GLNG
Gas Transmission Pipeline

EPBC Environmental Management Plan
Curtis Island GTP

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Appendices

ABBREVIATIONS

Abbreviation	Description
AASS	Actual Acid Sulfate Soils
ACHA	*Aboriginal Cultural Heritage Act 2003*
AIM	Audit and Inspection Manager
AOPC	Area of Potential Concern
APIA	Australian Pipeline Industry Association
APIA Code	*Australian Pipeline Industry Association Code of Environmental Practice for Onshore Pipelines*
APLNG	Australia Pacific Liquefied Natural Gas
AS	Australian Standard
ASS	Acid Sulfate Soils
ASSMP	Acid Sulfate Soils Management Plan
AS/NZS	Australian Standard/New Zealand Standard
BAAM	Biodiversity Assessment and Management
CAEMP	Contractors Award Environmental Management Plan
CEMP	Construction Environmental Management Plan
CG	Coordinator General
CHMP	Cultural Heritage Management Plan
CICGSDA	Common Infrastructure Corridor Gladstone State Development Area
cm	Centimetre
CMP	Construction Management Plan
CO_2	Carbon dioxide
CPIC	Common Pipeline Infrastructure Corridor
CSG	Coal Seam Gas
dB	Decibel
DEEDI	Department of Employment, Economic Development and Innovation
DERM	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
DMP	Dredge Management Plan
DP	Decommissioning Plan
DPI&F	Department of Primary Industries and Fisheries (now DEEDI)
DSEWPC	Department of Sustainability, Environment, Water, Population and Communities
DTMR	Department of Transport and Main Roads
E	Endangered
EA	Environmental Authority
EC	Electrical Conductivity
EHSMS	Environment, Health and Safety Management System
EHS&S	Environmental, Health, Safety and Security
EIS	Environmental Impact Statement
EM Plan	Environmental Management Plan
EO	Environmental Officer
EP Act	*Environmental Protection Act 1994*
EPA	Environmental Protection Agency (now DERM)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*

Abbreviation	Description
ERA	Environmentally Relevant Activity
ERP	Emergency Response Plan
ESA	Environmentally Sensitive Area
ESCP	Erosion and Sediment Control Plan
ESP	Exchangeable Sodium Percentage
EVNT	Endangered, Vulnerable and Near Threatened
FA	Financial Assurance
FEED	Front End Engineering Design
FMP	Fauna Management Plan
GBRMP	Great Barrier Reef Marine Park
GBRMPA	Great Barrier Reef Marine Park Authority
GBR WHA	Great Barrier Reef World Heritage Area
GBR Region	Great Barrier Reef Region
GLNG	Gladstone Liquefied Natural Gas
GPS	Global Positioning System
GQAL	Good Quality Agricultural Land
GSDA	Gladstone State Development Area
GTP	Gas Transmission Pipeline
ha	Hectares
HAT	Highest Astronomical Tide
HDD	Horizontal Directional Drilling
HDPE	High Density Polyethylene
Hz	Hertz
ILUA	Indigenous Land Use Agreement
IMP	Integrity Management Plan
IMS	Incident Management System
kg	Kilograms
km	Kilometres
LAT	Lowest Astronomical Tide
LC	Least Concern
LNG	Liquefied Natural Gas
LPG	Liquid Petroleum Gas
LP Act	*Land Protection Act 2002*
LRMP	Landscape Rehabilitation Management Plan
m	Metres
M	Medium
Ma	Marine
Mi	Migratory
MLV	Mainline Valve
mm	Millimetres
MMMP	Mosquito and Midge Management Plan
MSDS	Material Safety Data Sheet
mtpa	Million tonnes per annum
NATA	National Association of Testing Authorities
NC Act	*Nature Conservation Act 1992*
NDT	Non-destructive Testing
NGL	Natural Ground Level

Abbreviation	Description
NIC	Northern Infrastructure Corridor
N/A	Not applicable
NT	Near Threatened
OC	Of Concern
OH&S	Occupational Health and Safety
OMP	Operational Management Plan
PASS	Potential Acid Sulfate Soils
PCCC	Port Curtis Coral Coast
P&G Act	*Petroleum and Gas (Production & Safety) Act 2004*
pH	Potential of Hydrogen
PJ	Petajoules
PPL	Petroleum Pipeline Licence
PSI	Preliminary Site Investigation
PWMP	Pest and Weed Management Plan
QCLNG	Queensland Curtis Liquefied Natural Gas
QGP	Queensland Gas Pipeline
Qld	Queensland
QLUMP	Queensland Land Use Mapping Program
QPIF	Queensland Primary Industries and Fisheries
QPS	Queensland Police Service
QR	Queensland Rail
RE	Regional Ecosystem
REDD	Regional Ecosystem Description Database
RNE	Register of the National Estate
RoW	Right-of-Way
s	Second
Safety IMP	Safety Incident Management Plan
SALNG	The Shell CSG (Australia) Pty Ltd LNG
SAP	Special Area Plans
SDPWO Act	*State Development and Public Works Act 1971*
SEIS	Supplementary Environmental Impact Statement
SEPM	Santos Environmental Pipeline Manager
SIMP	Santos Incident Management Plan
Social IMP	Social Impact Management Plan
SMP	Species Management Plan
SPA	*Sustainable Planning Act 2009*
SSMP	Significant Species Management Plan
Sustainability MP	Sustainability Management Plan
TAF	Temporary Accommodation Facility
TSS	Total Suspended Solids
Type A	Type A restricted plant under the provisions of the NC Act
VM Act	*Vegetation Management Act 1999*
Waste MP	Waste Management Plan
WONS	Weeds of National Significance
WHA	World Heritage Areas
$	Australian dollars
"	Inch

Abbreviation	Description
%	Percent
Hr/yr	Hour per year
>	Greater than

1. Introduction

1.1 Background

The GLNG Project involves the following:

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

1.1.1 Commonwealth legislation and approval

Separate referrals were submitted under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) for the various components of the GLNG Project, including the GTP (2008/4096).

On 22 October 2010, in accordance with the EPBC Act, the Minister approved the development, construction, operation and decommissioning of the GTP (and the other components of the GLNG Project). Conditions 2-4 of the EPBC Act approval for the GTP require an Environmental Management Plan (EM Plan) to be submitted to the Minister for approval. This EM Plan addresses those conditions.

1.1.2 State legislation and approval

On 16 July 2007, the Queensland Government declared the Project to be a Significant Project requiring an Environmental Impact Statement (EIS). Throughout 2008 and 2009 an EIS was prepared for the proposed Project (URS, 2009). The EIS was approved by the Coordinator-General (CG) for public and advisory agency comment from 20 June to 17 August 2009. Submissions received covered a broad range of environmental, social, accommodation, materials and employee transport, infrastructure location and regulatory approval matters.

The CG requested additional information about the EIS and the Project in the form of a Supplementary EIS (SEIS). A SEIS was subsequently prepared and provided to the Department of Infrastructure and Planning (now the Department of Local Government and Planning (DLGP)) in December 2009. The SEIS provided additional information to address the EIS submissions received, and identified a number of refinements to project design.

The CG Report was published in May 2010, which allowed the GLNG Project proceed, subject to conditions.

1.1.3 Curtis Island EM Plan

The proposed section of GTP that is the subject of this Environmental Management (EM) Plan is referred to as Curtis Island. The Curtis Island GTP will originate at Point H near Laird Point and connect to Point I, the LNG Facility on Curtis Island, a distance of approximately 5 km (refer Figure 1.2). Separate EM Plans will be submitted for the marine crossing and Curtis Island sections of the GTP

The Curtis Island GTP construction methodology is presented in Chapter 2 and provides details in relation to the open trenching process and piping along the Curtis Island GTP Right of Way (RoW).

This EM Plan has been prepared to satisfy the relevant parts of the CG Report and support the Environmental Authority (EA) application for Petroleum Pipeline Licence (PPL) No. 168 to the Department of Environment and Resource Management (DERM) for a Chapter 5A petroleum activity pursuant to the Queensland *Environmental Protection Act 1994* (EP Act). The EA and this EM Plan address the proposed works associated with construction and operation (including decommissioning) of the Curtis Island GTP under PPL No. 168.

It also addresses the requirements of conditions 2-4 of the EPBC Act approval for the GTP.

1.2 Purpose of this EM Plan

An EA pursuant to the EP Act is required to support the approval of a Chapter 5A Level 1 petroleum activity to be carried out under the Petroleum Pipeline License No. 168 to be issued pursuant to the *Petroleum and Gas (Production and Safety) Act 2004* (P&G Act).

The purpose of an EM Plan as defined in the EP Act is to identify the environmental values affected by the proposed activity and the mitigation and management commitments necessary to protect those values. The EM Plan is therefore to assist the administering authority DERM to make a determination on the EA application for the Curtis Island GTP.

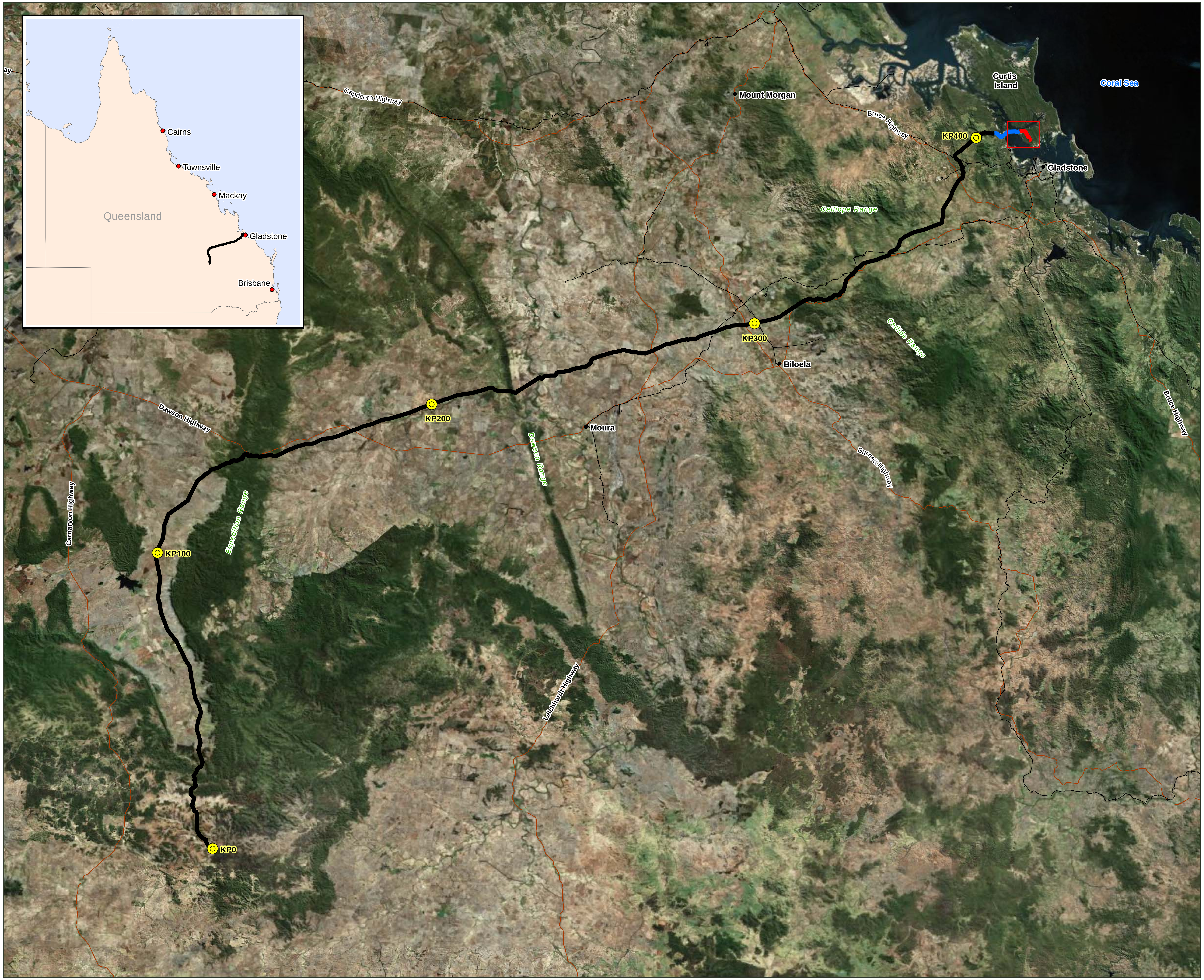
This EM Plan is also a planning document used to demonstrate that the Proponent has considered all potential impacts of the proposed construction and operation (including decommissioning) of the Curtis Island GTP (refer Figure 1.1). In particular, this EM Plan:

- Provides a description of the Curtis Island GTP, including the project rationale and details of the proponent and applicable legislation
- Describes the Curtis Island GTP construction methodology
- Identifies the environmental values that may be affected
- Informs the detailed design, construction and operational phases of the Project
- Is a planning document that informs the detailed design, construction and operational phases of the Curtis Island GTP
- Identifies and assesses cumulative impacts
- Identifies environmental protection commitments and environmental management procedures
- Provides evidence of practical and achievable plans to ensure that the project's environmental requirements for the construction and operation of the GTP are complied with
- Is an integrated plan for monitoring, assessing and controlling potential impacts
- Provides a common focus for local, State and Commonwealth authority approval conditions and compliance with policies and conditions
- Provides evidence for the broader community that the Curtis Island GTP portion will be managed in an environmentally acceptable manner consistent with the other components of the Project

1.3 Scope of this EM Plan

As required in the CG Report and the EPBC Act approval for the GTP, the GTP EM Plans are to be submitted (Mainland Section, Marine Crossing Section and Curtis Island Section) to support new EAs for the relevant PPL's and to satisfy conditions 2-4 of the EPBC Act approval. Each EM Plan has been prepared as a 'stand alone' document to be used as the basis for managing activities as the Project progresses.

This EM Plan describes the Curtis Island GTP (refer Figure 1.2), the surrounding and associated environmental values, the potential impacts, and the proposed management and mitigation measures to minimise potential impacts.



Curtis Island GTP EM Plan

Curtis Island GTP EM Project Area (Figure 1.2) Extent

Gas Transmission Pipeline (GTP)

Mainland GTP EM Plan

Marine Crossing GTP EM Plan

Curtis Island GTP EM Plan

Kilometre Post Distance Marker (km)

Major Road

Rail

Source:
Gas Transmission Pipeline (GTP): Santos, Jan 2011.
Aerial: BING, Feb 2011.

Locality Plan
Figure 1.1

A1 scale:1:600,000

0 10 20 30 40 50km

GLNG No: 3381-40-0463

Coordinate system: GCS_GDA_1994

Date: 08/04/2011

Version: 0

Map by: SLG P:\GIS\Projects\214208_Santos_EMP\CI_004.mxd 08/04/2011 08:13

Curtis Island GTP EM Plan

Gas Transmission Pipeline (GTP)
- Mainland GTP EM Plan
- Marine Crossing GTP EM Plan
- Curtis Island GTP EM Plan

Kilometre Post Distance Marker
- 5km
- 1km
- GTP Reference Point

Source:
Gas Transmission Pipeline (GTP): Santos, Jan 2011.
GTP Reference Point: GLNG, Feb 2011.
Aerial: Santos, Feb 2011.

A1 scale: 1:15,000

0 250 500 750 1,000 1,250 m

GLNG No: 3381-40-0464

Coordinate system: GCS_GDA_1994

Map by: RB P:\GIS\Projects\214208_Santos_EMP\CI_005.mxd 18/08/2011 10:20

Project Area
Figure 1.2

Date: 18/08/2011 Version: 0

This EM Plan has been prepared based on the findings outlined in the EIS (URS, 2009), studies undertaken during the preparation of the SEIS, and additional work undertaken to satisfy the conditions specified as per the CG Report (May 2010) and the EPBC Act approval for the GTP.

This EM Plan has been prepared in accordance with Queensland Government guidelines: *Preparing an EM Plan for Coal Seam Gas (CSG) activities* (DERM 2010), and covers construction and operational activities associated with the Curtis Island GTP (refer Figure 1.2). It is consistent with the Australian Pipeline Industry Association's (APIA) Code of Environmental Practice (2009) and complies with the relevant conditions of the CG Report that are applicable to the Curtis Island GTP.

1.4 EM Plan format

Table 1.1 sets out the structure of this EM Plan. Each chapter addresses the preconstruction, detailed design, construction and operational phases of the Curtis Island GTP. Environmental sub plans for each element where relevant have been developed and include specific mitigation measures and controls to address the impacts resulting from the construction and operation of the Curtis Island GTP.

Table 1.1 EM Plan elements

EM Plan chapter	Element addressed	Related management plan
Chapter 1	Introduction	No plan identified for this Chapter
Chapter 2	Project description	Construction Management Plan Operational Management Plan (OMP)
Chapter 3	Environmental management system	Project Health, Safety and Security Management Plan
Chapter 4	Financial assurance	No plan identified for this Chapter
Chapter 5	Air quality	Erosion and Sedimentation Control Plan Landscape Rehabilitation Management Plan
Chapter 6	Dams	Not applicable for the Curtis Island EM Plan
Chapter 7	Land management	Erosion and Sediment Control Plan (ESCP) Acid Sulfate Soils Management Plan (ASSMP)
Chapter 8	Land tenure and use	No plan identified for this Chapter
Chapter 9	Flora and fauna	Species Management Plan (SMP) Significant Species Management Plan (SSMP) Pest and Weed Management Plan (PWMP)
Chapter 10	Noise	No plan identified for this Chapter
Chapter 11	Social	Social Impact Management Plan (SIMP) Mosquito and Midge Management Plan (MMMP)
Chapter 12	Heritage	Cultural Heritage Management Plan (CHMP)
Chapter 13	Waste	Waste Management Plan (WM Plan)
Chapter 14	Water	Hydrostatic Testing Management Plan (HTMP) (to be developed by Contractor)
Chapter 15	Rehabilitation	Landscape Rehabilitation Management Plan (LRMP)

These elements are addressed in terms of environmental protection objectives, standard and measurable indicators, control strategies and corrective actions, as detailed in Table 1.2.

Table 1.2 Structure of environmental protection commitments, objectives and control strategies

Environmental protection objective	The objectives are to define the outcomes that are intended to be achieved
Specific objectives	The specific objectives outline limits or targets that are to be used when auditing the performance of the management/environmental protection objective
Control strategies	Measures to be taken to ensure that the objectives are being met or achieved
Performance indicators	Indicators to be used to gauge the level of compliance and performance of the control strategy
Monitoring, recording and corrective actions	Monitoring, recording and corrective actions have been addressed in Chapter 3 (Environmental Management System)

During the pre-construction, construction and operational phases of the Project, this EM Plan will be reviewed and updated to:

- Incorporate the outcomes of detailed design and construction contractor requirements
- Include the organisational structure for operations and allocation of responsibilities in line with the organisational structure
- Establish reporting lines based on the organisational structure
- Include relevant approval conditions resulting from the approval process and subsequent permits, authorities and licences relevant to the pipeline's operation
- Review control strategies, objectives and performance indicators to ensure that these are suitable for operations
- Include references to "as constructed" drawings, particularly those that reference areas of environmental value
- Review inspection and audit schedules to reference specific locations where a higher level of inspection may be required (eg to monitor rehabilitation success of sensitive areas)

1.5 Description of relevant resource (petroleum) authorities

1.5.1 Project name and general location

The name of the project is the GLNG Project. As part of this Project, work will be undertaken to develop, design, construct, operate and decommission a 420 km pipeline network to link CSG fields near Roma and Fairview in Queensland to the proposed LNG Facility located on Curtis Island, near Gladstone.

This EM Plan has been prepared for the Curtis Island GTP which runs from Point H near Laird Point to the proposed LNG Facility on Curtis Island (refer Figure 1.2).

1.5.2 Relevant resource authorities

This EM Plan relates to the PPL No. 168.

1.5.3 Relevant blocks and sub-blocks

A summary of the blocks traversed by the Curtis Island GTP, which are part of the PPL area, is provided in Table 1.3. The location of each block is illustrated in Figure 1.3.

Table 1.3 Relevant petroleum authority blocks and sub-blocks

PPL blocks	PPL sub-blocks	Map Name
3183	W	Rockhampton
3255	X	Rockhampton
3255	C	Rockhampton
3255	H	Rockhampton

1.5.4 Real property descriptions

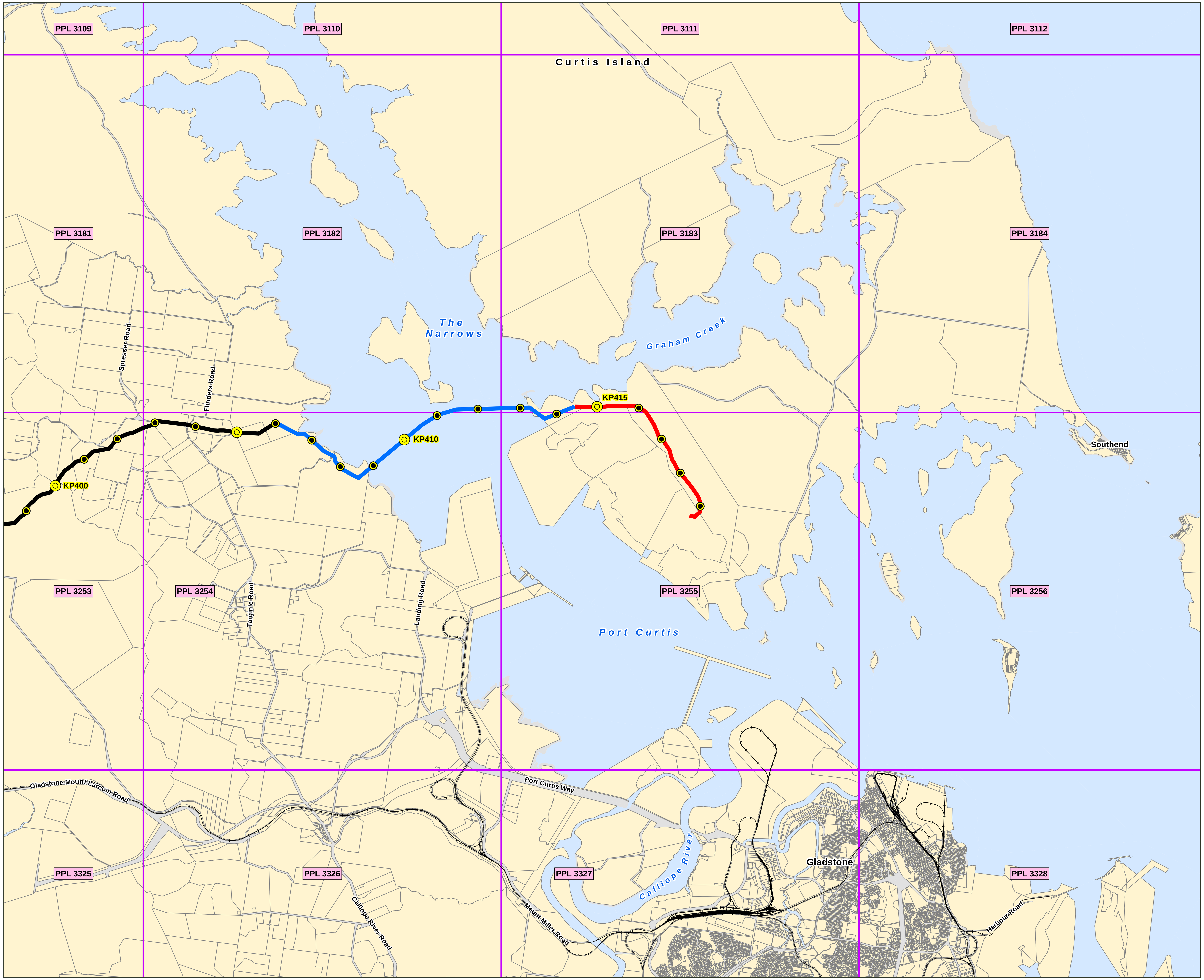
The land at the southern part of Curtis Island, through which the Curtis Island GTP will pass, is freehold land owned by the State of Queensland. The other areas of Curtis Island outside the RoW consist of Freehold, Leasehold, National Park, State Forest and Reserve land tenures. Figure 8.1 identifies the land tenures for Curtis Island and nearby areas.

1.6 Potentially affected properties

As Curtis Island is predominantly occupied by precincts of the Gladstone State Development Area (GSDA), State Land, National Park, and Conservation Parks, the nearest major population centre is Gladstone. Gladstone is located approximately 7 km from Curtis Island and has a population of approximately 30,000 persons (ABS 2010).

Southend is a township at the south-eastern corner of Curtis Island that contains a small number of dwellings and tourist accommodation.

Surface disturbance associated with the Curtis Island GTP will be limited to the RoW which is contained within the State Government nominated Common Infrastructure Corridor of the Gladstone State Development Area (CICGSDA) on Curtis Island.



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A1 scale: 1:50,000

0 1,000 2,000 3,000 4,000 5,000 m

GLNG No: 3381-40-0465

Coordinate system: GCS_GDA_1994

Curtis Island GTP EM Plan

Gas Transmission Pipeline (GTP)

- Mainland GTP EM Plan
- Marine Crossing GTP EM Plan
- Curtis Island GTP EM Plan

Kilometre Post Distance Marker

- 5km
- 1km

Petroleum Pipeline Licence (PPL) Block

Rail

Source:
Gas Transmission Pipeline (GTP): Santos, Jan 2011.
Cadastre, Tenure and Easements: Department of Environment and Resource Management, Jun 2011.
PPL Blocks: Santos, Feb 2011.

PPL Blocks Figure 1.3

Date: 18/08/2011 Version: 1

1.7 Relevant legislation

Table 1.4 outlines the legislation and policies that are applicable to the activities associated with the design, construction and operation of the Curtis Island GTP.

Table 1.4 Relevant legislation for the Curtis Island GTP

Legislation	Assessment authority	Relevant chapter(s) addressing legislation
Commonwealth legislation		
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)	Department of Sustainability, Environment, Water, Population and Communities (DSEWPC)	Chapter 9 – Flora and fauna
Native Title Act 1993	DSEWPC	Chapter 11 – Social Chapter 12 – Heritage
Great Barrier Reef Marine Park Act 1975	Great Barrier Reef Marine Park Authority (GBRMPA)	Chapter 9 – Flora and fauna Chapter 14 – Water
National Environmental Protection (Movement of Controlled Waste between States and Territories) Measure	Environment Protection and Heritage Council	Chapter 13 – Waste
State legislation		
Petroleum and Gas (Production and Safety) Act 2004	Department of Employment, Economic Development and Innovation (DEEDI)	Chapter 2 – Project description
Environmental Protection Act 1994 (EP Act)	Department of Environment and Resource Management (DERM)	This EM Plan
Environmental Protection Regulation 2008	DERM	This EM Plan
Sustainable Planning Act 2009 (SPA)	DERM	Chapter 2 – Project description Chapter 8 – Land tenure and use
Environmental Protection (Waste Management) Policy 2000	DERM	Chapter 13 – Waste
Environmental Protection (Waste Management) Regulation 2000	DERM	Chapter 13 – Waste
Environmental Protection (Air) Policy 2008	DERM	Chapter 5 – Air Quality Chapter 7 – Land Management
Environmental Protection (Noise) Policy 2008	DERM	Chapter 10 – Noise Chapter 11 – Social
Environmental Protection (Water) Policy 2009	DERM	Chapter 14 – Water
State Development and Public Works Organisation Act 1971 (SDPWO Act)	Department of Employment, Economic Development and Innovation (DEEDI)	Chapter 2 – Project description
Nature Conservation Act 1994 (NCA)	DERM	Chapter 9 – Flora and fauna
Aboriginal Cultural Heritage Act 2003 (ACH Act)	DERM	Chapter 12 – Heritage
Torres Strait Islander Cultural Heritage Act 2003	DERM	Chapter 12 – Heritage

Legislation	Assessment authority	Relevant chapter(s) addressing legislation
Transport Infrastructure Act 1994 (TIA)	Department of Transport and Main Roads (DTMR)	Chapter 2 – Project description
Transport Operations (Road Use Management) Act 1995	DTMR	Chapter 2 – Project description
Forestry Act 1959	DERM	Chapter 9 – Flora and fauna
Land Act 1994	DERM	This EM Plan
Land Protection (Pest and Stock Route Management) Act 2002	DERM	Chapter 9 – Flora and fauna Chapter 13 – Waste
Water Act 2000	DERM	Chapter 14 – Water
Marine Parks Act 2004	DERM	Chapter 9 – Flora and fauna Chapter 14 – Water
Fisheries Act 1994	DEEDI (Queensland Primary Industries and Fisheries)	Chapter 9 – Flora and fauna
Coastal Protection and Management Act 1995	DERM	Chapter 9 – Flora and fauna Chapter 14 – Water
Temporary SPP 1/10 – *Protecting Wetlands of High Ecological Importance in Great Barrier Reef Catchments*	State Government	Chapter 9 – Flora and fauna Chapter 14 – Water
Dangerous Goods Safety Management Act 2001	Department of Justice and Attorney-General	Chapter 13 – Waste
Dangerous Goods Safety Management Regulation 2001	Department of Justice and Attorney-General	Chapter 13 – Waste
SPP 1/92 – *Development and the Conservation of Agricultural Land*	State Government	Chapter 8 – Land tenure and use
SPP 2/02 – *Planning and Managing Development Involving Acid Sulfate Soils*	State Government	Chapter 7 – Land management
Waste Reduction and Recycling Strategy 2010 – 2020	State Government	Chapter 13 – Waste

1.8 Environmentally Sensitive Areas

In accordance with the CG Report, Environmentally Sensitive Areas (ESAs) within and adjacent to the RoW have been identified. For the purposes of this EM Plan, Category A and B ESAs have been defined pursuant to Sections 25 and 26 of the *Environmental Protection Regulations 2008*, whilst Category C ESA's have been defined pursuant to the DERM guideline *"Preparing an Environmental Management Plan (EM Plan) for Coal Seam Gas (CSG) activities"*.

The application of the ESAs to the Curtis Island GTP specifically dictates the width of the RoW. That is, where an ESA applies to a certain section, then the RoW is reduced accordingly from 40 m to 30 m.

Table 1.5 identifies the Category A, B and C ESAs that have been incorporated and addressed within this EM Plan. Table 1.5 also identifies the environmental elements the ESAs apply to and the chapter in which they have been addressed.

Table 1.5 Environmentally Sensitive Area classification

Category	ESA definition	Addressed in chapter
A	• Any of the following under the *Nature Conservation Act 1992*: – a national park (scientific) – a national park – a national park (Aboriginal land) – a national park (Torres Strait Islander land) – a national park (Cape York Peninsula Aboriginal land) – a national park (recovery) – a conservation park – a forest reserve	No Category A ESA's are located within the Curtis Island GTP RoW
	• The wet tropics area under the *Wet Tropics World Heritage Protection and Management Act 1993*	
	• The Great Barrier Reef Region under the *Great Barrier Reef Marine Park Act 1975* (Commonwealth)	
	• A marine park under the *Marine Parks Act 2004*, other than a part of the park that is a general use zone under that Act	
B	• Any of the following areas under the *Nature Conservation Act 1992*: – a coordinated conservation area – a wilderness area – a World Heritage management area – an international agreement area – an area of critical habitat or major interest identified under a conservation plan[1] – an area subject to an interim conservation order	Chapter 9 – Flora and Fauna
	• An area subject to the following conventions: – the 'Convention on the Conservation of Migratory Species of Wild Animals' (Bonn, 23 June 1979) – the 'Convention on Wetlands of International Importance, especially as Waterfowl Habitat' (Ramsar, Iran, 2 February 1971) – the 'Convention Concerning the Protection of the World Cultural and Natural Heritage' (Paris, 23 November 1972)	
	• A feature protection area, State forest park or scientific area under the *Forestry Act 1959*	
	• A declared fish habitat area under the *Fisheries Act 1994*	
	• A place in which a marine plant under the *Fisheries Act 1994* is situated	
	• An endangered regional ecosystem identified in the database known as the 'Regional ecosystem description database' kept by the department	
	• A zone of a marine park under the *Marine Parks Act 2004*	Chapter 8 – Land Tenure and Use
	• An area to the seaward side of the highest astronomical tide	N/A
	• The following under the *Queensland Heritage Act 1992*: – a place of cultural heritage significance – a registered place	Chapter 12 – Cultural Heritage

[1] Note: There are currently no declared 'critical habitats' or 'areas of major interest' listed under the *Nature Conservation Act 1992* (DERM 2011)

Category	ESA definition	Addressed in chapter
	• An area recorded in the Aboriginal Cultural Heritage Register established under the *Aboriginal Cultural Heritage Act 2003*, section 46, other than the area known as the 'Stanbroke Pastoral Development Holding', leased under the *Land Act 1994* by lease number PH 13/5398	
C	• Nature Refuges under the *Nature Conservation Act 1992*	N/A
	• Koala Habitat Areas as defined under the *Nature Conservation Act 1992*	
	• State Forests or Timber Reserves as defined under the *Forestry Act 1959*	
	• Resources reserves under the *Nature Conservation Act 1992*	
	• An area identified as 'essential habitat', defined under the *Nature Conservation Act 1992*	
	• "Of Concern" regional ecosystems identified in the database maintained by DERM called 'Regional ecosystem description database' containing regional ecosystem numbers and descriptions	
	• Declared catchment areas under the *Water Act 2000*	
	• Any wetland shown on the Map of Referable Wetlands available from DERM's website	

1.9 Coordinator-General Report conditions

The CG Report confirmed that the Project could proceed, subject to a number of conditions. The conditions related to specific components of the Project as well as the whole of the Project. In addition, Table 1.6 outlines the conditions of the CG report that are relevant to the Curtis Island GTP, as well as the chapters and sections in which these conditions are addressed in this EM Plan.

Table 1.6 CG Report conditions relevant to the Curtis Island GTP that are addressed in this EM Plan

Coordinator General conditions relevant to the Curtis Island GTP	Sections addressed
Appendix 1 – Part 2	
Condition 13. During the detailed design phase of the project and prior to any road or access track upgrade or construction for the project the proponent will consult with DERM to identify, assess and mitigate impacts to terrestrial and aquatic ecosystems and develop an EM Plan for design and construction of environmental offset and mitigation measures associated with road and access track works, including assessment of any proposed offsets	Access Tracks: Chapter 2, Section 2.5 Terrestrial and Aquatic ecosystems: Chapter 9 and Chapter 14
Appendix 3 – Part 1	
Condition 1. East of the Callide Range, the proponent must locate the gas transmission pipeline within the Callide Infrastructure Corridor State Development Area (CICSDA) and Gladstone State Development Area (GSDA)	N/A
Condition 4. The proponent is also required to obtain an environmental authority approval from DERM prior to the commencement of construction	This EM Plan will support the application for approval
Appendix 3 – Part 2	
Condition 3. The proponent must include provisions in the Environmental Management Plan for the gas pipeline, ensuring that, on land identified as being good quality agricultural land (GQAL), the pipeline contractor must:	Chapter 7, Section 7.5.5
a) on completion of construction, remove temporary access tracks	Chapter 7, Table 7.5, Table 15.1
b) on completion of construction, lightly rip disturbed areas, replace topsoil and return the surface to a land use condition that serves the preconstruction use	Chapter 7, Table 7.5, Table 15.1
c) on completion of construction, implement land management and erosion control measures	Chapter 7, Table 7.5, Table 15.1
d) on land with GQAL class A, B or C1, bury the pipeline to at least 0.9 m below finished land surface, or greater if deep ripping is a normal practice	N/A. No Government mapping of GQAL exists on Curtis Island
Condition 13. A mosquito and midge management plan will be developed as part of the EM Plan and will include:	Mosquito and Midge Management Plan (MMMP) (Appendix E)
a) assessment of work areas to be undertaken prior to works and on an informal basis to identify potential breeding sites	MMMP (Appendix E)
b) any required specific area control plans based on assessment of potential breeding sites will conform to DERM'S Mosquito Management Code of Practice for Queensland; and Queensland Health and the relevant local councils will be contacted for assistance in choosing a suitable method	MMMP (Appendix E)
Condition 25. Environmental authorities under section 310M of the EP Act and pipeline licences under section 410 of the *Petroleum and Gas (Production and Safety) Act 2004* may be issued separately for the following sections of the gas transmission pipeline:	
a) gas-fields to the Kangaroo Island wetlands	See Mainland EM Plan

Coordinator General conditions relevant to the Curtis Island GTP	Sections addressed
b) Kangaroo Island wetlands and the Narrows	See Marine Crossing EM Plan
c) Curtis Island	This EM Plan
Appendix 3 – Part 3	
Condition 1. The EM Plan developed in accordance with section 310D of the *Environmental Protection Act 1994* to support the applications for pipeline leases must provide:	
a) a construction schedule and methodology including plans and maps showing how the pipeline will be constructed through specific vegetation and soil types, topography and across riparian areas to avoid or minimise environmental harm	Chapter 2
b) details on how the proponent's pipeline will be constructed in common use infrastructure corridors in conjunction with other pipelines and services to minimise cumulative impacts, both on the Mainland and Curtis Island	Chapters 2, 5, 7, 8, 9, 10, 11, 12, 13 and 14.
c) details on waste management, treatment and disposal, including hydrostatic test water	Chapter 13
d) a maintenance and rehabilitation plan following construction to protect soil values and prevent weed invasion	Pest and Weed Management Plan (PWMP) (Appendix D) and Landscape Rehabilitation Management Plan (LRMP) (Appendix G)
Condition 2. The EM Plan developed in accordance with section 310D of the *Environmental Protection Act 1994* to support the applications for pipeline leases must:	
a) be prepared in accordance with the DERM published guideline: *Preparing an environmental management plan (EM Plan) for Coal Seam Gas (CSG) activities*, where relevant	This EM Plan
b) specifically address:	
i. the pipeline construction schedule and proposed methodology	Chapter 2
ii. construction in common use infrastructure corridors	Chapter 2
iii. the pipeline route on Curtis Island	Figure 1.2
A detailed illustrated and site specific construction methodology for Curtis Island must be provided, including information on necessary ancillary works and cumulative impacts arising from parallel construction of other gas pipelines, roadways, water pipelines and telecommunication cables to service multiple LNG facility sites	Section 2.5
Condition 3. Prior to the commencement of petroleum activities the proponent must provide to DERM for review the following aquatic values impacted by the Gas Transmission Pipeline, including:	Chapter 14
a) a detailed assessment of aquatic values (including animal breeding places) along the pipeline route must be provided. Site specific data must be included that accurately and comprehensively describes the environmental values and ecological condition at each aquatic site. The information must be used to determine the location of each watercourse or wetland crossing and site specific mitigation measures to protect the values identified	Chapter 14

Coordinator General conditions relevant to the Curtis Island GTP	Sections addressed
b) the information must also demonstrate that mitigation measures for permanent creek crossings are consistent with AS2885 - *Pipelines - Gas and Liquid Petroleum and the Australian Pipeline Industry Association (APIA) Code of Environmental Practice*. Those documents provide the approach to be taken when determining the optimal route selection as well as engineering standards that must be applied to the construction of the pipeline, including:	N/A
i. minimisation of adverse impacts on fauna and significant habitat areas	N/A
ii. minimisation of impacts on riparian, aquatic and water dependent flora and fauna	N/A
iii. minimise erosion and sediment impacts	N/A
iv. maintain water quality and water flow requirements	N/A
v. maximise rehabilitation success of achieving long term site stability	N/A
c) Soils ground truthing, including identification of all sensitive soil and landform areas along the pipeline corridor including Good Quality Agricultural Land, cross referenced to known information on land units and land systems. Any variation between identified land values and DERM data sets must be identified and explained. An assessment of the potential impacts must be provided along with appropriate mitigation measures and construction methods applicable to the identified soil types or landforms	Chapter 7, Section 7.5
d) protection and restoration of good quality agricultural land that could qualify as strategic cropping land under the Government's draft discussion paper Protection of Strategic Cropping Land	Chapter 7, Section 7.7, Table 7.5
e) Hydrostatic test water, including a detailed assessment of impacts from hydrostatic test water along the pipeline route, which must be provided. Source water quality data and characteristics of additives, particularly biocides) must be provided along with the proposed storage, treatment and disposal methods. The information must be used to determine the site specific mitigation measures including monitoring and reporting	Chapter 2, Chapter 13 Further detail will be provided prior to construction
Appendix 3 – Part 4	
Condition A12. An Environmental Management Plan (EM Plan) must be implemented that provides for the effective management of the actual and potential impacts resulting from the carrying out of the petroleum activities. Documentation relating to the EM plan must be kept	Chapter 3
Condition A13. The EM Plan required by condition (A12) must address, at least, the following:	
1. Describe each of the following:	
(a) each relevant resource authority for the environmental authority	Chapter 1, Section 1.6.2
(b) all relevant petroleum activities	This EM plan
(c) the land on which the activities are to be carried out	Chapter 8, Figure 7.1
(d) the environmental values likely to be affected by the activities	Chapters 5, 6, 7, 8, 9, 10, 11, 13 and 14

Coordinator General conditions relevant to the Curtis Island GTP	Sections addressed
(e) the potential adverse and beneficial impacts of the activities on the environmental values	Chapters 5, 7, 8, 9, 10, 11, 12, 13 and 14. Sections 5.6, 7.6, 8.3, 9.7, 10.6, 11.2, 12.3, 13.4, 14.4
2. State the environmental protection commitments the applicant proposes for the activities to protect or enhance the environmental values under best practice environmental management	Chapters 5, 7, 8, 9, 10, 11, 12, 13 and 14. Sections 5.9, 7.8, 8.5, 9.9, 10.8, 11.7, 12.5, 13.9, 14.6.
3. Include a rehabilitation program for land proposed to be disturbed under each relevant resource authority for the application	Chapter 15, LRMP (Appendix G)
4. State a proposed amount of financial assurance for the environmental authority as part of the rehabilitation program	Chapter 4
5. Training staff in the awareness of environmental issues related to carrying out the petroleum activities, which must include at least:	Chapter 3, Section 3.5
(b) Any relevant environmental objectives and targets, so that all staff are aware of the relevant performance objectives and can work towards these	Chapter 3 and Chapters 5, 7, 8, 9, 10, 11, 13 and 14. Sections 5.6, 7.7, 8.5, 9.8, 10.6, 11.3, 12.4, 13.7, 14.5.
(c) Control procedures to be implemented for routine operations for day to day activities to minimise the likelihood of environmental harm, however occasioned or caused	Chapter 3 and Chapters 5, 7, 8, 9, 10, 11, 13 and 14. Sections 5.6, 7.7, 8.5, 9.8, 10.6, 11.3, 12.4, 13.7, 14.5.
(d) Contingency plans and emergency procedures to be implemented for non routine situations to deal with foreseeable risks and hazards, including corrective responses to prevent and mitigate environmental harm (including any necessary site rehabilitation)	Chapter 3, Section 3.7
(e) Organisational structure and responsibility to ensure that roles, responsibilities and authorities are appropriately defined to ensure effective management of environmental issues	Chapter 3, 3.2
(f) Effective communication procedures to ensure two-way communication on environmental matters between operational staff and higher management	Chapter 3
(g) Obligations with respect to monitoring, notification and record keeping obligations under the EM Plan and relevant approvals	Chapter 3 and Chapters 5, 7, 8, 9, 10, 11, 13 and 14. Sections 5.6, 7.7, 8.5, 9.8, 10.6, 11.3, 12.4, 13.7, 14.5.
(h) Monitoring of the release of contaminants into the environment including procedures, methods and record keeping	Chapter 3, Section 3.5 Chapters 5, 7, 9, 10, 11, 13, 14 and 15. Sections 5.8, 7.5, 8.4, 9.5, 10.9, 11.7, 12.4, 13.4, 14.8 and 15.5.
6. The conduct of periodic reviews of environmental performance and procedures adopted, not less frequently than annually	Chapter 3, Section 3.6
7. A program for continuous improvement	Chapter 3

1.10 EPBC Referral No 2008/4096 conditions

Table 1.7 outlines the conditions of the EPBC Act approval for the GTP that are relevant to the Curtis Island GTP, as well as the chapters and sections in which the conditions are addressed in this EM Plan.

Table 1.7 EPBC conditions relevant to the Curtis Island GTP that are addressed in this EM Plan

EPBC conditions relevant to the Curtis Island GTP	Sections addressed
Environmental Management Plan (excluding the Narrows)	-
2. The proponent must prepare an Environmental Management Plan to manage the impacts of construction, operation and decommissioning of the pipeline (other than in relation to the Narrows) on listed threatened species and ecological communities, listed migratory species and values of the World and National Heritage-listed Great Barrier Reef	This EM Plan
3. The Environmental Management Plan must include:	-
a) provisions for detailed pre-clearance surveys by a suitably qualified ecologist along the entire length of the ROW, in accordance with conditions 5 to 10	Chapter 9, Table 9.13, Sub-heading - Vegetation clearing
b) measures to minimise native and riparian vegetation clearance and to minimise the impact on listed species, their habitat and ecological communities in accordance with management plans required for MNES under this approval	Chapter 9, Table 9.13, Sub-heading - Vegetation clearing
c) measures to manage the impact of clearing on each listed species and ecological community in accordance with management plans required for MNES under this approval	Chapter 9, Table 9.13, Sub-heading - Vegetation clearing
d) measures to regenerate vegetation on the ROW where natural regeneration is not successful to a condition at least equivalent to the ROW condition prior to commencement	Chapter 15. Landscape and Rehabilitation Management Plan (LRMP) (Appendix G)
e) measures to minimise impacts on fauna during pipeline construction, including:	-
i. measures to protect MNES in the areas of the ROW where trenching is being undertaken, including measures to exclude listed terrestrial fauna from gaining access to those areas of the ROW where trenching is currently being undertaken	Chapter 9, Table 9.13, Sub-headings – Fauna management, Fauna injury and mortality. Significant Species Management Plan (SSMP)
ii. mechanisms to allow fauna to escape from the pipeline trench	Chapter 9, Table 9.13, Sub-headings – Fauna management, Fauna injury and mortality. SSMP
iii. daily morning surveys for trapped fauna	Chapter 9, Table 9.13, Sub-heading – Fauna management
iv. mechanisms for a suitably qualified person to relocate fauna	Chapter 9, Table 9.13, Sub-headings - Conservation significant fauna species, Fauna injury and mortality. SSMP
v. record keeping for all survey, removal and relocation activities	Chapter 9, Table 9.13, Sub-headings - Conservation significant fauna species, Fauna injury and mortality. SSMP

EPBC conditions relevant to the Curtis Island GTP	Sections addressed
f) machinery wash down procedures and ongoing monitoring to minimise the spread and establishment of weeds in the ROW. Monitoring of weed infestations within disturbed areas must occur at least monthly during construction and then quarterly for a period of two years after completion of construction. Appropriate weed control measures must be implemented. After the two-year period, the frequency of monitoring must be reconsidered by the proponent, based on the success of control measures, the level of infestations and pipeline maintenance activities	Pest and Weed Management Plan (PWMP) (Appendix D)
g) measures to manage and control feral animals that may spread due to the establishment of the ROW	PWMP (Appendix D)
h) measures for the prevention of ignition sources to protect habitat values	Chapter 9 (Section 9.7.7), Table 9.13, Sub-heading – Fire
i) measures for the management of acid sulfate soils	Chapter 7
4. The Environmental Management Plan must be submitted for the approval of the Minister. Commencement must not occur without approval (except for activities critical to commencement and associated with mobilisation of plant, equipment, materials, machinery and personnel prior to start of pipeline construction which will have no adverse impact on MNES). The approved plan must be implemented	This EM Plan
Pre-clearance surveys	-
5. Before the clearance of native vegetation in the pipeline ROW, the proponent must:	-
a) undertake pre-clearance surveys for the presence of listed threatened species and migratory species, their habitat and listed ecological communities	Species Management Plan (SMP), SSMP
b) alternatively, where recent surveys have already been undertaken and those surveys meet the Department's requirements for surveys for the relevant MNES, the proponent may elect to develop management plans based on those surveys in accordance with the requirements of Condition 8	
6. Pre-clearance surveys must:	-
a) for each listed species, be undertaken in accordance with the Department's survey guidelines in effect at the time of the survey. This information can be obtained from http://www.environment.gov.au/epbc/guidelines-policies.html#threatened	SMP – Section 2.1.1. SSMP – Section 2.1.1
b) be undertaken by a suitably qualified ecologist approved by the Department in writing	All ecological surveys will be undertaken by suitably qualified ecologists who are approved by the Commonwealth prior to the survey period
c) document the survey methodology, results and significant findings in relation to MNES	This will be undertaken as part of the pre-clearance survey work
d) apply best practice site assessment and ecological survey methods appropriate for each listed threatened species, migratory species, their habitat and listed ecological communities	SSMP – Sections 4 to 6 Methodology to adopt Commonwealth guidelines, if not available State guidelines will be adopted

EPBC conditions relevant to the Curtis Island GTP	Sections addressed
7. Pre-clearance survey reports (which document the methods used and the results obtained) must be published by the proponent and provided to the Department on request	Upon completion of the targeted surveys, a report detailing the survey methodologies and the field results will be provided to the relevant State and Commonwealth agencies and additionally published on the Proponents website as per approval conditions
8. If a listed threatened species or migratory species or their habitat, or a listed ecological community is encountered during the surveys undertaken as required by condition 5 and is not specified in the Table 1 or 2 at condition 11 and 12, the proponent must submit a separate management plan for each species or ecological community to manage the unexpected impacts of clearing. In relation to each listed species or ecological community, each plan must address:	SSMP
a. the relevant characteristics describing each ecological community	SSMP
b. a map of the location of species, species' habitat, or ecological community in proximity to the ROW	SSMP
c. measures that will be employed to avoid impact on the species, species' habitat, or ecological community	Chapter 9, Table 9.7, Chapter 10, Table 10.5, SSMP and SMP
d. a quantification of the unavoidable impact (in hectares and/or individual specimens)	Chapter 9, Chapter 10, SSMP, GLNG Project Gas Transmission Pipeline Environmental Offset Plan (developed by Ecofund) as part of the GLNG Project
e. where impacts are unavoidable and a disturbance limit is not specified for the listed species or ecological community under condition 11, propose offsets to compensate for the impact on the population of the species' habitat, or the ecological community	SSMP to be updated, GLNG Project Gas Transmission Pipeline Environmental Offset Plan (developed by Ecofund) as part of the GLNG Project
f. current legal status (under the EPBC Act)	SSMP
g. known distribution	Chapter 9, Chapter 10, SSMP
For listed species, each plan must also include:	
a. known species' populations and their relationships within the region	Chapter 9, Chapter 10, SSMP
b. biology and reproduction	SSMP
c. preferred habitat and microhabitat including associations with geology, soils, landscape features and associations with other native fauna and/or flora or ecological communities	SSMP
d. anticipated threats to MNES from pipeline construction, operation and decommissioning	Chapter 9, Chapter 10, SSMP
e. management practices and methods to minimise impacts, such as:	

EPBC conditions relevant to the Curtis Island GTP	Sections addressed
i. site rehabilitation timeframes, standards and methods	Chapter 16
ii. use of sequential clearing to direct fauna away from impact zones	Chapter 16, SMP
iii. re-establishment of native vegetation in linear infrastructure corridors	Chapter 16
iv. handling practices for flora specimens	SSMP
v. translocation and/or propagation practices and monitoring for translocation/propagation success	SSMP
vi. monitoring methods including for rehabilitation success and recovery	Chapter 16
f. reference to relevant conservation advice, recovery plans, or other policies, practices, standards or guidelines relevant to MNES published or approved from time to time by the Department	Chapter 9, Chapter 10, SMP, SSMP
9. Each plan required under condition 8 must be submitted for the approval of the Minister. Commencement in the location covered by the management plan must not occur without approval. Each approved plan must be implemented	Chapter 1 and SSMP
10. If, during construction a listed threatened species or migratory species or their habitat, or a listed ecological community is encountered and is not specified in the table at condition 11 or 12, the proponent must submit a separate management plan for each species or ecological community in accordance with condition 8 within 20 business days of encountering that MNES. Work must not continue at the construction site where the MNES is encountered until the relevant management plan has been approved	SMP and SSMP
Disturbance limits	-

EPBC conditions relevant to the Curtis Island GTP	Sections addressed
11. The following maximum disturbance limits apply to any disturbances authorised for unavoidable impacts on listed threatened communities and potential habitat for listed threatened species or migratory species as a result of the construction, operation and decommissioning of the pipeline (and all associated activities)	SSMP

Table 1: EPBC Listed threatened ecological communities		
Ecological community	**EPBC status**	**Disturbance limit (ha)**
Brigalow (*Acacia harpophylla* dominant and co-dominant)	Endangered	4.4
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	Endangered	2.4
Species	**EPBC status**	**Disturbance limit (ha)**
Cycas megacarpa (Large-fruited Zamia)	Endangered	27.8

Note: These conditions provide offsets for species identified in Table 1 except for Brigalow, for which offsets are provided in EPBC 2008/4059 (Santos/PETRONAS coal seam gas fields expansion)

EPBC conditions relevant to the Curtis Island GTP	Sections addressed
12. The proponent must prepare a management plan for each species in the table below. Each plan must be prepared in accordance with the requirements of condition 8	SSMP

Table 2: Species management plans required before commencement	
Listed species	**EPBC Act Status**
Philotheca sporadica	Vulnerable
Cadellia pentasylis (Ooline)	Vulnerable
Paradelma orientalis (Brigalow Scaly-foot)	Vulnerable
Furina dunmalli (Dunmall's Snake)	Vulnerable
Egernia rugosa (Yakka Skink)	Vulnerable
Geophaps scripta scripta (Squatter pigeon – southern)	Vulnerable
Nyctophilus corbeni (Eastern Long-eared Bat)	Vulnerable
Chalinolobus dwyeri (Large-eared Pied Bat)	Vulnerable
Xeromys myoides (Water Mouse)	Vulnerable

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

EPBC conditions relevant to the Curtis Island GTP	Sections addressed
13. Each management plan must be submitted for the approval of the Minister. Commencement must not occur without approval. Commencement in the location covered by the management plan must not occur without approval. Each approved plan must be implemented	SSMP
14. Disturbance of vegetation related to the construction and maintenance of the pipeline must be confined to the ROW. Any proposed siting of construction camps, vehicle access tracks and pipe lay-down areas outside the ROW during construction must be undertaken so as to minimise potential adverse impacts on MNES and must comply with conditions 5 to 13	Chapter 9, Table 9.13, Sub-heading - Vegetation clearing, SSMP

EPBC conditions relevant to the Curtis Island GTP	Sections addressed
Auditing	-
52. On the request of and within a period specified by the Department, the proponent must ensure that:	-
a) an independent audit of compliance with these conditions is conducted	Chapter 3, Section 3.7
b) an audit report, which addresses the audit criteria to the satisfaction of the Department, is published on the Internet and submitted to the Department	Chapter 3, Section 3.7
53. Before the audit begins, the following must be approved by the Department:	-
a) the independent auditor	Chapter 3, Section 3.7
b) the audit criteria	Chapter 3, Section 3.7
54. The audit report must include:	-
a) the components of the project being audited	Chapter 3, Section 3.7
b) the conditions that were activated during the period covered by the audit	Chapter 3, Section 3.7
c) a compliance/non-compliance table	Chapter 3, Section 3.7
d) a description of the evidence to support audit findings of compliance or non-compliance	Chapter 3, Section 3.7
e) recommendations on any non-compliance or other matter to improve compliance	Chapter 3, Section 3.7
f) a response by the proponent to the recommendations in the report (or, if the proponent does not respond within 20 business days of a request to do so by the auditor, a statement by the auditor to that effect)	Chapter 3, Section 3.7
g) certification by the independent auditor of the findings of the audit report	Chapter 3, Section 3.7
55. The financial cost of the audit will be borne by the proponent	Chapter 3
56. The proponent must:	-
a) implement any recommendations in the audit report, as directed in writing by the Department after consultation with the proponent	Chapter 3, Section 3.7
b) investigate any non-compliance identified in the audit report	Chapter 3, Section 3.7
c) if non-compliance is identified in the audit report - take action as soon as practicable to ensure compliance with these conditions	Chapter 3, Section 3.7
57. If the audit report identifies any non-compliance with the conditions, within 20 business days after the audit report is submitted to the Department the proponent must provide written advice to the Minister setting out the:	-
a) actions taken by the proponent to ensure compliance with these conditions	Chapter 3, Section 3.7

EPBC conditions relevant to the Curtis Island GTP	Sections addressed
b) actions taken to prevent a recurrence of any non-compliance, or implement any other recommendation to improve compliance, identified in the audit report Note: To avoid doubt, independent third party auditing may include audit of the proponent's performance against the requirements of any plan required under these conditions	Chapter 3, Section 3.7
Reporting non-compliance	-
58. The proponent must, when first becoming aware of a non-compliance with these conditions, or a plan required to be approved by the Minister under these conditions:	-
a) report the non-compliance and remedial action to the Department within five business days	Chapter 3, Section 3.7
b) bring the matter into compliance within a reasonable time frame specified in writing by the Department	Chapter 3, Section 3.7
Record keeping	-
59. The proponent must:	-
a) maintain accurate records substantiating all activities associated with or relevant to these conditions of approval, including measures taken to implement a plan approved under these conditions	Chapter 3, Section 3.7
b) make those records available on request to the Department. Such records may be subject to audit by the Department or an independent auditor in accordance with section 458 of the EPBC Act, or used to verify compliance with these conditions Note: Audits or summaries of audits carried out under these conditions, or under section 458 of the EPBC Act, may be posted on the Department's website. The results of such audits may also be publicised through the general media	Chapter 3, Section 3.7
Financial assurance	-
60. The proponent must:	-
a) provide the Minster with a financial assurance in the amount and form required from time to time by the Minster for activities to which these conditions apply	Chapter 4
b) review and maintain the amount of financial assurance based on proponent reporting on compliance with these conditions, and any auditing of the activities	Chapter 4
61. The financial assurance is to remain in force until the Minister is satisfied that no claim is likely to be made on the assurance Note: The financial assurance may be used for rehabilitation of habitat and other purposes not addressed adequately by the proponent during the life of the project	Chapter 4

EPBC conditions relevant to the Curtis Island GTP	Sections addressed
Annual environmental return	-
62. The proponent must produce an Annual Environmental Return which:	-
a) addresses compliance with these conditions	Chapter 3, Section 3.6
b) records any unavoidable adverse impacts on MNES, mitigation measures applied to avoid adverse impacts on MNES; and any rehabilitation work undertaken in connection with any unavoidable adverse impact on MNES	Chapter 3, Section 3.6
c) identifies all non-compliances with these conditions	Chapter 3, Section 3.7
d) identifies any amendments needed to plans to achieve compliance with these conditions	Chapter 3, Section 3.7
63. The proponent must publish the Annual Environmental Return on its website within 20 calendar days of each anniversary date of this approval. In complying with this publication requirement, the proponent must ensure that it has obtained relevant rights in relation to confidentiality and intellectual property rights of third parties	Chapter 3, Section 3.7
64. If requested by the Department, the proponent must provide all species and ecological survey data and related survey information from ecological surveys undertaken for MNES. The data must be collected and recorded to conform to data standards notified from time to time by the Department	Chapter 3, Section 3.6

2. Project description

This EM Plan is for the Curtis Island GTP, which runs from Point H on the southwestern corner of Curtis Island to the LNG Facility at Point I, traversing a distance of approximately five (5) km. Details regarding this section of the Project as well as the construction methodology are presented in this chapter.

2.1 Project justification

2.1.1 International demand

World energy demand continues to rise. Between 2008 and 2030, energy demand is expected to increase by 45%, an annual average rate of increase of 1.6% (International Energy Agency, 2008). Simultaneously, there is increased pressure to find less carbon-intensive energy solutions in an increasingly carbon-constrained world. The Project is a less carbon-intensive energy solution than other fossil fuel alternatives. As such, the Project can be a global contributor to energy needs with reduced greenhouse gas outputs.

In the calendar year 2007, Australia exported 15.2 million tonnes of LNG, valued at $5,368 million (ABARE, 2008). Exports of LNG have increased strongly over the past 20 years, and have risen particularly rapidly over the past five years. Exports of approximately 25 million tonnes are predicted for 2011 to 2012.

ABARE (2008) predicts that this growth in exports will continue, with natural gas exports expected to grow by almost 8% per year until 2030. Most of this growth is expected to come from increased production from the North West Shelf project and the ConocoPhillips LNG plant in Darwin, supplying LNG to Japan. More West Australian operations are in the development phase, including Gorgon and Pluto projects in the Carnarvon Basin, and several in the Browse Basin.

The majority of the world's large importers of LNG are in the Asia Pacific region, giving Australia a natural advantage in terms of the relatively short distances to these key markets. In 2007 Australia exported over 20 billion m^3 of gas mainly to Japan and China.

ABARE (2008) predicts that the international demand from LNG importing countries will continue. This is expected to be 120 million tonnes in 2010 and increasing to over 150 million tonnes by 2015. There is a clear opportunity for the Project to meet part of these international needs.

2.1.2 Domestic demand

Within Australia, increasing demand for natural gas is likely to change the market structure in coming years. At present there are a small number of producers and a small number of large consumers, with relatively low household consumption. In 2007 there were approximately 3.75 million households in Australia using natural gas, most supplied by low pressure gas pipelines (ABARE, 2008).

Domestic consumption of natural gas is predicted to nearly double by 2030 (ABARE, 2008). This increase is due to increased demand for natural gas in electricity generation, manufacturing and mining, partly as a result of government policy incentives such as the Queensland 13% Gas Scheme. Under this scheme electricity retailers are required to source 13% of the electricity they sell in Queensland from gas-fired generation. The target will increase to 18% by 2020. The scheme is designed to diversify Queensland's energy mix towards the greater use of gas, assist in encouraging the development of new gas sources and infrastructure in Queensland, and reduce greenhouse gas emissions from the Queensland electricity sector.

In 2005-06, natural gas accounted for 565 PJ of Australia's domestic energy consumption, or around 16% of total consumption. This is projected to increase to 18% by 2029-30.

Santos made a comprehensive, commercial-in-confidence submission to the *Queensland Government LNG Industry Issues Paper* on December 17, 2008 in which Santos addressed the question of expected impacts of LNG on domestic gas and electricity prices. This has also been provided to the Government EIS assessment team to ensure the Project complies with the information provided in the EIS.

2.2 Curtis Island GTP alignment

The Curtis Island GTP forms a part of the proposed GTP, which runs from the CSG fields at Roma and Fairview to the LNG Facility on Curtis Island over a distance of approximately 420 km. The Curtis Island GTP itself will extend from Point H near Laird Point on the southwestern corner of Curtis Island to the LNG Facility at Point I, traversing approximately five (5) km.

2.2.1 Route alignment process

The route alignment for the Curtis Island GTP was defined by the Government in accordance with the GSDA and with agreement with the Joint Technical Working Group of the four primary LNG proponents.

2.2.2 Alternate Curtis Island GTP routes

No alternative routes were assessed, as the Curtis Island GTP was required to be contained within the RoW as defined by the CICGSDA.

2.2.3 Alignment of the Curtis Island GTP

The Curtis Island GTP will extend from Point H near Laird Point on the south-western corner of Curtis Island to the LNG Facility at Point I, traversing a distance of approximately five (5) km (refer Figure 1.2).

The route from Point H continues east crossing through a small hill and then along flat terrain for a short section onto a larger hill where the route turns and runs east-south-east. The route then crosses an ephemeral watercourse and then continues on the eastern side of the watercourse for an approximate distance of 0.6 km. The pipeline crosses back to the western side of the watercourse adjacent to QCLNG GTP alignment and then continues on this alignment until it terminates at the LNG Facility. The pipeline enters the LNG site from the southeastern boundary of the LNG Facility (refer Figure 1.2).

2.3 Project timing and life

The project timing and life for the Curtis Island GTP has been considered in terms of the overall Project as this section cannot be considered in isolation.

For the first stage of the Project the CSG fields are expected to produce approximately 5,300 petajoules (PJ) (140 billion m^3) to supply to the LNG Facility. This will involve the development of approximately 2,650 exploration and production wells. It is anticipated that approximately 1,200 wells will be established prior to 2015, with the potential for a further 1,450 or more additional wells to be established thereafter. Additional supporting infrastructure including field gathering lines, nodal compressor stations, centralised compression and water treatment facilities, accommodation facilities, power generation and water management facilities will also be installed.

The LNG Facility is to be developed in three stages. Each stage is called a train. Construction of the first train (Train 1) including the marine facilities and capital dredging is proposed to commence in 2011 with construction taking approximately 4 years with a projected completion date of December 2014.

The LNG Facility operations are planned to commence in early 2015. Construction of Train 2 will commence as early as 2012, which will bring the LNG Facility up to its ultimate capacity of 10 Mtpa. However the timing of these trains is dependant on market conditions, gas availability, labour availability and the economic climate. It is possible that construction of Trains 1 and 2 may overlap.

The Curtis Island GTP will not require duplication should the LNG Facility undergo future expansion.

During this time, development of the CSG fields will be ongoing up to the 5,300 PJ production rate required for Train 1. As each production well will have an approximate life of five (5) to 15 years it will be necessary to replace depleted wells with new ones. New wells will be developed at a rate that is sufficient to provide enough CSG for the annual LNG production.

The design life and the expected operation of the pipeline is approximately 42 years.

The proposed project construction and operation schedule is provided in Figure 2.1. Note that the operation for all project components will continue past the year 2022.

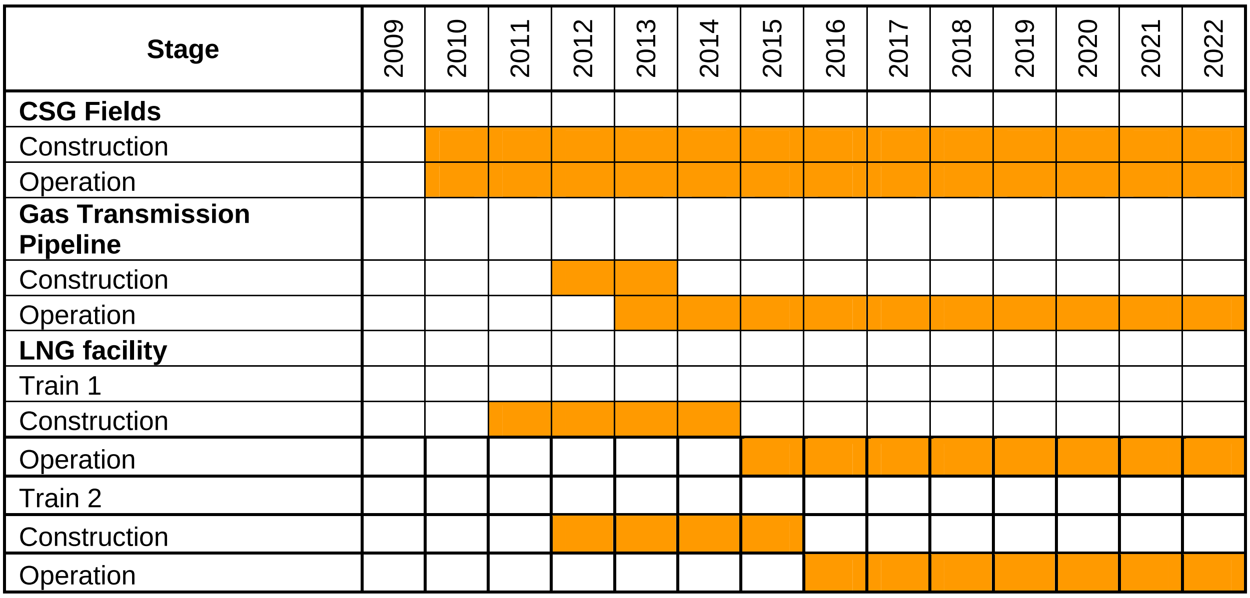


Figure 2.1 Project schedule

2.4 Design standards of the Curtis Island GTP

The Curtis Island GTP will be constructed using open cut trenching. The Curtis Island GTP will be designed and constructed in accordance with AS 2885.1 – 2007 Pipelines – Gas and Liquid Petroleum as well as other applicable standards and regulations, including the Australian Pipeline Industry Association (APIA 2009) *Code of Environmental Practice*. Key engineering and design features of the pipeline are provided in Table 2.1.

Table 2.1 Pipeline specification for Curtis Island GTP

Design element	Details
Type of petroleum activity	Gas transmission pipeline (GTP)
Approximate length	5 km
Maximum diameter	1,050 mm
Wall thickness	15.00 mm (standard); 17.9 to 19.7 mm (heavy walled)
Line pipe specification	API 5L X70 PSL2
Factory-applied external coating	Double layer Fusion-bonded Epoxy (FBE) coating
Factory-applied internal lining	Two-part liquid epoxy
Pipeline medium	Sales quality gas
Operational pressure	10.2 MPa (ranging up to 10.2 MPa depending on 1 or 2 trains)
Maximum allowable operating pressure (MAOP)	10.2 MPa
Specified minimum yield stress	485 MPa
Standard construction RoW width	40 m (narrowed to 30 m in sensitive areas where possible)
Operational easement width	30 m
Planned Project life – design and operation	Approximately 42 years
Minimum depth of cover	In accordance with AS 2885.1, typically: Creek Crossing – 1200 to 1500 mm Track and open ground – 900 mm to 1200 mm
Corrosion protection	External coating and impressed current cathodic protection
Non-destructive testing	100% radiography or ultrasonic testing of welded joints. Hydrostatic pressure testing of completed pipeline to 125% of MAOP as per AS2885 requirement
Pipeline monitoring system	SCADA system for remote monitoring and control of all facilities at each end of the pipeline such as flow rate, pressure, temperature, control main line valves and inlet/outlet valves
Main line valves	Main line valves will be located at intervals and used for isolating sections of the pipeline and venting gas to enable maintenance activities or isolation in the event of an incident
Gas receival stations and metering	A gas receival station will be constructed as part of the LNG facility on Curtis Island where the gas will leave the GTP. The gas receival station will consist of a station limit valve, scraper receiver, gas filters and flow control equipment together with metering
Area of disturbance	15 ha
Hours of operation (construction)	Typically 11 hours a day, 6.30 am to 6.30 pm (inc 1 hour break), 7 days a week. Further details provided in Section 2.5
Planned project life	Design – 42 years Operation – 42 years
Chapter 4 activities	See Table 2.2
Notifiable activities	See Section 2.9

2.5 Curtis Island GTP construction

In accordance with the construction schedule (refer Figure 2.1) and unless otherwise stated, it is expected that the activities associated with construction of the Curtis Island GTP will occur over a two month period and construction personnel will work continuously for 11 hours per day, seven days per week, and working on a 28 days on, 9 days off labour cycle.

