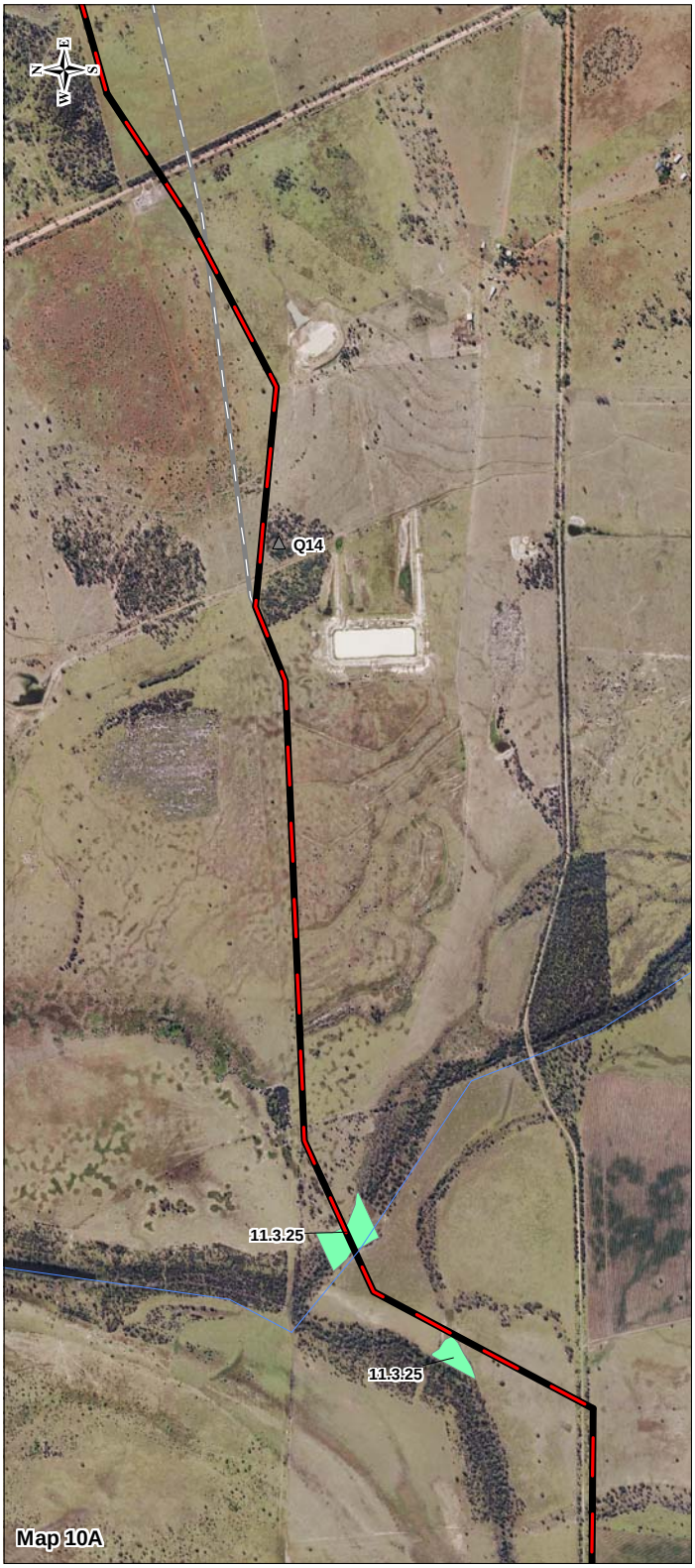
Title:
REGIONAL ECOSYSTEMS
GTP WEST OF BRUCE HIGHWAY
MAP 9 OF 19

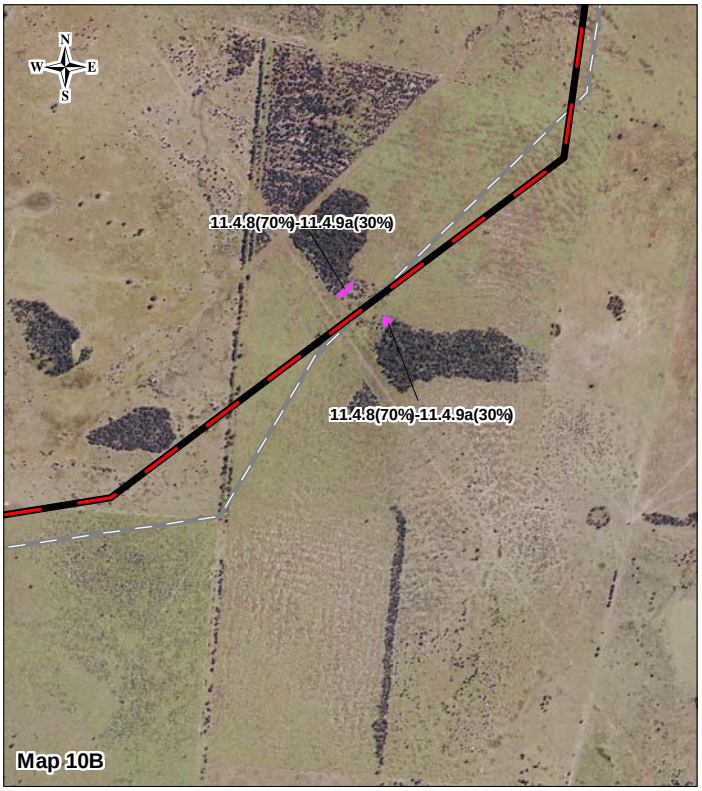
Drawn: RG	Approved: JB	Date: 09-11-2009
Job No: **42626440/**6220	File No: 42626440-g-2041.wor	

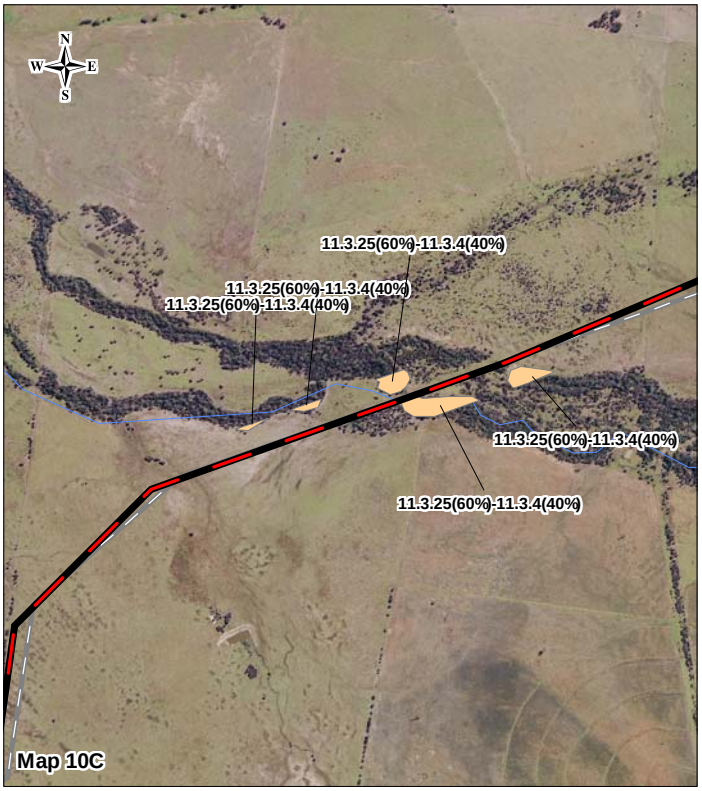
Figure: **11**

Rev:C

A4







Major Road
Minor Road
Major Drainage
Minor Drainage
GLNG Gas Transmission Pipeline (September 2009)
EIS Gas Transmission Pipeline (March 2009)
Secondary Sites
Quaternary Sites
Presence of Exotic Species (Refer Figure 22 for details)
Not of concern RE
Of concern dominant RE
Of concern sub-dominant RE
Endangered dominant RE

0 500 1000m

Scale: 1:25,000 (A4)
Projection: Geographic (GDA94)

Client: LNG

URS

Project:
GLADSTONE LNG PROJECT
ENVIRONMENTAL IMPACT STATEMENT SUPPLEMENT
TERRESTRIAL FLORA ASSESSMENT
GAS TRANSMISSION PIPELINE

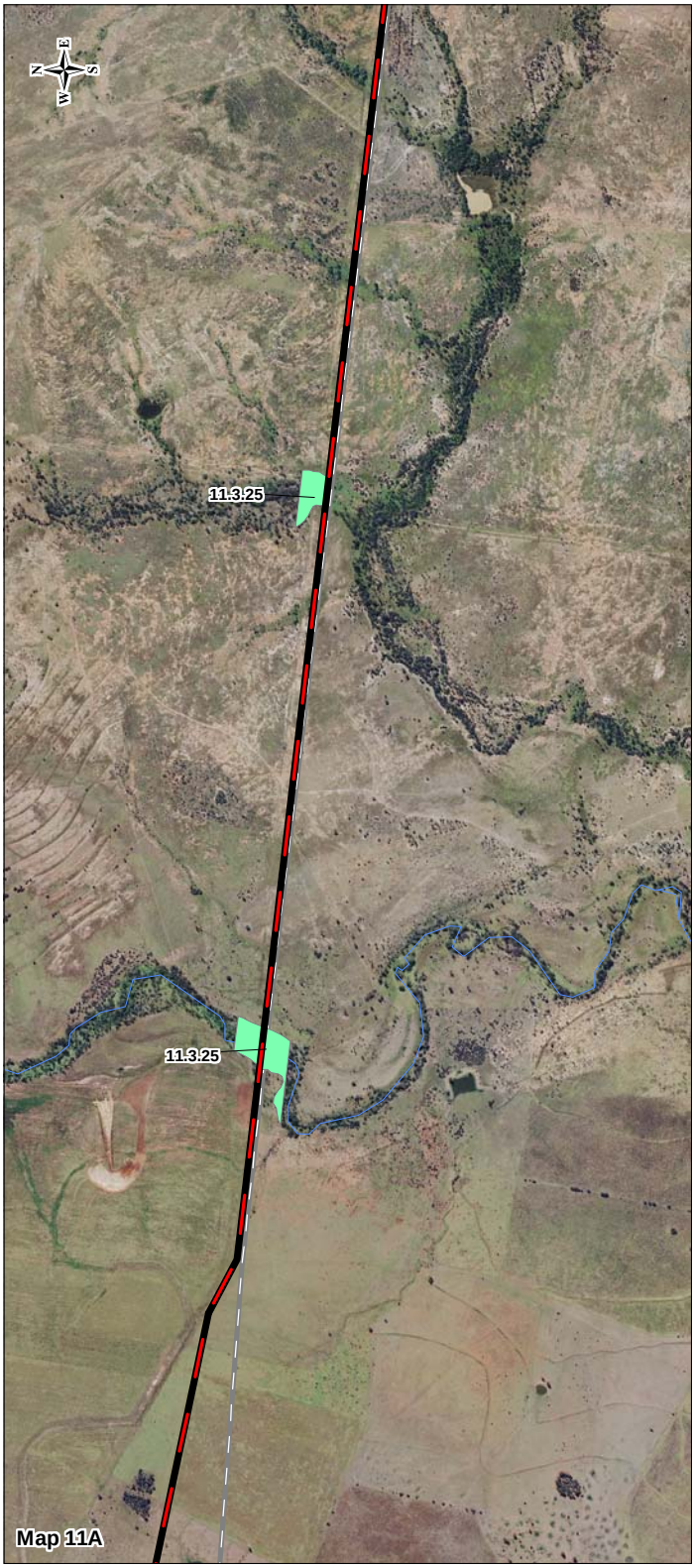
Title:
REGIONAL ECOSYSTEMS
GTP WEST OF BRUCE HIGHWAY
MAP 10 OF 19

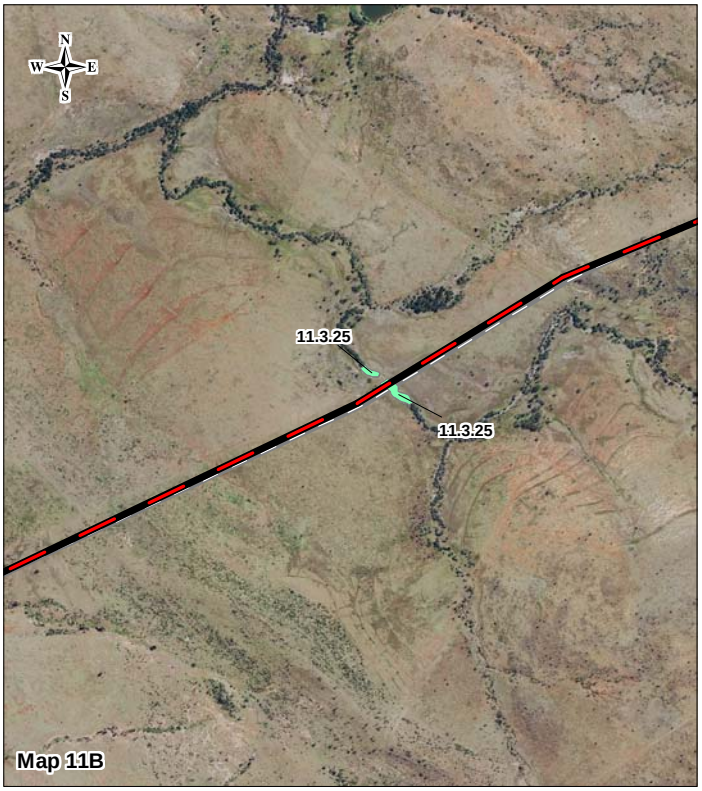
Drawn: RG	Approved: JB	Date: 23-10-2009
Job No: **42626440/**6220	File No: 42626440-g-2042.wor	

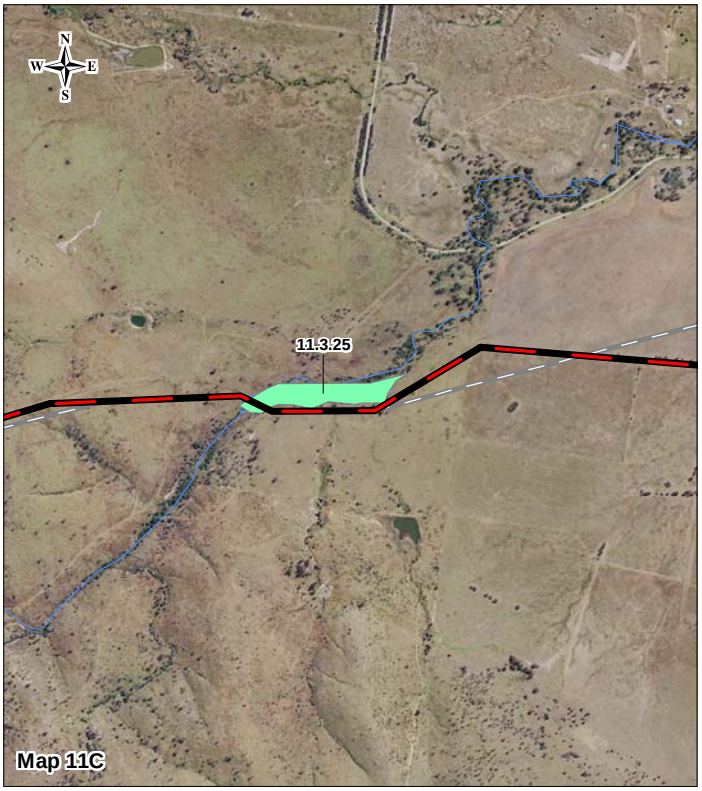
Figure: **12**

Rev:B

A4







Major Road
Minor Road
Major Drainage
Minor Drainage

GLNG Gas Transmission Pipeline (September 2009)
EIS Gas Transmission Pipeline (March 2009)

Secondary Sites
Quaternary Sites
Presence of Exotic Species (Refer Figure 22 for details)

Not of concern RE
Of concern dominant RE
Endangered dominant RE

0 500 1000m

Scale: 1:25,000 (A4)
Projection: Geographic (GDA94)

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Client

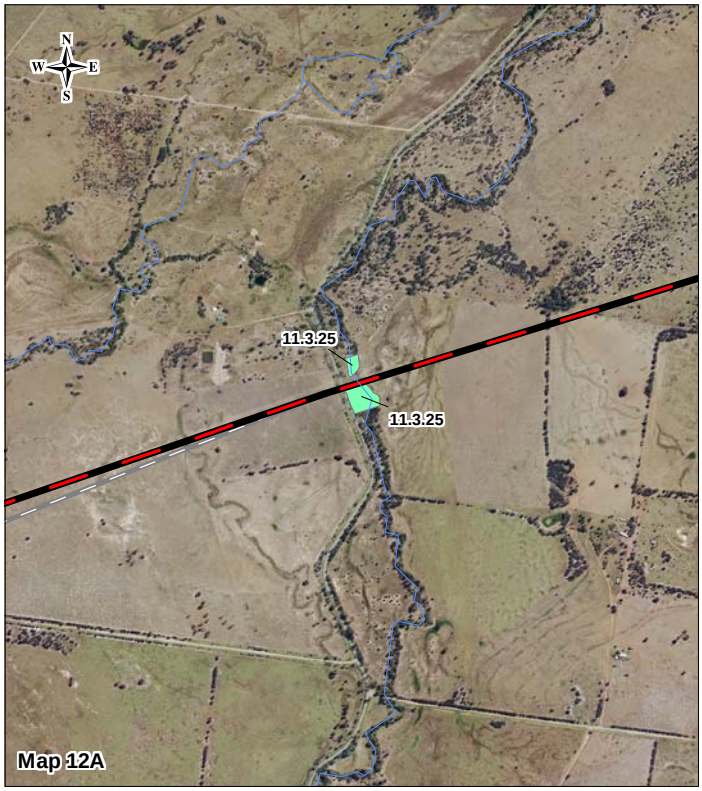
Project
GLADSTONE LNG PROJECT
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT
TERRESTRIAL FLORA ASSESSMENT
GAS TRANSMISSION PIPELINE

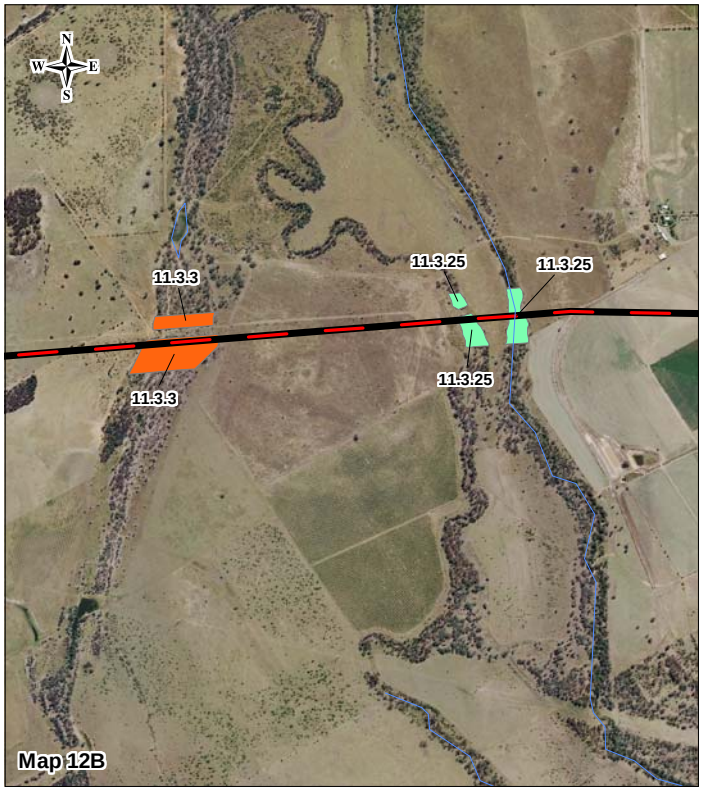
Title
REGIONAL ECOSYSTEMS
GTP WEST OF BRUCE HIGHWAY
MAP 11 OF 19

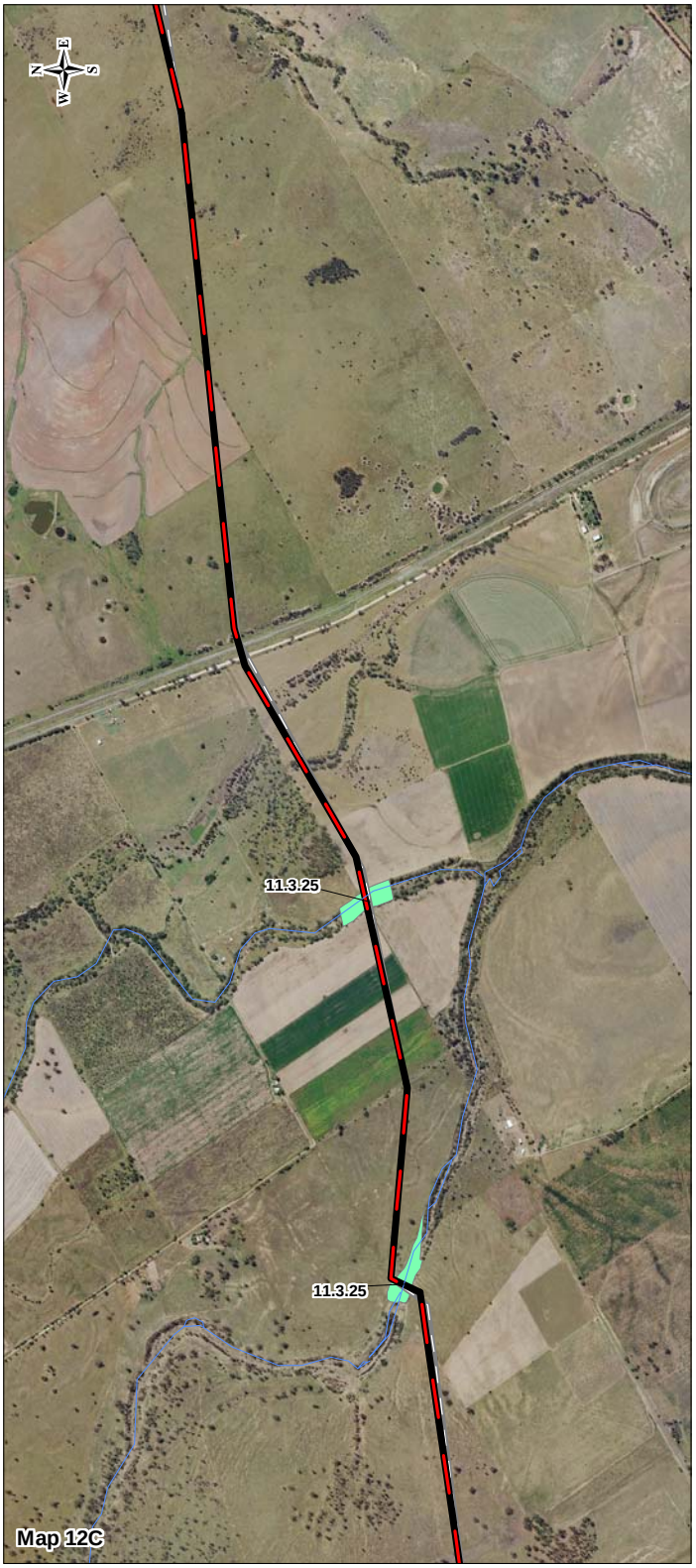
Drawn: RG	Approved: JB	Date: 23-10-2009
Job No: **42626440/**6220	File No: 42626440-g-2043.wor	

Figure: **13**

Rev:B
A4







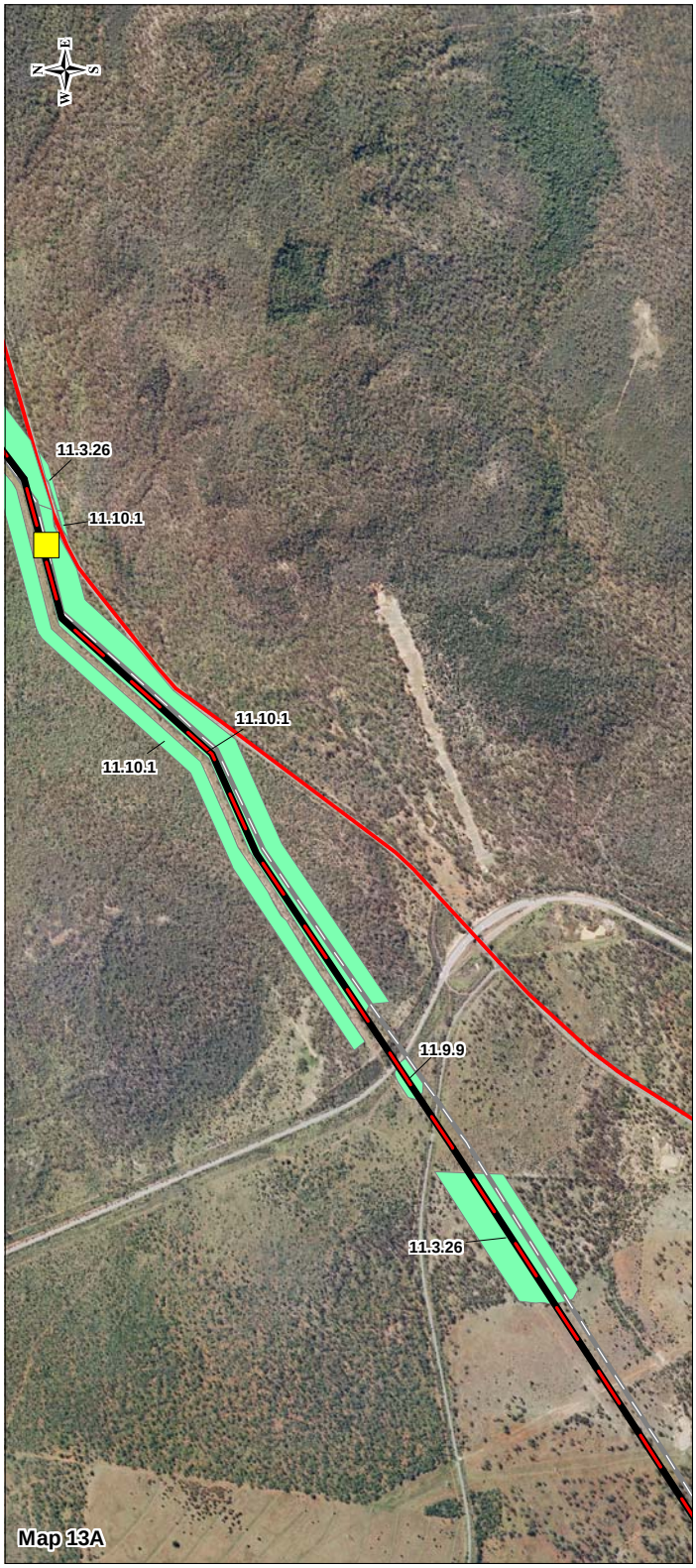
Major Road
Minor Road
Major Drainage
Minor Drainage
GLNG Gas Transmission Pipeline (September 2009)
EIS Gas Transmission Pipeline (March 2009)
Secondary Sites
Quaternary Sites
Presence of Exotic Species (Refer Figure 22 for details)
Not of concern RE
Of concern dominant RE
Endangered dominant RE

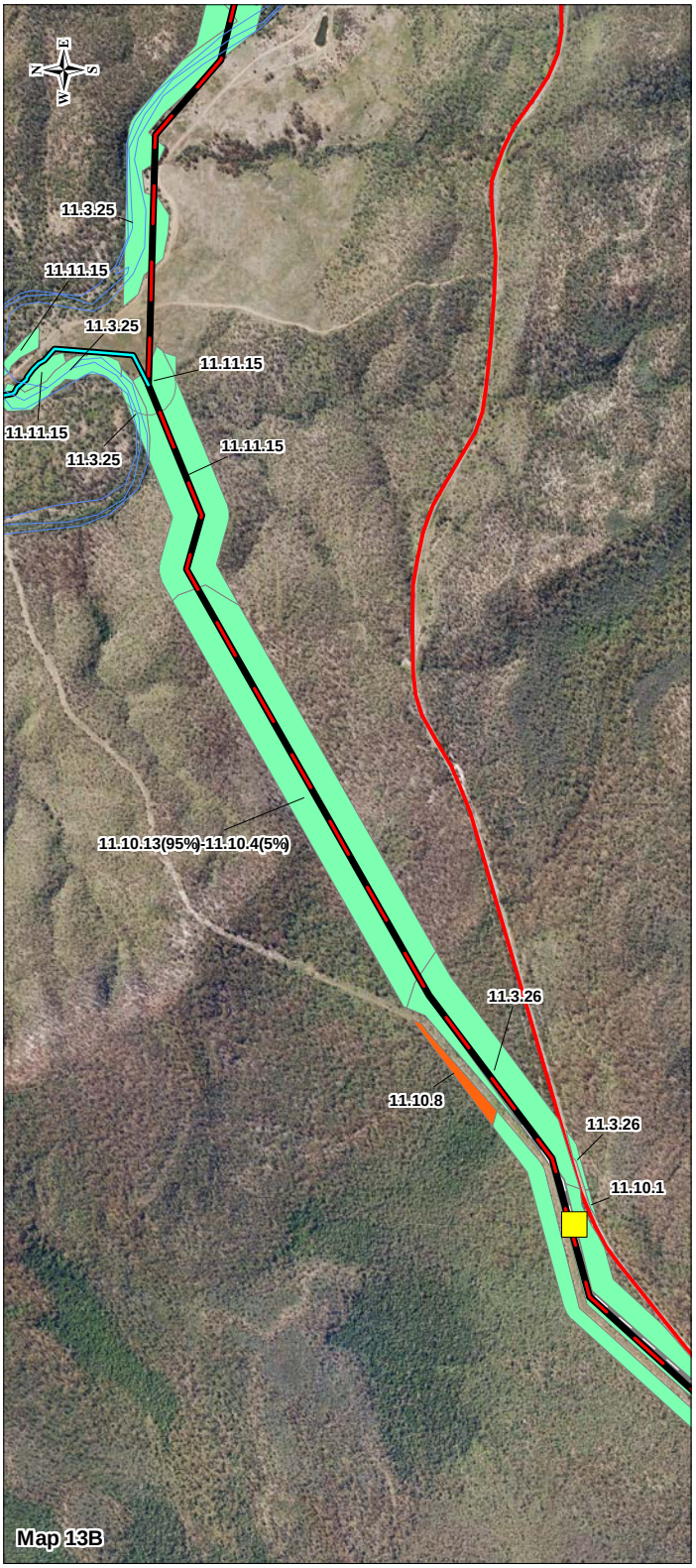
0 500 1000m

Scale: 1:25,000 (A4)
Projection: Geographic (GDA94)

Source:This map may contain data which is sourced and Copyright. Refer to Section 18.2 of the EIS for Ownership and Copyright.