2.5.1 Clear and grade

Clear and grade will be carried out to provide an access for a construction Right-Of-Way (RoW) for plant, equipment and vehicular movement. Clearing of vegetation during construction of the Curtis Island GTP RoW will be restricted to the designated RoW, which is limited to a width of 30 m for the entire length of the Curtis Island GTP RoW section (ie the area is mapped as a Category B ESA and this is in accordance with the CG report). A typical 30 m RoW layout is presented in Figure 2.2.

Clearing within the RoW will be in accordance with the Significant Species Management Plan (SSMP). In the case of protected or retained vegetation within the RoW (refer Chapter 9), the vegetation will be marked with yellow flagging or marker tape to indicate that it is to be avoided.

The plant and equipment to clear and level the RoW is listed below. Clearing of the RoW shall include the removal as required of trees, brush, stumps and other obstacles, and the grubbing, or removal otherwise, of stumps in the way of the trench line and in trafficked areas. All cut timber and other vegetation shall be stockpiled along the edges and within the RoW. Selected trees, timber and vegetation cleared and stockpiled on the working side of the RoW will be re-spread during rehabilitation to optimise re-growth and RoW reinstatement.

Existing water flows across the RoW will be maintained during clearing and grading, where necessary by the use of temporary drainage structures. All temporary drainage structures will be removed when no longer required. All grading works will be undertaken in accordance with the requirements stipulated in the Erosion and Sediment Control Plan (ESCP) (refer Appendix A).

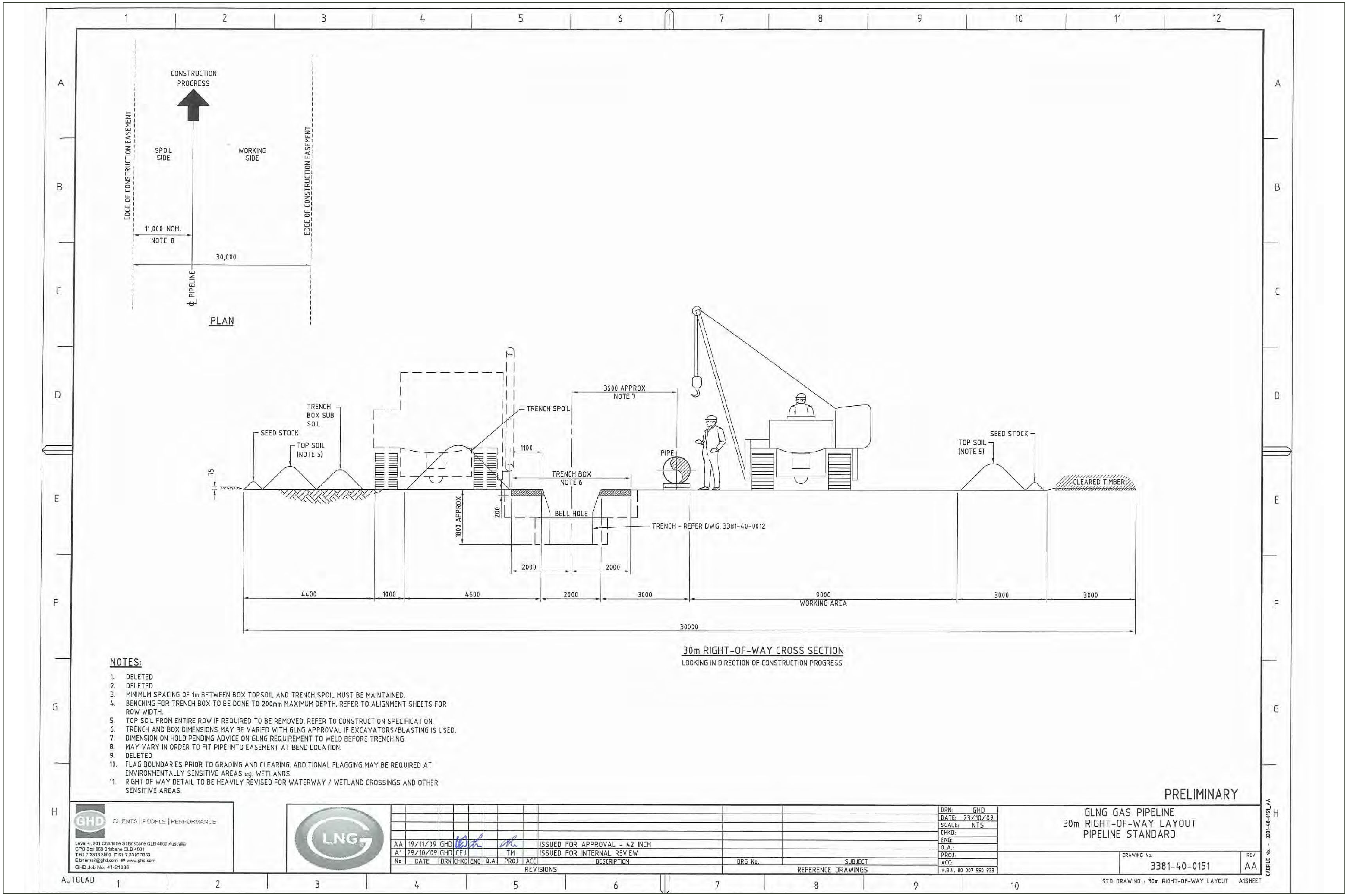
Topsoil will be stripped from the RoW to a depth not more than 200 mm, and will generally be undertaken to ensure the following:

- Topsoil will be removed from the trench line and trafficked areas, and stockpiled as windrows along the edge of the RoW, where topsoil has not been previously stripped
- Topsoil stockpiles shall not be placed within drainage lines
- Proper openings in trench spoil banks will be provided to allow normal drainage of the area and to prevent surface water from ponding
- Topsoil will not be placed up against trees

Topsoil stripped from access tracks within the RoW will be stockpiled for reinstatement.

Subsoil from the levelling of the RoW will be stockpiled separately from vegetation and topsoil. It will be placed to assist with restoring original contours. In rock areas surplus excavated rock material and surface boulders within the RoW will be stockpiled separately.

Map by: SLG P:\GIS\Projects\214208_Santos_EMP\Cl_027.mxd 08/04/2011 08:55



Proposed plant and equipment

The plant and equipment proposed for the clearing and grading are listed below:

- Excavators
- Front end loaders
- Dozers
- Mulchers
- Graders
- Water tankers
- Vibrating rollers

2.5.2 Stringing and bending

Pipe stringing involves laying the pipe out in lengths in preparation for welding. Pipe will be transported to the Curtis Island GTP on trucks that will come across from the Mainland via barge (refer Section 2.5.11).

The pipes will be placed on wooden skids in order to elevate the pipe from the ground surface, standing water and mud. Where required, pipe lengths are bent to match changes in elevation of trench direction using a hydraulic bending machine.

Proposed plant and equipment

The plant and equipment proposed for the pipeline stringing and bending operations are listed below:

- Excavators modified for string and bending operations
- Side-boom or crane with suitable rigging
- Spreader bar with guide lines at each end
- Bending machine
- Trucks – sand delivery

2.5.3 Welding and coating

Once the pipe is strung it will then be positioned using side boom tractors and clamped for welding. All separated sections of the pipeline will be welded into a continuous length after lowering-in of the strings. Tie-in connections will be completed by special crews, fully equipped with all necessary cutting, bevelling and welding equipment. Following welding and non-destructive testing the weld joints will be cleaned by grit blasting and coated with speciality polymer coating (SP-2888 R.G. Brush Grade Base White).

Proposed plant and equipment

The plant and equipment proposed for welding and tie-in operations are listed below:

- Side-booms
- Pay welder sets
- Trucks equipped with working tools
- Diesel welding machines
- Holiday detectors
- Backhoe excavators

2.5.4 Trenching

Trenching will be undertaken either prior to, during or after pipe stringing, and will depend upon the project schedules, terrain and other logistical factors.

The trench shall be excavated to sufficient depth to ensure the proper installation of the pipeline in accordance with AS 2885.1 and Table 2.1.

Trench spoil will be windrowed beside the trench allowing gaps at regular intervals for access tracks and for surface drainage. The amount of open trench will be restricted to that which is necessary for efficient completion of the work. If open trench distances are substantial, backfill will be required at intervals to form stock crossings and fauna exits from the trench.

All water in the bottom of the trench shall be removed where practical and disposed of in accordance with the water management measures (refer Chapter 14) and ESCP (refer Appendix A) prior to lowering the pipe into the trench. In ASS areas, discharge shall comply with the ASSMP presented in the Marine Crossing EM Plan.

Proposed plant and equipment

The plant and equipment proposed for trenching are listed below:

- Trenchers with either buckets or chain
- Excavators with rock hammers
- Traxcavator (combined excavator and track machine)
- Dewatering equipment
- Concrete trucks where required
- Dumper trucks

2.5.5 Lowering and backfilling

Typically, the pipe will be placed directly on the trench bottom without bedding beneath it. When trenching through areas where bedding is required (ie continuous rock or rock-bearing soil) then bedding, shading and padding will be used. The pipe string will generally be located in the centre of the trench, away from trench walls.

Where it is intended to place bedding and shading/padding material in a single pass, the pipe will be supported from the invert of the trench using foam pillow, or if necessary, soil filled bags.

Trapped fauna will be removed from the trench prior to lowering-in. Plugs will be excavated prior to lowering-in. The pipe will be lowered into the trench using side-booms with roli-cradles.

The trench will be visually inspected before bedding, padding and backfilling operations commence.

Backfill soils will be compacted to a level consistent with surrounding soils, with the aim of preventing trench subsidence and water ponding.

The trench backfilling will be compacted by rubber-tyred wheel rollers. Any subsidence that occurs, including any subsidence occurring during the contract maintenance period, will be rectified. Surplus excavated material will be spread across the RoW in accordance with the requirements of the ESCP (refer Appendix A).

Proposed plant and equipment

The plant and equipment proposed for the lowering and backfilling operations are listed below:

- Side-booms
- Roli-cradles
- Holiday detector
- Excavator
- Front loaders
- Dozers
- Padding machine
- Trucks
- Rollers
- Water tankers

2.5.6 Hydrostatic testing, cleaning and commissioning

Hydrostatic testing

Pipe integrity will be verified by hydrostatic testing. Hydrostatic testing will be undertaken in accordance with the Hydrostatic Testing Management Plan (HTMP), which will be developed during the design stage prior to construction.

During hydrostatic testing (hydrotesting) the pipe will be filled with water. The location, source and amount of water supplied for testing will be determined prior to commencing construction during the design phase. The pipeline once capped and filled is then pressurised. A 24-hour leak test then follows. The water from hydrotesting may be recycled from one test section to another with slight loss and make up. All hydrotesting water from the Curtis Island GTP will be tested to comply with discharge limits before being released to land (refer Chapter 14 and the HTMP).

Cleaning and commissioning

After completion of hydrotesting the pipeline will be de-watered, cleaned and dried such that:

- All residual free water is removed and drained to land in accordance with the HTMP
- The entire internal surface area is dry
- The pipeline section is substantially free of residual dust

Commissioning of the pipeline will be undertaken at the completion of hydrotesting and cleaning.

2.5.7 Ephemeral drainage line crossings

There are no major water courses that will be crossed for the Curtis Island GTP however there are a number of ephemeral drainage lines which the pipeline will traverse (refer Chapter 14).

A risk assessment will be undertaken for drainage line crossing to identify the risk of flows occurring during construction, taking into account time of year, and catchment characteristics. Where there is a risk of flows during construction, a dedicated localised construction method will be applied that:

- Minimises the area of disturbance
- Minimises the overall length of time for disturbance, and in particular, the length of time that trenches will remain open in the bed and banks
- Provides for preservation of the sediment/soil profile
- Provides for prompt stabilisation of the bed and banks following pipe placement
- Provides for special reinstatement techniques to restore aquatic ecosystems and prevent scouring and/or pipeline exposure and damage by subsequent flows

The width of cut in the RoW in the vicinity of the ephemeral drainage line will be minimised. Topsoil removed from the drain line will be conserved.

After vegetation and topsoil removal and stockpiling, the drainage line material will be separately stockpiled in a location that will not obstruct the drain line.

The drainage lines will be restored and obstructions resulting from construction of the pipeline will be removed and disposed of in accordance with the Landscape Rehabilitation Management Plan (LRMP) (refer Appendix G).

Proposed plant and equipment

The plant and equipment proposed for the crossing of the ephemeral drainage lines will include the following:

- Excavators
- Front loaders
- Dozers
- Padding machines
- Dumper trucks
- Water tankers

2.5.8 Post construction rehabilitation and clean up

Waste from construction including pipes, pipe off cuts and spacers will be collected and disposed of in accordance with the Waste Management Plan (WM Plan) (refer Appendix F).

On completion of construction the RoW will be rehabilitated in accordance with the LRMP (refer Appendix G).

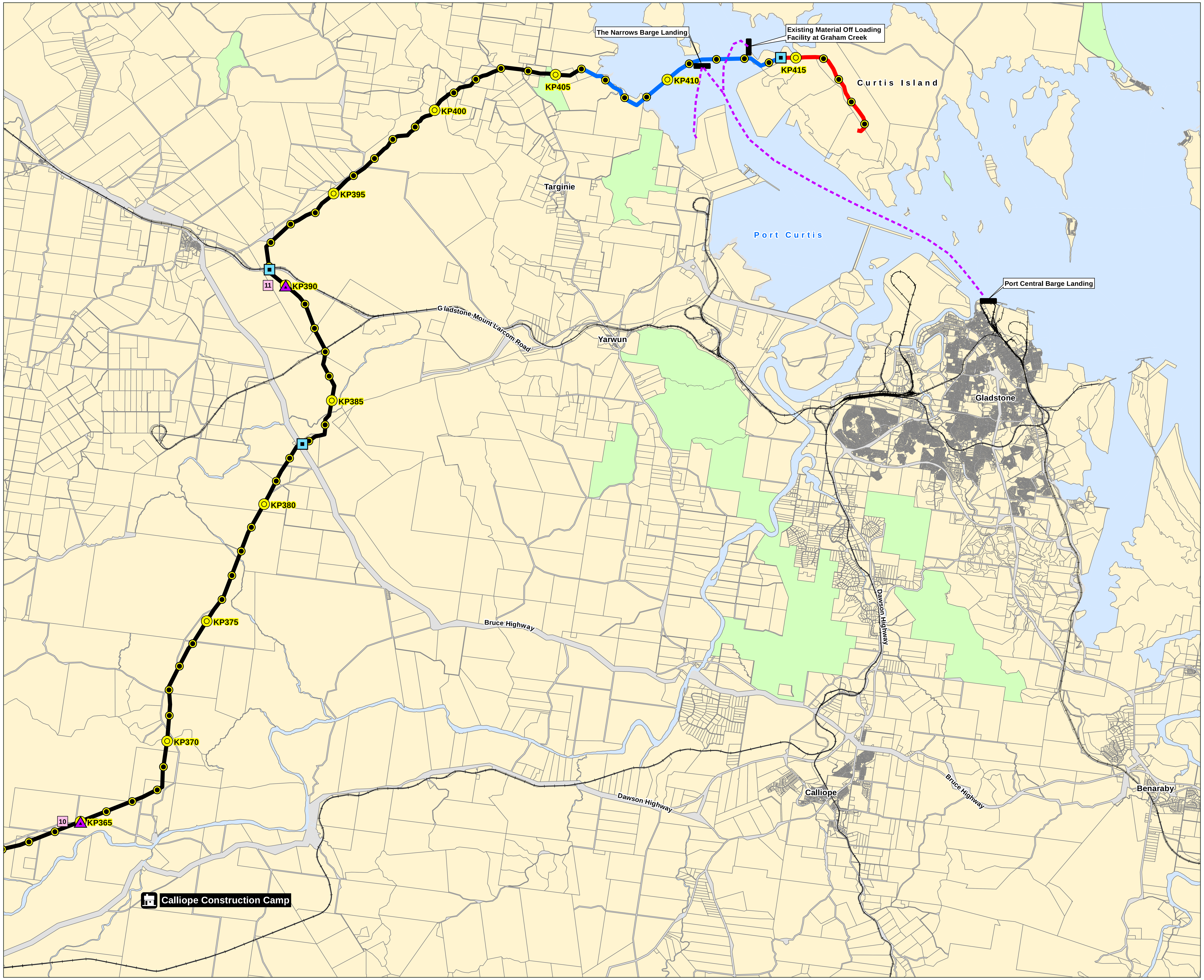
2.5.9 Construction camp

Construction personnel working on the Curtis Island GTP will be accommodated at a construction camp located on the Mainland at Calliope Camp – KP 355 (refer Figure 2.3 for the location of the proposed construction camp). This camp will be sized to accommodate approximately 450 persons and will take up an area of approximately eight (8) ha. This camp will also accommodate construction personnel from the Mainland GTP. Construction camp effects are considered in the Mainland EM Plan.

2.5.10 Gladstone logistic base

A logistic base to support the site construction activities near Gladstone (Auckland Point Lot 300) will be established and will be operational for the duration of the Project. The base will include the following features:

- Equipment maintenance workshop
- Fuelling facilities for vehicles
- Warehouse and lay down yard



Curtis Island GTP EM Plan

Gas Transmission Pipeline (GTP)
- Mainland GTP EM Plan
- Marine Crossing GTP EM Plan
- Curtis Island GTP EM Plan

Kilometre Post Distance Marker
- 5km
- 1km
- Calliope Construction Camp
- Vehicle Washdown and RoW Access Point (Indicative Location Only)
- Temporary Pipe Storage Site
- Barge Landing (Indicative Location Only)
- Barge Haulage Route
- Protected Area
- Rail
- Cadastre

Source:
Gas Transmission Pipeline (GTP): Santos, Jan 2011.
Aerial: Santos, 2011.
Protected Areas: Department of Environment and Resource Management, Feb 2011.
Cadastre: Department of Environment and Resource Management, Jun 2011.
Temporary Pipe Storage Site: GLNG Pipeline Logistics Study, GHD, Nov 2009.
Vehicle Washdown Points: Aurecon, Feb 2011.
Accommodation Camps: GLNG Pipeline Logistics Study, GHD, Nov 2009.

Note:
Barge landing and routes are approximate only.

Key GTP Construction Infrastructre Figure 2.3

A1 scale: 1:75,000

0 1,500 3,000 4,500 6,000 7,500m

GLNG No: 3381-40-0468

Coordinate system: GCS_GDA_1994

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Map by: RB

- Prefabrication workshop

The Gladstone logistic base at Auckland Point (Lot 300) used for temporary pipe receiving area for Curtis Island is a separate approval to the Curtis Island GTP.

2.5.11 Transportation

Transportation of pipe from overseas to the Project and Curtis Island GTP

The pipe joints for the Project will be shipped from overseas in 12 m lengths. It will be received by the construction contractor at the Port of Gladstone from December 2011 to September 2012 for the GTP in four (4) ship consignments. Of the four (4) ship consignments to the Auckland Point temporary pipe receiving area, approximately five (5) km of pipe length (210 pipes) will be required for the Curtis Island GTP. Unloading of each ship is expected to take four days working 24 hours per day. The pipe joints (for the Curtis Island GTP) will be transferred on to a barge via semitrailers and cranes.

The barge will travel to an existing barge landing facility located on Curtis Island (Graham Creek) (refer Figure 2.3). All barge and semitrailer transport will be carried out continuously during daylight hours (allowing10 hours per day) and operating on a 28 days on, 9 days off labour cycle.

Once on Curtis Island the pipe will then be trucked directly to the RoW and laid down ready for stringing and lowering.

Transport of plant, equipment and other construction related materials

Other heavy vehicle movements associated with construction of the Curtis Island GTP includes the transport of the plant and equipment to the Curtis Island RoW. Plant, equipment and other related construction related materials will also be moved on a daily basis through Auckland Point via barge and trucks to the Curtis Island RoW.

Transport along the ROW and access tracks on Curtis Island

All access to and from the access tracks and RoW on Curtis Island will be via wash down facilities (Figure 2.3). These wash down facilities will be used to control pest and weeds and will therefore be operated in accordance with the Pest and Weed Management Plan (PWMP) (refer Chapter 9).

Transport of construction personnel

The total project peak workforce is expected to be approximately 900 (850 contractors and 50 GLNG staff). Of this total, it is expected that approximately 90 will be working on the Curtis Island GTP at its peak.

Construction personnel are assumed to be non-resident operating on a fly-in/fly-out basis and will use commercial flights to gain access to Gladstone and Rockhampton airports. Construction personnel will then be transported to and from the airports in project vehicles including buses. The Contractor shall provide bus transportation services for the movement of its construction workforce to and from the marine area to designated worker parking areas as agreed with the Gladstone Port Corporation (GPC) and Gladstone Regional Council (GRC).

Daily movements of construction personnel from the Calliope Camp – KP 355 to the Curtis Island GTP work site will be via dedicated buses to a ferry service located at the Gladstone Port, from which construction personnel will then be transferred across to the existing barge landing facility located on Curtis Island (Graham Creek). The ferry service will run in the morning and at the end of each day to coincide with completion of daily works. The existing barge landing facility at Graham Creek will not be upgraded.

The dedicated buses will have capacity ranging from 17 to 50 seats. Once on Curtis Island the construction personnel movement will be predominantly along the RoW using 4WD vehicles and buses.

The plant and equipment proposed for personnel movement includes ferries, barges, 4WDs, utilities and buses.

2.5.12 Construction waste management

The construction process is not expected to generate large quantities of non reusable or non-recyclable materials. The anticipated waste streams from the construction process generally falls into one of the follow broad areas:

- General waste
- Recyclable waste such as paper, cardboard, plastics, glass, aluminium and timber
- Putrescible waste
- Medical and first-aid waste
- Scrap metals
- Sanitary waste
- Hydrotest water
- Waste oils and chemicals
- Regulated waste

Construction of the Curtis Island GTP will generate varying waste materials through the construction process. The management of these waste streams is outlined in Chapter 13.

2.6 Curtis Island GTP operation

2.6.1 Description of operational activities

The operation of the Curtis Island GTP will be in accordance with the EA and the Projects Health, Safety and Security Management Plan (HSSMP), AS 2885, the APIA *Code of Environmental Practice – Onshore Pipelines* and the Operational Management Plan (OMP), which will be developed and implemented prior to operation.

The OMP will include a maintenance program that will include leak detection and external coating surveys, ground and/or aerial patrols, repair or replacement of faulty/damaged components, internal cleaning of the GTP, corrosion monitoring and remediation, and easement and lease area maintenance.

Aerial and/or ground inspections will include checking for encroachment activities close to the Curtis Island GTP corridor, discolouration of vegetation which can be an indicator of a gas leak, detection of erosion, monitoring of rehabilitation success and detection of weed species. Monitoring of the cathodic protection system will be undertaken in accordance with the requirements stipulated in the OMP. The frequency of monitoring to be included in the OMP will be determined during the development of the detailed operating procedures and detailed design (prior to commencement of operation).

The operational workforce for the entire GTP (including the Curtis Island GTP) is anticipated to be between 15 and 20 persons. This crew will be responsible for undertaking the operational and maintenance activities as described above. Further details of the key operational and maintenance activities are provided below.

Operational monitoring

The Curtis Island GTP is to be monitored remotely from a gas control centre via a supervisory control and data acquisition system located at the LNG Facility by GLNG Operations personnel.

Ground patrols

Ground control inspections by GLNG Operations personnel will be carried out along the pipeline RoW by vehicle and foot patrols to check on the condition of the RoW and identify any activities that may have the potential to impact on the integrity of the GTP. The frequency of these inspections will be stipulated in the OMP. The inspections will also be undertaken as per the monitoring and auditing measures stipulated OMP. Typical inspections will include:

- Evidence of activity on the Curtis Island GTP corridor and in the vicinity
- Use of access tracks and pipeline corridor and any unauthorised traffic
- Access track condition and maintenance requirements
- Evidence of erosion, washouts or land subsidence
- Evidence of pipeline exposure
- Vegetation cover
- Excess vegetation on the pipeline corridor
- Weed and pest infestation
- Condition of pipeline crossings
- Disturbance to protected heritage sites
- Indications of leaks
- The presence of refuse or litter
- Damages to fences, gates, signs, markers etc
- Security of sites and evidence of unauthorised entry

Additional patrols will be undertaken after heavy storms or significant events to check for damage to the pipeline. In particular, low level remediation for erosion, subsidence and weeds is likely to be necessary primarily during the first 12 months following construction.

Aerial surveillance

Aerial patrols by GLNG Operations personnel along the Curtis Island GTP RoW will be undertaken on in accordance with the programme stipulated in the OMP. Typical aerial surveillance will check for:

- Bare patches or damaged vegetation (indicating possible leaks or erosion)
- GTP exposure
- Scouring, sink holes, areas of active or potential erosion
- Condition of water crossings
- Noxious weed areas
- Ploughed areas and/or evidence of third party activity
- Areas of limited revegetation success
- Vegetation regrowth

Internal pipeline inspection

Internal pipeline inspections are required to monitor the integrity of the pipe which will be carried out by intelligent pigs on an as-required basis.

Cathodic protection surveys

A cathodic protection system is required to protect the pipe and it will be installed along the length of the Curtis Island GTP, and checked in accordance with the requirements of the OMP.

Issue specific monitoring

The OMP will identify areas that require a high level of monitoring. These areas will be incorporated into the OMP operational monitoring program and monitored.

Special ground, marine and/or aerial patrols may be undertaken after heavy storms or earthquakes to check for damage to the RoW.

2.7 Decommissioning

2.7.1 Description of decommissioning activities

The Curtis Island GTP has a design life and an expected operational life of approximately 42 years. At project closure, it will be decommissioned or reused in consultation with regulatory authorities.

In the event that the GTP is no longer required, it will be decommissioned in accordance with the legislative requirements of the day, AS2885 and the APIA *Code of Environmental Practice – Onshore Pipelines* (APIA, 2005) or equivalent of that time.

2.8 Proposed environmentally relevant activities

This EM Plan supports an application for an Environmental Authority for a petroleum activity and hence the relevant Environmentally Relevant Activities (ERA's) are Chapter 5A Activities. Details of the Chapter 5A and Chapter 4 activities that could be triggered as a result of Project activities are provided in Table 2.2 below.

Table 2.2 Environmentally relevant activities

Environmentally relevant activity	Comment
3. A petroleum activity that is likely to have a significant impact on a category A or B environmentally sensitive area	The GTP is within the allocated ribbon of the GSDA
5. Constructing a new pipeline of more than 150 km under a petroleum authority	The Curtis Island GTP will be approximately 5 km in length, however the overall GLNG GTP will be approximately 420 km long
8. A petroleum activity, other than a petroleum activity mentioned in items 1 to 7, that includes a chapter 4 activity for which an aggregate environmental score is stated	See below, Schedule 5 - Level 1 Chapter 5A
Schedule 2, Activity 8 – Chemical Storage	Chemicals maybe stored within designated areas
Schedule 2, Activity 17 – Abrasive blasting	Pipe joints, welds and possibly cold pipe bends may require abrasive blasting to remove rust and scale prior to welding
Schedule 2, Activity 38 – Surface coating	Pipes will be coated with a corrosion protection substance
Schedule 2, Activity 47 – Timber milling and wood	Some timber removed from the RoW may be milled or chipped as part of project activities
Schedule 2, Activity 50 - Bulk material handling	Loading and unloading of pipes and other construction material will occur as part of project works

2.9 Notifiable activities

The following Notifiable Activities may occur as a result of construction of the Curtis Island GTP:

1. Abrasive blasting—carrying out abrasive blast cleaning (other than cleaning carried out in fully enclosed booths) or disposing of abrasive blasting material.

7 Chemical storage (other than petroleum products or oil under item 29)—storing more than 10t of chemicals (other than compressed or liquefied gases) that are dangerous goods under the dangerous goods code.

23 Metal treatment or coating—treating or coating metal including, for example, anodising, galvanising, pickling, electroplating, heat treatment using cyanide compounds and spray painting using more than 5L of paint per week (other than spray painting within a fully enclosed booth).

2.10 Cumulative impacts process

The approach taken in this report is aligned with the approach outlined in the CG Report. It aims to identify potential cumulative impacts related to the Curtis Island GTP as part of the identification of management measures which have a multi-project component. In doing so it considers the following:

- Sensitive receptors (environmental values): stated receptors of defined sensitivity upon which impacts may be caused
- Project scope / assessment scenario: the combination of projects being assessed
- Temporal scope: time period over which impacts are assessed and extent to which overlapping or contiguous timeframes for different projects contribute to cumulative impacts
- Geographical scope: geographical extent of the assessment of direct and indirect impacts
- Cumulative impacts: as defined in the CG report
- Cumulative impact mitigation: specific measures for mitigating cumulative impacts (as opposed to those for stand alone projects)

2.10.1 Sensitive receptors

The environmental values are taken as the starting point for identifying the cumulative impacts. No further desk, field or model based information about environmental receptors has been obtained in the preparation of this assessment. The receptors affected by cumulative impacts are described in full in the relevant section of this EM Plan.

2.10.2 Temporal scope

It is proposed to assess a construction only scenario which considers both the cases of maximum likely intensity (ie greatest project overlap) and maximum likely duration. Programme information available in the public domain is high level and with conservative timescales for activities on Curtis Island for each scheme. The proposed programme of activities is described in Section 2.3.

2.10.3 Geographical scope

The Curtis Island GTP is part of a larger linear development. However this EM Plan covers one section with defined start and finish points. Therefore this report covers the terrestrial elements of the RoW within the Corridor from the end of the GLNG HDD crossing to the boundary of the GLNG Facility and indirect impacts resulting elsewhere from activities occurring within.

The geographical scope is based on the spatial extent of the impacts and the area within which the projects interact including:

- The footprint of the development
- Downstream/tidally connected water bodies influenced by construction activities
- Habitat of fauna outside these areas influenced by activities in areas above through severance of migratory pathways

The Curtis Island GTP represents only a very small fraction of the economic and social activity associated with the overall LNG project construction works, and it is not possible to isolate the economic and social effects of the Marine Crossing component from the broader project. Consequently social, economic and community impacts on populations outside the construction footprint and immediately adjacent areas are not considered in this EM Plan.

2.10.4 Cumulative impact identification approach

Impact identification

Identification of cumulative impacts involves the following steps:

- Establish a distinct scenario for the assessment
- Identify the activities within each *scenario* in aggregate as distinct from each project, and establish the temporal scale for when these activities occur
- Identify the impacts that result from each activity and where the similar impacts result from different activities
- Identify receptors (or categories of receptors) that are affected by each impact
- Evaluate the impacts on receptors

Impact scoring

This EM Plan contains a qualitative assessment using a matrix based comparison of project activities, timescales and impacts with environmental values using professional judgement and reference to previous studies.

An indicative evaluation of the impact will be undertaken based on the magnitude of impact (ie the size of the potential change to the environment resulting from the project) and the sensitivity of the affected receptor. The approach to ranking of significance is displayed in Table 2.3 and has been used throughout the cumulative impact sections of this EM Plan.

Table 2.3 GLNG cumulative impact scoring

Significance	Description	Matrix Indicator
Major negative	Widespread, prolonged and/or large magnitude impacts affecting the quality or viability of a receptor at a State or National level. Should be avoided or eliminated wherever possible, and otherwise offset or fully compensated. Plans of specific mitigation and targeted monitoring program must be included in the EM Plan	***
Moderate negative	Locally widespread and/or moderate magnitude impacts affecting quality or viability of a receptor at a regional or local level. Plans of specific mitigation and targeted monitoring program must be included in the EM Plan	**
Minor negative	Localised, short term and/or low level impacts managed by standard environmental management practices and routine monitoring	*
Negligible	No measurable impacts following implementation of standard measures	N
Positive	Impacts where a beneficial impact on the receptors are anticipated	+
Permanent	Impacts that are effectively permanent	(P)

3. Environmental management system

3.1 Environmental management

Not all the impacts of the Curtis Island GTP, especially location specific design detail is known at this time. This EM Plan recognises that there is a continuous improvement process that leads from the concept to the detail. This EM Plan therefore provides the values and commitments which are to inform the detailed design, construction and operation of the GTP. The detailed design of the GTP will inform the construction methodology and also the method of operation and maintenance (refer Figure 3.1).

The role of the Curtis Island GTP EM Plan is to identify the primary environmental values; the potential environmental impacts; and means of managing and mitigating these impacts. The Curtis Island GTP EM plan also identifies who is responsible and what are the performance criteria for measuring the achievement of objectives and what are the triggers for corrective action.

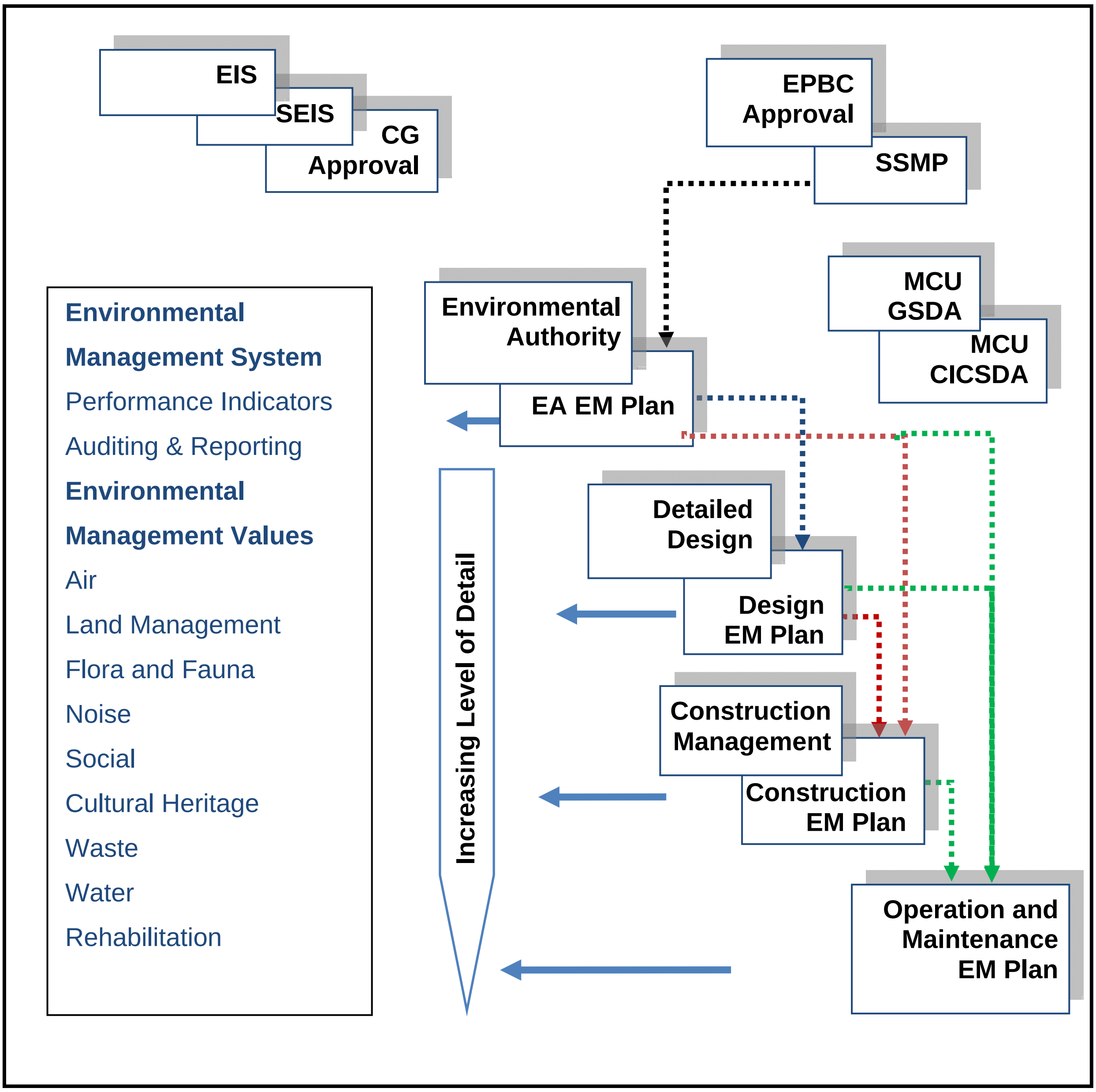


Figure 3.1 Future environmental documentation processes

3.2 Health, Safety and Security

A Health, Safety and Security Management Plan (HSSMP) has been developed and describes the Proponents personnel and contractor's responsibilities for managing health, safety and security (HS&S) issues during the construction and operation of the Curtis Island GTP. This is the primary Project document for the overall management of health, safety and security matters. The specific purpose of the HSSMP is:

- To clearly detail the health and safety objectives and expectations and provide guidance for the Proponents and contractor's personnel in satisfying them
- To list personnel responsibilities (or reference associated documents in which these are detailed)
- To document the methods by which health, safety and security issues shall be identified, communicated and managed
- To list the systems, processes, tools, risk controls and mitigation measures to be used in achieving the health, safety and security objectives

This HSSMP will be progressively updated by the Proponents Health, Safety and Security Manager as the risk profile of the GLNG Project changes and as new relevant information becomes available to ensure that potential hazards and impacts are understood and addressed.

The HSSMP is a working document that will be revised and re-issued as necessary.

3.3 Roles and responsibilities

The Proponents staff and contractors will be responsible for implementing this EM Plan in a manner which complies with all relevant environmental standards, adheres to all legislative requirements and ensures that all environmental objectives associated with the work are achieved.

Contract documents for the detailed design, construction, maintenance and operation will include the environmental commitments in this EM Plan, as well as requiring compliance with the Environmental Authority, design and construction specifications, technical drawings and the general environmental duty.

All staff are responsible for the environmental performance of their activities and for complying with the EP Act. Specific environmental responsibilities assigned to organisational roles are detailed in Table 3.1.

Table 3.1 Specific environmental responsibilities

Position	Overview
The Proponents Pipeline Project Manager	The Pipeline Project Manager is ultimately responsible for the standard of management, including environmental management. To assist in fulfilling this responsibility, the Pipeline Project Manager is supported by a series of specialised personnel
Construction Manager	The Construction Manager is responsible for all construction activities including planning, procedure's approvals and execution of works. The Construction Manager is also responsible for ensuring that adequate provision is made for compliance activities
Engineering Manager	The Engineering Manager is responsible for generating the design drawings and specifications consistent with the EM Plan and AS2885

Position	Overview
Pipeline Construction Superintendent	The Pipeline Construction Superintendent will direct work in a manner that complies with all relevant environmental procedures; adheres to all legislative requirements and ensures that all environmental objectives associated with the GTP are achieved. The Pipeline Construction Superintendent has “stop task” and “stop work” authority
Environmental Manager	The Environmental Manager will direct work in a manner that complies with all relevant environmental procedures; adheres to all legislative requirements and ensures that all environmental objectives associated with the GTP are achieved. The Environmental Manager has “stop task” and “stop work” authority
Construction Contractor	The Construction Contractor is responsible for ensuring compliance with this EM Plan and the development and implementation of a contractor specific EM Plan. This will include training of personnel (refer Section 3.5), provision and maintenance of equipment, facilities and associated services and consumables and the monitoring of compliance to this EM Plan

3.4 Project specific documentation

3.4.1 Key management plans

Erosion and sediment control plan

An Erosion and Sediment Control Plan (ESCP) (refer Appendix A) has been prepared and details typical control measures for erosion and sediment impacts associated with the GTP.

Species management plan

A Species Management Plan (SMP) has been prepared and addresses the impacts to all affected flora and fauna species (regardless of status) and habitat, provides for the survival of the species in the wild and achieves a net conservation benefit for the species. The SMP will be provided to DERM for approval prior to commencing construction.

Significant species management plan

A Significant Species Management Plan (SSMP) has been prepared and details the specific mitigation measures for the mitigation or offsetting of all impacts to significant flora and fauna species in accordance with the CG Report. The SSMP will also be provided to DERM for approval prior to construction commencing.

Pest and weed management plan

A Pest and Weed Management Plan (PWMP) (refer Appendix D) has been prepared and details the requirements for the management of pest and weeds associated with the construction of the GTP (including the Curtis Island GTP). It outlines pest and weed management protocols for the various stages of the GTP to ensure all construction activities (surveys, landholder access, site visits, infrastructure upgrades and preparation) do not transfer Class 1 or 2 weeds from areas currently infested to new “clean” areas.

Mosquito and midge management plan

A Mosquito and Midge Management Plan (MMMP) (refer Appendix E) has been prepared and outlines measures for the control of mosquito’s and biting midges whose populations could increase as a result of GLNG Project activities.

Social impact management plan

A Social Impact Management Plan (SIMP) has been developed for the GLNG Project and outlines measures to reduce any potential adverse impacts that the local community may be subjected to as a result of the proposed works. The SIMP is currently being reviewed by the Department of Local Government & Planning, Communities Branch.

Waste management plan

A Waste Management Plan (WM Plan) (refer Appendix F) has been prepared and specifies criteria and standards for the management of waste for all sections of the Project including the Curtis Island GTP.

Landscape rehabilitation management plan

A Landscape Rehabilitation Management Plan (LRMP) (refer Appendix G) has been developed and specifies criteria and standards for rehabilitation and monitoring of all areas impacted by pipeline activities.

Construction Environmental Management Plan

A Construction Environmental Management Plan (CEMP) will be developed to address the protection of environmental values during construction activities.

Operational management plan

An Operational Management Plan (OMP) will be developed during detailed design and prior to completion of construction. The OMP includes a summary of legal and community requirements and the responsibilities of all levels of personnel involved with the GLNG Project, along with guidance on the management of environmental impacts during operational activities.

3.5 Induction and training

The Proponents personnel, contractors and visitors are required to undertake relevant environmental training and induction programs. Personnel will not be allowed to access the GLNG project sites unless properly trained. Competencies and training results from the assessment of all staff and contractors will be identified and recorded.

All staff will complete a comprehensive GLNG Project induction. The induction will include a comprehensive review of environmental requirements and standards, safety, and access protocols. All supervisors and managers will have additional detailed training on the use and implementation of this EM Plan.

All managers and supervisors will hold regular toolbox meetings with personnel to discuss issues associated with their scheduled work. This will include highlighting and discussing relevant environmental issues. Any environmental issues will be captured and reviewed by through the hazard identification system.

All staff working on the GTP will receive training as to the following:

- The environmental policy of the Proponents and their contractor
- Any relevant environmental objectives and targets
- Control procedures to be implemented for routine operations for day to day activities to minimise the likelihood of environmental harm, however occasioned or caused
- Basic identifying features of declared weeds including the major weed species posing as a threat within and to the area
- Weed reporting procedures

- Weed risk assessment forms and vehicle washdown requirements
- Completion of the DEEDI Weed Hygiene Declaration and vehicle/machinery inspection report
- Explanation of any quarantine zones and relevant procedures for decontamination that apply
- Contingency Plans and Emergency Response Plans (ERPs) to be implemented for non-routine situations to deal with foreseeable risks and hazards, including corrective responses to prevent and mitigate environmental harm
- Organisational structure and responsibility to ensure that roles, responsibilities and authorities are defined to ensure effective management of environmental issues
- Effective communication procedures to ensure two-way communication on environmental matters between operational staff and higher management
- Obligations with respect to monitoring, notification and record keeping obligations under this EM plan and relevant approvals and procedures outlined in this EM Plan and the CEMP
- Monitoring of the release of contaminants into the environment including procedures, methods and record keeping

All personnel will be made aware of potential contamination issues during induction. Site inductions will also consist of fire safety awareness training

3.6 Environmental monitoring

Monitoring programs will be undertaken in accordance with this EM Plan. Routine environmental monitoring of the Curtis Island GTP will be conducted to ensure compliance with performance standards. Monitoring, undertaken by personnel and specialist service providers, will be periodically conducted in accordance with site-specific monitoring plans.

Specialist studies to investigate particular aspects of the environment (eg flora and fauna, weeds, hydrological risk) will be periodically commissioned when a need is determined during environmental review and risk assessment.

Suitably qualified, experienced and competent person(s) will conduct all monitoring. All monitoring results will be recorded, compiled and kept for a minimum of five years and made available for inspection upon request by administering authority.

Monitoring results relating to rehabilitation will be kept until the relevant petroleum tenure is surrendered.

The weed control program will consist of the following strategies:

- Vehicle and equipment washdowns
- Record keeping
- Close monitoring
- Spraying
- Vehicle stickers
- Training
- Management of vehicle movements

An annual return will be prepared and submitted to DERM.

If requested by the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC), all species and ecological survey data and related survey information from ecological surveys undertaken for MNES will be provided. The data will be collected and recorded to conform to data standards notified from time to time by DSEWPaC.

3.7 Reporting, recording and auditing

During construction and operation, compliance audits will be conducted in accordance with the requirements of this EM Plan as well as the relevant legislation and approvals. To ensure stakeholders are adequately informed of relevant EHS performance, reports, where necessary will be prepared for internal and external stakeholder review.

All inspection and audit reports of environmental performance will be stored in the Proponent's electronic database which will record incidents, complaints and audit finding and enable corrective actions identified during the inspection / auditing process to be recorded, tracked and closed out. Third party audits will be conducted to determine compliance and the reports from these audits provided to the CG, DSEWPaC and published on the internet. Prior to beginning the audit process, the independent auditor and the audit criteria will be approved by DSEWPaC.

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

The external auditors report will document the following:

- The components of the project being audited
- The conditions that were activated during the period covered by the audit
- A compliance/non-compliance table
- A description of the evidence to support audit findings of compliance or noncompliance
- Recommendations on any non-compliance or other matter to improve compliance
- A response by the proponent to the recommendations in the report (or, if the proponent does not respond within 20 business days of a request to do so by the auditor, a statement by the auditor to that effect)
- Certification by the independent auditor of the findings of the audit report

Audits or summaries of audits carried out under these conditions, or under section 458 of the EPBC Act, may be posted on the Department's website. The results of such audits may also be publicised through the general media.

Based on the outcomes of the auditing process, the following will be undertaken:

- Implement any recommendations in the audit report, as directed in writing by the Department after consultation with the proponent
- Investigate any non-compliance identified in the audit report
- If non-compliance is identified in the audit report - take action as soon as practicable to ensure compliance with these conditions

In addition to the monitoring and reporting requirements documented in the relevant sections of this EM Plan, the following auditing regime will be implemented:

- During construction, the Contractor will be required to report on environmental compliance of an incident, on a monthly basis with a corrective actions process established
- During construction, internal audits will be undertaken at regular intervals to verify that all work is proceeding in accordance with this EM Plan

- A post-construction audit of the Curtis Island GTP RoW and other related infrastructure will be conducted annually for two years following completion of construction to evaluate revegetation, erosion and soil stability, weed control, watercourse alteration prevention and success of bed and bank re-profiling
- The Proponents will act upon any matters contained within the audit report and record the findings in the database to facilitate, investigate, close out and remediate actions as appropriate
- Following the submission of the audit report, the Proponents will provide written advice to the CG and DSEWPaC for review and will address the following:
  - Actions taken to ensure compliance with the conditions in the CG Report
  - Actions taken to routinely prevent a recurrence of any non-compliance issues
- When first becoming aware of a non-compliance, the Contractor will:
  - Undertake action to bring the matter into compliance within an effective time frame
  - Report the non-compliance and remedial action to GLNG Operations, who will report up to DSEWPaC within the specified timeframe
- Environmental incidents (including complaints) will be recorded on a database and addressed. Each incident will be investigated to determine the underlying causes and actions to prevent recurrences

GLNG Operations will also produce an Annual Environmental Return, which will be published on its website and submitted to DSEWPaC electronically, within 20 business days of each anniversary date from the date of Commonwealth approval. The Annual Environmental Return will document the following information:

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

The financial cost of the audit will be borne by the proponent.

Regulatory agencies will be notified of non-conformance with statutory approvals within the specified timeframe.

Relevant records supporting inspections and audits (in addition to monitoring and other critical aspects of the management system) will be generated and maintained. GLNG Operations will:

- Maintain accurate records substantiating all activities associated with or relevant to these conditions of approval, including measures taken to implement a plan approved under these conditions
- Make those records available on request to the Department

3.8 Emergency response

The Proponent recognises that emergencies arising from activities could have serious and long term health and safety effects (HSE). The Proponent will develop and implement an ERP to address emergency situations at the operating sites, premises and relevant functions. The ERP will outline the emergency procedures and describe the organisation, defining members, tasks, responsibilities and role of the emergency response team. The ERP will include the following:

- Information outlining the connection to relevant legislation as well as specific EM Plans

- Inclusion of the District Officers from the local police districts to represent the Queensland Police Service (QPS) as a stakeholder when developing the ERP
- Communication and coordination between the Proponents and the District Disaster Management Group regarding the GLNG Project's activities
- Development of a response, investigation, command, control and recovery for both natural disasters and other disasters/emergencies and incidents
- Engagement with QPS and other agencies in emergency response exercises
- Response procedures in the event of a fire, chemical release, spill, leak, explosion, equipment failure, bomb threat, natural disaster (including severe storm and flood events) or any other likely emergency
- Communication arrangements and contact details
- Roles and responsibilities of responsible personnel
- Emergency controls and alarms
- Evacuation procedures
- Emergency response equipment
- Leak detection and control points
- Training requirements
- Site access and security

4. Financial assurance

The financial assurance (FA) for the Project which includes the Curtis Island GTP has been prepared in accordance with the Department of Environment and Resource Management (DERM) guideline "*Financial Assurance for Petroleum Activities*" using quantities determined from this EM Plan.

4.1 Background

Under section 312O of the EP Act, the administering authority may require the giving of financial assurance in a stated form or amount.

The purpose of the FA is to provide security for compliance with the environmental authority and certain costs and expenses.

The proposed amount of FA for this Project is:

- Calculated on a Project basis (ie may cover several petroleum activities on one or more petroleum authorities)
- Based on estimates for the work to be completed by third party contractors. This will ensure that the total cost of rehabilitation is specific to the site and is a realistic estimate of the cost expected to be incurred by the government should it be required to rehabilitate the disturbed areas (the estimates must cover the full extent of work necessary to meet the conditions of the environmental authority)
- Estimated using the *Schedule of disturbance for chapter 5A projects*

The main components of the schedule of disturbance that contribute to the annual rehabilitation costs are:

- The Total Rehabilitation Cost – which is the sum of the rehabilitation costs [R] for each type of disturbance and partly rehabilitated areas. The costs are calculated using the formula below:
  - Rehabilitation Cost [R] = Unit Rehabilitation Cost [C] x Disturbed Area [A]
  - where C = the unit rehabilitation cost [C] (ie the cost per unit area to complete rehabilitation for each type of disturbed or partially rehabilitated area)
  - A = maximum significantly disturbed area for each type of disturbance (eg evaporation pond) proposed during the period of the work program or development plan including any carryover of existing significant disturbance at commencement of program or plan

Consumer Price Index (CPI) – has been incorporated into the estimate of financial assurance to cover inflation for the term of the work program or development plan.

Goods and Services Tax (GST) – rate of ten (10) percent on all taxable supplies listed above that do not include GST.

The amount of FA that is required is defined as the maximum total rehabilitation cost for complete rehabilitation of all disturbed areas, which may vary on an annual basis due to progressive rehabilitation. The amount required for the financial assurance must be the highest total rehabilitation cost calculated within the period covered by the work program or development plan.

4.2 Project specific financial assurance

The GTP FA cost estimate has been developed by an independent consulting firm. The FA estimate is based on a combination of contractor bids for specific tasks developed as part of the Mainland GTP FA process and engineering estimates developed by EHS Support using third-party unit rates.

The Curtis Island GTP FA estimate has been developed based on the discrete phases of the Project. This phasing of the Project is consistent with that used for the financial assurance cost estimate for the Mainland section of the GTP. The four phases of the Project comprise:

- Phase 1 – GTP Construction (Q1/Q2 2013), in which the entire trench has been excavated (planned to be in one 5.2 km trenching assignment) and the pipe has been placed and is ready for installation. Restoration and rehabilitation activities include removal of all pipe, trench backfilling, GTP easement rehabilitation, and removal of surface facilities
- Phase 2 – GTP Construction Complete (Q3/Q4 2013), but trenches are still open. Restoration and rehabilitation activities include backfilling, GTP easement rehabilitation, and removal of surface facilities
- Phase 3 – Abandonment of the completed GTP and monitoring of the restored disturbance (2014 - 2016). In this phase of the Project, if the Project was terminated, the ultimate use of the GTP will be unknown, and as a result, costs have been allowed to protect the GTP for future use (nitrogen purge and installation of cathodic protection)
- Phase 4 – Formal abandonment of the GTP (2017) involving cut and capping of the GTP in two key areas: entrance of the GTP to Curtis Island and entrance to the GLNG Facility

For the purposes of the financial assurance assessment, it has been assumed that trenching for the Curtis Island GTP will be excavated in one event and will be maintained open during the entire piping construction activity. The phasing of this Project will be conducted sequentially with restoration only commencing once the GTP is fully installed. The construction methodology employed is not consistent with that used on the mainland where the Contractor will be concurrently trenching, laying pipe and backfilling during the GTP construction.

Specific to Phase 1, the scrap value of pipe has also been considered in the process. Consistent with the waste hierarchy (refer Chapter 13), it has been assumed that if the Project is terminated in a partially complete state, the surplus pipe and pipe not installed will be cut and sold as scrap. In order to be conservative, and to reflect the potential that a contractor could remove all pipe, but not complete other rehabilitation and restoration tasks (backfilling of trenches and reseeding), the value of scrap materials has only been used to offset the costs associated with handling and removal of the GTP for scrap. In the financial assurance calculations for Phase 1, the estimate provides the net proceeds from scrap resale; however, the proceeds exceed the cost of processing; therefore, the value in the estimation table has been set to $0.

Considering the lifecycle of the Project, estimates of the GTP financial assurance requirements for the phases discussed above are provided as follows:

- Phase 1 – GTP Construction (Q1/Q2 2013) – $1,221,000
- Phase 2 – GTP Construction Complete (Q2/Q3 2013) - $1,221,000
- Phase 3 – Abandonment of GTP Asset and monitoring of restored disturbance (2014 - 2016)- $358,000
- Phase 4 – Formal Abandonment of GTP Asset (2017) – $118,000

A further breakdown of these costs is provided in Tables 4.1 to 4.4.

All costs have been developed in accordance with DERM requirements for level 1 petroleum activities and have been calculated based on independent estimates (developed by EHS Support) using third-party unit rates. The estimates for rehabilitation and restoration of areas of soil disturbance were developed in accordance with the detailed methodologies provided in the Project EIS.

It has been assumed that acid sulfate soils (ASS) which may exist in the vicinity of Point H on Curtis Island will be managed in accordance with the acid sulfate soil management plan (ASSMP) presented in the Marine Crossing EM Plan, The FA estimate for ASS is considered conservative as it is likely the Contractor will consider treatment adjacent to the trench which would reduce the treatment and delivery costs by eliminating transportation to and from the excavated trench. The estimate is based on the following planned activities:

- Reinstatement of the GTP RoW
- Backfilling of the open trench
- Demobilisation of:
  - contractor facilities and low-value assets and equipment
  - surface facilities
- Monitoring of rehabilitation activities
- Contamination assessments (investigations) associated with the handling and storage of fuels
- Project management and contingency

The financial assurance for subsequent years will be provided based on the projected cost estimates for Phase 3 and Phase 4.

The amount of financial assurance will be reviewed and maintained based on the Proponent reporting on compliance with the conditions of the EPBC Act approval, and any auditing of the activities. The financial assurance will remain in force until the DSEWPaC is satisfied that no claim is likely to be made on the assurance.

Post-construction restoration and rehabilitation activities along the Curtis Island GTP RoW will be limited to monitoring, installation and operation of cathodic protection (refer Chapter 2). It has been assumed that the cathodic protection will be maintained and monitored. Should the project not proceed, it is assumed the cathodic protection will be maintained until 2016 to allow for reuse of the GTP. If a use has not been identified within this timeframe, the Curtis Island GTP will be abandoned in accordance with regulatory requirements.

5. Air quality

5.1 Chapter summary

This chapter describes the existing air environment, the potential effects of the construction of the Curtis Island GTP on air quality, and identifies suitable mitigation and management measures to address potential adverse impacts.

A quantitative air impact assessment has been undertaken (SLR Consulting, 2011) to identify potential sources of air emissions from the construction of the Curtis Island GTP and to investigate mitigation measures to ensure adverse air quality impacts do not occur as a result of these activities. The study considered the following:

- Existing environment values of the air environment within the Curtis Island GTP “pipeline study area”
- The nature and scale of activities that may result in release of contaminants to the air environment
- The location of sensitive receptors in relation to the emission sources
- Predicted concentrations of air pollutants downwind of the construction area
- Mitigation measures to reduce the identified potential impacts

5.1.1 Summary of existing air quality values:

- Air quality criteria will be set for the Project as part of the approvals process. In the interim, Section 5.3 sets the concentrations and deposition rates adopted in this EM Plan
- The nearest available meteorological monitoring station to Curtis Island is the Bureau of Meteorology’s (BoM) Gladstone Airport monitoring station, which is located approximately to the 12 km south
- No site-specific background air quality monitoring is available in the immediate locality of the Curtis Island GTP
- The air quality on Curtis Island in the vicinity of the RoW would generally reflect the land use pattern, i.e. low intensity pastoral activity
- The existing quality of the air along the Curtis Island GTP is expected to be affected to some extent by emissions from industrial facilities located in Gladstone and Fisherman’s Landing
- The sensitive receptors located nearest to the Curtis Island GTP section are those on Tide Island (3.6 km) and Witt Island (4.5 km)

5.1.2 Summary of impacts on air quality values

Construction

Dispersion modelling of the construction activities for the Curtis Island GTP indicates that no sensitive receptors are likely to be impacted by dust and any of the pollutants investigated. It is therefore concluded that air quality related impacts (in particular dust) resulting from the construction of the Curtis Island GTP are expected to be low and manageable, especially given that all works will be undertaken in accordance with the control strategies as outlined throughout this chapter .

Operation

Monthly inspections will be carried out along the Curtis Island GTP by vehicle and foot patrols to check on air quality related impacts on the GTP and associated infrastructure. Typically maintenance on the Curtis Island GTP will be carried out by light vehicles and maintenance crews on an annual basis.

Air quality impacts are expected to be low and manageable during the operational phase as all associated activities and works will be undertaken in accordance with the Operational Management Plan (OMP).

5.1.3 Summary of proposed mitigation measures

Table 5.1 Environmental protection commitments, objectives and control strategies – air quality

Item	Detail
Environmental protection objective	• To complete the installation of the GTP in a manner that maintains ambient air quality within the local airshed
Specific objectives	• No warranted complaints from landholders, and warranted complaints responded to within 2 working days • No excessive dust emissions during construction of the GTP • No air quality-related complaints from neighbouring residential areas and industrial areas
Control strategies	Refer to Table 5.22 for air quality and greenhouse gas emissions control strategies to be implemented during construction and operation of the Curtis Island GTP
Performance indicators	• Complaints responded to within 2 working days • No excessive dust emissions during construction of the Curtis Island GTP

5.2 Emission sources

The GTP on Curtis Island involves three distinct phases, which may result in emissions to air:

- Construction of the pipeline
- Operations of the pipeline
- Closure and rehabilitation of the RoW

The GTP on Curtis Island does not involve any point source combustion at any stage of the Project lifecycle. Combustion related air emissions (such as oxides of nitrogen or sulphur dioxide) are derived from mobile sources (e.g. motor vehicles or earth moving equipment). The effects of these mobile sources are transitory and are present on the RoW for short duration events and would not result in ground level concentrations of combustion gases in exceedance of Department of Environment and Resource Management (DERM) *Environmental Protection (Air) Policy 2008* guideline values. Consequently, these gases are not considered further in this assessment.

Particulate emissions may have the potential to cause impacts at sensitive receptors and need to be further assessed to determine the magnitude and possible duration of impact.

The most significant potential for release of particulate is during the construction period. After commissioning the pipeline, periodic inspection of the RoW will occur and this is expected to involve driving along the pipeline with no surface disturbance. Decommissioning is not expected to involve removal of the pipeline, or similar activity which would result in disturbance of the ground. Any release of particulate matter would be minor and of short duration.

For the purposes of this study, it is conservatively assumed that all of the machinery that would be used in the Mainland GTP construction has been employed on Curtis Island. In reality, a very small fraction of this equipment will be deployed, making the actual impact of construction on air quality less than the predicted impacts in this report (ie this report is worst case).

5.3 Air quality criteria

The legislative framework for management of Queensland's environment is the EP Act. Subordinate legislation under the EP Act establishes particular values of the environment to be enhanced or protected through Environmental Protection Policies. For the air environment values to be enhanced or protected are identified in schedules attached to the *Environmental Protection (Air) Policy 2008* (EPP Air).

Values to be enhanced or protected through the application of the EPP Air, and by extension to the EP Act are those values which are conducive to:

- Protecting the health and biodiversity of ecosystems
- Human health and wellbeing
- Protecting the aesthetics of the environment, including the appearance of buildings structures and other property
- Protecting agricultural use of the environment

The relevant air quality criteria within the EPP Air are:

- Particles as PM_{10}: a 24-hour average of 50 µg/m³
- Total suspended particulates (TSP): an annual average of 90 µg/m³
- Dust deposition: an annual average of 120 mg/m^2/day

It should be noted that the dust deposition guideline value is not defined within the schedule of the EPP Air, although it is used by DERM as an indication of amenity related concerns and potentially for defining environmental nuisance.

5.4 Existing environment

5.4.1 Climate and meteorology

The nearest available meteorological monitoring station to Curtis Island is the Bureau of Meteorology's (BoM) Gladstone Airport monitoring station, which is located approximately to the 12 km south. Long-term climate statistics for Gladstone Airport are discussed below.

Rainfall

Long-term rainfall statistics for Gladstone Airport (1994 to 2010) are summarised in Figure 5.1. Rainfall peaks during the summer months, with a maximum average of 195 mm recorded during February, which is associated with an average of 11.6 rain days per month. During the remainder of the year, the rainfall is much lower, ranging from 22 to 61 mm/month. The highest monthly rainfall recorded at Gladstone Airport over the time period examined was 657 mm recorded in February 2003.

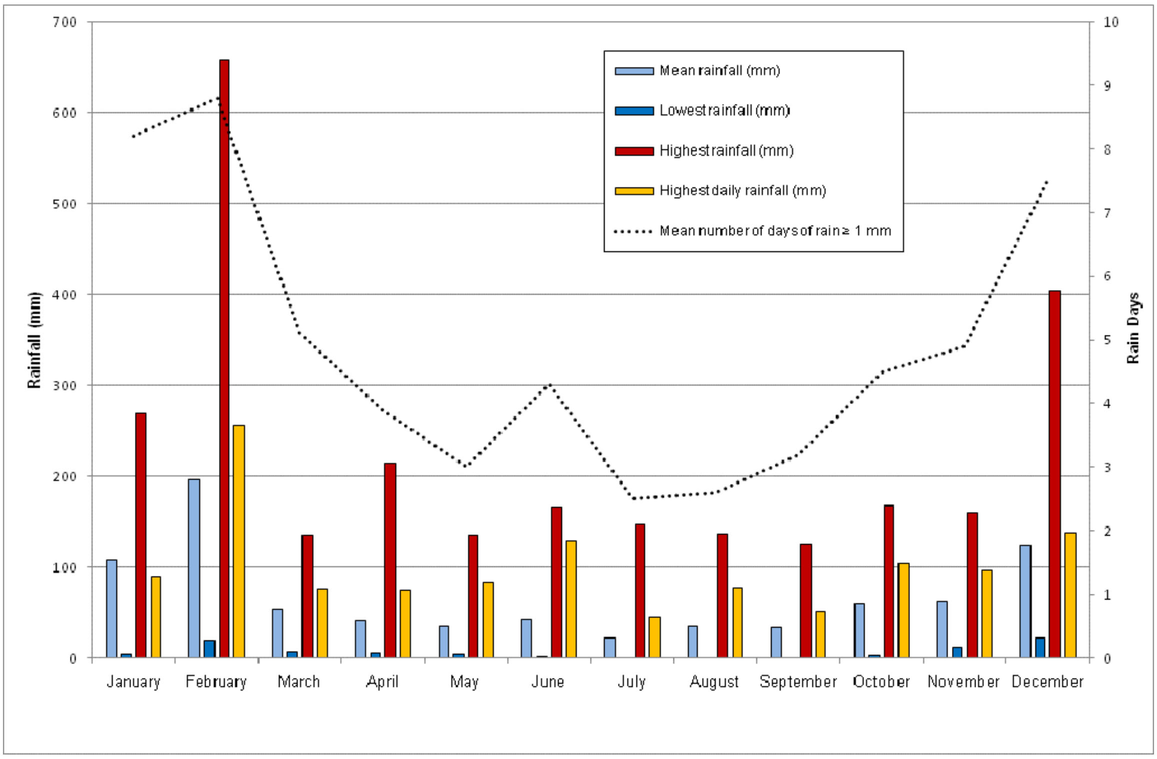


Figure 5.1 Long term rainfall data for Gladstone Airport (1994 – 2010)

Temperature

Long-term temperature statistics for Gladstone Airport (1993 to 2010) are summarised in Figure 5.2. Mean maximum temperatures range from 23°C in winter to 31°C in summer, while mean minimum temperatures range from 12°C in winter to 23°C in summer.

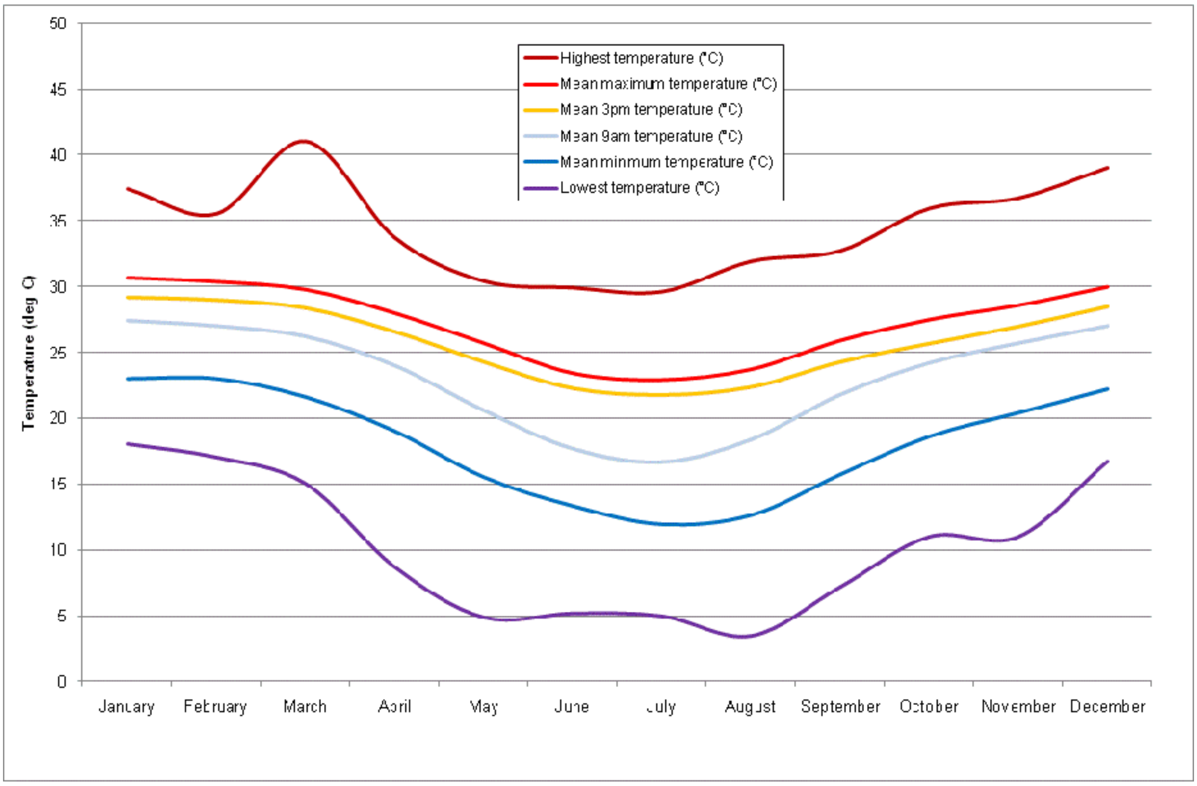


Figure 5.2 Long term temperature data for Gladstone Airport (1993 – 2010)

Wind speed and direction

Analysis of Gladstone Airport meteorology[1] shows the following:

- From January to April, morning winds are predominantly southeasterlies, shifting to easterlies during the afternoon
- During winter (May to August) morning winds blow predominantly from the southwest to southeast quadrant. In the afternoon, easterly winds continue to predominate, with northeasterly winds occurring with increasing frequency over this period
- During spring and early summer (September to December) the morning winds are slightly more widespread, with easterly and south easterlies predominating. In the afternoon, easterly and northeasterly winds continue to predominate
- Strong winds (>30 km/hr) generally only occur from the east and are more frequent during the afternoon

5.4.2 Existing air environment

The existing quality of the air along the Curtis Island GTP is expected to be affected to some extent by emissions from industrial facilities located in Gladstone and Fisherman's Landing. These facilities include:

- Rio Tinto Alumina's Yarwun refinery
- Cement Australia
- Fisherman's Landing
- Gladstone Power Station
- Queensland Energy Resources
- QAL Aluminium Smelter
- Gladstone Port

Additionally there are two proposed LNG facilities that are approved (and under construction) on the southern end of Curtis Island. Additional LNG facilities are proposed for the area and may be constructed.

DERM operate an ambient air quality network in the Gladstone region, and data are available to define the regional airshed. A summary of monthly maximum 24-hour PM_{10} concentrations measured by DERM at Targinie over the past two years is presented in Figure 5.3. These data show that at times, exceedances of the EPP Air (2009) objective for 24-hour PM_{10} concentrations of 50 µg/m^3 have occurred. The very high reading of 314.6 µg/m^3 recorded in September 2009 was associated with a dust storm that swept across New South Wales and Queensland from 22 to 24 September. Since December 2009, no exceedances of the EPP Air (2009) objective have been recorded.

These recent data are consistent with those used in the EIS (URS, 2009). For the assessment of the potential impact of the GTP on the air environment, the EIS background concentrations were adopted i.e:

- Annual average TSP = 30 µg/m^3
- 24-hour average PM_{10} = 30 µg/m^3

[1] http://www.bom.gov.au/climate/averages/tables/cw_039326.shtml

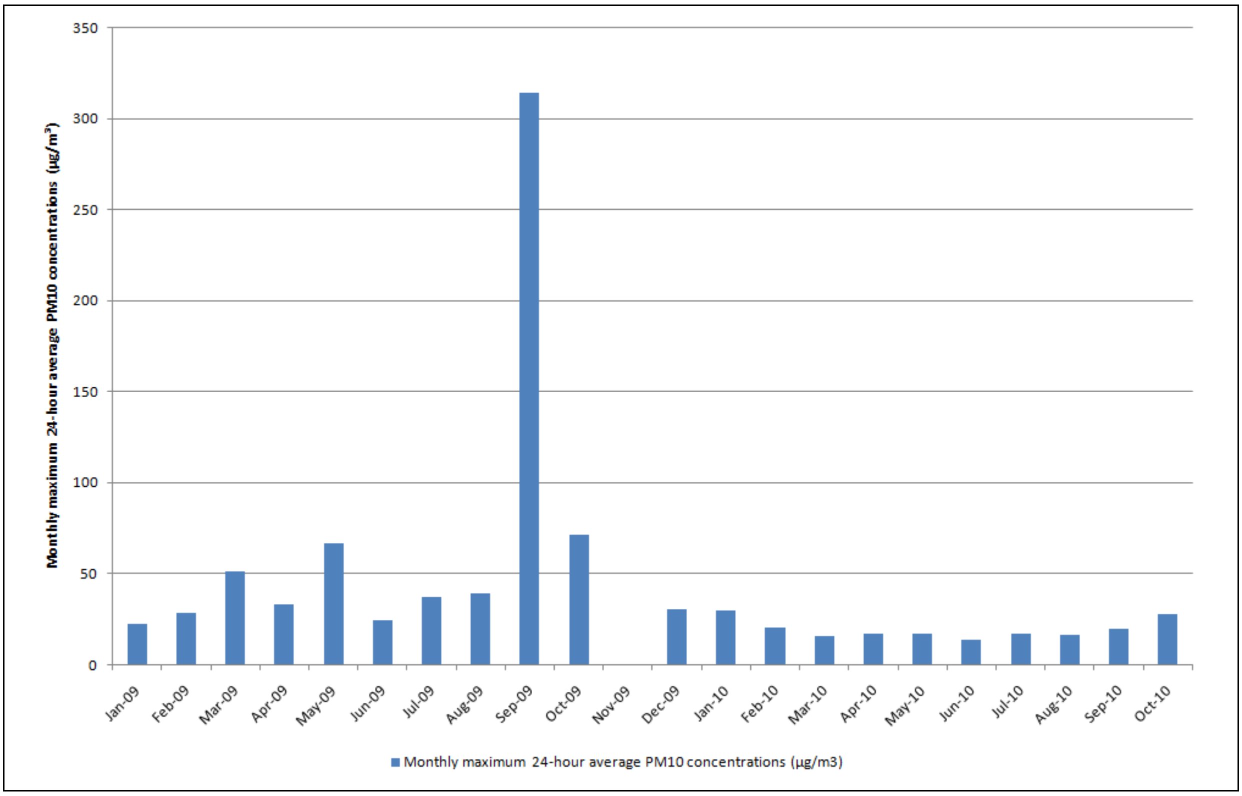


Figure 5.3 Ambient PM_{10} concentrations measured at Targinie (January 2009 to October 2010)

Source Air Quality Bulletin – Central Queensland (DERM, 2010)

No site-specific background air quality monitoring is available in the immediate locality of the Curtis Island GTP. The air quality on Curtis Island in the vicinity of the RoW would generally reflect the land use pattern, i.e. low intensity pastoral activity. These activities are not likely to result in the release of air quality contaminants which would exceed the criteria values of the EPP Air. Consequently, any current exceedances of guideline values would be associated with regional emissions advected over the area or peak events such as bushfire or dust storms. Although rare there are recorded instances of these events within the monitoring data (eg September 2009).

5.4.3 Sensitive receptors

The sensitive places (places of residence) located nearest to the Curtis Island GTP section are those on Tide Island (3.6 km) and Witt Island (4.5 km) (refer Figure 5.4).

A structure was noted on Curtis Island at 23°46’56” S and 151°13’33” E. This structure has been identified as being owned by the Gladstone Ports Authority and therefore has not been included as a sensitive receiver in the assessment. It is noted that this structure is located nearer to the Curtis Island GTP section than the receptors on Tide Island and Witt Island.

Figure 5.4 Curtis Island GTP section

5.5 Air quality modelling

This section presents the findings of a screening air dispersion modelling study performed to assess the potential for downwind air quality impacts due to emissions associated with the construction activities. It outlines the modelling methodology used and the emission sources assessed.

5.5.1 Air quality modelling methodology

Modelling of the Curtis Island GTP was conducted using the CALPUFF dispersion model employing a two- dimensional meteorological dataset that was generated using TAPM. Further details of the approach used are provided below.

5.5.2 Emission scenarios assessed

Construction works for the Curtis Island GTP would be carried out in accordance with the requirements of AS 2885 Pipelines – Gas and Liquid Petroleum and the APIA *Code of the Environmental Practice* (2005).

Table 5.2 summarises the proposed construction staging and plant items for the Curtis Island GTP construction works. Additionally it has been assumed that there will be the same amount of vehicle movements within the Right of Way (RoW)[2] as for the construction of the Mainland GTP (up to 700 vehicle movements per day). It has assumed that all equipment that would be employed in the construction of the Mainland GTP would be used on Curtis Island. This is extremely conservative as only a small proportion of this equipment will be used in the construction of the Curtis Island GTP RoW.

[2] The Right of Way (RoW) is a 30 m wide corridor cleared for the construction of the GTP along its alignment.

Table 5.2 Curtis Island GTP construction staging and typical plant items

Stage	Description	Typical plant items	No.
Right of way (RoW) and bush clearing	Graders, front end loaders and dozers are utilised for clearing and grading of the RoW. Trees, timbers and vegetation are stockpiled on the edge of the easement in preparation for re-spreading during rehabilitation	Motorgrader	2
		Dozer	2
		Excavator	2
		Front end loader (FEL)	2
		Vibrating roller	1
		Motorsaw	6
		Water tankers	1
		4WD	1
		Minibus 10 seats	2
Stringing and bending	Steel pipe is laid adjacent to the pipeline trench. If required, pipe sections are bent to match changes in the alignment of the pipeline	Sideboom	4
		Bending machine	2
		Road tractor	11
		Semitrailer	11
		Truck	2
		4WD	1
		Minibus 10 seats	4
Trenching	Trenches for the pipeline are dug	Backhoe	18
		Backhoe with hammer	2
		Greasing truck	1
		Bus 22 seats	1
		4WD	2
Welding	Pipe sections are welded together	Sideboom	6
		Pipe facing machine	5
		Crawler tow tractor	2
		Diesel welding machine	2
		Generator (200 kW)	4
		Truck	2
		Bus 50 seats	2
		4WD	1
Lowering and backfilling	Pipe string is lowered into the trench and the trench is backfilled with earth	Dozer	6
		FEL (wheel loader)	7
		Backhoe	8
		Mobile screen vulcano – 180 m^3/hr	4
		Sideboom	5
		Greasing truck	1
		Dump truck	10
		Bus 22 seats	2
		Minibus 10 seats	1
		4WD	2

Stage	Description	Typical plant items	No.
Clean-up and restoration	This phase may include contouring and revegetation of the work area	Dozer	2
		Motorgrader	1
		Backhoe	2
		Dump truck	4
		4WD	1

Emission estimates were compiled for six different construction activity scenarios listed in Table 5.2. These scenarios were then ranked according to the total 24-hour PM_{10} emission rate estimated for each stage of operations and the highest of these scenarios was modelled (lowering and backfilling).

5.5.3 TAPM derived meteorological data

Meteorology is a key input to most dispersion modelling assessments. This is particularly true of assessments that require averaging over periods of time greater than one modelling time step such as this study. To create realistic meandering of pollution plumes over the averaging period of interest, the modelled meteorology must reflect how the meteorology truly behaves. Ideally measured meteorology would be used to provide this realism, however due to the remote nature of most of the Curtis Island GTP, no locally-measured meteorological data are available.

The Air Pollution Model (TAPM) meteorological model (Version 4) was used to develop the meteorological files used in the dispersion modelling. TAPM, developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO), is a prognostic model which is commonly used to generate meteorology in areas where no meteorological data are available.

TAPM predicts wind speed and direction, temperature, pressure, water vapour, cloud, rain water and atmospheric turbulence. The program allows the user to generate synthetic observations by referencing databases (covering terrain, vegetation and soil type, sea surface temperature and synoptic scale meteorological analyses) which are subsequently used in the model to generate site-specific hourly meteorological observations at user-defined levels within the atmosphere. Table 5.3 details the parameters used in the TAPM meteorological model for this assessment.

Table 5.3 Meteorological parameters used for this study (TAPM v4.03)

TAPM parameter	Setting
Number of grids	4
Grid spacing	30 km, 10 km, 3 km, 1 km
Number of grid points	25 x 25 x 25
Year of analysis	2009
Centre of analysis	(310,613 m E, 7,371,291 m S) UTM zone 56

Wind speed and direction

A wind speed frequency plot for the Curtis Island GTP from the 2009 meteorological dataset used in the modelling study, (which was extracted from the TAPM meteorological model output at the coordinates shown in Table 5.3), is presented in Figure 5.5. A summary of the annual wind behaviour predicted by TAPM at this location is also presented as wind roses in Figure 5.6.

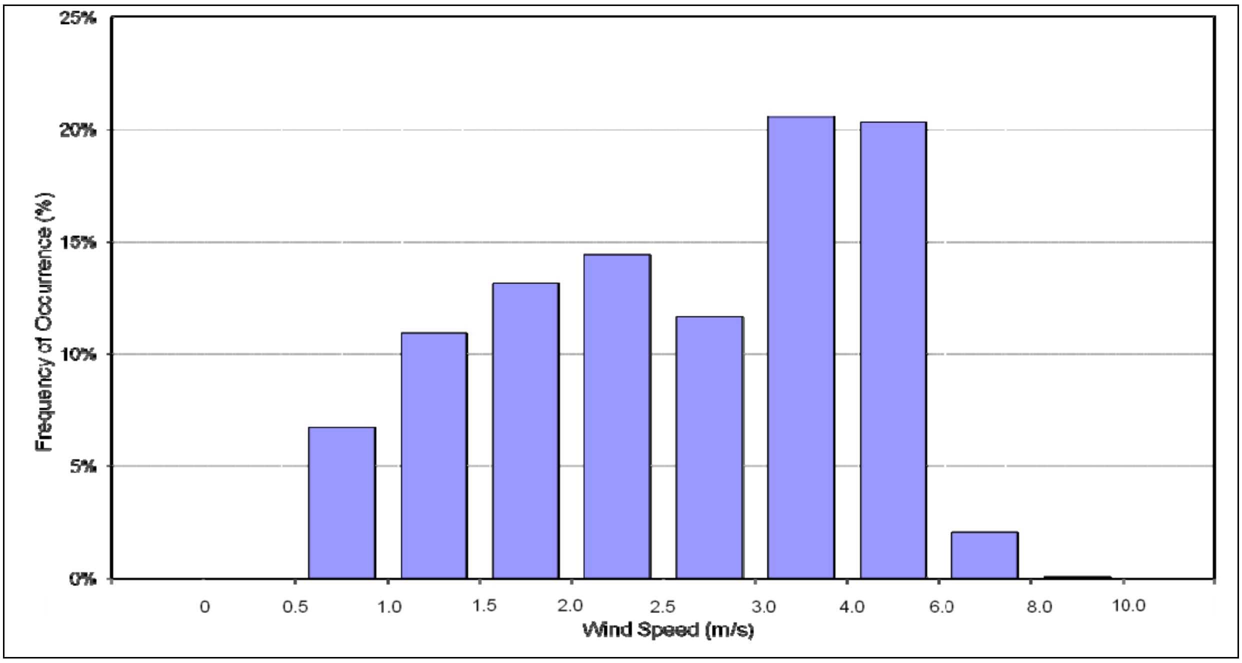


Figure 5.5 **Wind speed frequency distribution for the Curtis Island GTP, as predicted by TAPM**

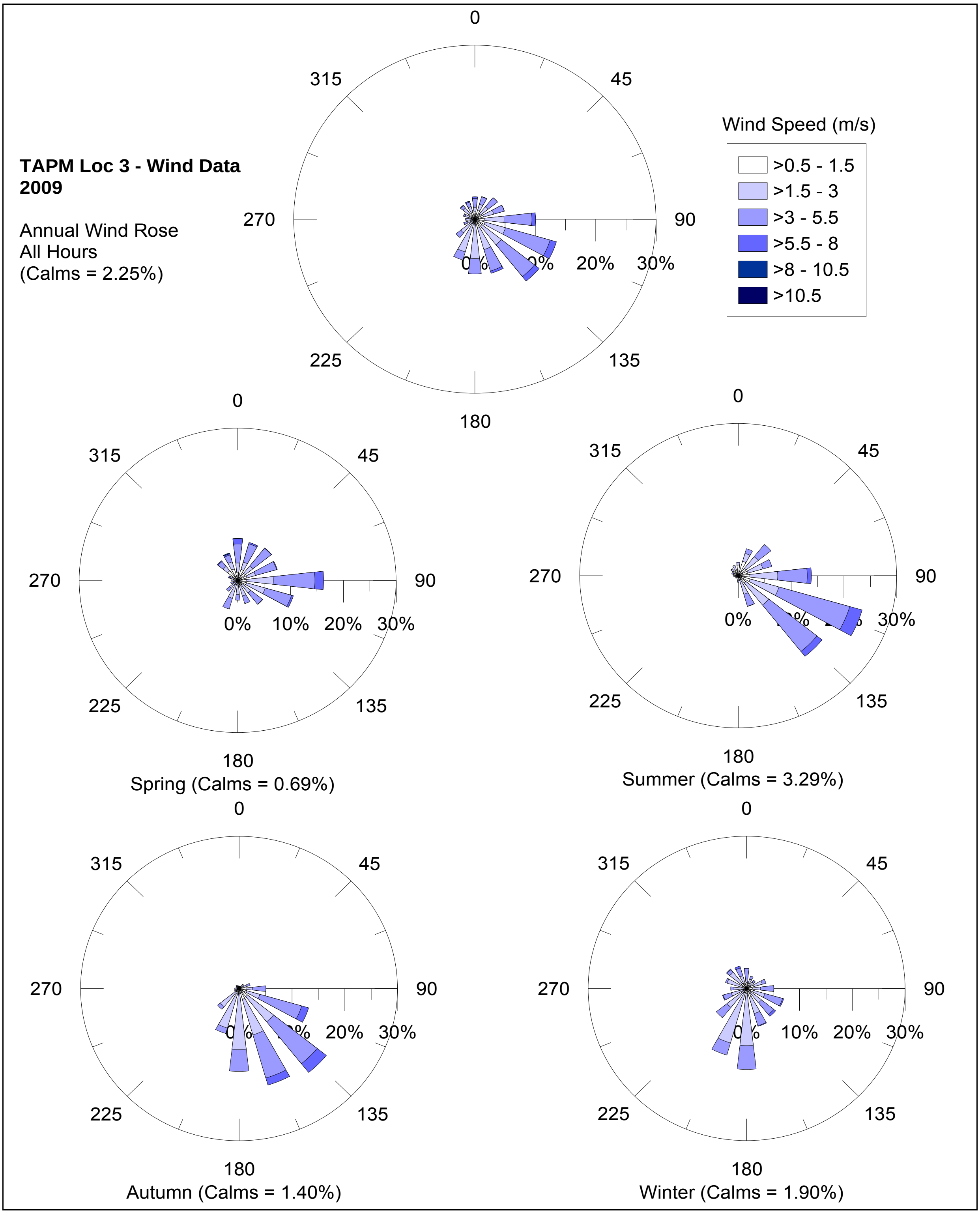


Figure 5.6 Wind roses for the Curtis Island GTP, as predicted by TAPM

Figure 5.5 and Figure 5.6 indicate that winds experienced at the site are predominantly light to moderate (between 1.5 m/s and 8 m/s) from the southeast quadrant. The wind roses show the following:

- During winter (June to August) winds blow predominately from the south and south-southwest
- During autumn (March to May) winds blow predominately from the southeast quadrant
- During spring (September to November) winds blow predominately from the east
- During summer (December to February) winds blow predominately from the southeast quadrant

Calm wind conditions (wind speeds less than 0.5 m/s) were predicted to occur around 2% of the time throughout 2009.

The seasonal wind roses show a similar pattern to that seen in the long term Gladstone wind roses, with predominant easterly and southeasterly winds during spring and summer, and southeasterly and southwesterly winds being predominant during winter.

Atmospheric stability

Atmospheric stability refers to the tendency of the atmosphere to resist or enhance vertical motion. The Pasquill-Turner assignment scheme identifies six Stability Classes, A to F, to categorise the degree of atmospheric stability (refer Table 5.4). These classes indicate the characteristics of the prevailing meteorological conditions and are used as input into various air dispersion models.

Table 5.4 Description of atmospheric stability classes

Atmospheric stability class	Category description
A	Very unstable, low wind, clear skies, hot daytime conditions
B	Unstable clear skies, daytime conditions
C	Moderately unstable Moderate wind, slightly overcast daytime conditions
D	Neutral high winds or cloudy days and nights
E	Stable moderate wind, slightly overcast night-time conditions
F	Very stable low winds, clear skies, cold night-time conditions

The frequency of each stability class predicted by TAPM during 2009 is presented in Figure 5.7. The results indicated high frequencies of Stability Class D and Stability Class F. with a very high frequency of conditions typical to Stability Class D (over 40%). Stability Class D is indicative of neutral conditions, conducive to a moderate level of pollutant dispersion due to mechanical mixing, while Stability Class F is indicative of very stable low wind speed conditions. An extremely low frequency of Stability Class A conditions have been predicted by TAPM. These conditions relate to well-mixed atmospheres where there is rapid dispersion. The low frequency of Stability Class A conditions predicted will result in a conservative over-estimate of impacts by the modelling for this location.

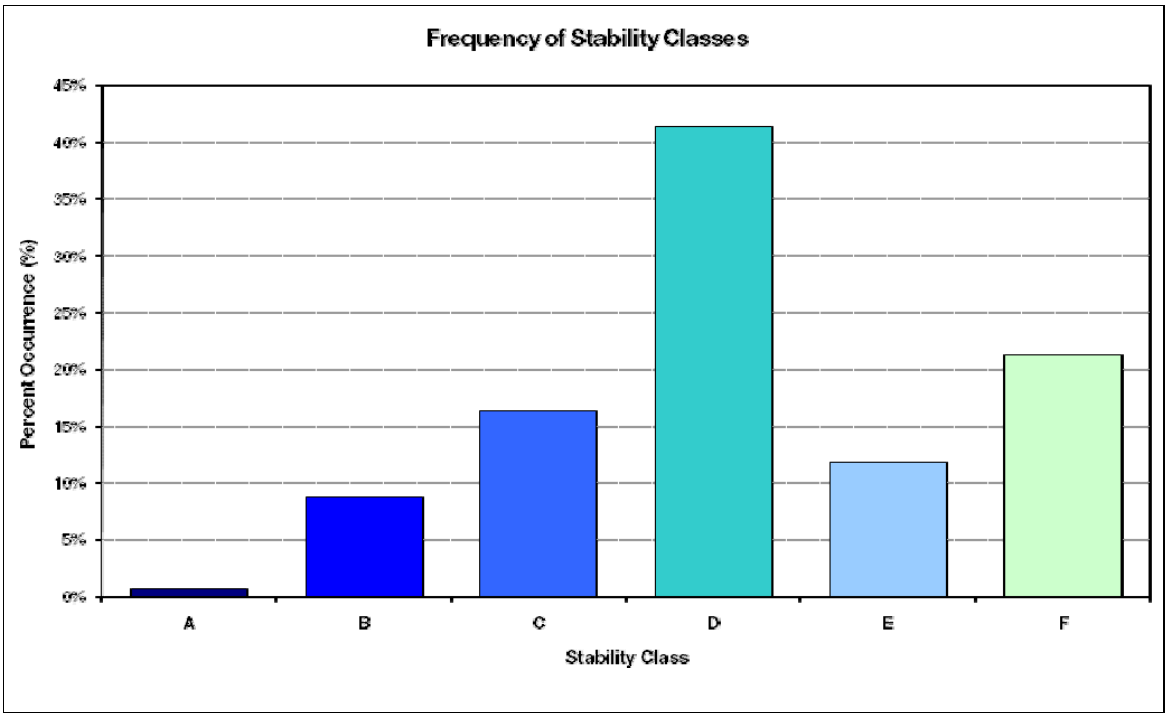


Figure 5.7 Stability class distribution predicted by TAPM at the Curtis Island GTP

Mixing height

Diurnal variations in maximum and average mixing depths predicted by TAPM at the Curtis Island GTP during 2009 are illustrated in Figure 5.8. The data show a slight increase in the mixing depth during the morning, arising due to the onset of vertical mixing following sunrise. Mixing heights increase during the day, peaking in the mid afternoon, followed by a decrease as the heat goes out of the day. The relatively slow decrease in afternoon mixing heights is likely to be due to the moderating influence of the ocean on temperature.

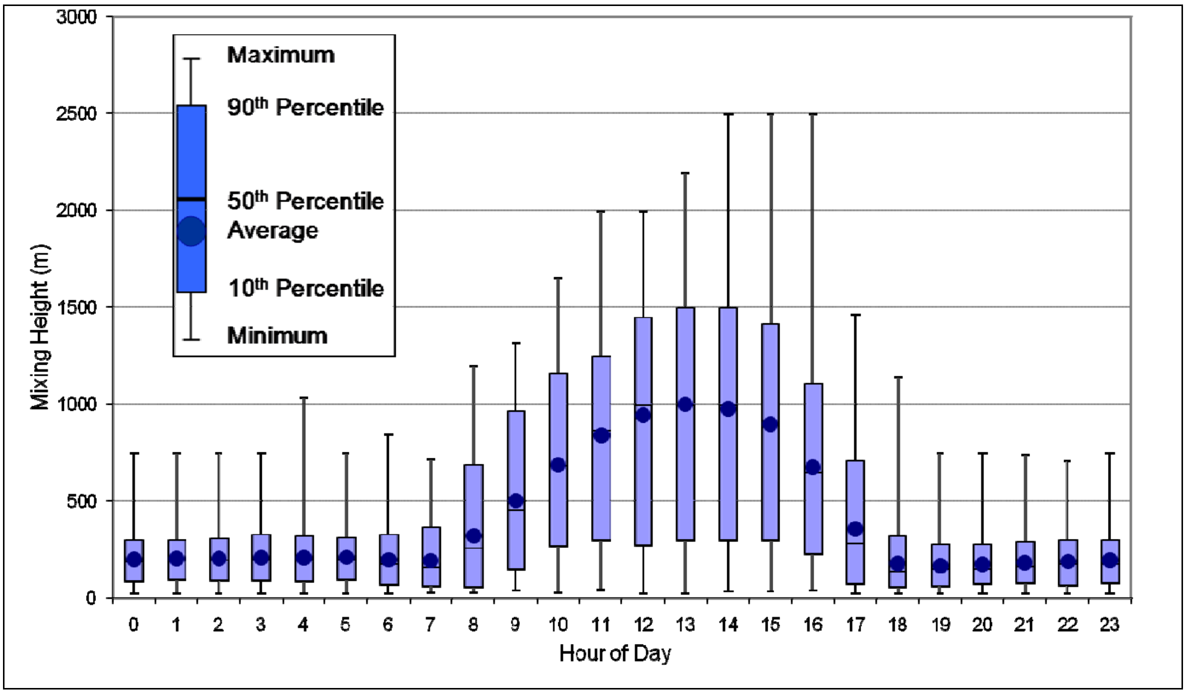


Figure 5.8 Mixing heights predicted by TAPM at the Curtis Island GTP

5.5.4 Terrain data and receptor locations

As it is difficult to model all terrain types and configurations for the Curtis Island GTP and as construction works will move relatively quickly, the modelling has been performed without consideration of terrain effects. To compensate for possible impacts of terrain on the predicted concentrations which have not been able to be accounted for in the modelling, a buffer of 25% was applied to all modelling results.

5.5.5 Emission estimation

Preliminary emissions estimation was completed for all scenarios listed in Table 5.2. As summary of the emissions estimated for each construction scenario is provided in Figure 5.9.

As shown in Figure 5.9 and discussed in Section 5.5.2, emissions for lowering and backfilling were estimated to produce the greatest quantities of TSP, PM_{10} and $PM_{2.5}$ emissions. This scenario was therefore chosen for further assessment using atmospheric dispersion modelling.

Due to the very short length of time that it will take to construct the 5 km of GTP on Curtis Island (approximately three (3) months for the entire operation) annual averages have been ignored in this assessment.

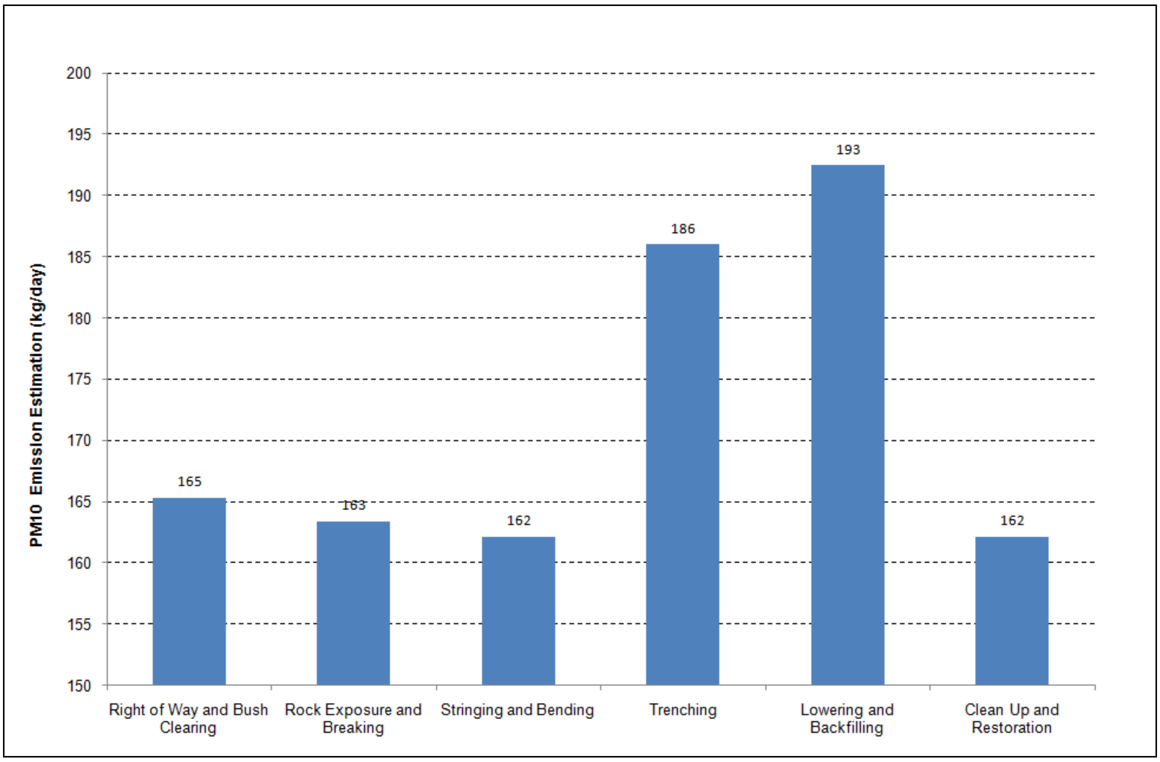


Figure 5.9 Summary of 24 hour maximum PM_{10} emission rates for each scenario

Assumptions

The construction scenario used in the assessment was based on the following assumptions.

- Work will be carried out 11 hours per day (allowing for breaks) (6.30 am to 6.30 pm) and 7 days per week
- Stockpile dust (PM_{10}) emissions vary according to variable rates dependent upon wind speed

- Rock breaking will produce the same amount of dust (PM_{10}) emissions as drilling
- Work is anticipated to progressively move along the RoW road alignment; hence the entire section of RoW road will not be under full construction at any one time
- All stockpiles were assumed to be located within the RoW area
- It was assumed that there will be a maximum of 25 vehicles servicing the site per hour. Each vehicle was assumed to be a truck with an assumed load capacity of 30 tonnes (t) and a mean gross weight of 50 t
- The hourly mass of excavated material is assumed to be 60 t per hour (40 m^3 x 1.5 t/m^3)
- It was assumed (as a worst case) that each haul truck traverses the entire section of the RoW access road, which was assumed to have a length of 5,000 m. Assuming 25 heavy vehicles travel up and down the road route each hour, this gives a distance travelled of 125 vehicle kilometres travelled per hour (VKT/hour)
- The unsealed RoW access road was assumed to have a silt content of 8.5% in accordance with US EPA (2006)
- A control factor of 72% was applied to the estimates of uncontrolled emissions from the RoW access road, which is based on water at rates of up to 2 L/m^2/hour and that speed is restricted to under 40 km/h on the RoW access road
- It is expected that a water truck will be used to wet the RoW access road surface and any stockpiles to control dust during dry periods

Emissions from haul roads

All of the scenarios modelled included emissions from the RoW access road.

Emissions from the trucks travelling on the internal unpaved RoW access road have been estimated using the AP-42 equation derived emission factors as follows:

$$EF_{TSP} = 2.82 * (s/12)^{0.8} * (W/3)^{0.5} / (M/0.2)^{0.4} \text{ kg/VKT}$$

$$EF_{PM10} = 0.733 * (s/12)^{0.8} * (W/3)^{0.4} / (M/0.2)^{0.3} \text{ kg/VKT}$$

where:

- s = surface material silt content (%)
- W = vehicle gross mass (tonnes)
- M = surface material moisture content (%)
- kg/VKT = kg particulate per vehicle kilometre travelled

The parameters used in this assessment and resulting uncontrolled emission factors and emission rates are summarised in Table 5.5.

Table 5.5 Estimation of emissions from RoW access roads

Vehicles / Hour	EF – TSP kg/VKT	ER – TSP kg/annum total	EF - PM_{10} kg/VKT	ER - PM_{10} kg/annum total	EF – $PM_{2.5}$ kg/VKT	ER – $PM_{2.5}$ kg/annum total
25	1.46	187,050	0.39	49,432	0.039	4,943

Rock exposure and blasting scenario

Drilling and rock breaking

The emissions from drilling have been estimated using the NPI EETM default emission factor of 0.59 kg/hole for TSP and 0.31 kg/hole for PM_{10} for 1 hole drilled/ hour.

Table 5.6 Estimation of emissions from drilling

Number of Drills	EF – TSP kg/hole	ER – TSP kg/annum/ drill	EF - PM_{10} kg/hole	ER - PM_{10} kg/annum/ drill	EF – $PM_{2.5}$ kg/hole	ER – $PM_{2.5}$ kg/annum/ drill
4	0.59	2,153.5	0.31	1,131.5	0.0465	169.7

As there were no emission factors for a backhoe with a hammer, the emissions were estimated using the drilling NPI EETM default factors as above and for 1 rock break/hour.

Table 5.7 Estimation of emissions from rock breaking (using a backhoe with a hammer)

Number of backhoes (with hammer)	EF - TSP kg/hole	ER – TSP kg/annum/ backhoe	EF - PM_{10} kg/hole	ER - PM_{10} kg/annum/ backhoe	EF – $PM_{2.5}$ kg/hole	ER – $PM_{2.5}$ kg/annum/ backhoe
2	0.59	2,153.5	0.31	1,131.5	0.0465	169.7

Blasting

It is not envisaged that blasting will occur for the construction of the Curtis Island GTP, however should blasting be required, estimated emissions are provided below.

The emissions for blasting have been estimated using the NPI EETM emission factors as follows:

$$EF_{TSP} = 344 \text{ x } A^{0.8} \text{ x } M^{-1.9} \text{ x } D^{-1.8} \text{ kg/blast}$$

$$EF_{PM10} = EF_{TSP} \text{ x } 0.52 \text{ kg/blast}$$

where,

- EF = emission factor
- A = Blast Area
- M = Moisture content (%)
- D = Blast Hole Depth

For a blast area of 5 m^2, a moisture content of 7.9% and a blast hole depth of 1.5 m, the emission factors and emission rates are calculated as shown below in Table 5.8.

Table 5.8 Estimation of Emissions from Blasting

Number of blasts/ hour	EF – TSP kg/blast	ER – TSP kg/annum (total)	EF - PM_{10} kg/blast	ER - PM_{10} kg/annum (total)	EF – $PM_{2.5}$ kg/blast	ER – $PM_{2.5}$ kg/annum (total)
1	11.8	4,307	6.16	2,248.4	0.923	336.9

Bulldozer

Emissions from the bulldozers in the pit were estimated using the NPI EETM factor for a bulldozer on overburden as follows:

$$EF_{TSP} = 2.6 * s^{1.2} / M^{1.3} \text{ kg/h}$$

$$EF_{PM10} = 0.34 * s^{1.5} / M^{1.4} \text{ kg/h}$$

where:

- s = silt content (%)
- M = surface material moisture content (%)

The parameters used in this assessment and resulting emission factors and emission rates are summarised in Table 5.9 using a silt content of 6.9% and a moisture content of 7.9%.

Table 5.9 Estimation of emissions from bulldozers

Number of Bulldozers	EF – TSP kg/hour	ER – TSP kg/annum (total)	EF - PM_{10} kg/hour	ER - PM_{10} kg/annum (total)	EF – $PM_{2.5}$ kg/hour	ER – $PM_{2.5}$ kg/annum (total)
1	1.8	6,570	0.341	1,244.7	0.189	186.9

Backhoe

Emissions from backhoe were estimated using the NPI EETM factor for a front end loader working on overburden as follows:

$$EF_{TSP} = 0.74 * 0.0016 * (U/2.2)^{1.3} / (M/2)^{-1.4} \text{ kg/tonne}$$

$$EF_{PM10} = 0.35 * 0.0016 * (U/2.2)^{1.3} / (M/2)^{-1.4} \text{ kg/tonne}$$

where:

- U = mean wind speed (m/s)
- M = surface material moisture content (%)

The parameters used in this assessment and resulting emission factors and emission rates are summarised in Table 5.10 using a mean wind speed of 2.4m/s (from TAPM derived meteorological data) and a moisture content of 7.9%.

Table 5.10 Estimation of emissions from backhoes

Number of Backhoes	EF – TSP kg/tonne	ER – TSP kg/annum (total)	EF - PM_{10} kg/tonne	ER - PM_{10} kg/annum (total)	EF – $PM_{2.5}$ kg/tonne	ER – $PM_{2.5}$ kg/annum (total)
1	0.000197	43.1	0.0000933	20.4	0.000014	3.1

Stockpiles

Emissions from wind erosion of the soil stockpiles were estimated using the default *NPI EETM for Mining* factors of 0.4 kg/ha/hr for TSP and 0.2 kg/ha/hr for PM_{10} (NPI EETM for Mining, Table 1). Emissions were assumed to occur 24 hours per day varying according to wind speed.

The parameters used in this assessment and resulting emission factors and emission rates are summarised in Table 5.11.

Table 5.11 Estimation of emissions from stockpiles

Number of Stockpiles	EF – TSP kg/year	ER – TSP kg/annum/ stockpile	EF - PM_{10} kg/year	ER - PM_{10} kg/annum/ stockpile	EF – $PM_{2.5}$ kg/year	ER – $PM_{2.5}$ kg/annum/ stockpile
6	0.4	1.75	0.2	0.88	0.03	0.13

Lowering and backfilling scenario

Bulldozer

Emissions from the bulldozers were estimated using the NPI EETM factor for a bulldozer on overburden (representative of a trenching operation) as follows:

$$EF_{TSP} = 2.6 * s^{1.2} / M^{1.3} \text{ kg/h}$$

$$EF_{PM10} = 0.34 * s^{1.5} / M^{1.4} \text{ kg/h}$$

where:

- s = silt content (%)
- M = surface material moisture content (%)

The parameters used in this assessment and resulting emission factors and emission rates are summarised in Table 5.12 using a silt content of 6.9% and a moisture content of 7.9%.

Table 5.12 Estimation of emissions from bulldozers

Number of Bulldozers	EF – TSP kg/hour	ER – TSP kg/annum/ bulldozer	EF - PM_{10} kg/hour	ER - PM_{10} kg/annum/ bulldozer	EF – $PM_{2.5}$ kg/hour	ER – $PM_{2.5}$ kg/annum/ bulldozer
6	1.8	6,570	0.341	1,244.7	0.189	186.9

Front end loader

Emissions from a front end loader were estimated using the NPI EETM factor for a front end loader working on overburden as follows:

$$EF_{TSP} = 0.74 * 0.0016 * (U/2.2)^{1.3} / (M/2)^{-1.4} \text{ kg/tonne}$$

$$EF_{PM10} = 0.35 * 0.0016 * (U/2.2)^{1.3} / (M/2)^{-1.4} \text{ kg/tonne}$$

where:

- U = mean wind speed (m/s)
- M = surface material moisture content (%)

The parameters used in this assessment and resulting emission factors and emission rates are summarised in Table 5.13 using a mean wind speed of 2.4 m/s (from TAPM derived meteorological data) and a moisture content of 7.9%.

Table 5.13 Estimation of Emissions from front end loaders

Number of FEL	EF – TSP kg/hour	ER – TSP kg/annum/ FEL	EF - PM_{10} kg/hour	ER - PM_{10} kg/annum/ FEL	EF – $PM_{2.5}$ kg/hour	ER – $PM_{2.5}$ kg/annum/ FEL
7	0.000197	34.5	0.0000933	16.3	0.000014	2.5

Backhoe

Emissions from backhoe were estimated using the NPI EETM factor for a front end loader working on overburden (representative of trenching operations) as follows:

$$EF_{TSP} = 0.74 * 0.0016 * (U/2.2)^{1.3} / (M/2)^{-1.4} \text{ kg/tonne}$$

$$EF_{PM10} = 0.35 * 0.0016 * (U/2.2)^{1.3} / (M/2)^{-1.4} \text{ kg/tonne}$$

where:

- U = mean wind speed (m/s)
- M = surface material moisture content (%)

The parameters used in this assessment and resulting emission factors and emission rates are summarised in Table 5.14 using a mean wind speed of 2.4 m/s (from TAPM derived meteorological data) and a moisture content of 7.9%.

Table 5.14 Estimation of emissions from backhoes

Number of Backhoes	EF – TSP kg/hour	ER – TSP kg/annum/ backhoe	EF - PM_{10} kg/hour	ER - PM_{10} kg/annum/ backhoe	EF – $PM_{2.5}$ kg/hour	ER – $PM_{2.5}$ kg/annum/ backhoe
8	0.000197	34.5	0.0000933	16.3	0.000014	2.5

Stockpiles

Emissions from wind erosion of the stockpiles were estimated using the default NPI EETM for Mining factors of 0.4 kg/ha/hr for TSP and 0.2 kg/ha/hr for PM_{10} (NPI EETM for Mining, Table 1). Emissions were assumed to occur 24 hours per day varying according to wind speed.

The parameters used in this assessment and resulting emission factors and emission rates are summarised in Table 5.15.

Table 5.15 Estimation of emissions from stockpile

Number of Stockpiles	EF – TSP kg/year	ER – TSP kg/annum (total)	EF - PM_{10} kg/year	ER - PM_{10} kg/annum (total)	EF – $PM_{2.5}$ kg/year	ER – $PM_{2.5}$ kg/annum (total)
1	0.4	1,892.2	0.2	946.1	0.03	141.9

5.5.6 Source layout

All sources identified in Table 5.2 for the dust scenarios modelled, Rock Exposure and Blasting, and Lowering and Backfilling were evenly spaced across a 5 km stretch of the 30 m wide RoW. They were modelled as volume sources except for the RoW access road which was modelled as a line source. A stockpile was also modelled in the Lowering and Backfilling scenario that stretched along a 5 km section of the Mainland GTP RoW. This was also modelled as a line source.

The welding scenario was modelled as a single volume source emitting at a unit emission rate and the resulting ground level concentrations were scaled according to the estimated emission rates for each metal.

The modelling configuration as set out by the calpuff 'Key Variable Field Extraction Module' is detailed in Table 5.16 and Table 5.17 below for the Lowering and Backfilling scenario.

Table 5.16 CALPUFF model switch options

MGAUSS	MSLUG	MCHEM	MAQCHEM	MWET	MDRY	MTILT	MDISP	MDISP2	MPDF	MTURBVW	MTAULY	MTAUADV	MCTURB	MROUGH	MBDW	MTRANS	MTIP	MSHEAR	MPARTL	MTINV	MCTADJ	MCTSG	MSPLIT	MSGTIBL	MBCON	MSOURCE	MFOG	MREG
1	0	0	0	0	1	0	2	3	0	3	1	1	1	0	1	1	1	0	1	0	3	0	0	0	0	0	0	0

Table 5.17 CALPUFF source details

Source	Mean X km	Mean Y km	Release Height m	Base Elev m(MSL)	Sigma Y m	Sigma Z m	TSP Rate kg/h	PM_{10} Rate kg/h	$PM_{2.5}$ Rate kg/h
SRC_2	999.11	999.992	4	0	4.65	1	4.00E-03	2.00E-03	3.00E-04
SRC_3	999.17	1000.007	4	0	11.63	1	7.50E-01	1.41E-01	7.90E-02
SRC_4	999.239	999.992	4	0	4.65	1	4.00E-03	2.00E-03	3.00E-04
SRC_5	999.326	1000.006	4	0	4.65	1	4.00E-03	2.00E-03	3.00E-04
SRC_6	999.417	1000.001	4	0	4.65	1	4.00E-03	2.00E-03	3.00E-04
SRC_7	999.516	999.991	4	0	4.65	1	4.00E-03	2.00E-03	3.00E-04
SRC_8	999.609	1000.008	4	0	11.63	1	7.50E-01	1.41E-01	7.90E-02
SRC_9	999.723	999.993	4	0	11.63	1	7.50E-01	1.41E-01	7.90E-02
SRC_10	999.826	1000.005	4	0	4.65	1	4.00E-03	2.00E-03	3.00E-04
SRC_11	999.934	999.991	4	0	4.65	1	4.00E-03	2.00E-03	3.00E-04
SRC_12	1000.082	1000.006	4	0	4.65	1	4.00E-03	2.00E-03	3.00E-04
SRC_13	1000.176	999.992	4	0	11.63	1	7.50E-01	1.41E-01	7.90E-02
SRC_14	1000.267	1000.008	4	0	11.63	1	7.50E-01	1.41E-01	7.90E-02
SRC_15	1000.35	999.992	4	0	4.65	1	4.00E-03	2.00E-03	3.00E-04
SRC_16	1000.447	999.999	4	0	4.65	1	4.00E-03	2.00E-03	3.00E-04
SRC_17	1000.55	1000.007	4	0	4.65	1	4.00E-03	2.00E-03	3.00E-04
SRC_18	1000.642	999.992	4	0	11.63	1	7.50E-01	1.41E-01	7.90E-02
SRC_19	1000.727	1000.008	4	0	4.65	1	4.00E-03	2.00E-03	3.00E-04
SRC_20	1000.809	999.992	4	0	4.65	1	4.00E-03	2.00E-03	3.00E-04
SRC_21	1000.888	1000.007	4	0	4.65	1	4.00E-03	2.00E-03	3.00E-04
SRC_23	1000	1000	4	0	4.65	1	4.00E-03	2.00E-03	3.00E-04

5.6 Potential adverse or beneficial impacts on air quality (construction and operation)

5.6.1 General

Dispersion modelling predictions of dust deposition rates and ambient TSP, PM_{10} and $PM_{2.5}$ concentrations at distances from the pipeline attributable to the Curtis Island GTP construction scenarios are presented in Section 5.6.2 to Section 5.6.4.

Source layout

All sources identified in Table 5.2 for the scenario modelled, in this instance lowering and backfilling, were evenly spaced across a 5 km stretch of the 30 m wide RoW.

- The access road within the RoW was modelled as a line source
- Stockpiles were modelled as a line source
- All other sources were modelled as volume sources

5.6.2 Dust deposition

The results of the modelling indicate that deposited dust will settle relatively close to the emission source and the concentration of particulate matter diminishes rapidly with distance from the source (refer Figure 5.10). The data indicate that effects of construction on air quality will be insignificant at sensitive receptors.

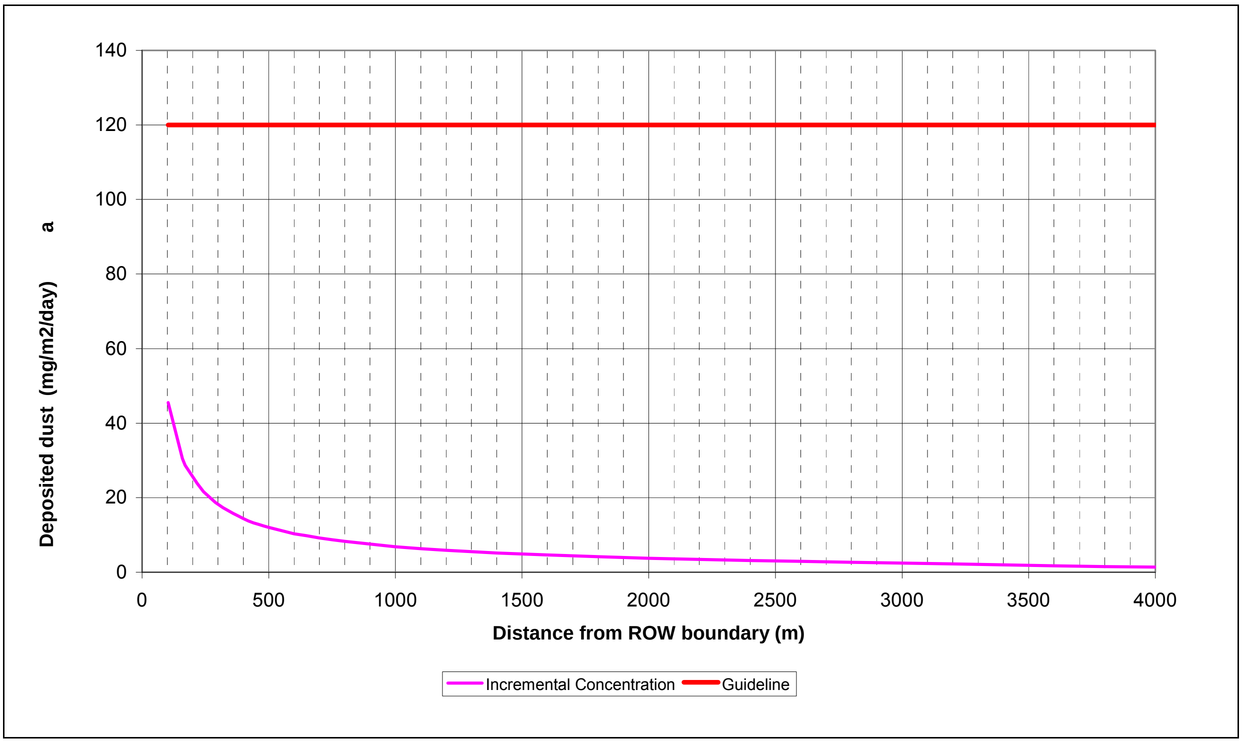


Figure 5.10 Predicted annual average dust deposition rate (mg/m^2/day) versus distance from the Curtis Island GTP

5.6.3 TSP

Construction activities are of short duration with completion of all activities within six months and construction activities which may result in air quality impacts occurring over an expected three month period. Any influence on annual average TSP concentrations from the GTP construction on Curtis Island will be minor.

5.6.4 PM_{10}

PM_{10} concentrations from non-buoyant linear sources (such as the construction of the GTP) are predicted to rapidly reduce downwind from the emission source.

The modelling results indicate that the construction of the pipeline will not affect the air quality at the nearest sensitive receptor (greater than 4 km distant from the activity).

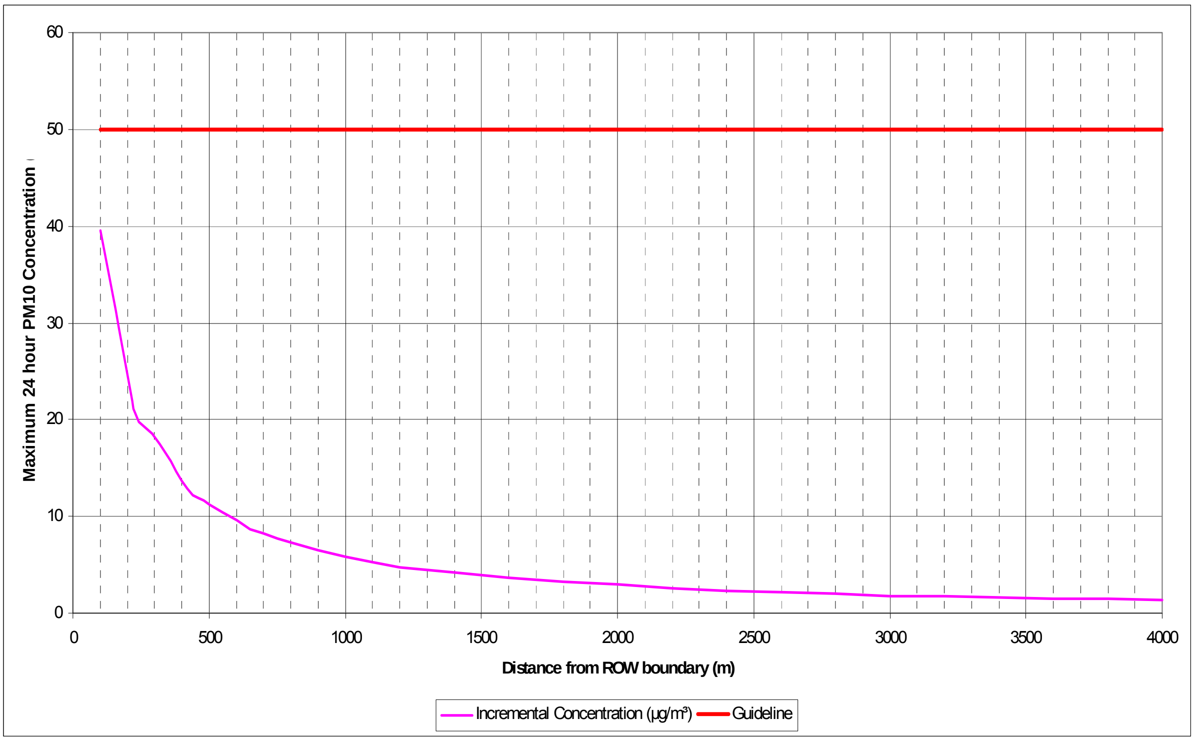


Figure 5.11 **Maximum predicted 24 hour average PM10 concentrations versus distance from the Curtis Island GTP**

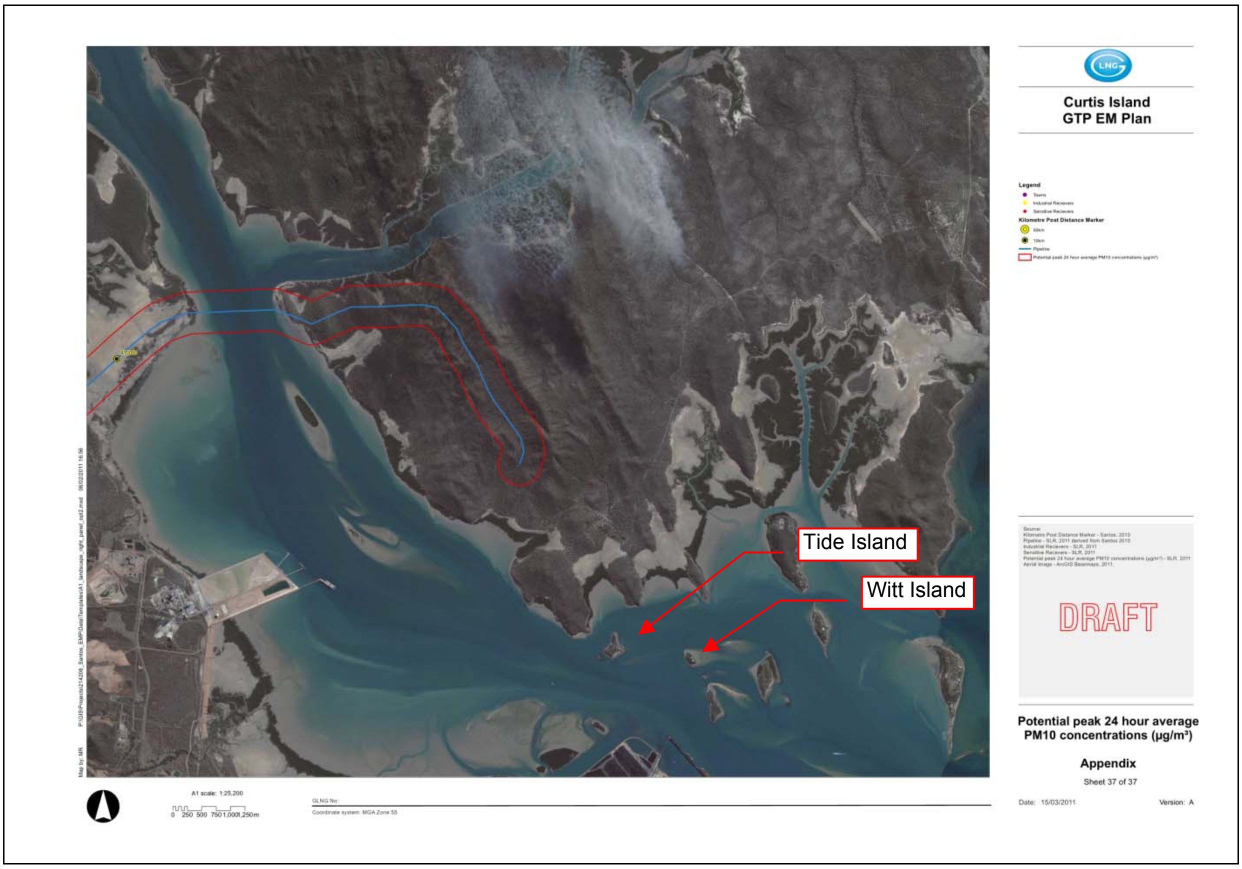


Figure 5.12 **Area potentially affected by maximum predicted 24 hour average PM_{10} concentrations**

5.6.5 Summary of construction impacts

Dispersion modelling of the construction activities for the Curtis Island GTP indicates that no sensitive receptors are likely to be impacted by dust and any of the pollutants investigated. It is therefore concluded that air quality related impacts (in particular dust) resulting from the construction of the Curtis Island GTP are expected to be low and manageable, especially given that all works will be undertaken in accordance with the control strategies as outlined in Section 5.9.

5.6.6 Operational impacts

Monthly inspections will be carried out along the Curtis Island GTP by vehicle and foot patrols to check on air quality related impacts on the GTP and associated infrastructure.

Typically maintenance on the Curtis Island GTP will be carried out by light vehicles and small maintenance crews on an annual basis.

Air quality impacts are expected to be low and manageable during the operational phase.

Furthermore, all activities and works associated with these operational activities will be in accordance with the Operational Management Plan (OMP) which will be developed and implemented prior to the completion of the construction phase. Typical OMP control measures have been outlined in Section 5.9.

The effects of particulate emissions are summarised in Table 5.18.

Table 5.18 Particulate emissions during different phases of the Project

Source Parameter	GTP Construction	GTP Operation	GTP decommissioning
Proximity to Receptors (metres)	>4000	>4000	>4000
Source Potential	High	Low	Low
Frequency and Duration	One-off – Construction period expected to be approximately three months	Design life 42 years	Short duration
Potential for Adverse Air Quality Impacts	Very Low and Manageable	Very Low and Manageable	Very Low and Manageable

5.6.7 Regional Scale Impacts

Construction and operational activities will have insignificant impact on regional scale air quality values.

5.7 Greenhouse gas assessment

Greenhouse gas (GHG) emissions for the gas transmission pipeline have been inventoried and assessed as a component of the GHG assessment for the GLNG Project. This section provides an overview of the gas pipeline GHG assessment.

The gas pipeline has been addressed as a whole rather than being split into three sections, as the GHG emissions from the shorter sections associated with the marine crossing and Curtis Island represent a very small (and immaterial) component of the pipeline (and Project) GHG emissions profile and do not warrant separate assessment.

Methodology

The GHG emissions inventory has been prepared in accordance with the methodology set out *in The Greenhouse Gas Protocol*: *a Corporate Accounting and Reporting Standard* (The Protocol), the relevant emissions factors in the National Greenhouse Accounts (NGA) Factors (November 2008), the *Methodology for the Estimation of Greenhouse Gas Emissions and Sinks 2006 – Energy (Fugitive Fuel Emissions)* and the Intergovernmental Panel on Climate Change Good Practice Guidance.

The main GHGs emitted during project activities will be carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). To report these emissions, they have been converted to carbon dioxide equivalents (CO_2-e) using their global warming potential, as detailed in the NGA Factors. Construction activities associated with the pipeline will result in the emission of CO_2 and trace amounts of N_2O from diesel combustion in stationary and mobile engines. Trace amounts of methane may be emitted as a result of vegetation clearing. Operational emissions of GHG will be from vehicles involved in inspection and maintenance (mostly CO_2). Methane is not likely to be released during the operational phase.

The Protocol defines direct and indirect emissions through the concept of emission “scopes”:

- *Scope 1 – Direct GHG Emissions* are produced as a direct result of activities that constitute a facility controlled by a company (eg emissions from combustion in boilers or vehicles, fugitive emissions and emissions from on-site power generators) or directly associated with an operational activity
- *Scope 2 – Electricity Indirect GHG Emissions* arise from purchased electricity, heat or steam
- *Scope 3 – Other Indirect GHG Emissions* are emissions that occur outside the boundary of a facility as a result of activities at the facility. This is an optional reporting class that accounts for all other indirect GHG emissions resulting from a company’s activities but occurring from sources not owned or controlled by the company. Examples include transportation of products and end use of sold products and services

Emission Sources

Scope 1 GHG emissions for the gas pipeline arise from land clearing and the on-site consumption of diesel fuel in construction equipment and vehicles during construction.

Scope 2 emissions arise from electricity purchased for workforce accommodation facilities during construction of the pipeline.

Scope 3 emissions during pipeline construction are due to transport of construction materials in vehicles not owned or controlled by the GLNG Project.

GHG emissions during operation of the gas pipeline are assumed to be immaterial, as:

- the pipeline will be fully welded
- there will be no regular process emissions
- compression of the gas will be carried out at the coal seam gas field facilities (i.e. there are no compressor stations on the pipeline itself)

Carbon sequestration due to the rehabilitation of cleared areas has not been included in the inventory, this provides a worst case assessment of emissions (i.e. the estimate of greenhouse gas presented in this assessment is highly conservative).

Emission Factors

Emission factors have been used to estimate GHG emissions, in accordance with the Protocol.

Emission factors for the carbon loss associated with land clearing along the gas pipeline were obtained using the FullCAM model, from the Department of Climate Change's National Carbon Accounting Toolbox, in combination with data on vegetation types obtained from vegetation studies of the pipeline corridor. A value of 36.7 t C/ha (135 t CO_2-e/ha) was calculated by modelling several points along the pipeline with representative types and amounts of vegetation and averaging the results.

Emission factors used to calculate GHG emissions for diesel combustion, electricity consumption and freighting of equipment by rail have been sourced from the Department of Climate Change NGA Factors Workbook, 2008 and the Queensland Rail Greenhouse Challenge Cooperative Agreement 2000. These are shown in Table 5.19.

Table 5.19 Emission factors used in the GHG inventory for the GTP

Emission Source	Emission Factor				Units
	CO_2	CH_4	N_2O	Total	
Scope 1 – Diesel combustion	2.67	0.01	0.02	2.7	t CO_2-e/kL
Scope 2 – Electricity Consumption (Queensland)				0.91	kg CO_2-e/kWh
Scope 3 – Transport of freight by rail				0.26	g CO_2-e/net tonne km

Estimated Emissions

A summary of Scope 1 and Scope 2 emissions for the entire pipeline is provided in Table 5.20. The calculation of emissions from diesel combustion during construction assumed a construction period of 21 months, with a 6 month ramp-up / ramp-down period with activity rates 50% of that occurring during the main construction period (15 months). Activity rates for the main construction period assumed a workforce of 1000 workers and construction equipment of 100 heavy vehicles operating 10 hours per day.

Worst case assumptions have been incorporated in calculating carbon loss associated with land clearing. These assumptions are:

- complete clearance of an easement for the 420 km length of the pipeline
- vegetation of the entire route characterised by vegetation types that are present close to the main watercourses

This has resulted in a conservative estimate of the greenhouse gas emissions.

Table 5.20 Total Scope 1 and Scope 2 Greenhouse Gas Emissions for the GTP (tonnes CO_2-e)

Emissions Source	Scope 1 Emissions	Scope 2 Emissions
Construction Equipment	2,962	0
Land Clearing	171,588	0
Accommodation	0	4,095
Total	174,550	4,095

Scope 3 emissions have been investigated and estimated for the GLNG project as a whole. It is noted that Scope 3 emissions are not routinely reported by companies because emissions are difficult to estimate accurately, the company does not have effective control of the emission sources and they will be reported elsewhere by a second company as their Scope 1 emissions.

Table 5.21 outlines indicative estimates of Scope 3 emissions for construction and transport for the GLNG Project for two scenarios, one option using rail to deliver materials to laydown points along the GTP.

Table 5.21 Total GLNG Project Scope 3 Emissions from Construction and Transport (tonnes CO_2-e)

Scenario	Scope 3 Emissions
No rail	17,850
Rail	19,415

Impacts

GHG emissions from the GTP component form a small part of the total GHG emissions profile for the GLNG Project and are relatively small in comparison to State and National emissions. The estimated annual Scope 1 emissions from the pipeline over the 21 month construction period represent approximately 0.05% of Queensland's annual emissions (2008 data) and less than 0.02% of Australian annual emissions (2006 data). The impact of GLNG Project GHG emissions in the context of the regulatory framework and State and National emissions and targets are further discussed in the EIS (URS, 2009).

Greenhouse Gas Management Strategy

Climate change is a global issue requiring significant resources to meet complex environmental, energy, economic and political challenges. As a global stakeholder in the energy business, GLNG Operations recognise that one of its most important environmental responsibilities is to pursue strategies that address the issue of GHG emissions.

In accordance with the EIS approval conditions (Condition 4 in Appendix 1 Part 1 of the CG report for the GLNG Project), a GHG reduction strategy will be implemented for the Project and submitted to the Coordinator-General (CG) for approval. The foundation for the strategy will be the Climate Change Policy and the Climate Change Management Standard under the Environment Health and Safety Management System. The Climate Change Policy embodies commitments to reduce the carbon intensity of pipeline construction and operation by focusing on energy efficiency, technology development, embedding a carbon price in all activities and continuing public emissions reporting.

The key components addressed by the Project GHG reduction strategy will be:

- design and construction of assets (development)
- energy efficiency and continuous improvement (operations)
- measurement and reporting of GHG emissions

The philosophy of design applied to the GLNG Project explicitly requires that environmental considerations, including maximising energy efficiency and minimising GHG emissions, are given priority in the design of the GLNG Project. The requirements include quantitative guidelines and general qualitative goals. All equipment to be installed must be compared against best-practice performance to ensure that the most up-to-date technologies are used.

Opportunities to reduce GHG emissions from the GTP are more limited and relate principally to minimising land clearing, the use of fuel efficient equipment and operational procedures that minimise gas releases. These pipeline-specific measures are listed in Section 5.4.

Climate change performance will be reported and disclosed according to legislative requirements and numerous voluntary commitments, including:

- Publication of emissions profile on the GLNG website and Annual and Sustainability Reports
- Energy Efficiency Opportunities program
- Reporting under the *National Greenhouse and Energy Reporting Act 2007*
- International Carbon Disclosure Project

GLNG emissions inventory is subject to voluntary assurance by independent auditors in accordance with Australian Auditing and Assurance Standard ASAE 3000 *Assurance Engagements Other than Audits or Reviews of Historical Financial Information*.

Appropriate emission and inventory databases are maintained to meet these reporting requirements.

5.8 Cumulative impacts

Cumulative impacts on air quality are outlined below. This cumulative impact assessment is based on the impact scope, identification and scoring methodology described in Chapter 2 of this EM Plan. Air emissions from construction of the Curtis Island GTP will consist primarily of dust and combustion pollutants. Potential sources of air emissions include clearing and grading of vegetation and soil, trenching and vehicle and machinery movements. The relatively short timeframe for the construction period and distance from the site to the nearest sensitive receptor will result in minor, short term impacts. In regard to GHG emissions, no cumulative (ie more than additive) impacts are predicted.

Air quality (boat movement/emissions from vehicles)

Air emissions may be generated from boats and construction vehicle movements. The generation of emissions that may reduce local and regional air quality are considered to be an additive impact. However, it is unlikely that these emissions will combine to exceed air quality objectives except in an extremely localised and short term manner.

Implementation of the measures set out in this EM Plan will result in negligible cumulative impacts on air quality from pipeline construction within the GSDA corridor on Curtis Island. No additional mitigation measures to the EM Plan are required.

Air quality (dust impacts on human receptors)

The primary source of air emissions from construction of the Curtis Island GTP will be dust generated by the vehicle movements, earthmoving and construction activities, as well as construction of other infrastructure and the LNG facilities.

Dust emissions from individual or combined activities are unlikely to affect sensitive human receptors due to the effective buffer between the GTP and sensitive receptors. The potential effect of dust on adjacent vegetation is presented in Chapter 9. Any effect of dust on vegetation is expected to be during the period of construction and no long term effects are expected.

Implementation of measures set out in this EM Plan will result in negligible cumulative impacts on air quality from pipeline construction within the GSDA corridor on Curtis Island. No additional mitigation measures to the EMP are required.

Greenhouse gas

Greenhouse gas (GHG) emissions may be produced by the following activities:

- Boat movements
- Construction vehicle movements on site
- Creation of vegetation waste
- Disturbance to existing land use
- Construction plant equipment

Total GHG emissions are simply additive and will not change if projects are constructed at the same time. There may be some opportunities for combining activities between projects such that GHG emissions are reduced, however in the context of the overall projects, these are not likely to be significant unless implemented across all of the projects.

Implementation of measures set out in this EM Plan will result in negligible cumulative impacts on GHG from pipeline construction within the GSDA corridor on Curtis Island.

Opportunities to share infrastructure and logistics between various LNG projects may arise in the future and these could reduce overall GHG emissions.

5.9 Environmental protection commitments, objectives and control strategies – air quality (construction and operation)

The following discussion of best practice control measures for the minimisation of particulate emissions from various construction activities has been sourced from a recent review of international best practice completed by Katestone Environmental for the NSW DECCW.[3]

For clarification of the impact that the sources can have, the emission rates from the various sources in the lowering and backfilling scenario have been plotted in Figure 5.13. It clearly shows that the haul roads, which include access tracks within the Curtis Island GTP are by far the largest single dust source.

3 *NSW Coal Mining Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining*, Prepared by Katestone Environmental Pty Ltd for DECCW, December 2010.