Client: LNG / URS	Project: GLADSTONE LNG PROJECT ENVIRONMENTAL IMPACT STATEMENT SUPPLEMENT TERRESTRIAL FLORA ASSESSMENT GAS TRANSMISSION PIPELINE	Title: **REGIONAL ECOSYSTEMS GTP WEST OF BRUCE HIGHWAY MAP 12 OF 19**
	Drawn: RG | Approved: JB | Date: 09-11-2009 Job No: **42626440/**6220 | File No: 42626440-g-2044.wor	Figure: **14** | Rev:C | **A4**





Major Road
Minor Road
Major Drainage
Minor Drainage

GLNG Gas Transmission Pipeline (September 2009)
Callide Range Alternative Route (September 2009)
EIS Gas Transmission Pipeline (March 2009)

Secondary Sites
Quaternary Sites
Presence of Exotic Species (Refer Figure 22 for details)

Not of concern RE
Of concern dominant RE
Endangered dominant RE
Cycas megacarpa (Endangered - NC Act and EPBC Act)

0 500 1000m

Scale: 1:25,000 (A4)
Projection: Geographic (GDA94)

Client

Project
GLADSTONE LNG PROJECT
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT
TERRESTRIAL FLORA ASSESSMENT
GAS TRANSMISSION PIPELINE

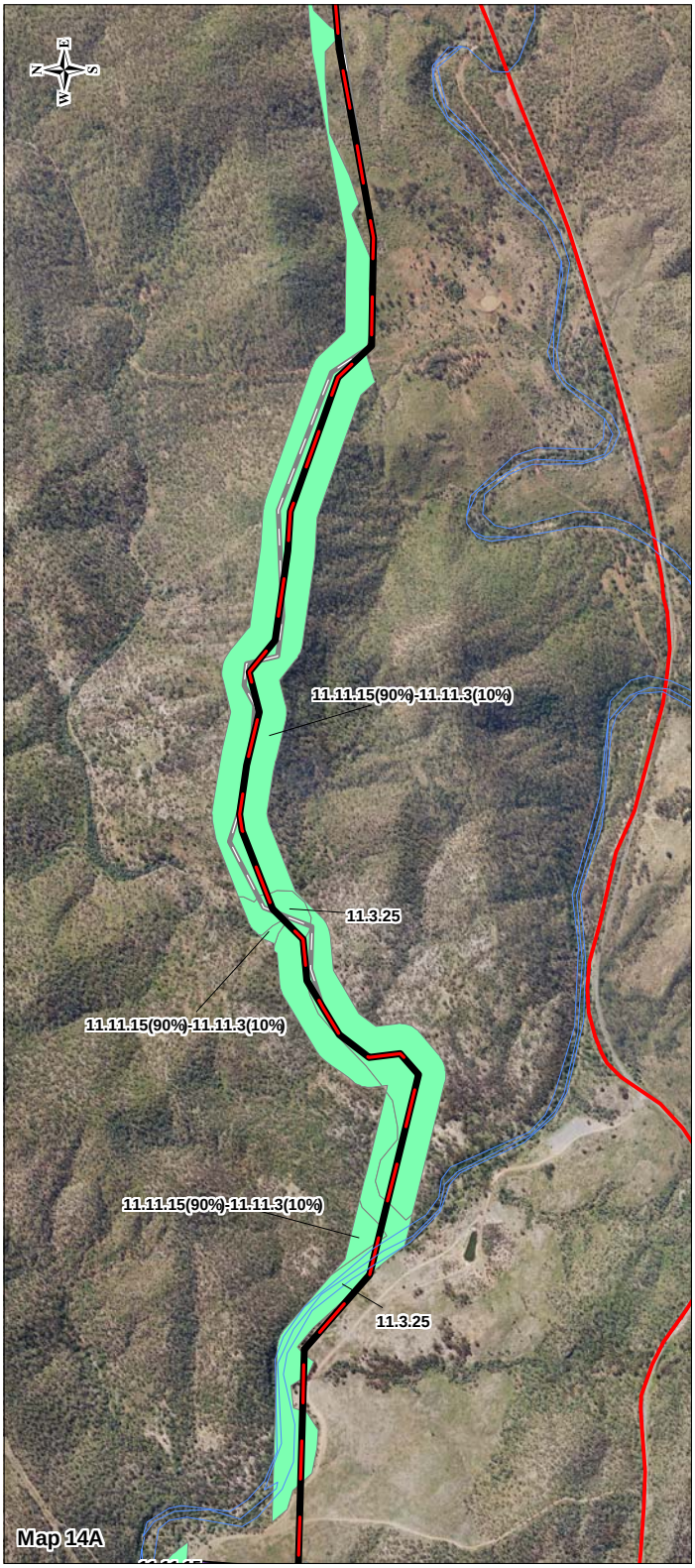
Title
REGIONAL ECOSYSTEMS
GTP WEST OF BRUCE HIGHWAY
MAP 13 OF 19

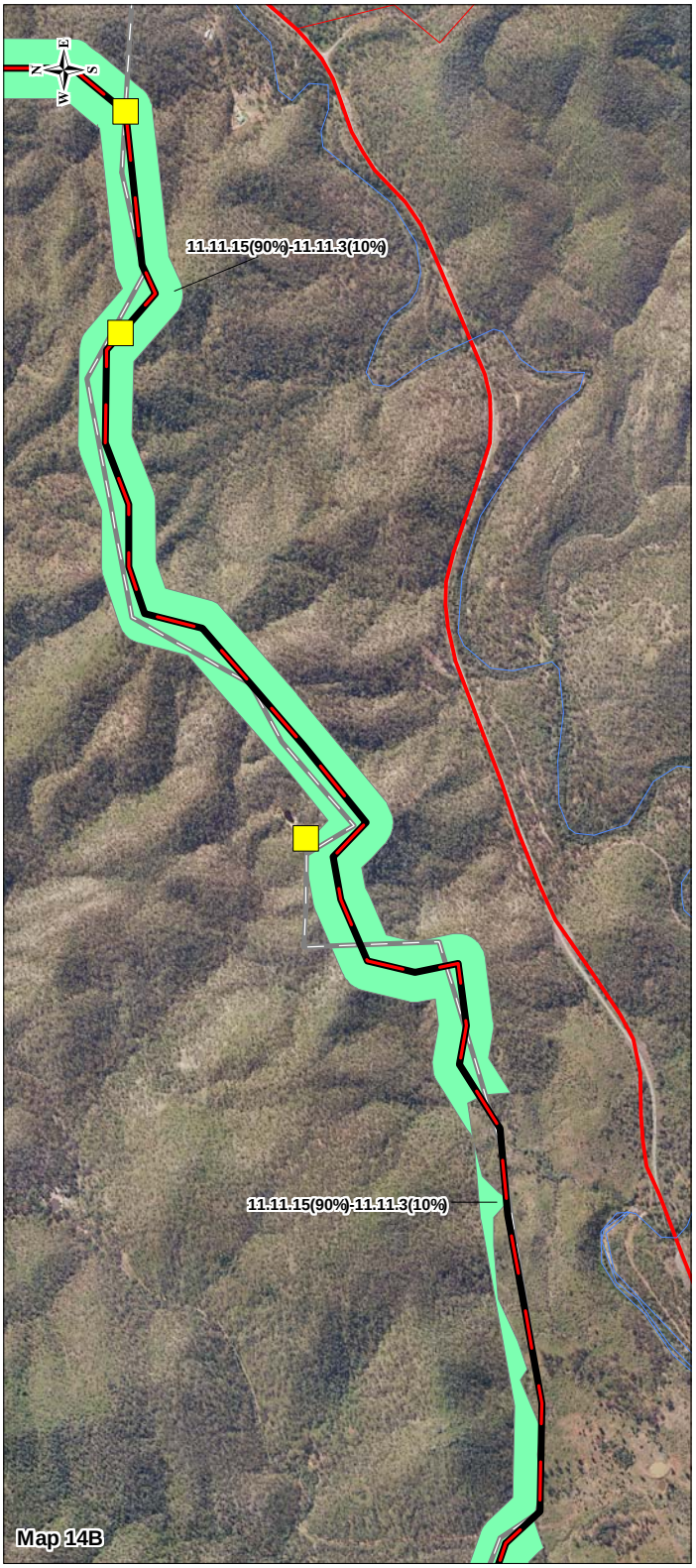
Drawn: RG	Approved: JB	Date: 23-10-2009
Job No: **42626440/**6220	File No: 42626440-g-2045.wor	

Figure: **15**

Rev:B

A4





Major Road
Minor Road
Major Drainage
Minor Drainage

GLNG Gas Transmission Pipeline (September 2009)
EIS Gas Transmission Pipeline (March 2009)

Secondary Sites
Quaternary Sites
Presence of Exotic Species (Refer Figure 22 for details)

Not of concern RE
Of concern dominant RE
Endangered dominant RE
Cycas megacarpa (Endangered - NC Act and EPBC Act)

0 500 1000m

Scale: 1:25,000 (A4)
Projection: Geographic (GDA94)

Source:This map may contain data which is sourced and Copyright. Refer to Section 18.2 of the EIS for Ownership and Copyright.

Client

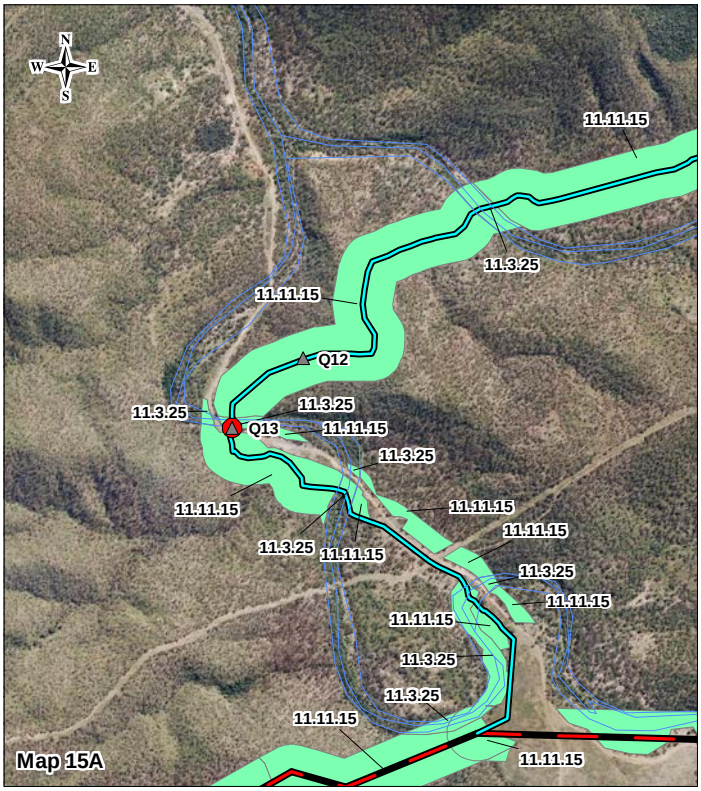
Project
GLADSTONE LNG PROJECT
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT
TERRESTRIAL FLORA ASSESSMENT
GAS TRANSMISSION PIPELINE

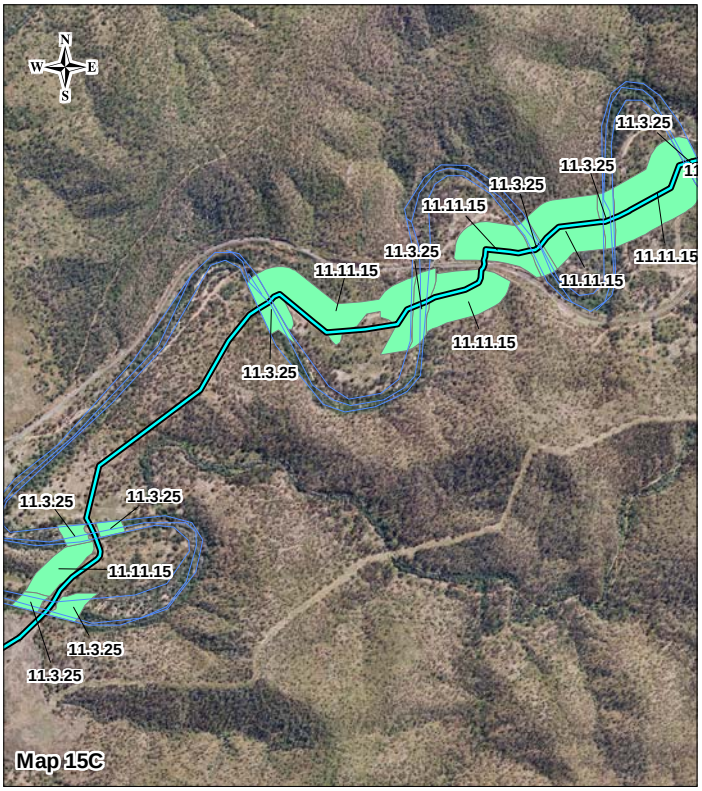
Title
REGIONAL ECOSYSTEMS
GTP WEST OF BRUCE HIGHWAY
MAP 14 OF 19

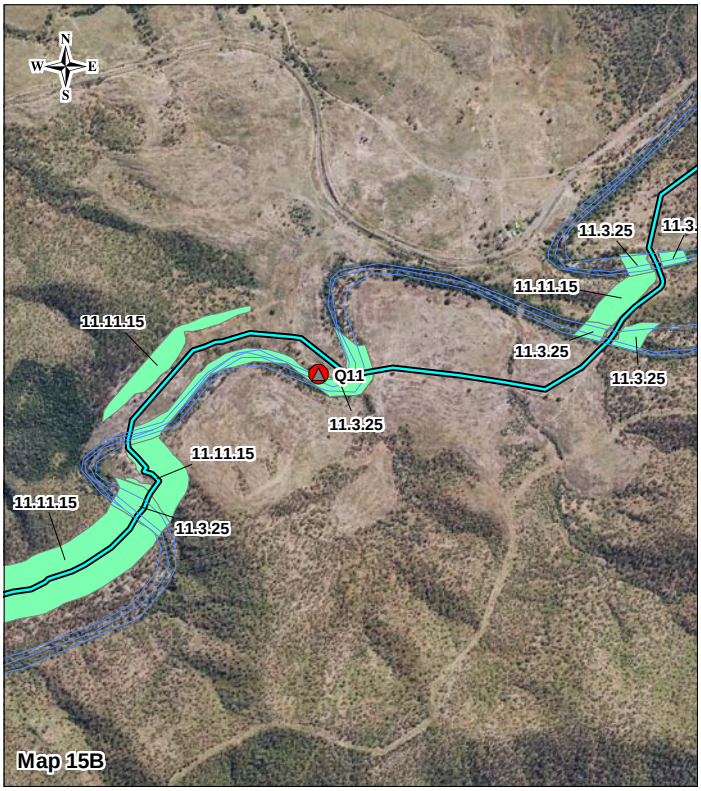
Drawn: RG	Approved: JB	Date: 23-10-2009
Job No: **42626440/**6220	File No: 42626440-g-2046.wor	

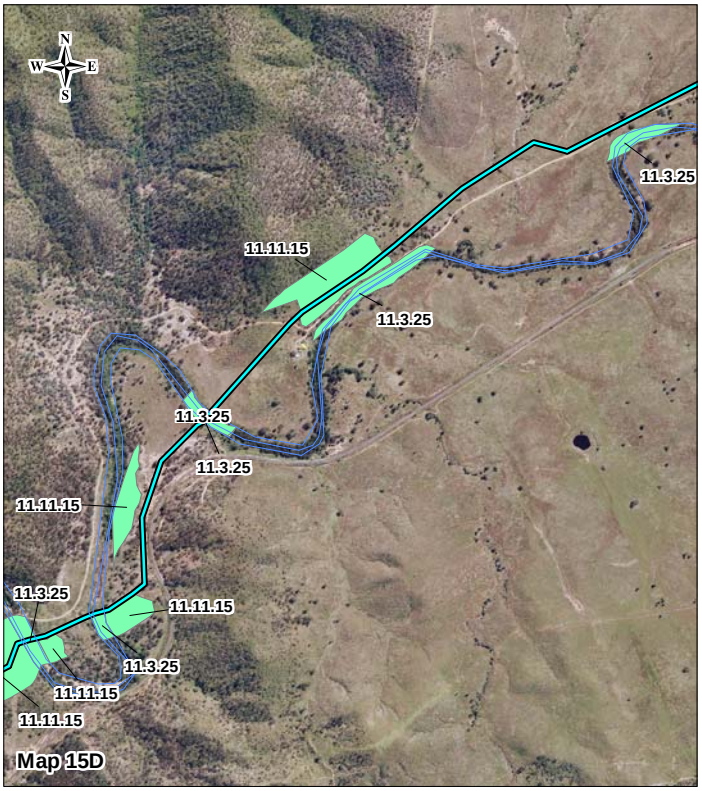
Figure: **16**

Rev:B
A4









Major Road
Minor Road
Major Drainage
Minor Drainage

GLNG Gas Transmission Pipeline (September 2009)
Callide Range Alternative Route (September 2009)
EIS Gas Transmission Pipeline (March 2009)

Secondary Sites
Quaternary Sites
Presence of Exotic Species (Refer Figure 22 for details)

Not of concern RE
Of concern dominant RE
Endangered dominant RE

0 500 1000m

Scale: 1:25,000 (A4)
Projection: Geographic (GDA94)

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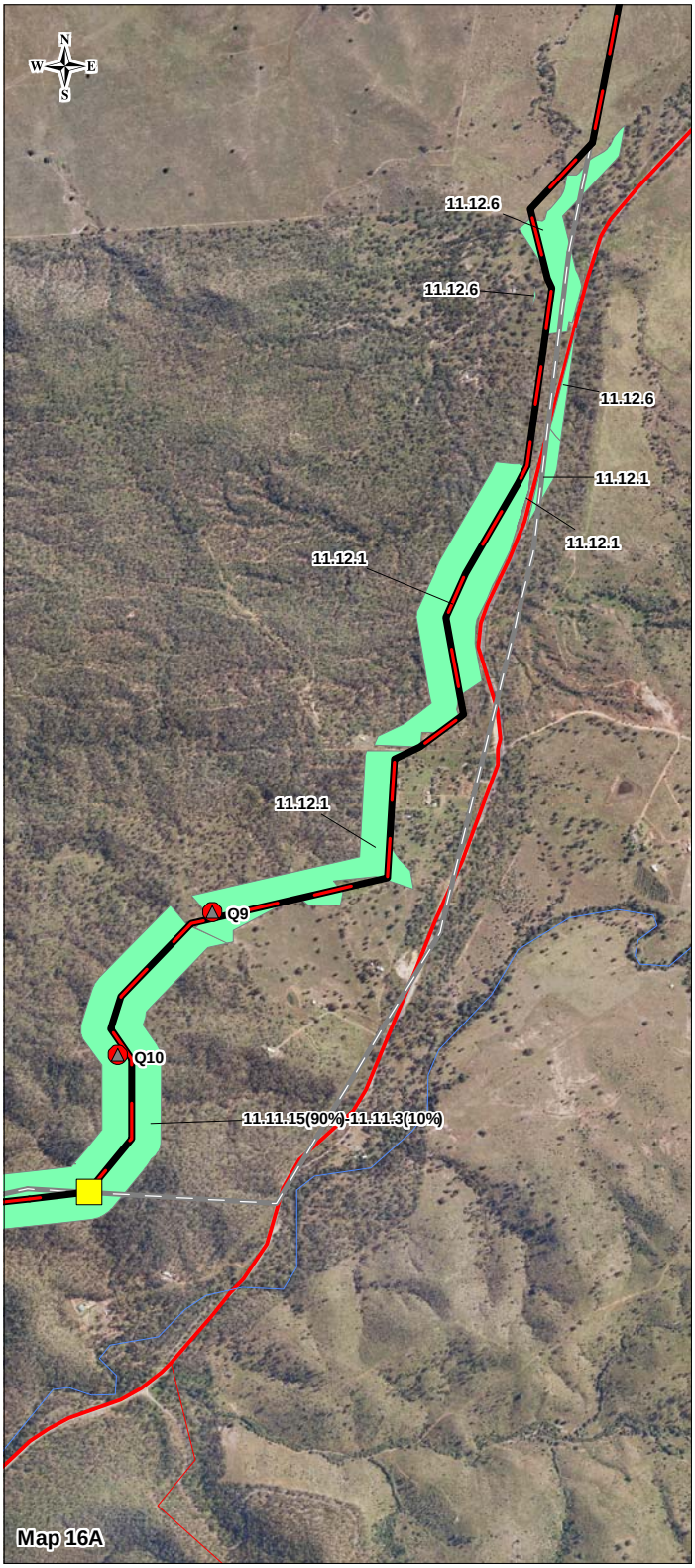
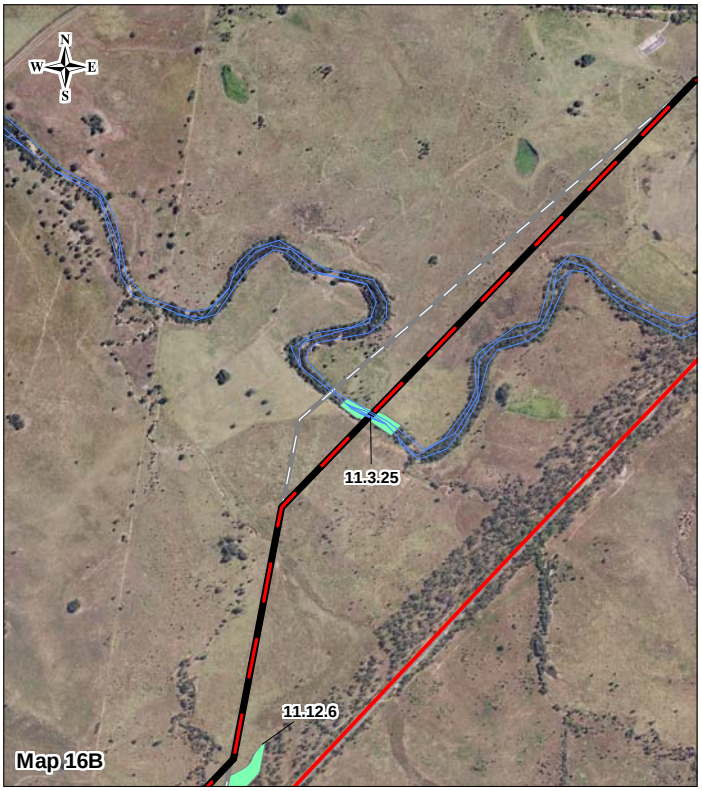
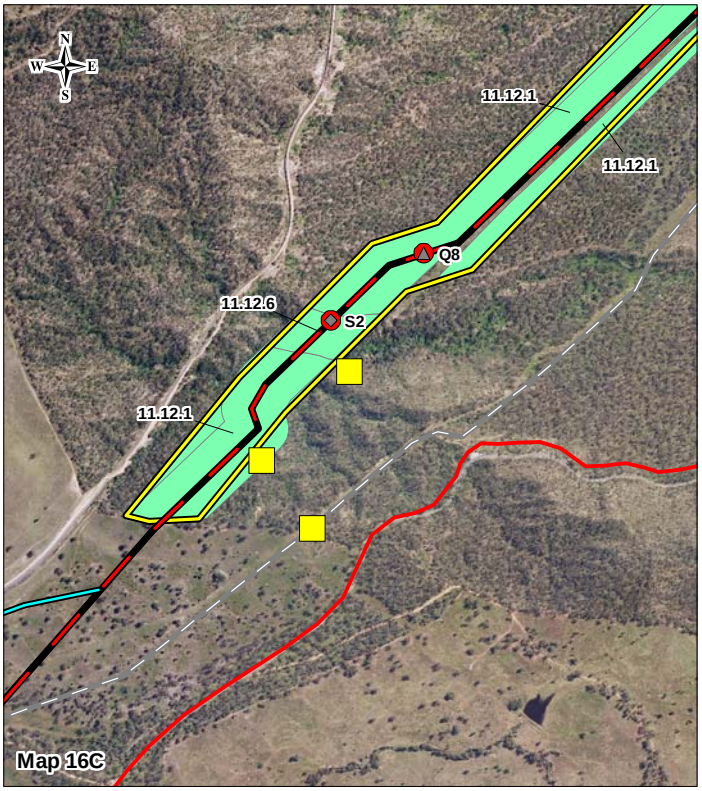
Client: LNG / URS	Project: GLADSTONE LNG PROJECT ENVIRONMENTAL IMPACT STATEMENT SUPPLEMENT TERRESTRIAL FLORA ASSESSMENT GAS TRANSMISSION PIPELINE	Title: **REGIONAL ECOSYSTEMS GTP WEST OF BRUCE HIGHWAY MAP 15 OF 19**
	Drawn: RG | Approved: JB | Date: 23-10-2009 Job No: **42626440/**6220 | File No: 42626440-g-2047.wor	Figure: **17** | Rev:B | **A4**







Major Road
Minor Road
Major Drainage
Minor Drainage

GLNG Gas Transmission Pipeline (September 2009)
Callide Range Alternative Route (September 2009)
Common Pipeline Infrastructure Corridor (CICSDA Section) (September 2009)
EIS Gas Transmission Pipeline (March 2009)

Secondary Sites
Quaternary Sites
Presence of Exotic Species (Refer Figure 22 for details)

Not of concern RE
Of concern dominant RE
Endangered dominant RE
Cycas megacarpa (Endangered - NC Act and EPBC Act)

0 500 1000m

Scale: 1:25,000 (A4)
Projection: Geographic (GDA94)

Client

Project
GLADSTONE LNG PROJECT
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SUPPLEMENT
TERRESTRIAL FLORA ASSESSMENT
GAS TRANSMISSION PIPELINE

Title
REGIONAL ECOSYSTEMS
GTP WEST OF BRUCE HIGHWAY
MAP 16 OF 19

Drawn: RG	Approved: JB	Date: 09-11-2009
Job No: **42626440/**6220	File No: 42626440-g-2048.wor	

Figure: **18**

Rev:C

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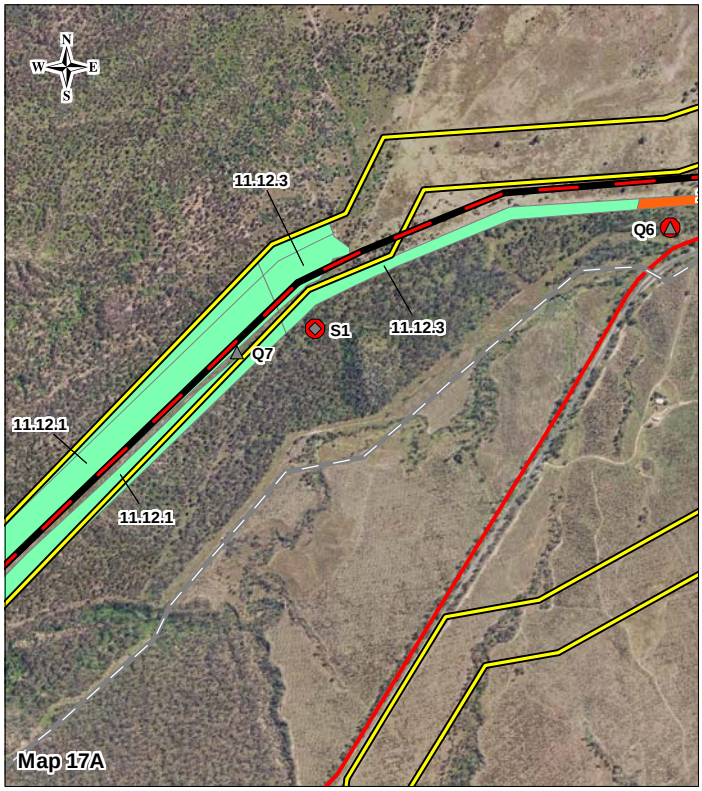

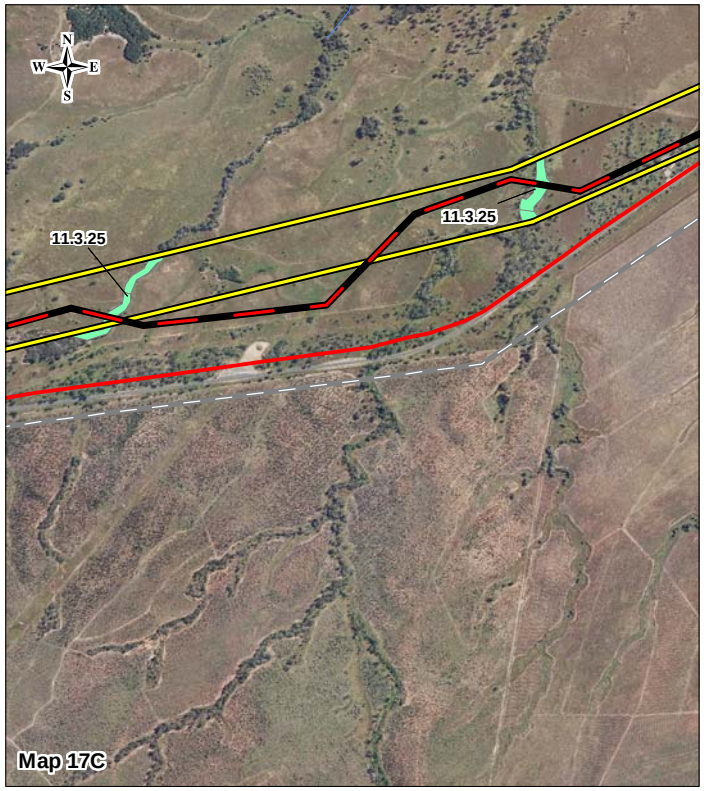

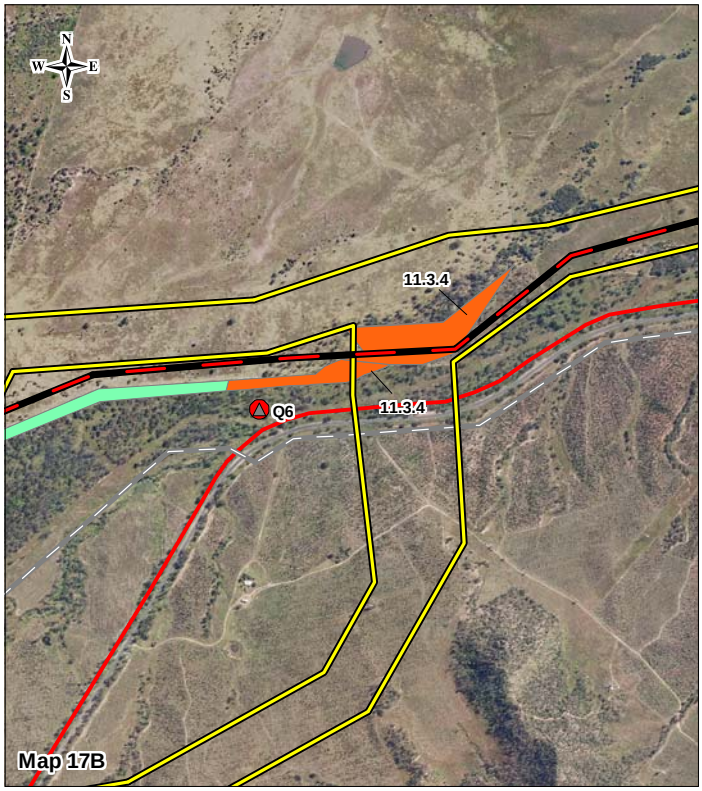

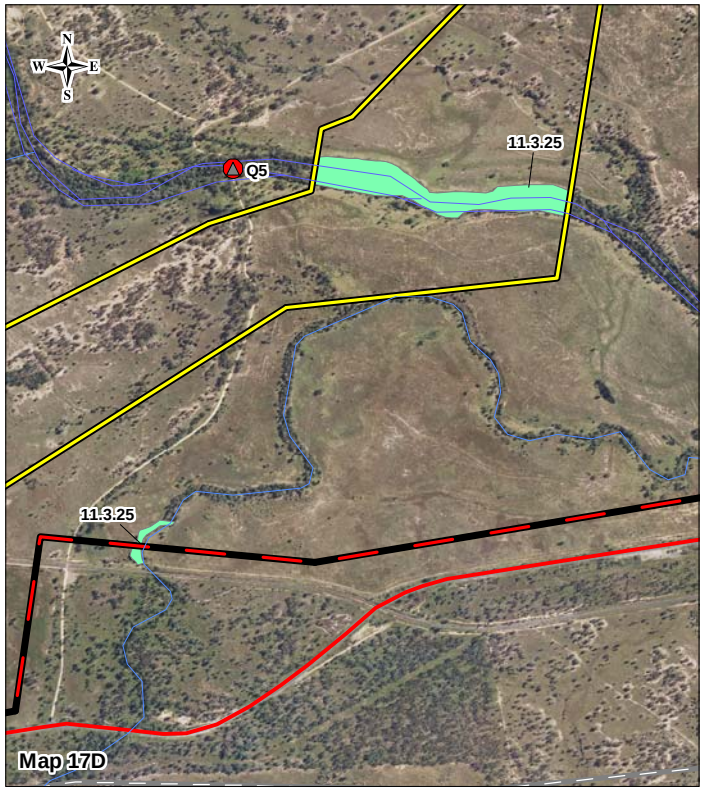

Major Road
Minor Road
Major Drainage
Minor Drainage

GLNG Gas Transmission Pipeline (September 2009)
Common Pipeline Infrastructure Corridor (CICSDA Section) (September 2009)
EIS Gas Transmission Pipeline (March 2009)

Secondary Sites
Quaternary Sites
Presence of Exotic Species (Refer Figure 22 for details)

Not of concern RE
Of concern dominant RE
Endangered dominant RE

0 500 1000m

Scale: 1:25,000 (A4)
Projection: Geographic (GDA94)

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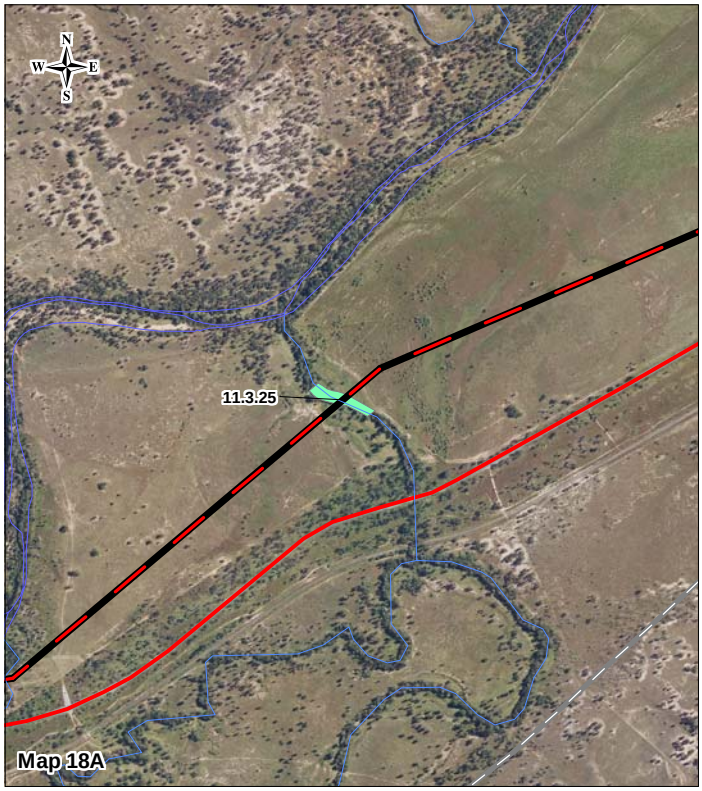
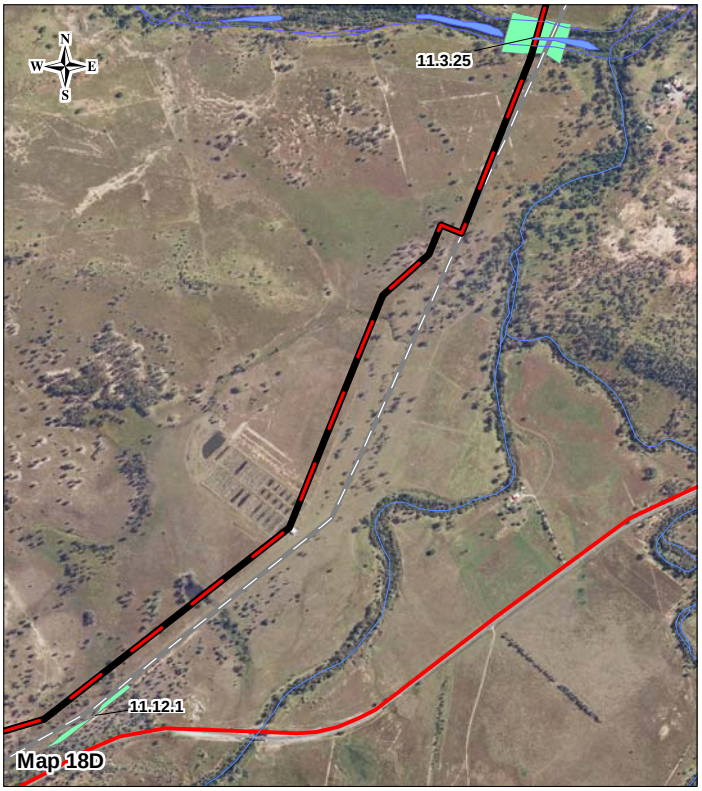
URS	Drawn: RG | Approved: JB | Date: 09-11-2009 Job No: **42626440/**6220 | File No: 42626440-g-2049.wor	Figure: **19** | Rev:C | **A4**