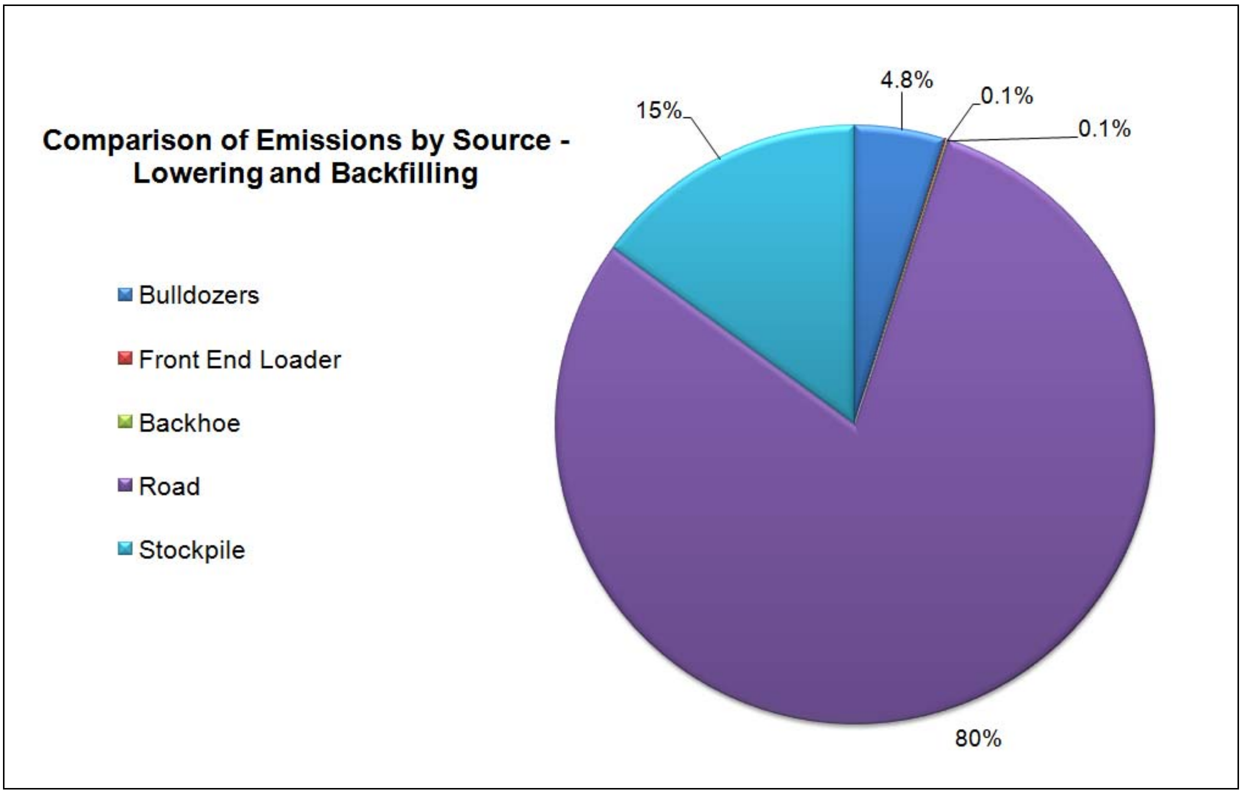


Figure 5.13 Comparative source contributions for the Lowering and Backfilling scenario

Proposed environmental protection commitments, objectives and control strategies are presented in Table 5.22.

Table 5.22 Environmental protection commitments, objectives and control strategies – for air quality

Item	Detail
Environmental protection objective	• To complete the installation of the GTP in a manner that maintains ambient air quality within the local airshed
Specific objectives	• No warranted complaints from landholders • No excessive dust emissions during construction of the GTP • The release of odour, dust or any other airborne contaminant(s), or light from the petroleum activity must not cause an environmental nuisance at any sensitive place or commercial place
Control strategies	**Preconstruction phase** • GLNG Operations must develop and implement a greenhouse gas reduction strategy for the Project. The strategy must include, but not be limited to, GLNG Operations' policy on GHG emissions, an energy efficiency program, a continuous improvement program, better control systems and a CO_2 recovery plan. The strategy must be submitted to the Coordinator General for approval within three months of the granting of the petroleum facilities licence for the LNG Facility **Construction phase** • Consult with and advise any landholders with the potential to be impacted by temporary construction dust emissions prior to the commencement of activities • Vehicles and machinery will be fitted with appropriate exhaust systems and emission control devices. The devices will be maintained in good working order • Construction sites and access roads will be watered on an as required basis to minimise the potential for environmental nuisance due to dust. Watering frequency will be increased during periods of high risk (eg high winds) • The extent and period of exposure of bare surfaces will be minimised • The disturbed corridor will be promptly restored following construction to stabilise the disturbed surface and limit the potential for dust generation • Vehicles speeds will be controlled within the RoW • A "no burning" policy for cleared vegetation will be implemented • Ensure excessive dust deposition does not occur on the foliage of significant plants and ecological communities adjacent the disturbance footprint and affect the plants ability to photosynthesise • The release of odour, dust or any other airborne contaminant(s), from the petroleum activity must not cause an environmental nuisance at any sensitive place or commercial place. Sensitive or commercial place is any Residential Dwelling, School, University, Child Care Facility, Hospital or commercial place within 500 m of the pipeline corridor • The Contractor will provide to GLNG Operations for approval, a Sustainability Management Plan (Sustainability MP) that includes specific criteria and deliverables that will demonstrate how a high performance for all sustainability indicators for the design and construction of the proposed Pipeline will be achieved. This plan will include appropriate chapters or sub plans regarding energy efficiency and greenhouse gas emissions including site-specific targets **Operational phase** • Typical mitigation and controls for the operational phase of the Project will be detailed in the Operational Management Plan, which will be developed prior to construction
Performance indicators	• Complaints responded to within 2 working days

6. Dams

No dams are proposed to be constructed within the proposed Curtis Island GTP section, and as such they have not been considered or assessed as part of the Curtis Island GTP EM Plan.

7. Land management

7.1 Chapter summary

This section provides a summary of the existing environmental values, potential impacts and proposed mitigation measures detailed throughout this chapter.

7.1.1 Summary of existing land values:

- The near surface geology on Curtis Island is dominated by sandstone, conglomerate and breccia layers. Sandstone forms the higher elevation areas of Curtis Island, with surface cobbles and boulders found overlying mudstone on the lower slopes
- The southern portion of Curtis Island is characterised by a series of north-north-west-trending steep-sided rounded ridges and remnant hills rising above broad, gullied valleys
- Approximately 3 km east of Laird Point along the Curtis Island GTP the pipeline corridor follows a north-north-west trending narrow valley en-route to the LNG Facility site
- Remnant hills along the Curtis Island GTP rise up to over 100 m above the surrounding valleys, with side slopes often over 30°
- Variable topography and undulating relief along the Curtis Island GTP has resulted in small pockets of variable soil groups occurring across the Curtis Island GTP
- Only four of soil groups occur in the Curtis Island GTP; these are:
  - Sandy Uniform and Gradational Soils
  - Sandy Texture Contrast Soils
  - Loamy Texture Contrast Soils
  - Uniform or Gradational Non-Cracking Soils
- The major soil groups along the RoW are characterised by high erosion potential and low GQAL classification
- An assessment of Good Quality Agricultural Land (GQAL) in the Curtis Island GTP was undertaken by reviewing terrain classes and identified land as falling within Categories C (Pasture Land) and D (Non-agricultural Land) (refer Table 7.4)
- No strategic cropping land areas are located on Curtis Island within the GTP RoW
- Areas of previous disturbance along the Curtis Island GTP RoW are subject to accelerated soil erosion
- Sodic soils (level of exchangeable sodium in the soil) are likely to be encountered throughout the Curtis Island GTP, generally on duplex soil profiles (large contrast between the soil structure of the A horizon and the B horizon) which are likely to have sodic subsoils (Sodosols)
- Acid sulfate soil forming conditions do not occur within the area of this EM Plan. Acid sulfate soils which may exist in the vicinity of Point H will be managed in accordance with the acid sulfate soil management plan presented in the Marine Crossing GTP EM Plan

7.1.2 Summary of potential impacts to land management

Construction

Without appropriate mitigation measures the construction of the Curtis Island GTP may result in a range of impacts including erosion and sediment, soil inversion, soil compaction, salinity related impacts and differential settlement. Of these impacts, soil erosion and sediment presents a slightly higher risk as the soils within the Curtis Island GTP are identified as having a moderate to high erosion potential. Despite this risk soil and erosion related impacts are expected to be acceptable and manageable as construction works will be undertaken in accordance with control strategies as outlined in Section 7.8 and the ESCP (refer Appendix A).

Further clearing of vegetation and stripping will increase the risk of erosion.

Operation

During the operational phase regular inspections will be undertaken in accordance with the approved monitoring program, along the Curtis Island GTP. These will be done by vehicle and foot patrols, and will check on the condition and identify activities that have the potential to impact on the integrity of the pipeline. Impacts from operational and maintenance activities should be low and manageable as these will occur infrequently and involve low levels of vehicle movements. Maintenance activities should occur in accordance with the operational management plan (OMP) and include the relevant sections of the management plans (such as the ESCP and the SSMP).

The OMP will be further developed during construction activities and be implemented following completion of the pipeline and during the operational phase of the pipeline. Typical OMP control measures are outlined in Section 7.8 of this EM Plan.

7.1.3 Summary of proposed mitigation measures for land management

Table 7.1 Environmental protection commitments, objectives and control strategies – for land management

Item	Detail
Environmental protection objective	To minimise and manage adverse impacts to soils by: • Limiting the occurrence and extent of trench subsidence and soil erosion • Preventing soil inversion • Developing a stable, vegetated RoW post-construction
Specific objectives	• Erosion controlled and limited to that consistent with "natural processes" such that pipeline cover is maintained and land capacity is not reduced • All erosion control strategies implemented and functional • All topsoil stockpiled separately and no spoil piles remain on surface after restoration • All access contained to designated areas
Control strategies	Refer Table 7.5 for land mitigation measures to be implemented during construction and operation of the Curtis Island GTP
Performance indicators	• Erosion is controlled to a degree that is consistent with "natural processes". • Land capability is not being reduced • Erosion control strategies are functional • Topsoil is stored separately and no spoil piles remain on surface after restoration

7.2 Land tenure and use

Land tenure and use has been addressed in Chapter 8.

7.3 Landscape and visual amenity

Landscape and visual amenity has been addressed in Chapter 8.

7.4 Flora, fauna and bio-regions

Flora and fauna and associated elements have been addressed in Chapter 9.

7.5 Existing soil, land and geological environment

The terrain within the Curtis Island GTP RoW was assessed to identify geological regimes, landform types and associated soils. Terrain mapping was carried out with reference to existing geological, topographic and soils information. This information was compiled using the background data sources listed below which have provided the basis for identifying *Terrain Units* that occur within the Curtis Island GTP RoW. Where this information is illustrated in Figures, it is done so in a 2 km corridor along the Curtis Island GTP RoW. Background data sources used include:

- Colour aerial photography – The State of Queensland (Department of Natural Resources, Mines and Energy) Series QAP 5719 flown 02/05/99 at a nominal scale of 1:40,000 for the Curtis Island GTP pipeline corridor; colour 06.ECW (SPOT) imagery provided by Santos Ltd. for the mainland sectors of the pipeline corridor
- Route corridor topographic data with 5 m Lidar Contours provided by Santos Ltd. covering the majority of the main route corridor; with Geoscience Australia (100k) 20 m contours, supplemented by reference to Google Earth 3D imagery, where required
- Geological mapping derived from Regional Geological Map Sheets of the Surat Basin and the Bowen Basin and the Gladstone 1:100,000 Series Geological Mapping, included in the Geoscience Data Set compiled by the Geological Survey of Queensland (July 2004)
- Land resources digital data sets including CSIRO Land Research Series No. 19 (1967) – Lands of the Isaac-Comet Area Queensland; CSIRO Land Research Series No. 21 (1968) – Lands of the Dawson Fitzroy Area – Queensland; CSIRO Land Research Series No. 34 (1974) – Lands of the Balonne-Maranoa Area Queensland
- Land Resources and Evaluation of the Capricornia Coastal Lands (CCL) – Sheet 3 Calliope area, NRW Data (1995)
- Queensland Department of Natural Resources and Water (NRW – 2004) regional compilation of and mapping (1:250,000) Central West Region - Good Quality Agricultural Lands (GQAL)
- Denison Trough Gas Project – Gladstone Option. Results of Terrain Analysis and Field Investigations, prepared by Terrain Analysis QLD Pty Ltd on behalf of CSR Oil and Gas Division (1984)

A terrain unit comprises a single or recurring area of land that is considered to have a predictable combination of physical attributes in terms of bedrock, surface slope and form, and soil/substrate conditions.

During soil assessment for this EM Plan, further information obtained from field geotechnical investigations have been used to ‘ground truth’ the Terrain Units. This information has been incorporated below to assess the soil, land and geological environment of the Curtis Island GTP.

7.5.1 Geology

The geology of the general area of interest has been mapped by the Geological Survey of Queensland (GSQ) in the Geoscience Datasets (2005) as shown on the 1:100,000 “Gladstone Special” (Sheet 9150) map. The near surface geology on Curtis Island is dominated by sandstone (including highly resistant greywacke), conglomerate and breccia layers. Sandstone forms the higher elevation areas of Curtis Island, with surface cobbles and boulders found overlying mudstone on the lower slopes.

The geology in the Curtis Island GTP RoW is considered to have low environmental value.

Curtis Island consists of sedimentary rocks from The Curtis Island Group, comprised of the Doonside, Wandilla and Shoalwater formations. In this group, the Wandilla Formation conformably overlies the older Doonside Formation. The Group comprises Devonian to Carboniferous age clastics (weakly metamorphosed conglomerate to quartzitic and greywacke sandstone and mudstone). Parts of the sequence are typified by deep trench deposits (radioloarian chert and pelagic mudstone is found), whilst the Group is dominated by series of fining upward clastic sequences. These deposits are characteristic of turbidite deposits (coastal shelf landslides). The sequences are intensely folded due to thrust against the continent at a tectonic boundary (Coffey Geotechnics, 2009a).

The mudstones of the Wandilla Formation are characteristically dark grey, weathering to pale brown. Thin quartz veinlets and localised thick veins penetrate the rocks parallel to foliation. The sequences are locally interspersed with muddy limestone and volcanic rock. The Doonside formation is essentially similar, although observation reveals extensive weathered mudstone, distinctive chert and, possibly, volcanic rocks (Connell Wagner, 2008).

Geological Structural Features and Faults

From the published geological maps it is apparent that extensive faulting exists within the Curtis Island study area. A major north south trending inferred fault line runs parallel to the western coastline of “The Narrows” waterway. Approximately 3 km east of Laird Point on Curtis Island GTP the pipeline corridor follows a north-north-west trending narrow valley (a fault bounded graben), en-route to the LNG Facility site. A series of six east west trending fault lines have been identified along this sector which trend towards or intersects the pipeline corridor between KP 418 to KP 422 km (Connell Wagner, 2008). These faults are not thought to be active at the present time, however their existence can produce variation in the underlying geology.

The geological regime of the Curtis Island GTP is depicted in Figure 7.1.

7.5.2 Topography

The Curtis Island GTP commences in the pipeline corridor at Point H (KP 414.75) at the southwestern corner of Curtis Island. The corridor runs along the southern margin of the Graham Creek inlet, turning inland to run adjacent to the ridge (the Spine).

The southern portion of Curtis Island is characterised by a series of north-northwest-trending steep-sided rounded ridges and remnant hills rising above broad, gullied valleys. The island is densely forested at present, with hardy schlerophyll species suited to thin soils. The coastline is characterised by rocky headlands separated by broad inter-tidal mudflats. Mangroves fringe the low-lying edge of the Narrows (URS, 2009).

The Curtis Island GTP is dominated by the Spine hogsback. This ridge has scarp/dip slopes of well over 30°. The remnant hills can rise up to 100 m above the surrounding valleys, with side slopes occasionally over 30°. The higher elevation areas represent more resistant layers of the Wandilla Formation, generally containing chert.

The Curtis Island GTP along the Graham Creek coastal margin is characterised by a narrow strip of low-relief land sandwiched between, and occasionally crossing, steep remnant hills (with slopes approaching 20° in places). The Curtis Island GTP then follows deeply incised creek valleys adjacent to the Spine: one flowing north into Graham Creek and the other south towards China Bay. The north-flowing valley floor is dissected by several gullies up to 3 m deep. There is evidence that flash flooding occurs within this valley causing rapid channel change, including avulsions, gully headcutting and transport/deposition of sizeable gravel and cobble sediment slugs. Exposures indicate mixed colluvium and alluvium. The south-flowing valley sides and floor appear less undulating, although gullying is still present.

P:\GIS\Projects\214208_Santos_EMP\CI_018.mxd 18/08/2011 10:16

Map by: RB

A1 scale: 1:15,000

0 250 500 750 1,000 1,250 m

GLNG No: 3381-40-0469

Coordinate system: GCS_GDA_1994

Curtis Island GTP EM Plan

Gas Transmission Pipeline (GTP)
- Mainland GTP EM Plan
- Marine Crossing GTP EM Plan
- Curtis Island GTP EM Plan

Kilometre Post Distance Marker
- 5km
- 1km

Geological Regime
- Cw Carboniferous Wandilla Formation
- Qa Quaternary Alluvium
- Qe Quaternary (Holocene) Estuarine Sediments
- Fault

Note: All figures should be reviewed in conjunction with Table 7.1 *"Generic Key to the identification of Terrain Units", URS 2009.*

Source:
Gas Transmission Pipeline (GTP): Santos, Jan 2011.
Aerial: Santos, Feb 2011.
GLNG Terrain Units: Supplementary EIS, URS, 2009.
Fault Lines: Department of Mines and Energy, 2008.

Geological Regime
Figure 7.1

Date: 18/08/2011 Version: 0

The topography of the Curtis Island GTP is depicted in Figure 7.2.

7.5.3 Soils

Soil groups in the Curtis Island GTP RoW have been assessed using terrain units to identify their occurrence and distribution.

Soil characteristics are strongly related to parent material, formation process and relief (McDonald *et al*, 1990). The dominant parent material in the Curtis Island GTP is sedimentary rocks (as indicated in the geology section) as well as alluvium and colluvium. The variable topography and undulating relief has resulted in small pockets of variable soil groups occurring across the Curtis Island GTP.

Soil groups along the length of the pipeline from Fairview to the Curtis Island LNG Facility were determined during the EIS from interpretation of available data, combined with field logs and visual interpretation from photographs of soil exposures (URS, 2009). Nine soil groups were identified as occurring across the length of the pipeline, however a review of the EIS mapping indicates only four of these soil groups (Groups 4-7) occur in the Curtis Island section of the GTP. These groups along with their typical characteristics, constraints and properties are summarised below.

The soils have been described using the Australian Soil and Land Survey Field Handbook (McDonald *et al*, 1990). Soil groups have been classified using texture grade and key features, in accordance with the Australian Soil Classification (Isbell, 2002).

Soil Groups

The four broad soil groups which occur in the Curtis Island GTP (4-7) are listed below from least to most clay content. The occurrence of these soils is mapped on Figure 7.3:

Soil Group 4 – *Sandy* Uniform and Gradational Soils

i) Uniform or gradational loam to clay loam soil profiles with clay loam, light clay or medium clay subsoils
ii) Soil depth varies from 0.2 m to 1.0 m in depth
iii) Soils have massive to weakly structured subsoils
iv) Soils are frequently stony or gravelly
v) Generally Red or Brown in colour

On Curtis Island, these soils occur on the higher parts of strongly undulating to low hilly lands and on the crestal areas and upper marginal slopes of hilly and high hilly lands, where they comprise mainly shallow (<0.5 m) stony and/or ferruginous gravelly uniform or weakly gradational brownish black, brown, red-brown or red massive loams and clay loam soil profiles underlain by weathered rock. These soils are classified as *Leptic Rudosols, Red-Brown Kandosols.*

Curtis Island GTP EM Plan

Gas Transmission Pipeline (GTP)
- Mainland GTP EM Plan
- Marine Crossing GTP EM Plan
- Curtis Island GTP EM Plan

Kilometre Post Distance Marker
- 5km
- 1km

Contour (5m)

Note: All figures should be reviewed in conjunction with Table 7.1 *"Generic Key to the identification of Terrain Units", URS 2009.*

Source:
Gas Transmission Pipeline (GTP): Santos, Jan 2011.
Aerial: Santos, Feb 2011.
Topography: Santos, Feb 2011.

Topography
Figure 7.2

A1 scale: 1:15,000

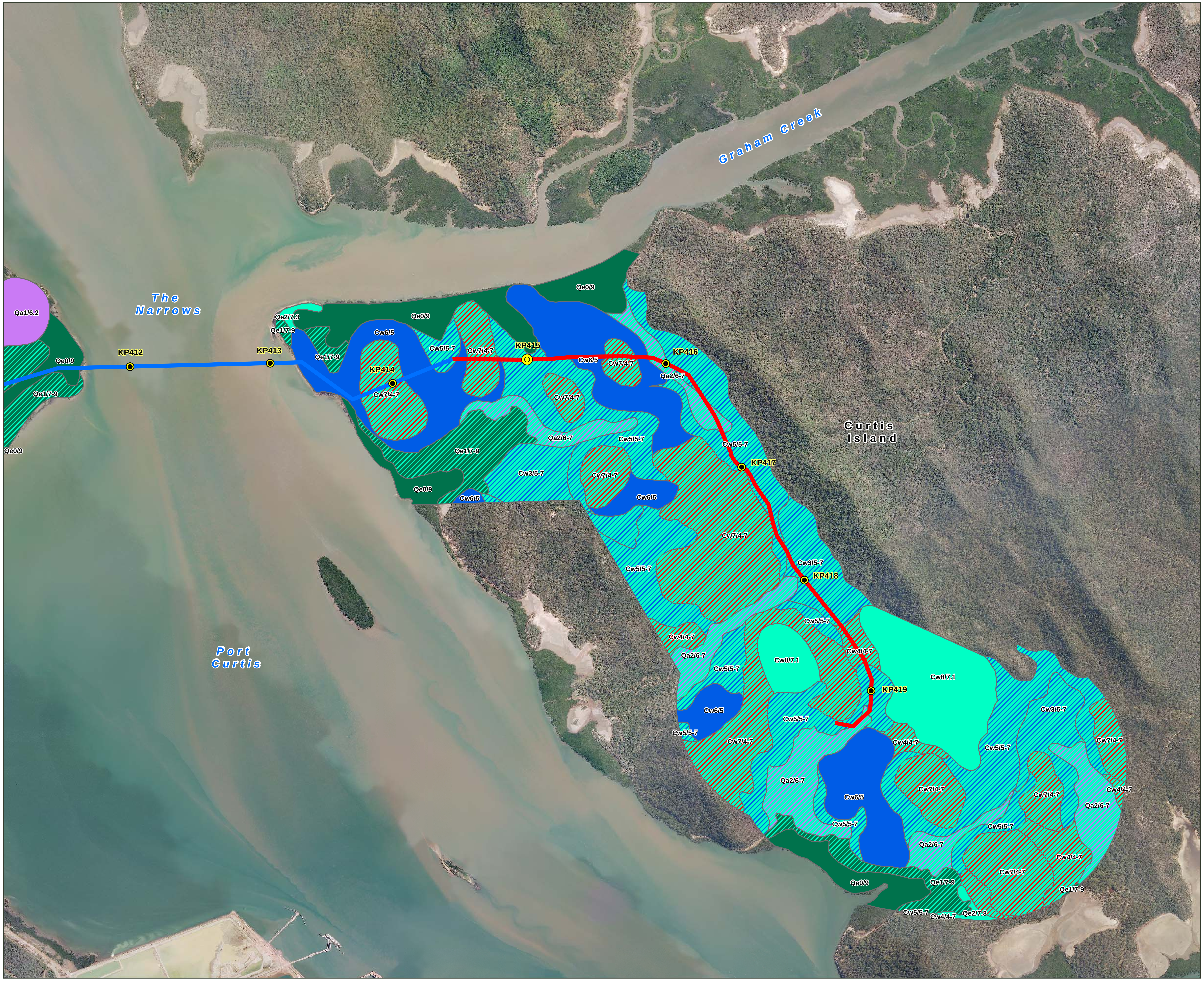
0 250 500 750 1,000 1,250 m

GLNG No: 3381-40-0470

Coordinate system: GCS_GDA_1994

Date: 08/04/2011 Version: 0

Map by: RB P:\GIS\Projects\214208_Santos_EMP\CI_022.mxd 08/04/2011 11:17



Curtis Island GTP EM Plan

Gas Transmission Pipeline (GTP)
- Mainland GTP EM Plan
- Marine Crossing GTP EM Plan
- Curtis Island GTP EM Plan

Kilometre Post Distance Marker
- 5km
- 1km

Soil Group
- 4 - Medium-textured gravelly uniform or gradational loam to clay loam soils
- 5 - Sandy or loamy duplex profiles with clay subsoils
- 6 - Loamy or clayey duplex profiles with medium to heavy clay subsoils
- 7 - Shallow and deep uniform fine-textured (non-cracking) clay soils
- 9 - Tidal area soils

Combined Soil Group
- 4-7
- 5-7
- 6-7
- 7-9

Note: All figures should be reviewed in conjunction with Table 7.1 *"Generic Key to the identification of Terrain Units", URS 2009.*

Source:
Gas Transmission Pipeline (GTP): Santos, Jan 2011.
Aerial: Santos, Feb 2011.
GLNG Terrain Units: Supplementary EIS, URS, 2009.

Soil Groups
Figure 7.3

Date: 18/08/2011 Version: 0

A1 scale: 1:15,000

0 250 500 750 1,000 1,250m

GLNG No: 3381-40-0471

Coordinate system: GCS_GDA_1994

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Map by: RB

Soil Group 5 – Sandy Texture Contrast Soils

i) Soils have a distinct texture contrast between the surface horizon and the subsoil, generally with a change from sandy to loamy with a sandy clay to medium to heavy clay subsoils
ii) The boundaries between the horizons are clear, abrupt or sharp
iii) Subsoils have mostly acidic to neutral or slightly alkaline pH levels

Within the Curtis Island GTP RoW, these soils occur on slopes and have variable depth of surface soils consisting of (0.1 to 0.3 m) sandy, sandy loam or loamy surface soils that tend to be hard-setting, usually with a pale or bleached (A2) sub-surface horizon underlain by brown or yellowish brown sandy clay or medium clay neutral to moderately acidic hard, medium to coarse blocky structured subsoils. These soils are classified as *Red-Brown Chromosols*, *Red-Brown Sodosols* and *Sodic Kurosols*.

Soil Group 6 – Loamy Texture Contrast Soils

i) Soils have a distinct texture contrast between the surface horizon and the subsoil
ii) Surface soils are mostly thin fine sandy loam, silt loam or clay loamy with medium to heavy clay or heavy clay subsoils.
iii) Subsoils are neutral to alkaline, often strongly alkaline, usually with carbonate present

These soils occur on gently to moderately inclined foot-slopes and on alluvial plains, stream terraces and floodplains associated with major streams and rivers. The soils comprise medium to deep (0.5->1.0 m) mainly thin (<0.3 m) hard-setting slightly acidic, fine sandy to silt loamy or clay loamy surface duplex soils in places with a pale or bleached sub-surface (A2) horizon. There is a sharp transition to the subsoil (B) horizon which comprises brown, yellow-brown or red-brown alkaline to strongly alkaline medium to heavy clay subsoils which have moderate amounts of soft carbonate inclusions and weak to moderate blocky to columnar soil structure with hard dry consistence. The deeper subsoils tend to become more massive, apedal and strongly cohesive heavy clays with low to moderate levels of sodicity and salinity usually present. These soils may be classified as *Red-Yellow-Brown Calcic Mesonatric Sodosols.*

Analytical data from one profile in terrain unit Qa2/6-7 on Curtis Island, indicates medium to high levels of Cation Exchange Capacity (CEC) and Plant Available Water Capacity (PAWC). The soils are non-saline and non-sodic in the surficial soil layers becoming sodic, moderately dispersive and moderately saline in the deeper subsoils. The ratio of calcium to magnesium is low (<1.0) throughout the profile. Data available on these soils from the CSIRO Land Research Series No. 19 (1967) indicates that calcium is the dominant metal cation in the surface soils whilst magnesium is dominant in the subsoils. Exchangeable sodium is high in the subsoils and the preponderance of sodium and magnesium accounts for the poor physical properties and dispersive characteristics of the subsoil layers.

Soil Group 7 – Uniform or Gradational Non-Cracking Soils

i) Shallow and deep uniform fine-textured (non-cracking) clay soils and gradational soils
ii) Clay loam or light clayey surface soils with either acidic or alkaline, often sodic and in places saline medium to heavy clay or heavy clay subsoils
iii) Locally the soils tend to exhibit characteristics of (incipient) cracking clay soils

Three soil variants have been identified, details of which are as follows:

Soil Group 7.1 – These soil profiles occur mainly on low hilly, hilly and higher hilly lands where mainly developed on argillaceous sedimentary rock types and intermediate to basic volcanic rock lithologies. They comprise mainly shallow to medium deep (0.5 to 0.7 m) uniform light to medium acidic clays, or gradational clay loam, gravelly clay loam or gravelly clay surface soils with 30 to 50% fine gravel and coarse stone over gravelly acidic or alkaline dark brown, grey-brown clays or medium to heavy clay subsoils underlain by weathered rock generally below about 0.6 to 0.8 m. These soils are classified as *Gravelly Grey-brown and Red-Brown Dermosols.*

Analytical data from two sites tested during the EIS, indicates the clayey subsoils contain slightly to moderately sodic and dispersive soil layers. The ratio of calcium to magnesium in samples tested was very low, indicating potential soil structural stability problems.

Soil Group 7.2 – These soils occur mainly on undulating alluvial plains and on undulating lowlands and gently inclined slopes adjacent to and along drainage lines. They comprise medium to deep uniform clay soil profiles with light to medium clay texture throughout, or grade from clay loam at the surface to light to medium clay subsoils below about 0.3 to 0.5 m. The surface soils have granular structure becoming sub-angular blocky in the subsoils, tending to massive in the deeper subsoils. The surface soils are mostly dark brown and neutral to moderately acidic, with a gradual change to brown, yellowish or reddish-brown moderately to strongly alkaline clay subsoils. These soils are classified as *Grey, Brown or Red Dermosols*.

Limited available analytical data from two sites analysed during the EIS indicates these soils tend to be slightly sodic and dispersive in the upper soil layers and strongly sodic and dispersive in the deeper subsoils. Soil salinity levels are low near the surface and in places become moderately high in the deeper subsoils.

Soil Group 7.3 – These soil profiles occur locally in association with soils of Group 5 on the lower foot-slopes in terrain unit Cw5/5-7 and on the slightly elevated estuarine flats in terrain unit Qe2/7.3 on Curtis Island. The soils comprise deep uniform clays or gradational brown to yellowish red silty clay or heavy clay surface soils with diffusely mottled reddish-brown, brown or yellow-brown neutral to acidic, in places strongly acidic, sodic and locally approaching the coast, moderately to highly saline in the medium to heavy or heavy clay subsoils. These soils may be classified as *Acidic Sodic Mottled Grey, Brown and Red-brown Dermosols* or *Acidic Sodic Dermosolic Hydrosols.*

Indicative soil testing and analytical data from one site tested in terrain unit Qe2/7.3 on Curtis Island, during the EIS, indicates that these soils are sodic and tend to become increasingly sodic to very high levels in the deeper heavy clay subsoils. However the samples tested from similar depths for dispersion class were non-dispersive, possibly related to the strong levels of acidity throughout the profile. Calcium/magnesium ratios were all very low and soil salinity levels were moderate increasing to high in the deeper medium to heavy clay subsoil layer.

7.5.4 Terrain Unit Distribution along Curtis Island GTP

The distribution of geology, landform and soil groups as terrain units along the Curtis Island GTP RoW is presented in Figure 7.3. Note that information on terrain units should be read in conjunction with Table 7.2 *“Generic Key to the identification of Terrain Units”, URS 2009.*

Table 7.3 provides additional information and describes the constraints associated with each land unit type.

Table 7.2 Generic key to the identification of terrain units (URS, 2009)

Generic Key to the Identification of Terrain Units

GEOLOGICAL REGIME

Symbol	Description
Qe	Quaternary (Holocene) Estuarine Sediments
Qa	Quaternary Alluvium
Czs	Cainozoic Sediments
Ts	Tertiary Sediments
Tb	Tertiary Volcanic Rocks mostly basalt
Jp	Jurassic Precipice Sandstone
Je	Early-Middle Jurassic Evergreen Formation
Jh	Early Jurassic Hutton Sandstone
Rc	Early-Middle Triassic Clematis Group
Rm	Triassic Moolayember Formation
Ra	Triassic Arcadia Formation, Rewan Group
Ps	Permian Sediments
Pv	Permian Volcanics
Pfi	Late Permian-Early Triassic Felsic Intrusives
Pii	Late Permian Intermediate Intrusive Rocks
Ct	Carboniferous Torsdale Volcanics
Cr	Carboniferous Rockhampton Group
Cw	Carboniferous Wandilla Formation
Dcs	Late Devonian Intermediate Extrusive Rocks
Sf	Silurian-Devonian Volcaniclastic Rocks
W	Water Body
D	Disturbed Area – not mapped
Note:	Refer to EIS Report Section 1.3 for more detailed descriptions of Geological Regimes.

LANDFORM – TERRAIN TYPE

Type	Surface Form and Slope
0	Channel floors, banks and active levees of major streams and waterways with irregular steep, and locally benched bank slopes and low flood terraces. Locally tidal mangrove and marine flats and tidal inlets with mangroves fringing.
1	Floodplains, alluvial flats, lower stream terraces and flat to broadly depressional backplains, slopes typically <1%; periodically floodprone and locally poorly drained areas. Locally comprising estuarine/marine plains, extratidal and supratidal flats subject to periodic tidal inundation; slopes mostly <0.5%.
2	Flat to gently undulating or gently inclined intermediate to higher stream terraces, older alluvial plains or, floodplains and higher stream terraces, with slopes generally <2%; occasionally floodprone in lower-lying areas and along tributary drainage channels.
3	Undulating plain and gently rolling to broadly rounded rises with gently inclined planar to concave intervening lower-lying broadly depressional areas; slopes mostly in the range 1-3%.
4	Undulating to strongly undulating plains and rolling rises, locally flat to undulating upland plateau crestal areas and undulating uplands; with slopes mostly in the range 3-5%.
5	Gently to moderately inclined planar to concave intermediate to lower hill and ridge slopes or convex planar dissection slope interfluves; slopes variable mostly within the range 5-12%.
6	Isolated low rounded hills and rises and low hilly lands mostly with broadly rounded crestal areas and hill slopes in the range 12-25%.
7	Steep hilly lands with mostly narrow rounded hill and ridge crests and steep irregular planar hill and ridge slopes mostly in the range 20-40%.
8	Steep to very steep ridges and high hilly lands; mostly with narrow rounded ridge and spur crests, with slopes typically in the range 30-50%, with local sub-vertical rocky scarps and bluffs
9	Very steep high hilly to mountainous lands or very steep to locally sub-vertical or vertical escarpment slopes 35 ->100%.
	__Example__: Terrain Unit Qa2/6-7 Qa (Geological Regime) 2 (Landform) 6-7 (Soils)

SOILS

Group	Soil Types (1)
0	Extensive areas of rock outcrop, locally with skeletal to shallow usually stony or gravelly soils.
1	Skeletal, rocky or gravelly soils (>60% coarse fragments) with sandy, silty, loamy or clayey soil matrix (K- Uc1, Um1, Gn1, Uf1).
2	Sand soils; shallow to deep uniform or weakly gradational profiles; includes stratified alluvial soils, residual sand soils, earthy sands (Uc1-Uc6) (2) ; Rudosols or Tenosol Soil Orders. (3)
3	Coarse to medium-textured soils; uniform or gradational profiles; predominantly sandy earths, silty or clayey sand profiles (Uc4-5, Um1-3); Tenosols or Podosol Soil Orders.
4	Medium-textured sandy, sandy loam or silt to clay loamy surface uniform or gradational profiles, often (siliceous or ferruginous) gravelly or stony soils; (Um4-7, Gn1-2); Tenosols, Kandosols or Ferrosol Soil Orders.
5	Sandy to loamy surface duplex soils with neutral to acidic, in places strongly acidic sandy clay to medium to heavy clay subsoils (Dr1-5, Dy1-5); Chromosol or Kurosol Soil Orders.
6	Fine sandy, silty or clay loamy surface duplex soils with neutral to alkaline often calcareous, sodic and locally saline medium to heavy clay or heavy clay subsoils; (Db-Dd-Dy1-5); Chromosols, Sodosols or Calcarosols Soil Orders.
7	Uniform fine-textured (non-cracking) clay soils or gradational clay loam or light clay surface soils with acidic or alkaline often sodic and/or saline medium to heavy clay subsoils – locally incipient cracking clays; (Uf5-6); Dermosol or Hydrosol Soil Orders.
8	Uniform fine-textured (cracking) clay soils, locally with thin self-mulching surficial soils with dark grey, brown or black mostly alkaline or alkaline over acidic heavy clay subsoils; (Ug5-Ug6); Vertosols Soil Order.
9	Uniform, weakly gradational or weak duplex soils with highly organic silty to clay loamy surficial soils and seasonally or permanently saturated often gleyed and saline silty clay or medium to heavy clay subsoils; Um, Dd-Dy, Uf-Ug 5-6 profiles; Organosols, Hydrosols some Vertosol Soil Orders.
	Notes:- (1) – Soil profile form and texture class (2) – Principal Profile Form (Northcote, 1974) (3) – Australian Soil Classification (Isbell, 1996) Dual symbols eg (2-7) indicate both soil types may be present.

Table 7.3 Additional information and constraints associated with each land unit type

KP	Terrain unit*	Geology	Landform	Soil groups	Notes and associated constraints
Point H - KP414.75	Cw7/4-7	Carboniferous Wandilla Formation	Steep hilly lands with narrow rounded hill and ridge crests and steep irregular planar slopes 20-40%	Shallow (<0.5m) uniform gravelly clay soils (Group 4), with friable to granular brown gravelly clay loam surface soils over gravelly loam-loamy gravel subsoils on crests and upper slopes; shallow to medium deep uniform gravelly clay soils (Group 7.1) with red-brown or yellow-brown medium to heavy clay or gravelly clay subsoils on mid to lower slopes	Surficial soil horizons contain 40-60% fine to coarse gravel and stone The clayey fines and deeper clay subsoils may be moderately sodic and dispersive
KP414.75 - KP415.25	Cw5/5-7	Carboniferous Wandilla Formation	Gently to moderately inclined planar to concave intermediate and lower hill and ridge slopes and dissection slope interfluves; slopes variable 5-12%	Medium to deep gravelly clay loam and silt loamy surface duplex soils (Group 5) with medium to heavy acidic sodic clay subsoils; with medium to deep gradational gravelly clay loam over acidic structured clay subsoils (Group 7.3) on lower slopes	Surficial soil horizons contain 40-60% fine to coarse gravel and stone In some lower-lying areas the silt loamy surface duplex soils may be strongly sodic, dispersive and moderately saline in heavy clay subsoils
KP415.25 - KP415.5	Cw6/5	Carboniferous Wandilla Formation	Low rounded hills and rises and strongly undulating to low hilly lands, mostly with broadly rounded crestal areas and hill slopes mostly in the range 12-25%	Medium to deep (0.5-1.0 m+) dark brown gravelly clay loamy surface duplex soil with a pale or bleached gravelly loam or gravelly clay (A2) horizon over red, red-brown, yellow-brown and pale grey varigated medium to heavy acidic clay subsoils	Surficial soil horizons contain 40-60% fine to coarse gravel and stone The rock substrate may be dispersive
KP415.5 - KP415.75	Cw7/4-7	Carboniferous Wandilla Formation	Steep hilly lands with narrow rounded hill and ridge crests and steep irregular planar slopes 20-40%	Shallow (<0.5 m) uniform gravelly clay soils (Group 4.1), with friable to granular brown gravelly clay loam surface soils over gravelly loam-loamy gravel subsoils on crests and upper slopes; shallow to medium deep uniform gravelly clay soils (Group 7.1) with red-brown or yellow-brown medium to heavy clay or gravelly clay subsoils on mid to lower slopes	Surficial soil horizons contain 40-60% fine to coarse gravel and stone The clayey fines and deeper clay subsoils may be moderately sodic and dispersive
KP415.75 - KP416	Cw6/5 and Qa2/6-7	Quaternary Alluvium	Near flat to gently undulating alluvial plains, stream terraces, backplains and gently inclined slopes to drainage; slopes mostly <2%	Deep fine sandy to loamy surface duplex soils (Group 6) with neutral to alkaline typically sodic medium to heavy clay subsoils); together with uniform or gradational fine-textured alluvial soils (Group 7) with dark grey- brown neutral to moderately alkaline silty clay to medium clay subsoils	N/A

KP	Terrain unit*	Geology	Landform	Soil groups	Notes and associated constraints
KP416 - KP417.75	Cw5/5-7	Carboniferous Wandilla Formation	Gently to moderately inclined planar to concave intermediate and lower hill and ridge slopes and dissection slope interfluves; slopes variable 5-12%	Medium to deep gravelly clay loam and silt loamy surface duplex soils (Group 5) with medium to heavy acidic sodic clay subsoils; with medium to deep gradational gravelly clay loam over acidic structured clay subsoils (Group 7) on lower slopes	Surficial soil horizons contain 40-60% fine to coarse gravel and stone In lower-lying areas the silt loamy surface duplex soils may be strongly sodic, dispersive and moderately saline in heavy clay subsoils
KP417.75 - KP418.5	Cw3/5-7	Carboniferous Wandilla Formation	Undulating plains and lowlands, undulating valley floors; slopes 1-3%	Medium to deep gravelly clay loam and silt loamy surface duplex soils (Group 5) with medium to heavy acidic sodic clay subsoils; with medium to deep gradational gravelly clay loam over acidic structured clay subsoils (Group 7) on lower slopes	Surficial soil horizons contain 40-60% fine to coarse gravel and stone
KP418.5 - KP418.75	Cw4/4-7	Carboniferous Wandilla Formation	Undulating plains dissection slope interfluves, low rises and locally low saddles between higher hilly lands; slopes in the range 3-5%	Shallow (<0.5m) uniform gravelly clay soils (Group 4), with friable to granular brown gravelly clay loam surface soils over gravelly loam-loamy gravel subsoils on mid to lower slopes; with shallow uniform gravelly clay soils (Group 7) with red-brown or yellow-brown medium to heavy clay or gravelly clay subsoils on rises and low saddles	Surficial soil horizons contain 40-60% fine to coarse gravel and stone
KP418.75 – LNG Facility gate	Cw5/5-7	Carboniferous Wandilla Formation	Gently to moderately inclined planar to concave intermediate and lower hill and ridge slopes and dissection slope interfluves; slopes variable 5-12%	Medium to deep gravelly clay loam and silt loamy surface duplex soils (Group 5) with medium to heavy acidic sodic clay subsoils; with medium to deep gradational gravelly clay loam over acidic structured clay subsoils (Group 7) on lower slopes	Surficial soil horizons contain 40-60% fine to coarse gravel and stone In some lower-lying areas the silt loamy surface duplex soils (Group 5.1) may be strongly sodic, dispersive and moderately saline in heavy clay subsoils

Note: NA = not applicable; KP: = Kilometre Point

7.5.5 Good Quality Agricultural Land

An assessment of the agricultural land capability of the area was conducted during the EIS to provide a benchmark of existing/potential agricultural land use. Land within the Curtis Island GTP RoW was identified in accordance with State Planning Policy 1/92: *Development and the Conservation of Agricultural Land*, the assessment was based on the four class system for defining Good Quality Agricultural Land (GQAL) as detailed in the Planning Guidelines - Department of Primary Industries (DPI) and the Department of Housing and Local Government (DPI/DHLGP - 1993).

Four classes of agricultural land have been defined in Queensland, and presented in Table 7.4.

Table 7.4 Good Quality Agricultural Land descriptions

Class	Description
Class A	Cropland – Land that is suitable for current and potential crops with limitations to production which range from none to moderate levels. Considered to be GQAL in all areas
Class B	Limited cropland – Land that is marginal for current and potential crops due to severe limitations; and suitable for pastures. Engineering and/or agronomic improvements may be required before the land is considered suitable for cropping. Considered to be GQAL in most areas
Class C	Pasture land – Land that is suitable only for improved or native pastures due to limitations which preclude continuous cultivation for crop production; but some areas may tolerate a short period of ground disturbance for pasture establishment. Not considered to be GQAL
Class D	Non-agricultural land – Land is not suitable for agricultural uses due to extreme limitations. This may be undisturbed land with significant habitat, conservation and/or catchment values or land that may be unsuitable because of very steep slopes, shallow soils, rock outcrop or poor drainage. Not considered to be GQAL

Source: DPI/DHLGP 1993

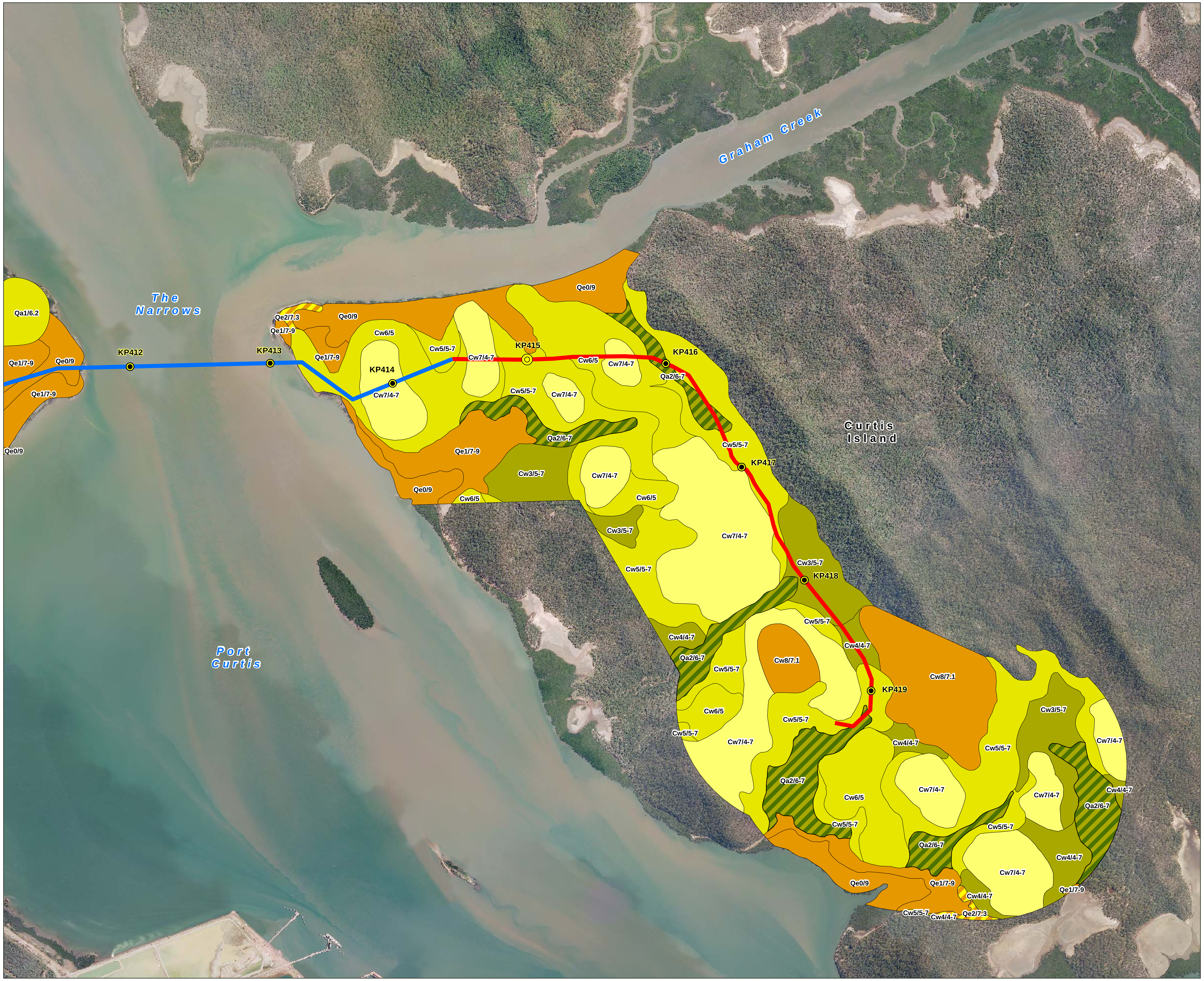
Class A land in all areas is considered to be good quality agricultural land. In some areas, Class B land (where agricultural land is scarce) and better quality Class C land (where pastoral industries predominate), are also considered to be good quality agricultural land (DPI/DHLGP 1993).

The assessment of GQAL in the Curtis Island GTP RoW was undertaken by reviewing terrain classes, as Queensland government GQAL mapping does not currently cover Curtis Island. Based on a review of the terrain classes within the Curtis Island GTP RoW, land has been identified as falling within Categories A, C and D as described in Table 7.3 above. Within Category C, three sub-classes have been identified as occurring within the Curtis Island GTP, these are:

C1. Some areas may tolerate an occasional cultivation for improved pasture and suitable for native pastures
C2. Areas primarily suited to grazing of native pastures, with or without the addition of improved pasture species but without ground disturbance
C3. Land that is suited to restricted light grazing of native pastures in accessible areas, otherwise steep to very steep hilly lands more suited for forestry, conservation or catchment protection

Figure 7.4 presents the distribution of these classes.

Based on the terrain unit mapping, small pockets of Class A land (in conjunction with Class C1 land) has been identified as occurring on Curtis Island. The small extent and distribution of this land is considered unsuitable for cropping and therefore these areas are not considered to be GQAL.



Curtis Island GTP EM Plan

Gas Transmission Pipeline (GTP)

- Mainland GTP EM Plan
- Marine Crossing GTP EM Plan
- Curtis Island GTP EM Plan

Kilometre Post Distance Marker

- 5km
- 1km

Agricultural Land Class

- A , C1
- C1
- C2
- C3
- C-D
- D

Note: All figures should be reviewed in conjunction with Table 7.1 *"Generic Key to the identification of Terrain Units", URS 2009.*

Source:
Gas Transmission Pipeline (GTP): Santos, Jan 2011.
Aerial: Santos, Feb 2011.
GLNG Terrain Units: Supplementary EIS, URS, 2009.

Good Quality Agricultural Land Figure 7.4

A1 scale: 1:15,000

0 250 500 750 1,000 1,250 m

GLNG No: 3381-40-0474

Coordinate system: GCS_GDA_1994

Date: 27/05/2011

Version: 1

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It must be noted that the Curtis Island GTP RoW falls within the Gladstone State Development Area (GSDA). The GSDA has been established in recognition of the overriding need for orderly industrial development in the Gladstone/Curtis Island area (DIP, 2008). The purpose of the GSDA is to secure and protect land for industrial development. Therefore, as this land has been reserved for industrial use, it is unlikely that any agricultural uses will prevail in the Curtis Island GTP area.

7.5.6 Strategic cropping land

The Queensland Government defines Strategic Cropping Land, as "*land that is suitable and available for current and potential future cropping with limitations to production that range from moderate to none*" (DPI 2010). Draft trigger maps released identified around 4% of Queensland's land mass as having potential for strategic cropping and being eligible for possible protection.

The preliminary mapping produced by the Queensland Government indicates that the Curtis Island GTP does not lie within an area classified as Strategic Cropping Land. Cropping limitations on Curtis Island are high due to unfavourable soil and topography.

7.5.7 Salinity and erosion potential

Salinity

Salinity refers to the concentration of soluble salts in the soil water. Salinity can adversely affect plant growth and/or land use. At high concentrations, soil salinity can increase the potential for corrosion of buried steel and/or concrete.

Salinity in the project area has been rated during the EIS (URS, 2009) based on the following soil attributes:

Low (L) – EC (mS/cm) <0.25 (sand), <0.4 (loam), <0.55 (clay) – Nil to low salinity

Moderate (M) – EC (mS/cm) 0.25-0.47 (sand), 0.4-0.8 (loam), 0.55-1.15 (clay) – Medium salinity

High (H) – EC (mS/cm) >0.47 (sand), >-0.8 (loam), >1.15 (clay) – High to very high salinity

The distribution of potentially saline soils in the Curtis Island GTP is presented in Figure 7.5.

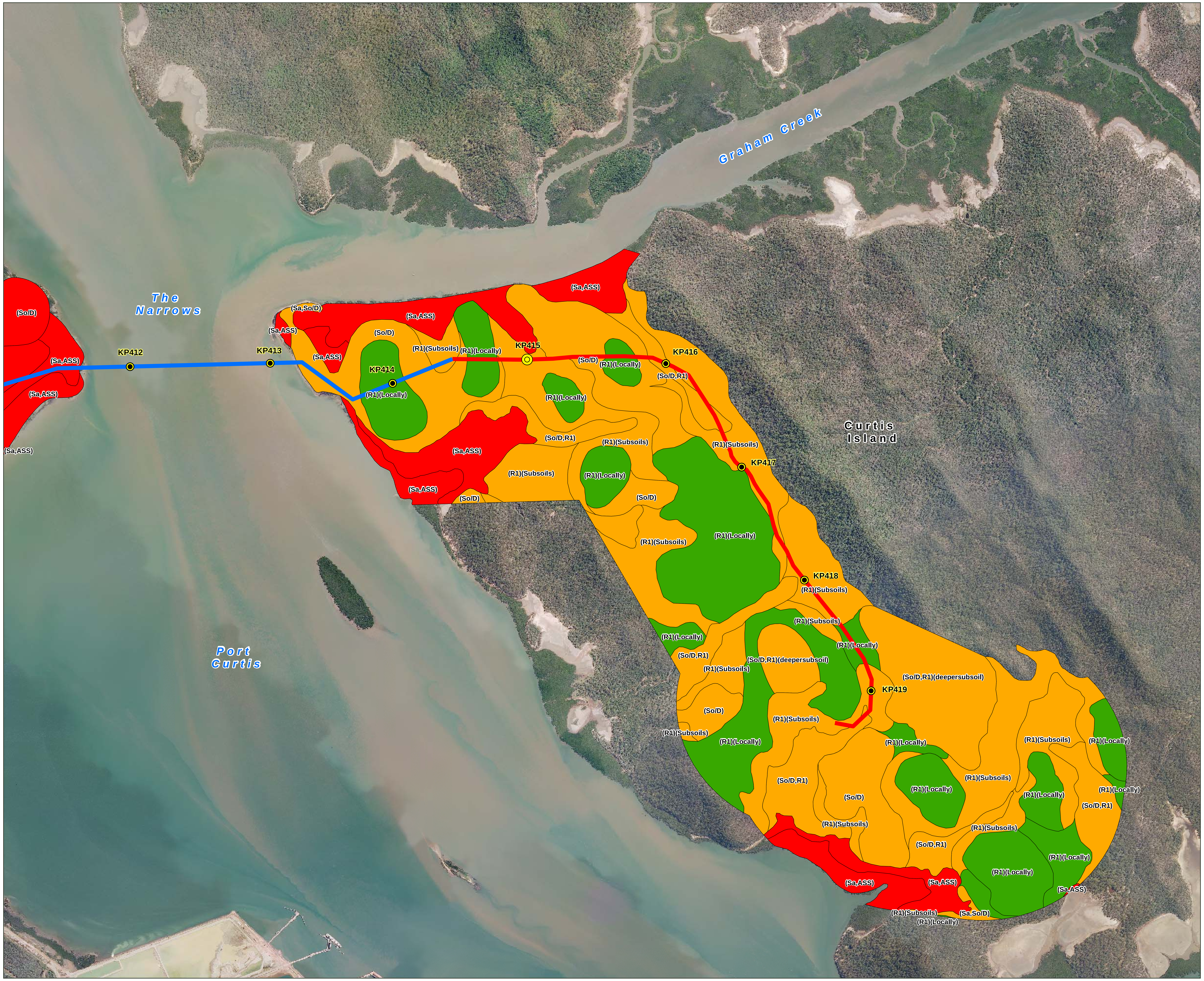
There is little evidence of salinity in the Curtis Island GTP RoW.

Erosion

Erosion processes within the Curtis Island GTP can be divided into: surface (river, runoff/sheetwash, rainsplash, rilling and gullying), subsurface (piping/tunnelling) and wind. Eroded material can be redeposited downslope, downstream or down-wind.

The erosion potential due to construction activities in the project area as a result of clearing and/or surface disturbance have been assessed in the EIS (URS, 2009) into the following classes:

- *Low (L)* – The combination of surface slope, run-on/run-off and soil erodibility is such that no appreciable erosion damage is anticipated
- *Moderate (M)* – Significant short term erosion is likely to occur due to the combination of slope, soil erodibility factors and extent of run-on/run-off. Erosion control can be achieved using structural works, topsoiling and re-vegetation techniques and other site specific intensive soil conservation works. Some slightly dispersive soil layers may be present in the profile



Curtis Island GTP EM Plan

Gas Transmission Pipeline (GTP)
- Mainland GTP EM Plan
- Marine Crossing GTP EM Plan
- Curtis Island GTP EM Plan

Kilometre Post Distance Marker
- 5km
- 1km

Problem Soil
- High
- Moderate
- Low

Description:

R
Soil Reactivity
L - Nil or low soil
R1 - Moderately reactive soils
R2 - Shallow or medium deep, highly reactive (cracking) clay soils
R3 - Deep, highly reactive (cracking) clay soils

Sa
Soil Salinity
L - Nil to Low Salinity
M - Medium Salinity
H - High to Very High Salinity

So
Sodicity (ESP)
N - Very low or non Sodic, ESP <6%
Rating 1 - Sodic, ESP 6-14%
Rating 2 - Strongly Sodic, ESP >14-25%
Rating 3 - Very strongly Sodic, ESP >25%

D
Dispersion Class
N - Non-dispersive
Sl - Slightly Dispersive
M - Moderately Dispersive
H - Strongly Dispersive

ASS
Acid Sulfate Soils

Note: All figures should be reviewed in conjunction with Table 7.1 *"Generic Key to the identification of Terrain Units", URS 2009.*

Source:
Gas Transmission Pipeline (GTP): Santos, Jan 2011.
Aerial: Santos, Feb 2011.
GLNG Terrain Units: Supplementary EIS, URS, 2009.

Soil Constraints: Problem Soils
Figure 7.5

Map by: RB P:\GIS\Projects\214208_Santos_EMP\Ci_021.mxd 08/04/2011 09:12

A1 scale: 1:15,000

0 250 500 750 1,000 1,250 m

GLNG No: 3381-40-0472

Coordinate system: GCS_GDA_1994

Date: 08/04/2011 Version: 0

- *High (H)* – High to very high erosion/sediment losses are likely, due to the steepness of slopes, surface condition, soil texture and erodibility factors and surface runoff conditions. Intensive soil conservation works will be required to minimise the effects of erosion. Moderately high to highly dispersive soil layers are usually present within the soil profile

The erosion potential of soils in the Curtis Island GTP is represented in Figure 7.6.

Terrain Units Cw7/4-7, Cw5/5-7 and Cw6/5.3 have been identified as having moderate to high erosion potential. These are either duplex or gradational soils with sodic and/or dispersive clay subsoils. Only two terrain units in the Curtis Island GTP were identified as having a low to moderate erosion potential, these were Cw3/5-7 and Cw4/4-7, occurring between KP 417.75 and KP 418.75.

Examination of the imagery along the Curtis Island GTP indicates areas of disturbance are subject to accelerated soil erosion. In general, further clearing of vegetation and stripping of topsoil resources along the Curtis Island GTP will expose the land to varying levels of erosion due to the combined effects of surface slope and form, soil group, surface run-on/run-off potential and wind erosion over time, necessitating the implementation of erosion and sediment control strategies as appropriate to the soil type and disturbance pattern (refer to the ESCP, Appendix A).

7.5.8 Sodicity

Sodicity is the level of exchangeable sodium in the soil and is determined using the exchangeable sodium percentage (ESP), which is the amount of exchangeable sodium expressed as a percentage of the Cation Exchange Capacity (CEC). Sodic soils are susceptible to structural degradation on exposure tend to exhibit the following general problems:

i) Severe surface crusting
ii) Likely dispersion on wetting
iii) Very low infiltration and hydraulic conductivity
iv) Very hard dense subsoils
v) High susceptibility to severe gully erosion if exposed and unprotected
vi) High susceptibility to tunnel erosion

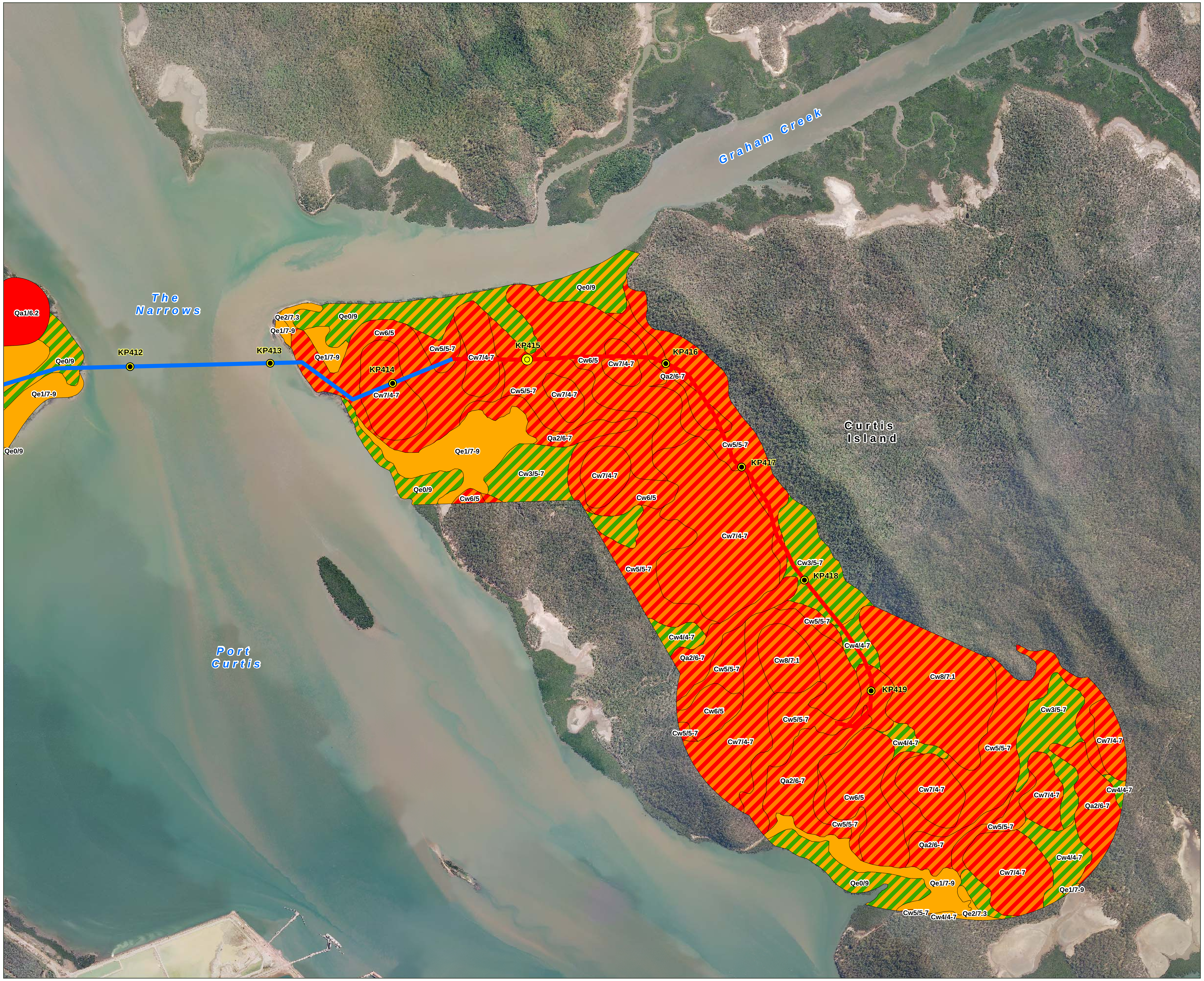
Sodicity in the Curtis Island GTP RoW has been rated based on ESP (taken from Northcote & Skene (1972))

- *Negligible* – very low or non Sodic, ESP<6%
- *Rating 1* – Sodic, ESP 6-14%
- *Rating 2* – Strongly sodic, ESP >14%
- *Rating 3* – Very strongly sodic, ESP >25%

The distribution of sodic soils associated terrain units within the Curtis Island GTP RoW is shown in Figure 7.5. The figure indicates that sodic soils are likely to be encountered throughout the Curtis Island GTP RoW, generally on duplex soil profiles which are likely to have sodic subsoils (Sodosols).

7.5.9 Acid sulfate soils

Current information (Australia Pacific, 2010; Coffey Geotechnics, 2009; Geocoastal, 2008 and GHD, 2008) suggests that ASS forming conditions do not occur past Point H within the Curtis Island GTP area. Land in the vicinity of Point H will be subject to a detailed ASS investigation in accordance with QASSIT Guidelines (1998) and State Planning Policy 2/02 (2002) prior to construction.



Curtis Island
GTP EM Plan

Gas Transmission Pipeline (GTP)

- Mainland GTP EM Plan
- Marine Crossing GTP EM Plan
- Curtis Island GTP EM Plan

Kilometre Post Distance Marker

- 5km
- 1km

Erosion Potential

- High (H) - High to very high erosion/sediment losses are likely, due to the steepness of slopes,surface condition, soil texture and erodibility factors and surface runoff conditions.
- Moderate - High (M-H)
- Moderate (M) - Significant short term erosion is likely to occur due to the combination of slope, soil erodibility factors and extent of run-on/run-off.
- Low - Moderate (L-M)
- Low (L) - The combination of surface slope, run-on/run-off and soil erodibility is such that no appreciable erosion damage is anticipated.

Note: All figures should be reviewed in conjunction with Table 7.1 *"Generic Key to the identification of Terrain Units", URS 2009.*

Source:
Gas Transmission Pipeline (GTP): Santos, Jan 2011.
Aerial: Santos, Feb 2011.
GLNG Terrain Units: Supplementary EIS, URS, 2009.

Soil Constraints: Erosion Potential
Figure 7.6

Map by: RB P:\GIS\Projects\214208_Santos_EMP\CI_020.mxd 08/04/2011 09:16

A1 scale: 1:15,000

0 250 500 750 1,000 1,250m

GLNG No: 3381-40-0473

Coordinate system: GCS_GDA_1994

Date: 08/04/2011

Version: 0

7.5.10 Contaminated land

The lots traversed by the Curtis Island GTP were assessed for contaminated land during a baseline assessment in the EIS using Tier 1 and 2 literature reviews to identify potentially contaminated land or areas of potential concern (AOPC).

The baseline assessment was conducted in accordance with the Department of Environment, *Draft Guidelines for the Assessment and Management of Contaminated Land in Queensland* (2008) and included a Tier 1 and Tier 2. The Tier 1 review indicated contamination activities were unlikely to have occurred within the lots traversed by the Curtis Island GTP (Lot 1 SP228454 and Lot 4 SP228454). A Tier 2 review was not completed based on these findings.

Details of notifiable activities that may occur as a result of construction of the Curtis Island GTP have been listed in Chapter 2. Any lots on which these activities may occur will be notified and included on the environmental register once the proposed works commence.

7.6 Potential adverse or beneficial impacts on land management (construction and operation)

The construction related activities and aspects of the Curtis Island GTP that potentially impact on land management values include the following:

- Clearing of vegetation
- Stripping of topsoil
- Bulk earthworks
- Trenching
- Disturbance of unknown contaminated soils
- Construction in high rainfall periods
- Slow or ineffective design and/or installation of erosion and sediment control measures
- Slow rehabilitation/revegetation works
- Backfilling and rehabilitation activities
- Nutrients from fertilisers, herbicides and pesticides used in rehabilitation

Potential impacts from these construction related activities and aspects are discussed in the following sections.

7.6.1 Potential erosion and sedimentation impacts

Construction of the Curtis Island GTP will involve clearing and earthworks in the general vicinity of the pipeline trench, in areas where temporary and permanent access roads are proposed and in associated infrastructure areas.

Potential environmental impacts that may result from construction activities primarily relate to the erosion potential of the land in areas that are subject to clearing or are disturbed including:

- Loss of topsoils and sub-soils due to erosion
- Siltation and sediment movement affecting land and water
- Reduced potential for rehabilitation success due to loss of topsoil
- Higher sediment loads due to accelerated erosion impacts
- Potential for extensive sheet and gully erosion should a high rainfall event occur during construction

Soils within the Curtis Island GTP RoW are typically shallow and gravelly, with low fertility. Therefore, limited quantities of topsoil and subsoil may be available for ‘capping’ the backfilled trenches and for use in rehabilitation (refer Appendix G). Any loss of these soil resources through accelerated erosion processes is likely to hinder rehabilitation efforts.

As identified in Figure 7.6, the majority of soils in the Curtis Island GTP RoW are identified as having a moderate to high erosion potential. Only soils in the vicinity of KP 418 have a lower erosion potential of low to moderate.

The mitigation measures that may be applied to control this risk are detailed in Table 7.5 and include separate stockpiling of topsoils and subsoil, the implementation of the erosion and sediment control plan (refer Appendix A), and timely rehabilitation of disturbed areas.

7.6.2 Potential soil inversion impacts

Inversion of the soil profile and backfill materials during reinstatement can cause patchy exposure of sodic and saline subsoils. This leads to increased erodibility and irregular vegetation growth.

Burying a pipeline with exposed subsoil may create a preferential pathway for subsurface flow. Water that accumulates and flows alongside the buried pipeline pathway may result in piping (tunnelling) erosion. Collapse of the subsurface void may lead to pipeline exposure.

Soil inversion can occur in any soil type along the alignment where soil has been excavated and incorrectly backfilled. Its impacts will be the greatest in sodic soils where sodic material is exposed to the surface. Given that top soil and sub soil will be stockpiled separately and replaced in their original soil horizons, impacts associated with soil inversion are anticipated to be minimal. Additional mitigation measures that may be applied to control this risk are detailed in Table 7.5.

7.6.3 Potential soil compaction impacts

Project activities that subject the ground to loading, such as access tracks, lay-down areas and facilities, can cause soil compaction. Once compacted, it can be difficult to return the material to its original uncompacted state. Vegetation is difficult to establish on compacted soils.

While all soils in the Curtis Island GTP are considered to be susceptible to some degree of compaction, impacts are likely to be greater in soil groups 6 and 7. The degree of compaction will also be influenced by the moisture condition of the soils during the compaction event. Compaction is most likely to occur as a result of vehicles straying from access tracks or from soil being reinstated with inappropriate handling measures.

Mitigation measures for soil compaction associated with these activities are detailed in Table 7.5. It is anticipated that the implementation of these mitigation measures will result in impacts associated with compaction being minimal.

7.6.4 Potential impacts to GQAL and strategic cropping land

The Curtis Island GTP which includes the RoW does not support the deep, fertile soils necessary for classification as GQAL under SPP 1/92, and as such is not currently used for agriculture. Therefore the construction of the Curtis Island GTP will not impact soils classified as GQAL.

No mitigation measures are necessary to protect GQAL.

7.6.5 Potential salinity impacts

Saline soils have been identified on Curtis Island, however they have not been identified as occurring within the construction zone of the Curtis Island GTP RoW. As such it is anticipated that these soils will not be disturbed during the construction.

As the physical construction and operation of the Curtis Island GTP are unlikely to contribute to salinity in the existing environment, therefore no mitigation measures are necessary to address salinity.

7.6.6 Potential acid sulfate soil impacts

Current information (Australia Pacific, 2010; Coffey Geotechnics, 2009; Geocoastal, 2008 and GHD, 2008) suggests that ASS forming conditions do not occur past Point H within the Curtis Island GTP area. Land in the vicinity of Point H will be managed in accordance with the Acid Sulfate Soils Management Plan presented in the Marine Crossing GTP EM Plan.

Typical mitigation measures that may be applied to control this risk are detailed in Table 7.5.

7.6.7 Potential soil contamination impacts

Previous investigations have indicated that contamination is not expected to exist in the Curtis Island GTP RoW.

Mitigation measures that may be applied to control this risk include measures which will prevent spills and releases of contaminants to soils as detailed in Chapter 3 (EMS). Should contaminated soils be encountered during construction then a remediation plan to manage the risk associated with the contaminated soils will be developed and submitted to DERM.

7.6.8 Potential impact from differential settlement of backfill

It is likely that backfilled and filled areas will not be returned to original compaction levels. Differential settlement of fill within the extent of the pipeline trench could cause depressions or mounds to form which could potentially lead to drainage concentration and gullying or waterlogging.

However, it is considered that differential settlement of backfill related impacts resulting from the construction of the Curtis Island GTP are expected to be low and manageable as works will be undertaken in accordance with the control strategies as outlined in Table 7.5.

7.6.9 Summary of potential impacts

Construction

The construction of the Curtis Island GTP is expected to generate a range of impacts including erosion and sediment, soil inversion, soil compaction, salinity related impacts and differential settlement. Of these impacts, soil erosion and sediment presents a slightly higher risk as some soils within the Curtis Island GTP RoW are identified as having a moderate to high erosion potential. Despite this risk soil and erosion related impacts are expected to be acceptable and manageable as construction works will be undertaken in accordance with control strategies as outlined in Section 7.8 and the ESCP (refer Appendix A).

Operation

Regular inspections will be carried out along the Curtis Island GTP by vehicle and foot patrols to check on the condition and identify any activities that may have the potential to impact on the integrity of the pipeline. The soil related impacts as outlined and described above will also apply to a lesser extent resulting from the operation of the Curtis Island GTP.

Operational and maintenance activities involve low number of vehicle movements, and infrequent maintenance activities and that these activities will be undertaken in accordance with the ASSMP, ESCP and the OMP. Consequently, the risk of impact from operational and maintenance activities is considered to be low and manageable.

The OMP will be developed prior to construction and implemented during all stages of the project, including construction, operation and decommissioning. Typical OMP control measures have been outlined in Section 7.8.

7.7 Cumulative impacts

Cumulative impacts on land and land management practices are described below. This cumulative impact assessment is based on the impact scope, identification and scoring methodology described in Chapter 2 of this EM Plan. The significance of cumulative impacts on land and land management practices is expected to be negligible to moderately negative. In particular, cumulative soil erosion impacts may occur without coordinated soil erosion control.

Cumulative impacts under consideration include the construction of the GLNG GTP, the QGCLNG and the APLNG pipelines. These pipelines will be in adjacent RoWs within the GSDA corridor established by the Coordinator-General (CG) for the pipelines. Each proponent is allocated an area within the GSDA corridor and will construct within the allocated area.

This section examines the potential cumulative impacts associated with the construction of the three pipelines within the GSDA corridor.

Soils (soil erosion)

The major soil groups along the RoW are characterised by high erosion potential and low GQAL classification.

The cumulative impacts may worsen soil degradation by:

- Increasing the vulnerability of narrow areas between RoWs to disturbance from construction activities
- Potentially exacerbated runoff effects
- Increased risks of spills from site traffic collisions
- Degrading limited topsoil resources

Cumulative impact issues will arise from combined effects of erosion from one or more construction RoWs open at one time. These will include loss of topsoil quality, and subsequent reduced effectiveness of rehabilitation, as well as reduced stormwater runoff quality and subsequent effects on sensitive coastal receiving environments.

This risk can be mitigated by staggering construction so that pipelines are constructed sequentially rather than concurrently. Pipeline proponents are working with the Queensland Government to minimise potential cumulative impacts. The proponents have established a Joint Technical Working Group to examine technical matters and participate in regular meetings coordinated through DEEDI to facilitate resolution of issues.

7.8 Proposed environmental protection commitments, objectives and control strategies – land management (construction and operation)

Environmental protection commitments, objectives and control strategies proposed are discussed in Table 7.5.

Table 7.5 Environmental protection commitments, objectives and control strategies – for land management

Item	Detail
Environmental protection objective	To minimise and manage adverse impacts to soils by: • Limiting the occurrence and extent of trench subsidence and soil erosion • Preventing soil inversion • Developing a stable, vegetated RoW post-construction
Specific objectives	• Erosion controlled and limited to that consistent with "natural processes" such that pipeline cover is maintained and land capacity is not reduced • All erosion control strategies implemented and functional • All topsoil stockpiled separately and no spoil piles remain on surface after restoration • All access contained to designated areas

Control strategies	**Preconstruction phase**
	• Soil management procedure for the Curtis Island GTP will be developed and implemented and include:
	– The establishment of baseline soils information including soil depth, pH, electrical conductivity (EC), chloride, cations (calcium, magnesium and sodium), exchangeable sodium percentage (ESP), particle size and soil fertility (including nitrogen, phosphorous, potassium, sulphur and micronutrients)
	– A soils monitoring programme outlining parameters to be monitored, frequency of monitoring and maximum limits for each parameter
	– The identification of soil units within areas to be disturbed by petroleum activities at a scale of 1:100000, in accordance with the "Guidelines for Surveying Soil and Land Resources, 2nd Edition" (McKenzie et al. 2008), "Australian Soil and Land Survey Handbook, 3rd Edition" (National Committee on Soil and Terrain 2009) and "The Australian Soil Classification" (Isbell 2002)
	– Soil descriptions for the assessment of soils for agricultural suitability, topsoil assessment, erodibility and rehabilitation including:
	  – shallow cracking clay soils
	  – deep cracking clay soils
	  – deep saline and/or sodic cracking clay soils with melonholes
	  – thin surface, sodic duplex soils
	  – medium to thick surface (>15 cm), sodic duplex soils, and vi) non-sodic duplex soils
	  – Detailed mitigation measures and procedures to manage the risk of adverse soil disturbance in the carrying out of the petroleum activity
	A copy of the soils management procedures will be made available to the administering authority upon request

Item	Detail
	• Soil ground truthing, including identification of all sensitive soil and landform areas along the pipeline corridor including Good Quality Agricultural Land, will be cross referenced to known information on land units and land systems. Any variation between identified land values and DERM data sets will be identified and explained. An assessment of the potential impacts will be provided along with mitigation measures and construction methods applicable to the identified soil groups or landforms including protection and restoration of GQAL that could qualify as strategic cropping land under the Government's *Strategic Cropping Land Bill 2011* (DERM 2010) • An Erosion and Sediment Control Plan for construction, in accordance with Best Practice Erosion and Sediment Control – for building and construction sites, 2008, which has been certified by a Certified Professional in Sediment and Erosion Control, or a professional with relevant experience and/or qualifications accepted by the Administering Authority will be developed and implemented for all stages of pipeline activity prior to construction • The Erosion and Sediment Control Plan for construction will provide appropriate measures to include for the following: - diverting uncontaminated stormwater run-off around areas disturbed by petroleum activities or where contaminants or wastes are stored or handled that may contribute to stormwater - collecting, treating, reusing or releasing contaminated stormwater runoff and incident rainfall in accordance with the conditions of the environmental authority - roofing or minimising the size of areas where contaminants or wastes are stored or handled - using alternate materials and or processes (such as dry absorbents) to clean up spills that will minimise the generation of contaminated waters - erosion and sediment control structures are placed to minimise erosion of disturbed areas and prevent the contamination of any waters - an inspection and maintenance program for the erosion and sediment control features - provision for adequate access to maintain all erosion and sediment control measures especially during the wet season months from December to March - identification of remedial actions that would be required to ensure compliance with the conditions of the environmental authority • Erosion protection measures and sediment control measures will be implemented and maintained to minimise erosion and the release of sediment and contamination of stormwater from disturbed areas **Construction phase** *Access* • Where present, topsoil will be stripped across the RoW and trench for re-use • Topsoil and subsoil will be stockpiled separately within the easement and all necessary measures will be taken to prevent contamination • Topsoil will be placed on the high side of the RoW on hills and slopes where practicable and safe to do so • Where access is required in the long term, tracks will be constructed with a gravel surface and maintained to permit all weather access. Where access is required for temporary (construction) use only, disturbed areas will be rehabilitated • Construction activities will be scheduled to occur during dry season (April to September) to reduce the risk of adverse weather conditions • Disturbed areas will be graded to a level consistent with lands adjacent, pre-stripped topsoil replaced and erosion protection measures installed

Item	Detail

	Clearing and grading
	
	• Clearing and grading will be conducted in a manner that:
	  – limits the right of way width to a maximum of 30 m except as otherwise authorised by the administering authority in writing
	  – minimises disturbance to land in order to prevent land degradation
	  – ensures that for land that is to be significantly disturbed by petroleum activities (except in areas of highly erosive soils), the top layer of the soil profile is removed; and (a) stockpiled in a manner that will preserve its biological and chemical properties, and (b) used for rehabilitation purposes in accordance with condition
	• Cleared vegetation or soil will not be pushed up against trunks of trees
	• Cleared vegetation and soil will not be stored against fence lines
	• Soil stockpiles will not be placed within the bed or banks of watercourses
	• The stockpiles will be breached in suitable locations (coinciding with designated access roads or tracks, fence lines) to allow vehicular, stock and wildlife access. Vehicular movement over stockpiled soil will not be allowed
	• Soil and surface stability will be maintained at all times (eg temporary erosion control berms, drains and sediment barriers will be installed as necessary and maintained until final construction clean-up is completed)
	• Install, maintain and monitor erosion and sediment control devices (eg berms, jute matting) so that ground is stable and vegetation cover is maintained and promoted
	• Ensure that runoff control devices (eg whoa boys) are maintained and work at all times to prevent erosion
	• Carry out excavation works in conformity with the provisions of the construction EMP
	• Install permanent erosion controls around active erosion adjacent to the RoW and watercourses as needed to keep areas stable
	• Maintain sediment control devices to ensure they remain effective including emptying regularly
	• Consider erosion potential, sedimentation and land contamination issues when formulating incident specific emergency responses
	• Sediment control measures will be used to preserve stockpiled soils to prevent siltation of any land surface and water or blockage of any existing drainage channels
	• Where erosion management structures are impacted they will be reinstated as quickly as practicable or alternative structures erected to retain an adequate level of erosion control
	• Temporary and permanent erosion control banks will be installed across slopes and in the vicinity of drainage lines along the easement as necessary to avoid and control stormwater (ie temporary drainage diversion control measures will be installed along the easement and in lay down and storage areas as necessary to avoid and control stormwater runoff)
	• Permanent trench breakers will be placed at regular intervals along sloping trenches, at the bases of slopes, adjacent to water bodies and wetlands and at road crossings
	• Location of trench breakers will be marked prior to backfilling
	• Erosion control measures put in place prior to construction will be recontoured to the original conditions as soon as practicable following construction, in consultation with the landholder
	• An inspection and maintenance program for the erosion and sediment control features will be developed
	• Inspection and maintenance of erosion control devices will ensure adequate access to control devices and identification of measures required to remediate any failures

Item	Detail
	• In sodic soil areas, the following measures will be applied: – Energy dissipaters at the end of contour banks – Avoid unnecessary exposing or disturbance of sodic soils – Retention of topsoil – Capping of sodic soils with other material (eg non sodic soils) – Avoiding ponding of water on site, allow water to drain from the site and disperse *Trenching* • Known contaminated areas will be identified on field maps, located on site, fenced and avoided • Trenching supervisor will be instructed in process for handling previously unidentified contaminated areas (eg dip, waste pit) or acid sulfate soil (ASS) in the event that any such areas are uncovered during trenching. These will include: – Cessation of trenching at the location – Relocation and recommencement of trenching 50 m ahead – Advising Construction Manager and completing an assessment of the potential contamination. This may require the collection and analysis of the soil – Initiating suitable remedial action based on the assessment. This may include deviating around the site • Topsoil stockpiles will not exceed 1.5 m in height • Trench spoil (sub soils) will be stockpiled separately to topsoil and vegetation • Where practicable, additional topsoil and subsoil from places where cut and fill is required will be stockpiled in a temporary work space, wherever possible, practicable or relevant • Soil stockpiles near drainage lines will be bound with silt fencing on the down slope and placed at least 10 m away (where practicable) from banks (ie unless otherwise outlined in other management plans (eg SSMP) soil stockpiles will be located at least 10 m from the high banks of water courses) • Areas of potential ASS will be clearly marked on construction drawings. Where potential or actual ASS is disturbed during trenching, trench must be stockpiled within a contained area • Trench spoil will be stockpiled outside watercourses, and/or behind containment structures so as to prevent siltation of any land or surface water or blockage of any existing drainage channels • Regular gaps and spaces in the topsoil, subsoil and vegetation stockpile will be provided for fauna movement • The distances between gaps in stockpiles will be reduced at approaches to stream crossings • Trench plugs will be utilised at regular intervals to minimise erosion and allow access across the RoW • The pipeline trenches will be left open for the minimum time practicable • The trench will not be left open for extended periods on slopes leading to drainage lines or watercourses • Temporary sediment and erosion control devices will be reinstated

Item	Detail

	Pipe laying and backfilling
	• Compaction will be carried out in layers and will use techniques and equipment that will not damage the pipeline or pipeline coating
	• Pipe laying crews will prepare for identified third party crossings and will have materials and equipment available
	• Gentle crown to be left over the trench line to allow for future settlement of soils, with breaks to allow for natural surface water flows across the RoW
	• Measures including pipeline markers will be used to alert third parties to the presence of the buried pipelines. Markers will be installed with consideration to land use
	• Topsoil will not be used as bedding material
	• Topsoil will only be reinstated after the excavated spoil has been backfilled and compacted
	• Compaction is to be completed prior to spreading topsoil
	• Erosion berms will be constructed across the RoW on slopes to divert rainfall runoff away from the RoW and to discharge onto stabilised areas
	• Measures will be installed to prevent subterraneous water movement along the backfilled trench
	• Where possible original trench material will be reused to backfill, otherwise measures will be installed to provide a barrier against preferential flow paths associated with backfilled trench
	• Mounding of the trench backfill to allow for sufficient settling and no development of a linear depression for ponding of water
	Rehabilitation
	• Rehabilitation will be undertaken in accordance with the LRMP (refer Appendix G) and will typically include the following:
	• Rehabilitated areas must be maintained to ensure:
	  - Stability
	  - Erosion control measures remain effective and stormwater runoff does not negatively affect waters
	  - Plants show healthy growth and recruitment is occurring
	  - Declared pest plants are controlled to a level consistent with the surrounding property and prevented from spreading to unaffected areas
	• Subsoil will be respread and compacted over the trench, with crown development, and used for the construction of contour banks on steep slopes and above banks at water crossings
	• Areas of the RoW will be deep ripped prior to topsoil spreading in consultation with the landholder
	• The RoW will be re-profiled to original or stable contours, re-establishing surface drainage lines and other land features
	• Topsoil application will only take place after subsoil respreading and compaction and will be evenly spread and left with a slightly rough surface
	• Driving vehicles on freshly topsoiled RoW will be prohibited
	• Subsoil displaced by the pipe, and not utilised in backfill, may be stockpiled in locations for use during operations

Item	Detail

	• Imported topsoil, of a suitable quality and weed free, may be required for RoW repairs,
	• Flagging used to identify clearing boundaries and sensitive features will be removed
	• Erosion and sediment control measures will be installed. Existing soil erosion measures will be reinstated to a condition at least equal to the pre-existing state
	Fertilisers and soil supplements will be used only as necessary with the agreement of authorities
	Specific soils
	Sodic Soils
	• Sodic Soil topsoil removal will be limited to the area along the trench and where subsoil is to be placed
	• Clearing methods, in sodic soils, will be utilised that minimise ground disturbance and maintains root stock as far as possible
	• In areas of sodic soil, vegetation will be mulched to provide additional organic matter to the soil for the reinstatement process
	• In areas of sodic soil additional soil and erosion control measures will be implemented where evidence or erosion or scouring is found
	• Areas of sodic soil will be clearly marked on alignment sheets
	• Where strongly or very strongly sodic and/or dispersive materials are identified they will not be used for rehabilitation purposes. Suspected sodic or dispersive materials exposed as a result of site earthworks will be treated in accordance with the soil management procedure
	Acid Sulfate Soils (ASS)
	• ASS/PASS are not expected to be encountered on the Curtis Island RoW, should the soils be identified on the RoW then the following mitigation measures would be applied.
	• Management of ASS will be undertaken in accordance with the ASSMP (refer Appendix B). and will typically include the following:
	• An ASS investigation will be undertaken for the proposed linear disturbance (excavation, filling) on land areas that may potentially contain ASS (including all areas <5m AHD) according to the Guidelines for Sampling and Analysis of Lowland Acid Sulfate Soils (ASS) in Queensland 1998
	  - Detailed management measures will be provided in accordance with the Queensland Acid Sulfate Soil Technical Manual, Soil Management Guidelines 2002 to the administering authority at least 20 business days prior to commencement of excavation or filling activities within areas identified as potential for containing ASS in the investigation outlined above
	  - Due regard to any comments provided by the administering authority will be taken when implementing ASS management measures
	• The location of AASS or PASS will be clearly indicated on design drawings, alignment sheets and in the field. Cross references will be made to relevant management protocols
	• Where potential or actual ASS is disturbed during trenching, the spoil must be stockpiled within a contained area
	• If ASS material is excavated, immediate steps will be undertaken to segregate and contain the material within approved areas and dealt with according to the established ASSMP

Item	Detail
	Land Contamination • Consultation will continue with landholders prior to construction to determine whether any potential areas of contamination are located within the RoW • A suitably qualified person will be onsite to identify any evidence of contamination in sections of the pipeline • Site-specific and contaminant-specific management measures will be developed for any areas that are not avoidable through realignment of the pipeline • If suspect contamination is found during earthworks, work in that area will stop until a suitably qualified person has inspected the site, the hazard has been assessed and action has been taken • DERM approval will be obtained if contaminated material must be removed from the work area • All personnel will be made aware of potential contamination issues during induction training • Within 3 months post construction, where land has been subject to contamination caused by petroleum activities, the contaminated land status must be investigated in accordance with *Environmental Protection Act 1994* requirements and the *National Environment Protection (Site Assessment) Measure 1999* • Known contaminated areas will be identified on field maps, located on site, fenced and avoided • Trenching supervisor will be instructed in process for handling previously unidentified contaminated areas (eg dip, waste pit) or acid sulfate soil (ASS) in the event that any such areas are uncovered during trenching. These will include: - Cessation of trenching at the location - Relocation and recommencement of trenching 50 m ahead - Advising Construction Manager and completing an assessment of the potential contamination. This may require the collection and analysis of the soil **Operational phase** • Typical mitigation and controls for the operational phase of the Project will be detailed in the Operational Management Plan, which will be developed prior to construction
Performance indicators	• Erosion is controlled to a degree that is consistent with natural processes • Land capability is not being reduced • Erosion control strategies are functional • Topsoil is stored separately and no spoil piles remain on surface after restoration

8. Land tenure and use

8.1 Chapter summary

This section provides a summary of existing land tenure and use along the Curtis Island GTP RoW and identifies potential impacts to land tenure and use as a result of proposed construction and operation activities.

8.1.1 Summary of existing land tenure and use

- Curtis Island is State-owned land and lies within the Great Barrier Reef World Heritage Area (GBRWHA) and is part of the Gladstone State Development Area (GSDA)
- Curtis Island National Park occurs on the eastern side of the Island
- The Curtis Island GTP will pass through the Materials Transportation and Services Corridor (refer Section 8.2)
- The Curtis Island GTP RoW will be constructed on Freehold land (owned by the State)
- Current land uses in the southern section of Curtis Island include:
  - Agricultural
  - Industrial
  - Conservation
  - Tourism
  - Recreation

8.1.2 Summary of potential impacts to land tenure and use

The Curtis Island GTP is to be strategically placed to avoid interference and adverse impacts on existing land uses where practical. In addition, the route of all GTPs through the GSDA follows the Materials Transportation and Services Corridor as specified in the GSDA Development Scheme. Furthermore land directly affected and immediately adjoining the RoW is solely freehold land owned by the State which simplifies the level of co-ordination required with landholders. This said, potential impacts to land uses during construction and operation of the Curtis Island GTP include:

- A temporary restriction of agricultural and grazing activities during construction
- Restricted access to the project area
- Reduced visual amenity as a result of earthworks and removal of vegetation
- Reduced visual amenity during operation as a result of signage and mainland valves

8.1.3 Summary of proposed mitigation measures for land tenure and use

Table 8.1 Environmental protection commitments, objectives and control strategies – land tenure and use

Item	Detail
Environmental protection objective	• To minimise any social disruption to the local communities from the construction of the pipeline • To minimise potential impacts to third party infrastructure during the construction of the pipeline
Specific objectives	• No warranted complaints from landholders and the community, and warranted complaints responded to within two working days • Minimal interruption to third party infrastructure • No unauthorised impacts on third party infrastructure
Control strategies	Refer Table 8.2 for land use mitigation measures to be implemented during construction and operation of the Curtis Island GTP

Item	Detail
Performance indicators	• Record the number of complaints received from stakeholders and the time taken to investigate, take suitable action and close out. Warranted complaints to be responded to within two working days • Report on the performance in management of complaints to the Gladstone Regional Coordination Committee

8.2 Existing land tenure and use

Curtis Island adjoins the Great Barrier Reef Coast Marine Park (Queensland) and the Great Barrier Reef Marine Park (Commonwealth). However, as the GTP corridor is outside these areas, it is not an Environmentally Sensitive Area (ESA) as defined in the Coordinator-General's (CG) conditions for the whole of the Project (refer Chapter 1). Curtis Island does fall within the Great Barrier Reef World Heritage Area and is principally State-owned land, including land which has been set aside for the Gladstone State Development Area (GSDA), land within the Curtis Island State Forest and land designated as Conservation Park. The balance of the island is land within the Curtis Island National Park which occupies the eastern part of the island.

The Curtis Island GTP will pass through the Curtis Island Corridor Sub-Precinct of the Materials Transportation and Services Corridor as shown in the *Gladstone State Development Area Development Scheme (December 2010)* (GSDA Development Scheme), except for its final section where it enters the site of GLNG Facility, located in the Curtis Island Industry Precinct.

The construction of the GTP within the area identified as the Curtis Island Corridor Sub-Precinct of the Materials Transportation and Services Corridor, is considered to be "highly likely" of meeting the objectives of Schedule 3 of the GSDA Development Scheme. A development application for a material change of use will be made under the GSDA Development Scheme.

8.2.1 Easements

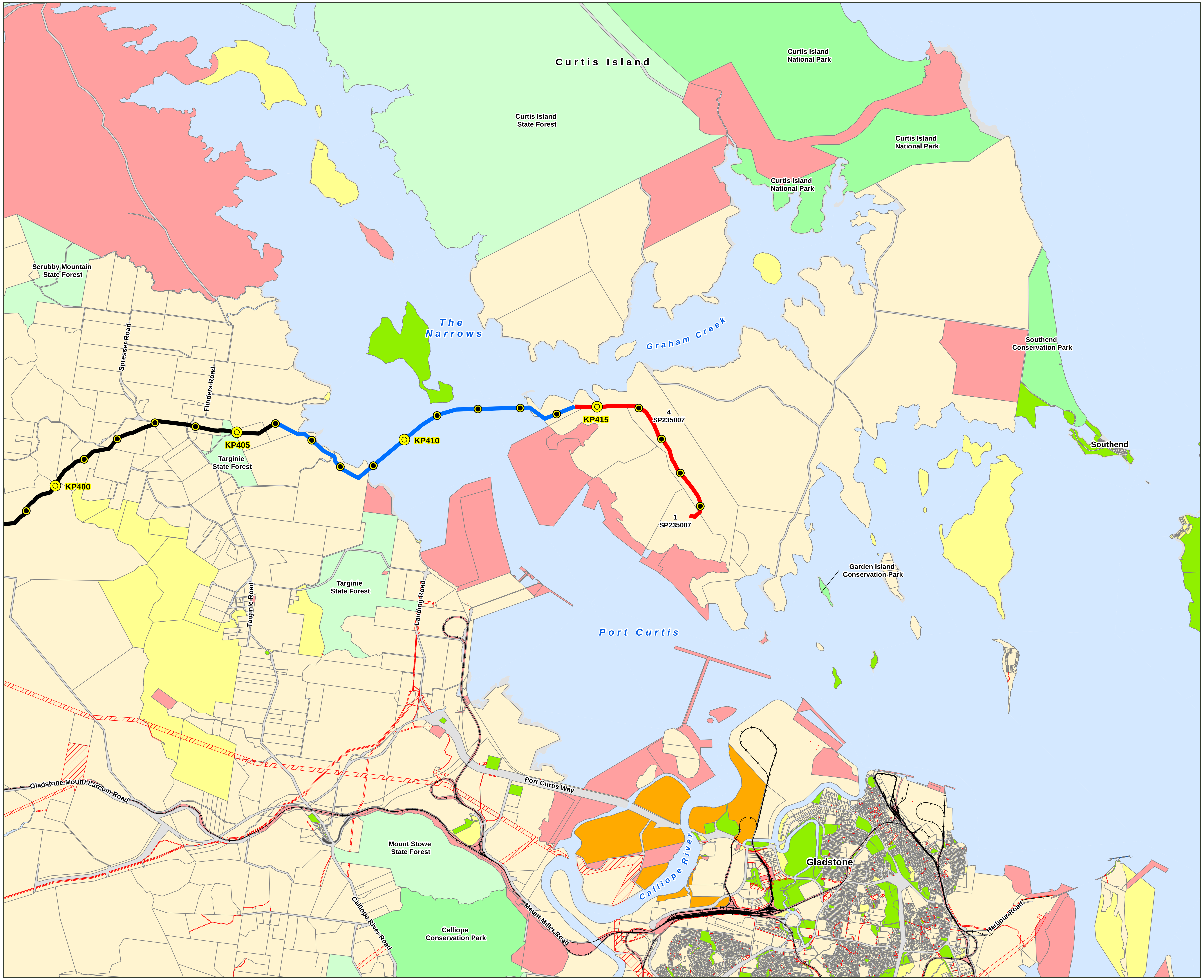
The Curtis Island GTP does not cross any existing easements and is not located near to any existing easements. An easement will be established for the Curtis Island GTP. Other CSG proponents are also likely to seek similar easements in the vicinity as the Queensland Government has expressed a preference for the GTPs to be contained within a common pipeline corridor across the GSDA.

8.2.2 Land tenure

The land at the southern part of Curtis Island, through which the Curtis Island GTP will pass, is Freehold Land owned by the CG (Lot 4 on SP2350007) and Santos CSG Pty Ltd (Lot 1 on SP2350007). The other areas of Curtis Island outside the RoW consist of Freehold, Leasehold, National Park, State Forest and Reserve land tenure types. Figure 8.1 identifies the land tenures for Curtis Island and nearby areas.

8.2.3 Resource tenures

The Curtis Island GTP contains only one registered resource tenure application for an Exploration Permit (Minerals) (refer Figure 8.2). No other resource tenures currently apply (ie mining leases, mineral development leases, exploration permits (coal), petroleum leases, or petroleum permits).



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Map by: RB

A1 scale: 1:50,000

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GLNG No: 3381-40-0475

Coordinate system: GCS_GDA_1994

Curtis Island GTP EM Plan

Gas Transmission Pipeline (GTP)
- Mainland GTP EM Plan
- Marine Crossing GTP EM Plan
- Curtis Island GTP EM Plan

Kilometre Post Distance Marker
- 5km
- 1km

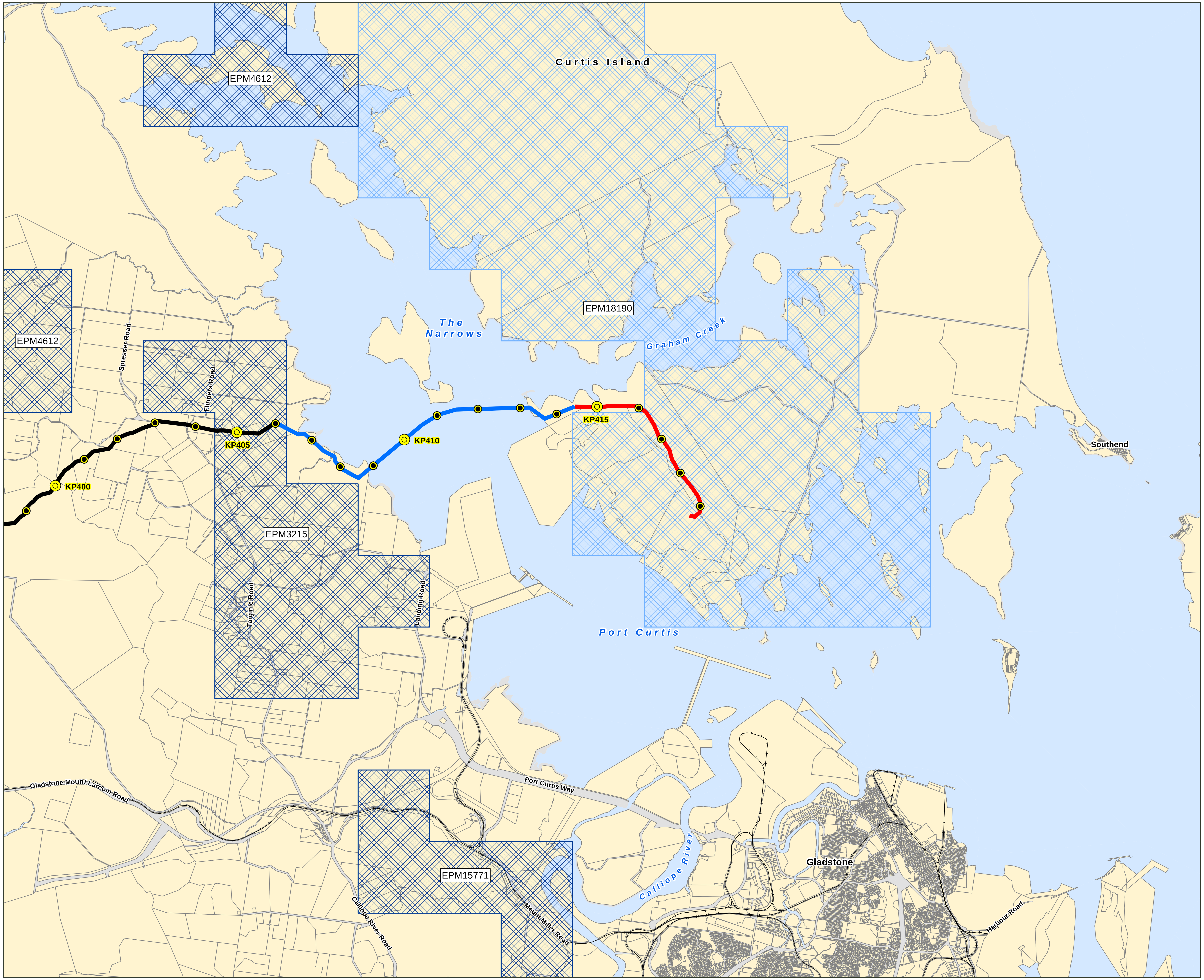
Land Tenure
- Freehold
- Housing Land
- Industrial Estates
- Lands Lease
- National Park
- Port and Harbour Boards
- Reserve
- Railway
- State Forest
- State Land
- Easement
- Road Parcel
- Water Parcel
- Rail

Source:
Gas Transmission Pipeline (GTP): Santos, Jan 2011.
Cadastre, Tenure and Easements: Department of Environment and Resource Management, Jun 2011.

Note:
Lot and Plan details given only for cadastre intersecting Curtis Island GTP

Land Tenure
Figure 8.1

Date: 18/08/2011 Version: 1



Curtis Island
GTP EM Plan

Gas Transmission Pipeline (GTP)
- Mainland GTP EM Plan
- Marine Crossing GTP EM Plan
- Curtis Island GTP EM Plan

Kilometre Post Distance Marker
- 5km
- 1km

Exploration Permit for Minerals
- Granted
- Application
- Rail
- Cadastre

Source:
Gas Transmission Pipeline (GTP): Santos, Jan 2011.
Cadastre: Department of Environment and Resource Management, Jun 2011.
Resource Tenure: Department of Mines and Energy, Feb 2011.

Resource Tenure: Exploration Permit for Minerals
Figure 8.2

A1 scale: 1:50,000

0 1,000 2,000 3,000 4,000 5,000 m

GLNG No: 3381-40-0476

Coordinate system: GCS_GDA_1994

Date: 18/08/2011

Version: 1

Map by: RB P:\GIS\Projects\214208_Santos_EMP\Cl_014.mxd 18/08/2011 09:53

8.2.4 Land use

The key land uses of the southern part of Curtis Island (and the wider area) are identified in Figure 8.3. Those of relevance to the Curtis Island GTP section are agricultural (grazing natural vegetation) and conservation. Curtis Island is currently being developed for industrial uses. Recreation and tourism is also relevant to the wider area. These are discussed below.

Agricultural

The southern part of Curtis Island supports cattle grazing. This agricultural use also occurs on other parts of Curtis Island and has led to conservation action being introduced to protect significant habitat. The cattle grazing is taking place on land that is not identified as GQAL (refer Section 7).

Industrial

The south-western corner of Curtis Island is designated as the Curtis Island Industry Precinct in the GSDA Development Scheme. This precinct is to play a significant role in regional and national economic development being the location of heavy industry processing natural gas to be exported as LNG. It will also provide a source of local employment and generate activity for service industries in Gladstone.

While much of the Curtis Island Industry Precinct has been assigned to industrial use, there are also parts of the precinct that have been designated as wetlands and/or marsh land for conservation purposes.

Conservation

While much of the southern part of Curtis Island is located in the GSDA, a large section of the GSDA is designated as the Environmental Management Precinct. This adjoins land held in reserve or for other conservation purposes such as the Southend Conservation Park. To the north is the Curtis Island State Forest, the Curtis Island Conservation Park, and the Curtis Island National Park (refer Figure 8.4a to 8.4b).

Recreation and tourism

Curtis Island provides for recreation and tourism based on the natural values of the island and also due to its close proximity to the Great Barrier Reef Coast Marine Park. The eastern section of the island is a popular camping destination.

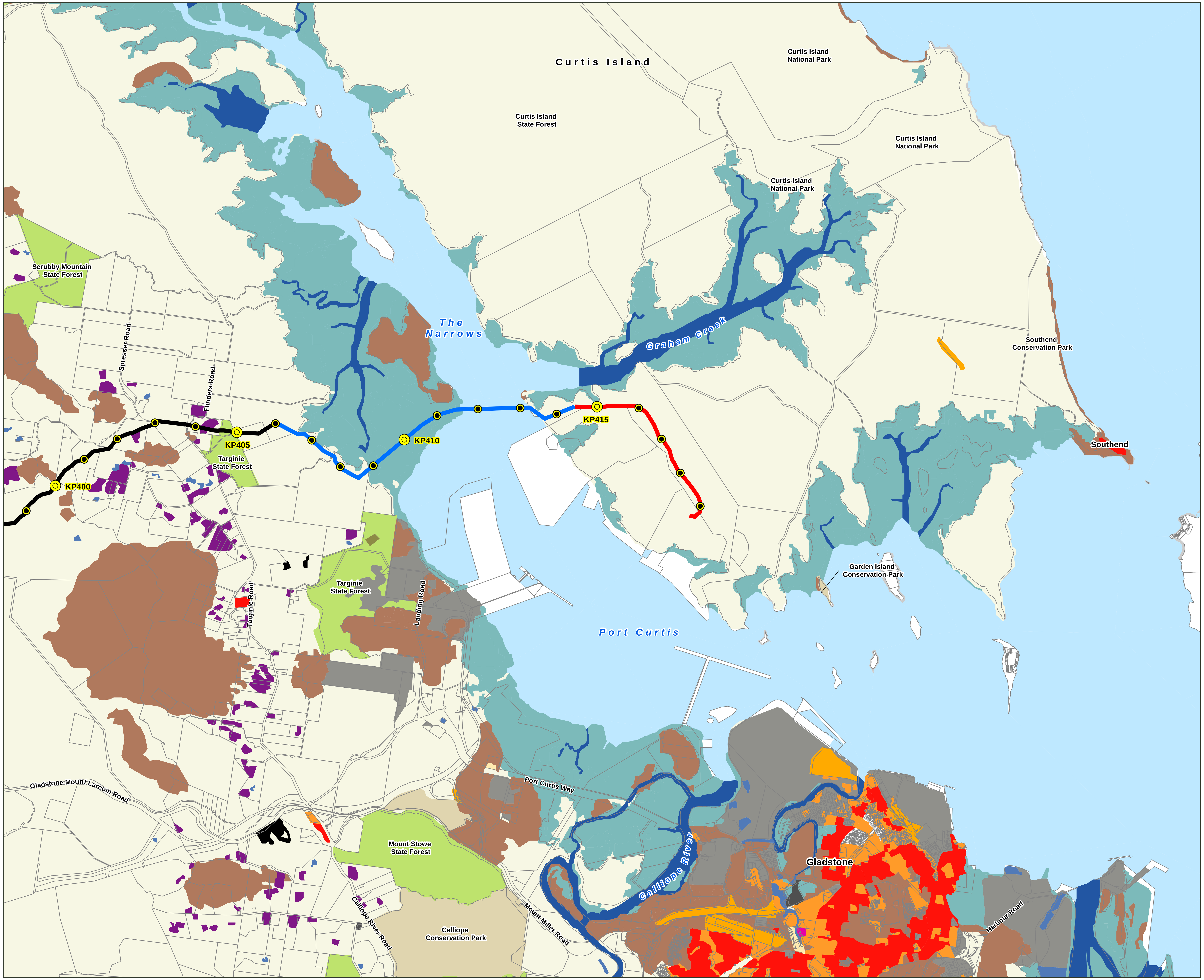
The camp sites at Southend on Curtis Island are accessible by boat from the Gladstone Port via Farmers Point on Facing Island. Boating lines, walking and 4WD tracks provide access to the dwellings and camp sites located in Southend. This coastal camping area provides a point from which to base visits to the national parks of the area.

8.2.5 Population centres and nearby residences

As Curtis Island is predominately occupied by precincts of the GSDA, State Land, National Park, and Conservation Parks the nearest major population centre is Gladstone. Gladstone, which is located approximately 7 to 8 km away, has a population of approximately 28,808.[1]

Southend is a township at the southeastern corner of Curtis Island that contains a small number of dwellings and tourist accommodation.

[1] Australian Bureau of Statistics, *Census 2006*



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A1 scale: 1:50,000

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GLNG No: 3381-40-0477

Coordinate system: GCS_GDA_1994

Curtis Island GTP EM Plan

Gas Transmission Pipeline (GTP)

- Mainland GTP EM Plan
- Marine Crossing GTP EM Plan
- Curtis Island GTP EM Plan

Kilometre Post Distance Marker

- 5km
- 1km

Queensland Land Use Mapping Program (2004)

- Nature conservation
- Other minimal use
- Grazing natural vegetation
- Production forestry
- Plantation forestry
- Irrigated perennial horticulture
- Intensive horticulture
- Manufacturing and industrial
- Residential
- Services
- Utilities
- Transport and communication
- Mining
- Waste treatment and disposal
- Reservoir/dam
- River
- Marsh/wetland
- Cadastre

Source:
Gas Transmission Pipeline (GTP): Santos, Jan 2011.
Cadastre: Department of Environment and Resource Management, Jun 2011.
Queensland Land Use Mapping Program: Queensland Land UseMapping Program1999 with updates from 2004.
Queensland Government, 1999, 2004.
Cadastre: DERM, Jan 2011.

Note: Cadastral boundaries shown only for non residential areas

Land Use
Figure 8.3

Date: 18/08/2011 Version: 1

Curtis Island GTP EM Plan

Gas Transmission Pipeline (GTP)
- Mainland GTP EM Plan
- Marine Crossing GTP EM Plan
- Curtis Island GTP EM Plan

Kilometre Post Distance Marker
- 5km
- 1km

- Great Barrier Reef Marine Park (Cth)
- Great Barrier Reef Coast Marine Park (Qld)

Marine Park Zone
- Conservation Park Zone
- General Use Zone
- Habitat Protection Zone
- Marine National Park Zone

Cth - Commonwealth Great Barrier Reef Marine Park
Qld - Queensland Great Barrier Reef Coast Marine Park

Source:
Gas Transmission Pipeline (GTP): Santos, Jan 2011.
Aerial: BING, 2011.
Queensland Great Barrier Reef Coast Marine Park, DERM, Feb, 2011.
Commonwealth Great Barrier Reef Marine Park, Great Barrier Reef Marine Park Authority, 2009.

Conservation Areas: Marine Park Zoning Figure 8.4a

A1 scale: 1:50,000

0 1,000 2,000 3,000 4,000 5,000 m

GLNG No: 3381-40-0478

Coordinate system: GCS_GDA_1994

Date: 08/04/2011 Version: 0

Map by: SLG P:\GIS\Projects\214208_Santos_EMP\CI_012.mxd 08/04/2011 09:36

Curtis Island GTP EM Plan

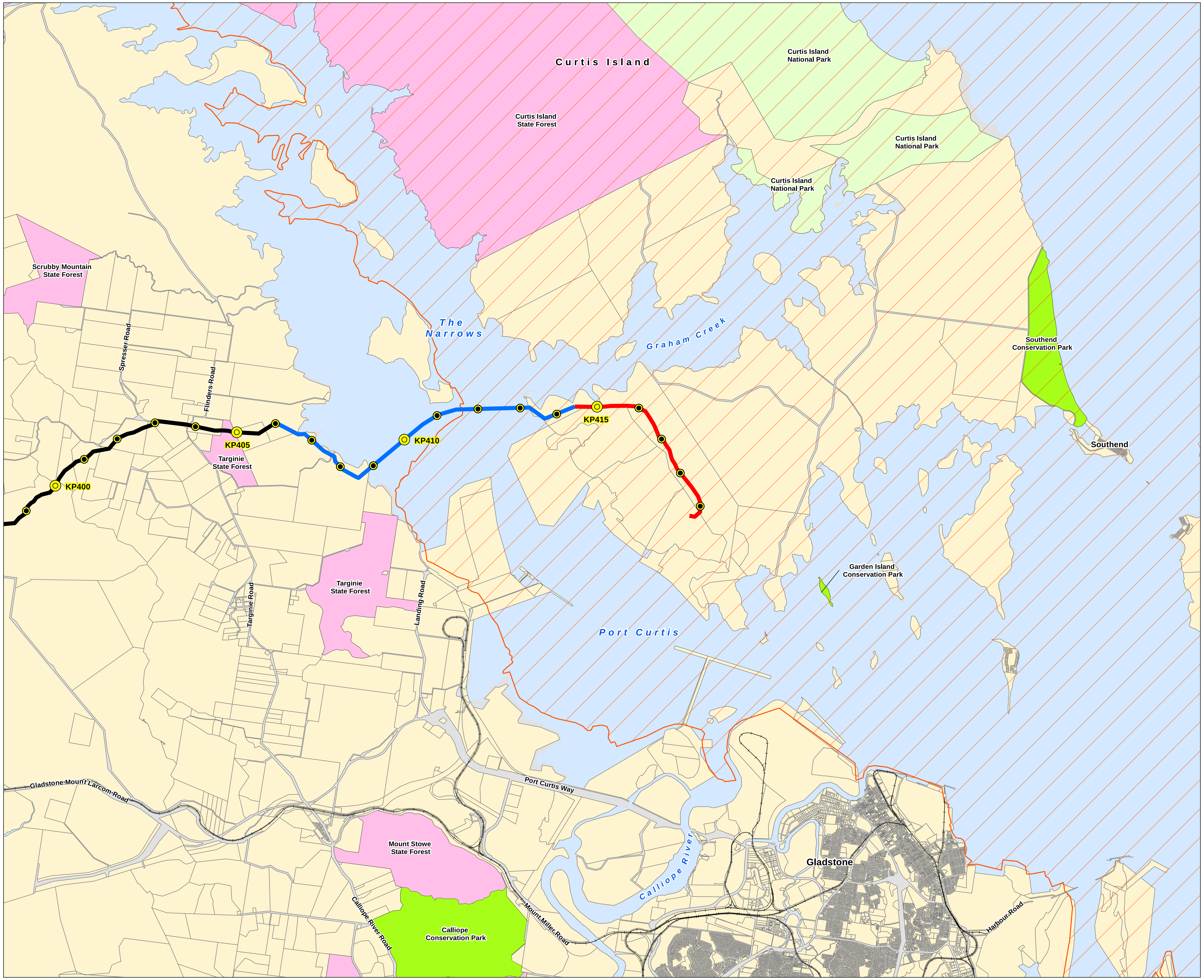
Gas Transmission Pipeline (GTP)
- Mainland GTP EM Plan
- Marine Crossing GTP EM Plan
- Curtis Island GTP EM Plan

Kilometre Post Distance Marker
- 5km
- 1km

- World Heritage Area

Protected Area
- National Park
- Conservation Park
- State Forest

- Rail
- Cadastre



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A1 scale: 1:50,000

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GLNG No: 3381-40-0479

Coordinate system: GCS_GDA_1994

Source:
Gas Transmission Pipeline (GTP): Santos, Jan 2011.
Protected Areas: Department of Environment and Resource Management, Jun 2011.
World Heritage Area: Department of Environment and ResourceManagement, Feb 2011.

Conservation Areas: World Heritage Area and Protected Areas Figure 8.4b

Date: 18/08/2011 Version: 1

8.2.6 Infrastructure crossings

The Curtis Island GTP crosses an access track near KP 416. At this stage, there are no other infrastructure crossings (eg road, rail, powerlines) within the project area.

8.2.7 Easements and major infrastructure

There are no easements or other major infrastructure (eg high voltage powerlines, pipelines) that exist within the RoW on the Curtis Island GTP. The nearest Exploration Permits (Minerals) are located on the mainland to the west of Curtis Island.

Future major infrastructure facilities on Curtis Island include the future LNG Facilities and the Fishermans Landing Reclamation Area.

8.2.8 Roads

The road system on Curtis Island is a mixture of gazetted but unformed roads, formed roads (often not on the gazetted alignment) and tracks. The majority of these roads are located along and near Southend on the eastern side of the island (refer Figure 8.1).

8.2.9 Stock routes

Although Curtis Island contains agricultural land uses, there are currently no stock routes intersecting the RoW.

8.2.10 Visual amenity

The Curtis Island GTP will be constructed in a bushland environment that is remote from populated areas. There will be no clear line of site from Gladstone or populated areas on Curtis Island to the Curtis Island GTP.

8.3 Potential adverse or beneficial impacts on land tenure and use (construction and operation)

8.3.1 Landholders and land use

The Curtis Island GTP is to be strategically placed to avoid interference and adverse impacts on existing land uses where practical. In addition, the route of all GTPs through the GSDA follows the Materials Transportation and Services Corridor as specified in the GSDA Development Scheme.

Land directly affected and immediately adjoining the RoW is solely freehold land owned by the State or Santos CSG Pty Ltd, which simplifies the level of co-ordination required with landholders.

The main potential impact of the Curtis Island GTP on agricultural land uses will occur during construction when agricultural and grazing activities will be temporarily restricted over the RoW. Land use can generally recommence following construction with landholders retaining full access and use of the surface area above the buried pipeline subject to some minor restrictions to preclude activities that would threaten pipeline integrity or significantly impede future access to the pipeline (eg construction above the pipeline, planting trees or invasive crops in close proximity to the pipeline, or installation of subsurface infrastructure). The terms and conditions are to be negotiated with each landholder and recorded in Land Management Plans that will be registered with the RoW.

The 30 m wide RoW for the Curtis Island GTP will provide sufficient area for all construction activities. As pipeline construction will advance at an average rate of approximately 1.8 km per day, the period that any one location is affected by the peak of construction activities will be limited.

There will be no need for temporary workers accommodation for the Curtis Island GTP as it is proposed to accommodate construction personnel at a construction camp on the mainland located at Calliope Camp – KP 355.

Land use impacts resulting from the construction and operation of the Curtis Island GTP are expected to be negligible and works will be undertaken in accordance with the control strategies outlined in Section 8.5.

8.3.2 Recreation

There is currently no restriction of access to the GSDA from other parts of Curtis Island. Recreational users of the island will have restricted access to the project area once construction commences and the GLNG Facility commences operations. The declaration of the GSDA for industrial uses has already signalled this end to any informal access for recreation.

No impacts on recreational users resulting from construction and operation of the Curtis Island GTP are expected.

8.3.3 Community

There will be no community access to the RoW. All personnel entering the RoW are required to complete environmental and safety inductions.

Consequently, there are no community related safety issues expected to result from construction and operation of the GTP.

8.3.4 Visual amenity

During construction, earthworks will be required involving the disturbance to the land and the removal of vegetation. This will have temporary impacts on the visual amenity of the area within the vicinity of the Curtis Island GTP. Rehabilitation of disturbed areas provides an opportunity to restore this visual amenity and ensure much of the visual impacts are temporary.

During operations, visual effects will be limited to warning signs and mainline valve since the proposed GTP is proposed to be underground. There will be a mainline valve located on Curtis Island within a small compound of approximately 20 m x 50 m.

Visual amenity related impacts resulting from the construction and operation of the Curtis Island GTP are expected to be negligible as the GTP RoW will not be seen from Gladstone or the populated areas on Curtis Island.

8.3.5 Infrastructure

There is no infrastructure and services existing within the proposed RoW of the Curtis Island GTP, with the exception of an access track near KP 416. Potential impacts on this access track will be managed as per the mitigation measures outlined in Table 8.2.

8.4 Cumulative impacts

The corridor affected by the GTPs is designated as the Gladstone State Development Area (GSDA). Informal public access is not permitted and no other significant formal existing land uses are identified within the RoWs. Therefore, cumulative impact of the RoWs on land uses within Curtis Island is not expected.

Implementation of mitigation measures set out in this EM Plan will result in negligible cumulative impacts on land tenure and use from pipeline construction within the GSDA corridor on Curtis Island.

8.5 Environmental protection commitments, objectives and control strategies – land tenure and use (construction and operation)

Table 8.2 Environmental protection commitments, objectives and control strategies – land tenure and use

Item	Detail
Environmental protection objective	• To minimise any social disruption to the local communities from the construction of the pipeline • To minimise potential impacts to third party infrastructure during the construction of the pipeline
Specific objectives	• No warranted complaints from landholders and the community, and warranted complaints responded to within two working days • Minimal interruption to third party infrastructure • No unauthorised impacts on third party infrastructure
Control strategies	**Construction phase** *Landholders and land use* • GLNG Operations will plan to locate infrastructure such as pipelines, roads and wells so that they will not adversely impact on existing landholder management practices such as placement of farm infrastructure, fences and erosion management structures • Workers' accommodation must be located to the satisfaction of the DERM and have regard to potential noise emissions in accordance with Draft State Planning Policy: Air, Noise and Hazardous Materials • Permanent pipeline warning signs will be erected along the easement • Where practicable temporary exclusion fencing to restrict fauna access to the trench will be installed • Where required along the route, temporary fences will be installed to protect humans and livestock • Fences or other barriers will be installed where appropriate and where approved by the landholder to minimise unauthorised access • Property fences and gates will be installed, maintained and reinstated to a condition at least equal to the pre-existing condition • Landholder complaints will be recorded in a complaints register and appropriate corrective actions will be implemented and closed out by the Environmental Manager • Rehabilitation of disturbed areas will be undertaken progressively as works progress • Rehabilitation can be considered successful when it achieves the same pre disturbed land use and suitability class with no greater maintenance requirements (or as otherwise agreed in a written document with the landowner/holder and administering authority) is established

Item	Detail
	Community • Contribute to local liveability programs and initiate a community consultation and awareness campaign to promote project benefits to the community *Visual amenity* • Existing roads and tracks will be used where practicable • Restricting access to the RoW and requiring all visitors and personnel to complete safety and environmental inductions • Workers' accommodation must be located to the satisfaction of the DERM and have regard to potential noise emissions in accordance with Draft State Planning Policy: Air, Noise and Hazardous Materials *Infrastructure* • New tracks will be located as close to fences or property boundaries as possible subject to the requirements of the landholder • The location of the existing third party infrastructure in the RoW will be accurately identified on the alignment sheets and marked physically on the ground prior to trenching activities *Transport* • Equipment and material transport routes and storage areas will be planned in consultation with Gladstone Regional Council, Department of Environment and Resource Management (DERM), Gladstone Port Corporation, Maritime Safety Queensland (MSQ), and the Gladstone Economic and Industry Development Board to minimise disruption to road and other transport route users • The Company and the Contractor shall enter into an Agreement with Council identifying the likely issues associated with road infrastructure related to the Project. This Agreement will identify the contribution attributable to the project for its specific impact on road infrastructure and identify the means of mitigating this impact **Operational phase** • Typical mitigation and controls for the operational phase of the Project will be detailed in the Operational Management Plan, which will be developed prior to construction
Performance indicators	• Record the number of complaints received from stakeholders and the time taken to investigate, take suitable action and close out. Warranted complaints to be responded to within two working days • Report on the performance in management of complaints to the Gladstone Regional Coordination Committee

9. Flora, fauna and world heritage values

9.1 Chapter summary

This chapter identifies the ecological attributes of the terrestrial environment associated with the Curtis Island GTP with respect to both Commonwealth and State legislation and the significance of these attributes from a local, regional, state and national perspective.

This chapter identifies the potential impacts that the Curtis Island GTP may have on local ecological values, and considers the potential cumulative impacts from a regional perspective. Mitigation measures for the protection of ecological values are outlined including management strategies to protect existing environmental values.

As mentioned in Chapter 2, it has been assumed as part of this assessment that the proposed Curtis Island GTP Right of Way (RoW) is 30 m wide (refer Figure 1.2).

9.2 Summary of existing flora and fauna values

- Curtis Island forms part of the NC Act listed World Heritage Management Area (WHMA)
- The Curtis Island GTP RoW is predominately located within a shallow, narrow valley between low metamorphic ranges. Dominant vegetation communities present include Spotted gum and Narrow-leaved ironbark woodlands. These are generally found on low hills on skeletal and rocky soils. These communities have been subjected to grazing and clearing and/or thinning in the past. A small number of mature trees bear hollows which would support populations of hollow-dependant species, including arboreal mammals, microbats and nocturnal birds
- Three heterogeneous REs (12.3.3/12.3.7, 12.3.7/12.3.11, and 12.11.6/12.11.14) and one homogenous RE (12.11.6) occur within the Curtis Island GTP RoW. Ground-truthing exercises have confirmed that RE mapping (version 6.0) provided by DERM has a high degree of accuracy (URS 2008)
- RE12.3.3/12.3.7 is mapped as 'endangered dominant' and is also recognised as a Category B ESA under the EP Act (ie due to the dominance of RE12.3.3, which has an endangered biodiversity status)
- RE12.11.6, which is no concern at present (biodiversity status), is the dominant community mapped along the RoW, approximately 49% of the RoW
- No conservation significant flora species listed under State and/or Commonwealth legislation were identified within the Curtis Island GTP RoW during field investigations. Furthermore, no species identified through database search results are considered likely to occur within the Curtis Island GTP RoW, based on the deficit of suitable habitat and/or the location of the RoW outside of the species' known distribution
- Of the 80 flora species recorded during the EIS process, 72 are native and are listed as Least Concern under the provisions of the NC Act. The remaining eight species recorded are exotic
- Two of the exotic flora species (Lantana and Common prickly pear) detected during field surveys are declared weeds under the provisions of the LP Act and are also listed in the Weeds of National Significance framework. The remaining 6 exotic species identified are considered general environmental weeds
- Type A restricted plants, as defined by the NC Act, have been detected within the Curtis Island GTP RoW, namely *Xanthorrhoea johnsonii* (Forest grass tree) and *Livistona decipiens* (Weeping cabbage palm)
- Of the 35 conservation significant fauna species identified by environmental databases, 21 are known to occur within a 5 km radius of the Curtis Island GTP RoW. Eight of the remaining 14 species identified are considered to have a moderate likelihood of occurrence within the Curtis Island GTP RoW, whilst seven are considered to have a low likelihood

- Field investigations identified an additional seven birds (listed as significant or migratory/marine) that occur within or adjacent to the Curtis Island GTP RoW (DSEWPaC 2011; Wildlife Online 2011)
- In totality 180 species, including 13 amphibians, 22 reptiles, 120 birds, and 25 mammals have been detected within and/or adjacent to the Curtis Island GTP RoW
- It is unlikely that the Curtis Island GTP RoW supports core habitat for many native amphibians. However, it is expected that native amphibians would be present during periods of water inundation and may utilise ephemeral waterways at these times for breeding
- Despite the high avian diversity with the Curtis Island region, it is unlikely that the Curtis Island GTP RoW provides core habitat for a number of the species detected within the region (particularly shorebirds) as a result of low foraging potential
- Three birds listed as vulnerable under the provisions of the NC Act have been detected within the vicinity of the Curtis Island GTP RoW, namely Powerful owl (*Ninox strenua*), Glossy black cockatoo (*Calyptorhynchus lathami lathami*) and Beach stone curlew (*Esacus neglectus*)
- DERM mapping illustrates Essential Habitat for the Koala (*Phascolarctos cinereus*) within REs 12.3.3/12.3.7 and 12.3.7/12.3.11 present within and adjacent to the Curtis Island GTP RoW. This mapping is based on habitat modelling, rather than actual records from the area
- It is considered unlikely that the mapped Essential Habitat that occurs within the Curtis Island GTP RoW provides core habitat for Koalas. Should this species occur within the south-western region of Curtis Island, population densities would be expected to be low
- Three pest species (listed under the provisions of the EPBC Act and/or LP Act) have been detected within, or within the vicinity of the Curtis Island GTP RoW during field investigations

9.3 Summary of potential impacts to flora and fauna

9.3.1 Construction

The construction of the Curtis Island GTP is expected to generate a range of impacts relating to ESAs (as described in Chapter 1), conservation significant fauna and flora, vegetation clearing, dust, weeds, edge effects, changes to fire regimes, erosion and sedimentation, loss of habitat, fauna injury and/or mortality, pests, noise and vibration, and lighting.

These impacts are considered to be relatively localised and the degree of impacts will likely be minimised to a manageable level with the implementation of appropriate measures described in Section 9.7, the SMP and SSMP.

9.3.2 Operation

From an operational perspective, impacts along the RoW are likely to be restricted to maintenance activities. Adverse impacts associated with maintenance activities may include clearing of any regrowth vegetation that emerges following the construction phase (where necessary). Beneficial impacts of the operational phase include the management of weeds within the Curtis Island GTP RoW.

An Operational Management Plan (OMP) will be developed prior to construction. Typical OMP control measures have been outlined in Section 9.7.

9.4 Summary of proposed mitigation measures for flora and fauna

Table 9.1 Environmental protection commitments, objectives and control strategies – flora and fauna

Item	Detail
Environmental protection Objective	• To minimise adverse impacts to flora and fauna, and avoid the spread of weeds and pathogens • To promote and maintain native vegetation cover site during operations
Specific objectives	• Minimal disturbance of terrestrial and aquatic flora and fauna during construction of the pipeline, associated tracks, services and accommodation facilities • No unplanned or unapproved damage to flora and fauna • No overall net loss of threatened species or communities • To appropriately rehabilitate RoW to pre-construction condition, as soon as reasonably practical after construction • To avoid the introduction or spread of weeds and pathogens and undertake weed control where required during construction • To ensure that pests, weeds and pathogens are controlled during operations at a level that is at least consistent with adjacent land • Where additional flowlines are required, regrowth will be promoted and maintained on the easement over the long-term to be consistent with the surrounding area • To minimise additional clearing of native vegetation as part of operational activities • To ensure that maintenance activities are planned and conducted in a manner that minimises impacts on native fauna
Control strategies	Refer to Table 9.14 for flora and fauna control strategies to be implemented during construction and operation of the Curtis Island GTP
Performance indicators	• No evidence of vehicle deviation from designated access tracks • No clearing outside marked RoW clearing boundaries • No mortalities of fauna or livestock as a result of project activities • No proliferation of weeds on the project site or immediate surrounds • Evidence of appropriate vegetation stockpiling and respreading during and following construction • All onsite vehicles have certification of appropriate washdown / cleanliness as per the requirements of the Proponents PWMP

9.5 Background

The Project EIS was approved as part of the EIS process which included flora and fauna surveys of the GTP RoW. Subsequent to the EIS a number of other environmental and ecological surveys have been undertaken within the local area, Table 9.2 outlines the environmental and ecological surveys undertaken on behalf of the Proponents, within the vicinity (ie <5 km) to the Curtis Island GTP RoW. A compilation of the results presented within these reports has been incorporated into this chapter, where relevant.

Table 9.2 Previous ecological assessments of the Curtis Island region

Date	Author	Report title	Assessment details
May 2008	URS	GLNG Project - Environmental Impact Statement	Comprehensive ecological survey of the GLNG RoW
December 2009	BAAM	Curtis Island Water Mouse, Powerful Owl and Wading Bird Investigation	Targeted assessment of the potential occurrence of, and habitat values for, Powerful Owl (*Ninox strenua*), Water Mouse (*Xeroyms myoides*), and migratory wading birds on properties located on the south-west portion of Curtis Island
September 2009	URS	GLNG Project - Environmental Impact Statement Supplement	Targeted searches for Koala (*Phascolarctos cinereus*) within mapped Essential Habitat areas of the Curtis Island RoW
August 2010	Sandpiper Ecological Surveys	Narrows Pipeline Crossing Review of Regional Shorebird Data And Discussion Of Impacts	A desktop assessment of the potential impact of The Narrows Crossing section of the QCLNG Coal Seam Gas Export Pipeline on migratory shorebirds, specifically Far Eastern Curlew, Whimbrel, Bar-tailed Godwit, Common Greenshank and Red-necked Stint, and the importance of habitat in the vicinity of the pipeline corridor to the local and regional shorebird population
October 2010	Ecologica Consulting	Significant Species Management Plan / Species Management Plan	Targeted survey within Endangered, Of Concern and Least Concern Regional Ecosystems within the GLNG RoW, focussing on the identification of threatened flora and fauna, assessment of habitat values for common and conservation significant species
October 2010	Footprints	Review of Shorebird Impacts within the Kangaroo Island Wetlands and the Narrows Crossing area	A desktop assessment of the shorebirds of the Kangaroo Island wetlands and The Narrows, and an evaluation of the impacts of the construction and operation of the GTP on the birds and their habitats
November 2010	Worley Parsons	Environmental Assessment of the Kangaroo Island Wetlands and The Narrows	An environmental assessment of the crossing of The Narrows, which addresses Matters of National Environmental Significance, and includes detail regarding terrestrial flora and fauna associated with the Kangaroo Island wetlands and Curtis Island
July 2010	GHD	Weed mapping along the GTP RoW	A targeted survey of the GTP RoW to identify and map the extent of weeds within the GLNG GTP RoW

9.6 Methodology

9.6.1 Desktop assessment

As part of the works the abovementioned studies were reviewed and information considered relevant and scientifically robust was extracted and forms the basis for describing the existing environment. In addition, these studies will also assist in qualifying and where necessary quantifying the potential impacts, construction and operation, and assessing the effectiveness of the proposed mitigation measures and commitments resulting from the EIS process. In addition to a review of the existing studies and reports, a search of the following environmental and ecological databases was also undertaken:

- EPBC Protected Matters Search Tool (EPBC report) provided by Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC)
- Wildlife Online (provided by DERM)

- Queensland Museum
- DERM's Environmentally Sensitive Areas – Chapter 5a Activities (*Environmental Protection Act 1994*)
- DERM's Regional Ecosystem (RE) Mapping Version 6.0
- DERM's Essential Habitat Mapping Version 3.0
- DERM's Regrowth Mapping Version 2.0
- DERM's Wetland info
- Queensland Herbarium Regional Ecosystem Description Database (Version 6.0b)
- Queensland Herbarium (HERBRECS)
- Bird's Australia Birdata

The limitations of the data are discussed within this section. In addition to the desktop assessment a review of recent legislation applicable to the above mentioned works was also undertaken.

Previous survey methodologies

The following section provides an overview of the methodologies adopted during the EIS and subsequent studies (refer Table 9.2), to describe the existing environment.

Flora

The flora survey undertaken to support the EIS focussed on the anticipated areas of disturbance for the Curtis Island GTP. The EIS flora survey (including both mainland and Curtis Island components) was conducted over three periods during May to October 2008 (dry season). A total of 32 days of field survey was undertaken by two qualified ecologists.

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) including the use of secondary transects, quaternary sample plots and random meander searches.

As part of the flora survey community structural formation classes were assessed according to Neldner *et al.,* 2005, and RE classification of communities was determined as per Sattler and Williams (1999), and in accordance with the RE Description Database (REDD) Version 6.0b (DERM, 2011).

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).

Twenty quaternary and eleven secondary sites (Neldner *et al.,* 2005) were assessed within or adjacent to the Curtis Island RoW (URS 2008).

A subsequent flora survey was conducted within the revised Curtis Island RoW by Ecologica Consulting in August/September 2010. This survey was a targeted threatened species survey of the ROW, based on Cropper 1993.

Combined, all these assessments aimed to:

- Identify and describe the status of the vegetation within and adjacent the RoW on a local, regional and national scale (eg EPBC listed Threatened Ecological Communities)
- Verify and delineate DERM's RE mapping
- Describe the extent, floristic structure and composition of vegetation communities
- Identify of the ecological values associated with the vegetation on the site

- Identify and delineate the extent of significant flora species, listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and *Nature Conservation Act 1992* (NC Act), populations within and adjacent the RoW
- Assess the diversity of terrestrial vascular flora within the study area and identification of environmentally sensitive areas (ESAs)
- Describe and map the extent of weed species and their distribution in the study area
- Identification of the potential impacts relating to the construction and operation of the GTP on the surrounding vegetation in order to develop appropriate management strategies

Fauna

Field-based fauna assessments focused on the anticipated areas of disturbance for the proposed Curtis Island GTP, and the surrounding areas (ie LNG Facility).

An EIS fauna survey was conducted over a ten-day period between 14 and 23 May 2008 (URS 2008). The fauna survey was undertaken in keeping with the accepted standard methods for the systematic survey of terrestrial fauna in eastern Australia (Eyre *et al*, 1997 and EPA, 1999) and a number of non-standard observational methods (URS, 2008).

BAMM also undertook a targeted survey for the Powerful owl (*Ninox strenua*), Water mouse (*Xeromys myoides*) and wading birds. One Water mouse survey site was assessed adjacent to the Curtis Island RoW (BAMM 2009). The survey involved an active search of suitable habitat. It should be noted that since the survey was conducted more rigorous guidelines for the Water mouse (ie Draft *Significant Impact Guidelines for the Vulnerable Water Mouse* (*Xeromys myoides*) *(*DEWHA 2009)) have been developed. However it is noted that the works will not occur within known Water mouse habitat.

A comprehensive literature review to describe the values of the area for migratory and resident shorebird species was undertaken by Sandpiper, Worley Parsons and Footprints. Additional fauna surveys have also subsequently been conducted along the Curtis Island GTP RoW and adjacent areas (Ecologica, 2010; BAAM 2009).

Where dense vegetation precluded access to the RoW, alternative sites were chosen to reflect similar dominant vegetation communities based on ease of access. The surveys sampled principal habitat types within the vicinity of the RoW, based on knowledge of the site gained during the desktop assessment, aerial photograph interpretation, the LNG Facility study and a scoping foray.

A series of targeted fauna assessments predominately focussed on searches for conservation significant species (including Koala), identification of suitable habitat for common and conservation significant species, anabat recording, and trace identification (ie scats, scratches etc) were also undertaken. Incidental species encountered (including fly-overs) were also recorded as part of these assessments.

9.6.2 Limitations to previous survey methodologies

Field surveys

Data acquisition during flora surveys can have inherent limitations especially in relation to variability of vegetation communities across a site, and changes to the detectability and presence of species as a result of seasonal influences. All survey sites were strategically located to capture representative samples of communities and the seasonal conditions during which the surveys were undertaken. The sites selected were conducive to a relatively high degree of detectable floral diversity. However, flora surveys conducted on Curtis Island did not present 100 percent floral diversity.

Similarly, all fauna surveys are subject to inherent limitations in the detection success of target species. Some fauna species may become more cryptic (ie harder to find) or are transient species that typically become absent during certain periods due to a variety of reasons (eg weather conditions, absence of food sources, migratory nature). For migratory or nomadic species not recorded during field investigations, habitat assessments have been completed to determine the likelihood of their occurrence within, and/or adjacent to the Curtis Island GTP RoW.

These limitations often result in a degree of false-absence records (ie a species is present, but not detected). It is important, therefore, that the limitations to fauna surveys are identified and the fauna survey results are viewed with these constraints in mind.