Major Road
Minor Road
Major Drainage
Minor Drainage

GLNG Gas Transmission Pipeline (September 2009)
Common Pipeline Infrastructure Corridor (CICSDA Section) (September 2009)
EIS Gas Transmission Pipeline (March 2009)

Secondary Sites
Quaternary Sites
Presence of Exotic Species (Refer Figure 22 for details)

Not of concern RE
Of concern dominant RE
Endangered dominant RE

0 500 1000m

Scale: 1:25,000 (A4)
Projection: Geographic (GDA94)

Client: LNG

URS

Project:
GLADSTONE LNG PROJECT
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT
TERRESTRIAL FLORA ASSESSMENT
GAS TRANSMISSION PIPELINE

Title:
REGIONAL ECOSYSTEMS
GTP WEST OF BRUCE HIGHWAY
MAP 18 OF 19

Drawn: RG	Approved: JB	Date: 09-11-2009
Job No: **42626440/**6220	File No: 42626440-g-2050.wor	

Figure: **20**

Rev:C

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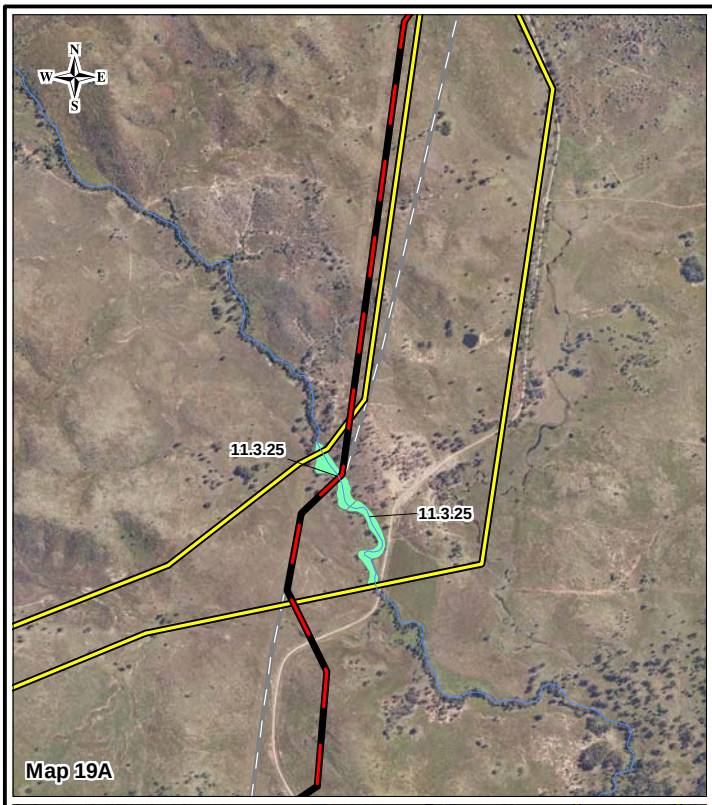

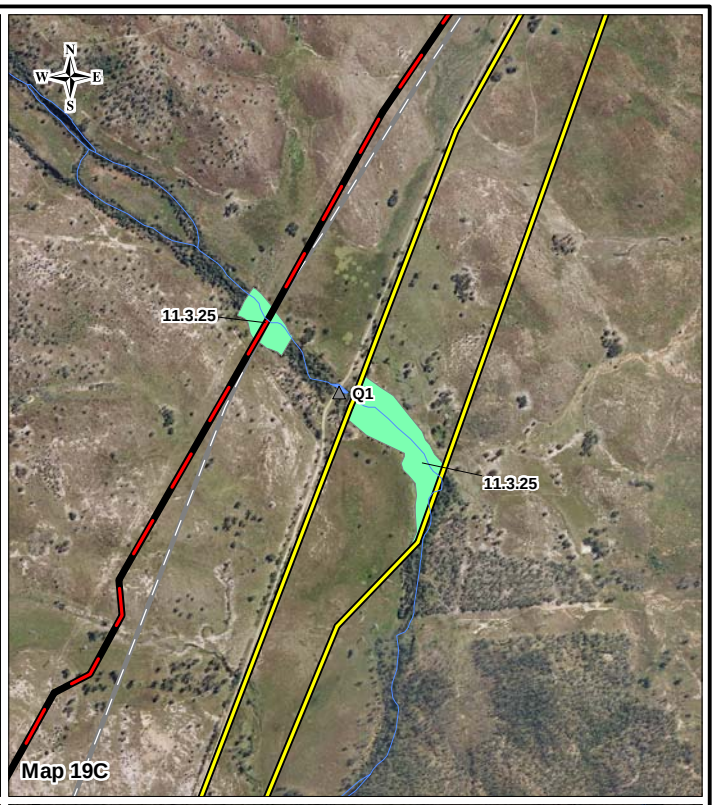

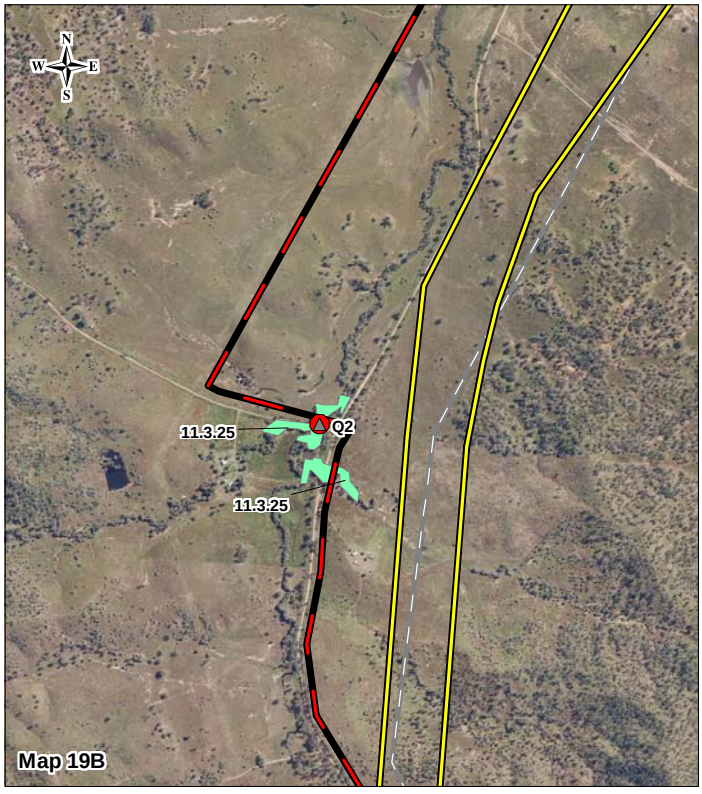

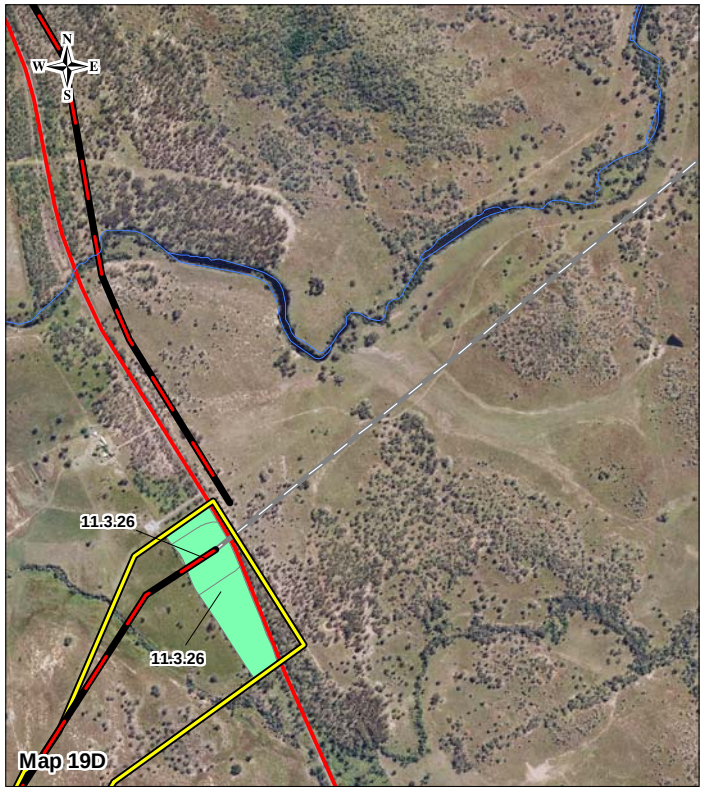

Major Road
Minor Road
Major Drainage
Minor Drainage

GLNG Gas Transmission Pipeline (September 2009)
Common Pipeline Infrastructure Corridor (CICSDA Section) (September 2009)
EIS Gas Transmission Pipeline (March 2009)

Secondary Sites
Quaternary Sites
Presence of Exotic Species (Refer Figure 22 for details)

Not of concern RE
Of concern dominant RE
Endangered dominant RE

0 500 1000m

Scale: 1:25,000 (A4)
Projection: Geographic (GDA94)

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TERRESTRIAL FLORA ASSESSMENT
GAS TRANSMISSION PIPELINE

Title: **REGIONAL ECOSYSTEMS GTP WEST OF BRUCE HIGHWAY MAP 19 OF 19**

Drawn: RG	Approved: JB	Date: 09-11-2009	Figure: 21	Rev:C
Job No: **42626440/**6220	File No: 42626440-g-2051.wor			A4

◆ Secondary Sites

Site Reference	*Cascabela thevetia* (Yellow Oleander)	*Celtis sinensis* (Chinese Celtis)	*Cryptostegia grandiflora* (Rubber Vine)	*Lantana camara* (Lantana)	*Lantana montevidensis* (Creeping Lantana)	*Macfadyena unguis-cati* (Cats Claw Creeper)	*Opuntia stricta* (Common Prickly Pear)	*Opuntia tomentosa* (Velvety Tree Pear)	*Parthenium hysterophorus* (Parthenium)	*Sporobolus pyramidilis* (Giant Rats Tail)
1				●				●		
2								●		
3								●		
6								●		

◀ Quaternary Sites

Site Reference	*Cascabela thevetia* (Yellow Oleander)	*Celtis sinensis* (Chinese Celtis)	*Cryptostegia grandiflora* (Rubber Vine)	*Lantana camara* (Lantana)	*Lantana montevidensis* (Creeping Lantana)	*Macfadyena unguis-cati* (Cats Claw Creeper)	*Opuntia stricta* (Common Prickly Pear)	*Opuntia tomentosa* (Velvety Tree Pear)	*Parthenium hysterophorus* (Parthenium)	*Sporobolus pyramidilis* (Giant Rats Tail)
2				●						
3		●	●							
4			●							
5	●		●							
6				●						
8				●						
9					●		●			
10					●					
11				●	●	●				
13				●		●				
15									●	
20								●		

Client

Project
GLADSTONE LNG PROJECT
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT
TERRESTRIAL FLORA ASSESSMENT
GAS TRANSMISSION PIPELINE

Title
REGIONAL ECOSYSTEMS
WEST OF BRUCE HIGHWAY
LEGEND TO EXOTIC SPECIES

Drawn: RG | Approved: JB | Date: 16-10-2009

Job No: **4262 6440**/6220 | File No: 42626220-g-2052.wor

Figure: **22**

Rev: A

A4

Appendix A Secondary Transect Data

Secondary Transect 1 **Pipeline** 02/09/09	
R.E.	11.12.3
Transect Start	150.745855; -24.120093
Transect End (50m)	150.745857; -24.120475
Bearing	North-east
Aspect	Flat
Slope	Flat
Soil	Sandy-loam
Weeds	*Opuntia tomentosa*, Lantana camara**
Grazing impacts	Occasional
Erosion	Negligible
Fire history	5-10 years
Fauna habitat	Hollows, stags, dense groundcover
Notes	
Strata	**Dominant Species**
Canopy (T1): 18-20 m **FPC: 50%**	*Eucalyptus crebra*
	Eucalyptus tereticornis
Canopy (T2): 10-16 m **FPC: 30%**	*Corymbia tessellaris*
	Corymbia clarksoniana
	Eucalyptus tereticornis
Shrub (S1): 1-3 m **FPC: 5%**	*Lantana camara**
	Acacia salicina
	Acacia leiocalyx
	*Opuntia tomentosa**
	Petalostigma pubescens
Ground (G): <1 m **FPC: 80%** **Litter: 10%** **Bare: 10%**	*Cyanthilium cinereum*
	Pterocaulon sphacelatum
	Stylosanthes scabra
	Heteropogon contortus
	Themeda triandra
	Grewia latifolia
	Cymbopogon refractus
	Panicum decompositum
	Cyperus gracilis
	Sida cordifolia
	Aristida sp.
	Setaria sp.
	Hyparrhenia rufa
	Melinis repens

Secondary Transect 2 **Pipeline** 02/09/09	
R.E.	11.12.6
Transect Start	150.730757; -24.131733
Transect End (50m)	(centroid only)
Bearing	East
Aspect	North
Slope	50%
Soil	Sandy/ decomposed granite gravel
Weeds	*Opuntia tomentosa*, Lantana camara**
Grazing impacts	Nil
Erosion	Minor
Fire history	5-10 years
Fauna habitat	Hollows, stags
Notes	Occasional *Cycas megacarpa* on slopes
Strata	**Dominant Species**
Canopy (T1): 14-18 m **FPC: 15%**	*Corymbia citriodora*
Canopy (T2): 8-12 m **FPC: 20%**	*Eucalyptus crebra*
	Lophostemon suaveolens
Shrub (S1): 1-4 m **FPC: 5%**	*Alphitonia excelsa*
	Acacia disparrima
	Cycas megacarpa
	Capparis ornans
	Acacia leiocalyx
Ground (G): <1 m **FPC: 30%** **Litter: 40%** **Bare: 30%**	*Heteropogon contortus*
	Lantana camara
	Xanthorrhoea johnsonii
	Macrozamia sp. (collected)
	Themeda triandra
	Opuntia tomentosa
	Cyanthilium cinereum
	Aristida sp.
	Cheilanthes sieberi
	Alchornea ilicifolia

Appendix A

Secondary Transect 3 **Pipeline** 03/09/09	
R.E.	11.5.9
Transect Start	149.708623; -24.463555
Transect End (50m)	149.709053; -24.46372
Bearing	East
Aspect	South
Slope	<5%
Soil	sandy
Weeds	*Opuntia tomentosa**
Grazing impacts	Heavy
Erosion	Low
Fire history	>10 years
Fauna habitat	Thickets, ground timber
Notes	
Strata	**Dominant Species**
Canopy (T1): 10-14 m **FPC: 20%**	*Eucalyptus melanophloia*
	Eucalyptus populnea
Canopy (T2): 6-10 m **FPC: 10%**	*Eucalyptus melanophloia*
Shrub (S1): 1-4 m **FPC: 25%**	*Alectryon diversifolius*
	Geijera parviflora
	Denhamia oleaster
	Diospyros geminata
	*Opuntia tomentosa**
	Petalostigma pubescens
	Alphitonia excelsa
Ground (G): <1 m **FPC: 50%** **Litter: 10%** **Bare: 40%**	*Aristida caput-medusae*
	Carissa ovata
	*Stylosanthes scabra**
	*Pennisetum ciliare**
	Capparis lasiantha
	Everistia vacciniifolia
	*Melinis repens**
	Enneapogon lindleyanus
	Nyssanthes erecta
	Urochloa mosambicensis
	Sida subspicata

Secondary Transect 4 **Pipeline** 04/09/09	
R.E.	11.8.4
Transect Start	149.03100; -24.654233
Transect End (50m)	149.030982; -24.654655
Bearing	North
Aspect	East
Slope	<5%
Soil	sandy loam
Weeds	*Opuntia tomentosa**
Grazing impacts	Nil
Erosion	Nil
Fire history	5-10 years
Fauna habitat	Hollows, stags, native grass cover
Notes	Bandicoots diggings and high bird diversity present
Strata	**Dominant Species**
Canopy (T1): 25-30 m **FPC: 25%**	*Corymbia citriodora*
Canopy (T2): 12-18 m **FPC: 20%**	*Corymbia citriodora*
	Eucalyptus crebra
	Eucalyptus melanophloia
Shrub (S1): 1-4 m **FPC: 5%**	*Alphitonia excelsa*
Ground (G): <1 m **FPC: 60%** **Litter: 30%** **Bare: 10%**	*Heteropogon contortus*
	Panicum effusum
	Arundinella nepalensis
	Imperata cylindrica
	Grewia latifolia
	Eragrostis brownii
	Themeda triandra

Appendix A

Secondary Transect 5 **Pipeline** 06/09/09	
R.E.	11.10.3
Transect Start	148.874412; -25.5843133
Transect End (50m)	148.874143; -25.583993
Bearing	North-west
Aspect	South-west
Slope	10%
Soil	sandy soil
Weeds	nil
Grazing impacts	nil
Erosion	Minor sheet erosion
Fire history	<5 years
Fauna habitat	Hollows, ground timber, thickets, stags
Notes	This community has been heavily impacted by fire in the past with significant subsequent changes to structural and floristic composition. However, it still fits within 11.10.3.
Strata	**Dominant Species**
Emergent (E): 10-14 m FPC: 5%	*Eucalyptus tenuipes*
	Eucalyptus exserta
Canopy (T1): 8-10 m **FPC: 20%**	*Acacia catenulata*
	Allocasuarina inophloia
	Acacia shirleyi
	Lysicarpus angustifolius
	Callitris endlicheri
Shrub (S1): 1-4 m **FPC: 3%**	*Acacia longispicata*
	Acacia macradenia
	Alphitonia excelsa
Ground (G): <1 m **FPC: 40%** **Litter: 20%** **Bare: 40%**	*Dodonaea triangularis*
	Panicum effusum
	Aristida caput-medusae
	Cymbopogon refractus

Secondary Transect 6 **Pipeline** 01/07/08	
R.E.	11.10.8
Transect Start	148.915978; -25.731393
Transect End (50m)	(centroid only)
Bearing	North-west
Aspect	South-east
Slope	<10%
Soil	Sandstone boulders; skeletal sandy soil
Weeds	*Opuntia tomentosa**
Grazing impacts	occasional
Erosion	negligible
Fire history	>10 years
Fauna habitat	Rocks, scarps, thickets
Notes	Narrow strip of SEVT near top of scarp
Strata	**Dominant Species**
Canopy (T1): 8-12 m **FPC: 10%**	*Brachychiton rupestris*
	Callitris endlicheri
Shrub (S1): 1-3 m **FPC: 60%**	*Pouteria sericea*
	Diospyros geminata
	Denhamia oleaster
	Breynia oblongifolia
	Cupaniopsis anacardioides
	Santalum lanceolatum
	Pandorea pandorana
	Eremophila mitchellii
	Bursaria incana
	Atalaya hemiglauca
	Alectryon diversifolius
Ground (G): <1 m **FPC: 30%** **Litter: 45%** **Bare: 25%**	*Carissa ovata*
	Jasminum simplicifolium
	Jasminum didymum
	Pennisetum ciliare
	Platycerium superbum
	Croton insularis
	Capparis loranthifolia

URS Australia Pty Ltd
Level 16, 240 Queen Street
Brisbane, QLD 4000
GPO Box 302, QLD 4001
Australia
T: 61 7 3243 2111
F: 61 7 3243 2199

www.ap.urscorp.com

3

Part 3 Gladstone State Development Area

Report

Part 3 - GSDA

November 2009

Prepared for

Santos

32 Turbot Street
Brisbane, Qld 4000

42626442

URS

Project Manager:

Jim Barker
Associate Environmental Scientist

URS Australia Pty Ltd

Level 16, 240 Queen Street
Brisbane, QLD 4000
GPO Box 302, QLD 4001
Australia
T: 61 7 3243 2111
F: 61 7 3243 2199

Project Director:

Chris Pigott
Senior Principal

Author:

Vanessa Wood
Environmental Scientist

Reviewer:

Dan Simmons
Associate Environmental Scientist

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Appendices

Abbreviations

Abbreviation	Description
APIA	Australian Pipeline Industry Association
BoM	Bureau of Meteorology
CSG	Coal Seam Gas
CPIC	Common Pipeline Infrastructure Corridor
DEEDI	Queensland Department of Employment, Economic Development and Innovation
DERM	Queensland Department of Environment and Resource Management
DEWHA	Department of Environment, Water, Heritage and the Arts
DIP	Department of Infrastructure and Planning
DIWA	Directory of Important Wetlands in Australia
DNRW	Department of Natural Resources and Water
DPI	Department of Primary Industries
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EPA	Environmental Protection Agency
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESA	Environmentally Sensitive Areas
EVR	Endangered Vulnerable and Rare
FPC	Foliage Projection Cover
GLNG	Gladstone Liquid Natural Gas
GRT	Giant Rat's Tail
GSDA	Gladstone State Development Area
GTP	Gas Transmission Pipeline
HERBRECS	A database maintained by the Queensland Herbarium that provides a list of specimens and collections for a specified search area.
LNG	Liquefied Natural Gas
LP Act	Queensland *Lands Protection (Pest and Stock Route Management) Act* 2002
MNES database	Commonwealth Department of the Environment, Water, Heritage and the Arts (DEWHA) Matters of National Environmental Significance database
Qld.	Queensland
NC Act	Queensland Nature Conservation Act 1992
RE	Regional Ecosystems
REDD	Regional Ecosystems Description Database
ROW	Right of Way
SF	State Forest
VM Act	Queensland *Vegetation Management Act* 1999
VM Status	Vegetation Management Status
WONS	Weeds of National Significance

Executive Summary

This report discusses two gas transmission pipeline (GTP) routes for Gladstone Liquid Natural Gas (GLNG) within the Gladstone State Development Area (GSDA) (Figure 1). These are known as the Common Pipeline Infrastructure Corridor (CPIC) and the GLNG GTP (September 2009) route. The GSDA lies to the north and north-west of Gladstone and extends approximately 20 km from the Bruce Highway in a north-east direction across The Narrows to Curtis Island. This report refers to only the mainland portion of the GSDA, with the Curtis Island portion being discussed in Part 4 Curtis Island.

The aims of the ecological investigation were to map the vegetation communities of the GLNG GTP (September 2009) route within the GSDA and the CPIC (GSDA Section) Route, identify areas of vegetation or species of conservation significance, identify potential fauna habitat and assess the impacts of the GTP and the CPIC on the flora and fauna of the region. A desktop review of existing information was undertaken to identify the range of species, habitats, and communities that may be present within the proposed GTP study area. Vegetation mapping was undertaken for a 200 metre wide survey corridor of the GTP for both the CPIC (GSDA Section) Route and the GLNG GTP (September 2009) route.

Thirty-four conservation significant flora species listed under both state and commonwealth legislation were identified from the desktop review. Twenty-five of these were considered either 'possible' or 'likely' and eight of these considered 'unlikely' within the GTP corridor. Fieldwork was conducted over one week and a total of 24 sites assessed.

A field survey of the relevant portions of the GSDA area was undertaken. The field survey identified the presence of 71 taxa representing 36 families and 65 genera. One species of conservation significance (*Macropteranthes leiocaulis*) was identified within the GSDA, although outside of the GTP corridors. Of the 11 exotic weed species recorded in this survey of the GTP, four are declared species and two species are also listed as Weeds of National Significance. Within the 200 m wide corridor, 10 REs and 11 REs were mapped for the CPIC (GSDA Section) Route and GLNG GTP (September 2009) Alignment respectively.

The clearance of the estimated CPIC (GSDA Section) Route ROW used will result in the disturbance of approximately 109.68 ha of land which will include approximately 28 ha of remnant vegetation. The clearance of the GLNG GTP (September 2009) Alignment ROW will result in the disturbance of approximately 115.96 ha of land, which will include approximately 20.08 ha of remnant vegetation. Fauna mortality impacts and predator prey disruption from habitat loss are expected to be relatively low in the context of the overall landscape ecology and there should not be significant long-term impacts to overall faunal assemblages and species populations. Appropriate management strategies and mitigation measures are discussed including clearing schemes and the management of conservation significant communities. It is not anticipated that the proposed works will significantly further reduce current values if the mitigation measures outlined within this report are utilised. Given the rise of industrial development in Gladstone and environs, cumulative impacts pose a threat to the remnant vegetation and fauna habitat of this region.

1

Introduction

1.1 Background

This report discusses two gas transmission pipeline (GTP) routes for Gladstone Liquefied Natural Gas (GLNG) within the Gladstone State Development Area (GSDA) (Figure 1). The GSDA lies to the north and north-west of Gladstone and extends approximately 20 km from the Bruce Highway in a north-east direction across The Narrows to Curtis Island. This report refers to only the mainland portion of the GSDA, with the Curtis Island portion being discussed in Part 4 Curtis Island.

Designation of the government preferred option known as the Common Pipeline Infrastructure Corridor (CPIC) is still to be finally determined by the Department of Infrastructure and Planning (DIP). This corridor aims to provide a common use corridor for multiple pipelines through the GSDA. Santos' use of the CPIC is also dependent on the government's resumption of the relevant underlying land interest and negotiation of access terms and conditions. As the CPIC (GSDA Section) Route was not finalized at the time the GLNG Environmental Impact Statement (EIS) was submitted, only limited assessment of the corridor was possible. The GLNG GTP (September 2009) route within the GSDA differs in several locations from the CPIC (GSDA Section) Route (Figure 1) and has been included to ensure that the study area covers the GTP deviation from the proposed CPIC (GSDA Section) Route.

Throughout this document, a reference to the study area is a reference to both the GTP option routes within the GSDA area as designated above. A reference to the study corridor or GTP corridor refers to the area within each individual pipeline route; either the CPIC or the GLNG GTP (September 2009) route as shown in Figure 1.

1.2 Study Aim and Objectives

The aims of the ecological investigation were to map the vegetation communities of the GLNG GTP (September 2009) route and the CPIC (GSDA Section) Route (Figure 1), identify areas of vegetation or species of conservation significance, identify potential fauna habitat and assess the impacts of the GTP and the CPIC on the flora and fauna of the region.

In meeting these aims, the objectives of the survey were to:

- Review existing terrestrial vegetation data for the local area and region;
- Provide baseline data on Regional Ecosystems (REs) occurring in the study area;
- Assess the diversity of terrestrial vascular flora within the study area and identify ecologically sensitive areas;
- Identify and/or verify the occurrence or expected occurrence of conservation significant flora species;
- Identify and assess potential fauna habitat in the study area;
- Describe weed species and their distribution in the study area;
- Determine the impacts of GLNG GTP and CPIC on the surrounding vegetation; and
- Develop appropriate management strategies.

Access permissions to the study area for this GSDA survey were not previously available for the course of the EIS study period in 2008 and so the survey has been undertaken now as access permissions are present as a part of the EIS Supplement studies. The GSDA study area is described in further detailed in Section 2.1.4.

1.3 Legislative Context

1.3.1 Environment Protection and Biodiversity Conservation Act, 1999

The Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999* (EPBC Act) provides for the protection of the environment, especially relating to matters of National Environmental Significance (Protected matters) and is administered by the Commonwealth Department of the Environment, Water, Heritage and the Arts (DEWHA). It is designed to provide for the conservation of biodiversity through the protection of threatened species and ecological communities, migratory, marine and other protected species listed under the Act. In general, the *EPBC Act* streamlines the national environmental assessment and approvals process, protects Australian biodiversity and integrates management of important natural and cultural places.

1.3.2 Nature Conservation Act, 1992

The Queensland *Nature Conservation Act, 1992* (NC Act) is administered by the Queensland Department of Environment and Resource Management (DERM) and is the principal legislation for the conservation and management of the State's native flora and fauna. The primary objective of the *NC Act* is to ensure the preservation of endangered, vulnerable and rare (EVR) species of flora and fauna as listed under the *Nature Conservation (Wildlife) Regulation 2006*.

1.3.3 Lands Protection Act, 2002

The Queensland *Lands Protection (Pest and Stock Route Management) Act 2002* (LP Act) legislation provides pest management for agricultural lands. There are currently 84 declared plants (or plant groups) identified for Queensland. In order to prioritise the control of weeds in Queensland, declared plants are categorised into three separate classes, each with their own set of legal requirements as detailed below (Department of Primary Industries, 2002).

Class 1 Declared Weeds

A Class 1 declared weed is a species that has the potential to become a very serious pest in Queensland in the future. All landholders are legally required to keep their land free of Class 1 pests.

Class 2 Declared Weeds

Class 2 declared weeds are generally pest species that have already spread across substantial areas of Queensland, but the impact is so serious that control is needed to avoid further spreading of the weed. Landholders are legally required to take reasonable steps to keep their property free from Class 2 declared weeds.

Class 3 Declared Weeds

A Class 3 pest is one that is very common in Queensland, but is having a serious impact on native bushland. The control of a Class 3 declared weed is not required unless it is impacting, or has potential to impact, on a nearby environmentally significant area (e.g. a national park or reserve).

1.3.4 Vegetation Management Act, 1999

The purpose of the Queensland *Vegetation Management Act 1999* (VM Act) is to:

1 Introduction

- Regulate the clearing of native vegetation (i.e. remnant vegetation mapped as 'Endangered', 'Of Concern' and 'Not of Concern' Regional Ecosystems (REs)) to prevent the loss of biodiversity or any increase in land degradation from vegetation clearing;
- Maintain ecological processes; and
- Reduce greenhouse gas emissions.

Additionally, areas of remnant vegetation specific to conservation significant species (listed under the *NC Act*) are further classified as Essential Habitat.

The DERM uses certified mapping of remnant vegetation and Essential Habitat to administer the *VM Act*. Clearing of native vegetation mapped as REs and/or Essential Habitat is subject to assessment against the applicable Regional Vegetation Management Code for the Brigalow Belt and South-east Queensland Bioregions (Department of Natural Resources and Water, 2008).

Remnant Vegetation Conservation Status

The Regional Ecosystem Description Database (REDD) lists the status of regional ecosystems as gazetted under the *VM Act* (Vegetation Management Status) and their Biodiversity Status as recognised by the DERM.

The construction and operation of the GTP is subject to the requirements of the *VM Act*.

Biodiversity status of affected communities is to be listed in the EIS as requested within the Terms of Reference; however the *VM Act* status is the primary classification.

Vegetation Management Status

Not of Concern

Regional Ecosystems are listed as 'Not of Concern' under the *VM Act* if the remnant vegetation for the community is over 30 per cent of its pre-clearing extent across the bioregion, and the remnant area is greater than 10,000 hectares.

Of Concern

Regional Ecosystems are listed as 'Of Concern' under the *VM Act* if the remnant vegetation for the community is 10 to 30 per cent of its pre-clearing extent across the bioregion; or more than 30 per cent of its pre-clearing extent remains and the remnant extent is less than 10,000 hectares.

Endangered

Regional Ecosystems are listed as 'Endangered' under the *VM Act* if the remnant vegetation for the community is less than 10 per cent of its pre-clearing extent across the bioregion; or 10 to 30 per cent of its pre-clearing extent remains and the remnant vegetation is less than 10,000 hectares.

1 Introduction

Biodiversity Status

Biodiversity status is defined by the DERM and is based upon "an assessment of the condition of remnant vegetation in addition to the pre-clearing and remnant extent of a regional ecosystem" (DERM, 2009).

Not of Concern

A regional ecosystem is listed as 'Not of concern' when remnant vegetation is over 30 per cent of its pre-clearing extent across the bioregion; the remnant area is greater than 10,000 hectares and the degradation criteria[1] for 'Endangered' or 'Of concern' regional ecosystems are not met.

Of Concern

A regional ecosystem is listed as having an 'Of concern' biodiversity status when remnant vegetation is 10-30 per cent of its pre-clearing extent across the bioregion; or more than 30 per cent of its pre-clearing extent remains and the remnant extent is less than 10,000 hectares, and if 10-30 per cent of its pre-clearing extent remains unaffected by moderate degradation and/or biodiversity loss.

Endangered

A regional ecosystem is listed as having an 'Endangered' biodiversity status when less than 10 per cent of the pre-clearing extent of remnant remains unaffected by severe degradation and/or biodiversity loss; or 10 to 30 per cent of its pre-clearing extent remains unaffected by severe degradation and/or biodiversity loss and the remnant vegetation is less than 10,000 hectares; or it is a rare regional ecosystem subject to a threatening process.

EPBC Act Status

The *EPBC Act* defines an 'Endangered' community as an ecological community that is not critically endangered but it is facing a very high risk of extinction in the wild in the near future.

Vegetation Clearing

The following information describes the circumstances in which vegetation clearing may be undertaken in relation to the construction and operation of the GTP.

Santos is authorised to undertake vegetation clearing as an incidental activity within the area of the pipeline licence where the vegetation clearing is reasonably necessary for the construction or operation of the pipeline. The clearing of vegetation outside the area of the pipeline licence is subject to the *VM Act*.

[1] Severe degradation and/or biodiversity loss is defined as:
floristic and/or faunal diversity is greatly reduced but unlikely to recover within the next 50 years even with the removal of threatening processes; or soil surface is severely degraded, for example, by loss of A horizon, surface expression of salinity, surface compaction, loss of organic matter or sheet erosion. (DERM, 2009)

2

Methodology

2.1 Field Survey Approach

The flora survey employed an assessment of floral taxa and Regional Ecosystems in keeping with the methodology employed by the Queensland Herbarium for the survey of Regional Ecosystems and vegetation communities (Neldner *et al.,* 2005). The survey design was established in consultation with the DERM.

Vegetation mapping was restricted to a 200 metre wide survey corridor of the GTP for both the CPIC (GSDA Section) Route and GLNG GTP (September 2009) route within the GSDA. Preliminary identification of the vegetation communities was conducted prior to the commencement of fieldwork using 1:100 000 Regional Ecosystems coverage Version 5.0 for the region (DERM, 2009a).

Preliminary community definition was used to identify locations for representative field survey plots to ground truth communities and obtain floristic and structural data. Fieldwork for the flora survey was conducted over one week from 14 to 18 September 2009 (dry season) by two qualified ecologists. A total of 24 sites were assessed as part of the fieldwork (Figure 3 to Figure 5). Field surveys involved conducting botanical assessments in environmentally sensitive areas including REs of conservation significance, riparian areas and DERM Essential Habitat[2]. A number of standard botanical assessment methods were employed including secondary transects, quaternary sample plots, and random meander searches. Vehicle traverses of the GSDA GTP study area were also undertaken throughout the survey period to identify changes in landform and community boundaries. Community structural formation classes were assessed according to Neldner *et al.,* 2005. Regional ecosystem classification of communities was determined as per Sattler and Williams (1999) and in accordance with the REDD Version 5.2 (DERM, 2007).

Vegetation surveys of the mangrove and saltpan community were not undertaken during this field study due to physical constraints. As this area had previously been surveyed for the Marine Ecology Technical Report (EIS Appendix R1), the existing survey data and aerial photograph interpretation were used to delineate the regional ecosystems present.

Final vegetation mapping was undertaken utilising field survey data and aerial photograph interpretation of stereo pair images at a scale of approximately 1:22,000 (Aerometrex, 2008). Full details on the methodology employed can be found in Appendix A.

2.1.1 Survey Extent

The flora field surveys focussed on areas considered environmentally sensitive along the GTP. These areas were classified as meeting one or more of the following criteria:

- Support ‘Endangered’ or ‘Of Concern’ Regional Ecosystems (as identified in DERM mapping);
- Support large tracts of remnant vegetation (e.g. range crossings);
- Major river crossings;
- Known habitat of significant species; and
- DERM Essential Habitat areas.

[2] Essential habitat is vegetation in which a species that is endangered, vulnerable, rare or near threatened has been known to occur.

Regrowth Vegetation

Regrowth is native vegetation that is regenerating following clearing or other disturbance but does not meet the definition of remnant[3] vegetation.

Regrowth was not mapped as part of this survey however it is recognised that regrowth vegetation is present within the GSDA GTP corridors and it will be identified during pre-construction surveys. Identification of regrowth vegetation may also be relevant to vegetation offset planning.

2.2 Desktop Study

2.2.1 Review of Existing Information

In order to identify the range of species, habitats, and communities that may be present within the proposed GTP study area a review of existing data was compiled through the acquisition of the following key references:

- Queensland DERM Herbarium flora database (HERBRECS and CORVEG);
- Queensland DERM Wildlife Online Database;
- Queensland DERM 1:100, 000 Regional Ecosystems and Essential Habitat mapping;
- Queensland DERM Ecomap environmentally sensitive areas database;
- DEWHA 'Matters of National Environmental Significance' EPBC Act database (DEWHA, 2008a);
- Species distribution maps from current field guides;
- GLNG EIS: Marine Ecology Report (EIS Appendix R1); and
- GLNG EIS: Nature Conservation Gas Transmission Pipeline Report (EIS Appendix N2).

2.2.2 Target Species

34 conservation significant flora species listed under both state and commonwealth legislation were identified from the above sources as being potentially present within the study area. Twenty-five of these species were considered either 'possible' or 'likely' to be present and eight of these species considered 'unlikely' within the GTP corridor based upon their known distributions and habitat requirements. These species were targeted as part of the field survey effort. One species was confirmed as being present within the study area based during the field survey. This list of target species is provided in Appendix A. Conservation significant species identified include any Critically Endangered, Endangered, Vulnerable or Rare taxa listed as per:

- The *NC Act*; and
- The *EPBC Act*.

2.2.3 Nomenclature

Taxonomic nomenclature used for the description of floral species is according to Bostock and Holland (2007). Exotic flora species are signified in all text by an asterisk (*).

[3] Vegetation is identified as 'remnant' under the VM Act where the predominant canopy of the vegetation: covers more than 50% of the equivalent undisturbed canopy; averages more than 70% of the vegetations undisturbed height and is composed of species characteristic of the vegetations undisturbed predominant canopy.

2 Methodology

2.2.4 Survey Limitations

Methodology

Data acquisition during flora surveys has inherent limitations associated with variability of vegetation communities across a site, and changes to the detectability and presence of species with seasonal variation. All survey sites were strategically located to capture representative samples of all communities and the seasonal conditions during which this survey was undertaken were conducive to a relatively high degree of detectable floral diversity (Section 2.2.1). However field studies cannot account for 100 % of potential floral diversity present within a site.

Surveys were undertaken during the dry season in September 2009. This timing is considered suitable for assessment of woodland communities. Full details on the methodology employed can be found in Appendix A.

3

Existing Environmental Values

3.1 Regional Context

3.1.1 Bio-region

The GSDA section of the GLNG GTP (September 2009) is predominantly situated within the Brigalow Belt bioregion, with a very small northern section of the study area situated within the South-East Queensland bioregion. The bioregions of Queensland are based on landscape patterns that reflect changes in geology and climate, as well as major changes in floral and faunal assemblages at a broad scale and are used as the fundamental framework for the planning and conservation of biodiversity.

The Brigalow Belt bioregion is approximately 36,400,000 ha in size. Nature conservation of the bioregion has received increasing attention due to the rapid and extensive loss of habitat that has occurred. Major impacts upon vegetation of the Brigalow Belt include tree clearing, high grazing pressure and the proliferation of exotic species such as the prickly pear (Young *et al.*, 1999).

The South East Queensland bioregion is one of the most species rich and diverse parts of Australia for flora and fauna. The bioregion is approximately 6,600,000 ha in size and contains localised areas of endemism and a wide range of habitat types (Young and Dilewaard, 1999).

3.1.2 Sub-regions

The Brigalow Belt bioregion contains 36 sub-regions or provinces that delineate significant differences in geology and geomorphology (Young *et al.*, 1999). The GLNG GTP (September 2009) within the GSDA and CPIC (GSDA Section) Route falls primarily within the Mount Morgan Ranges sub-region of the Brigalow Belt bioregion with a very small part within the Marlborough Plains sub-region.

A minor section within the northern end of the GLNG GTP (September 2009) falls within the South East Queensland bioregion. This bioregion contains 10 sub-regions or provinces that delineate significant differences in geology and geomorphology (Young and Dilewaard, 1999). The section of the proposed GLNG GTP (September 2009) and CPIC (GSDA Section) Route within the South East Queensland bioregion is located within the Burnett-Curtis Hills and Ranges sub-region.

3.1.3 Regional Ecosystems

REs describe the relationships between major floral species and the environment at the regional scale. They are mostly derived from linking vegetation mapping units recognised at a scale of 1:100,000 to land zones that represent major environmental variables, in particular geology and landform. Under the *VM Act* REs are assigned a conservation status (Vegetation Management Status) based on an assessment of the pre-clearing and remnant extent of a RE.

The Queensland Herbarium has developed a program for mapping remnant REs across Queensland, however it should be noted that there are inaccuracies inherent in RE mapping at a scale of 1:100,000. As a result these maps provide an indication of what is potentially present and cannot be relied upon as an inherently correct source of vegetation mapping. On-site ground truthing is required to confirm the presence of RE types and extents, verify floristics and structure and confirm conservation status. Within the three sub-regions occurring within the GSDA study area the number of REs mapped within each sub-region ranges from 93 to 104. The average number of REs per sub-region is 97. Thirteen REs were identified by field studies as being present along the GTP alignment. The legislative framework for regulating conservation significant REs is outlined above in Section 1.2.4. REs of specific relevance to this study are further discussed in Section 2.2.3.

3.1.4 Study Site Characteristics

The GSDA has been established by Government as a site for large-scale industry development important for both regional and state economic growth. It covers approximately 22,000 ha of land and is an area of state and national significance (EPA, 2003). The GSDA lies to the north and north-west of Gladstone and extends approximately 20 km from the Bruce Highway in a north-east direction across The Narrows to Curtis Island. This report refers to only the mainland portion of the GSDA, with the Curtis Island portion being discussed in Part 4 Curtis Island. The widest point of the GSDA, in the west of the study area, is approximately 9 km in a north-south alignment. There are no major communities within the GSDA; however the townships or localities of Mount Larcom, Butlerville, Targinie and Aldoga are positioned in close proximity to the study area boundary.

The majority of the GSDA has been subject to the clearing of native vegetation for pastoral activities. Despite this, areas of remnant vegetation are still present. Topographical features within the GSDA include the Mt. Larcom Range, positioned within the central portion; a number of smaller ranges and hills, and the coastal plain adjacent to Port Curtis and The Narrows.

A number of creek systems are found within the GSDA, including Larcom Creek, Mosquito Creek, Targinie Creek, and the headwaters of many minor waterways. Most waterways within the study area are ephemeral. The eastern portions of Mosquito Creek within the coastal plain are estuarine. Generally the waterways are fringed by a narrow riparian strip of vegetation that remains as relics of the extensive woodlands once present throughout the region.

4

Results

4.1 Survey Results

This section documents the floristics, vegetation communities and fauna habitat values of the proposed GTP corridors. Community descriptions and quantitative data, including floristics and structure for each survey site are detailed in Appendix A. A complete flora species list for all taxa identified is provided in Appendix B.

4.2 Flora

4.2.1 Weather Conditions

Flora assessment for the GSDA section of the GLNG GTP (September 2009) and CPIC (GSDA Section) Route was undertaken during one week, from 14th to 18th September 2009. Weather conditions were typical for the season in the region; warm days and mild nights with occasional gusty winds. Bureau of Meteorology daily weather observations at the Gladstone Radar shows that the minimum and maximum temperatures were 16.5° C and 29.4° C respectively. Relative humidity for the survey period averaged 52.6 % and a total rainfall of 1.4 mm was recorded over the eight days of survey (BoM, 2009).

4.2.2 Species Diversity

The field survey identified the presence of 71 taxa representing 36 families and 65 genera. Families represented by 3 or more genera included Asclepediaceae (3), Euphorbiaceae (3), Malvaceae (3), Mimosaceae (4), Myrtaceae (16), Poaceae (12), Rutaceae (3) and Xanthorrhoeaceae (3).

Genera represented by 3 or more species included *Acacia* (3 species), *Corymbia* (3), *Eucalyptus* (4), and *Melaleuca* (5).

The survey identified 11 exotic taxa representing 6 families within the study area. Families with three or more exotic weed taxa include Asclepediaceae (3) and Poaceae (4). Weed species are discussed further in Section 2.2.4.

A full flora species list and a list of exotic species are provided in Appendix B.

4.2.3 Regional Ecosystems

CPIC (GSDA Section) Route

Ten REs were described and mapped (Figure 3 to Figure 5) within the 200 m corridor of the CPIC (GSDA Section) Route, based upon the field survey results and interpretation of aerial photo stereo images. Table 4-1 details the total area of each community found within the 200 m corridor of the GTP within the CPIC (GSDA Section) Route. It also shows the area for each vegetation community within each sub-region (as defined by RE types within the Mount Morgan Ranges, Marlborough Plains and the Burnett-Curtis Hills and Ranges sub-regions). Field data collected at secondary survey sites including floristics, structure, location, ecological integrity and disturbance notes are given in Appendix A.

4 Results

Table 4-1 Regional Ecosystems Mapped Within the CPIC in the GSDA

RE	Community Description	Area within 200 m corridor (ha)	Area within Sub-regions (ha)[1]	% of regional extent
11.1.1	*Sporobolus virginicus* grassland on marine clay plains	2.04	12015	0.02
11.1.2	Samphire forbland on marine clay plains	53.73	71251	0.08
11.1.4	Mangrove forest/woodland on marine clay plains	16.59	54700	0.03
11.3.4	*Eucalyptus tereticornis* and/or Eucalyptus spp. tall woodland on alluvial plains	37.12	47648	0.08
11.3.25	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	2.47	35608	0.007
11.9.9b	*Eucalyptus crebra* ± *E. exserta* ± Corymbia spp woodland.	25.00	539	4.6
11.11.3	*Corymbia citriodora*, *Eucalyptus crebra, E. acmenoides* open forest on old sedimentary rocks with varying degrees of metamorphism and folding. Coastal ranges	10.96	67309	0.02
11.11.15	*Eucalyptus crebra* woodland on deformed and metamorphosed sediments and interbedded volcanics. Undulating plains	13.45	164847	0.008
11.11.18	Semi-evergreen vine thicket on old sedimentary rocks with varying degrees of metamorphism and folding. Lowlands	1.22	3276	0.04
11.12.3	*Eucalyptus crebra*, *E. tereticornis, Angophora leiocarpa* woodland on igneous rocks especially granite	2.56	5486	0.05
n/a	Cleared areas (e.g. improved pastures, cropping land or non-remnant regrowth vegetation)	447.40	n/a	n/a
TOTAL		612.54	n/a	n/a

[1] Derived from RE data for each bioregion as per Accad *et al.* (2008)

GLNG GTP (September 2009) Alignment

Eleven REs were described and mapped (Figure 3 to Figure 5) within the 200 m corridor of the GLNG GTP (September 2009) Alignment within the GSDA, based upon the field survey results and interpretation of aerial photo stereo images. Table 4-2 details the total approximate area of each community found within the 200 m corridor of the GLNG GTP (September 2009) Alignment. It also shows the approximate area for each vegetation community within each sub-region (as defined by RE types within the Mount Morgan Ranges, Marlborough Plains and the Burnett-Curtis Hills and Ranges sub-regions). Community descriptions including floristics, structure, location, ecological integrity and disturbance notes are given in Appendix A.

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Table 4-2 Regional Ecosystems Mapped Within the GLNG GTP Alignment

RE	Community Description	Area within 200 m corridor (ha)	Area within Sub-regions (ha)[1]	% of regional extent
11.1.1	*Sporobolus virginicus* grassland on marine clay plains	10.89	12015	0.09
11.1.2	Samphire forbland on marine clay plains	40.95	71251	0.06
11.1.4	Mangrove forest/woodland on marine clay plains	3.20	54700	0.006
11.3.4	*Eucalyptus tereticornis* and/or Eucalyptus spp. tall woodland on alluvial plains	0.48	47648	0.001
11.3.25	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	7.83	35608	0.02
11.3.25b	Riverine wetland or fringing riverine wetland. *Melaleuca leucadendra* and/or *M. fluviatilis*, *Nauclea orientalis* open forest	5.21	35608	0.01
11.3.26	*Eucalyptus moluccana* or *E. microcarpa* woodland to open forest on margins of alluvial plains	0.78	19516	0.004
11.11.15	*Eucalyptus crebra* woodland on deformed and metamorphosed sediments and interbedded volcanics. Undulating plains	6.52	164847	0.004
11.11.18	Semi-evergreen vine thicket on old sedimentary rocks with varying degrees of metamorphism and folding. Lowlands	1.06	3276	0.03
11.12.3	*Eucalyptus crebra*, *E. tereticornis, Angophora leiocarpa* woodland on igneous rocks especially granite	3.59	5486	0.07
12.3.6	*Melaleuca quinquenervia*, *Eucalyptus tereticornis*, *Lophostemon suaveolens* woodland on coastal alluvial plains	24.61	1684	1.5
n/a	Cleared areas (e.g. improved pastures, cropping land or non-remnant regrowth vegetation)	475.66	n/a	n/a
TOTAL		580.78	n/a	n/a

[1] Derived from RE data for each bioregion as per Accad *et al.* (2008)

Ecological Integrity of Impacted Communities

Most vegetation communities surveyed within the GSDA study area have been impacted by grazing, thinning and exotic weed invasion. The steep terrain of the range crossings afforded the highest levels of ecological integrity. However, weeds such as *Opuntia tomentosa*,* and in places, *Lantana montevidensis** have invaded some isolated areas thereby reducing ecological functionality.

4.2.4 Weeds of Concern

Of the 11 exotic weed species recorded in this survey of the study area, four are declared species under the Queensland *Land Protection (Pest and Stock Route Management) Act, 2002* (Table 4-3). Two of these species (rubber vine and lantana) are also listed as Weeds of National Significance (WONS). WONS are exotic weed species identified as causing significant environmental damage on a

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national scale (Thorp and Lynch, 2000). All exotic weed species identified in this study are listed within the full flora species list in Appendix B. The locations of declared weeds recorded during the field survey are shown in Figure 3 to Figure 6.

Table 4-3 Declared Weeds Identified Within the GSDA study area

Species	Common Name	State/Federal Declared Status[1]	Site Number	Regional Ecosystems affected
*Cryptostegia grandiflora**	rubber vine	Class 2/WONS	S2, S7	11.11.15, 12.3.6
*Lantana camara**	lantana	Class 3/WONS	S2, S4, S7	11.11.15, 11.3.25b, 12.3.6
*Opuntia stricta var. stricta**	prickly pear	Class 2	S2, Q9	11.11.15, 11.3.25
*Sporobolus pyramidalis**	giant rat's tail grass	Class 2	S3	11.9.9b

[1] Status under the Queensland *Land Protection (Pest and Stock Route Management) Act, 2002* and Weeds of National Significance.

Rubber Vine

*Cryptostegia grandiflora** (rubber vine) was identified within both the GLNG GTP (September 2009) Alignment within the GSDA and CPIC (GSDA Section) Route at two locations (Figure 4 and Figure 5). Rubber vine is a Weed of National Significance and is regarded as one of the worst weeds in Australia because of its invasiveness, potential for spread, and economic and environmental impacts. Rubber vine is a native of south-west Madagascar, although the exact date of its introduction into Australia is not known.

Rubber vine is a woody perennial vine that colonises areas aggressively, forming impenetrable thickets which smother vegetation. It prefers areas where annual rainfall is between 400 mm and 1400 mm, and is well adapted to a monsoonal climate. Rubber vine was declared a noxious weed in Queensland in 1955. It is now present across 20 per cent of the state and densely infests over 700,000 hectares (Department of Employment, Economic Development and Innovation , 2009a).

Lantana

Lantana camara * (lantana) was found in a number of locations within the study area, particularly within riparian areas and semi-evergreen vine thickets (Figure 3 to Figure 6). Lantana is a Weed of National Significance and is regarded as one of the worst weeds in Australia. Lantana forms dense, impenetrable thickets that take over native bushland and pastures throughout the east coast of Australia. It competes for resources with, and reduces the productivity of, pastures and forestry plantations. It adds fuel to fires, and is toxic to stock (Weed Management CRC, 2003).

Prickly Pear

*Opuntia stricta var. stricta** (prickly pear) was found in a few vegetation communities within the study area, although densities were consistently low (Figure 3 to Figure 6). These species were introduced into pastoral districts in the 1840's and by 1925 the pest had invaded over 24 million hectares. The

introduction of the moth, *Cactoblastis cactorum*, in the 1920's controlled the pest, and by the mid-1930's, prickly pear was no longer a major problem (DEEDI, 2009b).

Giant Rat's Tail (GRT)

*Sporobolus pyramidalis** (GRT) was identified in a single location in the south of the study area (Figure 3). GRT is an invasive grass species that grows to a height of 0.6 to1.7 m with a seed head that changes from a 'rats tail' shape when young to an elongated pyramid shape at maturity. The species can affect cattle health and productivity and following soil disturbance or overgrazing, can quickly dominate a pasture. It can be difficult to distinguish from other Sporobolus grasses and can be challenging to control (DEEDI, 2009c).

4.2.5 Vegetation of Significance

Conservation Significant Species

The desktop literature review (Appendix A) identified 34 flora species of conservation significance as being potentially present within the study area. Locations of conservation significant species identified within the HERBRECS database search are presented in Figure 2.

All of the potentially occurring species were considered either 'possible' or 'likely' to be present within the study area based upon their known distribution or habitat requirements and were targeted as part of the field survey effort.

One flora species of conservation significance, *Macropteranthes leiocaulis* (northern bonewood), was identified from the field survey (Figure 4). *Macropteranthes leiocaulis* is a medium-sized shrub to small deciduous tree that is listed as Rare under the *Queensland NC Act* and is not listed under the Commonwealth EPBC Act. It has smooth and often blotchy bark with variable leaves from 1 to 8 cm long. This species tends to grow in vine thickets and dry rainforest northwards from the Binjour Plateau (Harden *et. al,* 2006).

Macropteranthes leiocaulis was identified from only one location in the semi-evergreen vine thicket community (RE 11.11.18) where it was observed as an uncommon shrub species. However, this location lies outside of the study area. This vegetation community was surveyed because it is mapped by the DERM as an 'Endangered' community within very close proximity (200 m) to the proposed routes.

A voucher specimen of this species was sent to the Queensland Herbarium to confirm identification (Herbarium reference number Qh180004136).

Culturally Significant Species

Within the study area many flora species of cultural significance were identified including species traditionally utilised for food or medicinal purposes, painting or decoration. Common bush tucker foods identified include *Avicennia marina* (grey mangrove), *Carissa ovata* (currant bush), Dianella species, *Eustrephus latifolius* (wombat berry), *Lomandra confertifolia subsp. pallida*, and Melaleuca species. Species of cultural value to the indigenous traditional owners of the area are discussed within the GTP Indigenous Cultural Heritage Report (EIS Appendix Y).

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Commercially Significant Species

Many of the woodland species identified over the study area are considered a potential commercial resource and suitable timber for flooring, telephone poles and other wood products. Commercial timber sources found within the study area include *Corymbia citriodora* subsp*. citriodora* (lemon-scented gum), used for saw logs, fencing material, firewood, turnery, power poles and house poles; *Eucalyptus crebra* (narrow-leaved ironbark), used for power poles, house poles, fencing, and firewood; and *Eucalyptus tereticornis* (forest red gum), used for saw logs, power poles, posts, fencing material and firewood (Taylor and Williamson, 2000).

Significant Regional Ecosystems- CPIC

Four REs recorded within the 200 metre study corridor of the CPIC (GSDA Section) Route are identified as having either 'Of Concern' or 'Endangered' Vegetation Management Status (VM Status) and 'Of Concern' or 'Endangered' Biodiversity status. One of these vegetation communities (RE 11.11.18) is also listed under the EPBC Act as 'Endangered'. The conservation status of these communities is detailed below in Table 4-4.

Table 4-4 Conservation Significant Regional Ecosystems Identified Within the CPIC (GSDA Section) Route

RE	Community Description	VM Status	Biodiversity Status	EPBC Act Status
11.3.25	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	Not of Concern	Of Concern	Not listed
11.3.4	*Eucalyptus tereticornis* and/or Eucalyptus spp. tall woodland on alluvial plains	Of Concern	Of Concern	Not listed
11.11.18	Semi-evergreen vine thicket on old sedimentary rocks with varying degrees of metamorphism and folding. Lowlands.	Endangered	Endangered	Endangered
11.12.3	*Eucalyptus crebra*, *E. tereticornis, Angophora leiocarpa* woodland on igneous rocks especially granite	Not of Concern	Of Concern	Not listed

Significant Regional Ecosystems- GLNG GTP (September 2009) Alignment

Five REs recorded within the 200 metre study corridor of GLNG GTP (September 2009) Alignment within the GSDA are identified as having either 'Of Concern' or 'Endangered' VM Status and 'Of Concern' or 'Endangered' Biodiversity status. One of these vegetation communities (RE 11.11.18) is also listed under the *EPBC Act* as 'Endangered'. The conservation status of these communities is detailed in below in Table 4-5.

Table 4-5 Conservation Significant Regional Ecosystems Identified Within the GLNG GTP (September 2009) Alignment

RE	Community Description	VM Status	Biodiversity Status	EPBC Act Status
11.3.25	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	Not of Concern	Of Concern	Not listed

RE	Community Description	VM Status	Biodiversity Status	EPBC Act Status
11.3.25b	Riverine wetland or fringing riverine wetland. *Melaleuca leucadendra* and/or *M. fluviatilis*, *Nauclea orientalis* open forest	Not of Concern	Of Concern	Not listed
11.3.4	*Eucalyptus tereticornis* and/or Eucalyptus spp. tall woodland on alluvial plains	Of Concern	Of Concern	Not listed
11.11.18	Semi-evergreen vine thicket on old sedimentary rocks with varying degrees of metamorphism and folding. Lowlands.	Endangered	Endangered	Endangered
11.12.3	*Eucalyptus crebra*, *E. tereticornis, Angophora leiocarpa* woodland on igneous rocks especially granite	Not of Concern	Of Concern	Not listed

4.2.6 Regional Connectivity

Ecological corridor linkages are typically poor within the GSDA due to historical clearing of vegetation. Remnant vegetation on the Mt Larcom Range, on the coastal plain and along watercourses offers the few functional opportunities for fauna movement and ecosystem connectivity.

On Mt Larcom Range (including Mt Larcom State Forest) remnant vegetation has remained relatively untouched due to steep terrain and inaccessibility. This range fails to provide an extensive corridor linkage however, as the foothills and surrounding landscape has been predominantly cleared. Ecological corridor linkages exist within the minor watercourses of the GSDA, although in most places clearing of lowlands and grazing land has extended right to the riparian zone, thereby narrowing these vegetated corridors and reducing their functional viability. The coastal plain itself has remained relatively untouched due to both the tidal influences and unsuitable saline conditions, allowing connectivity to be somewhat retained along the coast.

A significant amount of vegetation regrowth exists within the GSDA and specifically the study area. Given time and appropriate growing conditions and removal of disturbance this vegetation would likely form remnant vegetation communities. This expansion of remnant vegetation has the potential to increase ecological connectivity on a regional and local scale, although this result is subject to an absence of further clearing.

4.3 Fauna

4.3.1 Habitat Values

The widespread clearing of native vegetation for the pastoral industry has reduced the quality and quantity of habitat available for native fauna. The proximity of the major urban and industrial centre of Gladstone has further reduced the viability of habitat within the GSDA. However, habitat for hardier, generalist fauna is present in places. Expanses of remnant vegetation are found adjacent to the western boundary, on the Mount Larcom Range, on the coastal plains and within intertidal areas. These are largely unconnected, as the landscape has been modified in intervening areas.

Remnant vegetation in terrestrial areas is largely restricted to open forests and woodlands dominated in the canopy by species such as *Eucalyptus moluccana* (gum-topped box), *Corymbia citriodora* subsp. *citriodora* (lemon-scented gum) and *E. crebra* (narrow-leaved ironbark). Small areas of

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microphyll vine forest and semi-evergreen vine thicket are also present. These communities would act as habitat for a range of mammals, reptiles, amphibians and birds. However, their relatively small size, the presence of disturbance and lack of functional connectivity would tend to limit fauna diversity and capacity to support sensitive species dependent upon high quality core habitat.

The microhabitat features present would also dictate faunal usage. Arboreal hollows, normally found in mature trees, would support possums, gliders, microbats and hollow-nesting birds where retained. In such an altered landscape, the narrow riparian fringe of *E. tereticornis* (forest red gum) along ephemeral waterways is one of the few communities where arboreal hollows are common. Fire and forestry practices may have reduced hollow availability in many of the other remnant communities. The presence of stock can also reduce habitat values. Ground microhabitat such as grass tussocks, fallen timber, soil fissures and surface rocks are subject to disturbance by cattle where grazing is occurring. The steeper slopes of the Mt. Larcom Range and other outcrops support rocky habitat suitable for reptiles and ground mammals in particular. The unsuitability of steeper terrain for intensive grazing further increases their value for fauna as secure refugia.

It is likely that macropods are relatively common throughout the GSDA as their mobility and size gives them an advantage over smaller mammals that are subject to predation by feral animals and sensitive to habitat disturbance. The eastern grey kangaroo (*Macropus giganteus*), red-necked wallaby (*M. rufogriseus*) and swamp wallaby (*Wallabia bicolor*) would be widespread in respective habitat types. A number of other macropod species may be common in very restricted habitat.

Birds, being the most mobile of all terrestrial fauna, would be well represented across all feeding groups. As with other fauna, sensitive species or specialists (such as those favouring semi-evergreen vine thickets) may become locally rare as habitat quality and quantity is reduced.

Due to the likely ephemerality of most of the streams present within the GSDA, permanent populations of fish are unlikely to be retained. The occasional flow events may result in fish such as the spangled perch (*Leiopotherapon unicolor*) and bony bream (*Nematalosa erebi*) repopulating isolated waterholes. The lower brackish or saline reaches of Mosquito Creek would support a typical suite of estuarine fish species found in the area.

Saltwater crocodiles (*Crocodylus porosus*) are known to infrequently utilise the estuarine habitats of the Gladstone area. Given their mobility and the relative abundance of habitat in the area, the potential for the pipeline to impact on this species is minimal.

5

Potential Impacts and Mitigation Measures

5.1 Potential Impacts

5.1.1 Proposed Development

The GLNG GTP (September 2009) within the GSDA and CPIC (GSDA Section) Route will approach Gladstone from the north and will pass through the GSDA, before crossing The Narrows from Friend Point to Curtis Island. To cross over to Curtis Island the GLNG GTP will be trenched into the seabed. In addition to the original EIS GTP (March 2009) route, Santos is also considering two alternative pipeline route options, which are being considered for the approach to The Narrows, referred to in this Supplementary EIS as the CPIC and the GLNG GTP (September 2009) Alignment (Figure 1). The lengths of these routes are: 29 km for the GLNG GTP (September 2009) Alignment and 28 km for the CPIC.

Typical construction procedures and activities include:

- Survey of the pipeline route;
- Provision of access tracks and temporary facilities;
- Clear and grade of the right-of-way (ROW) including vegetation removal;
- Trenching;
- Dredging of The Narrows;
- Pipe stringing and bending;
- Pipe welding;
- Pipe placement in the trench (lowering in and laying);
- Backfilling;
- Hydro-testing; and
- Rehabilitation.

The clearing of remnant vegetation within the pipeline ROW will provide the greatest impacts to flora. The ROW width will be 40 m except where it crosses an environmentally sensitive area (see Section 3.2.3), in which case the ROW shall be reduced to 30 m.

5.1.2 Vegetation Disturbance – CPIC

At the time of assessment, the location of each pipeline (including the GLNG GTP – September 2009) within the proposed CPIC had not yet been determined by the government and the various proponents. Consequently, for the purposes of impact assessment, an arbitrary centreline alignment has been used to calculate an estimate for vegetation clearing along the CPIC route. Throughout the length of the 200 metre wide CPIC, the ROW will be a maximum width of 40 m.

The clearance of the CPIC (GSDA Section) Route ROW used will result in the disturbance of approximately 109.68 ha of land which will include approximately 28 ha of remnant vegetation. A breakdown of the disturbance to REs as a result of this clearing is presented below in Table 5-1. The table also shows the disturbance to each community as a percentage of the RE within the sub-regions of Mount Morgan Ranges, Marlborough Plains or Burnett-Curtis Hills and Ranges Sub-region.

5 Potential Impacts and Mitigation Measures

Table 5-1 Proposed area of Vegetation Communities to be Removed from the CPIC (GSDA Section) Route

RE	Community Description	VM Status	Biodiversity Status	EPBC Act Status	Ha Cleared[1]	Area within Sub-regions (ha)[2]	% of Sub-regions Extent
11.1.1	*Sporobolus virginicus* grassland on marine clay plains	Not of Concern	Not of Concern	Not listed	0.36	12015	0.003
11.1.2	Samphire forbland on marine clay plains	Not of Concern	Not of Concern	Not listed	10.04	71251	0.01
11.1.4	Mangrove forest/woodland on marine clay plains	Not of Concern	Not of Concern	Not listed	3.60	54700	0.007
11.3.4	*Eucalyptus tereticornis* and/or Eucalyptus spp. tall woodland on alluvial plains	Of Concern	Of Concern	Not listed	5.90	47648	0.01
11.3.25	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	Not of Concern	Of Concern	Not listed	0.19	35608	0.005
11.9.9b	*Eucalyptus crebra* ± *E. exserta* ± Corymbia spp woodland.	Not of Concern	Not of Concern	Not listed	3.13	539	0.6
11.11.3	*Corymbia citriodora*, *Eucalyptus crebra, E. acmenoides* open forest on old sedimentary rocks with varying degrees of metamorphism and folding. Coastal ranges	Not of Concern	Not of Concern	Not listed	2.08	67309	0.003
11.11.15	*Eucalyptus crebra* woodland on deformed and metamorphosed sediments and interbedded volcanics. Undulating plains	Not of Concern	Not of Concern	Not listed	2.80	164847	0.002
n/a	Cleared areas (e.g. improved pastures, cropping land or non-remnant regrowth vegetation)	n/a	n/a	n/a	81.58	n/a	n/a
TOTAL					109.68	n/a	n/a

[1] Hectare clearance is approximate and is based upon 40 m ROW unless listed as conservation significant RE, in which case it is a 30 m ROW.