A summary of the limitations to the fauna surveys conducted include:

- Temporal variation is limited as there was a one off comprehensive survey
- The survey period not coinciding with the period that some migratory or nomadic species occur in the locality
- Species with a large home ranges (eg owls and raptors) were not present in this part of their home range during the survey period
- The difficulty in detecting certain species during the survey period (eg cryptic species, species present in the study area at very low densities, and trap-shy species)
- Biological factors such as sex, age-class, and breeding biology, which may influence species' habitat use and detectability during different times of the year
- The lack of suitable climatic conditions necessary for the presence and/or detectability of certain species (eg amphibians following heavy rainfall)

Database results

Caveats are attached to the information gained from database searches, including Wildlife Online and the EPBC Report. The Wildlife Online database search is primarily based on specimens that have been actually identified and recorded within the vicinity of the given location(s). Thus, the absence of specimen records for a particular species does not indicate that the species does not occur in the area. Furthermore, species records may be dated, and thus may not provide an accurate representation of the species currently found within the region.

Results of the EPBC report is based on a combination of actual records (primarily from State Government databases), combined with modelled distributions of species according to their ecological characteristics. Not all species listed under the EPBC Act have been mapped and therefore the EPBC Report is to be used as a general guide only.

Species record data received through the Queensland Museum and Queensland Herbarium (HERBRECS) may vary in precision (accuracy) up to approximately 100 km in some cases. Furthermore, some of the species records may be dated (ie pre 1950), and thus may not provide an accurate representation of species that currently exist within the region.

These factors have been considered when describing the existing environment, including the likelihood of a species inhabiting an area.

9.7 Existing ecological environment

9.7.1 Regional and site context

The Curtis Island GTP RoW is situated within the South-East Queensland bioregion, close to the adjoining Brigalow Belt bioregion (Sattler and Williams, 1999) and is located within the Burnett-Curtis Hills and Ranges sub-region. It should be noted that the RoW is situated within close proximity to the northern-most periphery of this sub-region, bordering on the Marlborough Plains sub-region of the adjacent Brigalow Belt bioregion.

Typical landforms on Curtis Island include moderate to steep wooded slopes, wooded alluvial plains, ephemeral watercourses, estuarine systems and fresh and saltwater wetlands.

The Curtis Island GTP RoW is located adjacent to the intertidal areas of Graham Creek (refer Figure 1.2). Saltpan and mangrove communities are present within these sheltered intertidal zones, outside of the Curtis Island GTP RoW.

The Curtis Island GTP RoW is to be constructed primarily in the basin of a narrow fluvial valley. The valley is dominated by *Eucalyptus* and *Corymbia* woodlands on moderate to low slopes.

The hill top and mid-slope areas of the Curtis Island GTP RoW support open forest dominated by *Corymbia citriodora* (Spotted gum). The ground layer within the open forest is considered to be relatively sparse due to the rocky substrate and shallow soils exhibited on the slopes and hills within the RoW. The lower slopes and flat, coastal areas generally support grassy woodlands dominated by *Eucalyptus tereticornis* (Queensland blue gum) and *Eucalyptus crebra* (Narrow-leaved ironbark).

As discussed in Chapter 1, and in accordance with the CSG Guidelines, Environmentally Sensitive Areas (ESAs) within and adjacent to the Curtis Island RoW have been considered.

A number of flora and fauna related ESAs (Category B and C) have been mapped by DERM as occurring within, and/or adjacent to the Curtis Island RoW (refer Figure 9.1), namely:

- World Heritage Management Area (WHMA) – Category B
- Endangered regional ecosystem – Category B
- Of Concern regional ecosystem – Category C
- Referable wetlands – Category C
- Essential habitat – Category C[1]

These ESAs are discussed in Sections 9.7.2, 9.7.3 and 9.7.4.

9.7.2 Protected areas

The Great Barrier Reef

The Great Barrier Reef is one of Queensland's five World Heritage Areas (WHAs), which meet all the criteria for natural world heritage as it:

- Represents major stages of the earth's evolutionary history
- Is an outstanding example of ongoing ecological and biological processes
- Contains superlative natural phenomena

1 Within the Curtis Island RoW, Essential habitat for Koala is mapped associated with Endangered RE, and is therefore mapped as a category B.

Curtis Island GTP EM Plan

Gas Transmission Pipeline (GTP)
- Mainland GTP EM Plan
- Marine Crossing GTP EM Plan
- Curtis Island GTP EM Plan

Kilometre Post Distance Marker
- 5km
- 1km

Environmentally Sensitive Area
- Category A
- Category B
- Category C
- Great Barrier Reef Coast Marine Park (Qld)

Source:
Gas Transmission Pipeline (GTP): Santos, Jan 2011.
Environmentally Sensitive Areas: Santos, Feb 2011.
Queensland Great Barrier Reef Coast Marine Park: Department of Environment Resource and Mangement, Feb 2011.
Aerial: Santos, Feb 2011.

Note: The Category A Environmentally Sensitive Area was originally provided by Santos, however has been redefined based on a directive from Santos to remove an illustrative 500m buffer.

Environmentally Sensitive Areas
Figure 9.1

A1 scale: 1:15,000

0 250 500 750 1,000 1,250 m

GLNG No: 3381-40-0480

Coordinate system: GCS_GDA_1994

Date: 22/06/2011 Version: 1

Map by: RB P:\GIS\Projects\214208_Santos_EMP\CI_025.mxd 22/06/2011 17:01

- Contains important natural habitats for conservation of biological diversity

The Great Barrier Reef World Heritage Area (GBRWHA) consists of an area approximately 348 000 km^2. It extends from the low water mark of the mainland, and includes all islands (ie Curtis Island), internal waters of Queensland, and *Seas and Submerged Lands Act 1973* exclusions.

Curtis Island forms part of the NC Act listed World Heritage Management Area (WHMA), which is considered an ESA Category B, as defined in Chapter 1.

The Curtis Island GTP RoW occurs within 1 km of the Great Barrier Reef Region[2] (ESA Category A), listed under the provisions of the *Great Barrier Reef Marine Park Act 1975* (GBRMP Act).

Furthermore, the Curtis Island GTP RoW is located adjacent (within 500 m) to The Narrows Habitat Protection Zone of the Great Barrier Reef Coast Marine Park (GBR Coast MP). Under the *Environment Protection Act 1994* this area is defined as a Category A ESA.

Under the conditions of approval outlined in the CG Report, works cannot occur within or within 200 m of the Category A ESA. Potential impacts to Category A ESA and the associated 200 m buffer zone (based on the CG Report) are discussed in Section 9.11.

International and National important wetlands

There are no internationally listed RAMSAR wetlands on Curtis Island. Furthermore, no nationally important wetlands occur within the Curtis Island GTP RoW. However, as discussed in Chapter 14, the national Directory of Important Wetlands in Australia (DIWA) lists 4 nationally important wetlands within the adjacent regions (<15 km) of the RoW (Environment Australia, 2001). Refer to Table 9.3 for the list of nationally important wetlands within close proximity to the RoW.

These wetlands are considered nationally important as they meet at least one of the following criteria:

i) It is a good example of a wetland type occurring within a biogeographic region in Australia
ii) It is a wetland which plays an important ecological or hydrological role in the natural functioning of a major wetland system/complex
iii) It is a wetland which is important as the habitat for animal taxa at a vulnerable stage in their life cycles, or provides a refuge when adverse conditions such as drought prevail
iv) The wetland supports 1% or more of the national populations of any native plant or animal taxa
v) The wetland supports native plant or animal taxa or communities which are considered endangered or vulnerable at the national level
vi) The wetland is of outstanding historical or cultural significance

Table 9.3 Nationally important wetlands within the broader region

Nationally important wetland	Approximate location	Criterion for inclusion
Great Barrier Reef Marine Park	9.3 km of KP 418.75	i-vi
Northeast Curtis Island	15 km N of KP 415.75	i to iii and vi
Port Curtis	0.9 km W of KP 414.5	i-vi

2 The Great Barrier Reef Region (GBRR) (Register of National Estate Place ID 8230) exists as approximately 34,870,000 ha of sea bed, reefs, islands and seas, along the Queensland coast between the tip of Cape York and Fraser Island. The GBRR excludes Queensland owned islands (including Curtis Island).

Nationally important wetland	Approximate location	Criterion for inclusion
The Narrows	0.5 km N of KP 414.5	i to iii and vi

Table notes
Source Environment Australia (2001)

A map of referable wetlands for Curtis Island (refer Figure 14.2) illustrates the presence of wetland management areas (WMAs) and associated triggers areas (ie 100 m buffers) that intercept the Curtis Island GTP RoW (Category C ESA). These wetlands are minor ephemeral tributaries (Stream Order 1) associated with The Narrows and Graham Creek, and are discussed in further detail in Chapter 14.

Protected areas under the NC Act

The Curtis Island GTP RoW will not intersect any areas protected under the *Nature Conservation (Protected Areas) Regulation 1994* (NCPA Reg) (eg listed national parks, conservation parks, forest reserves, resource reserves or nature refuges). Chapter 8 describes the status of these areas under the EP Act.

Furthermore, the Curtis Island GTP RoW will not intersect areas protected under the provisions of the *Forestry Act 1959* (Forestry Act) (eg State forest parks, State reserves/forests and timber reserves) (refer Chapter 8).

A number of protected areas occur within the broader Curtis Island region (ie within 10 km of the RoW (DERM, 2010):

- Curtis Island National Park
- Curtis Island State Forest
- Curtis Island Nature Refuge
- Garden Island Conservation Park
- Southend Conservation Park
- Port of Gladstone – Rodd's Bay Dugong Protection Area (Zone B)

The abovementioned areas are sufficiently displaced, except for the Dugong Protection Area (DPA), therefore no impacts as a result of the works are anticipated. At the closest point (KP 414.5), the DPA occurs within approximately 800 m of the Curtis Island GTP RoW.

9.7.3 Flora

Threatened ecological communities

Based on database searches (EPBC Report) there is the potential for two EPBC listed Threatened Ecological Communities to occur within and adjacent the RoW.

DERM Regional Ecosystem mapping (version 6.0) identifies a number of REs within and adjacent the RoW. No RE communities present within or adjacent to the Curtis Island GTP RoW are considered analogous to any EPBC Threatened Ecological Community.

It should be noted that the criteria, including vegetation composition, structure and characteristics for an EPBC Threatened Ecological Community can differ to that required for an RE, including analogous REs. In addition the criteria for REs is not sufficiently robust to quantify small patches (<2 ha) EPBC listed Threatened Ecological Communities.

As such, ground truthing of the RoW was undertaken as part of the EIS (URS 2008) and also by Ecologica Consulting (2010). These surveys confirmed that no EPBC Threatened Ecological Communities occur within and adjacent the RoW.

Regional ecosystems

As illustrated in Figure 9.2, the Curtis Island GTP RoW intersects three 'heterogeneous' RE polygons (eg 12.3.7/12.3.11, 12.3.3/12.3.7, and 12.11.6/12.11.14). It should be noted that the heterogeneous RE 12.3.3/12.3.7 is mapped as essential habitat under the VM Act. A description of the five REs intersected by RoW is provided in Table 9.4.

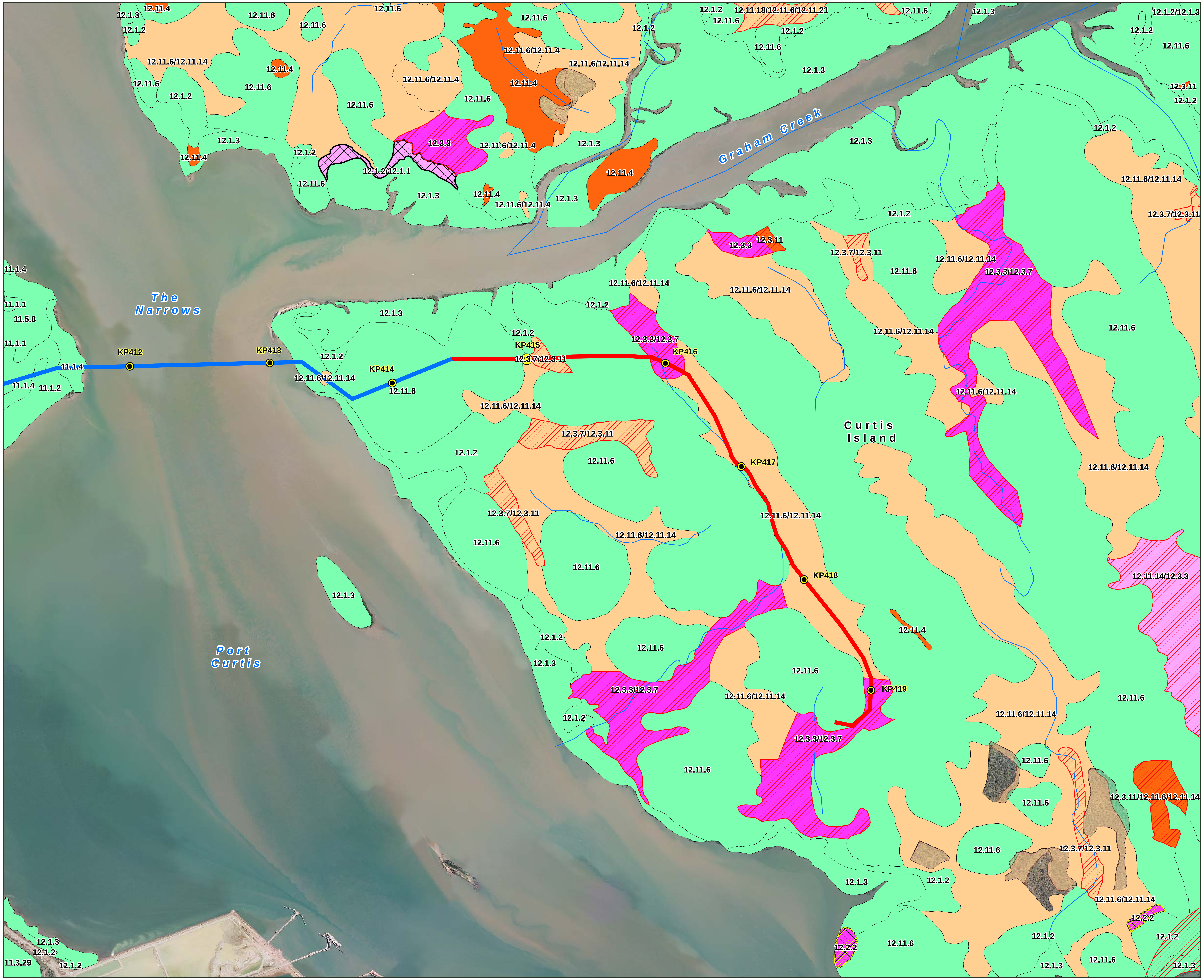
Table 9.4 Regional Ecosystems mapped within the Curtis Island GTP RoW

RE	Community descriptions	Biodiversity status	VM Act status	ESA Category
12.3.3/12.3.7	*Eucalyptus tereticornis* woodland to open forest on alluvial plains/ *Eucalyptus tereticornis, Melaleuca viminalis, Casuarina cunninghamiana* fringing forest	E/NC	E/LC	B
12.3.7/12.3.11	*Eucalyptus tereticornis, Melaleuca viminalis, Casuarina cunninghamiana* fringing forest/ *E. tereticornis, Eucalyptus siderophloia, Corymbia intermedia* open forest on alluvial plains near coast	NC/OC	LC/OC	C
12.11.6/12.11.14	*Corymbia citriodora*, *Eucalyptus crebra* open forest on metamorphics ± interbedded volcanics/ *Eucalyptus crebra*, *E. tereticornis* woodland on metamorphics ± interbedded volcanics	NC/OC	LC/OC	C
12.11.6	*Corymbia citriodora*, *Eucalyptus crebra* open forest on metamorphics ± interbedded volcanics	NC	LC	-
Table notes: Source: REDD database (version 6.0b), 2011 RE – Regional ecosystem		E – Endangered OC – Of Concern LC – Least Concern NC – No concern at present		

Ground-truthing exercises within the Curtis Island GTP RoW have confirmed that RE mapping (as illustrated in Figure 9.2) has a high degree of accuracy (URS 2008).

The heterogeneous RE12.3.3/12.3.7 is mapped as endangered dominant and is also recognised as a Category B ESA under the EP Act (ie due to the dominance of RE12.3.3, which has an endangered biodiversity status). This heterogeneous RE is dominated by *Eucalyptus tereticornis* and *Lophostemon suaveolens* (Swamp box). The shrub layer is represented by *Sida hackettiana* and *Planchonia careya* (Cocky apple). Species present within the ground layer include *Heteropogon contortus* (Giant spear grass), *Leptochloa decipiens* subsp. *decipiens* (Slender cane grass), *Indigofera hirsuta* (Hairy indigo), *Panicum effusum* (Hairy panicum), *Crotalaria montana* var. *angustifolia*, *Cyperus gracilis* (Graceful sedge) and *Eustrephus latifolius* (Wombat berry).

RE12.11.6, which is no concern at present (biodiversity status), is the dominant community mapped along the RoW, approximately 49% of the RoW. This community exists as an open woodland, with a canopy and mid-story that is dominated by *Eucalyptus citriodora* and *Eucalyptus crebra*. The shrub layer is dominated by *Acacia leiocalyx* (Black wattle), *Dodonea lanceolata* var. *subsessilifolia* (Native hop bush), and *Pogonolobus reticulatus* (Medicine bush). *Xanthorrhoea johnsonii* (Forest grass tree) are also present within the shrub layer. The ground cover within this community comprises *Cassytha filiformis* (Dodder laurel), *Eragrostis brownii* (Brown's lovegrass), *Cymbopogon refractus* (Barbed wire grass), *Glycine tabacina* (Glycine pea), and *Lomandra confertifolia* subsp. *pallida* (Matrush).



Map by: RB P:\GIS\Projects\214208_Santos_EMP\Cl_001.mxd 08/04/2011 09:40

A1 scale: 1:15,000

0 250 500 750 1,000 1,250 m

GLNG No: 3381-40-0481

Coordinate system: GCS_GDA_1994

Curtis Island GTP EM Plan

Gas Transmission Pipeline (GTP)
- Mainland GTP EM Plan
- Marine Crossing GTP EM Plan
- Curtis Island GTP EM Plan

Kilometre Post Distance Marker
- 5km
- 1km

Regional Ecosystem - Biodiversity Status
- Endangered - dominant
- Endangered - sub-dominant
- Of Concern - dominant
- Of Concern - sub-dominant
- Not of Concern

High Value Regrowth Vegetation
- Endangered Regional Ecosystem
- Of Concern Regional Ecosystem
- Least Concern Regional Ecosystem

- EPBC Threatened Species/ Ecological Community
- Regional Ecosystem where VM and BD status differ
- Essential Habitat
- Watercourse

Source:
Gas Transmission Pipeline (GTP): Santos, Jan 2011.
Regional Ecosystems: Version 6, The State of Queensland (Department of Environment and Resource Management), Nov 2009.
High Value Regrowth Vegetation: Version 2, The State of Queensland (Department of Environment and Resource Management), Nov 2009.
EPBC Threatened Species and Ecological Community: Department of the Environment, Water, Heritage and the Arts, 2010.
Aerial: Santos, Feb 2011.

Regional Ecosystems, High Value Regrowth Vegetation and Essential Habitats Figure 9.2

Date: 08/04/2011 Version: 0

The heterogeneous RE12.3.7/12.3.11 is mapped as of concern subdominant. This heterogeneous RE is dominated by *Eucalyptus tereticornis*, with fringing *Melaleuca viminalis* (Weeping bottlebrush) and *Casuarina cunninghamiana* (River sheoak). As these communities border the intertidal wetlands of Graham Creek there is some localised marine plant intrusion (eg *Sporobolus virginicus*) within the understory.

The heterogeneous RE12.11.6/12.11.14 is mapped as of concern subdominant. This heterogeneous RE is dominated in areas by *Eucalyptus crebra* and *Eucalyptus tereticornis*, with *Lophostemon suaveolens* also present in the sub-canopy. Dominant species within the shrub layer include *Planchonia careya* and *Acacia leiocalyx. Lantana camara* has been detected within this RE community. The ground cover is represented by species including Barbed wire grass, *Eragrostis brownii*, *Leptochloa decipiens* subsp. *decipiens*, *Sida hackettiana*, *Cyanthillium cinereum*, *Panicum effusum* and *Themeda triandra* (Kangaroo grass).

Conservation significant species

A review of environmental databases identified five flora species, listed as conservation significant (ie listed as Endangered, Vulnerable or Near Threatened) under the EPBC Act and/or the NC Act, as potentially occurring within a 5 km radius of the Curtis Island GTP RoW (refer Table 9.5).

The likelihood of their occurrence within the Curtis Island GTP RoW has been assessed and given a rating, as follows:

- "Known" - indicates that the species has been recorded during field investigations; a species record occurs (ie HERBRECS) within close proximity; and/or discussions with land holders have indicated that this species occurs within the area
- "High" - indicates that good quality, suitable, habitat occurs within and/or adjacent to the RoW and a species record occurs (ie HERBRECS) within close proximity
- "Moderate" - indicates that potentially suitable habitat occurs within and/or adjacent to the RoW, but is considered very small or exists in a degraded state
- "Low" - indicates that suitable habitat does not occur within and/or adjacent to the RoW. This rating may also indicate that the site is outside of the recognised geographic range of the species

No conservation significant flora species listed under State and/or Commonwealth legislation were identified within the Curtis Island GTP RoW during field investigations. Furthermore, no species identified in Table are considered likely to occur within the Curtis Island GTP RoW based on the deficit of suitable habitat and/or the location of the RoW outside of the species' known distribution.

Table 9.5 Likelihood of significant flora species occurring within the vicinity of the Curtis Island GTP RoW

Scientific name	Common name	NC Act status	EPBC Act status	Habitat	Likelihood of occurrence
Cupaniopsis shirleyana	Wedge-leaf tuckeroo	V	V	Known to occur within a variety of rainforest types on hillslopes, mountain tops, rocky headlands and creek banks	**Low** likelihood of occurrence within the Curtis Island GTP RoW due to absence of suitable habitat. This species was not detected during targeted field and database searches
Cycas megacarpa	Large-fruited zamia palm	E	E	Usually inhabits sclerophyll dominated grassy woodlands/open woodlands on rocky substrates (usually granite based). In the Calliope and Callide Ranges, this species is also commonly observed along drainage lines and dry creek beds beneath a dry rainforest canopy	**Low** likelihood of occurrence within the Curtis Island GTP RoW due to absence of suitable habitat. This species was not detected during targeted field and database searches
Cycas ophiolitica	Marlborough blue zamia palm	E	E	Typically associated with *Corymbia* woodlands on serpentinite substrates, mudstone and alluvial loams to 80-400 mm altitude in the Marlborough – Rockhampton region of central-eastern Queensland	**Low** likelihood of occurrence within the Curtis Island GTP RoW. This species was not detected during targeted field and database searches
Quassia bidwillii	Quassia	V	V	Occurs within lowland rainforests or rainforest margins and occasionally open forests, woodlands and mangroves in lithosols, skeletal soils, loamy sands and sandy soils to 1 – 617 m altitude in coastal regions	**Low** likelihood of occurrence within the Curtis Island GTP RoW due to absence of suitable habitat. This species was not detected during targeted field and database searches
Taeniophyllum muelleri	Ribbon-root orchid	-	V	Epiphyte on branches and branchlets of rainforest trees in coastal regions	**Low** likelihood of occurrence within the Curtis Island GTP RoW due to lack of suitable habitat (ie coastal rainforest). This species was not detected during targeted field and database searches

Status NT = Near Threatened; V = Vulnerable; E = Endangered; CE = Critically Endangered
Sources Wildlife Online and EPBC Databases; Herbrecs data 2010

Curtis Island GTP RoW floristic diversity

In total, 80 flora species have been recorded within or adjacent to the Curtis Island GTP RoW (URS 2008; Ecologica 2010). A complete flora species list for all taxa identified during various surveys of the Curtis Island GTP RoW and adjacent areas is presented in Table 9.8. An overview of the vegetation communities is provided in the Regional Ecosystems Section (Section 9.7.3), including the dominant and/or species within each community identified from the GTP RoW.

Of the 80 flora species recorded during the EIS process (URS 2009), 72 are native and are listed as Least Concern under the provisions of the NC Act. The remaining eight species recorded are exotic. Two of the exotic species (Lantana and Common prickly pear) are declared weeds under the provisions of the LP Act and are also listed in the Weeds of National Significance framework. The remaining six exotic species identified are considered general environmental weeds (refer Table 9.8).

Although no mangroves or seagrass occurs within the Curtis Island GTP RoW, saline grass intrusion occurs within the RoW, adjacent to the intertidal areas of Graham Creek. In some instances, *Melaleuca* species (paper barks) and *Casuarina* species (she-oaks) (particularly within RE 12.3.7/12.3.11) may also be considered marine plants under the *Fisheries Act 1994* definition, as these species are commonly found within the intertidal reaches and the associated terrestrial ecotone (eg Graham Creek).

Queensland Type A restricted plants

In accordance with the Coordinator-General (CG) conditions, consideration has been made to Type A restricted least concern plants (Type A plants) that occur within the Curtis Island RoW.

The following is a list of Type A plants, declared under the provisions of the NC Act:

- A plant of the family *Orchidaceae* (other than *Spathoglottis plicata*)
- A plant of the genus *Xanthorrhoea* (grass trees)
- A plant of the genus *Myrmecodia* (ant plants)
- A plant of the genus *Hydnophytum* (ant plants)
- A plant of the family *Cycadaceae* (cycads)
- A plant of the family *Zamiaceae* (cycads)
- A plant of the genus *Huperzia* (lace plants)
- A plant of the family *Platycerium* (staghorns and elkhorns)
- A plant of the genus *Brachychiton* (bottle trees)
- A plant of the genus *Livistona* (cabbage palms)

Type A restricted plants, as defined by the NC Act, have been detected within the Curtis Island GTP RoW namely *Xanthorrhoea johnsonii* (Forest grass tree) and *Livistona decipiens* (Weeping cabbage palm). A Type A Restricted Salvage Plan will be prepared as part of the Significant Species Management Plan (SSMP).

Weeds of National and State significance

A review of the EPBC Protected Matters databases (DSEWPaC, 2011) identified seven species, listed as Weeds of National Significance (WONS) under the National Weed Strategy framework, as potentially occurring within a 5 km radius of the Curtis Island GTP RoW (refer Table 9.6). These species are also considered declared weeds under the Queensland Government's Land Protection (Pest and Stock Route) Management Act 2002 (LP Act) and are outlined in Table 9.6.

Table 9.6 Weeds of National significance potentially occurring within the RoW

Scientific name	Common name	LP Act Class[3]
Alternanthera philoxeroides	Alligator weed	1
Chrysanthemoides monilifera	Bitou bush	1
Cryptostegia grandiflora	Rubber vine	2
Hymenachne amplexicaulis	Hymenachne	2
Lantana camara	Lantana	3
Parkinsonia aculeata	Parkinsonia	2
Parthenium hysterophorus	Parthenium	2

Source EPBC Protected Matters Search Tool, 2011; DEEDI 2011

Table 9.7 outlines weed species detected within or adjacent to the Curtis Island GTP RoW during field investigations.

Table 9.7 National and State declared weeds identified within or adjacent to the RoW

Scientific name	Common name	WONS	LP Act class
Lantana camara	Lantana	Yes	3
Opuntia stricta var. *stricta*	Common prickly pear	No	2

Source URS 2008; URS 2009; Ecologica 2010; DEEDI 2011

Seven other introduced or non-declared species under the LP Act, were detected within or adjacent to the Curtis Island GTP RoW during flora surveys. These species, in addition to native species identified within the GTP RoW are listed in Table 9.8.

3 There are three classes of declared weeds under the LP Act. These plants are targeted for control because they have, or could have, serious economic, environmental or social impacts. The three classes are as follows:

Class 1: has the potential to become a very serious pest in Queensland in the future. All landholders are required by law to keep their land free of Class 1 pests. It is a serious offence to introduce, keep, release or sell Class 1 pests without a permit
Class 2: has already spread over substantial areas of Queensland. By law, all landholders must try to keep their land free of Class 2 pests and it is an offence to possess, sell or release these pests without a permit
Class 3: is commonly established in parts of Queensland and a notice may be issued on a landowner to take reasonable action against the weed if it is causing, or has the potential to cause an adverse impact, on a nearby 'environmentally significant area' (eg a national park)

Table 9.8 Curtis Island GTP RoW flora species list

Family	Scientific name	Common name	NC Act status	EPBC Act status	Notes
Canopy					
Myrtaceae	*Corymbia citriodora* subsp. *citriodora*	Lemon-scented gum	LC	-	-
Myrtaceae	*Corymbia clarksoniana*	Clarkson's bloodwood	LC	-	-
Myrtaceae	*Corymbia intermedia*	Pink bloodwood	LC	-	-
Myrtaceae	*Corymbia tessellaris*	Moreton bay ash	LC	-	-
Myrtaceae	*Eucalyptus crebra*	Narrow-leaved ironbark	LC	-	-
Myrtaceae	*Eucalyptus exserta*	Queensland peppermint	LC	-	-
Myrtaceae	*Eucalyptus tereticornis*	Queensland blue gum	LC	-	-
Myrtaceae	*Lophostemon suaveolens*	Swamp box	LC	-	-
Myrtaceae	*Melaleuca viridiflora*	Broad leaved tea-tree	LC	-	-
Phyllanthaceae	*Glochidion lobocarpum*	Cheese tree	LC	-	-
Mid-storey					
Apocynaceae	*Alstonia constricta*	Bitter bark	LC	-	-
Arecaceae	*Livistona decora*	Weeping cabbage palm	LC	-	Type A
Avicenniaceae	*Avicennia marina*	Grey mangrove	LC	-	Marine
Casuarinaceae	*Allocasuarina torulosa*	Forest she-oak	LC	-	-
Combretaceae	*Lumnitzera racemosa*	-	LC	-	-
Lecythidaceae	*Planchonia careya*	Cocky apple	LC	-	-
Mimosaceae	*Acacia amblygona*	Fan-leaf wattle	LC	-	-
Mimosaceae	*Acacia decora*	Pretty wattle	LC	-	-
Mimosaceae	*Acacia disparrima*	Hickory wattle	LC	-	-
Mimosaceae	*Acacia leiocalyx*	Black wattle	LC	-	-
Phytolaccaceae	*Petalostigma pubescens*	Quinine tree	LC	-	-
Rhamnaceae	*Alphitonia excelsa*	Red ash	LC	-	-

Family	Scientific name	Common name	NC Act status	EPBC Act status	Notes
Rhizophraceae	*Ceriops tagal*	Yellow mangrove	LC	-	Marine
Rhizophraceae	*Rhizophora stylosa*	Spotted mangrove	LC	-	Marine
Rubiaceae	*Timonius timon* var. *timon*	Timonius	LC	-	-
Sapotaceae	*Pouteria sericea*	Mongo	LC	-	-
Shrub layer					
Adiantaceae	*Adiantum hispidulum* var. *hispidulum*	A fern	LC	-	-
Asteraceae	*Pterocaulon sphacelatum*	Applebush	LC	-	-
Cactaceae	*Opuntia stricta* *	Common prickly pear	-	-	Class 2
Euphorbiaceae	*Breynia oblongifolia*	Coffee bush	LC	-	-
Fabaceae	*Indigofera hirsuta*	Hairy indigo	LC	-	-
Fabaceae	*Jacksonia scoparia*	Dogwood	LC	-	-
Malvaceae	*Hibiscus diversifolius*	Swamp hibiscus	LC	-	-
Rubiaceae	*Pogonolobus reticulatus*	Medicine bush	LC	-	-
Sapindaceae	*Dodonaea lanceolata* var. *subsessilifolia*	Native hop bush	LC	-	-
Sparrmanniaceae	*Grewia retusifolia*	Dysentery plant	LC	-	-
Verbenaceae	*Lantana camara* *	Lantana	-	WONS	Class 3
Xanthorrhoeaceae	*Xanthorrhoea johnsonii*	Grass tree	LC	-	Type A
Ground layer					
Adiantaceae	*Adiantum atroviride*	Maidenhair fern	LC	-	-
Asteraceae	*Bidens pilosa var. pilosa* *	Cobblers pegs	-	-	
Asteraceae	*Cyanthillium cinereum*	-	LC	-	-
Asteraceae	*Helichrysum lanuginosum*	White everlasting daisy	LC	-	-
Boraginaceae	*Cordia dichotoma*	-	LC	-	-
Chenopodiaceae	*Sarcocornia quinqueflora*	Bead weed	LC	-	-
Cyperaceae	*Cyperus cyperoides*	A sedge	LC	-	-

Family	Scientific name	Common name	NC Act status	EPBC Act status	Notes
Cyperaceae	*Cyperus gracilis*	Graceful sedge	LC	-	-
Cyperaceae	*Scleria brownii*	-	LC	-	-
Fabaceae	*Cajanus reticulatus*	-	LC	-	-
Fabaceae	*Crotalaria montana* var. *angustifolia*	Rattlepod	LC	-	-
Fabaceae	*Flemingia parviflora*	Flemingia	LC	-	-
Hemerocallidaceae	*Dianella brevipedunculata*	Flax lilly	LC	-	-
Lamiaceae	*Anisomeles malabarica*	Sida	LC	-	-
Lauraceae	*Cassytha filiformis*	Dodder laurel	LC	-	-
Malvaceae	*Sida hackettiana*	-	LC	-	-
Malvaceae	*Sida rhombifolia* *	Common flannel weed	-	-	
Myoporaceae	*Eremophila debilis*	Winter apple	LC	-	-
Poaceae	*Alloteropsis semialata*	Cockatoo grass	LC	-	-
Poaceae	*Aristida queenslandica*	Wire grass	LC	-	-
Poaceae	*Bothriochloa decipiens* var *decipiens*	Pitted bluegrass	LC	-	-
Poaceae	*Cenchrus echinatus**	Mossman River grass	LC	-	-
Poaceae	*Chloris inflata* *	Purpletop chloris	-	-	
Poaceae	*Cymbopogon refractus*	Barbwire grass	LC	-	-
Poaceae	*Eragrostis brownii*	Brown's lovegrass	LC	-	-
Poaceae	*Heteropogon contortus*	Giant speargrass	LC	-	-
Poaceae	*Imperata cylindrica*	Blady grass	LC	-	-
Poaceae	*Leptochloa decipiens* subsp. *decipiens*	Slender cane grass	LC	-	-
Poaceae	*Melinis repens* *	Red natal grass	-	-	
Poaceae	*Panicum effusum*	Hairy panicum	LC	-	-
Poaceae	*Paspalidium distans*	Shotgrass	LC	-	-
Poaceae	*Perotis rara*	Comet grass	LC	-	-

Family	Scientific name	Common name	NC Act status	EPBC Act status	Notes
Poaceae	*Sorghum nitidum forma. aristatum*	Brown sorghum	LC	-	-
Poaceae	*Sporobolus virginicus*	Saltwater couch	LC	-	-
Poaceae	*Themeda triandra*	Kangaroo grass	LC	-	-
Xanthorrhoeaceae	*Lomandra confertifolia* subsp. *pallida*	Matrush	LC	-	-
Xanthorrhoeaceae	*Lomandra longifolia*	Spiny-headed mat rush	LC	-	-
Xanthorrhoeaceae	*Lomandra multiflora*	Many-flowered mat rush	LC	-	-
Vines / creepers					
Fabaceae	*Glycine tabacina*	Glycine pea	LC	-	-
Passifloraceae	*Passiflora foetida* *	Stinking passion flower	-	-	
Passifloraceae	*Passiflora suberosa* *	Corky passion flower	-	-	
Smilacaceae	*Eustrephus latifolius*	Wombat berry	LC	-	-

Table notes * denotes exotic species
Status Type A = Type A Restricted least concern plant under the provisions of the NC Act; Marine = Marine Plant under the provisions of the Fish Act; WONS = Weeds of National
Significance Class 2 / 3 = Declared weed classification under the LP Act; LC = Least Concern NT = Near Threatened; V = Vulnerable; E = Endangered; CE = Critically Endangered;
Sourc URS 2008, Ecologica 2010b

9.7.4 Fauna

Conservation significant species

A recent (January 2011) review of environmental databases identified 35 species, listed as significant and/or migratory/marine under the provisions of the EPBC Act and/or NC Act, as potentially occurring within, or within 5 km, of the Curtis Island GTP RoW (refer Table 9.9).

The likelihood of their occurrence within the Curtis Island GTP RoW (based on the suitability of habitat) has been assessed and given a rating, as follows:

- "Known" - indicates that the species has been recorded during field investigations; a species record occurs (ie Queensland Museum); or discussions with land holders have indicated that this species occurs within the area
- "High" - indicates that good quality, suitable, habitat occurs within and/or adjacent to the RoW
- "Moderate" - indicates that potentially suitable habitat occurs within and/or adjacent to the RoW, but is considered very small or exists in a degraded state
- "Low" - indicates that suitable habitat does not occur within and/or adjacent to the RoW. This rating may also indicate that the site is outside of the recognised geographic range of the species

It should be noted that, given the terrestrial nature and location of the Curtis Island GTP RoW, marine and/or pelagic species (eg whales, dolphins, dugongs etc) as well as shoreline-dependent marine species (eg turtles) have been omitted from this assessment, as activities associated with the construction of the Curtis Island GTP will not impact on the marine or shoreline environment.

Marine and shoreline dependent marine species are unlikely to utilise habitats within the Curtis Island GTP RoW as the area is primarily terrestrial and sufficiently displaced from the marine environment.

Of the significant fauna and/or migratory/marine species listed in Table 9.9, 21 are known to occur within a 5 km radius of the Curtis Island GTP RoW. Of the remaining 14 species identified in Table 9.9, eight are considered to have a moderate likelihood of occurrence within the Curtis Island GTP RoW, whilst seven are considered to have a low likelihood.

Field investigations identified an additional seven birds (listed as significant or migratory/marine) that occur within or adjacent to the Curtis Island GTP RoW, despite their omission from the database search results (DSEWPaC 2011; Wildlife Online 2011).

Table 9.9 Conservation significant species listed under the EPBC Act and/or NC Act

Species	Common name	NC Act status	EPBC Act status	Habitat	Likelihood of occurrence
Arenaria interpres	Ruddy turnstone	S	Mi/Ma	Non-breeding summer migrant predominately found in coastal areas on exposed rock/coral reefs, platforms, shelves, often with shallow tidal pools, also on sand and coral beaches and estuaries, harbours, bays and coastal lagoons (Higgins and Davies 1996). Roosts and loafs on beaches, among rocks, shells, rocky islets, mudflats and sandflats above tide line (Higgins and Davies 1996)	**Moderate** likelihood of occurrence. This species may utilise the intertidal areas of Graham Creek, adjacent to the Curtis Island GTP RoW. During the summer months this species is **known** to roost and feed within the intertidal wetlands of Port Curtis, including Kangaroo Island and Curtis Island (Ecologica 2010a; Worley Parsons 2010)
Calidris acuminata	Sharp-tailed sandpiper	S	Mi/Ma	A summer migrant to Australia, however it may occasionally remain throughout winter. This species is usually observed on mudflats, saltmarshes, mangroves, shallow fresh, brackish or saline inland wetlands, floodwaters, irrigated pastures, sewerage ponds, and salt fields (Pizzey and Knight 2007)	During the summer months this species is **known** to roost and feed within the intertidal wetlands of Port Curtis, including Kangaroo Island and Curtis Island (Ecologica 2010a; Worley Parsons 2010)
Calidris canutus	Red knot, knot	S	Mi/Ma	Non-breeding migrant to Australia, restricted mainly to coastal regions, within sheltered coastal habitats supporting large intertidal mud/sand flats including bays, inlets, estuaries, harbours lagoons and also ocean beaches (Higgins and Davies 1996). Foraging occurs within the intertidal flats in shallow water, soft mud/sand, at the water edge, often as tide recedes, with roosting occurring in sheltered areas near foraging areas (Higgins and Davies 1996)	During the summer months this species is **known** to roost and feed within the intertidal wetlands of Port Curtis, including Kangaroo Island and Curtis Island (Ecologica 2010a; Worley Parsons 2010)
Calidris ferruginea	Curlew sandpiper	S	Mi/Ma	Non-breeding summer migrant. Occurs on both coastal and inland wetland habitats, though not as widespread as red-necked stint and sharp-tailed sandpiper (Higgins and Davies 1996). Prefers bare, wet, muddy surfaces and adjoining shallow water margins of fresh, saline, or brackish open water bodies and wetlands (Lane 1987; Higgins and Davies 1996)	**Moderate** likelihood of occurrence. This species may utilise the intertidal areas of Graham Creek, adjacent to the Curtis Island GTP RoW. However, targeted searches on Curtis Island have not resulted in the detection of this species. No Queensland Museum records for this species occur within close proximity to the Curtis Island GTP RoW

Species	Common name	NC Act status	EPBC Act status	Habitat	Likelihood of occurrence
Calidris ruficollis	Red-necked stint	S	Mi/Ma	Non-breeding summer migrant. Occurs in a wide variety of coastal and inland wetland habitats from salt lakes, freshwater swamps, intertidal mudflats and sandy ocean beaches (Lane 1987; Higgins and Davies 1996). More abundant coastally where it mainly feeds wet or drying mud near waterline on intertidal mudflats and roosts on sandy beaches (eg spits) (Lane 1987)	During the summer months the species is **known** to roost and feed within the intertidal wetlands of Port Curtis, including Kangaroo Island and Curtis Island (Ecologica 2010a) This species has been recorded within the vicinity of the Curtis Island GTP RoW (BAAM 2009), and within The Narrows and Kangaroo Island areas (Worley Parsons 2010)
Calidris tenuirostris	Great knot	S	Mi/Ma	Non-breeding migrant to Australia, restricted mainly to coastal regions, within sheltered coastal habitats supporting large intertidal mud/sand flats including bays, inlets, estuaries, harbours lagoons and also ocean beaches (Higgins and Davies 1996). Foraging occurs within the intertidal flats in shallow water, soft mud/sand, at the water edge, often as tide recedes, with roosting occurring in sheltered areas near foraging areas (Higgins and Davies 1996)	During the summer months the species is **known** to roost and feed within the intertidal wetlands of Port Curtis, including Kangaroo Island and Curtis Island (Ecologica 2010a; Worley Parsons 2010)
Charadrius bicinctus	Double-banded plover	S	Mi/Ma	Distribution in Qld primarily restricted to the south east. South of Rockhampton, birds are found within estuarine and fresh or saline terrestrial wetlands within the littoral zone including saltmarsh areas (Marchant and Higgins 1993). Birds roost in bare open earth areas, either adjacent to or hundreds of metres away from foraging areas which include open shallow waters, muddy flats, rocky/gravelly areas etc. (Marchant and Higgins 1993)	**Moderate** likelihood of occurrence. This species may utilise the intertidal areas of Graham Creek, adjacent to the Curtis Island GTP RoW, as foraging habitat. However, targeted searches on Curtis Island have not resulted in the detection of this species. Furthermore, no suitable roosting habitat has been identified within the vicinity of the Curtis Island GTP RoW
Charadrius leschenaultii	Greater sand plover, Large sand plover	S	Mi/Ma	Non-breeding summer migrant. Mainly sandy or muddy beaches with large intertidal sandbanks or mudflats (Marchant and Higgins 1993). Typically roost on sand spits and banks, often on rocky points (Marchant and Higgins 1993)	This species is **known** to occur within The Narrows and south-western region of Curtis Island (Worley Parsons 2010). It is possible that this species may utilise the intertidal areas of Graham Creek, adjacent to the Curtis Island GTP RoW

Species	Common name	NC Act status	EPBC Act status	Habitat	Likelihood of occurrence
Charadrius mongolus	Lesser sand plover, Mongolian plover	S	Mi/Ma	Non-breeding summer migrant. Mainly sandy or muddy beaches with large intertidal sandbanks or mudflats (Marchant and Higgins 1993). Typically roost near feeding grounds on sand spits and banks, occasionally on rocky points and reefs (Marchant and Higgins 1993)	During the summer months the species is **known** to roost and feed within the intertidal wetlands of Port Curtis, including Kangaroo Island and Curtis Island (Ecologica 2010a)
Esacus neglectus	Beach stone-curlew	V	-	Found exclusively on the coastline in a range of habitats including undisturbed beaches, islands, reefs, estuarine intertidal sand and mudflats	This species is **known** to occur on Curtis Island. This species has been observed foraging on the foreshore of Laird Point on Curtis Island in the vicinity of the boat ramp (Ecologica, 2010a). However, targeted searches within the Curtis Island GTP RoW have not resulted in the detection of this species. This species is not expected to utilise the Curtis Island GTP RoW as core habitat, due to the lack of suitable habitat
Gallinago hardwickii	Latham's snipe, Japanese snipe	S	Mi/Ma	Non-breeding summer migrant in a variety of freshwater and brackish wetlands. Feeds on soft wet ground or in shallow water for invertebrates, seeds and vegetation (Higgins and Davies 1996; Todd 2000). Usually found close to dense ground cover (Garnett and Crowley 2000)	**Low** likelihood of occurrence within the vicinity of the Curtis Island GTP RoW due to absence of suitable habitat (ie freshwater wetlands). This species was not identified from ecological database searches for the area and Curtis Island, or during fauna surveys of the area
Haliaeetus leucogaster	White-bellied sea-eagle	S	Mi/Ma	This species is a local migrant throughout Australia and inhabits coastal areas, islands, estuaries, inlets, rivers and inland lakes (Pizzey and Knight 2007)	**Known** to occur on Curtis Island. A nesting pair has been sighted on Curtis Island close to the RoW during field surveys (Worley Parsons 2010)
Heteroscelus brevipes	Grey-tailed tattler	S	Mi/Ma	A summer migrant to Australia and observed on tidal mudflats, estuaries, mangroves, rocky shorelines and reefs, river margins (coastal and inland) (Pizzey and Knight 2007)	During the summer months this species is **known** to roost and feed within the intertidal wetlands of Port Curtis, including Kangaroo Island wetlands and Curtis Island (Ecologica 2010a; BAAM 2009; Worley Parsons 2010)

Species	Common name	NC Act status	EPBC Act status	Habitat	Likelihood of occurrence
Hirundapus caudacutus	White-throated needletail	S	Mi/Ma	Usually a summer migrant to Australia. Widespread in eastern Queensland and regularly observed flying over forests, woodlands, pastoral areas, floodplains, lakes and coastlines (Pizzey and Knight 2007)	**Known** to occur within the greater area (Sandpiper 2010; Worley Parsons 2010). This species is expected to over-fly the Curtis Island GTP RoW
Hirundo rustica	Barn swallow	S	Mi/Ma	Migrant to coastal and sub-coastal areas. Non-breeding in Australia. Found in a wide variety of habitat with the exception of the more heavily forested regions and drier inland areas. Often near water	**Moderate** likelihood of occurrence. This species may occur within the Port Curtis region, however, targeted searches on Curtis Island have not resulted in the detection of this species. In addition, this species was not identified from ecological database searches for the area and Curtis Island
Limosa lapponica	Bar-tailed godwit	S	Mi/Ma	Non-breeding summer migrant. Exclusively coastal, inhabiting broad intertidal mud or sand flats (often with seagrass meadows) and feeding on soft wet mud and/or shallow waters (Higgins and Davies 1996). High tide roosts on sandy beaches, spits, muddy bars and islets in sheltered environments (Lane 1987; Higgins and Davies 1996)	During the summer months this species is **known** to roost and feed within the intertidal wetlands of Port Curtis, including Kangaroo Island wetlands and Curtis Island (Ecologica 2010a; Worley Parsons 2010)
Macronectes giganteus	Southern giant-petrel	E	E/Ma	A marine bird that occurs in Antarctic to subtropical waters. It is widespread throughout the Southern Ocean, most abundant around ice packs where penguins are breeding or over the continental shelf. Nests on offshore islands, often near a steep drop or on a slope	**Low** likelihood of occurrence within the vicinity of the Curtis Island GTP RoW due to absence of suitable nesting habitat. This species was not identified from ecological database searches for the area and Curtis Island, or during fauna surveys of the area
Merops ornatus	Rainbow bee-eater	S	Mi/Ma	This species is a local migrant along the east coast of Australia and inhabits open woodlands with sandy/loamy soils, sandridges, sandpits, riverbanks, road cuttings, beaches, dunes, cliffs, mangroves and rainforest communities (Pizzey and Knight 2007)	This species is **known** to occur on Curtis Island and the broader region (URS 2008; Worley Parsons 2010; BAAM 2009). This species was detected within the hinterland margins of Curtis Island during intertidal surveys (URS 2008)

Species	Common name	NC Act status	EPBC Act status	Habitat	Likelihood of occurrence
Monarcha trivirgatus	Spectacled monarch	S	Mi/Ma	This species is a local migrant along the east coast of Australia and inhabits the understorey of mountain/lowland rainforests, densely wooded gullies and riparian vegetation (Pizzey and Knight 2007)	**Moderate** likelihood of occurrence within the vicinity of the Curtis Island GTP RoW This species has been recorded within the greater Port Curtis region, however targeted searches on Curtis Island have not resulted in the detection of this species. This species was not identified from ecological database searches for the area
Myiagra cyanoleuca	Satin flycatcher	S	Mi/Ma	Distributed along the east coast of Australia from far northern Queensland to Tasmania. Found in forests, woodlands, mangroves and coastal heath but avoids rainforest	**Known** to occur on Curtis Island. This species has been recorded within the adjacent LNG facility site, towards the southern end to the Curtis Island GTP RoW (URS 2009)
Nettapus coromandelianus albipennis	Australian cotton pygmy-goose	NT	Mi/Ma	Considered an uncommon or rate vagrant over most of its range. Coastal wetlands, preferring those with deep pools and abundant aquatic grasses	**Low** likelihood of occurrence within the vicinity of the Curtis Island GTP RoW as a result of the absence of suitable habitat. This species was not identified from ecological database searches for the area and Curtis Island, or during fauna surveys of the area
Numenius madagascariensis	Eastern curlew	NT	Mi/Ma	Non-breeding summer migrant. Intertidal mud or sand flats of sheltered coasts, estuaries and harbours (Higgins and Davies 1996). High tide roosts on sandy spits and beaches, though also amongst coastal vegetation such as salt marsh and mangroves (Lane 1987)	This species is **known** to occur in the intertidal habitats of Curtis Island during the summer months (Ecologica 2010a; BAAM 2009), and has been detected within The Narrows and Kangaroo Island wetlands (Worley Parsons 2010)
Numenius minutus	Little curlew, Little whimbrel	S	Mi/Ma	Non-breeding summer migrant, occurring in fresh and saline wetland habitats, feeding mostly in dry grasslands and sedgelands but have been recorded from flooded claypans and flood plains inundated from spring/king tides (Higgins and Davies 1996)	This species is **known** to occur in the intertidal wetlands of Port Curtis, including Kangaroo Island and Curtis Island (Ecologica 2010a; Worley Parsons 2010)

Species	Common name	NC Act status	EPBC Act status	Habitat	Likelihood of occurrence
Numenius phaeopus	Whimbrel	S	Mi/Ma	Non-breeding summer migrant. Prefers mudflats within mangrove habitats, though also forage at low tide on open tidal mudflats, on sandy beaches, and along banks of tidal rivers and creeks (Lane 1987; Higgins and Davies 1996). Roost in mangrove trees, though also on muddy, sandy or rocky beaches (Higgins and Davies 1996)	During the summer months this species is **known** to roost and feed within the intertidal wetlands of Port Curtis, including Kangaroo Island and Curtis Island (Ecologica 2010a; Worley Parsons 2010). This species has been recorded in the vicinity of the Curtis Island GTP RoW (BAAM 2009)
Pluvialis fulva	Pacific golden plover	S	Mi/Ma	Non-breeding summer migrant. Mainly sandy or muddy beaches with large intertidal sandbanks or mudflats, though also salt marsh, mangroves and estuarine mudflats (Lane 1987; Marchant and Higgins 1993)	During the summer months this species is **known** to roost and feed within the intertidal wetlands of Port Curtis, including Kangaroo Island and Curtis Island (Ecologica 2010a; Worley Parsons 2010). However, targeted searches within the Curtis Island GTP RoW have not resulted in the detection of this species
Pluvialis squatarola	Grey plover	S	Mi/Ma	Non-breeding summer migrant. Mainly marine shores, sandy or muddy beaches with large intertidal sandbanks or mudflats, though also salt marsh, mangroves and estuarine mudflats (Lane 1987; Marchant and Higgins 1993)	This species is **known** to occur on Curtis Island. It has previously been detected at Southend (Worley Parsons 2010). However, targeted searches within the Curtis Island RoW have not resulted in the detection of this species
Pterodroma neglecta-neglecta	Kermadec petrel (western)	V	V	The Kermadec petrel is a large pelagic bird that breeds on islands across the south west Pacific Ocean	**Low** likelihood of occurrence within the vicinity of the Curtis Island GTP RoW. Curtis Island does not form part of the Kermadec petrel's feeding or nesting range, and it is highly unlikely that it would even be an accidental visitor (URS 2008). This species was not identified from ecological database searches for the area and Curtis Island, or during fauna surveys of the area

Species	Common name	NC Act status	EPBC Act status	Habitat	Likelihood of occurrence
Sternula albifrons	Little tern	E	Mi	Coastal waters, bays, inlets, saline or brackish lakes, salt fields and sewage ponds near coast	This species is **known** to occur within the greater Port Curtis region (Worley Parsons 2010) However, targeted searches within the Curtis Island GTP RoW have not resulted in the detection of this species
Tringa stagnatilis	Marsh sandpiper, Little greenshank	S	Mi/Ma	Non-breeding summer migrant occurring in coastal and inland permanent and ephemeral wetlands of varying salinity including swamps, estuaries, saltpans, saltmarshes, inundated floodplains and intertidal mudflats (Higgins and Davies 1996). Foraging occurs within shallow water at edge of wetland and roosts on tidal mudflats, mew low saltmarsh and inland swamps (Higgins and Davies 1996)	During the summer months this species is **known** to roost and feed within the intertidal wetlands of Port Curtis, including Kangaroo Island and Curtis Island (Ecologica 2010a). However, targeted searches within the Curtis Island GTP RoW have not resulted in the detection of this species
Turnix melanogaster	Black breasted button quail	V	V	Leaf-litter in drier rainforests, vine thickets, scrubby woodlands of eucalypts, she oaks, bottle brushes, brush box, brigalow and Acacia, thickets of lantana on rainforest fringes, hoop pine plantations, grain stubbles	**Low to moderate** likelihood of occurrence within the Curtis Island GTP RoW, due to the presence of potentially suitable habitat. However, grazing and other disturbances caused by cattle, horses and feral pigs may deter the species from utilising the area. This species was not identified from ecological database searches for the area and Curtis Island, or during fauna surveys of the area
Xenus cinereus	Terek sandpiper	S	Mi/Ma	Non-breeding summer migrant. Exclusively coastal, feeding on soft muddy substrates, especially near mangroves within sheltered estuaries, harbours and coastal lagoons (Higgins and Davies 1996). High tide roosts on beaches, though often prefers mangroves when present (Lane 1987)	During the summer months this species is **known** to roost and feed within the intertidal wetlands of Port Curtis, including Kangaroo Island and Curtis Island (Ecologica 2010a; Worley Parsons 2010). This species has been recorded within The Narrows and the south-west Curtis Island region (BAAM 2009)

Species	Common name	NC Act status	EPBC Act status	Habitat	Likelihood of occurrence
Mammals					
Xeromys myoides	Water mouse	V	V	Saline grassland, mangroves, margins of freshwater swamps and lakes close to foredunes	**Low** likelihood of occurrence within the RoW. However, potentially suitable habitat for this species occurs within the intertidal habitats of Graham Creek adjacent to the RoW. Targeted searches within potentially suitable habitat throughout Curtis Island have not resulted in the detection of this species (BAAM 2010). This species was also not identified from ecological database searches for the area

Table notes NCA Status: E = Endangered, V = Vulnerable, S = Special Least Concern; LC = Least Concern
EPBC Status: E = Endangered, V = Vulnerable; Mi = Migratory; Ma = Marine

Source EPBC Protected Matters Search Tool 2011; Wildlife Online 2011

Curtis Island GTP RoW Faunal diversity

A complete fauna species list for all taxa identified during various recent surveys (within approximately 5 km of the Curtis Island GTP RoW) is presented in Table 9.10. In totality 180 species, including 13 amphibians, 22 reptiles, 120 birds, and 25 mammals have been detected within and/or adjacent to the Curtis Island GTP RoW (URS 2008 and Ecologica 2010).

Due to the typical highly mobile/vagrant nature of birds, those avian species known from the Port Curtis region (ie The Narrows and Kangaroo Island) have been included within Table 9.10

Table 9.10 Fauna species known to occur within 5 km of the RoW

Scientific Name	Common name	NC Act status	EPBC Act status	Source				
				URS 2008/2009	BAAM 2009	Worley Parsons 2010	Footprints 2010	Ecologica Consulting 2010
Amphibians								
Crinia deserticola	Desert froglet	LC	-	-	X			-
Limnodynastes terrareginae	Northern banjo frog	LC	-	X	-			-
Litoria caerulea	Green tree frog	LC	-	X	X			-
Litoria fallax	Eastern dwarf tree frog	LC	-	-	X			-
Litoria gracilenta	Dainty green tree frog	LC	-	-	X			-
Litoria inermis	Peter's frog	LC	-	-	X			-
Litoria latopalmata	Broad-palmed frog	LC	-	-	X			-
Litoria nasuta	Rocket frog	LC	-	-	X			-
Litoria rothii	Roth's tree frog	LC	-	-	X			-
Litoria rubella	Desert tree frog	LC	-	X	-			-
Opisthodon ornatus	Ornate burrowing frog	LC	-	X	-			-
Rhinella marinus[*]	Cane toad	-	-	X	-			-
Uperoleia fusca	Dusky toadlet	LC	-	-	X			-
Reptiles								
Antaresia maculosa	Spotted python	LC	-	X	-			-
Boiga irregularis	Brown tree snake	LC	-	X	-			-
Carlia munda	Jewel skink	LC	-	X	X			-
Carlia pectoralis	Jewel skink	LC	-	X	-			-
Carlia schmeltzii	Jewel skink	LC	-	X	-			-
Carlia sp.	-	LC	-	-	-			X

Scientific Name	Common name	NC Act status	EPBC Act status	Source				
				URS 2008/2009	BAAM 2009	Worley Parsons 2010	Footprints 2010	Ecologica Consulting 2010
Cryptoblepharus litoralis	Supralittoral shinning-skink	LC	-	-	X	-	-	-
Cryptoblepharus virgatus	Striped wall skink	LC	-	X	X	-	-	X
Ctenotus sp.	-	LC	-	-	-	-	-	X
Ctenotus taeniolatus	Copper-tailed skink	LC	-	X	X	-	-	-
Dendrelaphis punctulatus	Common tree snake	LC	-	X	X	-	-	-
Diplodactylus vittatus	Wood gecko	LC	-	-	X	-	-	-
Gehyra dubia	Tree dtella	LC	-	X	-	-	-	X
*Hemidactylus frenatus**	House gecko	-	-	-	X	-	-	-
Heteronotia binoei	Bynoe's gecko	LC	-	X	-	-	-	X
Lampropholis delicata	Eastern grass skink	LC	-	X	-	-	-	X
Menetia timlowi	Skink	LC	-	X	-	-	-	-
Mentia sp.	-	LC	-	-	-	-	-	X
Pseudechis porphyriacus	Red-bellied black snake	LC	-	X	-	-	-	-
Ramphotyphlops sp.	Blind snake	LC	-	X	-	-	-	-
Tropidonophis mairii	Freshwater snake	LC	-	-	X	-	-	-
Varanus tristis	Freckled monitor	LC	-	X	-	-	-	-
Avian								
Actitis hypoleucos#	Common sandpiper	S	Mi/Ma	-	-	-	-	-
Anas superciliosa	Pacific black duck	LC	-	X	-	-	-	-
Ardea intermedia	Intermediate egret	LC	-	X	X	-	-	-
Ardea modesta	Great egret	S	Mi/Ma	X	-	-	-	-
Artamus leucorhynchus	White-breasted woodswallow	LC	-	-	X	-	-	-

Scientific Name	Common name	NC Act status	EPBC Act status	Source				
				URS 2008/2009	BAAM 2009	Worley Parsons 2010	Footprints 2010	Ecologica Consulting 2010
Aviceda subcristata	Pacific baza	LC	-	X	-	-	-	-
Burhinus grallarius#	Bush stone-curlew	LC	-	X	X	-	X+	-
Butorides striatus	Striated heron	LC	-	-	X	-	-	-
Cacomantis flabelliformis	Fan-tailed cuckoo	LC	-	X	-	-	-	-
Calidris acuminata#	Sharp-tailed Sandpiper	S	Mi/Ma	-	-	-	X+	-
Calidris ruficollis#	Red-necked stint	S	Mi/Ma	-	X	-	X+	-
Calidris tenuirostris#	Great knot	S	Mi/Ma	-	-	-	X+	-
Calyptorhynchus banksii	Red-tailed black-cockatoo	LC	-	X	X	-	-	-
Calyptorhynchus lathami	Glossy black cockatoo	V	-	X	-	-	-	-
Centropus phasianinus	Pheasant coucal	LC	-	X	X	-	-	X
Charadrius mongolus#	Lesser sand plover, mongolian plover	S	Mi/Ma	-	-	-	X+	-
Charadrius ruficapillus#	Red-capped plover	LC	-	X	X	-	X+	X
Chenonetta jubata	Australian wood duck	LC	-	-	X	-	-	-
Chroicocephalus novaehollandiae	Silver gull	LC	-	X	X	-	-	-
Chrysococcyx minutillus	Little bronze-cuckoo	LC	-	X	-	-	-	-
Cinnyris jugularis	Olive-backed sunbird	LC	-	X	X	-	-	-
Colluricincla harmonica	Grey strike-thrush	LC	-	-	X	-	-	X
Colluricincla megarhyncha	Little shrike-thrush	LC	-	X	-	-	-	-
Coracina novaehollandiae	Black-faced cuckoo-shrike	LC	-	X	X	-	-	X
Coracina papuensis	White-bellied cuckoo-shrike	LC	-	X	-	-	-	-
Coracina tenuirostris	Cicadabird	LC	-	X	-	-	-	X

Scientific Name	Common name	NC Act status	EPBC Act status	Source				
				URS 2008/2009	BAAM 2009	Worley Parsons 2010	Footprints 2010	Ecologica Consulting 2010
Corcorax melanorhamphos	White-winged Chough	LC	-	-	-	-	-	X
Corvus coronoides	Australian raven	LC	-	-	-	-	-	X
Corvus orru	Torresian crow	LC	-	X	X	-	-	-
Corvus orru	Torresian crow	LC	-	-	-	-	-	X
Coturnix ypsilophora	Brown quail	LC	-	X	X	-	-	X
Cracticus nigrogularis	Pied butcherbird	LC	-	X	X	-	-	X
Cracticus torquatus	Grey butcherbird	LC	-	X	-	-	-	-
Dacelo leachii	Blue-winged kookaburra	LC	-	X	-	-	-	-
Dacelo novaeguineae	Laughing kookaburra	LC	-	X	X	-	-	X
Dicaeum hirundinaceum	Mistletoe bird	LC	-	X	X	-	-	X
Dicrurus bracteatus	Spangled drongo	LC	-	X	X	-	-	X
Egretta novaehollandiae	White-faced heron	LC	-	X	-	-	-	-
Egretta sacra	Eastern reef egret	S	Mi/Ma	-	X	X[+]	-	-
Entomyzon cyanotis	Blue-faced honeyeater	LC	-	X	-	-	-	X
Esacus neglectus[#]	Beach stone-curlew	V	-	X	X	-	-	-
Eudynamys orientalis	Pacific koel	LC	-	-	X	-	-	-
Eurostopodus mystacalis	White-throated nightjar	LC	-	-	X	-	-	-
Eurystomus orientalis	Dollarbird	LC	-	-	X	-	-	X
Falco peregrinus	Peregrine falcon	LC	-	-	-	-	-	X
Geopelia cuneata	Diamond dove	LC	-	-	-	-	-	X
Geopelia humeralis	Bar-shouldered dove	LC	-	X	X	-	-	X
Geopelia striata	Peaceful dove	LC	-	X	X	-	-	X
Gerygone levigaster	Mangrove gerygone	LC	-	X	X	-	-	X

Scientific Name	Common name	NC Act status	EPBC Act status	Source				
				URS 2008/2009	BAAM 2009	Worley Parsons 2010	Footprints 2010	Ecologica Consulting 2010
Gerygone olivacea	White-throated gerygone	LC	-	X	-	-	-	-
Glossopsitta pusilla	Little lorikeet	LC	-	X	-	-	-	X
Grallina cyanoleuca	Magpie lark	LC	-	-	-	-	-	X
Gymnorhina tibicen	Australian magpie	LC	-	X	X	-	-	X
Haematopus fuliginosus[#]	Sooty oystercatcher	NT	-	X	X	-	-	-
Haematopus longirostris[#]	Pied oystercatcher	LC	-	X	X	-	X[+]	-
Haliaeetus leucogaster	White-bellied sea-eagle	S	Mi/Ma	X	-	-	-	X
Haliastur indus	Brahminy kite	LC	-	X	X	-	-	-
Haliastur sphenurus	Whistling kite	LC	-	X	X	-	-	X
Hirundapus caudacutus	White-throated needletail	S	Mi/Ma	-	X	-	-	-
Hirundo neoxena	Welcome swallow	LC	-	X	X	-	-	X
Lalage leucomela	Varied triller	LC	-	X	X	-	-	-
Lichenostomus virescens	Mangrove honeyeater	LC	-	X	X	-	-	-
Lichmera indistincta	Brown honeyeater	LC	-	X	-	-	-	-
Limicola falcinellus#	Broad-billed sandpiper	S	Mi/Ma	-	-	-	X[+]	-
Limosa limosa[#]	Bar-tailed godwit	S	Mi/Ma	-	-	-	X[+]	-
Malurus melanocephalus	Red-backed fairy wren	LC	-	-	X	-	-	-
Manorina melanocephala	Noisy miner	LC	-	X	-	-	-	X
Meliphaga lewinii	Lewin's honeyeater	LC	-	-	-	-	-	X
Melithreptus albogularis	White-throated honeyeater	LC	-	X	X	-	-	-
Merops ornatus	Rainbow bee-eater	S	Mi/Ma	X	X	X[+]	-	-
Milvus migrans	Black kite	LC	-	-	-	-	-	X

Scientific Name	Common name	NC Act status	EPBC Act status	Source				
				URS 2008/2009	BAAM 2009	Worley Parsons 2010	Footprints 2010	Ecologica Consulting 2010
Myiagra alecto	Shining flycatcher	LC	-	X	-	-	-	-
Myiagra cyanoleuca	Satin flycatcher	S	Mi/Ma	X	-	-	-	-
Myiagra rubecula	Leaden flycatcher	LC	-	X	X	-	-	-
Ninox connivens	Barking owl	LC	-	X	-	-	-	-
Ninox novaeseelandiae	Southern bookbook	LC	Ma	-	X	-	-	-
Ninox strenua	Powerful owl	V	-	X	-	-	-	X
Numenius madagascariensis#	Eastern curlew	NT	Mi/Ma	-	X	X+	X+	-
Numenius phaeopus#	Whimbrel	S	Mi/Ma	X	X	X+	X+	-
Ocyphaps lophotes	Crested pigeon	LC	-	-	-	-	-	X
Pachycephala rufiventris	Rufous whistler	LC	-	X	-	-	-	-
Pandion cristatus	Osprey	S	Mi/Ma	X	X	-	-	-
Pardalotus striatus	Striated pardalote	LC	-	X	X	-	-	-
Pelecanus conspicillatus	Australian pelican	LC	-	-	X	-	-	-
Petrochelidon ariel	Fairy martin	LC	-	-	-	-	-	X
Petrochelidon nigricans	Tree martin	LC	-	-	X	-	-	X
Phalacrocorax melanoleucos	Little pied cormorant	LC	-	-	X	-	-	-
Phalacrocorax varius	Pied cormorant	LC	-	X	X	-	-	-
Phalacrocorax varius	Pied cormorant	LC	-	-	X	-	-	-
Phaps chalcoptera	Common bronzewing	LC	-	-	X	-	-	-
Philemon buceroides	Helmeted friarbird	LC	-	X	-	-	-	-
Philemon citreogularis	Little friarbird	LC	-	X	-	-	-	-
Philemon corniculatus	Noisy friarbird	LC	-	X	X	-	-	X

Scientific Name	Common name	NC Act status	EPBC Act status	Source				
				URS 2008/2009	BAAM 2009	Worley Parsons 2010	Footprints 2010	Ecologica Consulting 2010
Platycercus adscitus	Pale-headed rosella	LC	-	X	X	-	-	X
Pluvialis fulva#	Pacific golden plover	S	Mi/Ma	-	-	X+	X+	-
Podargus strigoides	Tawny frogmouth	LC	-	-	X	-	-	-
Rhipidura albiscapa	Grey fantail	LC	-	X	-	-	-	-
Rhipidura leucophrys	Willy wagtail	LC	-	X	-	-	-	X
Scythrops novaehollandiae	Channel-billed cuckoo	LC	-	-	X	-	-	X
Sphecotheres vieilloti	Australasian figbird	LC	-	-	X	-	-	X
Sterna caspia	Caspian tern	S	Mi/Ma	X	-	X$^+$	-	-
Sterna hirundo	Common tern	S	Mi/Ma	-	X	-	-	-
Sterna nilotica	Gull-billed tern	LC	-	X	-	-	-	-
Strepera graculina	Pied currawong	LC	-	X	-	-	-	-
Tachybaptus novaehollandiae	Australasian grebe	LC	-	-	X	-	-	-
Taeniopygia bichenovii	Double-barred finch	LC	-	-	-	-	-	X
Thalasseus bergii	Crested tern	S	Ma	X	X	-	-	-
Todiramphus chloris	Collared kingfisher	LC	-	X	X	-	-	-
Todiramphus macleayii	Forest kingfisher	LC	-	X	X	-	-	X
Todiramphus sanctus	Sacred kingfisher	LC	-	X	-	-	-	X
Trichoglossus chlorolepidotus	Scaly-breasted lorikeet	LC	-	-	-	-	-	X
Trichoglossus haematodus	Rainbow lorikeet	LC	-	X	X	-	-	X
Tringa brevipes[#]	Grey-tailed tattler	S	Mi/Ma	-	X	-	X$^+$	-
Tringa nebularia[#]	Common greenshank	S	Mi/Ma	-	X	-	X$^+$	-

Scientific Name	Common name	NC Act status	EPBC Act status	Source				
				URS 2008/2009	BAAM 2009	Worley Parsons 2010	Footprints 2010	Ecologica Consulting 2010
Tringa stagnatilis#	Marsh sandpiper little greenshank,	S	Mi/Ma	-	-	-	X+	-
Vanellus miles#	Masked lapwing	LC	-	X	X	-	X+	-
Vanellus tricolor#	Banded lapwing	LC	-	X	-	-	-	-
Xenus cinereus#	Terek sandpiper	S	Mi/Ma	-	-	-	X+	-
Zosterops lateralis	Silvereye	LC	-	-	-	-	-	X
Mammals								
*Bos taurus**	Domestic cow	-	-	X	-	-	-	-
Canis lupus	Dog	-	-	X	-	-	-	-
Chaerephon jobensis	Northern free-tailed bat	LC/CB	-	(X)	-	-	-	-
Chalinolobus gouldii	Gould's wattled bat	LC/CB	-	(X)	-	-	-	-
Chalinolobus nigrogriseus	Hoary wattled bat	LC/CB	-	(X)	-	-	-	-
Chalinolobus picatus	Little pied bat	NT/CB	-	-	-	-	-	X
*Equus caballus**	Domestic horse	-	-	X	X	-	-	-
*Felis catus**	Feral cat	-	-	X	-	-	-	-
Macropus giganteus	Eastern grey kangaroo	LC	-	X	X	-	-	-
Miniopterus australis	Little bent-winged bat	LC/CB	-	X	-	-	-	-
Miniopterus orianae oceanensis	Eastern bent-winged bat	LC/CB	-	X	-	-	-	-
Mormopterus beccarii	Beccari's free-tailed bat	LC/CB	-	X	-	-	-	-
Mormopterus ridei	Eastern free-tailed bat	LC/CB	-	(X)	-	-	-	-
Nyctophilus sp.	Unknown long-eared bat	LC/CB	-	(X)	-	-	-	-
Petaurus australis australis	Yellow-bellied glider	LC	-	-	-	-	-	X
Petaurus norfolcensis	Squirrel glider	LC	-	X	-	-	-	X

Scientific Name	Common name	NC Act status	EPBC Act status	Source				
				URS 2008/2009	BAAM 2009	Worley Parsons 2010	Footprints 2010	Ecologica Consulting 2010
Phascolarctos cinereus	Koala	V/IC	-	(X)		-	-	-
Saccolaimus flaviventris	Yellow-bellied sheath-tailed bat	LC/CB	-	(X)	-	-	-	-
Scoteanax rueppellii	Greater broad-nosed bat	LC/CB	-	(X)	-	-	-	-
Scotorepens balstoni	Inland broad-nosed bat	LC/CB	-	(X)	-	-	-	-
Scotorepens greyii	Little broad-nosed bat	LC/CB	-	X	-	-	-	-
*Sus scrofa**	Feral pig	-	-	X	X	-	-	-
Tachyglossus aculeatus	Short-beaked Echidna	S/IC	-	-	-	-	-	X
Austronomus australis	White-striped free-tailed bat	LC/CB	-	X	-	-	-	-
Trichosurus vulpecula	Common brushtail possum	LC	-	X	-	-	-	X

Table notes _ = species has been detected on Curtis Island, however not necessarily within the RoW; + = species has been detected within The Narrows or the Kangaroo Island Wetlands () = species was unreliably identified due to poor quality Anabat data or indistinguishable similarity between species tracks/traces; * = exotic species; # = shorebird species

NCA Status E = Endangered, V = Vulnerable, NT = Near Threatened; S = Special Least Concern; LC = Least Concern I = Introduced; IC = Iconic species; CB = Colonial breeding species

EPBC Status E = Endangered, V = Vulnerable; Mi = Migratory; Ma = Marine

Source EPBC Protected Matters Search Tool 2011; Wildlife Online 2011

Amphibians

Thirteen amphibian species were recorded during the fauna surveys surrounding the Curtis Island GTP RoW (including the LNG Facility). Despite the diversity of amphibians recorded, only one species was detected within the actual RoW, namely the Cane toad (*Rhinella marinus*). The lack of suitable habitat present, and the prevailing weather conditions (dry prior to and during) during the fauna investigations for the Curtis Island GTP RoW may explain the lack of native amphibian species detected.