[2] Indicates disturbed % of vegetation community within the relevant Mount Morgan Ranges, Marlborough Plains or Burnett-Curtis Hills and Ranges Sub-region as per Accad *et. al*. (2008)

Non-remnant areas including improved pastures, cropping land and regrowth vegetation are to be subjected to the majority of proposed disturbance (81.58 ha). This represents 74 % of the total area of disturbance.

Of the remnant vegetation to be cleared, the vegetation community of Samphire forbland on marine clay plains (RE 11.1.2) is to be subjected to the majority of proposed disturbance (10.04 ha). This disturbance represents approximately 0.01 % of this community within the relevant sub-regions. This vegetation community has no current conservation significance under state or commonwealth legislation.

The vegetation community of Mangrove forest/woodland on marine clay plains (RE 11.1.4) is subject to the third greatest disturbance of remnant vegetation overall (3.60 ha). This disturbance represents approximately 0.007 % of this community within the relevant sub-regions. This vegetation community has no current conservation significance under state or commonwealth legislation.

The vegetation community of *Eucalyptus crebra* ± *E. exserta* ± Corymbia spp woodland (RE 11.9.9b) is subject to the greatest disturbance of remnant vegetation when viewed as a percentage of the sub-regional extent (0.6 %). Approximately 3.13 ha of this RE is proposed to be cleared, meaning this community is subject to the third highest amount of disturbance. This vegetation community has no current conservation significance under state or commonwealth legislation.

Significant Regional Ecosystems

Of the conservation significant REs recorded along the CPIC (GSDA Section) Route, the vegetation community subjected to the highest amount of clearing is *Eucalyptus tereticornis* and/or Eucalyptus spp. tall woodland on alluvial plains (RE 11.3.4). This community is listed as 'Of Concern' under the *VM Act*, but not listed under the *EPBC Act*. Approximately 5.90 ha of this community will potentially be cleared. However, when viewed in a sub-regional context, this disturbance represents only 0.01 % of this community.

5.1.3 Vegetation Disturbance – GLNG GTP (September 2009) Alignment

The clearance of the GLNG GTP (September 2009) Alignment ROW will result in the disturbance of approximately 115.96 ha of land, which will include approximately 20.08 ha of remnant vegetation. A breakdown of the disturbance to REs as a result of this clearing is presented below in Table 5-2. The table also shows the disturbance to each community as a percentage of the RE within the sub-regions of Mount Morgan Ranges, Marlborough Plains or Burnett-Curtis Hills and Ranges Sub-region.

Table 5-2 Proposed area of Vegetation Communities to be Removed from the GLNG GTP (September 2009) Alignment

RE	Community Description	VM Status	Biodiversity Status	EPBC Act Status	Ha Cleared[1]	Area within Sub-regions (ha)[2]	% of Sub-regions Extent
11.1.1	*Sporobolus virginicus* grassland on marine clay plains	Not of Concern	Not of Concern	Not listed	1.43	12015	0.01
11.1.2	Samphire forbland on marine clay plains	Not of Concern	Not of Concern	Not listed	8.89	71251	0.01
11.1.4	Mangrove forest/woodland on marine clay plains	Not of Concern	Not of Concern	Not listed	0.70	54700	0.001
11.3.25	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	Not of Concern	Of Concern	Not listed	1.43	35608	0.004
11.3.25b	Riverine wetland or fringing riverine wetland. *Melaleuca leucadendra* and/or *M. fluviatilis*, *Nauclea orientalis* open forest	Not of Concern	Of Concern	Not listed	1.34	35608	0.004
11.3.26	*Eucalyptus moluccana* or *E. microcarpa* woodland to open forest on margins of alluvial plains	Not of Concern	Not of Concern	Not listed	0.02	19516	0.0001
11.11.15	*Eucalyptus crebra* woodland on deformed and metamorphosed sediments and interbedded volcanics. Undulating plains	Not of Concern	Not of Concern	Not listed	1.38	164847	0.0008
12.3.6	*Melaleuca quinquenervia*, *Eucalyptus tereticornis*, *Lophostemon suaveolens* woodland on coastal alluvial plains	Not of Concern	Not of Concern	Not listed	4.89	1684	0.3
n/a	Cleared areas (e.g. improved pastures, cropping land or non-remnant regrowth vegetation)	n/a	n/a	n/a	95.88	n/a	n/a
TOTAL					115.96	n/a	n/a

[1] Approximate hectare clearance based upon 40 m ROW unless listed as conservation significant RE, in which case it is a 30 m ROW.

[2] Indicates disturbed % of vegetation community within the relevant Mount Morgan Ranges, Marlborough Plains or Burnett-Curtis Hills and Ranges Sub-region as per Accad *et. al*. (2008)

5 Potential Impacts and Mitigation Measures

Non-remnant areas including improved pastures, cropping land and regrowth vegetation are to be subjected to the majority of proposed disturbance (95.88 ha). This represents 83 % of the total area of disturbance.

Of the remnant vegetation to be cleared, the vegetation community of Samphire forbland on marine clay plains (RE 11.1.2) is to be subjected to the majority of proposed disturbance (8.89 ha). This disturbance represents approximately 0.01 % of this community within the relevant sub-regions. This vegetation community has no current conservation significance under state or commonwealth legislation.

The vegetation community of *Melaleuca quinquenervia*, *Eucalyptus tereticornis*, *Lophostemon suaveolens* woodland on coastal alluvial plains (RE 12.3.6) is subject to the second greatest disturbance of remnant vegetation overall, and also the greatest disturbance when viewed as a percentage of the sub-regional extent (0.3 %). Approximately 4.89 ha of this RE is proposed to be cleared. This vegetation community has no current conservation significance under state or commonwealth legislation.

Significant Regional Ecosystems

Of the conservation significant REs recorded along the GLNG GTP (September 2009) within the GSDA, the vegetation community subjected to the highest amount of clearing is *Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines (RE 11.3.25). This community is listed as 'Of Concern' under Biodiversity Status (as per DERM biodiversity rating), 'Not of Concern' under the Vegetation Management Status (as per the *VM Act*), and is not listed under the *EPBC Act*. Approximately 1.43 ha of this community will potentially be cleared. This disturbance represents 0.004 % of this community found within the sub-regions, which is also the highest disturbance when viewed as a percentage of the sub-regional extent.

The second greatest area of clearance of a significant RE will be the vegetation community of Riverine wetland or fringing riverine wetland: *Melaleuca leucadendra* and/or *M. fluviatilis*, *Nauclea orientalis* open forest (RE 11.3.25b). This community is listed as 'Of Concern' under Biodiversity Status, 'Not of Concern' under the *VM Act*, and not listed under the *EPBC Act*. Approximately 1.34 ha of this community will potentially be cleared. This disturbance represents only 0.004 % of this community found within the sub-regions, which is also the highest disturbance when viewed as a percentage of the sub-regional extent.

Ecological Integrity of Impacted Communities

Vegetation within the GSDA study area has a long history of disturbance including grazing, thinning, cropping and exotic weed invasion. In more recent years, disturbances have included the development of industry-related infrastructure including pipelines and roads. Most areas of remnant vegetation surveyed have been disturbed by human activity to some degree and, as such, ecological integrity within the corridor was found to be relatively moderate to low.

The highest levels of ecological integrity are evident within the northern end of the GLNG GTP (September 2009) within the GSDA and the CPIC (GSDA Section) Route in the vicinity of The Narrows. This includes Targinie State Forest adjacent to the coastal plain and the coastal plain itself. These areas have been afforded protection from repeated clearing due to the saline and intertidal conditions of the coastal plain, and the protection of integral woodland communities under State

Forest legislation. However remnant vegetation of Targinie State Forest may be cleared for forestry purposes and the ecological integrity of the coastal plain and associated mangroves have been compromised by stormwater, industrial effluents and large-scale clearing leading to increased turbidity, siltation and nutrient loads (DEWHA, 2009a). Creek crossings at Targinie creek and Larcom Creek also generally support higher levels of ecological integrity than surrounding areas, however these crossings are still often degraded by grazing and weed invasion.

Cumulative Impacts

Although the proposed overall clearing of vegetation communities throughout the GSDA is generally minor, the cumulative impacts of external proposed development within the region must also be taken into account. This issue is addressed in further detail in the Cumulative Impacts Section 5.2.7.

5.1.4 Impacts to Conservation Significant Species

Macropteranthes leiocaulis (northern bonewood) was only recorded in low numbers from one location within the GSDA. The desktop searches conducted for the pipeline (Appendix A) did not indicate the presence of any other populations of the species within a 5 km buffer of either the GLNG GTP (September 2009) within the GSDA or the CPIC (GSDA Section) Route, suggesting the species may not be widespread within the area. As the recorded location of this species lies outside of both GTP routes there is potentially no impact to this species from clearing. However, the potential that this species may exist along the GSDA pipeline cannot be discounted, particularly within the vegetation community of semi-evergreen vine thicket (RE 11.11.18). Mitigation measures will be required to reduce any potential impacts this project may have on *Macropteranthes leiocaulis* and are discussed above and in Section 5.2.3. A clearing permit will be required under the *NC Act* where clearance of this species cannot be avoided.

5.1.5 Dust Impacts

Deposition of dust, sand and soil may have potential impacts on vegetation if excessive levels are sustained over extended periods. When dust settles on plant foliage, it can reduce the amount of light penetration on the leaf surface, block and damage stomata, and slow rates of gas exchange and water loss. Reduction in the ability to photosynthesise due to physical effects may result in reduced growth rates of vegetation and decreases in floral vigour and overall community health. The potential effects of dust deposition on vegetation are determined by a number of factors including:

- The characteristics of leaf surfaces, such as surface roughness, influencing the rate of dust deposition on vegetation;
- Concentration and size of dust particles in the ambient air and its associated deposition rates; and
- Local meteorological conditions and the degree of penetration of dust into vegetation.

The dominant woodland species of the vegetation communities along the study area typically exhibit physiological qualities that are not sensitive to dust deposition. The sclerophyllous foliage of *Eucalyptus* and *Corymbia* species is generally pendulous (i.e. points down), with a thick smooth cuticle that does not encourage particulate matter to remain on the surface. The dominant woodland species are also generally hardy and well adapted to adverse conditions (e.g. extended dry conditions and low nutrient soils).

There is evidence however, that carbon dioxide exchange in mangroves may be inhibited by increased dust deposition. The mangrove *Avicennia marina* (grey mangrove), as found in the proposed GTP (where the GLNG GTP September 2009 enters the CPIC (GSDA Section) Route on the coast) intertidal zone on and adjacent to Curtis Island, has been shown to demonstrate reduced carbon dioxide exchange of the upper and lower leaf surfaces and thus reduced photosynthetic performance of leaves coated in coal dust (Naidoo & Chirkoot, 2004). This result is exacerbated by the presence of sticky brine secreted by salt glands. Although no significant long-term dust deposition is anticipated from the GTP construction program, the vulnerability of mangroves to dust deposition should be considered.

The GSDA study area is situated near and within the city of Gladstone, Queensland's largest industrial centre. Air-borne particulate matter deposition related to Gladstone industrial development should therefore also be taken into account when considering dust impacts on the vegetation of the GSDA study area. The primary contributor to dust impacts will be during the construction phase. Potential dust impacts should therefore be only a temporary issue that will be remediated using common management measures to reduce dust particles.

Control measures will be implemented as per the GTP EMP (EIS Section 12) to minimise dust generation during the construction and operational phases of the GLNG GTP (September 2009) or CPIC development, and it is not expected that potential effects of dust deposition on vegetation within close proximity to GLNG GTP (September 2009) or CPIC operations will be significant.

5.1.6 Loss of Fauna Habitat

The construction of the GTP may involve the loss of habitat through initial site preparation and clearing. This may result in the removal of habitat features such as trees, shrubs, ground cover, rocks and timber within the two GTP ROWs. Impacts to fauna as a result of these measures may include mortality and loss of habitat and breeding areas. Implementation of appropriate strategies (EIS Appendix N2, Section 3.1.3) will considerably reduce the potential for fauna mortality. As approximately 83 % of the GLNG GTP (September 2009) Alignment ROW within the GSDA and 74 % of the CPIC (GSDA Section) Route traverses cleared or non-remnant vegetation with reduced habitat values the impacts to fauna overall should be low.

During the pipe trenching phase, the open trench will create an obstacle for fauna. The trench may effectively act as a large pitfall trap where fauna may fall in and will not be able to escape. The most serious implication for fauna is mortality of some individuals due to heat stress. Mitigation measures for these potential impacts are discussed in the EIS Appendix N2 (Section 3.1.3).

Members of all fauna groups may be impacted to some extent. Small ground mammals (e.g. rodents and dasyurids), reptiles and amphibians will be directly disturbed by vehicular movement and groundbreaking activities. As many species within these groups shelter within or utilise ground habitat features, there is the potential for these groups to be affected by these works.

Fauna utilising arboreal hollows and feeding resources such as possums, gliders and many species of birds and insectivorous bats, may be affected by the removal of these habitat features. In addition to the possibility of some fauna mortality during clearing, the loss of nesting resources may affect local prey and predator fauna populations into the future. Avian fauna will be less affected by the proposed GTP construction due to their ability to easily move from the zone of impact. In addition, while the loss of habitat may affect certain types of birds, the alteration may be beneficial to others. For example, in

a woodland area that is to be cleared, a displacement of forest birds may occur with a subsequent replacement by grassland species in the vicinity of the study area.

Mortality impacts and predator prey disruption from habitat loss are expected to be relatively low in the context of the overall landscape ecology and there should not be significant long-term impacts to overall faunal assemblages and species populations.

5.1.7 Fragmentation

The construction of the GLNG GTP (September 2009) and CPIC may create a barrier to fauna movement within the well-vegetated areas along the two route options within the GSDA. In particular this may apply to the northern end of both pipeline routes where ecological connectivity is slightly higher.

The fragmentation of remnant vegetation can result in a reduction of functional habitat. Habitat alteration may potentially result in certain species abandoning the area. Edge effects compound the impacts of fragmentation so that functional habitat is further reduced. Reduced buffers to core habitat may result in disturbances to fauna and a further reduction in habitat quality. The disturbance of soil and increased light levels will potentially enhance conditions for weed infestations. Mitigation measures to minimise these impacts including rehabilitation and limiting clearance of remnant vegetation are discussed below in Sections 5.2.3, 5.2.4 and 5.2.5.

5.1.8 Impacts to Marine Plants

The potential clearing of marine plants may affect the following REs: RE 11.1.1, RE 11.1.2, RE 11.1.4, RE 12.1.2, RE 12.1.3. An application to clear these marine plants will be required under the *Fisheries Act 1994*. Impacts to marine plants are detailed within EIS Section 8.4.4.4.

5.1.9 Weed Impacts

Desktop and field studies have confirmed the presence of the declared weeds *Sporobolus pyramidalis** (giant rats tail grass), *Opuntia stricta** (prickly pear), *Cryptostegia grandiflora** (rubber vine), and *Lantana camara** (lantana) within the GSDA study area (Section 2.2.4). Of these species, giant rats tail grass has the greatest potential to impact upon grazing and ecological values in the area. The majority of the corridor remains free of giant rats tail grass. However, the weed could easily be introduced to new areas through poor weed hygiene practices. Introduction to areas previously free of infestations could cause major impacts including loss of grazing potential, reduction in habitat value and increase in fire risk (DEEDI, 2009c). Mitigation controls and measures to manage potential impacts from weed species are outlined below (Section 5.2.4).

5.1.10 Edge Effects

The fragmentation and modification of ecosystems following land clearing can lead to changes in physical edge effects (Lindenmayer & Burgman, 2005). These edge effects occur when disturbances to the edge of a habitat or ecosystem result in a change or disturbance to the interior of that area. Examples of edge effects that may be associated with vegetation communities of the study area include weed invasion and altered micro-climatic conditions.

Within the GSDA study area, semi-evergreen vine thicket vegetation communities (RE 11.11.18) are more susceptible to edge effects. The limited size of these remnants and their general proximity to

modified non-remnant grasslands increases their potential susceptibility to exotic weed infestation. Potential exists for weed invasion to occur as a result of RE clearing for the GLNG GTP (September 2009) within the GSDA however this result may be mitigated by the instigation of weed control measures as detailed in Section 5.2.4.

5.1.11 Impacts Associated with Erosion and Sedimentation

There is potential for erosion on areas disturbed by works associated with the construction of the GLNG GTP (September 2009) within the GSDA and CPIC (GSDA Section) Route. Where these activities occur on erosive soils and/ or on slopes, mobilisation of sediment into watercourses can occur. Impacts to aquatic ecosystems can include build-up of sediment in waterholes with a subsequent reduction in available habitat, smothering of aquatic plants and substrate and cumulative downstream impacts on estuarine and offshore marine habitats.

The northern end of the GLNG GTP (September 2009) within the GSDA and CPIC (GSDA Section) Route are situated within the intertidal area known as The Narrows. If increased sedimentation load reached this intertidal area it could, in turn, create an increased sediment load for the Gladstone Harbour and impact the mangrove and grassland vegetation communities associated with The Narrows. However, the majority of the two GSDA pipeline routes traverse a reasonably flat open landscape and encounter sloped terrain only during a short section. The potential for erosion and sedimentation impacts does exist during the construction phase of the project however and will be mitigated by measures to reduce erosion and sedimentation, particularly surrounding watercourses, as detailed in Section 5.2.3.

5.2 Impact Mitigation

5.2.1 Pipeline Route Selection

A detailed route selection process was undertaken prior to selection of the current GTP alignment in accordance with the Australian Pipeline Industry Association (APIA) - Code of Environmental Practice (APIA, 2005). An initial alignment was selected based on avoidance of National Parks, mining leases, and environmentally sensitive areas (EIS Appendix N2).

Within the GSDA, the GLNG GTP (September 2009) route differs from that presented in the EIS and has been reconsidered based upon additional detailed knowledge of environmental, social and economic values within the region. Further effort has been made to minimise potential impacts to these values. The most obvious deviation of the GLNG GTP (September 2009) alignment to the CPIC (GSDA Section) Route is the southern deviation from the corridor just prior to the Narrows. This has been shifted so that the GLNG GTP (September 2009) approaches the marine crossing from the south west along the mud flats, thereby avoiding several very sharp banked creeks with very thick mangroves either side. By avoiding these areas of mangroves, the GLNG GTP (September 2009) alignment eliminates the need to excavate large cuttings in the banks in order to create the necessary approach and exit gradients for the creek crossings.

5.2.2 Pre-Construction Procedures

The pre-construction procedures will include undertaking targeted surveys to identify specific population size and locations of species of conservation significance to mitigate potential impacts (for

example, adjusting the location of the GTP within the corridor to minimise impact on identified species). The surveys will particularly target areas near known populations of *Macropteranthes leiocaulis* (northern bonewood), which was identified during the field study (Figure 4), and *Atalaya collina* (Yarwun whitewood) which was identified by the desktop study as within the GLNG GTP (September 2009) within the GSDA and CPIC (GSDA Section) Route buffer zone (Figure 2).

In addition to this, a further commitment has been added to the GLNG GTP EMP for a Significant Species Management Plan to be developed prior to the disturbance of any EVR species. Specific measures for the mitigation of any disturbed EVR flora species including potential options for propagation or translocation will be detailed in the Significant Species Management Plan.

5.2.3 Clearing Scheme

Areas of vegetation to be cleared will be restricted to the minimum width required, that is generally 40 m, but reduced to 30 m within environmentally sensitive areas, as depicted in Figure 3 to Figure 5. Environmentally sensitive areas include river crossings, DERM Essential Habitat, or 'Endangered' and 'Of Concern' REs. The use of tape, pegs or other markers will be employed to clearly delineate areas to be cleared, prior to commencement. Particular attention will be paid when delineating clearing areas in proximity to 'Endangered' and 'Of Concern' REs. Pre-clearing surveys will be undertaken by a qualified ecologist to identify potential risks to fauna and significant flora species to enable measures to be employed to mitigate impacts on these species. During clearing of these areas, an accredited fauna spotter/catcher will be present to remove individuals from the danger zone, or rescue any injured animals.

Clearing of all remnant REs and particularly 'Of concern' and 'Endangered' REs will be avoided for ancillary areas including construction workforce accommodation facilities, vehicle tracks and lay down areas.

Any clearing involving the removal of expansive stands of woodland vegetation will be undertaken progressively in one direction to facilitate an easy escape and reduce disruption for fauna dispersal, thereby retaining habitat connectivity.

Where possible, large scale burning of cleared vegetation will be avoided and timber will be stacked into piles to provide fauna habitat and assist revegetation.

All vegetation clearance will be undertaken in accordance with Santos EHS Management System Standard – EHS01 Land Disturbance and Section 12.16.2 (Clearing and Grading) of the GTP EMP. These include measures such as maintaining soil and surface stability, placing stockpiles away from the beds or banks of watercourses, and the use of containment devices (e.g. silt fences) to preserve stockpiled soils and prevent siltation of any land surface water.

Management of Conservation Significant Species

The species of conservation significance recorded along the GLNG GTP (September 2009) within the GSDA and CPIC (GSDA Section) Route will require appropriate management actions. The management priority will be avoidance of impact to these areas where practicable following the actions described below.

The pre-construction procedures will include pre-clearing surveys to identify specific populations of conservation significant species to enable mitigation measures to be employed (e.g. to adjust the

location of the GTP within the corridor to minimise impact) (EIS Section 12.16.8, Flora and Fauna EMP). This will target areas of known habitat for *Macropteranthes leiocaulis* in addition to areas considered potential habitat for conservation significant species identified as 'likely' or 'possibly' present.

Prior to vegetation clearing, all individuals of *Macropteranthes leiocaulis* will be flagged by a qualified botanist to provide an accurate number of individuals to be removed. To offset any net loss of this species, the planting of seed should be considered as part of the project's rehabilitation program (Section 5.2.5).

Additional management strategies will include:

- Reduce ROW width where possible near areas of conservation significant species;
- Awareness presentation of conservation significant species to pipeline construction crews;
- Increased monitoring of dust, water movement, and weeds around areas supporting conservation significant species; and
- A Significant Species Management Plan (as outlined above in Section 5.2.3)

Management of Impacts to Fauna

Mitigation measures to reduce impacts to fauna were outlined in the EIS. Additional strategies include:

- If fencing of the ROW or other facilities is to occur outside of grazing country, non-barbed wire will be used to reduce the mortality of gliders and fruit bats. There is evidence to suggest that greater than 95 % of entanglements and subsequent death of native fauna on barbed wire fences occurs on standard height farm fencing (van der Ree, 1999). This is a priority in well-vegetated areas and vegetated creek crossings where gliders will be required to volplane across the ROW.
- Research has shown that most fauna entanglements with barbed wire fences occur on the top strand of barbed wire (van der Ree, 1999). Thus, within grazing country, the top strand of fencing will be replaced by non-barbed wire where possible in consultation with respective landholders. The use of non-barbed wire as a fencing style has proven to be of equal or greater benefit for stock management and plain high-tensile fencing wire can contain most stock (van der Ree, 1999).
- Where possible, arrangements are to be made with wildlife carers to receive injured or displaced fauna in case this eventuates. Contact details are to be made known at all staging workforce accommodation facilities and site offices.

River Crossings

Where clearing of vegetation is within or in close proximity to riparian communities, adequate erosion and sedimentation mitigation measures will be utilised to ensure waterways are not impacted and riparian vegetation is not unduly affected as per Section 12.16.10 (Water Management) and Section 12.16.11 (Soil Management) of the GTP EMP.

For minor watercourse crossings such as at Larcom Creek and Humpy Creek, open trenches will be used. Where possible existing gaps in tree cover will be utilised and mature trees will be avoided to minimise impacts to vegetation communities. Watercourse bed and bank material and trench spoil will be stockpiled separately, away from banks to reduce the likelihood of sedimentation from surface runoff. To minimise the period of construction and subsequent environmental disturbance, it is proposed to complete watercourse crossings within the shortest period practicable. Further erosion control measures are detailed in EIS sections 7.3.3, 7.5.4 and 7.11.4.

Marine Plants

Clearing will be minimised as much as practicable within areas of marine plants (RE 11.1.1, RE 11.1.2, RE 11.1.4, RE 12.1.2, RE 12.1.3). Possible mitigation measures will include the reduction of ROW width, revegetation of marine plant communities and additional erosion control measures.

5.2.4 Weed Control

The introduction of vehicles and heavy machinery may potentially increase the risk of introducing new and declared weeds, and spread existing weeds across the site and its surrounds. Appropriate weed management strategies will be implemented for controlling the spread of weeds, including continued weed monitoring as per section 12.16.9 (Weed Management) of the GLNG GTP EMP. A separate Weed Management Plan for the GTP has also been developed and implemented for the GLNG GTP. Management Strategies in the Weed Management Plan include, but are not limited to:

- Effective management strategies to control the spread of declared weed species in keeping with Santos Standards (including Santos EHS09 Weeds and Pest Animal Control), regional management practice or DNR&W pest control fact sheets;
- Ongoing monitoring of the project site to identify any new incidence of weed infestation;
- Regular targeted spraying of the project area to minimise the risk of vehicles driving over a mature weed plant in seed or flower;
- Provision of information for project staff on the identification of declared weeds and their dispersal methods;
- Wash down protocols for any vehicles or machinery entering and leaving site, and when moving from weed zones to clean zones;
- Implementing vehicle movement protocols to limit the movement of vehicles from a weed zone to a clean zone (e.g. having a clean and dirty construction spread and strategic placement of workforce accommodation facilities);
- Implementing a sticker identification program to enable easy identification as to whether a vehicle is certified to be in that area;
- Authorised weed inspectors at vehicle wash down bays; and
- Recording of all vehicle movements in wash down registers and vehicle logs.

5.2.5 Rehabilitation of Disturbed Areas

A rehabilitation strategy developed for the areas to be disturbed is outlined in Section 12.16.7 (Rehabilitation) of the GTP EMP. Rehabilitation of vegetated areas will involve the re-establishment of ground cover along the GTP ROW following construction. Rehabilitation methods will be in keeping with current best practice and will employ techniques involving natural regeneration, direct seeding and / or tube stock to ensure a viable success rate of re-established vegetation. Tree species will be excluded from the ROW to minimise risk of pipeline damage from root interference. Monitoring of the rehabilitated areas will be undertaken to ensure long term viability and allow adaptive management of rehabilitation strategies where necessary.

Because considerable sections of the GSDA study area have established weed species through modification such as grazing practices and human development, the establishment of native vegetation will require consistent monitoring to ensure that rehabilitation remains viable and edge effects (Section 3.1.9) are negated.

Santos is currently undertaking a detailed evaluation of acid sulphate soils present within the intertidal mud flat areas on the mainland side of The Narrows. This study will identify the appropriate measures for dealing with acid sulphate soils. A project specific management plan will also be prepared and implemented by Santos for the acid sulphate soils present.

5.2.6 Biodiversity Offsetting

EIS Appendix N2 outlines legislative and corporate requirements for biodiversity offsetting.

Subsequent to this a biodiversity offsets package is being developed by Santos in conjunction with Ecofund Queensland (a Queensland government advisory service) as a Biodiversity Offset Management Plan to address the objectives of both the current State and Commonwealth legislative biodiversity offsetting requirements. An analysis has been undertaken to identify the offset requirements for proposed impacts for the CSG field, Gas Transmission Pipeline and LNG facility components of the GLNG Project. Analysis requirements being undertaken for offsets include:

- Extent and size of offsets required to be secured for the GTP;
- Ecological values required to be offset;
- Options available for pooling or consolidation offset requirements;
- Options for securing offsets;
- Offset assessment and analysis includes the co-ordination of multiple offset requirements and is being carried out under the following policies;
- Vegetation management offsets under the *VM Act*;
- Fish habitat offsets under the *Fisheries Act, 1992*;
- Protected plants offsets under the *NC Act*;
- Biodiversity offsets under the Draft Policy for Biodiversity Offsets 2008 (Qld); and
- Environmental offsets under the *EPBC Act*.

Further steps to be undertaken within a suitable timeframe as part of the process include:

- Identification of suitable offset options;
- Assessment of properties;
- Landholder liaison and negotiation to secure required offsets;
- Offset validation and preparation of specific Biodiversity Offset Management Plan(s); and
- Liaison to finalise contractual arrangements and covenants.

In addition to the objectives outlined above and those previously stated within the EIS (Sections 6.4, 7.4, 8.4 and Appendices N1, N2 and N3). The Biodiversity Offset Management Plan will be implemented over an appropriate time frame to accomplish the following specific aims:

- Identification of suitable potential offset areas with ecological values analogous to impacted ecological communities;
- Assessment of the ecological value and equivalence of offsets to ensure suitable offset extent, species assemblage, floristic structure and ecological integrity utilising an appropriate biometric field methodology;
- Development of appropriate management prescriptions to ensure long term viability of offsets (such as pest control, livestock management, access exclusion, ameliorative plantings and fire regime management);
- Placement of appropriate covenants for future conservation and management of offsets; and

- Development of appropriate monitoring and maintenance activities and performance review processes to ensure long term viability of the offsets.

The process of developing a suitable Biodiversity Offset Management Plan is an iterative process with State and Commonwealth regulatory bodies and the outcome will be coordinated with the other Santos components.

5.2.7 Cumulative Impacts

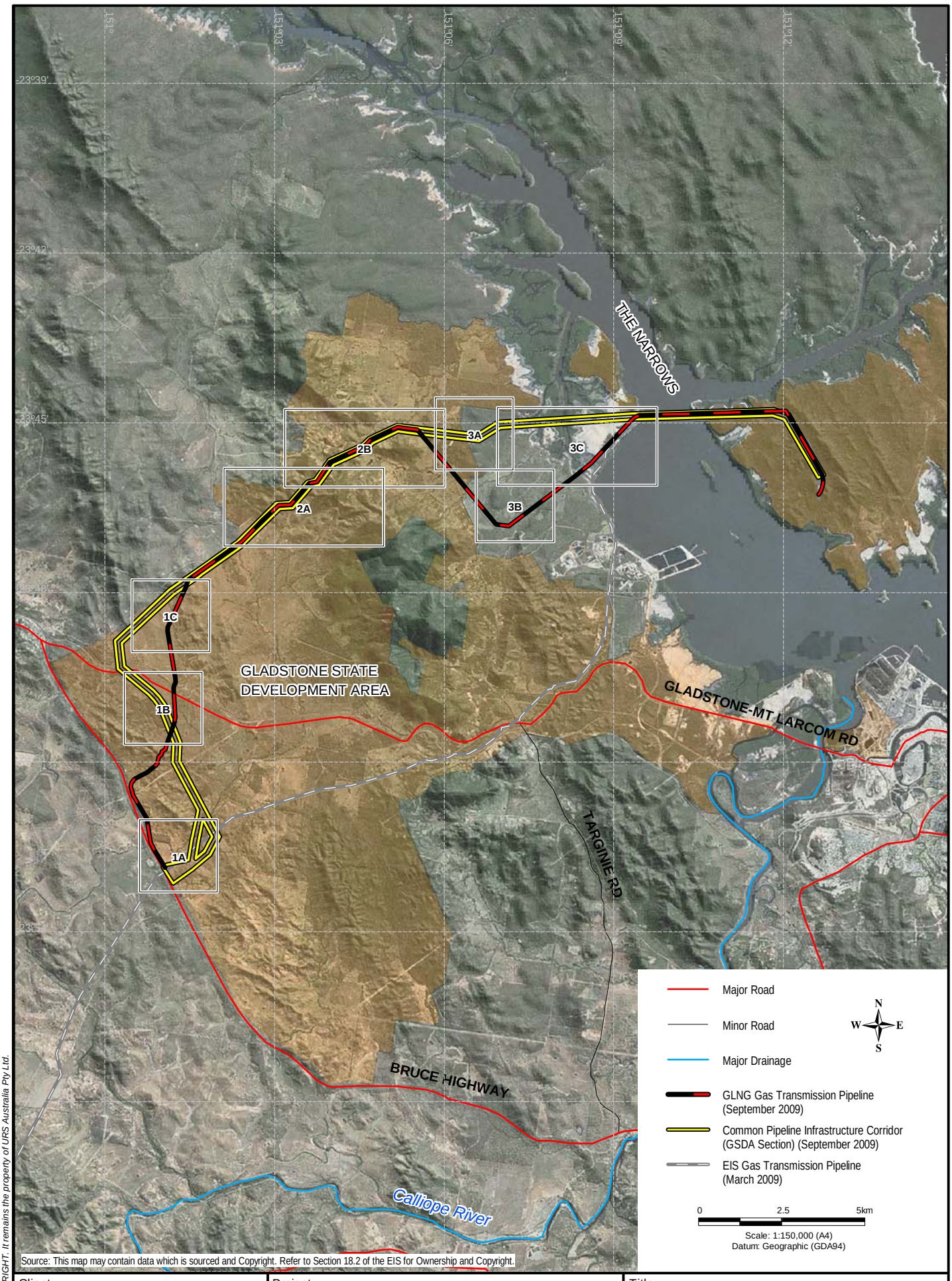
The GSDA area that the GLNG GTP (September 2009) and CPIC traverse has been historically altered by clearing for pastoral, agricultural and developmental activities. In addition, clearing for road infrastructure and forestry have also reduced the amount of remnant vegetation within the area. In this context, the construction of the GLNG GTP or CPIC will not significantly reduce the overall conservation values of the area. Initial planning and route selection has aimed to minimise impact on remnant vegetation, significant vegetation communities and fauna habitat through the avoidance of these areas wherever practicable. Nonetheless, an estimated 17 % of the GLNG GTP (September 2009) Alignment ROW within the GSDA and 26 % of the CPIC (GSDA Section) Route traverses remnant vegetation.

Field studies have determined that areas of remnant vegetation impacted by the ROW have often experienced historical disturbance from forestry and grazing activities (Section 2.2.3). Given the mitigation strategies outline above, it is therefore not anticipated that the proposed works will significantly further reduce current values.