It is unlikely that the Curtis Island GTP RoW supports core habitat for many native amphibians. However, it is expected that native amphibians would be present during periods of water inundation and may utilise ephemeral waterways at these times for breeding.

No EVNT amphibians have been detected, or are considered likely to occur within the vicinity of the Curtis Island GTP RoW.

Reptiles

Twenty-two species of reptile were recorded during fauna surveys within and surrounding the Curtis Island GTP RoW. Of these species, five were detected within the actual RoW. The structural complexity and microhabitats (eg rocky outcrops) of the Curtis Island GTP RoW offers suitable habitat for a variety of reptile species. It is likely that those species detected within the surrounding areas of Curtis Island also occur within the Curtis Island GTP RoW.

No EVNT reptiles have been detected, or are considered likely to occur within the vicinity of the Curtis Island GTP RoW.

Birds

One hundred and twenty bird species were recorded during fauna surveys within and surrounding the Curtis Island GTP RoW. Birds were recorded from all feeding groups, especially insectivores, nectarivores, marine raptors and shore/wading birds.

Despite the high avian diversity with the Curtis Island region, it is unlikely that the Curtis Island GTP RoW provides core habitat for a number of the species detected within the region (particularly shorebirds) as a result of low foraging potential.

Littoral communities form a relatively small proportion of ecosystem types along the Curtis Island GTP RoW. As a result, the Curtis Island GTP RoW is not expected to provide sufficient resources for shorebirds. Despite this, 21 shorebirds have been recorded within the vicinity of the RoW and cannot be discounted from potential impacts from construction of the Curtis Island GTP RoW (eg noise and lighting).

Threatened species

Despite their omission from the database search results, three birds listed as vulnerable under the provisions of the NC Act have been detected within the vicinity of the Curtis Island GTP RoW, namely Powerful owl (*Ninox strenua*), Glossy black cockatoo (*Calyptorhynchus lathami lathami*) and Beach stone curlew (*Esacus neglectus*).

The Powerful owl relies on large arboreal hollows (hollow bearing trees) for nesting, a resource in abundance on Curtis Island. Arboreal hollows are also utilised by Powerful owl primary prey species such as squirrel gliders (*Petaurus norfolcensis*) and Common brushtail possums (*Trichosurus vulpecula*). The Powerful owl breeds during June to September. It is important to note that this species may desert a nest after minimal human disturbance, particularly early in the breeding season.

The Glossy black cockatoo also relies on large arboreal hollows for nesting. This species forages on seeds of the *Allocasuarina littoralis* (black sheoak) and *Allocasuarina torulosa* (Forest oak), both of which are well distributed across Curtis Island. Breeding for this species occurs every two years, due to extended juvenile dependency. Glossy black cockatoos have exhibit a strong fidelity to particular trees, returning to feed in selected trees over consecutive years (GBC 2010).

Access to Curtis Island will intersect known foraging and roosting habitat for the following threatened bird species. The vulnerable (NC Act) Beach stone-curlew is found exclusively on the coastline in a range of habitats including undisturbed beaches, islands, reefs, estuarine intertidal sand and mudflats. This species breeds above the littoral zone between September and November. The Beach stone-curlew is known to occur on Curtis Island, and has been observed foraging on the foreshore of Laird Point, within the vicinity of the Graham Creek boat ramp (Ecologica 2010).

The NC Act listed, Near Threatened, Sooty oystercatcher (*Haematopus fuliginosus*) has been identified adjacent to the Curtis Island GTP RoW (URS 2008; BAAM 2009). This species favours rocky headlands, rocky shelves, exposed reefs with rock pools, beaches and muddy estuaries. The Sooty oystercatcher forages on exposed rock or coral at low tide, and breeds in spring and summer, almost exclusively on offshore islands. Potentially suitable habitat occurs within the intertidal regions of Graham Creek, adjacent to the Curtis Island GTP RoW.

Migratory birds and shorebirds

During the summer months, a number of migratory, marine and shorebirds are known to roost and feed within the intertidal wetlands of Curtis Island which adjoin the RoW. These include such species as the Eastern curlew (*Numenius madagascariensis*), Common greenshank (*Tringa nebularia*),Sharp-tailed sandpiper (*Calidris acuminata*), Great knot (*Calidris tenuirostris*), Lesser sand plover (*Charadrius mongolus*), Grey-tailed tattler (*Heteroscelus brevipes*), Bar-tailed godwit (*Limosa lapponica*), Pacific golden plover (*Pluvialis fulva*), Marsh sandpiper (*Tringa stagnatilis*) and Terek sandpiper (*Xenus cinereus*) (Ecologica 2010; Worley Parsons 2010). Whimbrel (*Numenius phaeopus*) and Red-necked stint (*Calidris ruficollis*) have also been recorded foraging in the intertidal wetlands within the vicinity (<500 m) of the Curtis Island GTP RoW (BAAM 2009).

Further desktop investigations identified another ten migratory and seabird species (including those listed under the EPBC Act and/or NC Act) known to occur within, or within 5 km, of the Curtis Island GTP RoW. These include Great egret (*Ardea ibis*), Osprey (*Pandion cristatus*), Caspian tern (*Sterna caspia*), Eastern reef egret (*Egretta sacra*), Common tern (*Sterna hirundo*) and Crested tern (*Thalasseus bergii*).

Suitable habitat for these shorebird species is limited within and directly adjacent the actual RoW, and mainly occurs within the adjacent intertidal areas associated with The Narrows, Kangaroo Island and Curtis Island. Access to Curtis Island will intersect known foraging and roosting habitat for the abovementioned species. In addition, the works will occur within 200 m of these habitats.

No known roosting areas have been identified within close proximity to the works, however indirect impacts on foraging and behaviour may occur as a result of noise, lighting and also visual disturbance during the works. The retention of intertidal and terrestrial vegetation between the works and the foraging areas should reduce the potential impact.

Rainbow bee-eater (*Merops ornatus*) and Satin flycatcher (*Myiagra cyanoleuca*) and have also been recorded during recent investigations on Curtis Island. Rainbow bee-eater was detected within the hinterland margins of Curtis Island during surveys within the intertidal areas of the Curtis Island GTP RoW (URS 2008). Satin flycatcher was recorded within the adjacent LNG Facility site, towards the southern end of the Curtis Island GTP RoW (URS 2009).

A nesting pair of White-bellied sea-eagles (*Haliaeetus leucogaster)* has been recorded on Curtis Island, within close proximity to the Curtis Island GTP RoW (Worley Parsons 2010). This species is known to breed between the months of May and August.

Fork-tailed swift (*Apus pacificus*), White-throated needletail (*Hirundapus caudacutus*) and Little tern (*Strunla albifrons*) have also been recorded within the broader Curtis Island area (Worley Parsons 2010; Sandpiper 2010), and although not expected to utilise the Curtis Island GTP RoW as core habitat, these species are considered likely transients during the migratory period (October to April).

Furthermore, Barn swallow (*Hirundo rustica*), Spectacled monarch (*Monarcha trivirgatus*), and Black-breasted button quail (*Turnix melanogaster*) are considered to have a moderate likelihood of occurrence within the vicinity of the Curtis Island GTP RoW due to the presence of potentially suitable habitat. However, targeted searches within and adjacent to the Curtis Island GTP RoW have not resulted in the detection of these species.

Mammals

Twenty-five mammalian species were recorded during surveys of the Curtis Island GTP RoW and surrounds.

Small ground-dwelling fauna were poorly represented within the Curtis Island GTP RoW during surveys. One ground-dwelling mammal, namely Short-beacked echidna (*Tachyglossus aculeatus*) was detected within the RoW. Echidnas are considered iconic species listed as 'special native' under the provisions of the NC Act. Echidnas are usually found among rocks, in hollow logs and in holes among tree roots.

Three arboreal mammalian species, namely Common brushtail possum (*Trichosurus vulpeculai)*, Squirrel glider (*Petaurus norfolcensis*), and Yellow-bellied glider (*Petaurus australis australis*) were recorded within woodland communities at low densities.

Fourteen microbat species are known to utilise the woodlands of the south west coast of Curtis Island. A major factor influencing the distribution and abundance of bats is the abundance of roost sites within the local area. Within forest areas, where there is a large choice of roost sites available, bats may use several roost areas regularly. However, cave dwelling species may be more limited in the number of roosts available.

The bat species that have been identified within the Curtis Island GTP RoW include hollow-dependent species (ie White-striped free-tailed bat [*Austronomus australis*], Eastern free-tailed bat [*Mormopterus ridei*], Yellow-bellied sheath-tailed bat [*Saccolaimus flaviventris*], Little broad-nosed bat [*Scotorepens greyii*], Western broad-nosed bat [*Scotorepens balstoni*], Greater broad-nosed bat [*Scotorepens rueppellii*], Hoary wattled bat [*Chalinolobus nigrogriseus*] and Gould's wattled bat [*Chalinolobus gouldii*]), in addition to those which roost in caves, under overhangs and in rocky outcrops (ie Little bent-wing bat [*Miniopterus australis*], Eastern bent-wing bat [*Miniopterus orianae oceanensis*]). The Little pied bat and the Northern free-tailed bat (*Chaerephon jobensis*) areknown to roost in both caves and tree hollows. Beccari's free-tailed bat [*Mormopterus beccarii*] commonly roosts in hollows but is also known from cave in other areas within its distribution.

Based on the microbat assemblage, hollow bearing trees and other tree habitat (eg demarcating bark) within the Curtis Island GTP RoW are potentially used by mircobats. No caves or rocky outcrops were identified in the project area and it is likely that the cave dwelling species are roosting in other areas with the vicinity of the GTP RoW and utilising the area as a foraging resource.

Megabat species such as the Black flying fox (*Pteropus alecto*), Grey-headed flying fox (*Pteropus poliocephalus*) and Little red flying fox (*Pteropus scapulatus*) were not observed during the recent surveys due to restrictions on nocturnal surveys (Ecologica 2010). However, these species are known from the Port Curtis locale and are likely to forage within and adjacent the Curtis Island RoW. No flying fox camps are known within close proximity to the Curtis Island RoW.

Two species of gliders have been identified from the project area, the Yellow-bellied glider (*Petaurus australis*) and Squirrel glider (*Petaurus norfolcensis*). All of these arboreal species are hollow-dependent, thus the age of the woodlands within the project area would influence local distribution and abundance.

The Eastern grey kangaroo (*Macropus giganteus*) was commonly observed within the Curtis Island GTP RoW. This species is listed under the provisions of the NC Act as Least Concern, and is often considered abundant where the clearing of bushland and the creation of improved pasture has occurred.

Five non-native fauna species were recorded within and adjacent to the Curtis Island GTP RoW, namely Domestic horse (*Equus caballus*), Feral pig (*Sus scrofa*), Domestic cow (*Bos taurus*), Wild dog (*Canis familiaris*) and Feral cat (*Felis catus*).

Threatened species

DERM mapping illustrates Essential Habitat for the Koala (*Phascolarctos cinereus*) within REs 12.3.3/12.3.7 and 12.3.7/12.3.11 present within and adjacent to the Curtis Island GTP RoW. This mapping is based on habitat modelling, rather than actual records from the area.

The SEIS field survey (URS 2009) conducted targeted searches for Koala. Markings identified as "possible" Koala markings were identified on a large *Eucalyptus tereticornis* located to the east of Laird Point, adjacent to Graham Creek (within mapped Essential Habitat; RE 12.3.7/12.3.11).

It is important to note that the project area is located within District C as described in the *Nature Conservation (Koala) Conservation Plan 2006 and Management Program 2006-2016*. Within this district there is evidence of Koala population decline. However, Koalas are generally classified as being of special least concern wildlife under the provisions of the NC Act due to a generally lower perceived threat to their survival (EPA 2006). This is despite a portion the area being within the SEQ bioregion, in which Koalas are listed as vulnerable under the provisions of the NC Act.

When assessing the likelihood of this species occurring within the Curtis Island GTP RoW, a number of factors have been considered, including:

- The presence of habitat trees and the absence of sightings and reliable evidence of Koala (ie scats) recorded during the SEIS field survey (URS 2009)
- Target searches conducted as part of the EIS (URS, 2008) and subsequent targeted searches conducted (Ecologica, 2010) did not detect this species, nor evidence of this species
- The absence of official species records (eg Wildlife Online and Queensland museum databases) for Koala within the region, despite the number of surveys conducted within the south-western region of Curtis Island

- Anecdotal evidence from local landowners and Queensland Parks and Wildlife Service within the southern region of Curtis Island that suggests that Koalas have not been seen within the region for 15 years
- It is not always possible to confidently distinguish Koala scratches from those of other arboreal animals (Phillips and Callaghan, 1995)
- Koalas were not identified from surveys undertaken on behalf of other LNG proponents within the area

It is considered unlikely that the mapped Essential Habitat that occurs within the Curtis Island GTP RoW provides core habitat for Koalas. Should this species occur within the south-western region of Curtis Island, population densities would be expected to be low.

Despite its omission from the database search results (EPBC 2011; Wildlife Online 2011), the Little pied bat (*Chalinolobus picatus*), which is listed under the provisions of the NC Act as Near Threatened, has been detected within the vicinity of the Curtis Island GTP RoW during recent field investigations (Ecologica 2010). Breeding habitat is present within the Curtis Island GTP RoW in the form of hollow-bearing trees.

It is also considered highly likely that the Coastal sheathtail bat (*Taphozous australis*) (which is listed as Vulnerable under the provisions of the NC Act) occurs within the vicinity of the Curtis Island GTP RoW as a result of suitable foraging habitat. This species is known from the broader area, including habitat which is similar in composition and structure to that within the RoW. However, suitable breeding habitat for Coastal sheathtail (ie rocky crevices) is limited within and adjacent to the RoW.

The Vulnerable (EPBC Act) Grey-headed flying fox (*Pteropus poliocephalus*) is known from the Gladstone region, and is likely to forage within Curtis Island GTP RoW (ie suitable foraging trees are present within the RoW). However, no known flying fox camps (can be a mix of species) have been identified within or adjacent to the Curtis Island GTP RoW.

Pests of National and State significance

A review of the EPBC Protected Matters databases (DSEWPaC, 2011) identified four pest species, as potentially occurring within 5km of the Curtis Island GTP RoW, namely:

- Goat (*Capra hircus*)
- Feral cat (*Felis catus*)
- European rabbit (*Oryctolagus cuniculus*)
- Red fox (Vulpes vulpes)

These species are declared under the LP Act as a Class 2 pest[4]. In addition, there are approved threat abatement plans under the EPBC Act for goats, rabbits, foxes and cats. There is also an approved threat abatement plan under the EPBC Act for feral pigs.

Table 9.11 outlines declared pest species detected within, or within the vicinity of the Curtis Island GTP RoW during field investigations.

4 There are three classes of declared pests under the LP Act:

Class 1: is not commonly present in Queensland, and if introduced would cause an adverse economic, environmental or social impact. Class 1 pests established in Queensland are subject to eradication from the state. Landowners must take reasonable steps to keep land free of Class 1 pests
Class 2: is established in Queensland and has, or could have, a substantial adverse economic, environmental or social impact. Management of these pests requires coordination and they are subject to programs led by local government, community or landowners. Landowners must take reasonable steps to keep land free of Class 2 pests
Class 3: is established in Queensland and has, or could have, an adverse economic, environmental or social impact. Landholders are not required to control Class 3 pests unless their land is in or adjacent to an environmentally significant area

Table 9.11 Pest species identified within or adjacent to the Curtis Island RoW

Scientific name	Common name	LP Act class	EPBC act status	EPBC threat abatement plan
Canis lupus dingo	Dingo	2	-	-
Felis catus	Feral cat	2	Invasive	✓
Sus scrofa	Feral pig	2	-	✓

Table notes
Source EPBC Protected Matters Search Tool; DEWHA 2008; DEWHA 2005

An additional four introduced fauna species, not listed under the EPBC Act or LP Act, were detected within or adjacent to the Curtis Island GTP RoW during fauna surveys. The species included the Cane toad, Asian house gecko and species associated with local agricultural practices (cow and horse).

9.7.5 Habitat values

The Curtis Island GTP RoW is predominately located within a shallow, narrow valley between low metamorphic ranges. Dominant vegetation communities present include Spotted gum and Narrow-leaved ironbark woodlands. These are generally found on low hills on skeletal and rocky soils. These communities have been subjected to grazing and clearing and/or thinning in the past. A small number of mature trees bear hollows which would support populations of hollow-dependant species, including arboreal mammals, microbats and nocturnal birds.

Whilst some areas support a dense understory of *Acacia* spp. (wattles), red ash, and juvenile eucalypts, much of the community is devoid of a shrub layer. Similarly, the ground strata are variably dense or sparse depending upon shade and soil depth. There is generally an abundance of ground habitat features such as timber, rocks and clumps of native grasses. Areas supporting a denser mid-storey are attractive to forest birds, whilst honeyeaters and canopy gleaners are active in the upper strata (URS 2008).

Within the valleys and gullies, narrow fringing woodland of *Eucalyptus tereticornis* is found along the ephemeral watercourses on alluvium. Trees of this species are generally mature with a large number of habitat hollows. Recruitment is occurring at low levels. A low tree layer featuring *Acacia* spp. (wattles), *Allocasuarina torulosa* (sheoak) and juvenile *Eucalyptus* and *Corymbia* species is present. The alluvial areas generally possess a denser ground covering due to the moister microclimate and more fertile soils in these areas (URS 2008).

As elsewhere in the area, ground habitat features are abundant and include rank grasses, fallen timber and microhabitat within the creek lines. Field studies confirmed that the high concentration of hollows within the alluvial communities support arboreal fauna such as the Common brushtail possum and Squirrel glider, along with their primary predator, the Powerful owl. The canopy, when in blossom, supports flocks of lorikeets, honeyeaters and insectivores. Where a denser mid-layer is present, insectivorous birds such as the Rufous whistler (*Pachycephala rufiventris*), Satin flycatcher (*Myiagra cyanoleuca*) and Grey fantail (*Rhipidura fuliginosa*) are active.

All waterways within the Curtis Island GTP RoW are ephemeral (stream order 1), and as such are dry for the majority of the year. All flows stem from heavy and sustained rain in the catchments, with flows generally ceasing quickly. Isolated pools within the waterways dry up soon after storm events. All watercourses within the Curtis Island GTP RoW share similar attributes, as summarised below:

- All waterways are ephemeral and are mostly unmodified except for track crossing points

- Channels vary from highly sinuous to straight
- Channel shapes vary from flat to steep sided. Undercutting is often present
- Bank erosion is common, especially where steeper banks exist
- Sediment deposition is common and consists of fines, pebbles and boulders
- Instream leaf and branch debris is common, and native grasses and forbs are locally abundant in places

An analysis of the physical characteristics shows that while habitat features such as undercut banks, a variety of substrate types and instream debris and plants are present, the ephemeral nature of the watercourses reduces opportunities for aquatic fauna. Even at times of flow, the waterways within the study area would not support fish as there are no populations present to act as sources for reintroduction of species. Semi-aquatic fauna such as frogs would be present and would utilise ponds in the waterways for breeding following rain events.

The majority of the island is undeveloped (ie primarily vegetated), largely due to 8,500 ha being national park (DERM, 2010). Curtis Island State Forest and Curtis Island Conservation Park also play a significant role representing large areas of core habitat in proximity to the Curtis Island GTP RoW.

In the overall sub-region, industrial development and tree clearing within the Gladstone region has greatly reduced the presence of integral continuous stands of vegetation. Significant gaps exist between remnant stands of vegetation surrounding Gladstone, where remnant vegetation appears to be restricted to the Rundle Ranges and Mount Larcom Range in the north, and the Mount Stowe State Forest and Calliope Forest Reserve to the immediate southwest (URS 2008). The remnant vegetation of Curtis Island thus represents a significant area of integral habitat at a regional scale, although habitat connectivity to the mainland is broken by the marine barrier of The Narrows, a naturally occurring estuarine passage.

There are four nationally important wetlands associated with Curtis Island, namely Northeast Curtis Island; Port Curtis; The Narrows; and the Great Barrier Reef Marine Park. The intertidal areas surrounding the Curtis Island GTP RoW therefore play an important role as a significant local ecosystem, providing habitat continuity between each wetland. The islands surrounding Curtis Island also act as vegetative corridors for local and migratory birdlife.

9.8 Great Barrier Reef World and National Heritage Areas values and potential impacts

9.8.1 Existing environmental values

Great Barrier Reef World Heritage Area

The Great Barrier Reef World Heritage Area (GBRWHA) encompasses an area of approximately 348,000 km^2, extending from the low water mark, and extending to the sea bed, of the non-tidal mainland and includes all islands, internal Queensland Waters and *Seas and Submerged Lands Act 1973* exclusions. The Narrows, Port Curtis and parts of the Port of Gladstone fall within the WHA boundaries, however they are controlled by the Queensland Government as they are defined as internal Queensland Waters.

Under the *Environmental Protection Act 1994* (EP Act) a World Heritage Management Area is defined as a Category B ESA. As such, works below the low water mark and on Curtis Island will occur within a Category B ESA (Figure 10.1). This includes the trenching activities on Curtis Island.

An assessment of the potential impacts on the GBRWHA is outlined in the Potential Impacts on Matters of National Environmental Significance Report (Appendix G of the EIS) and further discussed in the Marine Crossing GTP EM Plan.

Great Barrier Reef Marine Park

The Great Barrier Reef Marine Park (GBRMP) was declared in 1975 with the enactment of the *Great Barrier Reef Marine Park Act 1975*. This area extends from the mean low water mark out toward the 200 nautical mile Economic Exclusion Zone and includes all tidal waters and lands. The GBRMP extends from the low water mark of Curtis Island and Facing Island and includes Seal Rocks and the mainland south of Wild Cattle Island.

9.8.2 Potential impacts to Great Barrier Reef World and National Heritage Areas

Great Barrier Reef World and National Heritage values and associated potential impacts and mitigation measures for pipeline construction on Curtis Island are described in Table 9.12 below.

Table 9.12 Great Barrier Reef World and National Heritage values, associated potential impacts and mitigation measures

GBR World and National Heritage Values	Potential Construction Impacts and Mitigation Measures	Potential Operation and Decommissioning Impacts and Mitigation Measures
Exceptional natural beauty and aesthetic importance	Direct impacts to the exceptional natural beauty and aesthetic importance of the WHA will be low as the Curtis Island GTP involves the removal of approximately 15 ha of terrestrial vegetation on Curtis Island which is setback from Port Curtis with no clear line of sight from Gladstone or marine waters adjoining Curtis Island. Also construction shipping movements for the Curtis Island GTP will be minor given the existing industrial port nature of Port Curtis. Potential indirect impacts include a decrease in marine water quality from soil erosion, release of hydrocarbon and other liquid spills and/or waste materials. Potential impacts to WHA values of exceptional natural beauty and aesthetic importance will be minimised by implementing the Curtis Island GTP EMP, and Erosion and Sediment Control Plan and Waste Management Plan.	Potential operational and decommissioning impacts will be minimal and generally limited to soil erosion, spread of weeds and waste materials associated with maintenance and decommissioning activities along the Curtis Island GTP RoW. Potential impacts to WHA values during the operational and decommissioning phases of the Curtis Island GTP will be minimised by implementing the Landscape and Rehabilitation Management Plan and Waste Management Plan.
Significant geomorphic and physiographic features	Direct impacts to the significant geomorphic and physiographic features of the WHA will be low as the Curtis Island GTP and is set inland from the shoreline and marine waters adjoining Curtis Island. Additionally significant geomorphic and physiographic features such as coral reefs and cays are absent from the Port Curtis side of the Curtis Island area of the WHA. Potential indirect impacts include a decrease in marine water quality from soil erosion, release of hydrocarbon and other liquid spills and/or waste materials. Potential impacts to WHA values of significant geomorphic and physiographic features will be minimised by implementing the Curtis Island GTP EMP, and Erosion and Sediment Control Plan and Waste Management Plan.	
Significant ongoing ecological and biological processes **Significant natural habitat for in-situ conservation of biological diversity**	Direct impacts to significant ongoing ecological and biological processes, habitat and biological diversity of the WHA will be low as the Curtis Island GTP involves the removal of approximately 15 ha of terrestrial vegetation on Curtis Island which is set inland from the shoreline and marine waters adjoining Curtis Island. No conservation significant flora species listed under	

GBR World and National Heritage Values	Potential Construction Impacts and Mitigation Measures	Potential Operation and Decommissioning Impacts and Mitigation Measures
Significant ongoing ecological and biological processes **Significant natural habitat for in-situ conservation of biological diversity (continued)**	the EPBC Act were identified within the Curtis Island GTP RoW. Potential indirect impacts include a decrease in marine water quality from soil erosion, release of hydrocarbon and other liquid spills and/or waste materials. Potential impacts to WHA values of significant ongoing ecological and biological processes, habitat and biological diversity will be minimised by implementing the Curtis Island GTP EMP, Species Management Plan, Significant Species Management Plan, Erosion and Sediment Control Plan and Waste Management Plan.	Potential operational and decommissioning impacts will be minimal and generally limited to soil erosion, spread of weeds and waste materials associated with maintenance and decommissioning activities along the Curtis Island GTP RoW. Potential impacts to WHA values during the operational and decommissioning phases of the Curtis Island GTP will be minimised by implementing the Landscape and Rehabilitation Management Plan and Waste Management Plan.
The place has outstanding heritage value to the nation because of: • **the place's importance in the course, or pattern, of Australia's natural or cultural history;** • **the place's possession of uncommon, rare or endangered aspects of Australia's natural or cultural history;** • **the place's potential to yield information that will contribute to an understanding of Australia's natural or cultural history:** • **the place's importance in demonstrating the principal characteristics of a class of Australia's natural or cultural** – **places; or** – **environments; and** • **the place's importance in exhibiting particular aesthetic characteristics values by a community or cultural group.**	Direct impacts to the outstanding heritage values to the nation will be low as the Curtis Island GTP involves the removal of approximately 15 ha of terrestrial vegetation on Curtis Island which is set inland from the shoreline and marine waters. As no Indigenous or non-indigenous cultural heritage sites exist along the Curtis Island GTP RoW, construction activities will not impact on cultural history of the national heritage values. Potential indirect impacts include a decrease in marine water quality from soil erosion, release of hydrocarbon and other liquid spills and/or waste materials. Potential impacts to the outstanding heritage values to the nation will be minimised by implementing the Curtis Island GTP EMP, Species Management Plan, Significant Species Management Plan, Cultural Heritage Management Plan, Erosion and Sediment Control Plan and Waste Management Plan.	

Listed threatened species, ecological communities, and listed migratory species associated with the Great Barrier Reef World and National Heritage Areas are discussed in the SSMP and the Marine Crossing GTP EM Plan.

9.9 Potential impacts on flora and fauna (construction and operation)

This section addresses the potential impacts to ecological values on a local scale (within the Curtis Island GTP RoW and adjacent areas).

9.9.1 Protected areas

As discussed in Section 9.7.2 no protected areas will be directly impacted by the works. However, the works will occur entirely within a Category B ESA (ie Great Barrier Reef World Heritage Management Area) and will also occur within 500 m of a Category A ESA (ie Marine Park).

The works within this area are unavoidable as the RoW is located within the designated GSDA precinct.

In addition, DIP have nominated the portion of the GSDA corridor which is available to the Proponents and development to the north (outside of the corridor) is prohibited, while movement south is constrained by the other three LNG proponents.

There are no restrictions outlined in the CG Report for works in the abovementioned area (ie Category B). However, some restriction will apply to works within endangered and of concern REs within this area (refer Section 9.7.2).

The works will conform to the CG Condition E18:

“Notwithstanding Conditions E12 to E17 inclusive, the holder of this environmental authority must ensure that the gas pipeline is not located in or within 200 metres of any listed category AESA”.

Due to the proximity of the works there is the potential for indirect impacts on this area, including overland run-off, soils and leaks from site, disturbance of fauna utilising the habitats of Graham Creek and disturbance of ASS. In addition, the vegetation within this area is locally important, buffering the intertidal wetlands of Graham Creek.

These impacts should be relatively localised and the implementation of appropriate measures (including no-go zones, emergency response measures) should minimise the degree of impacts to a manageable level.

9.9.2 Vegetation clearing

Clearing of vegetation during construction, operation and decommissioning of the Curtis Island GTP RoW will be restricted to the designated RoW, which is limited to a width of 30 m for the entire length of the Curtis Island GTP RoW (ie the area is mapped as a Category B ESA and this is in accordance with the CG Conditions of approval).

Construction phase clearing activities within the Curtis Island GTP RoW will result in the disturbance of approximately 15 ha of remnant vegetation within a Category B ESA, including:

- 1.81 ha of Endangered RE
- 7.91 ha of Of concern RE
- 5.29 ha of Least concern RE

It should be noted that the essential habitat layer present over the endangered RE communities is based on habitat modelling only for the koala and not on actual observations.

No threatened ecological communities under the EPBC Act will be cleared as a result of the proposed works (based on RE mapping and ground truthing). A breakdown of the disturbance to REs as a result of this clearing is presented in Table 9.13. The table also outlines the estimated disturbance to each RE community as a percentage of the RE within the Burnett-Curtis Hills and Ranges sub-region.

Table 9.13 Construction phase vegetation clearing extent within the Curtis Island RoW

RE	Biodiversity status	ESA	Area to be cleared within row (~ha)	% of the remnant unit	Area within sub-region (~ha)[1]	~ % of sub-regional extent[2]
12.3.3/12.3.7[#]	E/NC	B	1	6.77		
12.3.3/12.3.7[#]	E/NC	B	0.81	1.85	17,765.16	0.01
12.3.7/12.3.11	NC/OC	C	0.53	14.42	17,85.934	0.81
12.11.6/12.11.14	NC/OC	C	7.26	9.67		
12.11.6/12.11.14	NC/OC	C	0.12	1.06	194,084.4	0.004
12.11.6	NC	-	3.06	0.03		0.0017
12.11.6	NC	-	1.53	0.72	176,246	0.0009
12.11.6	NC	-	0.7	27.23	176,246	0.0004003
TOTAL			15	NA	974,202.9	0.0015

Table notes
[1] Based on the heterogeneous polygon (12.3.3/12.3.7 (endangered dominant)) within the Burnett-Curtis Hills and Ranges Sub-region
[2] Indicates percentage of this RE combination within the Burnett-Curtis Hills and Ranges Sub-region to be cleared
Mapped as essential habitat (based on habitat modelling) for the Koala

The disturbance of these areas is unavoidable, as the Proponents have been directed by DIP that the works must occur within the nominated areas of the GSDA and the alignment is constrained by the other three LNG proponents to the south.

As depicted in Table 9.13 RE12.11.6 is subject to the greatest disturbance during the construction phase. This community has a 'no concern at present' Biodiversity Status, and is not listed under the EPBC Act. Approximately 11.5 ha of this RE is proposed to be cleared within the Curtis Island GTP RoW. This represents approximately 0.003% of this community found within the sub-region.

As illustrated in Table 9.13 the works will occur within endangered and of concern REs. Under the CG Conditions clearing can occur within an endangered or of concern RE if there is no reasonable or feasible alternative exists (ie the GTP cannot move outside the designated infrastructure corridor nor further south due to the presence of the other three LNG proponents).

Also, as illustrated in Table 9.13 the majority of the clearing works will result in the removal of less than 10% of the remnant unit. Where the clearing results in the removal of greater than 10% of the remnant unit, the works will be restricted to 30 m (RoW).

It is therefore considered that the potential impacts (excluding cumulative impacts) to vegetation during construction of the Curtis Island GTP RoW are expected to be moderate, but manageable.

Mitigation measures including vegetation offsetting will be implemented for the unavoidable clearing of remnant vegetation during the construction phase, in accordance with the EPBC Act and CG Conditions.

As discussed above, the works within these communities is unavoidable. The Proponents are currently in the process of finalising an offset strategy for the Project. The Offset strategy will address unavoidable impacts on State and/or Commonwealth listed areas, communities and/or species and will be approved and implemented prior to commencing construction in accordance with relevant approvals.

From an operational perspective, vegetation disturbance impacts along the RoW are likely to be restricted to maintenance activities. Adverse impacts associated with maintenance activities may include clearing of any regrowth vegetation that emerges following the construction phase (where necessary). Beneficial impacts of the operational phase include the management of weeds within the Curtis Island GTP RoW.

Minor impacts resulting from these activities will be managed through an Operational Management Plan (OMP), which will be produced prior to the completion of the construction phase. Details of mitigation measures that will be expanded upon are given in Table 9.14. It is therefore considered that the potential impacts to vegetation during the operational phase of the Curtis Island GTP RoW are expected to be low and manageable (refer Table 9.14).

9.9.3 Impacts on significant flora species

No conservation significant flora species are expected to be impacted by the construction, operation and decommissioning of the Curtis Island GTP RoW. As discussed in Section 9.7.3, no conservation significant flora species have been detected within, or within the vicinity of the Curtis Island GTP RoW. Furthermore, it is unlikely that any of the conservation flora species generated from database searches would occur within the Curtis Island GTP RoW, as a result of the lack of suitable habitat. Despite this, mitigation measures will be implemented to minimise the potential risk of unexpected impact to these species. It is therefore expected that the potential impacts to conservation significant flora will be low and manageable during the construction and operational phases of the Curtis Island GTP RoW.

Clearing of Type A restricted plants within the Curtis Island GTP RoW will be necessary during the clearing of the RoW. Control measures will be implemented to minimise any potential impacts to Type A restricted species during the construction and operation of the Curtis Island GTP RoW, including micrositing of the works (refer Section 9.11).

Mitigation measures for the avoidance and salvaging of Type A restricted plants are specifically addressed in the SSMP. It is therefore expected that the potential impacts to Type A restricted species will be low and manageable during the construction of the Curtis Island GTP RoW.

Potential disturbance to Type A restricted plants during the operation of the Curtis Island GTP RoW may also occur as a result of maintenance activities (ie vehicular movement etc). Minor impacts resulting from these activities will be managed through an OMP. Details of mitigation measures that will be expanded upon are provided in Table 9.14. It is therefore expected that the potential impacts to Type A restricted species will be low and manageable during the operational of the Curtis Island GTP RoW.

9.9.4 Dust impacts on adjacent vegetation

There is a potential for dust impacts on adjacent vegetation during the construction and decommissioning phases of the Curtis Island GTP RoW.

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
- Local meteorological conditions and the degree of penetration of dust into vegetation communities

The dominant woodland species of the vegetation communities along the Curtis Island GTP RoW are open sclerophyll woodlands dominated by Eucalypts. Typically these systems are generally hardy and well adapted to adverse conditions (eg extended dry conditions and low nutrient soils) and exhibit physiological qualities that are not sensitive to dust deposition (ie the sclerophyllous foliage of *Eucalyptus* and *Corymbia* species is generally pendulous (ie points down), with a thick smooth cuticle that does not encourage particulate matter to remain on the surface) (URS 2008).

There is evidence however, that carbon dioxide exchange in mangroves (which occur within the adjacent vegetation communities) (refer Chapter 1) may be inhibited by increased dust deposition. Grey mangrove (*Avicennia marina*), as found within the intertidal areas of Graham Creek, 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 construction and operation and decommissioning of the Curtis Island GTP RoW, the vulnerability of mangroves to dust deposition should be highlighted. Dust management measures will be implemented to minimise dust generation during construction of the Curtis Island GTP RoW (refer Chapter 5).

Works during the operational phase are likely to involve maintenance of the Curtis Island GTP RoW. The works are unlikely to result in the disturbance of the substrate, in addition the natural regeneration of the RoW will also reduce the potential for dust deposition. Thus it is unlikely that dust deposition impacts will be significant during the operational phase of the Curtis Island GTP.

Minor impacts resulting from these activities will be managed through an OMP, which will be produced prior to the completion of the construction phase. Details of mitigation measures that will be expanded upon are given in Table 9.14.

It is therefore expected that construction and operational dust impacts will be low and manageable.

9.9.5 Weeds

As discussed in Section 9.7.3, very few WONS and LP Act declared weed species were detected within the Curtis Island GTP RoW (refer Table 9.6 and Table 9.7). However, a Pest and Weed Management Plan (PWMP) (refer Appendix D) will be implemented with the aim of minimising the risk of spreading WONS and declared weeds (LP Act listed) during the construction and operational phases of the Project. A summary of mitigation measures is included in Section 9.11.

It is therefore anticipated that construction and operational weed impacts will be low and manageable.

9.9.6 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 Curtis Island GTP RoW include weed invasion and altered micro-climatic conditions.

Edge effects are likely to impact upon the habitats or ecosystems within and adjacent to the Curtis Island GTP RoW, as a result of vegetation disturbance associated with the construction, operation, maintenance and decommissioning activities.

A SMP and SSMP will be implemented to minimise the impact of clearing during the construction and operational phases of the Curtis Island GTP RoW (refer Section 9.11). Edge effects will be managed during the operational phase by an OMP. A summary of operational mitigation measures is included in Section 9.11.

It is therefore expected that edge effect impacts during the construction and operational phases will be low and manageable.

9.9.7 Changes to fire regimes

The majority of Australian terrestrial ecosystems and many endemic flora species are threatened by inappropriate fire regimes (Lindenmayer & Burgman, 2005). Changes to the landscape as a result of vegetation clearing could potentially impact the fire regime of the vegetation communities within close proximity to the Curtis Island GTP RoW. These impacts are dependent upon several factors, including type of vegetation community, fire history, and weather and rainfall history.

Furthermore, the intrusion of exotic grasses following vegetation clearing activities may alter the frequency and intensity of fire by increasing fuel loading in some cases.

As outlined in Section 9.11, fuel loads and potential sources for accidental ignition of fires will be managed during construction of the Curtis Island GTP RoW.

Fire effects will also be managed during the operational phase by an Operational EM Plan, which will be produced prior to the completion of the construction phase. A summary of operational mitigation measures is included in Section 9.11.

9.9.8 Erosion and sedimentation

There is potential for erosion on areas disturbed by works associated with construction, operation and decommissioning of the Curtis Island GTP (refer Chapter 7). Where these activities occur on erosive soils and/ or on slopes, mobilisation of sediment into ephemeral watercourses can occur.

Potential 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 sensitive estuarine and offshore marine habitats (including the intertidal areas of Graham Creek).

An Erosion and Sediment Control Plan (ESCP) (refer Appendix A) will be implemented to minimise erosion and sedimentation during the construction and operational phases of the Curtis Island GTP (refer Section 9.11). Erosion and sedimentation impacts will be managed during the operational phase by an OMP. A summary of operational mitigation measures is included in Section 9.11.

It is therefore expected that erosion and sedimentation related impacts during the construction and operational phases will be low and manageable.

9.9.9 Loss of habitat

Construction of the Curtis Island GTP RoW may involve the loss of approximately 15 ha of fauna habitat through initial site preparation and construction-related clearing activities.

Clearing activities within the Curtis Island GTP RoW are also expected to result in the removal of general habitat features such as trees, shrubs, ground cover, rocks and timber within the Curtis Island GTP RoW.

Members of all faunal groups may be impacted by the activities associated with the construction, operation (including maintenance), and decommissioning of the Curtis Island GTP RoW. Small ground mammals (eg rodents and Quolls), reptiles and amphibians may 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 (including Powerful owl and Glossy black cockatoo) and insectivorous bats, may be affected by the removal of these habitat features during construction of the Curtis Island GTP RoW.

While the loss of habitat may affect certain types of birds, the alteration may be beneficial to others. An example, in a woodland area, the displacement of forest birds may result in a subsequent replacement by grassland species in the vicinity of the Curtis Island GTP RoW. However, it may be expected that disturbance tolerant species prevail in these instances.

Mortality impacts and predator prey disruption from habitat loss are expected to be relatively low in the context of the overall landscape ecology.

An SMP and SSMP will be implemented to minimise potential impacts to habitat loss (ie salvaging of hollows, restriction of clearing etc) during construction (refer Section 9.11). It is therefore expected that impacts relating to habitat loss will be moderate, but manageable during construction of the Curtis Island GTP RoW.

In addition, and Offset Strategy is currently being finalised for the Project. This strategy will address offset requirements for State and/or Commonwealth list communities and species, including RE12.3.3, Powerful owl, Coastal sheathtail bat, Little pied bat and the koala.

Impacts relating to habitat loss during operation of the Curtis Island GTP RoW are likely to be minimal as operational works will mainly be restricted to maintenance activities within the GTP RoW. Potential impacts will be managed by the SMP, which will be produced prior to the completion of the construction phase. A summary of operational mitigation measures is included in Section 9.11. Impacts relating to habitat loss during the operational phases will be low and manageable.

9.9.10 Fragmentation and loss of movement opportunities

Construction and operational activities within the Curtis Island GTP RoW are likely to create movement barriers for certain species. Fauna such as small mammals and birds are often deterred from crossing cleared/open areas, or areas subject to noise, vibration and lighting. In addition, the crossing of such areas can increase the potential for predation by native and introduced predators.

For example, gliders (which are known to occur on Curtis Island) move through bushland by volplaning, or gliding from tree to tree. For Squirrel gliders and Sugar gliders (*Petaurus breviceps*), the maximum volplaning distance is approximately 60 m. For the Greater glider (*Petauroides volans*) and Yellow-bellied glider (*Petaurus australis*), the maximum volplaning distance can exceed 100 m. Often distances travelled are much less (20 to 30 m), and are partly dependent upon the height of trees utilised (Lindenmayer, 2002). The clearing of a 30 m wide RoW is not expected to have a significant effect on glider movement (depending upon local vegetation patterns).

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 will 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.

Construction and operation of the Curtis Island GTP RoW is expected to have moderate long term impacts with regard to fragmentation and loss of movement opportunity within the south-west region of Curtis Island.

Control measures in Section 9.11 will be implemented to minimise potential impacts to movement opportunities during construction of the Curtis Island GTP RoW. Subsequently, the impacts relating to fauna movement are likely to be moderate and manageable.

Impacts relating to fauna movement during operation of the Curtis Island GTP RoW are likely to be restricted to maintenance activities within the GTP RoW. Potential impacts will be managed by SMP. A summary of operational mitigation measures is included in Section 9.11, and includes rehabilitation of the GTP RoW. Impacts relating to habitat loss during the operational phases will be manageable.

9.9.11 Conservation significant fauna species

Conservation significant species known within the vicinity of the Curtis Island GTP RoW include Powerful owl, Glossy black cockatoo, Beach stone-curlew, Sooty oystercatcher, and Eastern curlew. As discussed in Section 9.7.4, a number of migratory and/or shorebirds are known from the habitats adjacent to the Curtis Island GTP RoW. Refer to Table 9.9 for a list of migratory species and shorebirds that are known to occur within habitats adjacent to Curtis Island.

No substantial evidence of Koala activity has been detected within the vicinity of the Curtis Island GTP RoW. However, should this species occur within the south-western region of Curtis Island, population densities would be expected to be low because of spotter catchers will be employed.

Where clearing of remnant vegetation will result in the loss of habitat (ie hollows, foraging material and shelter), fragmentation and temporary noise and vibration, during the construction phase, potential direct and indirect impacts to these species are likely to occur. In addition, nutrient runoff from construction of the Curtis Island GTP RoW may compromise the quality of water of intertidal wetlands adjacent to the RoW, where conservation significant migratory and resident shorebirds are known or likely to occur during certain times of the year.

It is important to note that Powerful owls are known to be highly sensitive to disturbance (ie noise, vibration, lighting etc) and may desert a nest after minimal human disturbance, particularly early in the nesting season.

The SSMP specifically addresses impacts and mitigation measures for conservation significant fauna species that are known or likely to occur within the vicinity of the Curtis Island GTP RoW. The adoption of appropriate management strategies during clearing will reduce potential impacts to conservation significant fauna during construction of the Curtis Island GTP RoW (refer Section 9.11). It is therefore expected that impacts relating to significant fauna will be moderate and manageable during construction of the Curtis Island GTP RoW.

Impacts relating to significant fauna during operation of the Curtis Island GTP RoW are likely to be minimal as operation works will mainly be restricted to maintenance activities within the GTP RoW. Potential impacts will be managed by the SSMP, which will be produced prior to the completion of the construction phase. A summary of operational mitigation measures is included in Section 9.11. Impacts relating to habitat loss during the operational phases will be low and manageable.

9.9.12 Fauna injury and mortality

Potential impacts relating to fauna mortality during construction of the Curtis Island GTP RoW may occur during associated clearing and trenching activities within the RoW. Such activities are may result in fauna mortality relating to displacement, resource competition, and vehicle/machinery strikes.

In addition to the possibility of some fauna mortality during clearing activities, the loss of nesting resources may affect local prey and predator fauna populations into the future. Avian fauna may be less affected by the proposal due to their ability to easily move from the zone of impact.

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 fail to escape. The most serious implication for fauna is mortality related to heat stress and entrapment.

Implementation of appropriate strategies (eg staged clearing, exclusion fencing) will considerably reduce the potential for fauna mortality (refer Section 9.11). It is therefore considered that impacts relating to fauna mortality during construction of the Curtis Island GTP RoW will be low and manageable.

Impacts relating to habitat loss during operation of the Curtis Island GTP RoW are likely to be minimal as operation works will mainly be restricted to maintenance activities within the GTP RoW. Impacts relating to fauna mortality during operation of the Curtis Island GTP RoW will be managed by a SMP and also where necessary the SSMP. A summary of operational mitigation measures is included in Section 9.11. Impacts relating to habitat loss during the operational phases will be low and manageable.

9.9.13 Pests

Introduction and proliferation of pest species on Curtis Island during construction and operational phases of the Curtis Island GTP RoW may cause significant environmental harm when appropriate mitigation measures are not implemented.

Pest species known to occur on Curtis Island are, namely pigs, feral cats, dogs, cane toads and horses. These species are highly mobile and will move through the area independent to the works. The pooling of water within the Curtis Island GTP RoW may result in the local increase in cane toads (ie breeding habitat), however the increase is likely to be minimal.

A PWMP will be implemented, with consideration to the existing EPBC Threat Abatement Plans for feral pigs and cats, to minimise potential for pest introduction and proliferation during construction of the Curtis Island GTP RoW (refer Section 9.11). It is therefore considered that pest related impacts during the construction phase of the Project will be low and manageable.

Pest related impacts during the operational phase will be managed by an OMP. This plan will be produced prior to the completion of the construction phase. A summary of operational mitigation measures is included in Section 9.11. Pest related impacts during the operational phase are expected to be low and manageable.

9.9.14 Noise and vibration

Secondary impacts to fauna include disturbance from noise and vibration during construction and operation of the Curtis Island GTP RoW. Fauna displacement will often occur as a result of noise and vibration impacts.

Construction related noise and vibration impacts associated with construction of the Curtis Island GTP RoW will be of a temporary nature, and may have the greatest impact on resident shorebirds and those less mobile species.

Control measures will be implemented to minimise potential noise and vibration impacts to fauna during construction of the Curtis Island GTP RoW (refer Section 9.11). It is therefore considered that noise and vibration related impacts during construction of the Curtis Island GTP RoW will be low and manageable.

Noise and vibration are not expected to be significant issues within the operational phase. Despite this, noise and vibration impacts during operation of the Curtis Island GTP RoW will be managed by an OMP. This plan will be produced prior to the completion of the construction phase. A summary of operational mitigation measures is included in Section 9.11. Impacts relating to noise and vibration during the operational phase are expected to be low and manageable.

9.9.15 Lighting

The use of lighting for both work and security may have both positive and negative impacts on fauna within the area. DEWHA (2009) refer to the impact of “excessive” lighting which may improve the ability of predators (including Powerful owls) to detect roosting birds and small mammals.

Artificial light during construction of the Curtis Island GTP RoW may enable some species to increase feeding rates which could compensate for declines during the day as a result noise and vibration disturbance.

Construction related lighting impacts will be of a temporary nature, and will not be an issue following construction of the Curtis Island GTP RoW.

Control measures will be implemented to mitigate lighting impacts to fauna during the construction and operational phases of the Curtis Island GTP RoW (refer Section 9.11).

Lighting related impacts during the operational phase will be further managed by an OMP. This plan will be produced prior to the completion of the construction phase. A summary of operational mitigation measures is included in Section 9.10 Impacts relating to lighting during the operational phase are expected to be low and manageable.

9.10 Cumulative impacts

Cumulative impacts on ecology are described below. This cumulative impact assessment is based on the impact scope, identification and scoring methodology described in Chapter 2 of this EM Plan. Clearing of the RoW for multiple projects may adversely impact on terrestrial flora and fauna through direct loss of species or by increasing fragmentation of terrestrial habitat. All three GTPs impact an area of 'Of Concern' RE at approximately 1 km from Laird Point. The GLNG and QCLNG pipelines impact some areas of 'Dominant' and 'Of Concern' RE. The cumulative impacts on flora and fauna range from negligible to moderate negative.

Terrestrial flora (regional ecosystems/threatened species)

It is assumed that the entire RoW will be cleared of existing vegetation communities. These impacts are effectively permanent as the easements will be subject to ongoing vegetation management during operations.

While there is a cumulative impact associated with the combined loss of vegetation for the three projects, this has effectively been addressed in individual EISs prepared for each project and there are no construction environmental management measures available to address the impacts of loss of vegetation.

Implementation of measures set out in this EM Plan will result in moderate negative impacts on terrestrial flora (regional ecosystems/threatened species) from pipeline construction within the GSDA corridor on Curtis Island.

Terrestrial flora (edge effects: altered hydrology/degraded water quality/dust)

Vegetation zones retained within the RoW, and the areas of the protected Environmental Precinct adjoining the RoW may be exposed to increased edge effects as a result of the cumulative actions of the GTP and other infrastructure projects.

These impacts may include:

- Altered hydrogeology and hydrology (anticipated to be low given the low predicted levels of alteration to runoff)
- Acid sulphate soil acidification
- Fuel and oil spills
- Dust

Edge effects on vegetation along the western edge of the Environmental Management Area will be exacerbated by the cumulative effects of the three projects over a two year period, particularly in relation to issues such as dust deposition and weed introduction. If management measures undertaken by each proponent to manage these impacts for each individual project are effective, cumulative impacts will be minimised. Hence, while additional management measures are not proposed in relation to cumulative impacts, the importance of management measures to address edge effects for each project is highlighted.

Dust deposition impacts on this vegetation could be intensified by overlapping construction activities which result in increased overall dust levels or prolonged where the construction programs do not overlap. A prolonged impact over several seasons may be particularly detrimental to vegetation as natural growth and seeding cycles may be affected by dust deposition. Each project will need to strictly manage dust levels to minimise deposition on vegetation in the Environmental Management Reserve. If rainfall does not occur and remove dust from vegetation, each project will use low pressure water sprays to remove dust from vegetation. Alternatively, retention of a vegetated buffer inside the infrastructure corridor will protect vegetation on the edge of the Environmental Management Precinct.

Implementation of mitigation measures set out in this EM Plan will result in moderate negative impacts on terrestrial flora (edge effects: altered hydrology/degraded water quality/dust) from pipeline construction within the GSDA corridor on Curtis Island.

Terrestrial flora (weeds)

The potential for cumulative impacts from weed invasion is likely given multiple projects constructing at similar times. This is related to the increased number of vehicles/machinery personnel entering the site, thereby increasing the risk of contamination of weed seeds to the RoW and associated areas as well as an increase in disturbed areas vulnerable to weed infestation.

The weed procedures and mitigation used for each project will be reliant on the enforcement for all projects, ie if one project is not a diligent as others, there is an increased risk of weed infestation in other project areas. Overlapping activities over two years may also exacerbate the spread of weeds by encouraging the multiple reworking of excavated material and topsoil through successive phases of development.

Overall, the risk of weed invasion for multiple projects is exacerbated compared to individual projects, and each project must be more diligent in relation to weed prevention and management than would be the case for individual projects occurring in isolation.

Implementation of mitigation measures set out in this EM Plan will result in moderate negative impacts on terrestrial flora (weeds) from pipeline construction within the GSDA corridor on Curtis Island.

Terrestrial fauna (habitat loss)

Impacts related to loss of terrestrial fauna habitat have been addressed in the EIS processes, and additional management measures for construction works are not required in relation to habitat loss.

Cumulative edge effects on remaining vegetation in the Environmental Management Area will need to be managed if habitat values of this area are to be maximised.

Implementation of mitigation measures set out in this EM Plan will result in moderate negative (permanent) impacts on terrestrial fauna (habitat loss) from pipeline construction within the GSDA corridor on Curtis Island.

Terrestrial fauna (fragmentation, death and injury)

The combined LNG projects will result in much of the vegetation being cleared from the RoW. Post construction the RoW will be rehabilitated, hence habitat fragmentation is a short term issue only, with the key issue being fauna moving between remaining habitat areas as each area is cleared.

The likelihood of injury or death occurring will be increased with multiple projects, particularly if these are carried out concurrently. If the projects are not carried out concurrently, this impact will be lessened.

From the EIS data, there do not appear to be any times of the year when native animals in the area are more vulnerable to fragmentation effects.

Implementation of mitigation measures set out in this EM Plan will result in moderate negative (permanent) impacts on terrestrial fauna (fragmentation, death and injury) from pipeline construction within the GSDA corridor on Curtis Island.

Terrestrial fauna (light/noise and vibration)

Cumulative impacts on fauna species from noise, light and vibration are likely to result from works occurring within the RoW over an extended period of time (up to two years).

Animals utilising habitat in the adjacent Environmental Management Precinct may be disturbed by noise and both additive impacts which increase noise levels and impacts of prolonged noise will exacerbate effects. However, animals will be able to move away from noisy activities.

Terrestrial fauna (altered hydrology/ASS acidification/turbidity and sedimentation)

Cumulative impacts to terrestrial fauna from the impacts on surface water (altered hydrology, ASS acidification) are likely to be minor. These impacts will be managed by mitigation measures stipulated in this EM Plan.

Marine/intertidal flora and fauna (ASS acidification/boat emissions/turbidity and sedimentation/hydrotest water)

Cumulative impacts to terrestrial flora and fauna from the impacts on surface water (altered hydrology, ASS acidification, release of hydrotest water, release of sediment contaminated runoff) are likely to be minor (refer Chapter 14).

However, cumulatively over an extended period of time, minor water quality impacts may have localised or possibly more widespread adverse impacts on marine and intertidal flora, even with effective controls from each project.

Of concern are the erosion and sediment impacts on water quality. It is unlikely that each project will be able to effectively manage erosion and sediment control in isolation. While some recovery time will occur between projects, ongoing reduced light penetration and deposition from sediment over several seasons may have impacts on seagrass and benthic organisms.

Assuming project specific controls are in place for ASS and other contaminant sources, the cumulative impacts to marine flora and fauna from these sources are likely to be low in intensity and as the three projects are not scheduled to coincide, recovery from minor impacts from these sources is likely to occur. However, a major incident from one project may affect marine and intertidal ecosystems beyond absorptive capacity. This highlights the needs for each project to strictly control ASS management and hazards such as fuel and oil spills and leaks.

Impacts from hydrotest water will largely depend on the nature of additives as some of these can be toxic to marine life. However, the three projects will not be discharging hydrotest water at the same time, and this will occur as isolated events, from which marine ecosystems should be able to recover, provided toxicity is not an issue. Note that direct impacts from the works on the Curtis Island RoWs are covered in the Marine Crossing EM Plan.

Implementation of mitigation measures set out in this EM Plan will result in minor negative impacts on marine/intertidal flora and fauna from pipeline construction within the GSDA corridor on Curtis Island.

Marine fauna (including migratory birds) (disturbance from noise and boat movements)

Boat movement to Curtis Island for the construction of the GTPs will include the transport of pipe and equipment and construction personnel from the Mainland to Laird Point.

Boat movements and other construction activities generating night time lighting, noise and vibration close to wetlands and intertidal areas may impact upon feeding and or breeding in migratory birds. Large marine fauna, such as turtles, dolphins and dugongs, are sensitive to boat activities, particularly from boat strikes.

Cumulative impacts from the increased number of boat movements are anticipated. Cumulative boat movements may result in:

- Increased disturbance of marine fauna and impact on the behaviour of marine species during construction activities
- Increase in direct collisions with marine species potentially resulting in fatalities or severe injuries
- Disruptions to turtle and marine mammal movement, feeding and breeding cycles peak activity period for which are September to March (although it is noted that turtles are not recorded as nesting in the Narrows)
- Disturbance to migratory and other sensitive marine/ intertidal bird communities, especially during the summer months (September to March) when numerous migratory species are known to inhabit the Narrows

Cumulatively impacts may act across a number of seasons and construction planning and logistics may lead to activities in sensitive areas during sensitive times of the year such as breeding season. Activities occurring on Curtis Island that are close to The Narrows may also act cumulatively with works and marine traffic described in the Marine Crossing EM Plan.

Implementation of measures set out in this EM Plan and the Marine Crossing EM Plan will result in moderate negative impacts on marine fauna (including migratory birds) from pipeline construction within the GSDA corridor on Curtis Island.

9.11 Environmental protection commitments, objectives and control strategies – flora and fauna

Table 9.14 below identifies the typical management measures that will be implemented during the pre-construction and construction phases of the project to manage the projects impacts on the pre-development flora and fauna environment in accordance with the requirements of the CG Report, the EPBC Act approval for the GTP and other environmental approvals.

In the case of the significant flora and fauna species that have been identified on Curtis Island, specific management measures for the protection of these species are provided in the SSMP. Where mitigation measures presented in this EMP contradict those listed in the SSMP for the protection of conservation significant flora and fauna species, the SSMP prevails and the EMP will be updated to remove the contradiction.

In order to meet the requirements of conditions 3b and 3c of the EPBC Referral Approval (2008/4096), specific measures will be undertaken to manage the impact of clearing on each listed threatened and migratory species and each ecological community as per the approved SSMP.