Given the rise of industrial development in Gladstone, cumulative impacts should be considered a very real threat to the remnant vegetation and fauna habitat of this region. The CSG industry in central Queensland, and in particular Gladstone, has considerably intensified of late and it is highly conceivable that other GTPs will be developed.

The introduction of multiple pipelines within the GSDA could lead to cumulative impacts on nature conservation values. Management plans have been prepared by the GLNG Project to minimise such impacts and it is expected that other pipeline projects will explore options such as retaining ecological corridor linkages and remnant vegetation when additional pipelines are considered in this region. Use of the CICSDA will ensure that such cumulative impacts are generally restricted to a defined area within the corridor and are not more widely dispersed throughout the region where the pipeline alignments coincide. Cumulative impacts within the GSDA are discussed further in Attachment J, Section 4.3.

Figures



Client

LNG

URS

Project

GLADSTONE LNG PROJECT
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT
TERRESTRIAL FLORA ASSESSMENT
GAS TRANSMISSION PIPELINE

Title

REGIONAL ECOSYSTEMS
GSDA
KEY MAP

Drawn: RG	Approved: JB	Date: 09-11-2009
Job No: **4262 6440/**6220	File No: 42626440-g-2053.wor	

Figure: **1**

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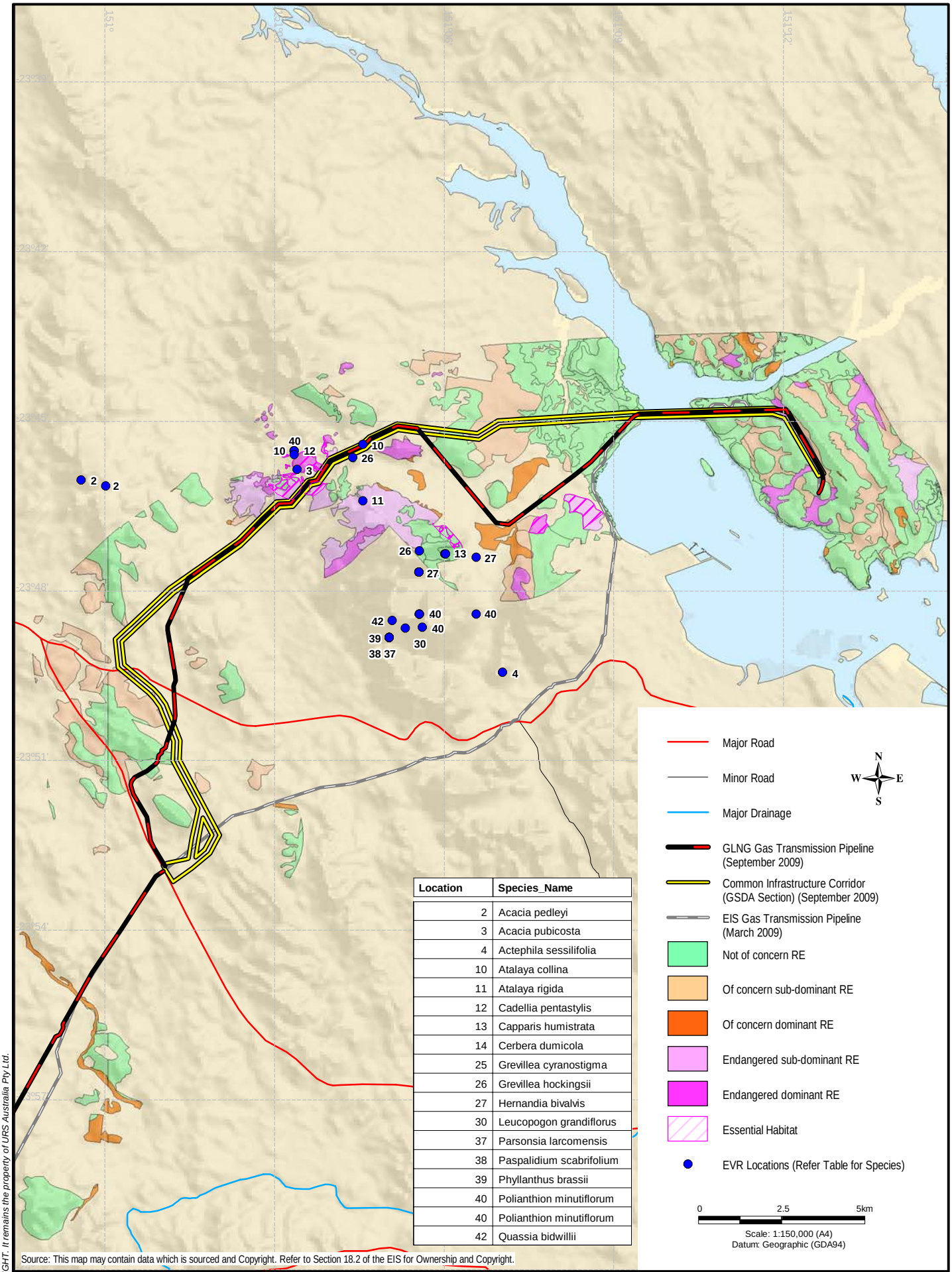

Location	Species_Name
2	Acacia pedleyi
3	Acacia pubicosta
4	Actephila sessilifolia
10	Atalaya collina
11	Atalaya rigida
12	Cadellia pentastylis
13	Capparis humistrata
14	Cerbera dumicola
25	Grevillea cyranostigma
26	Grevillea hockingsii
27	Hernandia bivalvis
30	Leucopogon grandiflorus
37	Parsonsia larcomensis
38	Paspalidium scabrifolium
39	Phyllanthus brassii
40	Polianthion minutiflorum
40	Polianthion minutiflorum
42	Quassia bidwillii

Client

Project
GLADSTONE LNG PROJECT
ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT
TERRESTRIAL FLORA ASSESSMENT
GAS TRANSMISSION PIPELINE

Title
REGIONAL ECOSYSTEMS
GSDA
ESSENTIAL HABITAT AND SIGNIFICANT SPECIES

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Job No: **4262 6440/**6220	File No: 42626440-g-2054.wor	

Figure: **2**

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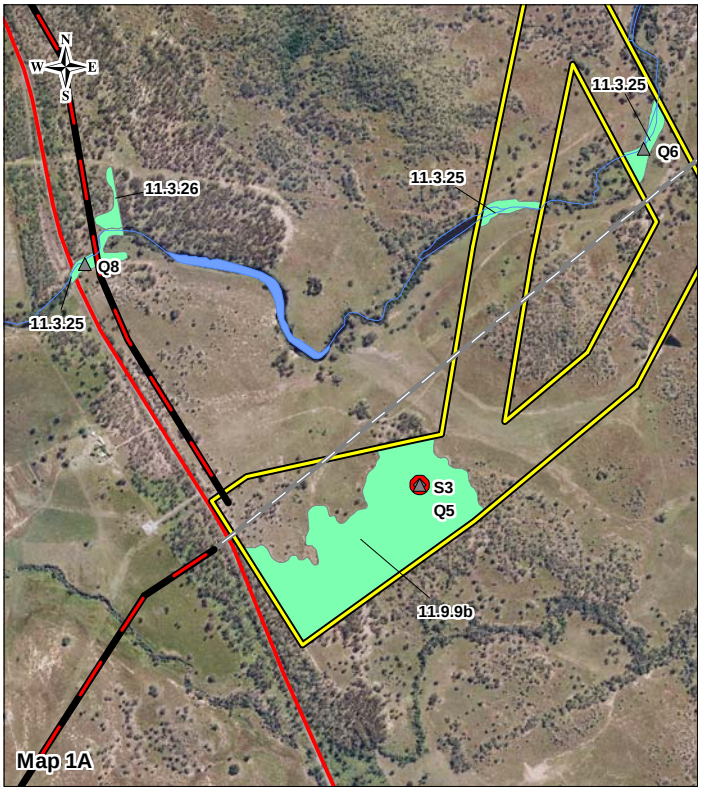

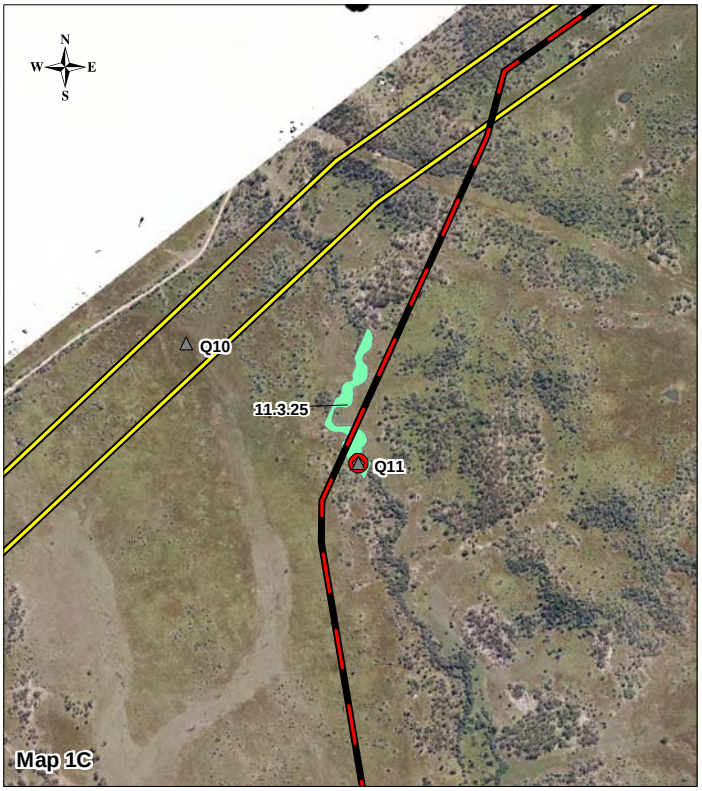

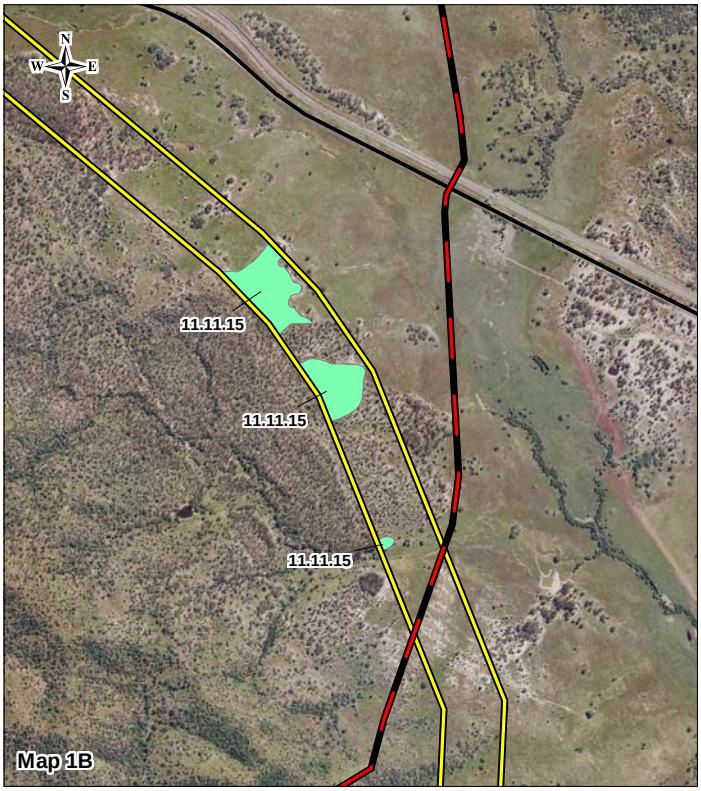

Major Road
Minor Road
Major Drainage
Minor Drainage

GLNG Gas Transmission Pipeline (September 2009)
Common Pipeline Infrastructure Corridor (GSDA Section) (September 2009)
EIS Gas Transmission Pipeline (March 2009)

Secondary Sites
Quaternary Sites
Presence of Exotic Species (Refer Figure 22 for details)

Not of concern RE
Of concern dominant RE
Endangered dominant RE

0 500 1000m

Scale: 1:25,000 (A4)
Projection: Geographic (GDA94)

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GAS TRANSMISSION PIPELINE

Title
REGIONAL ECOSYSTEMS GSDA MAP 1 OF 3

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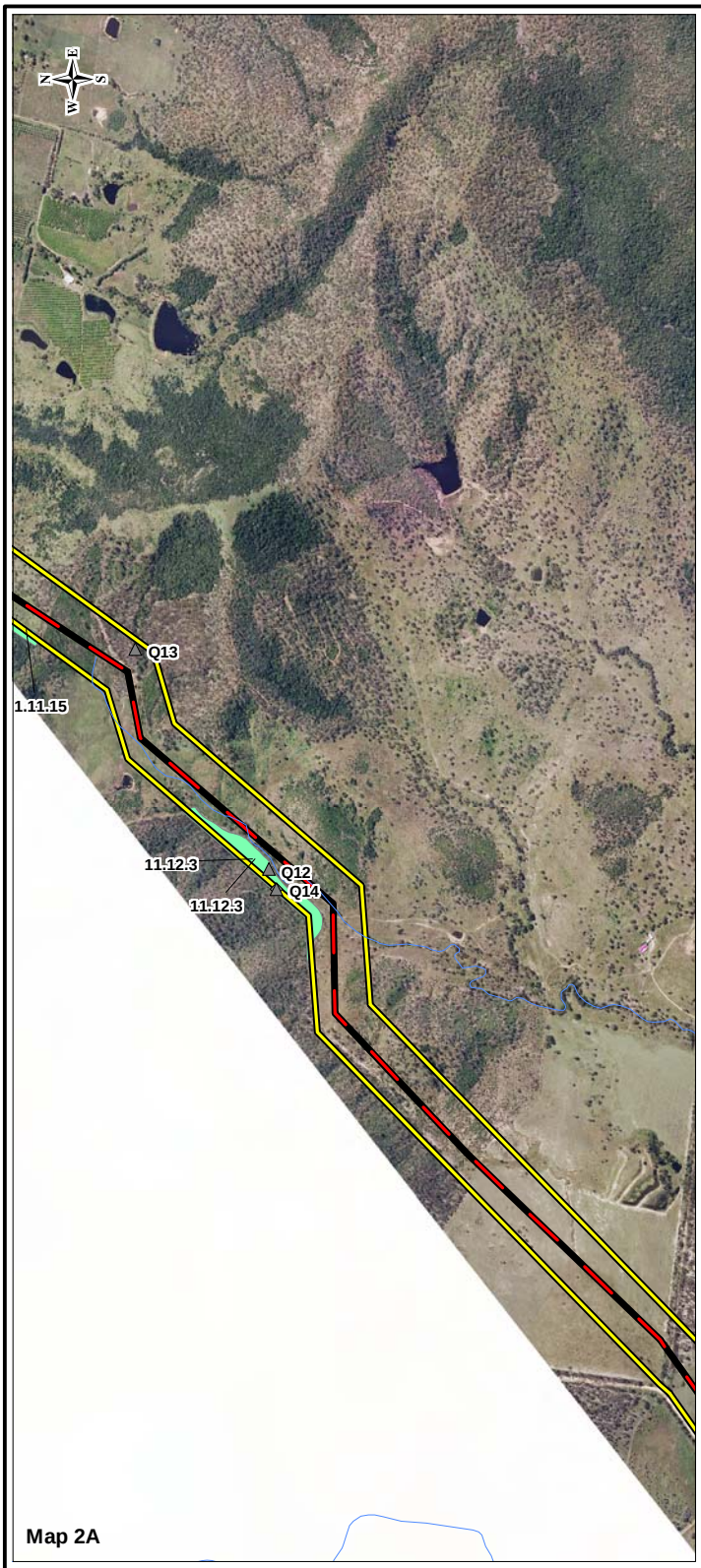
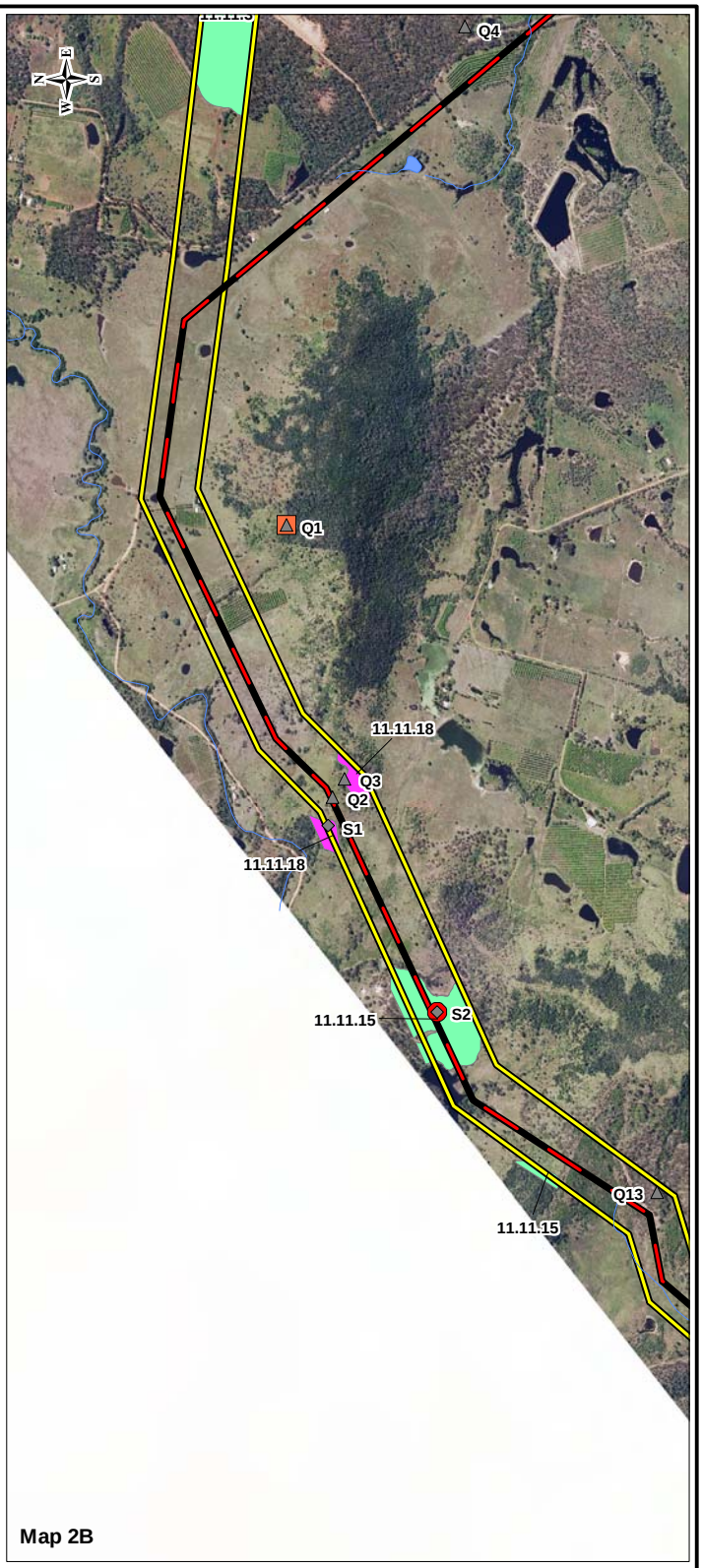


Map 2A



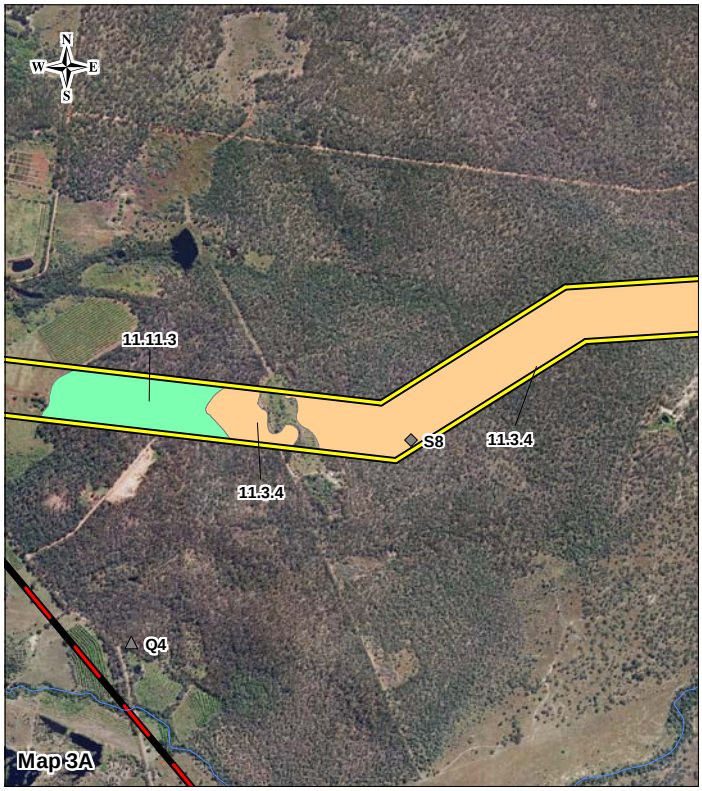
Map 2B

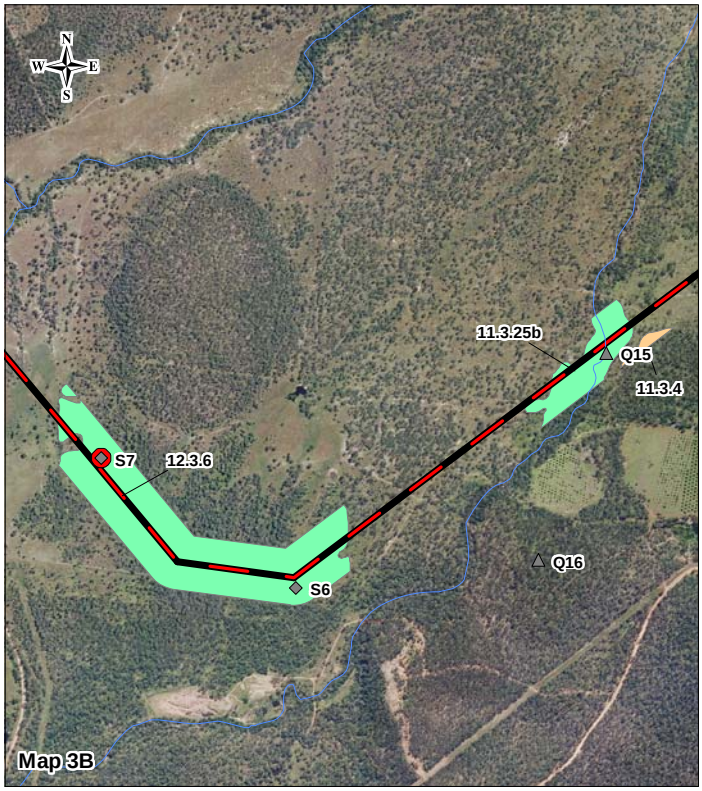
Major Road
Minor Road
Major Drainage
Minor Drainage
GLNG Gas Transmission Pipeline (September 2009)
Common Pipeline Infrastructure Corridor (GSDA Section) (September 2009)
EIS Gas Transmission Pipeline (March 2009)
Secondary Sites
Quaternary Sites
Presence of Exotic Species (Refer Figure 22 for details)
Not of concern RE
Of concern dominant RE
Endangered dominant RE
Macropteranthes leicocaulis

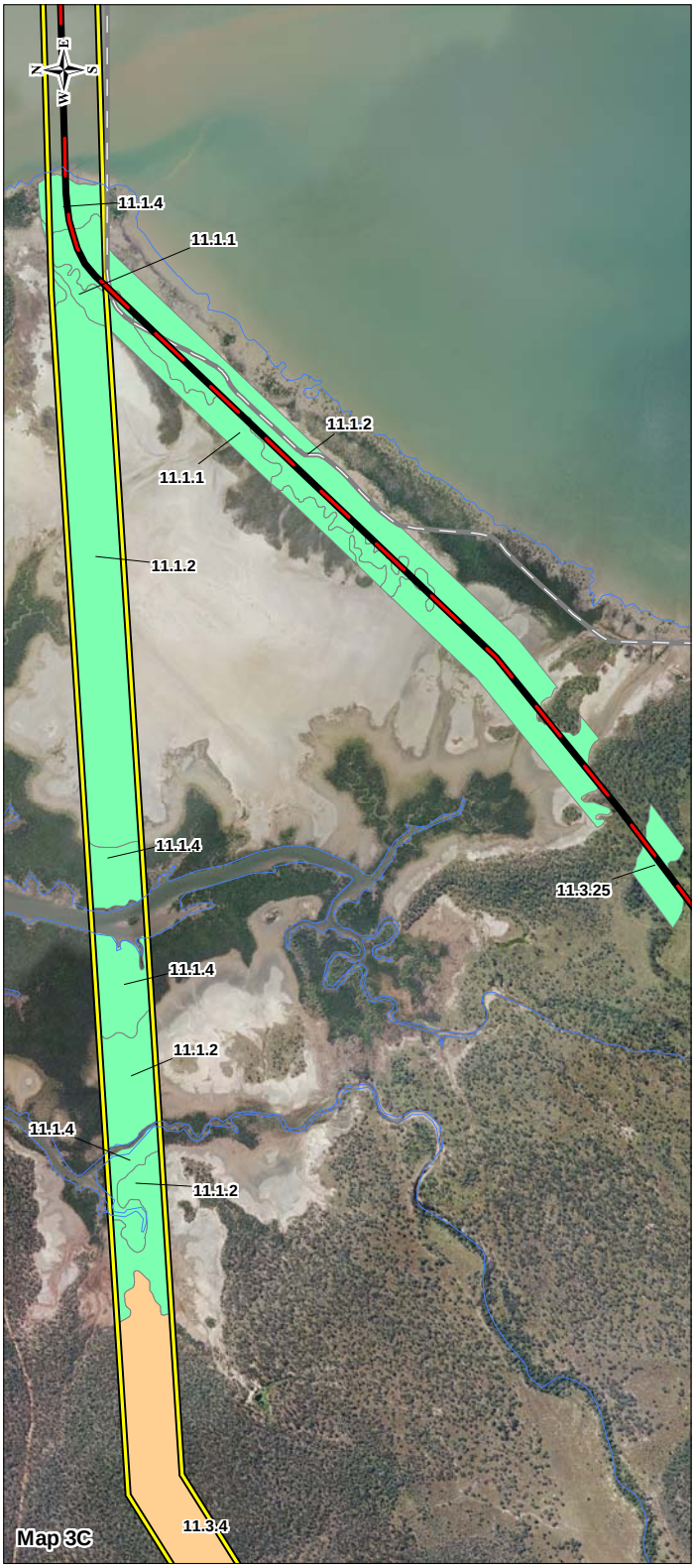
0 500 1000m

Scale: 1:25,000 (A4)
Projection: Geographic (GDA94)

Client: LNG / URS	Project: GLADSTONE LNG PROJECT ENVIRONMENTAL IMPACT STATEMENT SUPPLEMENT TERRESTRIAL FLORA ASSESSMENT GAS TRANSMISSION PIPELINE	Title: **REGIONAL ECOSYSTEMS GSDA MAP 2 OF 3**
	Drawn: RG | Approved: JB | Date: 09-11-2009 Job No: **42626440/**6220 | File No: 42626440-g-2056.wor	Figure: **4** | Rev:C | **A4**







Major Road
Minor Road
Major Drainage
Minor Drainage

GLNG Gas Transmission Pipeline (September 2009)
Commonn Pipeline Infrastructure Corridor (GSDA Section) (September 2009)
EIS Gas Transmission Pipeline (March 2009)

Secondary Sites
Quaternary Sites
Presence of Exotic Species (Refer Figure 22 for details)

Not of concern RE
Of concern dominant RE
Of concern sub-dominant RE
Endangered dominant RE

0 500 1000m

Scale: 1:25,000 (A4)
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ENVIRONMENTAL IMPACT STATEMENT SUPPLEMENT
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GAS TRANSMISSION PIPELINE

Title: **REGIONAL ECOSYSTEMS GSDA MAP 3 OF 3**

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Figure: **5**

Rev:C

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◆ Secondary Sites	1	2	3	4	7
Site Reference					
Cascabela thevetia (Yellow Oleander)					
Celtis sinensis (Chinese Celtis)					
Cryptostegia grandiflora (Rubber Vine)		●			●
Lantana camara (Lantana)	●	●		●	●
Lantana montevidensis (Creeping Lantana)					
Macfadyena unguis-cati (Cats Claw Creeper)					
Opuntia stricta (Common Prickly Pear)					
Opuntia tomentosa (Velvety Tree Pear)					
Parthenium hysterophorus (Parthenium)					
Sporobolus pyramidilis (Giant Rats Tail)			●		

▲ Quaternary Sites	6
Site Reference	
Cascabela thevetia (Yellow Oleander)	
Celtis sinensis (Chinese Celtis)	
Cryptostegia grandiflora (Rubber Vine)	
Lantana camara (Lantana)	
Lantana montevidensis (Creeping Lantana)	
Macfadyena unguis-cati (Cats Claw Creeper)	
Opuntia stricta (Common Prickly Pear)	●
Opuntia tomentosa (Velvety Tree Pear)	
Parthenium hysterophorus (Parthenium)	
Sporobolus pyramidilis (Giant Rats Tail)	

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ENVIRONMENTAL IMPACT STATEMENT
SUPPLEMENT
TERRESTRIAL FLORA ASSESSMENT
GAS TRANSMISSION PIPELINE

Title
REGIONAL ECOSYSTEMS
GSDA
LEGEND TO EXOTIC SPECIES

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Figure: **6**

Rev: A

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Appendix A GSDA Pipeline Flora

Report

GSDA Flora Appendix A

NOVEMBER 2009

Prepared for

Santos

32 Turbot Street
BRISBANE QLD 4000

42626442

URS

Project Manager:

Dan Simmons
Associate Environmental Scientist

URS Australia Pty Ltd

Level 16, 240 Queen Street
Brisbane, QLD 4000
GPO Box 302, QLD 4001
Australia
T: 61 7 3243 2111
F: 61 7 3243 2199

Project Director:

Chris Pigott
Senior Principal

Author:

Vanessa Wood
Environmental Scientist

Reviewer:

Dan Simmons
Associate Environmental Scientist

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Tables

Appendix A

1.1 Literature Search for Conservation Significant Flora

1.1.1 Search parameters

In order to identify the range of flora species present within the study area and the broader region, reviews of the below data sources were conducted for the area as defined by the coordinates presented in Table 1-1, below.

Table 1-1 Databases and search areas used for the GSDA study area

Database	Coordinates	Search Buffer
EPBC Protected Matters Report	Longitude 151.08E and Latitude 23.81S	25 kilometres
Wildnet Wildlife Online	Longitude 151.08E and Latitude 23.81S	25 kilometres
Regional Ecosystem mapping	Longitude 151.08E and Latitude 23.81S	10 kilometres
Essential Habitat Mapping	Longitude 151.08E and Latitude 23.81S	10 kilometres
Environmentally Sensitive Areas Mapping	Longitude 151.08E and Latitude 23.81S	10 kilometres
Queensland Herbarium HERBRECS		5 km buffer surrounding both GSDA pipeline options

1.1.2 Potentially Occurring Conservation Significant Flora Species

The 34 conservation significant flora species identified from the above parameters are detailed in Table 1-2 below.

Table 1-2 Conservation Significant Flora Species Identified from Literature Review in the GSDA Study Area

Species	Common Name	Status		Habitat/Distribution[6]	Likelihood of Presence
		NC Act[4]	EPBC Act[5]		
Acacia pedleyi[3]	No common name	R	Not Listed	The species is a slender, erect tree to 10 m high with predominantly smooth bark and dark green, feathery leaves. This species tends to grow in red loamy soil on slopes and ridge tops, in open eucalypt forest or woodland.	Possible
Acacia pubicosta[3]	No common name	R	Not Listed	Shrub to 5 m high; confined to rocky slopes. Restricted to the Biggenden area.	Possible
Acacia storyi[1]	No common name	R	Not Listed		Possible

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Actephila sessilifolia[1,3]	No common name	R	Not Listed	Shrub to 4 metres occurring in vine thicket and dry rainforest along creek/drainage lines on steep rocky slopes. *Actephila sessilifloria* is recorded as associating with the canopy tree - *Melaleuca leucadrendra* and numerous vine thicket species.	Possible
Alyxia magnifolia[1]	No common name	R	Not Listed	Shrub/small tree from the Apocynaceae family that grows to between 2 and 7m in height. This species is endemic to Queensland and has a restricted distribution that extends from Mount Greville in south-east Queensland north to Cathu State Forest, north-west of Mackay. *A. magnifolia* occurs commonly in wet sclerophyll forest, complex notophyll vine forest and araucarian microphyll vine forest between 130 – 800 m altitude.	Possible
Asplenium pellucidum[1]	No common name	V	V	Lithophytic or epiphytic fern which grows on mossy branches and rocks near in damp areas. The species is known from the Palmerston Valley within Wooroonooran National Park in north-east Queensland, recorded from a single collection.	Unlikely
Atalaya calcicola[1]	No common name	R	Not Listed	This species is found on boulder-strewn slopes, and on hills with granite, limestone, sandstone and basaltic rock outcrops dry in rainforest and deciduous vine thicket environments north from the Boyne Valley (south of Gladstone).	Possible
Atalaya collina[1,2,3]	No common	E	E	Grows on hillsides in remnant	Possible

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	name			dry scrubs, and is associated with *A. salicifolia*. Known only from Yarwun (near Gladstone, Queensland).	
Atalaya rigida[1,3]	No common name	R	Not Listed	This grows in red clay soil or black clay loam within vine thicket and araucarian microphyll notophyll vine forest. It is restricted to eastern Qld from Mt Aberdeen near Bowen, south to Mt Glastonbury south west of Gympie.	Possible
Bosistoa selwynii[2]	heart-leaved bosistoa	Not Listed	V	Grows in rainforests up to 300 m in altitude. From Maryborough in Queensland south to the Tweed River district in north-east NSW.	Possible
Bosistoa transversa[2]	three-leaved bosistoa	Not Listed	V	Grows in lowland subtropical rainforest up to 300 m in altitude. From Maryborough in Queensland south to the Nightcap Range north of Lismore in north-east NSW.	Unlikely
Bulbophyllum globuliforme[2]	miniature moss-orchid	R	V	This species is epiphytic, favouring subtropical rainforest, warm temperate rainforest, dry rainforest and wet sclerophyll forests. It's favoured (almost exclusive) host is *Araucaria cunninghamii*.	Possible
Capparis humistrata[3]	No common name	E	Not Listed	Shrub found only in Queensland.	Possible
Cerbera dumicola[3]	No common name	R	Not Listed	Shrub/small tree. Grows on ridge tops on lateritic soil.	Possible
Cupaniopsis shirleyana[1,2]	wedge-leaf tuckeroo	V	V	Small tree up to 10 m tall; usually seen as large bushy shrub. Endemic to Queensland, ranging from Carina, Brisbane to Bundaberg. Occurs in dry	Likely as Essential Habitat exists

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				rainforest.	
Cycas megacarpa[1,2]	No common name	E	E	Scattered and localised on clay-loam soils over several substrates, usually on sloping country in wet eucalypt forests or rainforests. Ranges from near Mount Morgan to near Goomeri in Qld.	Possible
Dansiea elliptica[1]	No common name	R	Not Listed	Grows on sandy granitic soils in low elevation dry rainforest and semi evergreen vine thickets in south-eastern Queensland and rainforest margins in north-eastern Queensland.	Possible
Denhamia parvifolia[1]	No common name	V	V	Shrub that grows to 3 m tall. Known from Eidsvold to Chinchilla and east of Kingaroy in Queensland. Grows in brown or brownish-red loams and clay-loams in vine thickets and softwood scrubs on hillslopes and crests.	Unlikely
Graptophyllum excelsum[1]	Scarlet fuschia	R	Not Listed	Shrub or small tree 1.5 to 8 m high. Known from eastern coast and ranges of Cape York and Port Curtis areas of Queensland. Grows in dry vine thickets usually on soils derived from limestone.	Possible
Grevillea cyranostigma[3]	No common name	R	Not Listed	Spreading shrub 0.5-2 m tall. Occurs in central Qld, endemic to the Carnarvon Range and adjacent area. Grows in eucalypt woodland or open forest, often on rocky slopes or cliffs in sandy soil over sandstone.	Unlikely
Grevillea hockingsii[3]	No common name	V	Not Listed	Erect shrub that grows to 2.5 metres in Eucalypt woodland or open forest around rocky sandstone breakaways and	Unlikely

				occasionally on sandy alluvium flats. Occurs from three disjunct areas in Queensland including Coominglah State Forest west of Monto; Callide Range east of Biloela; and Razor Back Range near Mt Morgan.	
Hernandia bivalvis[3]	grease nut	R	Not Listed	Small tree that grows in dry vine forests with shallow rocky soils. Distribution is north from the Brisbane River north of Ipswich.	Possible
Leucopogon cuspidatus[2]	No common name	Not Listed	V	Small shrub to 1.2 m with a spreading habit. Occurs in eastern Queensland from Blackdown Tableland in the south to the Mt Stewart area near Homestead Township in the north. Most populations occur on off-shore islands in the Great Barrier Reef and adjacent mainland coastal areas, although collections have been made as far west as Blackdown Tableland. Occurs in open forest, woodland and heath on rocky slopes with granitic or serpentinite substrates.	Possible
Leucopogon grandiflorus[3]	No common name	R	Not Listed	Grows on sandstone slopes ridge crests and cliff edges. This shrub species grows to 2 metres with a rounded or untidy growing form. Widespread throughout the Central Highlands sandstone belt and can be locally common.	Possible
Macropteranthes fitzalanii[1]	No common name	R	Not Listed	Occurs in notophyll and microphyll vine forests and littoral rainforests and is restricted to coastal areas of central Qld from the	Unlikely

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				Proserpine area to Rockhampton.	
Macropteranthes leiocaulis[1]	No common name	R	Not Listed	Small to medium-sized seasonally deciduous tree. This species grows in red euchrozems or sandstone Talus within deciduous vine thickets, semi-evergreen vine thickets and araucarian microphyll vine forests. Found north from the Binjour Plateau (north-west of Gayndah).	Confirmed from field survey.
Parsonsia larcomensis[1,2,3]	No common name	V	V	Occurs in open heathland and shrubland at or near the summits of mountain peaks from 350 to 750 m elevations and is restricted to central east and south-east Qld.	Unlikely
Parsonsia lenticellata[1]	narrow-leaved parsonsia	R	Not Listed	This species is found in coastal districts in drier rainforests and transitional zones to open forest from Mackay to Port Douglas.	Unlikely
Paspalidium scabrifolium[3]	No common name	R	Not Listed	Perennial grass with leaf blades linear or lancelote (8-30 cm long; 4-8 mm wide). Leaf blade surfaces scabrous on both sides.	Possible
Phyllanthus brassii[3]	No common name	R	Not Listed	Grows to 3 metres in heath on granite along creek lines.	Possible
Polianthion minutiflorum[3]	No common name	Not Listed	V	Shrub up to 1 m high. Known from five areas in east Queensland from Redcliff Vale west of Mackay, south to Kingaroy. Grows in forest and woodland on sandstone slopes and gullies with skeletal soil, also deeper soils adjacent to deeply weathered laterite.	Possible
Quassia bidwillii[2,3]	quassia	V	V	Shrub or small tree to 6 m that occurs from Gympie to Mackay. Grows in rainforest	Possible

				communities, or on the margins of these communities.	
Taeniophyllum muelleri[2]	minute orchid	Not Listed	V	Epiphytic orchid, favouring littoral rainforest, subtropical rainforest, wet sclerophyll forests and riparian areas.	Possible
Zieria actites[1]	No common name	V	Not Listed	Shrub to 1 m tall forming densely compact bush. Species is endemic to Qld and is known only from Mt Larcom north-west of Gladstone.	Possible

[1] Sourced from the EPA's Wildlife Online database.

[2] Sourced from the Commonwealth's EPBC Matters of Environmental Significance database.

[3] Sourced from the Queensland Herbarium HERBRECS database.

[4] Indicates the Queensland conservation status of each taxon under the Nature Conservation Act 1992. The codes are Presumed Extinct (PE), Endangered (E), Vulnerable (V), Rare (R), Common (C) or Not Protected ( ).

[5] Indicates the Australian conservation status of each taxon under the Environment Protection and Biodiversity Conservation Act 1999. The values of EPBC are Conservation Dependent (CD), Critically Endangered (CE), Endangered (E), Extinct (EX), Extinct in the Wild (XW) and Vulnerable (V).

[6] Information based on a number of sources including: Department of Environment and Conservation (NSW) (2005); Department of Environment and Heritage (2008); PlantNET (2009); World Wide Wattle (2007).

1.2 Flora Survey Methodology

The flora survey employed an assessment of floral taxa and vegetation communities in keeping with the methodology employed by the Queensland Herbarium for the survey of Regional Ecosystems and vegetation communities (Neldner *et al*., 2005). Preliminary identification of the vegetation communities of the project areas was conducted prior to the commencement of fieldwork. Preliminary identification included vegetation community definition from aerial photography and interpretation of 1:100 000 Regional Ecosystems coverage Version 5.2 for the region (DERM, 2007). The survey design was established in consultation with the DERM (formerly known as the EPA).

Preliminary community definition was used to identify locations for representative field survey sample plots to obtain floristic and structural data and ground truth communities. Field surveys involved a botanical assessment at a number of representative sites within each vegetation community, employing a number of standard methods including: modified secondary sample plots; quaternary sample plots; and random meander search area. Regional ecosystems that were 'Of Concern' and 'Endangered' were targeted for the survey, together with any riparian vegetation and DERM Essential Habitat. A number of vehicle traverses of the study site were also undertaken throughout the survey period to identify changes in landform and identify community boundaries. Community structural formation classes were assessed according to (Neldner *et al*., 2005). Regional ecosystem classification of communities was determined as per Sattler and Williams (1999), and in accordance with the Regional Ecosystems Description Database {REDD (DERM, 2007)}.

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A total of 8 secondary transects and 16 quaternary sites were surveyed along the pipeline. Final vegetation mapping was undertaken utilising field survey data and aerial photograph interpretation of stereo pair images at a scale of approximately 1:22,000 (Aerometrex, 2008).

The survey was conducted under Queensland Environmental Protection Agency Scientific Purposes Permit number WISP02056306.

A.1 Vegetation Communities

Secondary Transect 1 **GSDA 15/09/09** **GPS Location UTM WGS '84**	
Vegetation Community	Semi-evergreen vine thicket
R.E	11.11.18
Transect midpoint	303853.35 mE; 7371369.5 mN
Bearing	200° S
Aspect	280° W
Slope	25°
Soil	Dark brown sandy loam with igneous rocks
Weeds	*Lantana camara**
Fauna Habitat	No hollow bearing trees. Moderate, rocky habitat for reptiles. Dead grass smothering most ground cover.
Notes	Dominated by *Gossia acmenoides* in canopy. Moderate grazing impacts.
Strata	**Dominant Species**
Canopy (T1): 8-10 m	*Gossia acmenoides*
FPC: 78%	*Brachychiton australis*
Shrub (S1): 1-6 m	*Alchornea ilicifolia*
FPC: 70%	*Alyxia ruscifolia*
	Hovea longipes
	Flindersia dissasperma
	Strychnos psilosperma
	Cupaniopsis wadsworthii
	Ailanthus triphysa
Ground (G): <1 m	*Megathyrsus maximus**
FPC: 91%	*Arundinella napalensis*
Litter: 8%	
Bare: 1%	

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Secondary Transect 2 **GSDA 15/09/09** **GPS Location UTM WGS '84**	
Vegetation Community	*C. citriodora* open forest on metamorphics
R.E.	11.11.15
Transect midpoint	303229.58 mE; 7370962.48 mN
Bearing	240° W
Aspect	140°S
Slope	15°
Soil	Dark brown/black, sandy loam, fine grained, numerous small metamorphosed rocks
Weeds	*Cryptostegia grandiflora*, Lantana camara*, Opuntia stricta**
Fauna Habitat	Some hollow-bearing trees. Good quality native grass open ground cover and woody material.
Notes	Evidence of fire in the past 5 to 10 years.
Strata	**Dominant Species**
Canopy (T1): 14-20 m	*Corymbia citriodora subsp. citriodora*
FPC: 70%	*Eucalyptus crebra*
Shrub (S1): 4-6 m	*Corymbia citriodora subsp. citriodora*
	Eucalyptus exserta
Shrub (S2): 1-3 m	*Lantana camara**
FPC: %	*Xanthorrhoea johnsonii*
	*Cryptostegia grandiflora**
	*Opuntia stricta**
	Pogonolobus reticulatis
	Acacia disparrima
Ground (G): <1 m	*Heteropogon contortus*
FPC: 38%	*Lomandra confertifolia subsp. pallida*
Litter: 42%	*Eragrostis brownii*
Bare: 20%	*Chloris virgata*
	Eustrephus latifolius
	Arundinella nepalensis

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Secondary Transect 3 **GSDA 16/09/09** **GPS Location UTM WGS '84**	
Vegetation Community	*Eucalyptus crebra* woodland
R.E.	11.9.9b
Transect Start	298802.65 mE; 7357601.73 mN
Bearing	150° S
Aspect	50°S
Slope	5°
Soil	light brown sandy loam, fine sediments on undulating hills
Weeds	-
Fauna Habitat	Some hollow-bearing trees. Good quality native grass open ground cover and woody debris.
Notes	Evidence of fire in the past 5 years. Low sparse *E. crebra* woodland borderline remnant. Open grassy understorey with no shrub layer.
Strata	**Dominant Species**
Canopy (T1): 16-20 m	*Eucalyptus crebra*
FPC: 56%	
Tree (T2): 6-12 m	*Corymbia tesselaris*
	Eucalyptus crebra
	Corymbia clarksoniana
Shrub (S2): 1-5 m	*Pogonolobus reticulatis*
FPC: <5%	*Acacia disparrima*
	Bursaria spinosa
Ground (G): <1 m	*Heteropogon contortus*
FPC: 73%	*Panicum effusum*
Litter: 22%	*Eragrostis brownii*
Bare: 5%	*Themeda triandra*
	Cymbopogon refractus

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Secondary Transect 4 **GSDA 16/09/09** **GPS Location UTM WGS '84**	
Vegetation Community	*Melaleuca fluviatilis* fringing drainage lines
R.E.	11.3.25b
Transect midpoint	298264.81 mE; 7365508.31 mN
Bearing	120° E
Aspect	flat
Slope	flat
Soil	light grey sandy loam, alluvium
Weeds	*Asclepias curassavica*, Lantana camara**
Fauna Habitat	Good riparian corridor for arboreal mammals and birds.
Notes	Evidence of fire in the past 5 years. Ephemeral waterway.
Strata	**Dominant Species**
Canopy (T1): 10-15 m	*Melaleuca fluviatilis*
FPC: 60%	*Casuarina cunninghamiana*
	Melaleuca bracteata
Tree (T2): 2-6 m	*Melaleuca fluviatilis*
	Casuarina cunninghamiana
	Melaleuca bracteata
Shrub (S2): 0.5-1.5 m	*Casuarina cunninghamiana*
FPC: <5%	*Alphitonia excelsa*
	*Lantana camara**
Ground (G): <1 m	*Cynodon dactylon*
FPC: 16%	*Lomandra longifolia*
Litter: 81%	*Aristida calycina*
Bare: 3%	

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Secondary Transect 5 **GSDA 16/09/09** **GPS Location UTM WGS '84**	
Vegetation Community	*Eucalyptus crebra* woodland
R.E.	11.12.3
Transect midpoint	301833.06 mE; 7369622.79 mN
Bearing	200° E
Aspect	100° E
Slope	20°
Soil	light grey sandy/gravelly volcanics
Weeds	-
Fauna Habitat	
Notes	Evidence of fire in the past 5 years.
Strata	**Dominant Species**
Canopy (T1): 15-22 m	*Angophora leiocarpa*
FPC: 50%	*Eucalyptus exserta*
	Eucalyptus crebra
Tree (T2): 6-12 m	*Eucalyptus crebra*
	Angophora leiocarpa
	Eucalyptus exserta
Shrub (S2): 1-4 m	*Lophostemon confertifolius*
FPC: 12%	*Xanthorrhea johnsonii*
	Acacia disparrima
Ground (G): <1 m	*Heteropogon contortus*
FPC: 61%	*Themeda triandra*
Litter: 30%	*Aristida calycina*
Bare: 8%	

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Secondary Transect 6 **GSDA 17/09/09** **GPS Location UTM WGS '84**	
Vegetation Community	*Lophostemon suaveolens, Melaleuca quinquenervia* woodland
R.E.	12.3.6
Transect midpoint	308348.72 mE; 7368784.24 mN
Bearing	-
Aspect	-
Slope	-
Soil	light grey sandy alluvial sediments
Weeds	*Lantana camara**
Fauna Habitat	
Notes	Evidence of fire in the past 5 years.
Strata	**Dominant Species**
Canopy (T1): 15-22 m	*Lophostemon suaveolens*
FPC: 32%	*Eucalyptus exserta*
	Eucalyptus crebra
Tree (T2): 6-10 m	*Lophostemon suaveolens*
	Corymbia tesselaris
	Eucalyptus tereticornis
Shrub (S2): 1-4 m	*Lophostemon suaveolens*
FPC: 20%	*Melaleuca quinquenervia*
	Acacia leiocarpa
Ground (G): <1 m	*Heteropogon contortus*
FPC: 90%	*Themeda triandra*
Litter: 5%	*Aristida calycina*
Bare: 5%	*Arundinella nepalensis*

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Secondary Transect 7 **GSDA 17/09/09** **GPS Location UTM WGS '84**	
Vegetation Community	*Lophostemon suaveolens* and *Eucalyptus crebra* woodland
R.E.	12.3.6
Transect midpoint	307696.85 mE; 7369242.38 mN
Bearing	180°
Aspect	flat
Slope	flat
Soil	light grey sandy alluvial sediments
Weeds	*Lantana camara**
Fauna Habitat	Excellent habitat. Robust hollows and *Melaleuca* flowers.
Notes	Evidence of fire in the past 5 years. Regrowth community that just satisfies VM Act.
Strata	**Dominant Species**
Canopy (T1): 18-25 m	*Lophostemon suaveolens*
FPC: 34%	*Corymbia tesselaris*
	Eucalyptus tereticornis
Tree (T2): 8-15 m	*Lophostemon suaveolens*
	Corymbia tesselaris
Shrub (S2): 1-5 m	*Lophostemon suaveolens*
FPC: 20%	*Melaleuca quinquenervia*
	Acacia leiocarpa
	Planchonia careya
Ground (G): <1 m	*Heteropogon contortus*
FPC: 90%	*Sida cordifolia*
Litter: 5%	*Glossocardia bidens*
Bare: 5%	*Arundinella nepalensis*
	Dianella caerulea

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Secondary Transect 8 **GSDA 18/09/09** **GPS Location UTM WGS '84**	
Vegetation Community	*Eucalyptus crebra* and *Melaleuca viridilfora* woodland
R.E.	11.3.4
Transect midpoint	307465.56 mE; 7371649.24 mN
Bearing	180°
Aspect	flat
Slope	flat
Soil	light grey sandy gravelly loam
Weeds	*Lantana camara**
Fauna Habitat	Excellent habitat. Robust hollows and *Melaleuca* flowers.
Notes	Evidence of fire in the past 5 years. Regrowth community that just satisfies VM Act.
Strata	**Dominant Species**
Canopy (T1): 15-20 m	*Eucalyptus crebra*
FPC: 26%	*Eucalyptus exserta*
	Eucalyptus tereticornis
Tree (T2): 10-15 m	*Eucalyptus crebra*
	Melaleuca viridiflora
	Eucalyptus tereticornis
Shrub (S2): 1-5 m	*Lophostemon suaveolens*
FPC: 25%	*Melaleuca viridiflora*
	Acacia leiocarpa
	Terminalia oblongata
	Pogonolobus reticulatis
Ground (G): <1 m	*Heteropogon contortus*
FPC: 47%	*Eragrostis brownii*
Litter: 38%	*Aristida calycina*
Bare: 15%	

Limitations

URS Australia Pty Ltd (URS) has prepared this report in accordance with the usual care and thoroughness of the consulting profession. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the Proposal dated 15 July 2009.

The methodology adopted and sources of information used by URS are outlined in this report. URS has made no independent verification of this information beyond the agreed scope of works and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to URS was false.

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URS Australia Pty Ltd
Level 16, 240 Queen Street
Brisbane, QLD 4000
GPO Box 302, QLD 4001
Australia
T: 61 7 3243 2111
F: 61 7 3243 2199

www.ap.urscorp.com

B

Appendix B GSDA Flora Species List

			Conservation		Secondary Transects									Quaternary Transects														
Species	**Family**	**Common Name**	**Status***	**Introduced**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Acacia decora	Mimosaceae	pretty wattle																								U			
Acacia disparrima	Mimosaceae	Hickory Wattle				O	R		R	O										C	C								
Acacia leiocalyx	Mimosaceae	Black Hickory Wattle								C	O	C														O			
Ailanthus triphysa	Simaroubaceae	white bean			C																								
Alchornea ilicifolia	Euphorbiaceae	Native Holly			U																							C	
Alphitonia excelsa	Rhamnaceae	Red Ash				R		R	R																				O
Alyxia ruscifolia subsp. ruscifolia	Apocynaceae	Chainfruit			C																								
Angophora leiocarpa	Myrtaceae	smooth-barked apple							C								C							O	C				
Archidendropsis thozetiana	Mimosaceae	southern siris													O														
Aristida calycina	Poaceae						O	A	O	C		C																	
Arundinella nepalensis	Poaceae	reed grass			C	A	O		A	A	A	C		A	O	C	C							C					C
Asclepias curassavica *	Asclepiadaceae	Redhead Cotton Bush	Introduced	*				O			U							U	U										
Brachychiton australis	Sterculiaceae				O																								
Bursaria incana	Pittosporaceae	Prickly Pine												C															
Bursaria spinosa	Pittosporaceae						U																						
Capparis canescens	Capparaceae					O																							
Carissa ovata	Apocynaceae					U										C													
Casuarina cunninghamiana	Casuarinaceae							O										C	C									C	
*Chloris virgata**	Poaceae		Introduced	*		O																							
Cissus oblonga	Vitaceae	smooth watervine			O																								
Corymbia citriodora subsp. citriodora	Myrtaceae	Lemon-scented Gum				C																		C					C
Corymbia clarksoniana	Myrtaceae	Clarkson's Bloodwood					O																C	C					
Corymbia tessellaris	Myrtaceae	Moreton Bay Ash					O			U	C																		
Cryptostegia grandiflora *	Asclepiadaceae	Rubber Vine	Introduced	*		R					R																		
Cupaniopsis wadsworthii	Sapindaceae				U																								
Cynodon dactylon	Poaceae	Couch						A																					
Denhamia pittosporoides	Celastraceae	veiny denhamia			O																								
Dianella caerulea	Hemerocallidaceae							O	U		O	O																	
Dianella rara	Hemerocallidaceae									R																			
Diospyros geminata	Ebenaceae	scaly ebony				U																							
Drypetes deplanchei	Putranjivaceae	yellow tulip			O										O														
Ehretia grahamii	Boraginaceae	rough leaved koda													O														
Epaltes australis	Asteraceae																												
Eragrostis brownii	Poaceae	Brown's Lovegrass				C	O			O	O	O																	
Eucalyptus crebra	Myrtaceae	Narrow-leaved Ironbark				C	A		C	U		A					C									O			C
Eucalyptus exserta	Myrtaceae	Queensland Peppermint							O	O		O															O		
Eucalyptus molluccana	Myrtaceae																					C					C		
Eucalyptus tereticornis	Myrtaceae	Forest Red Gum								R	C	O						C	C	O	O	O			O				
Eustrephus latifolius	Smilacaceae	Wombat Berry				O	U	R																					
Flindersia dissasperma	Rutaceae				O																								
Geijera salicifolia	Rutaceae														U														
Glossocardia bidens	Asteraceae	Native Cobbler's Pegs									C																		
Gomphocarpus physocarpus *	Asclepiadaceae	Balloon Cotton Bush	Introduced	*						R	O																		
Gossia acmenoides	Myrtaceae				C											C													
Heteropogon contortus	Poaceae	Giant Speargrass				O	A		C	C	C	A										A							
Hibiscus divaricatus	Malvaceae					O			O	R																			
Homalium alnifolium	Flacourtiaceae														U														
Hovea longipes	Fabaceae				A																								
Jasminum didymum	Oleaceae	native jasmine			C																								
Lantana camara *	Verbenaceae	Lantana	Introduced	*	O	O		R			O																		
Lomandra confertifolia subsp. pallida	Xanthorrhoeaceae	Matrush				O			O			U																	
Lomandra longifolia	Xanthorrhoeaceae							U										O	O										
Lophostemon confertus	Myrtaceae								A															A	C	C			
Lophostemon suaveolens	Myrtaceae	Swamp Box								A	C	C																	
Macropteranthes leiocaulis	Combretaceae	northern bonewood	Rare											U															
Macrozamia miquelii	Zamiaceae	Zamia							O															O	U				
Mallotus philippensis	Euphorbiaceae	Kamala																										A	

			Conservation		Secondary Transects									Quaternary Transects															
Species	**Family**	**Common Name**	**Status***	**Introduced**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
*Megathyrsus maximus**	Poaceae	Guinea Grass			A																								
Melaleuca bracteata	Myrtaceae	black tea tree						U																					
Melaleuca fluviatilis	Myrtaceae							A																				C	
Melaleuca quinquenervia	Myrtaceae	Paper Tea-tree								C	C	O																	
Melaleuca viminalis	Myrtaceae	weeping bottlebrush																A	A										
Melaleuca viridiflora	Myrtaceae	Broad Leaved Tea-tree																		C	C								
Melia azedarach	Meliaceae	White Cedar																		C	C								
Micromelum minutum	Rutaceae	cluster berry														O													
*Opuntia stricta **	Cactaceae	Common Prickly Pear	Introduced	*		R																U							
Panicum effusum	Poaceae	Hairy Panicum					C																						
*Pennisetum ciliare**	Poaceae	buffel grass																C	C			C	C						
Petalostigma pubescens	Euphorbiaceae	Bitter Bark																											O
Planchonia careya	Lecythidaceae	Cocky Apple								O	O																		
Pogonolobus reticulatus	Rubiaceae	Medicine Bush				R	U					O				C													
Schoenoplectus validus	Cyperaceae	club rush									R																		
Sida cordifolia	Malvaceae	Flannel Weed								A	C																		
*Sida rhombifolia **	Malvaceae	Common Flannel Weed	Introduced	*																									
Sporobolus caroli	Poaceae	Fairy Grass					O		C	O		C																	
*Sporobolus pyramidilis**	Poaceae	Giant rat's tail		*			O																						
Strychnos psilosperma	Loganiaceae	strychnine tree			C									C		C													
*Stylosanthes scabra**	Fabaceae		Introduced	*							U																		
Terminalia oblongata	Combretaceae	yellow wood										O																	
Themeda triandra	Poaceae	Kangaroo Grass					C		C	C		C																	
Xanthorrhoea johnsonii	Xanthorrhoeaceae	Grass Tree	Common			O			C																				

URS Australia Pty Ltd
Level 16, 240 Queen Street
Brisbane, QLD 4000
GPO Box 302, QLD 4001
Australia
T: 61 7 3243 2111
F: 61 7 3243 2199

www.ap.urscorp.com

4

Part 4 Curtis Island

Report

Part 4 Curtis Island

NOVEMBER 2009

Prepared for

Santos

32 Turbot Street,
Brisbane, Qld 4000

42626442

URS

Project Manager:

Jim Barker
Associate Environmental Scientist

URS Australia Pty Ltd

Level 16, 240 Queen Street

Brisbane, QLD 4000

GPO Box 302, QLD 4001

Australia

T: 61 7 3243 2111

F: 61 7 3243 2199

Project Director:

Chris Pigott
Senior Principal

Author:

Vanessa Wood
Project Ecologist

Reviewer:

Dan Simmons
Associate Environmental Scientist

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Abbreviations

Abbreviation	Description
BoM	Bureau of Meteorology
CICSDA	Callide Infrastructure Corridor State Development Area
CPIC	Common Pipeline Infrastructure Corridor
DERM	Queensland Department of Environment and Resource Management
DEWHA	Department of Environment, Water, Heritage and the Arts
DPIF	Department of Primary Industry and Fisheries
EIS	Environmental Impact Statement
EPA	Environment Protection Agency
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESA	Environmentally Sensitive Areas
FPC	Foliage Projection Cover
GLNG	Gas Liquefied Natural Gas
GSDA	Gladstone State Development Area
GTP	Gas Transmission Pipeline
ha	hectares
HERBRECS	is a database maintained by the Queensland Herbarium that provides a list of specimens and collections for a specified search area.
LNG	Liquefied Natural Gas
LP Act	Queensland *Lands Protection (Pest and Stock Route Management) Act 2002*
m	metre
MNES database	Commonwealth Department of the Environment, Water, Heritage and the Arts (DEWHA) Matters of National Environmental Significance database
NC Act	*Queensland Nature Conservation Act 1992*
QCLNG	Queensland Curtis Liquefied Natural Gas
QLD	Queensland
RE	Regional Ecosystems
REDD	Regional Ecosystems Description Database
ROW	Right of Way
SF	State Forest
VM Act	*Queensland Vegetation Management Act* 1999
VM Status	Vegetation Management Status

Executive Summary

This report investigates the environmental conditions and potential impacts for the GLNG GTP (September 2009) (route alternatives identified by Santos since March 2009 as the result of further engineering, geotechnical, environmental and other investigations) and the Common Pipeline Infrastructure Corridor (CPIC) Route (the shared infrastructure corridor for multiple proponents proposed by the Queensland Government between Callide and the proposed Liquefied Natural Gas (LNG) facility sites on Curtis Island) on Curtis Island.

A targeted field survey was undertaken on 14 September 2009 on Curtis Island to assess areas designated as Queensland Department of Environment and Resource Management (DERM) 'Essential Habitat' for signs of koala (*Phascolarctos cinereus*) that were intercepted by the CPIC (GSDA Section) Route and the GLNG GTP (September 2009) on Curtis Island.

No further field surveys were required for terrestrial flora as previous studies had already been conducted for the EIS (EIS Appendix N2) either within the immediate area, or directly adjacent to the CPIC (GSDA Section) Route and the GLNG GTP (September 2009) on Curtis Island. As such, sufficient data exists to produce detailed vegetation mapping and assess ecological values and potential impacts for the Curtis Island GTP options.

Results of the targeted field survey detected characteristic signs attributable to koala (*Phascolarctos cinereus*) within the area designated as DERM 'Essential Habitat'.

Approximately 73.15 ha and 62.69 ha of remnant vegetation on Curtis Island is proposed to be impacted by the CPIC (GSDA Section) Route and GLNG GTP (September 2009) respectively. This includes approximately 10.96 ha and approximately 10.04 ha of 'Endangered' or 'Of Concern' vegetation communities within the CPIC (GSDA Section) Route and GLNG GTP (September 2009) respectively. Appropriate management strategies and mitigation measures are discussed including clearing schemes and the management of conservation significant communities. It is not anticipated that the proposed works will significantly further reduce current values if the mitigation measures outlined within both this report and EIS Appendix N2 are utilised. Given the rise of industrial development in Gladstone and environs, cumulative impacts pose a threat to the remnant vegetation and fauna habitat of this region.

Introduction

1.1 Background

The EIS described the environmental values, potential impacts and mitigation measures for the gas transmission pipeline (GTP) (EIS Section 6.4, 7.4, 8.4 and EIS Appendices N1, N2 and N3). Subsequent to the release of the EIS a number of route alternatives were identified by Santos as the result of further engineering, geotechnical, environmental and other investigations. For the purposes of the nature conservation component of the Supplementary EIS, the GTP has been separated into three portions:

- GLNG GTP (September 2009) – South Western Section (Part 2 West of Bruce Highway);
- The CPIC (GSDA Section) Route and GLNG GTP (September 2009) within the GSDA (Part 3 GSDA); and
- Curtis Island (both GLNG GTP (September 2009) and the CPIC (GSDA Section) Route) (described in this report (Part 4 Curtis Island)).

This report details the GLNG GTP (September 2009) and the CPIC (GSDA Section) Route alignments for the Curtis Island portion as presented in Figure 1-1 and associated vegetation mapping, environmental values, potential impacts and mitigation measures. This report builds on the assessment documented in the EIS (EIS Appendix N2). To this end, inclusion of the following sections in this report are omitted to avoid repetition, and can be referred to in the following sections of EIS Appendix N2.

- Review of Existing Information (EIS Appendix N2, Section 2.2);
- Target Species (Section 2.3);
- Legislative context (Section 2.4.4);
- Survey Limitations (Section 2.5.1);
- Nomenclature (Section 2.5.2);
- Regional Context (Section 3);
- Species Diversity (Section 3.2.1);
- Weeds of Concern (Section 3.2.3); and
- Regional Connectivity (Section 3.2.5).

For the full content of these sections, refer to EIS Appendix N2.

1.2 Study Scope

Following the finalisation of the EIS, a number of route changes or options were developed. This report investigates the environmental conditions and potential impacts of the alignments.

Comprehensive studies have been completed within the study area previously. The location of the GLNG GTP (September 2009) and the CPIC (GSDA Section) Route alignments on Curtis Island only differs slightly from the original EIS GTP (March 2009). Some changes exist in the length and formation of the pipeline and the terrain these new options traverse. Descriptions within this report are predominantly based upon desktop analyses and results from previous ground truthing studies (EIS Appendix N2).

1.3 Study Aims and Objectives

The aims of this supplementary investigation were to map the vegetation communities of the GLNG GTP (September 2009) and the CPIC (GSDA Section) Route alignments on Curtis Island and identify

areas of vegetation of conservation significance. In meeting these aims, the objectives of the study were to:

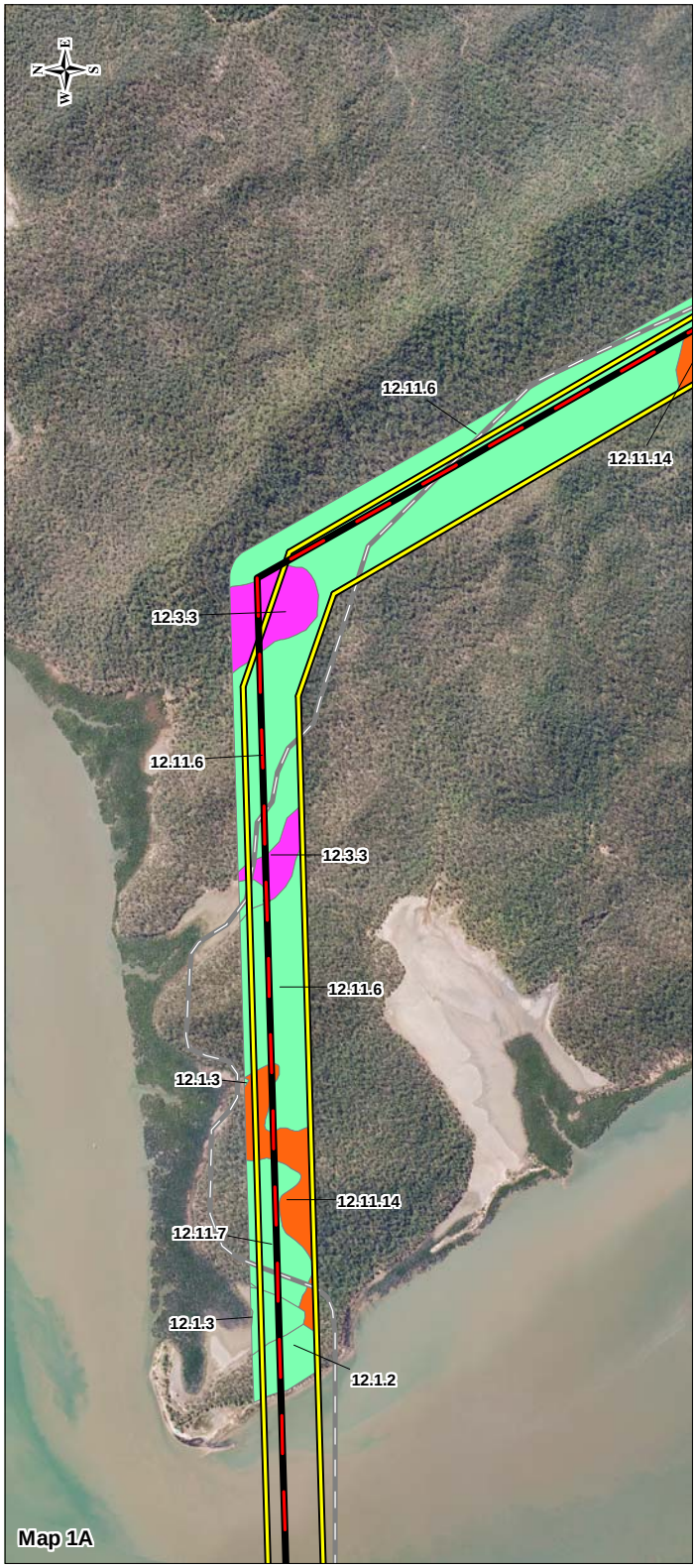
- Provide baseline data on Regional Ecosystems occurring in the study area;
- Identify and / or verify ecologically sensitive areas;
- Determine the impacts of the GTP on the surrounding vegetation and habitats; and
- Develop appropriate management strategies.

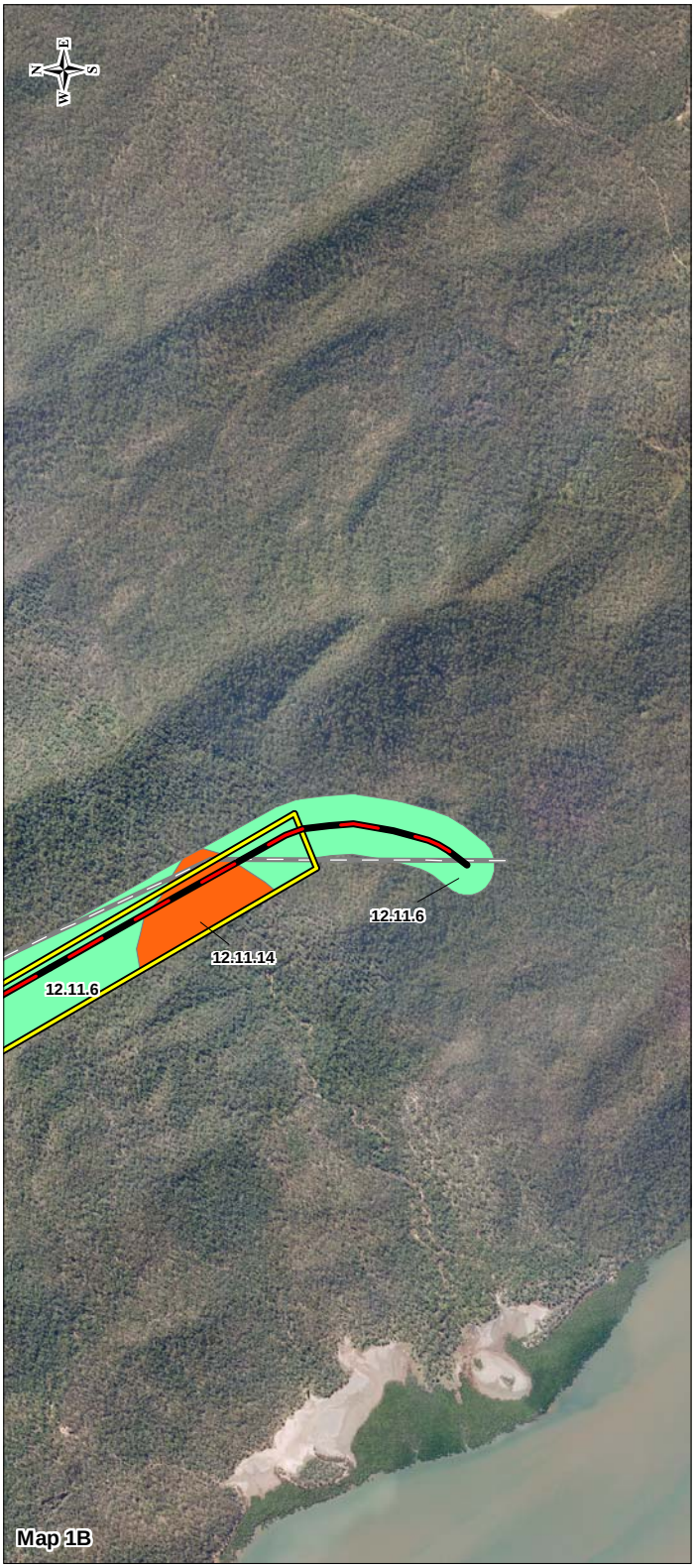
Fauna habitat values of the GLNG GTP (September 2009) and the CPIC (GSDA Section) Route alignments on Curtis Island are not considered to be appreciably different to those presented in the EIS and therefore have not been repeated within this report. For full details of the fauna habitat values refer to EIS Appendix N2.

1.4 Study Approach

Vegetation mapping was undertaken using the existing 1:100 000 Regional Ecosystems (RE) coverage Version 5.2 for the region (DERM, 2005) in conjunction with vegetation mapping and the results of ground truthing surveys undertaken for the EIS. Further investigation and confirmation of REs was undertaken employing aerial photograph interpretation of stereo pairs at a scale of approximately 1:22,000 (Aerometrix, 2005). Vegetation mapping was produced for a 200 metre wide survey corridor.

Both the GLNG GTP (September 2009) and the CPIC (GSDA Section) Route traverse areas identified by the Department of Environment and Resource Management (DERM) as 'Essential Habitat' for koala (*Phascolarctos cinereus*) (DERM, 2005a). A targeted field survey was undertaken on 14 September 2009 within these areas of 'Essential Habitat' for any evidence that koala utilise the area. Key indicators of koala presence searched for included scats, fur and characteristic markings on habitat trees.





Major Road
Minor Road
Major Drainage
Minor Drainage

GLNG Gas Transmission Pipeline (September 2009)
Common Pipeline Infrastructure Corridor (GSDA Section) (September 2009)
EIS Gas Transmission Pipeline (March 2009)

Secondary Sites
Quaternary Sites
Presence of Exotic Species (Refer Figure 22 for details)

Not of concern RE
Of concern dominant RE
Endangered dominant RE

0 500 1000m

Scale: 1:25,000 (A4)
Projection: Geographic (GDA94)

Source:This map may contain data which is sourced and Copyright. Refer to Section 18.2 of the EIS for Ownership and Copyright.

Client: LNG	Project: GLADSTONE LNG PROJECT ENVIRONMENTAL IMPACT STATEMENT SUPPLEMENT TERRESTRIAL FLORA ASSESSMENT	Title: **REGIONAL ECOSYSTEMS CURTIS ISLAND**	
URS	Drawn: RG / Approved: JB / Date: 09-11-2009 Job No: **42626440/**6220 / File No: 42626440-g-2059.wor	Figure: **1-1**	Rev:C **A4**

Environmental Values

2.1.1 Weather Conditions

During the day of survey on 14 September 2009, the local weather for Curtis Island was warm and dry. Daily weather observations from the Gladstone Radar indicate that the temperature ranged between 17.3° C and 28.8° C (BoM, 2009). No rainfall was recorded during the time of the survey.

2.2 Study Results

Results from this study provide additional values to those previously detailed in EIS Section 2.2 Appendix N2.

2.2.1 Regional Ecosystems

CPIC (GSDA Section) Route

Five REs are described and mapped within the CPIC (GSDA Section) Route on Curtis Island based upon previous field survey results and interpretation of aerial photo stereo images (Figure 1-1). Table 2-1 details the total area of each community found within this alignment. It also shows the area for each vegetation community as defined by RE types within the Burnett-Curtis Hills and Ranges sub-region.

Table 2-1 Regional Ecosystems Mapped within the CPIC (GSDA Section) Route alignment on Curtis Island

RE	Community Descriptions	Area within 200 m corridor (~ha)	Area within Sub-region (~ha)[1]	% of regional extent
12.1.2	Saltpan vegetation including grassland, herbland and sedgeland on marine clay plains	5.96	15,181	0.04
12.3.3	*Eucalyptus tereticornis* woodland to open forest on alluvial plains	6.68	26,250	0.03
12.11.6	*Corymbia citriodora*, *Eucalyptus crebra* open forest on metamorphics ± interbedded volcanics	68.41	178,525	0.04
12.11.7	*Eucalyptus crebra* woodland on metamorphics ± interbedded volcanics	6.26	19,196	0.03
12.11.14	*Eucalyptus crebra*, *E. tereticornis* woodland on metamorphics ± interbedded volcanics	15.64	4,620	0.34
TOTAL		135.26	243,772	0.4406

1 Derived from RE data for the Burnett-Curtis Hills and Ranges as per Accad *et al.* (2008)

GLNG GTP

Six REs were described and mapped along within the GLNG GTP (September 2009) route on Curtis Island, based upon previous field survey results and interpretation of aerial photo stereo images (Figure 1-1). Table 2-2 details the total area of each community found within this study area. This table also indicates the area for each vegetation community as defined by RE types within the Burnett-Curtis Hills and Ranges sub-region.

Table 2-2 Regional Ecosystems Mapped within the GLNG GTP (September 2009) on Curtis Island

RE	Community Descriptions	Area within 100 m buffer (~ha)	Area within Sub-region (~ha)[1]	% of regional extent
12.1.2	Saltpan vegetation including grassland, herbland and sedgeland on marine clay plains	7.20	15,181	0.05
12.1.3	Mangrove shrubland to low closed forest. Occurs on Quaternary estuarine deposits.	0.06	16,544	0.0004
12.3.3	*Eucalyptus tereticornis* woodland to open forest on alluvial plains	8.23	26,250	0.03
12.11.6	*Corymbia citriodora*, *Eucalyptus crebra* open forest on metamorphics ± interbedded volcanics	81.32	178,525	0.05
12.11.7	*Eucalyptus crebra* woodland on metamorphics ± interbedded volcanics	7.51	19,196	0.04
12.11.14	*Eucalyptus crebra*, *E. tereticornis* woodland on metamorphics ± interbedded volcanics	12.23	4,620	0.26
TOTAL		116.55	260,316	0.43

1 Derived from RE data for the Burnett-Curtis Hills and Ranges as per Accad *et al.* (2008)

2.2.2 Significant Regional Ecosystems

Two vegetation communities are identified within both the above alignments on Curtis Island as having either 'Of Concern' or 'Endangered' conservation status (as listed under the *Vegetation Management Act, 1999*) and 'Of Concern' or 'Endangered' status (as per the DERM Biodiversity Status listing). Neither of these communities has conservation status under the commonwealth *EPBC Act*. The conservation status of these communities is detailed below in Table 2-3.

Table 2-3 Regional Ecosystems of Conservation Significance within the GTP study areas on Curtis Island

RE	Community Description	Vegetation Management Act Status	Biodiversity Status	EPBC Act Status
12.3.3	*Eucalyptus tereticornis* open forest to woodland on Cainozoic alluvial plains	Endangered	Endangered	Not Listed
12.11.14	*Eucalyptus crebra*, *E. tereticornis* grassy woodland on Mesozoic to Proterozoic moderately to strongly deformed and metamorphosed sediments and interbedded volcanics	Of Concern	Of Concern	Not Listed

2.2.3 Environmentally Sensitive Areas

DERM Essential Habitat

RE 12.3.3 (*Eucalyptus tereticornis* woodland to open forest on alluvial plains) within the study area has been mapped by the DERM as 'Essential Habitat' for the koala (*Phascolarctos cinereus*) (DERM,

2005a). A total of approximately 9.96 ha of 'Essential Habitat' has been mapped within the CPIC (GSDA Section) Route alignment on Curtis Island and approximately 8.52 ha within the 100 m buffer of the GLNG GTP (September 2009) route (Figure 1-1).

2.2.4 Targeted Survey

The targeted field survey within essential habitat detected traces and signs that are attributable to koala (*Phascolarctos cinereus*) on a single tree within the area designated as DERM 'Essential Habitat'. Markings identified as characteristic koala scratchings were identified on a large *Eucalyptus tereticornis* (forest red gum) tree located in the 'Essential Habitat' to the east of Laird Point adjacent to Graham Creek (Plate 2-1). These markings indicate that at least an individual koala has utilised the area in relatively recent times.

The absence of any other signs for this species on any other habitat trees in the area surveyed, in conjunction with the absence of any other previous records for the species in the area indicates that this is unlikely to be a core habitat area for a significant koala population, and densities of any population of this species in the area would be expected to be low.

The presence of the markings found on a single tree is in line with the habits of koalas to show preference for specific habitat trees, and may also be attributable to a single individual koala migrating through the area ranging between areas of more significant core habitat. This area cannot be discounted as potential habitat for the species.

Plate 2-1 **Example of indicative scratchings identified on Eucalyptus tereticornis as attributable to koala (Phascolarctos cinereus) during field survey 14/09/2009**

Potential Impacts and Mitigation Measures

3.1 Potential Impacts

3.1.1 Proposed Development

The clearing of remnant vegetation within the study area on Curtis Island will impact fauna and flora. The pipeline ROW width will be approximately 40 m, except in Environmentally Sensitive Areas where the width will be reduced to approximately 30 m. The easement may however also accommodate a road and power line, thereby adding approximately a further 70 m to the width of the ROW. This equates to a possible total ROW width of either approximately 100 m or 110 m.

3.1.2 Vegetation Disturbance

CPIC (GSDA Section) Route alignment

A specific location for each proponent's pipeline within the section of the CPIC (GSDA Section) Route on Curtis Island has not yet been determined. For the purposes of impact assessment, an arbitrary centreline alignment has been used to calculate an indicative estimate for vegetation clearing along the Corridor.

The potential clearance of the CPIC (GSDA Section) Route ROW would result in the disturbance of approximately 53.41 ha of remnant vegetation. A breakdown of the disturbance to REs as a result of this clearing is presented below in Table 2-1. The table also shows the disturbance to each community as a percentage of the RE within the Burnett-Curtis Hills and Ranges sub-region.

Table 2-1 Proposed area of Vegetation Communities to be Disturbed within the CPIC (GSDA Section) Route on Curtis Island

RE	Community Description	VM Status	Biodiversity Status	EPBC Act Status	Ha Cleared[1]	% of Sub-regions Extent
12.1.2	Saltpan vegetation including grassland, herbland and sedgeland on marine clay plains	Not of Concern	Not of Concern	Not Listed	3.26	0.02
12.3.3	*Eucalyptus tereticornis* woodland to open forest on alluvial plains	Endangered	Endangered	Not Listed	3.82	0.01
12.11.6	*Corymbia citriodora*, *Eucalyptus crebra* open forest on metamorphics ± interbedded volcanics	Not of Concern	Not of Concern	Not Listed	35.37	0.02
12.11.7	*Eucalyptus crebra* woodland on metamorphics ± interbedded volcanics	Not of Concern	Not of Concern	Not Listed	3.82	0.02
12.11.14	*Eucalyptus crebra*, *E. tereticornis* woodland on metamorphics ± interbedded volcanics	Of Concern	Of Concern	Not Listed	7.14	0.2
TOTAL					53.41	0.27

[1] Hectare cleared based upon 70 m ROW + 40 m ROW unless listed as conservation significant RE, in which case it is a 70 + 30 m ROW.

[2] Indicates disturbed % of vegetation community within the Burnett-Curtis Hills and Ranges Sub-region as per Accad *et. al*. (2008)

Of the vegetation to be cleared, the community of *Corymbia citriodora*, *Eucalyptus crebra* open forest on metamorphics ± interbedded volcanics (RE 12.11.6) is to be subjected to the majority of proposed disturbance (approximately 35.37 ha). This disturbance represents approximately 0.03 % of this community within the sub-region. This vegetation community has no current conservation significance under state or commonwealth legislation.

The vegetation community of *Eucalyptus crebra* woodland on metamorphics ± interbedded volcanics (RE 12.11.7) is subject to the third greatest disturbance of remnant vegetation overall (approximately 5.08 ha). This disturbance represents approximately 0.02 % of this community within the sub-region. This vegetation community has no current conservation significance under state or commonwealth legislation.

Significant Regional Ecosystems

Of the conservation significant REs, the vegetation community of *Eucalyptus crebra*, *E. tereticornis* woodland on metamorphics ± interbedded volcanics (RE 12.11.14) is subjected to the greatest disturbance and is subject to the second greatest disturbance of remnant vegetation overall. This community is listed as 'Of Concern' under both the *VM Act* and Biodiversity Status but not listed under the *EPBC Act*. Approximately 7.14 ha of this RE is proposed to be cleared. This represents approximately 0.2 % of this community found within the sub-region, which is also the highest disturbance when viewed as a percentage of the sub-regional extent.

The vegetation community of *Eucalyptus tereticornis* woodland to open forest on alluvial plains (12.3.3) is the only other RE of conservation significance impacted by the proposed disturbance. This community is listed as 'Endangered' under both the *VM Act* and Biodiversity Status but not listed under the *EPBC Act.* Approximately 3.82 ha of this RE is proposed to be cleared. This represents approximately 0.01 % of this community found within the sub-region.

GLNG GTP (September 2009) Route

The clearance of the GLNG GTP (September 2009) Route ROW on Curtis Island will result in the disturbance of approximately 62.69 ha of remnant vegetation. A breakdown of the disturbance to REs as a result of this clearing is presented below in Table 2-2. The table also shows the disturbance to each community as a percentage of the RE within the Burnett-Curtis Hills and Ranges sub-region.

Table 2-2 Proposed area of Vegetation Communities to be Disturbed within the GLNG GTP (September 2009) on Curtis Island

RE	Community Description	VM Status	Biodiversity Status	EPBC Act Status	~ Ha Cleared[1]	% of Sub-regions Extent
12.1.2	Saltpan vegetation including grassland, herbland and sedgeland on marine clay plains	Not of Concern	Not of Concern	Not Listed	3.93	0.03

RE	Community Description	VM Status	Biodiversity Status	EPBC Act Status	~ Ha Cleared[1]	% of Sub-regions Extent
12.3.3	*Eucalyptus tereticornis* woodland to open forest on alluvial plains	Endangered	Endangered	Not Listed	4.16	0.02
12.11.6	*Corymbia citriodora*, *Eucalyptus crebra* open forest on metamorphics ± interbedded volcanics	Not of Concern	Not of Concern	Not Listed	44.22	0.02
12.11.7	*Eucalyptus crebra* woodland on metamorphics ± interbedded volcanics	Not of Concern	Not of Concern	Not Listed	4.50	0.02
12.11.14	*Eucalyptus crebra*, *E. tereticornis* woodland on metamorphics ± interbedded volcanics	Of Concern	Of Concern	Not Listed	5.88	0.1
TOTAL					62.69	0.19

[1] Hectare cleared based upon 70 m + 40 m ROW unless listed as conservation significant RE, in which case it is 70 m + 30 m ROW.

[2] Indicates disturbed % of vegetation community within the Burnett-Curtis Hills and Ranges Sub-region as per Accad *et. al*. (2008).

Of the remnant vegetation to be cleared, the vegetation community of *Corymbia citriodora*, *Eucalyptus crebra* open forest on metamorphics ± interbedded volcanics (RE 12.11.6) is to be subjected to the majority of proposed disturbance (approximately 44.22 ha). This disturbance represents approximately 0.02 % of this community within the sub-region. This vegetation community has no current conservation significance under state or commonwealth legislation.

The vegetation community of *Eucalyptus crebra* woodland on metamorphics ± interbedded volcanics (RE 12.11.7) is subject to the third greatest disturbance of remnant vegetation overall (4.50 ha). This disturbance represents approximately 0.02 % of this community within the sub-region. This vegetation community has no current conservation significance under state or commonwealth legislation.

Significant Regional Ecosystems

Of the conservation significant REs, the vegetation community of *Eucalyptus crebra*, *E. tereticornis* woodland on metamorphics ± interbedded volcanics (RE 12.11.14) is subjected to the greatest disturbance and is subject to the second greatest disturbance of remnant vegetation overall. This community is listed as 'Of Concern' under both the *VM Act* and Biodiversity Status but not listed under the *EPBC Act*. Approximately 5.88 ha of this RE is proposed to be cleared. This represents approximately 0.1 % of this community found within the sub-region, which is also the highest disturbance when viewed as a percentage of the sub-regional extent.

The vegetation community of *Eucalyptus tereticornis* woodland to open forest on alluvial plains (12.3.3) is the only other RE of conservation significance impacted by the proposed disturbance. This community is listed as 'Endangered' under both the *VM Act* and Biodiversity Status but not listed under the *EPBC Act*. Approximately 4.16 ha of this RE is proposed to be cleared. This represents approximately 0.02 % of this community found within the sub-region.

3.1.3 Impacts to Conservation Significant Species

The field study detected traces and signs attributable to koala (*Phascolarctos cinereus*) within essential habitat for this species to the north of the GTP study area on Curtis Island. Numerous full vertebrate fauna surveys undertaken by Unidel for British Gas (QCLNG, 2009) and by URS in 2008 (for the GLNG EIS) throughout the south-western portion of Curtis Island have not encountered this species to date. However, targeted koala field investigations have not been undertaken for this species until now. Based on the absence of previous records and the result of only one utilised habitat tree for this survey, it is likely that koala densities in this area are low (Section 2.2.4). Despite this, there is a chance that the clearing of vegetation within these pipeline options may impact upon koala habitat.

Indirect impacts from fragmentation, the creation of barriers to movement and mortality from vehicle strikes whilst crossing roads may occur. The adoption of appropriate management strategies (Section 3.2.1) during clearing will reduce any potential impacts to a negligible level.

3.1.4 Impacts to Fauna

Impacts will not be appreciably different to those detailed for the original EIS GTP (March 2009). For details, refer to Section 3.1 in EIS Appendix N2.

3.1.5 Impacts to Environmentally Sensitive Areas

Essential Habitat

A total of 5.36 ha of DERM 'Essential Habitat' is estimated to be cleared for the CPIC (GSDA Section) Route on Curtis Island. Alternatively for the GLNG GTP (September 2009) on Curtis Island the proposed area to be cleared totals 4.08 ha.

Impacts to Marine Plants

The potential clearing of marine plants may affect the vegetation community of Saltpan vegetation including grassland, herbland and sedgeland on marine clay plains (RE 12.1.2). An application to clear these marine plants will be required under the *Fisheries Act 1994*. Impacts to marine plants are detailed within EIS Section 8.4.4.4.

3.1.6 Impacts associated with changes to fire regimes

The clearing undertaken for construction of the GTP on Curtis Island will create a gap in the vegetation approximately 100 m to 110 m wide. This gap in vegetated cover can serve as a potential fire break and management access track and should be managed appropriately. Consideration will need to be given for potential sources of fire ignition in the vicinity of the GTP. Potential sources of ignition and further ecological impacts associated with changes to fire regime are discussed in Section 4.1.9 of EIS Appendix N2.

3.1.7 Impacts associated with Erosion and Sedimentation

There is potential for soil erosion in areas disturbed by works associated with the creation of the GTP. Where these activities occur on erosive soils and/or on slopes, mobilisation of sediment into watercourses can occur. Impacts to aquatic ecosystems can include build-up of sediment in

waterholes with a subsequent reduction in available habitat, smothering of aquatic plants and substrate and cumulative downstream impacts on estuarine and offshore marine habitats.

3.2 Impact Mitigation

3.2.1 Clearing Scheme

The clearing of vegetation communities along the CPIC (GSDA Section) Route or the GLNG GTP (September 2009) on Curtis Island should follow the scheme detailed below and in Section 4.2.3 within EIS Appendix N2.

Management of Conservation Significant Species

In order to minimise any potential impacts to koala, the following additional management techniques will apply to any clearing. The specific location of the GTP within the corridor will attempt to avoid any vegetation communities favoured by the species, including those areas designated for koala as 'Essential Habitat' by the DERM (DERM, 2005a). On ground verification of the corridor will be undertaken by an ecologist to confirm the specific location prior to the removal of any vegetation to avoid any individual habitat trees.

Qualified fauna spotters will be actively present during clearing of woodland vegetation and any other areas of faunal habitat. Their role will include following the path of the dozer and assessing the mid layer and canopy vegetation for koala or other arboreal mammals.

Where roads traverse suitable koala habitat (RE 12.3.3), fencing should be avoided or designed to allow for movement of koalas and other fauna species. The use of barbwire should be avoided to minimise impacts to gliders and bats.

To reduce the chances of fauna being harmed or killed by vehicle strike, an integrated approach to the design of roads should be undertaken. This could include the implementation of reduced speed limits, traffic calming or construction of fauna passages. A comprehensive plan to manage fauna mortality on Curtis Island roads will be developed with all contractors undertaking an induction prior to starting work.

Further details on the management of other fauna and flora species are included in EIS Appendix N2.

Marine Plants

Clearing will be minimised as much as practicable within areas of marine plants (RE 12.1.2). Mitigation measures will include the reduction of ROW width where possible, revegetation of marine plant communities and additional erosion control measures.

3.2.2 Impacts and Mitigation Previously Documented for the GTP

EIS Appendix N2 comprehensively covers potential impacts from the following sources:

- Dust (EIS Appendix N2 Section 4.1.4);
- Fragmentation (Section 4.1.5);
- Weeds (Section 4.1.7);
- Edge effects (Section 4.1.8);
- Changes to fire regimes (Section 4.1.9);

- Erosion and sedimentation (Section 4.1.10);
- River Crossings (Section 4.2.3);
- Weed Control (Section 4.2.4); and
- Rehabilitation of Disturbed Areas (Section 4.2.5).

These impacts and associated mitigation and management measures are also applicable to the current alignment options addressed in this study.

3.2.3 Cumulative Impacts

The vegetation communities present along the CPIC (GSDA Section) Route and GLNG GTP (September 2009) on Curtis Island contain remnant vegetation that has been historically grazed and is therefore considered to have moderate ecological integrity. Route selection has aimed to minimise impact on remnant vegetation, significant vegetation communities and fauna habitat through the avoidance of these areas wherever practicable. It is not anticipated that the proposed works will significantly further reduce current values if the mitigation measures discussed within this report and EIS Appendix N2 are utilised.

Given the rise of industrial development in Gladstone and environs, cumulative impacts need to be carefully considered if they are not to become a threat to the remnant vegetation and fauna habitat of this region. The CSG industry in central Queensland, and in particular Gladstone, has considerably intensified of late and care must be taken to retain ecological corridor linkages and remnant vegetation when additional pipelines are considered in this region. Co-locating multiple pipelines within the Callide Infrastructure Corridor State Development Area (CICSDA) will ensure that cumulative impacts due to clearing of remnant vegetation will be generally restricted to a defined area within the corridor and will not be more widely dispersed throughout the region where the pipeline alignments coincide. The adherence to sound environmental policy and planning frameworks, such as the Queensland Policy for Vegetation Management Offsets, will assist in ensuring that additional pipelines will not significantly impact on natural ecosystems.

Further details of cumulative impacts are provided in the Cumulative Impact Assessment (Attachment J).

URS Australia Pty Ltd
Level 16, 240 Queen Street
Brisbane, QLD 4000
GPO Box 302, QLD 4001
Australia
T: 61 7 3243 2111
F: 61 7 3243 2199

www.ap.urscorp.com

Glossary

Alluvium Material deposited by a river or other running water typically made up of a variety of materials, including fine particles of silt, clay, articles of sand and gravel.

Alluvial Relating to, composed of, or found in alluvium or alluvial soil.

Binominal nomenclature is the system used for zoological and **botanical** naming of species listed in a taxonomic classification. Each species name is in (modern scientific) Latin and has two parts, being the *Genus* and *species*

Biodiversity The number and variety of organisms found within a specified geographic region or within a given ecosystem.

Bioregion A landscape pattern that reflect changes in geology and climate, as well as major changes in floral and faunal assemblages at a broad scale.

Brigalow Belt A Bioregion that spans inland and eastern Queensland from Townsville in the north to northern New South Wales, covering an area of approximately six million hectares.

Brigalow Belt A Bioregion that spans inland and eastern Queensland from Townsville in the north to northern New South Wales, covering an area of about six million hectares.

CPIC Route the Common Pipeline Infrastructure Corridor, the shared infrastructure corridor for multiple proponents proposed by the Queensland Government between Callide and the proposed LNG facility sites on Curtis Island and is comprised by the CPIC (CICSDA Section) Route and the CPIC (GSDA Section) Route. Although it is Santos' preference to utilise the CPIC Route, this is dependent on the government's resumption of the underlying land interest and negotiation of access terms and conditions.

Ecosystem An interdependent system of interacting plants, animals and other organisms together with the non-living (physical and chemical) components of their surroundings.

Ecology Scientific study of abundance, distribution and interactions between organisms and their natural environment.

Endemic An endemic organism is exclusively native to a bio-geographic region, biota, or specific habitat.

GLNG GTP (September 2009) Route the route alternatives identified by Santos since March 2009 (as a single alignment) as the result of further engineering, geotechnical, environmental and other investigations. Santos is continuing to consider the EIS GTP (March 2009) route, the CPIC (CICSDA Section) Route, the CPIC (GSDA Section) Route, and the Callide Range Alternative Route. The final GTP route corridor will be determined once the final engineering design for the pipeline has been developed and is subject to Santos and/or the government obtaining the necessary underlying land interest and negotiation of access terms and conditions with respect to the CPIC Route.

Habitat The area or natural environment in which an organism or population normally lives. A habitat is made up of physical factors such as soil, moisture, range of temperature, and availability of light as well as biotic factors such as the availability of food resources and the presence of predators.

Herbarium Government institution where a collection of genotype specimens are held for use in scientific study as reference material for describing plant taxa.

5 Glossary

Nomenclature The procedure of assigning names to groups of organisms listed in a taxonomic classification.

Quaternary sample plots A standardised flora study to collect data to verify regional ecosystem and vegetation mapping. Data from these sites are generally collected throughout the field survey and entered on spreadsheets or databases. Quaternary sites may be collected at regular intervals along a traverse, and/or made where REs/vegetation communities change.

Ramsar wetlands of international significance The Ramsar Convention is an inter-governmental treaty adopted on 2 February 1971 in the Iranian city of Ramsar and is focussed on the conservation and sustainable use of wetlands as important ecosystems. The addition of a site to the 'List of Wetlands of International Importance' (the "Ramsar List") expresses the relevant government's commitment to take all steps necessary to ensure the maintenance of the ecological character of the site.

Regional Ecosystem (RE) Describes the relationships between major floral species and the environment at the regional scale. They are mostly derived from linking vegetation mapping units based on dominant canopy species, recognised at a scale of 1:100,000 to land zones that represent major environmental variables, in particular geology, rainfall and landform. Under the *VM Act* REs are assigned a conservation status based on an assessment of the pre-clearing and remnant extent of a RE.

Remnant Vegetation Vegetation is identified as 'remnant' under the *VM Act* where the predominant canopy of the vegetation: covers more than 50 % of the equivalent undisturbed canopy; averages more than 70 % of the vegetations undisturbed height and is composed of species characteristic of the vegetations undisturbed predominant canopy.

Scarp A steep slope, ridge or escarpment of rock.

Secondary sample plots Secondary sample plots are standardised transects used for classification and detailed descriptions of REs and vegetation communities. Data collected include all location, environmental and overall floristic and structural information as well as a list of all species present and basal area, percentage cover and stem density measures of abundance.

Threatened species/Conservation significant species a generic term for a plant or animal species listed as critically endangered, endangered, vulnerable or rare under either state or commonwealth threatened species legislation. The terms 'threatened' and 'conservation significant' are interchangeable in this context.

Volpane The act of gliding as undertaken by gliders

Weeds Plant species that invade native ecosystems and can adversely affect the survival of indigenous flora and fauna, often competing with indigenous plants for resources such as nutrients, moisture and light. They can prevent natural regeneration, reduce wildlife habitat, alter water flows, increase soil erosion, introduce poisons into the soil or poison animals, change fire behaviour and may introduce foreign genes into local plant populations. Weed species are not necessarily exotic non-indigenous species, but can also be non-endemic natives that are naturalised to areas outside of their natural distribution.

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The methodology adopted and sources of information used by URS are outlined in this report. URS has made no independent verification of this information beyond the agreed scope of works and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to URS was false.

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URS Australia Pty Ltd
Level 16, 240 Queen Street
Brisbane, QLD 4000
GPO Box 302, QLD 4001
Australia
T: 61 7 3243 2111
F: 61 7 3243 2199

www.ap.urscorp.com