Table 9.14 Environmental protection commitments, objectives and control strategies – flora and fauna

<table>
<tr><th>Item</th><th>Detail</th></tr>
<tr><td>Environmental protection Objective</td><td>To minimise adverse impacts to flora and fauna, and avoid the spread of weeds and pathogens
To promote and maintain native vegetation cover site during operations</td></tr>
<tr><td>Specific objectives</td><td>Minimal disturbance of terrestrial and aquatic flora and fauna during construction of the pipeline, associated tracks, services and accommodation facilities
No unplanned or unapproved damage to flora and fauna
No overall net loss of threatened species or communities
To appropriately rehabilitate the RoW as soon as reasonably practical
To avoid the introduction or spread of weeds and pathogens and undertake weed control where required during construction
To ensure that pests, weeds and pathogens are controlled during operations at a level that is at least consistent with adjacent land
Where additional flowlines are required, regrowth will be promoted and maintained on the easement over the long-term to be consistent with the surrounding area
To ensure that maintenance activities are planned and conducted in a manner that minimises impacts on native fauna</td></tr>
<tr><td>Control strategies</td><td>Pre-construction phase
Obtain all the appropriate approvals under local, State and Commonwealth legislation. This includes relevant approvals required to undertake site preparation and pre-clearing surveys and works
No invasive works (eg clearing, trenching) is to be undertaken until all local, State and Commonwealth approvals are obtained. The works must comply with the all relevant approval conditions (eg EPBC Act, NC Act approval)
Ensure that all the approval conditions have been addressed or adequate measures are included in the relevant management plans to address these conditions
Ensure that professionals are engaged to undertake specialist environmental investigations
Prior to carrying out field based activities, all relevant staff, contractors or agents carrying out those activities are to be made aware of the location of Category A, B and C Environmentally Sensitive Areas (ESAs) (as defined in Chapter 1)
ESAs including the following will be clearly defined and mapped:
Areas containing remnant vegetation with a biodiversity status of Endangered or Of Concern

Areas protected under the NC Act, Forestry Act or Fish Act (ie national parks, conservation parks, forest reserves, state forest parks, scientific area, declared fish habitat areas etc)

Areas mapped as essential habitat under the provisions of the VM Act
In an addition, the following Ecologically Sensitive Areas (EcoSAs) will be defined and mapped:
Vegetation communities listed under the EPBC Act (eg Brigalow)
Riparian zones of watercourses with a stream order above 3
High value habitat for threatened species known to inhabit the local areas
Prior to construction, an assessment to be undertaken of the condition, type and ecological value of any vegetation in such areas where the activity is proposed to take place. The assessment to be undertaken by a suitably qualified person(s) and include the carrying out of field validation surveys, observations and mapping of any Category A, B or C ESAs, ground truth, delineate and biocondition significant communities and the presence of species classed as endangered or vulnerable under the provisions of the NC Act and any other species listed in the SSMP
Where potential impacts to ESAs cannot be avoided, measures will be implemented prior to and during construction to minimise the impacts (ie a maximum clearing footprint of 30 m). Stored fill is not to be placed in areas where clearing of vegetation significantly isolates, fragments or dissects tracks of vegetation resulting in a reduction of ecosystem function. Fill is not to be placed in discharge areas</td></tr>
</table>

Item	Detail
	• Where clearing of remnant vegetation is required, clearing shall not exceed ten (10) metres in width for the purposes of establishing a track or twenty (20) metres for establishing a dual carriage road unless otherwise approved by the administering authority in writing • Where constructability allows, construction will be scheduled for the dry season to avoid potential impacts on aquatic fauna (including the Fitzroy River turtle, White-throated snapping turtle, Platypus etc) within wetlands and waterway crossings • A suitably qualified and experienced Environmental Officer (EO) will oversee the environmentally relevant tasks and activities. This may include (but not limited to) overseeing vegetation clearing, liaising with spotter/catcher contractors, reporting any environmentally relevant information to the GLNG Environmental Pipeline Manager (GEPM) and ensuring conformance occurs for all environmental requirements documented in the CEMP, Contractor's EMP and this Plan • Prior to site entry, all site personnel including contractors to be appropriately trained and made aware of the sensitive environs in which they will be working • Finalise construction site plans, including: – Extent of the clearing works – Location of environmentally and ecologically sensitive areas – Identification of 'no go' zones – Where necessary, fencing requirements – Microhabitats, including habitats trees to retained • Where constructability allows, establish a temporary 'no go' zone around active nests and breeding places (least concern) until the fledglings or young have left nest or roost. The status of the areas will be checked weekly in a way that does not risk the young being abandoned • No unauthorised entry to be allowed into 'no go' zones **Construction phase** *Vegetation clearing* Prior to clearing activities beginning, detailed ecological surveys will be undertaken along the entire length of the GTP ROW as well as any ancillary areas in accordance with conditions 5 to 10 of the EPBC Act approval. As a minimum, these surveys will target listed threatened species, migratory species and their habitats as well as ecological communities under the EPBC Act and NC Act. Ground truthing of remnant communities listed under the VM Act will also be undertaken at this time to determine any discrepancies in State mapping which may in turn also apply to Commonwealth listed communities. For each listed species and ecological community likely to occur, surveys will be undertaken in accordance with relevant Commonwealth survey guidelines and best practice in effect at the time of each survey. Where Commonwealth guidelines are not available, State guidelines will be adopted. All ecological surveys will be undertaken by suitably qualified ecologists who are approved by the Commonwealth prior to the survey period. Upon completion of the ecological surveys, a report detailing the survey methodologies and the field results will be provided to the relevant State and Commonwealth agencies and additionally published on the GLNG website. This report will also include the potential impacts to the ecological communities, listed species and the habitat of listed species as a result of clearing activities along with a quantification of the impacts. To meet the requirements of conditions 3b and 3c of the EPBC Referral Approval (2008/4096), it should be noted that specific measures will be undertaken to manage the impact of clearing on each listed threatened and migratory species and each ecological community as per the approved SSMP. • All vegetation clearing will comply with relevant clearing approval conditions (eg EPBC Act, EP Act, NC Act and other statutory approvals)

Item	Detail
	• Clearing to be used as a last resort – retention of vegetation, selective clearing, trimming and fauna spotting is the first priority • In the event of a non-compliance, the Contractor will issue a “stop work” order, upon which all work will cease until the non-compliance has been rectified and measures implemented to prevent the breach re-occurring • Identify alternative construction measures or techniques where vegetation clearing can be further reduced or minimised to that necessary for safe construction • Pre-clearing surveys will be undertaken by a suitably qualified ecologist(s) to ensure the identification and mapping of habitats, and to identify and map environmentally sensitive areas and key microhabitats within the RoW, including wetlands, permanent pools, habitat trees, rocky out crops and caves • A program to implement offsetting of cleared vegetation communities to be undertaken as required, in accordance with legislative criteria for the offsetting of significant vegetation communities • Where required, notify DERM and/or DSEWPaC of any inaccuracy in the regional ecosystem mapping, and where necessary amend the GLNG Offset Strategy to reflect the findings of the pre-clearing surveys • The location of vegetation to be retained to be clearly indicated on all construction drawings • Prior to works, the location of roads, site offices, stockpiling/laydown areas and plant and equipment storage areas (including heavy machinery) to be demarcated on site plans. The Contractor to ensure that such areas are located on existing cleared lands which are: – At least 100 m from mapped wetlands and watercourses – Outside of the intertidal zone or >200 m from the mapped roosting areas (migratory species) or Category A ESAs – At least 50 m away from the EPBC Act listed ecological communities (as per SSMP) • Flagging of clearing boundaries though areas of significant vegetation to be completed during the pre-construction pegging of the pipeline alignment • Prior to the commencement of construction clearing, a suitably qualified and experienced Environment Officer to mark out with barricade webbing, flagging tape, fluorescent dye or similar, the approved clearing areas and both temporary and permanent ‘no go’ zones • Ensure ‘no go zones’ are clearly sign-posted/ delineated on site prior to the commencement of works. The relevant EO to ensure that the clearing footprint and all ‘no go’ zones are adequately marked out for the clearing crew • Areas of vegetation to be cleared will be restricted to the minimum width required • All vegetation clearing to be confined to the RoW unless relevant permits and/or licenses have been approved. Any unauthorised clearing will incur an immediate stop work and a rehabilitation plan will be developed and approved by the Proponents prior to commencing that activity again. The rehabilitation plan will include timeframes • Where constructability allows, access tracks, laydown areas and other associated clearing will be avoided within environmentally and ecologically sensitive areas • With the exception of the RoW clearing requirements, clearing of remnant vegetation to not exceed ten (10) m in width for the purposes of establishing tracks and 20 m in width for dual carriageway roads unless otherwise approved by the administrating authority in writing • Clearing of all remnant REs will be avoided where possible. However, where unavoidable, areas to be cleared will be clearly delineated, prior to the commencement of clearing activities • Physical barriers will be installed around significant vegetation areas in order to restrict access and avoid disturbance • Any vegetation clearing in an Endangered/Of Concern RE or associated 200 m buffer zone to not exceed any of the following areas: – 10 percent of the remnant unit of Endangered/Of Concern RE as ground truthed and mapped before and activity commences as per section D1 and D2 of the Coordinator-General Report for the Project – 6 m in width for tracks and ten (10) m in width on corners or

Item	Detail
	– 30 m in width for pipeline construction purposes • Clearing within an Endangered and/or Of Concern Regional Ecosystem (RE) and its 200 m buffer zone clearing must be according to the following order of preference: – Pre-existing cleared areas or significantly disturbed areas less than 200m from an Endangered/Of Concern RE – Undisturbed areas less than 200 m from an Endangered/Of Concern RE – Pre-existing areas of significant disturbance within an Endangered/Of Concern RE (eg areas where significant clearing or thinning has been undertaken within a RE, and/or areas containing high densities of weed or pest species which has inhibited re-colonisation of native regrowth) – Areas where clearing of an Endangered/Of Concern Res is unavoidable • Details of any disturbance to land in or within 200 m of Endangered or Of Concern must be kept and submitted to the GLNG Operations upon request • The clearing of any threatened ecological communities must be undertaken in accordance with any approval conditions issued by the DSEWPaC, DERM and/or the Gladstone Regional Council • Clearing and disturbance in riparian areas will be minimised to that necessary to safely construct the pipelines and meet other environmental requirements (eg separation of stock piles, erosion control) and will be controlled by: – Education of all personnel on procedures for working in these environments – Reviewing and accepting detailed procedures to be submitted prior to commencing these activities – Continuous monitoring of these sensitive operations to ensure compliance with the procedures • To ensure clearing and disturbance is minimised in riparian areas, activities will be undertaken in accordance with the Aquatic Values Management Plan (AVMP), which contains an Aquatic Values Assessment with detailed descriptions of each watercourse. The AVMP also details management procedures, including: • Disturbance area for each crossing • Construction methodology for crossing of watercourses • Equipment to be used during construction in either wet or dry conditions • Restrictions on timing of construction works • Methodology for dealing with stream flows during construction • Bank reinstatement materials • Mitigation measures such as erosion and sediment control plans • To ensure clearing and disturbance in riparian areas is minimised, crossing locations have been selected to utilise, where possible, areas of watercourses that have already been substantially cleared or are degraded (eg due to cattle access) • Locations close to permanent standing or flowing water where watercourses are ephemeral will be avoided to minimise disturbance in riparian areas. • The relevant EO will coordinate with the spotter catchers and construction team during clearing activities • A licensed and experienced spotter catcher(s) will be present at each clearing front • Clearing will be conducted in a sequential manner and in a way that directs escaping wildlife away from the activity and into adjacent natural areas • Sequential clearing will be undertaken in accordance with Policy 6 of the *Nature Conservation Plan 2006*. This includes: – Clearing is carried out in stages and ensuring that no more than 50% is cleared in areas less than 6 ha and 3 ha or 3% in areas greater than 6 ha – Habitat links are maintained during clearing so animals can escape – Ensure between stages that there is at least one 12 hour (6 pm to 6 am) period where no vegetation clearing occurs • Where constructability allows, micrositing or selective clearing to avoid habitat trees

Item	Detail
	(hollow bearing trees) and other microhabitats identified during the pre-clearing surveys • Unless otherwise agreed by DERM, both active nests of significant species and their immediate surrounding area(s) must be declared temporary 'no go' zones until the chicks have left the nest. The spotter catcher or the EO will regularly check the status of active nests in a way that does not risk the nest being abandoned by the breeding pair (adult birds) • Due to the selective nature of Gliders and their food resources, Glider feeder trees will be retained wherever constructability allows • Stockpiled material (including mulch, rocks and cleared timber) should be placed in an already cleared area and away from wetlands and waterways • Minimise the double handling of stockpiled vegetation as cleared vegetation is likely to be used by native fauna, especially if not used for an extended period • Areas of reptile habitat (ie rock features) will be subject to mild active disturbance prior to clearing, to encourage natural relocation of resident fauna • Cleared native vegetation and timber will be stacked in piles and/or respread over the RoW to provide fauna habitat and assist revegetation (subject to landholder agreement). A "no burning" policy will be implemented • The natural regeneration of native species will be encouraged (in particular, groundcover and shrub species). However, seeding will be utilised in areas where rapid restoration is required (eg watercourse crossings and areas of high erosion potential) • Wetlands will be regenerated naturally. This will be achieved through regular weed control, maintaining existing tidal regimes, and mitigating issues with ASS • In areas that will be subject to significant disturbance the following in relation to soil is to occur: – The top layer of the soil profile is to be removed – Removed top layer is to be stockpiled in a manner that will preserve its biological and chemical properties – Stockpiled material is to be used for rehabilitation purposes • A return of operations form must be sent to the Proponents immediately after clearing activities are completed or if the NC Act clearing permit ceases to have affect. This document will include all details of the clearing outcomes • Collection of local provenance seed from the listed communities must be carried out prior to the commencement of clearing activities throughout the time between contract award and commencing clearing. Seed collection will be undertaken as per the Seed Collection Plan and in accordance with seed collection guideline document: *Model Code of Practice, Florabank Guideline 6: Native Seed Collection Methods*, Available at http://www.florabank.org.au/ 5 Feb 2012'. *Conservation and commercially significant flora* • A pre-construction vegetation survey will be completed in targeted areas of the RoW to identify for flagging individual EVNT species and trees that contain hollows that may be avoided during construction • Where required, notify DERM and/or DSEWPaC of any new species previously not discussed in the EIS, SEIS, SSMP or the SMP • A offset strategy and management plan will be developed and implemented for permanent loss of threatened species and their habitat and also significant vegetation communities 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 (DERM's ecological equivalence method) – 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

Item	Detail
	– 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 offset management plan will be an iterative process with State and Commonwealth regulatory bodies • For species listed under the provisions of the NC Act, and species identified as critical and high priority under the DERM Back on Track species prioritisation methodology, a SSMP will be developed and detail specific measures for the mitigation of all impacts and will be provided to GLNG Operations prior to construction • The Contractor is responsible for including within it's SSMP, details to ensure the following measures for Type A Restricted Least Concern Plants (Schedule 7 of the *Nature Conservation (Administration) Regulation 2006*) are implemented in order of preference: – Clearing will be avoided (eg edge of RoW) – Salvage and reuse for on-site revegetation – Salvage and reuse for local area revegetation – Collect seed of non-translocatable species for use in on-site revegetation – Use of seed for rehabilitation purposes (refer to the Landscape Rehabilitation Plan (LRMP) – Appendix G) – Commercial salvage – The SSMP is to be submitted to the Proponents for acceptance prior to commencing construction. Type A Restricted Plants includes species in the Family: Cycadaceae, Orchidaceae, and Zamiaceae; and species in the genus: Brachychiton; Hydnophytum; Huperzia; Livistona; Myrmecodia; Platycerium; and Xanthorrhoea • Flagging of clearing boundaries though areas of significant vegetation will be completed during the pre-construction pegging of the pipeline alignment • The clearing of any threatened ecological communities must be undertaken in accordance with any approval conditions issued by the DSEWPaC, DERM and/or relevant regional councils (this will be particularly relevant because of fauna habitat that may be associated with the community) • Dust suppression mechanisms will be put in place to ensure excessive dust deposition does not occur, especially in environmentally sensitive area (including the foliage of significant plants and ecological communities adjacent the disturbance footprint and watercourses and wetland ecosystems) *Pest and weeds* • The Contractor shall prepare a Pest and Weed Management Plan to minimise the risk of weed and pest species establishing within and adjacent to the RoW. The PWMP will be in accordance with the Proponents PWMP and shall specifically address: – The prevention and management of weed disturbance to significant ecological communities – The prevention and management of feral fauna species on mapped migratory bird roosting sites – The prevention and management of feral fauna species on significant ecological communities • To minimise the risk of weed and pest animal establishment within and adjacent to the RoW, the measures outlined in the PWMP shall be implemented by the Contractor. • Weed control measures will be designed to minimise impacts on native fauna (eg use of aquatic and frog friendly chemicals) *Edge effects* • Vehicle and pedestrian access to and from the RoW will be restricted to the defined access tracks *Fire* • Minimise fire risk through evaluation processes and management of those risks • Restrict high-risk activities in accordance with local fire bans or in times of high fire danger

Item	Detail
	• Smoking is to be undertaken in designated areas away from hazardous fuels, and extinguished completely prior to disposal • There will be no burning of stockpiled vegetation onsite • Maintain a plan for rapid and co-ordinated response to the outbreak of fire through an established fire response plan in conjunction with the local metropolitan and rural fire brigades • Conduct fire safety awareness training as part of site inductions • Adhere to fire bans • Maintain fire fighting equipment at all hot work sites • The following precautions will be taken to minimise the possibility of fire due to welding activities: – The construction area along the RoW (other than the designated stockpile areas) will be cleared of combustible vegetation to reduce the risk of fire – Stockpiled vegetation will be separated from welding activity – Welding activities will not be undertaken during designated high fire hazard (where practicable and possible) – Water trucks (also used for dust suppression) will be available for use as fire trucks in the event of fire *Erosion and sedimentation* • Where applicable, clearing slopes leading to watercourses shall be delayed until construction of the crossing is imminent, or alternative measures are employed to prevent and/or minimise erosion and sedimentation risk • Trench spoil will be stockpiled a minimum of 50 m from watercourse with a stream order of 1 and 2 and 100 m from watercourse with a stream order greater than 3 • Implement measures outlined in the Erosion Sediment Control Plan (refer Appendix A) *Loss of habitat* • Approximately 1-2 weeks prior to the commencement of construction clearing, a licensed and experienced spotter catcher(s) will undertake a pre-clearing survey of mapped habitat to determine the presence of any active roost and/or nests within or immediately adjacent the disturbance footprint. This will be done to reduce the overall risk of injury or fatality to local inhabitants during clearing activities • Approximately 1 week prior to the commencement of construction clearing, a licensed and experienced spotter catcher(s) will begin relocating fauna. This will be done to reduce the overall risk of injury or fatality to local inhabitants during clearing activities and will focus on key nests and hollows within the disturbance footprint • In designated areas (areas where hollow bearing trees are limited or the removal of habitat trees into this area are limited) install habitat nest boxes prior to clearing works • If colonial species roost(s) are located within or within close proximity to the RoW all practical and reasonable steps should be taken to avoid disturbing these sites. This will include: – The investigation of alternative construction measures near known and/or high value roost areas (eg caves) that will not compromise the stability of sandstone ridges containing bat caves/roosts – The retention of habitat trees in particular known roosting sites through micrositing the RoW or looping branches • If a maternity roost(s) for any bat species is located within or within close proximity to the RoW all practical and reasonable steps will be taken to avoid disturbing these sites. This will include the investigation of alternative construction measures near known roost areas that will not cause the bats to abandon the roost • Where habitat is to be cleared, appropriate mitigation measures will be implemented including adopting a protocol to ensure that appropriately licensed (DERM approved) and

Item	Detail
	experienced spotter catchers are onsite during all clearing • Unless otherwise agreed by DERM, both active nests of significant species and their immediate surrounding area(s) must be declared temporary 'no go' zones until the chicks have left the nest. The spotter catcher or the EO will regularly check the status of active nests in a way that does not risk the nest being abandoned by the breeding pair (adult birds) • Clearing will be conducted in a sequential manner and in a way that directs escaping wildlife away from the activity and into adjacent natural areas • Where pre clearing surveys indicate koala habitat, sequential clearing will be undertaken in accordance with Policy 6 of the *Nature Conservation Plan 2006*. This includes: – Clearing is carried out in stages and ensuring that no more than 50% is cleared in areas less than 6 ha and 3 ha or 3% in areas greater than 6 ha – Habitat links are maintained during clearing so animals can escape – Ensure between stages that there is at least one 12 hour (6 pm to 6 am) period where no vegetation clearing occurs • Where constructability allows, micrositing or selective clearing to avoid habitat trees (hollow bearing trees) and other microhabitats identified during the pre-clearing surveys • Due to the selective nature of Gliders and their food resources, Glider feeder trees will be retained wherever constructability allows. • Where habitat trees need to be removed the following measures will be implemented: – Non-hollow bearing trees will be removed before hollow-bearing (or potential habitat) trees, allowing fauna an opportunity to self-relocate from the potential habitat trees. This applies in the instance when the fauna cannot be relocated, and it is evident that an animal exists within the trees – Habitat trees will be left overnight from the time of the felling of the non-habitat trees nearby – Habitat trees will be inspected by a qualified spotter/catcher after at least one night has passed from the time that the surrounding vegetation has been cleared, to determine occupancy – The spotter/catcher will encourage the fauna to leave by reasonable means or capture and relocate it in the local environment prior to felling and trimming – Hollows identified as containing fauna shall be plugged with a suitable material such as a towel, the section removed from the tree and gently lowered to the ground using ropes. These sections will then be relocated to adjoining suitable habitat and either affixed to a tree or on the ground. Measures will be taken to avoid injuring animals. The suitability of adjacent vegetation for relocation will be determined on the basis of expert advice – Habitat trees will be shaken with the blade of the machine to allow fauna to escape – Habitat trees will be felled gently or lowered to the ground (by skilled plant operators), and trees will be left for a short period of time on the ground to give any fauna trapped in the trees an opportunity to escape before further processing of the trees – Displaced fauna shall then be relocated (within their hollows) to a suitable, previously identified recipient site provided the animal did not sustain any injuries. Any injured animals (native or introduced) are to be taken to receive veterinary attention immediately. Once recovered, animals will be relocated to an area of similar habitat adjoining the project area – Where there is a reasonable loss of hollow trees nesting boxes will be installed – All removed hollows not containing fauna shall be in rehabilitation works, unless artificial nest boxes have been put in place • Minimise the double handling of stockpiled vegetation as cleared vegetation is likely to be used by native fauna, especially if not used for an extended period • Areas of reptile habitat (ie rock features) will be subject to mild active disturbance prior to clearing, to encourage natural relocation of resident fauna

Item	Detail
	• Areas of reptile habitat that require removal will be relocated as soon as practical to adjacent habitat areas • Cleared native vegetation and timber will be stacked in piles and/or respread over the RoW to provide fauna habitat and assist revegetation (subject to landholder agreement). A “no burning” policy will be implemented • A licensed and experienced spotter catcher (s) will be present during earthworks to mitigate potential impacts to fauna. Only trained personnel (eg qualified spotter catchers) may remove fauna from trenches • Where applicable, the total clearing footprint within the riparian zones and wetlands will be no wider than 30 m, unless otherwise agreed by DERM *Fragmentation and loss of fauna movement opportunities* • Vegetation clearing will be restricted to the minimum width required • Adequate gaps or selective backfilling will be undertaken to allow fauna movement across the RoW trench and through areas where pipes are being strung *Fauna management* • Fauna management procedures will include but not be limited to: – Training and awareness of staff and contractors – Conduct of a preconstruction ecological survey to identify the presence of any endangered, vulnerable or rare fauna species and identify and mark hollow-bearing trees – Minimising the clearing of mature and hollow-bearing trees – Minimising the length of time the trench is open through the staging of activities – Temporary exclusion fencing where practicable to restrict fauna access to the trench – The use of .night caps. over open pipe string ends to prevent the ingress of wildlife – Pipes being strung with adequate gaps or selective backfilling to allow for fauna movement across the line of the pipe – A suitably qualified person for fauna handling must be present during clear and grade activities to relocate fauna or recover any injured fauna – Installation of ramps and trench plugs with a slope less than 50 per cent at least every 1000 m to assist fauna to leave the trench – Installation of shelter material to provide wet weather protection and reduction of heat stress, such as by placing sawdust filled Hessian bags in pairs every 250 m – The open trench will be checked by appropriately trained personnel for trapped fauna at least twice daily (early morning/late afternoon) • A copy of the fauna management procedures will be made available to the administering authority on request *Environmental Offsets* • Offsets will be provided for the permanent loss (take) of near threatened, rare, vulnerable and endangered plants in accordance with the Queensland Government Environmental Offsets Policy 2008 and generally in accordance with the Queensland Government Policy for Biodiversity Offsets (Consultation Draft). Details of proposed environmental offsets consistent with the Queensland Government Environmental Offset Policy 2008 and specific issue policies are to be provided upon request • An Environment Offsets Program, consistent with the Queensland Government Environmental Offset Policy 2008 and specific issue policies will be provided for approval to the Coordinator-General prior to environmental authorities being issued covering gas field development, pipeline construction and LNG facility construction and operation • The offset program will detail: – The principles adopted for the environmental offsets strategy – The predicted total loss (extent and type) of areas of ecological value, (eg remnant

Item	Detail
	vegetation, high value regrowth, wetlands, significant conservation species, habitat, biodiversity corridors) which, for the listed species and communities and essential habitats, shall be no greater than the areas specified for each item in the tables of section 6.5 of the Coordinator-General's report and corresponding tables in the Proponent's SEIS, with appropriate allowances for reductions due to co-location of species within habitats and ecosystems – The procedure to identify the requirements for environmental offsets for specific components of the project over the life of the project – Relevance to any legislative requirements for offsets – The mechanism to secure and manage the environmental offset for long term protection of values – The location, size and values of the offsets – Any management measures, including funding, required to maintain or enhance values for the life of the offset – A system for reporting to the Coordinator-General on offset arrangements, their management and how offset values are being maintained *Conservation significant fauna species* • Fauna Management Procedures will be developed as part of the Construction EM Plan, and be made available to the Proponents as requested and will detail all fauna mitigation measures • A pre-construction vegetation survey will be completed in targeted areas of the RoW to identify for flagging individual EVNT species and trees that contain hollows that may be avoided during construction • Where required, notify DERM and/or DSEWPaC of any new species not previously discussed in the EIS, SEIS, SSMP or the SMP • Pre-construction surveys must identify koala habitat as defined under the *Nature Conservation (Koala) Conservation Plan 2006* and any specific mitigation measures must be identified and implemented • Where roads traverse suitable koala habitat (RE12.3.3), fence design will incorporate the need to allow movement of koalas and other fauna species • Expert advice will be sought to assist in identifying the need and location of crossing points for gliders and other arboreal species (eg Koalas) • Where populations of conservation significant fauna, potential bat roosting sites or areas of high habitat value are identified within or adjacent to the RoW, alternative clearing plans will be evaluated and modified where practicable • Consult and brief local wildlife carers and vets on the project timing and works. This will include finalising the identification of primary and secondary wildlife carers within an area and procedures for injured fauna • For species listed under the provisions of the NC Act, and species identified as critical and high priority under the DERM Back on Track species prioritisation methodology, a Significant Species Management Plan (SSMP) will be developed and detail specific measures for the mitigation of all impacts and will be provided to the Proponent prior to construction • If significant fauna species are located within the RoW and cannot be avoided, individuals must, where practicable, be relocated using measures outlined as follows: – Individuals should be collected by a suitably licensed and experienced spotter catcher and placed in an appropriate container/bag for relocation – Individuals should be relocated to a location nearby providing similar habitat appropriate for that species – Numbers and location of individuals relocated must be recorded for reporting purposes – Hygiene protocols must be implemented and adhered to (eg measures for control of chytrid fungus which is a known pathogen of frogs) – The time taken for relocation must, where practicable, be kept to a minimum to minimise stress to the animal. A report outlining the potential relocation must be submitted to the DERM and QPIF prior to the commencement of construction

Item	Detail
	activities • Where avoidance is not possible, the loss significant species and their habitat will be offset in accordance with the requirement of the offset strategy • If colonial species roost(s) are located within or within close proximity to the RoW all practical and reasonable steps should be taken to avoid disturbing these sites. This will include: – The investigation of alternative construction measures near known and/or high value roost areas (eg caves) that will not compromise the stability of sandstone ridges containing caves/roosts – The retention of habitat trees in particular known roosting sites through micrositing the RoW or looping branches • If a maternity roost(s) for any bat species is located within or within close proximity to the RoW all practical and reasonable steps will be taken to avoid disturbing these sites. This will include the investigation of alternative construction measures near known roost areas that will not cause the bats to abandon the roost • DERM will be notified of breeding place and/or roosting sites for special least concern species observed during the construction phase. This will be done as part of the project reporting • Prior to commencement of construction, a species management plan for affected fauna, regardless of status (both terrestrial and marine) will be prepared in consultation with DERM for the total project including, development, operation and decommissioning phases. The plan must satisfy the requirements under section 322 of the *Nature Conservation (Wildlife Management) Regulation 2006* relating to tampering with animal breeding places. The plan will be developed to: – Address the impacts to the species – Provide for the survival of the species in the wild • The Contractor is responsible for developing a Species Management Plan (SMP) for affected fauna, regardless of status. The plan shall be in accordance with the Proponents SMP • The RoW should be located the maximum distance from the intertidal areas (eg Kangaroo Island Wetlands) and freshwater wetland ecosystems *Fauna injury and mortality* • Protocols and/or actions for when a threatened species or significant species is encountered during the clearing or construction works is provided in the SSMP (eg stop works, create a buffer zone and consultation with DERM) • Finalise the fauna handling protocols, including identifying the primary and secondary wildlife carers within an area, emergency procedures and ensuring that nominated personnel (eg spotter catchers) have access to the site (particularly the open trench) during all weather conditions to check for trapped fauna • Where applicable booklets and other documentation will be provided to construction staff outlining what to do if an animal is injured or a significant/threatened species is encountered • Educate staff on minimising risk to fauna, including restricting speeds, covering holes and pits and checking areas prior to clearing • Details of all surveys, fauna removal and relocation activities undertaken during construction of the Mainland GTP will be recorded in accordance with the SSMP, SMP and fauna management procedures • Traffic speeds to be limited in areas of high habitat value or known movement corridors, especially during dusk and dawn • Consult and brief local wildlife carers and vets on the project timing and works. This will include finalising the identification of primary and secondary wildlife carers within an area and procedures for injured fauna • Barbed wire fences will not be used within the RoW as these can cause mortality in bat, glider and bird populations. However, if the landholder requests a barb wire fence to be constructed, the top strand will be high tensile steel (non-barbed wire) to avoid fauna getting caught and tangled in the barbs

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	• All native fauna is protected, including snakes, and should not be disturbed, harassed or physically moved unless the animals are injured or they are at risk of injury
	• Where a temporary 'no go' zone cannot be established, a qualified and experience spotter catcher(s) will relocate the nest or breeding place to suitable habitat
	• Any animals injured by clearing activities will be referred to an appropriate wildlife carer group or veterinarian. DERM must also be notified within 24 hours of any injuries or deaths
	• Where habitat is to be cleared, appropriate mitigation measures will be implemented including adopting a protocol to ensure that appropriately licensed (DERM approved) and experienced spotter catchers are onsite during all clearing of identified at risk fauna areas
	• Any animals injured by clearing activities will be referred to an appropriate wildlife carer group or veterinarian. DERM must also be notified within 24 hours of any injuries or deaths
	• A licensed and experienced spotter catcher (s) will be present during all clearing activities (including earthworks) to mitigate potential impacts to fauna. Only trained personnel (eg qualified spotter catchers) may remove fauna from trenches
	• Where practicable, temporary exclusion fencing to restrict fauna access to the trench will be installed
	• Use of temporary fauna exclusion devices along the trench in areas of high habitat value. The exclusion devices can include:
	  – Devices installed as part of the security fences
	  – Stockpiled soil and sedimentation fences
	• The following measures shall be adopted to prevent fauna entrapment within the pipeline trench, such as:
	  – Trenching will occur progressively to minimise the period of time the trench is open, particularly in key habitat areas
	  – Constructing trench plugs with slopes less than 45° to provide exit ramps for fauna. These will be provided as a minimum every 500 m
	  – Fauna escape ramps of a slope less than 50% or trench plugs will be placed at least every 1000 m along any open trench
	  – In areas of known or high habitat value additional ramps, trench plugs branches and hessian bags for shelter will placed within the trench at greater than normal frequencies
	  – Branches, hessian sacks, ramped gangplanks or similar to be used to create 'ladders' to enable fauna to exit the trench. These will be provided as a minimum every 250 m
	  – Water-soaked, sawdust filled hessian sacks (used to support pipes prior to lay-in) will be placed every 250 m along the open trench to harbour fauna that may become trapped in the open trench
	  – Use of snake traps which can be retracted from trench
	  – Surveillance of the open trench in sensitive areas and the removal of wildlife from the trench by appropriately trained personnel (trench will be checked at least twice a day (early morning/late afternoon). During hotter months, where animals are more susceptible to dehydration or heat stress the frequency of checks will be reassessed
	  – Where there is a large number of animals being trapped additional measures will be implemented, including potentially exclusion fencing and increased frequency of checks
	• When an animal is noted as trapped, work in the immediate vicinity (ie 50 m) to stop immediately and the site supervisor notified
	• Fauna trapped in trenches should be removed as soon as possible by a suitably qualified person. No operations are to commence or continue until fauna have been removed
	• Suitably qualified personnel may encourage the animal to leave, or physically capture/trap the animal where required
	• It may be necessary to use additional devices to remove fauna from the trench due to OH&S issues. This may include nets or mesh in conjunction with shelter which can be extracted via ropes, placement of branches or ropes which fauna can scale. Contractor is

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	to submit a plan detailing how this activity is to occur and will cover all foreseeable problems prior to construction • Vehicle and pedestrian access to and from the RoW will be restricted to the defined access tracks • All contractors will be made aware of the risks associated with fauna and vehicle movement • Avoid the use of environmentally harmful chemical additives in the hydrotest water or near wetlands and watercourses • All waste/rubbish will be correctly disposed of and will not pose a risk to fauna. Plastic bags will be banned from all site offices and project areas within the coastal zone • All least concern animals, including injured animals, relocated or treated will be recorded in the wildlife register. The register will outline species encountered, number of individuals, are move from (including habitat if necessary), area moved to or appropriate wildlife carer group or vet. This report will be provided to DERM following construction • In the event of sick, injured or orphaned animals being located during clearing activities or within the trench, contact the site supervisor, environmental officer and/or a suitably qualified person (eg spotter catcher with a damage mitigation permit) • The animal is to be transported to a qualified wildlife carer and/or the taken to a veterinarian for assessment. The incident will be recorded in the wildlife register • Record observations, including date, time first observed, species (if possible), entry and exit times from safety and alert zones, and response actions, and report these to Environmental Officer at the end of the day • Records must be kept of all live and dead fauna, including amphibians, removed from the RoW, including trenches • Dead fauna should be removed and disposed of only by a suitably qualified person • Dead fauna will be recorded within the wildlife register and buried in an appropriate location and/or disposed of in accordance with the landowners/owners requirements *Feral Animals* • Fauna exclusion fencing to be utilised where necessary • If required, recommended active control methods include baiting, trapping, ground shooting and den fumigation • Fencing is recommended to keep cane toads out of ponds intended for native fish and frogs *Lighting* • Where constructability allows, avoid night works in the vicinity of light and noise sensitive areas as identified on the SEP. These areas include known glider roosting habitat and migratory bird/shorebird roosting areas • If night works are required, wherever constructability allows, any night lighting associated with the construction phase of the project shall be directed landwards and facing away from the coastline. In addition, measures to limit light pollution spilling onto mapped roosting area shall be implemented. This includes the use of light shades and low lighting in construction and operational areas located adjacent to remnant native vegetation **Operational phase** • Typical mitigation and controls for the operational phase of the Project will be detailed in the Operational Management Plan, which will be developed prior to construction
Performance indicators	• No evidence of vehicle deviation from designated access tracks • No clearing outside marked RoW clearing boundaries • No mortalities of fauna or livestock as a result of project activities • No proliferation of weeds on the project site or immediate surrounds • Evidence of appropriate vegetation stockpiling and respreading during and following construction • All onsite vehicles have certification of appropriate washdown / cleanliness as per the

Item	Detail
	requirements outlined in the PWMP

10. Noise

10.1 Chapter summary

This section provides a summary of the noise and vibration emissions assessment associated with the construction of the Curtis Island GTP RoW as well as proposed management plans to minimise impacts.

For noise purposes, the following construction activities have been assessed for the Curtis Island GTP:

- Ship unloading at Gladstone Port (Lot 300)
- Barging (equipment and pipeline joints)
- GTP construction
- Blasting

10.1.1 Summary of existing noise values

- The nearest major anthropogenic noise source to this area is the Fisherman's Landing cement plant, approximately 5 km to the southeast (on the mainland)
- Other industrial sources located several kilometres away include the Yarwun alumina refinery and the Gladstone coal terminal
- Noise from ships docking and unloading at the port is already part of the existing noise environment at this location. These activities will not change or deviate from those activities currently being carried out in the port area.
- Ambient noise monitoring was carried out on Tide Island as part of the 2008 EIS. This information is presented in Table 10.2

10.1.2 Summary of potential impacts of noise management

Construction

The maximum predicted noise level from the construction scenarios at any sensitive receiver is 24 dBA. Based on these predicted noise levels and the long separation distances it is considered that there will be no significant noise impacts at the sensitive receptors from construction of the Curtis Island GTP. Furthermore, all activities and works associated with construction of the Curtis Island GTP will be undertaken in accordance with the control strategies as outlined throughout this chapter.

The predicted vibration level at the nearest sensitive receptors (Tide Island and Witt Island) is below any predictable level due to the large separation distance and also having open water between source and receptors. There are not expected to be any vibration impacts from construction of the Curtis Island GTP at these receptors

Operation

Monthly inspections will be carried out along the Curtis Island GTP RoW by vehicle and foot patrols to check on the condition of the GTP and associated infrastructure. Typically maintenance on the Curtis Island GTP RoW will be carried out by light vehicles and small maintenance crews when required.

Noise impacts from these operational activities are expected to be low and manageable due to the low number of vehicles movements, infrequent maintenance activities and long separation distances from the Curtis Island GTP RoW to the sensitive receptors.

Furthermore, all activities and works associated with these operational activities will be in accordance with the Operational Management Plan (OMP) which will be developed and implemented prior to the completion of the construction phase.

10.1.3 Summary of proposed mitigation measures for noise management

Table 10.1 Environmental protection commitments, objectives and control strategies - noise

Item	Detail
Environmental Protection Objective	• To construct the GTP in a manner to minimise the impact of construction related noise and vibrations on surrounding residences and industry
Specific Objectives	• Compliance with the licence conditions and relevant guidelines and standards for noise and vibration associated with the operation and construction of the GTP
Control Strategies	• Refer to Table 10.10 for noise and vibration management control strategies to be implemented during construction and operation of the Curtis Island GTP
Performance Indicators	• No warranted complaints from residents and landholders, and warranted complained responded to within 2 working days • Compliance with licence conditions and industry standards • Blasting activities will meet the applicable Australian Standards and statutory requirements

10.2 Existing noise environment

The area of the Curtis Island GTP alignment is mainly uninhabited open forest/woodland with a history of grazing and clearing. The nearest major anthropogenic noise source to this area is the Fisherman's Landing cement plant, approximately 5 km to the southeast (on the mainland). Other industrial sources located several kilometres away include the Yarwun alumina refinery and the Gladstone coal terminal, shown in Figure 10.1.

Ambient noise monitoring was carried out on Tide Island as part of the 2008 EIS. Table 10.2 shows the results for the long term unattended ambient noise monitoring, whilst Table 10.3 shows the short term ambient attended monitoring. The background noise sources during the measurements were industry noise from Gladstone, some wave action on the shore, and insects and birds. Waves, insect and bird noise are intermittent and dependant on seasonal and meteorological conditions, while industry noise from Gladstone is expected to be relatively consistent throughout the year.

The noise levels presented in Table 10.2 and Table 10.3 are for the LA_{90T} noise level, as noise limits are to be set by comparing with the existing background noise level measured by the LA_{90T} parameter.

Table 10.2 Unattended ambient noise monitoring – Rating Background Level

Monitoring location	Monitoring period dated	Rating Background Level (dBA)		
		Day	Evening	Night
P1 – Tide Island	21 February to 6 March 2008	41	41	41

Note The Rating Background Level is the lowest 10th percentile of the background noise in an area (in accordance with DERM Ecoaccess Guideline "Planning for Noise Control")

Table 10.3 Attended ambient noise monitoring – Tide Island

Loc. ID	Date	Time (end of 15 min period)	Measured Noise Level (dBA)			Observations and comments	Photo
			LA90	LAeq	LA10		
P1 – Tide Island	21/02/08	8:30am	41	45	46	Industry from Gladstone audible, Insect and bird noise; occasional passing power boat	
	-	-	-	-	-	No evening attended measurement due to site access restrictions	
	-	-	-	-	-	No night time attended measurement due to site access restrictions	

Note that Table 10.2 are existing background noise levels adopted for the noise assessment undertaken for the Curtis Island GTP.

Noise monitoring was also undertaken at South End (Curtis Island), however this location is approximately 9.5 km from the Curtis Island GTP, and measurements at that location are not considered to be relevant to this assessment.

The nearest receptors to the Curtis Island GTP are the sensitive places on Tide Island (3.6 km) and Witt Island (4.5 km), shown in Figure 10.1. Therefore, the 41 dBA background noise level recorded for Tide Island is considered to be appropriate to adopt for the assessment of noise emissions from the Curtis Island GTP.

10.3 Sensitive receptors

The sensitive receptors located nearest to the Curtis Island GTP are those on Tide Island (3.6 km) and Witt Island (4.5 km), shown in Figure 10.1.

10.4 Modelling methodology

10.4.1 SoundPLAN

In order to calculate the noise emission levels at the various noise sensitive receiver locations from construction and operational plant and equipment associated with the Curtis Island GTP, SoundPLAN (Version 7.0) environmental computer modelling has been employed. SoundPLAN is a software package which enables compilation of a sophisticated computer model comprising a digitised ground map (containing ground contours), the location and acoustic sound power levels of potentially critical noise sources on site and the location of receptors for assessment purposes.

The computer model can generate noise emission levels taking into account such factors as the source sound power levels and locations, distance attenuation, ground absorption, air absorption and shielding attenuation, as well as meteorological conditions, including wind effects.

Due to the large spatial coverage of the Curtis Island GTP, predictions have been carried out for various construction scenarios to determine noise emission levels as a function of distance from construction activities. The function relating noise emission levels to distance for each construction scenario have been used to predict noise emission levels at the identified sensitive receptors (ie Tide and Witt Island). Noise predictions for activities associated with the Curtis Island GTP are based on the assumption that there is flat, soft ground between the noise source and the receiver and neutral weather conditions (refer Table 10.4).

10.4.2 CONCAWE

All noise predictions for this section of the Curtis Island GTP have been carried out utilising the CONCAWE prediction methodology within SoundPLAN.

The statistical accuracy of environmental noise predictions using CONCAWE was investigated by Marsh (Applied Acoustics 15 - 1982). Marsh concluded that CONCAWE was accurate to ±2 dBA in any one octave band between 63 Hz and 4 kHz and ±1 dBA overall.

Construction noise levels have been predicted for neutral weather conditions with the meteorological parameters in Table 10.4.

Table 10.4 Neutral weather conditions

Parameter	Neutral weather
Temperature	25°C
Humidity	70%
Pasquill Stability Category	D
Wind Speed	0 m/s

10.5 Assessment methodology and modelling assumptions

Curtis Island GTP noise and vibration emissions have been assessed for the following construction activities:

- Ship unloading at Gladstone Port
- Barge movements (equipment and pipeline joints)
- General construction activities associated with the Curtis Island GTP

10.5.1 Ship unloading at Gladstone Port

Ships containing pipe joints, required to construct the last 5 km of section of the Curtis Island GTP will be unloaded at Gladstone Port. Approximately 500 pipe joints will be barged to Curtis Island for the 5 km Curtis Island GTP.

Noise from ships docking and unloading at the port is already part of the existing noise environment at this location. The ship unloading and re-loading associated with the Curtis Island GTP will not change or deviate from those activities currently being carried out in the port area.

10.5.2 Barge movements

Figure 10.2 presents the proposed barge route between Gladstone mainland and the existing barge landing facility at Graham Creek. The proposed barge route travels the Targinie Channel from Berth No.4[1] at Auckland Point north of the Gladstone industrial precinct to existing barge landing facility at Graham Creek on Curtis Island. The barge is required for the transportation of plant, equipment and pipeline joints for the 5 km Curtis Island GTP.

[1] GHD, 12. Port of Gladstone Logistics Summary, *GLNG Pipeline FEED Logistics Study.* (page 73)

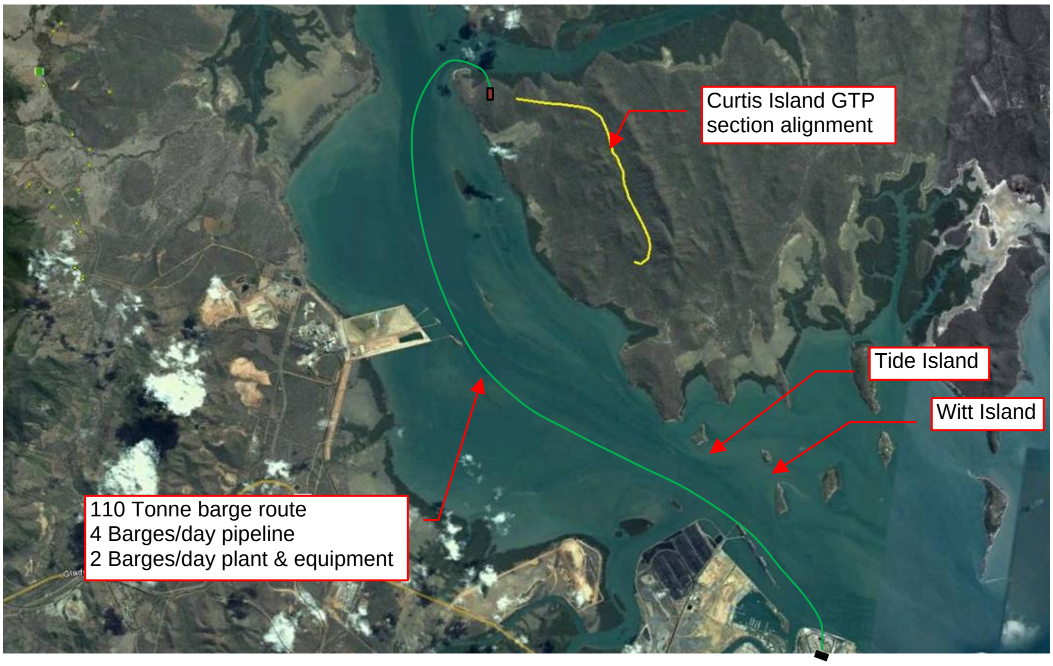


Figure 10.2 Curtis Island GTP related barge route

The coastal area north of Gladstone is predominantly used for industrial purposes. Any sensitive receptors located on the mainland are separated by sufficient distance (more than 4 km) such that noise from the Curtis Island GTP related barge movements will be negligible. The nearest noise sensitive receptors to the proposed barge route are located on Tide Island and Witt Island approximately 800 m and 1000 m from the barge route respectively.

Construction personnel working on the Curtis Island GTP will typically be ferried to the barge landing point on Curtis Island with one ferry in the morning and one ferry in the evening.

10.5.3 Construction of the Curtis Island GTP

The construction plant and equipment used for noise assessment are included in Table 10.5. Construction scenarios for noise modelling are presented in Table 10.6.

Predicted construction noise levels will inevitably depend upon the number of plant items and equipment operating at any one time and on their precise location relative to the receiver(s). Therefore a receiver will experience a range of noise levels representing “minimum” and “maximum” construction noise emissions depending upon:

- The location of the particular construction activity (ie if the plant item of interest were as close as possible to or further away from the receiver of interest)
- The likelihood of the various items of equipment operating simultaneously

The appropriate assessment parameter (L_{A90}, L_{A10} or L_{A1}) depends on the character of the noise source. For intermittent construction noise the appropriate (ie generally most stringent) assessment parameter is the L_{A10} parameter and have therefore been used throughout this assessment. Due to the large spatial area which the Curtis Island GTP will cover, the noise assessment methodology has been based on predicting noise levels at various offset distances from the RoW, assuming propagation over flat, soft ground. The distance from the construction of the Curtis Island GTP to each of the identified receptors along the whole RoW have then been used to calculate the noise level at each receiver. The predicted construction noise levels are assess for neutral meteorological conditions (refer Table 10.4).

Construction plant and equipment noise sources

The sound power levels shown in Table 10.5 are LA10 noise emission levels for plant and equipment items that would typically be used during the construction of the Curtis Island GTP. The sound power levels for the plant equipment items were obtained from the SLR Consulting Noise Source Database, US Department of Transport TNM (1998), British Standard BS 5228-1 (2009) and Engineering Noise Control by Bies, D.A., and Colin, H.H., (2003).

Table 10.5 Curtis Island GTP construction plant and equipment – Sound Power Levels (SWL)

Ref no.	Plant Item	A-weighted Sound Power Level LA10 in Octave Band Centre Frequency (Hz)									Overall dBA
		31.5	63	125	250	500	1k	2k	4k	8k	
1	Motorgrader	-	85	94	97	99	107	102	98	87	110
2	Dozer	69	86	95	99	107	103	102	100	92	110
3	Excavator	65	86	94	95	96	98	96	91	83	103
4	Front end loader (FEL)	66	91	96	101	104	102	104	95	86	109
5	Vibrating roller	55	73	88	98	99	100	98	92	84	105
6	Motorsaw	42	65	87	97	103	108	106	109	107	114
7	Water tankers	70	77	89	93	99	103	102	97	88	107
8	4WD	-	-	-	-	94	-	-	-	-	94
9	Minibus 10 seats	-	-	-	-	102	-	-	-	-	102
10	Backhoe	65	86	94	95	96	98	96	91	83	103
11	Backhoe with hammer	67	88	92	100	107	108	110	113	109	117
12	Rock drill equipment	66	88	94	96	103	105	106	104	97	111
13	Explosive truck	61	80	91	93	101	101	106	96	85	109
14	Compressor	59	67	77	83	92	98	99	97	92	104
15	Dump truck	70	77	89	93	99	103	102	97	88	107
16	Sideboom	69	86	95	99	107	103	102	100	92	110
17	Bending machine	67	79	96	100	100	97	97	92	86	106
18	Road tractor	-	76	78	92	95	101	94	85	77	103
19	Semitrailer flat bed 20/30 tons	73	94	96	103	105	105	104	99	90	111
20	Truck	61	80	91	93	101	101	106	96	85	109
21	Greasing truck	70	77	89	93	99	103	102	97	88	107
22	Bus 22 seats	-	-	-	-	102		-	-	-	102
23	Pipe facing machine	-	74	91	96	95	92	92	87	81	101
24	Crawler tow tractor	-	71	90	92	94	97	94	91	84	102
25	Diesel welding machine	63	76	81	85	96	96	102	93	84	104
26	Generator KW 200	67	78	95	99	99	96	96	91	85	105
28	Bus 50 seats	-	-	-	-	102	-	-	-	-	102
29	Mobile screen Vulcano – 180 m^3/h	-	81	89	93	99	97	98	95	86	104

Note - denotes not available
* Very steady state noise for some operational conditions will be limited by the $L_{A90,T}$, intermittent construction noise is limited by the $L_{A10,T}$ and some transient events may be limited by the $L_{A1,T}$. For this reason the construction noise has been assessed according to the $L_{A10,T}$ parameter

For the modelling of the Curtis Island GTP construction noise it has been assumed that there will the same amount of vehicle movements within the RoW as for the construction of the mainland GTP (up to 700 vehicle movements per day). This is a worst case assumption and would likely be significantly less for the Curtis Island GTP construction. This assumption is based on having a conservative estimate of noise emissions from this source. Of these 700 vehicle movements, 200 are considered to be from mobile plant items associated with construction activities being undertaken within the RoW. The remaining 500 vehicle movements are assumed to consist of 250 light and 250 heavy vehicle movements travelling on the access track within the ROW. The 4WDs and minibuses are considered to be light vehicles, whilst the buses, semi trailers, greasing truck and explosive trucks are considered to be heavy vehicles. For the purpose of SoundPLAN noise modelling, the light and heavy vehicle movements are presented as two separate line sources on the access road. All other construction plant items have been included as point sources in the SoundPLAN noise model.

The light vehicle movement on the access road within the RoW was modelled as a line source in SoundPLAN with a modelled traffic speed of 40 km/h. Based on a vehicle speed of 40 km/h, the calibrated vehicle pass-by distance of 15 m, and the sound power level for 250 light vehicles (4WDs) over a 12 hour period, the sound power level per meter of road was calculated to be 61 dBA/m.

The heavy vehicle movement on the access road was modelled as a line source in SoundPLAN with a modelled traffic speed of 30 km/h. Based on the vehicle speed of 30 km/h, the calibrated vehicle pass-by distance of 15m, and the sound power level for 250 heavy vehicles (buses) over a 12 hour period, the sound power level per meter of road was calculated to be 70 dBA/m.

Construction scenarios and typical plant items

Curtis Island GTP construction would be carried out in accordance with the requirements of *AS 2885 Pipelines – Gas and Liquid Petroleum* and the Australian Pipeline Industry Association *Code of the Environmental Practice (2005)*. Table 10.6 summarises the proposed construction scenarios and plant and equipment items.

Table 10.6 Curtis Island GTP construction scenarios and typical plant items

Stage	Scenario	Description	Typical plant items	Number
1	RoW and bush clearing	Graders, front end loaders and dozers are utilised for clearing and grading of the ROW. Trees, timbers and vegetation are stockpiled on the edge of the easement in preparation for re-spreading during rehabilitation.	Motorgrader	2
			Dozer	2
			Excavator	2
			Front end loader (FEL)	2
			Vibrating roller	1
			Motorsaw	6
			Water tankers	1
			4WD	1
			Minibus 10 seats	2

Stage	Scenario	Description	Typical plant items	Number
2	Rock exposure	Large exposed rocks are broken in small materials using dozers, backhoes and backhoes with hammers	Dozer	1
			Backhoe	1
			Backhoe with hammer	2
			4WD	3
			Minibus 10 seats	1
			Explosive truck	0
			Compressor	1
3	Stringing and bending	Steel pipe is laid adjacent to the pipeline trench. If required, pipe sections are bent to match changes in the alignment of the pipeline	Sideboom	4
			Bending machine	2
			Road tractor	11
			Semitrailer flat bed 20/30 tons	11
			Truck	2
			4WD	1
			Minibus 10 seats	4
4	Trenching	Trenches for the pipeline are dug	Backhoe	18
			Backhoe with hammer	2
			Greasing truck	1
			Bus 22 seats	1
			4WD	2
5	Welding	Pipe sections are welded together	Sideboom	6
			Pipe facing machine	5
			Crawler Tow Tractor	2
			Diesel Welding Machine	2
			Generator KW 200	4
			Truck	2
			Bus 50 Seats	2
			4WD	1
6	Lowering and backfilling	Pipe string is lowered into the trench and the trench is backfilled with earth	Dozer	6
			FEL (wheel loader)	7
			Backhoe	8
			Mobile screen. Vulcano – 180 m^3/h	4
			Sideboom	5
			Greasing truck	1
			Dump truck	10
			Bus 22 seats	2
			Minibus 10 seats	1
			4WD	2

Stage	Scenario	Description	Typical plant items	Number
7	Clean-up and restoration	This phase may include contouring and revegetation of the work area	Dozer	2
			Motorgrader	1
			Backhoe	2
			Dump truck	4
			4WD	1

It has been assumed that traffic movements on the access road within the RoW are not limited to only one construction stage (ie the vehicle movements on the access road may transport personnel or equipment between the various construction stages).

It is assumed that all semi trailers (flat bed 20/30 tonnes), required for the stringing and bending scenario, travel on the access road as do 5 of the 10 dump trucks required for the lowering and backfilling scenario.

10.5.4 Construction vibration

The following section addresses the vibration impacts associated with the construction of the Curtis Island GTP. The dominant vibration sources are:

- Rockbreaking
- Compaction with vibratory rollers
- Heavy vehicle movements

Heavy trucks passing over normal (smooth) road surfaces generate relatively low vibration levels, typically ranging from 0.01 mm/s to 0.2 mm/s at the footings of buildings located 10 m to 20 m from a roadway. Very large surface irregularities can cause levels up to 5 to 10 times higher. Based on a fairly rough gravel access road vibration levels of up to 1 mm/s at 10 m from the access road have been assumed.

The typical maximum levels of ground vibration from rockbreaking, vibratory rollers and heavy vehicle movements sourced from Heggies Vibration Measurement Data Base are shown in Figure 10.3.

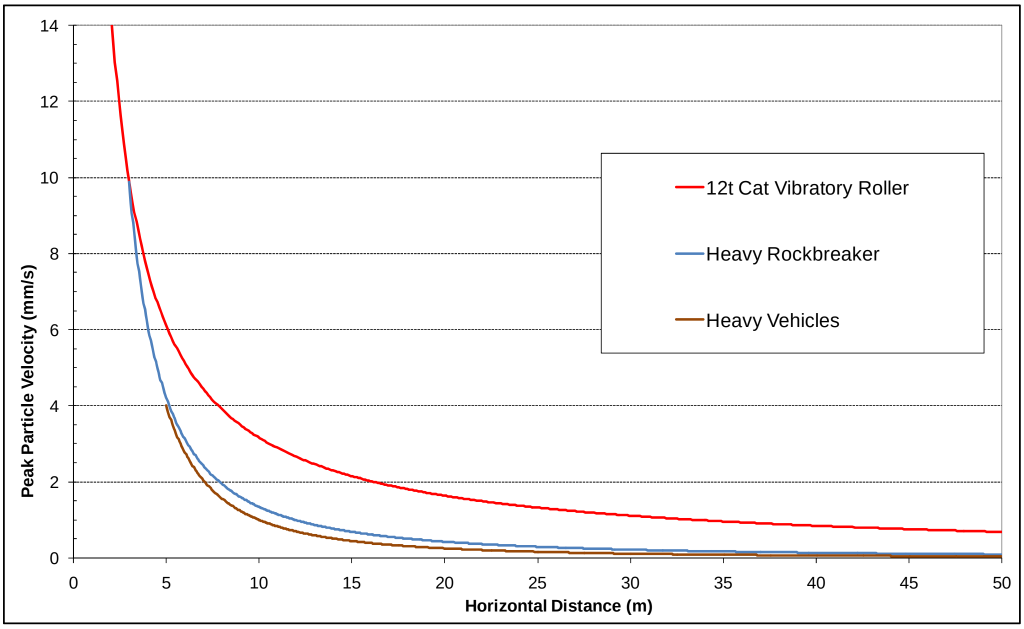


Figure 10.3 Maximum ground vibration – rockbreaking, vibratory rollers and heavy vehicles

10.5.5 Blasting

Blasting may be required to form the trench in areas of igneous rock which is not separable by mechanical methods (such as an excavator with rock hammer).

Details of the blast parameters and design required for the Curtis Island GTP section is not available at this stage, however should blasting be undertaken, it is assumed drill and blast techniques incorporating confined blasting (ie blasting of hole/trench on open ground) will be employed. It is assumed that no more than approximately 20 kg of Maximum Instantaneous Charge (MIC) will be required. The Australian Standard AS 2187.2 (2006) and the ICI Explosives Blasting Guide (1995) gives prediction formulas for predicting the ground vibration and airblast overpressure from blasting as follows:

<u>Ground Vibration</u>

$$V = 5000\left(\frac{\sqrt{Q}}{R}\right)^{1.6} \qquad \text{(Equation 2)}$$

Where, V = Ground vibration, mm/s

Q = Maximum Instantaneous Charge (MIC), kg

R = Distance from blast, m

<u>Airblast Overpressure</u>

$$P = 185 \times 10^3\left(\frac{Q^{1/3}}{R}\right)^{1.2} \qquad \text{(Equation 3)}$$

Where, P = Airblast overpressure, Pa

Q = Maximum Instantaneous Charge (MIC), kg

R = Distance from blast, m

The airblast overpressure can be significantly reduced if fully confined blast hole charges are employed (ie by using signal tube surface initiation, adequately covering all exposed detonating cord and by increasing the stemming and/or burden distance).

Detailed blast predictions should be carried out for locations where blasting may be required for the Curtis Island GTP section when the blast design and parameters have been confirmed.

10.6 Potential adverse or beneficial impacts on noise and vibration (construction and operation)

The following sections present the results of the noise and vibration modelling for the Curtis Island GTP. Where applicable, noise and vibration management and mitigation measures are nominated for scenarios where the applicable criteria are predicted to be exceeded.

10.6.1 Ship unloading at Gladstone Port

Noise from ships docking and unloading at the port is already part of the existing noise environment at this location. The ship unloading and re-loading associated with the Curtis Island GTP will not change or deviate from those activities currently being carried out in the port area. It should also be noted that there will only be two ships docking at Gladstone Port over a period of up to two months. Therefore, it is considered that the noise environment in the port area will not be adversely affected by ship unloading activities due to the existing noise environment associated with that activities already occurring within the area.

10.6.2 Barge movements

Noise emission levels from the barge movements (transportation of pipe joints, plant and equipment from the Gladstone Port to the Curtis Island GTP (Graham Creek barge landing facility)) have been predicted at the nearest sensitive receptors to the barge route (i.e. Tide Island and Witt Island). The predicted noise levels are based on the noise source data presented in Section 0. Table 10.7 shows the predicted noise levels from barge movements.

Table 10.7 Predicted noise levels – barge movements

Location	Approximate distance to barge route (m)	Predicted maximum barge pass-by noise level (dBA)
Tide Island	800	36
Witt Island	1,000	34

The predicted noise levels from barge movements associated with transportation of plant, equipment and pipe joints are below the existing daytime background noise level at Tide Island and Witt Island (refer Table 10.3). Also, barge movements will only occur during daytime, and as such it is considered that there will be no significant noise impact from barge movements associated with the construction of the Curtis Island GTP.

Construction personnel working on the Curtis Island GTP will be ferried to Curtis Island in the morning and returned to the mainland in the evening. The ferries will have lower noise emissions than the barges and as such no noise impact is expected from ferry movements.

Furthermore, all activities and works associated with barge movements will be undertaken in accordance with the control strategies as outlined in Section 0.

10.6.3 Construction of Curtis Island GTP

Noise emission levels from the construction of the Curtis Island GTP have been predicted for the construction scenarios presented in Section 0. The noise emission levels at the corresponding separation distances for the construction scenarios are presented in Table 10.8. The calculations have been based on the assumption of sound propagation over flat, soft ground to a typical receiver at height of 1.5 m above ground under neutral meteorological conditions (refer Table 10.4). Noise contours plans have been generated for a generic open flat ground for each of the construction scenarios (refer Figures 10.4 to 10.10).

Table 10.8 Predicted noise levels at corresponding separation distances for various construction scenarios – Curtis Island GTP

Stage	Scenario	Predicted distance to LA10 noise level (m)				
		50dBA	45dBA	40dBA	35dBA	30dBA
1	ROW and bush clearing	360	600	940	1400	1990
2	Rock exposure	410	570	800	1110	1550
3	Stringing and bending	240	380	630	1040	1590
4	Trenching	340	480	690	1000	1460
5	Welding	400	610	890	1290	1840
6	Lowering and backfilling	290	490	810	1310	2010
7	Clean Up and restoration	330	490	740	1070	1550

The functions relating noise emission levels to distance in Table 10.8 have been applied to predict the noise emission level at the receptors on Tide Island and Witt Island (refer Table 10.9).

Table 10.9 Predicted noise levels from construction of Curtis Island GTP

Receiver	Predicted noise level LA10 (dBA)						
	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6	Stage 7
Tide Island	24	17	17	22	18	21	24
Witt Island	21	14	14	19	14	18	22

The maximum predicted noise level from the construction scenarios at any sensitive receiver is 24 dBA. Based on these predicted noise levels and the long separation distances it is considered that there will be no significant noise impacts at the sensitive receptors from construction of the Curtis Island GTP.

Furthermore, all activities and works associated with construction of the Curtis Island GTP will be undertaken in accordance with the control strategies as outlined in Section 0.

10.6.4 Construction vibration

The dominant vibration sources during the construction of the Curtis Island GTP are expected to be from rockbreaking, compacting rollers and heavy vehicle movements with source vibration levels as shown in Figure 10.3 in Section 0.

The predicted vibration level at the nearest sensitive receptors (Tide Island and Witt Island) is below any predictable level due to the large separation distance and also having open water between source and receptors. There are not expected to be any vibration impacts from construction of the Curtis Island GTP at these receptors.

Furthermore, all activities and works associated with construction of the Curtis Island GTP will be undertaken in accordance with the control strategies as outlined in Section 0.

10.6.5 Operational impacts

Monthly inspections will be carried out along the Curtis Island GTP by vehicle and foot patrols to check on the condition of the GTP and associated infrastructure. Typically maintenance on the Curtis Island GTP will be carried out by light vehicles and small maintenance crews on an annual basis, or as and when required.

Noise impacts from these operational activities are expected to be low and manageable due to the low number of vehicles movements, infrequent maintenance activities and long separation distances from the Curtis Island GTP to the sensitive receptors.

10.6.6 Blasting

Blasting may be required to construct the trench in areas of igneous rock which is not separable by mechanical methods (such as an excavator with rock hammer).

It is assumed that no more than approximately 20 kg of Maximum Instantaneous Charge (MIC) will be required. The vibration and airblast overpressure prediction equations (Equation 2 and Equation 3 in Section 0) have been graphically presented in 11.

The airblast overpressure can be significantly reduced if fully confined blast hole charges are employed (ie by using signal tube surface initiation, adequately covering all exposed detonating cord and by increasing the stemming and/or burden distance). Airblast overpressure for fully confined blast hole charges is shown in 11 as the dashed brown line.

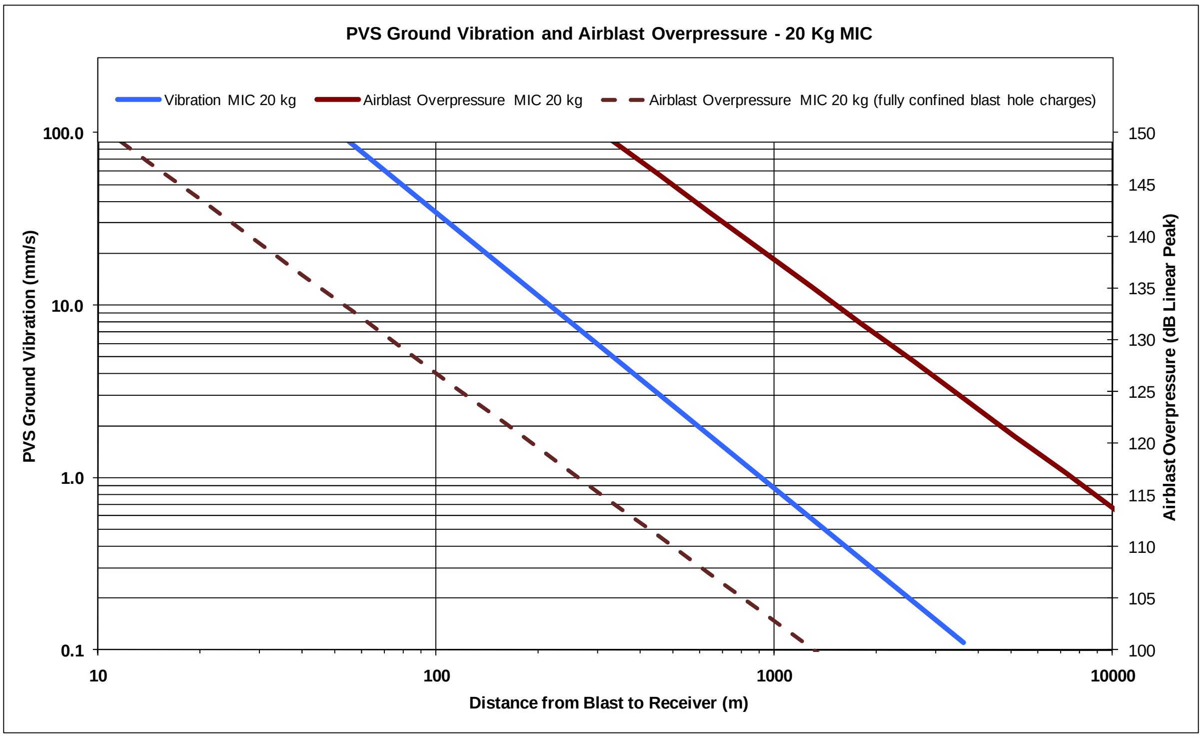


Figure 10.11 Vibration and Airblast Overpressure as a Function of Distance from Blast

Detailed blast predictions should be carried out for locations where blasting may be required for the Curtis Island GTP section when the blast design and parameters have been confirmed.

Furthermore, if undertaken, all blasting activities associated with construction of the Curtis Island GTP section will be in accordance with the control strategies as outlined in Section 0 to minimise potential vibration and airblast overpressure impacts from blasting.

10.7 Cumulative impacts

The primary potential cumulative impact from noise and vibration is to sensitive receptors during the extended construction phase of the projects. This cumulative impact assessment is based on the impact scope, identification and scoring methodology described in Chapter 2 of this EM Plan. Given the location of the project on Curtis Island, cumulative impacts from noise are anticipated to be negligible.

Human receptors (noise and vibration)

Cumulative impact of noise from construction activities on Curtis Island include noise impacts that could either be intensified by overlapping construction activities of prolonged by an extended overall construction programme. There are not anticipated to be any sensitive human noise receptors affected by the construction works on Curtis Island.

Refer Chapter 9 for potential noise impacts to fauna.

Implementation of measures set out in this EMP will result in negligible cumulative impacts on human receptors from pipeline construction within the GSDA corridor on Curtis Island. No additional mitigation measures to the EMP are required.

10.8 Environmental protection commitments, objectives and control strategies – noise (construction and operation)

Based on the results presented in Section 0, no adverse construction noise and vibration levels are predicted. Although the predicted noise and vibration levels indicate that there will be no significant impact associated with the construction of the Curtis Island GTP, examples of good practice noise and vibration management measures which should be implemented are described below in Table 10.10.

These noise and vibration mitigation and management measures are consistent with the type of recommendations described in AS 2436-1981 "Guide to Noise Control on Construction, Maintenance and Demolition Sites".

Table 10.10 Environmental protection commitments, objectives and control strategies – noise

Item	Detail
Environmental protection objective	• To construct the pipeline in a manner to minimise the impact of construction related noise and vibrations on surrounding residences and industry
Specific objectives	• Compliance with the licence conditions and relevant guidelines and standards for noise and vibration associated with the construction and operation of the GTP.
Control strategies	**Construction phase** • All activities will be conducted in accordance with licence conditions and industry standards • Where heavy rock-breaking and/or drilling and blasting is necessary for rock removal for pipeline trench excavation, the work will be carried out during normal daylight working hours. In general, any blasting that may be required will be carried out in accordance with relevant guidelines and AS 2885 • Adequate community consultation will be provided of any scheduled atypical noise events and protection of third party infrastructure • Where applicable, construction work during evening and night-time periods (6.30 pm to 6.30 am) and on Sundays/Public Holidays will be undertaken in accordance with "best practice" noise management • Any blasting will be carried out in accordance with relevant legislation • All blasting must be carried out in a proper manner by a competent person in accordance with best practice environmental management and Australian Standard 2187 • A blasting plan will be prepared prior to the commencement of any blasting activities, giving consideration of potential air blast pressure and vibration and will include mitigation measures • Construction equipment will be fitted with noise control devices • Construction equipment will be inspected regularly to maintain optimal working conditions. Throughout construction, the contractor's environmental representative will undertake regular environmental audits • Inspections of the site for compliance will occur on a daily, weekly and monthly basis • Audits will be conducted throughout the project to monitor against this EMP and other licence conditions • Monitoring and recording of air blast overpressure and ground borne vibration will be undertaken to investigate any complaint of nuisance, or at the request of The Company, and the results notified to The Company within an appropriate timeframe for assessment by the administering authority. Monitoring must include: - Maximum instantaneous charge - Location of the blast within the site (including any bench level) - Airblast overpressure level (dB Linear Peak) - Peak particle velocity (mms-1) - Location, date and time of recording - Measurement instrumentation and procedure - Meteorological conditions for blast monitoring (including temperature, relative humidity, temperature gradient, cloud cover, wind speed and direction) - Distance/s from blast site to potentially noise-affected building/s or structure/s

Item	Detail
	Managing complaints • When the administering authority advises the holder of a complaint alleging nuisance (e.g. caused by dust or noise), the holder must investigate the complaint and advise the administering authority of the action proposed or undertaken in relation to the complaint • If the administering authority is not satisfied with the proposed or completed action, the holder must undertake monitoring or other action requested by the administering authority • Landholder complaints will be recorded in a complaints register and appropriate corrective actions will be implemented and closed out by the Environmental Manager • Maintain a Complaints Register that includes the following information - identification of the complainant, the identity of the person who is receiving the complaint, the manner in which the complaint was made, the time and date on which the complaint was made, addressed and closed out and description of the complaint. The Register must include identification of the entity responsible for addressing the complaint, a brief summary of any action taken to address the complaint, and a notation as to the satisfaction or dissatisfaction of the complainant with the outcomes **Operational phase** • Typical mitigation and controls for the operational phase of the Project will be detailed in the Operational Management Plan, which will be developed prior to construction
Performance indicators	• No warranted complaints from residents and landholders, and warranted complaints responded to within 2 working days • Compliance with licence conditions and industry standards • Blasting activities will meet the applicable Australian Standards and statutory requirements

11. Social

11.1 Chapter summary

This section provides a summary of the existing social environment and identifies the potential impacts of the Curtis Island GTP RoW on the surrounding social environment.

11.1.1 Summary of existing social values

- A Social Impact management Plan (SIMP) was undertaken as part of the EIS process to identify the potential impacts of the entire GTP on the surrounding social environment
- The Gladstone region comprises a number of townships, communities and islands, with the City of Gladstone comprising a significant light industrial hub complementing heavy industry and port related activities
- Gladstone experienced the strongest population change of the study areas in the period to 2006 (16%). The estimated 2010 populations of the local and regional study areas correspond to 1.2% and 4.9% of the state study area population respectively
- There is a trend towards increasing unemployment rates over the last year, although there appears to be a slight decrease between the September and December quarters 2010. In the December quarter 2010 unemployment rates in the local study area ranged between 5.0% and 7.1%
- The regional area has extensive mineral deposits. Mining and mineral processing and service industries are important industries, both in Gladstone and the regional study area
- Gladstone supports a significant commercial fishing industry. The commercial fishing fleet operating out of Gladstone Harbour includes line fishers, net/crab fishers, trawl fishers and seasonal prawn fishers
- The major utility services operating in the Gladstone region include electricity and water
- Recreational fishing is a major recreational activity throughout the entire Gladstone region, with Gladstone city having one of the highest rates of boat ownerships of any community in Australia (GAPDL 2008)

11.1.2 Summary of potential impacts to social values

Construction

The potential community and social impacts are anticipated to occur during construction and to a lesser extent the operational (decommissioning) phase. The potential impacts associated with construction of the Curtis Island GTP primarily include the inconvenience to the community in the immediate and surrounding areas (ie on Curtis Island and Gladstone), and in particular any directly affected landholders and people that live on Curtis Island. To a lesser extent this includes people that use the port of Gladstone (The Narrows) and live in Gladstone City. Impacts to the community on Curtis Island are not expected to be significant due to the duration of construction, remoteness of the construction site from populated areas and the minor local employment opportunities.

In addition, GLNG Operations are in the process of developing a Social Impact Management Plan (SIMP) that will address local community and landholder concerns.

Operation

The operational workforce is anticipated to be approximately 20 persons. Operational activities will include inspections along the Curtis Island GTP by vehicle and foot patrols to check on the condition of the GTP and associated infrastructure. Due to the low number of operational vehicle movements, infrequent maintenance activities and remoteness of the Curtis Island GTP, social and community related impacts from these operational activities are not expected.

11.1.3 Summary of proposed mitigation measures for social values

Table 11.1 Environmental protection commitments, objectives and control strategies – social

Item	Detail
Environmental protection objective	• To minimise any social disruption to the local communities from the construction of the Curtis Island GTP
Specific objectives	• No warranted complaints from landholders and the community, and warranted complained responded to within two working days • To prevent the occurrence of potential mosquito and biting midge breeding sites and the presence of adult mosquitoes and biting midges
Control strategies	• Refer to Table 11.7 for social impact control strategies to be implemented during pre-construction, construction and operation
Performance indicators	• No warranted complaints from landholders and the community, and warranted complaints responded to within two working days

11.2 GLNG social impact management plan

A draft SIMP has been prepared for the GLNG project. The purpose of the SIMP is to define how the social impacts and opportunities associated with the construction, operation and decommissioning of the GLNG project will be managed.

The SIMP is a component of the social impact assessment process followed for the GLNG project, depicted in Figure 11.1. The process has comprised four phases and activities which have overlapped and have been iterative.

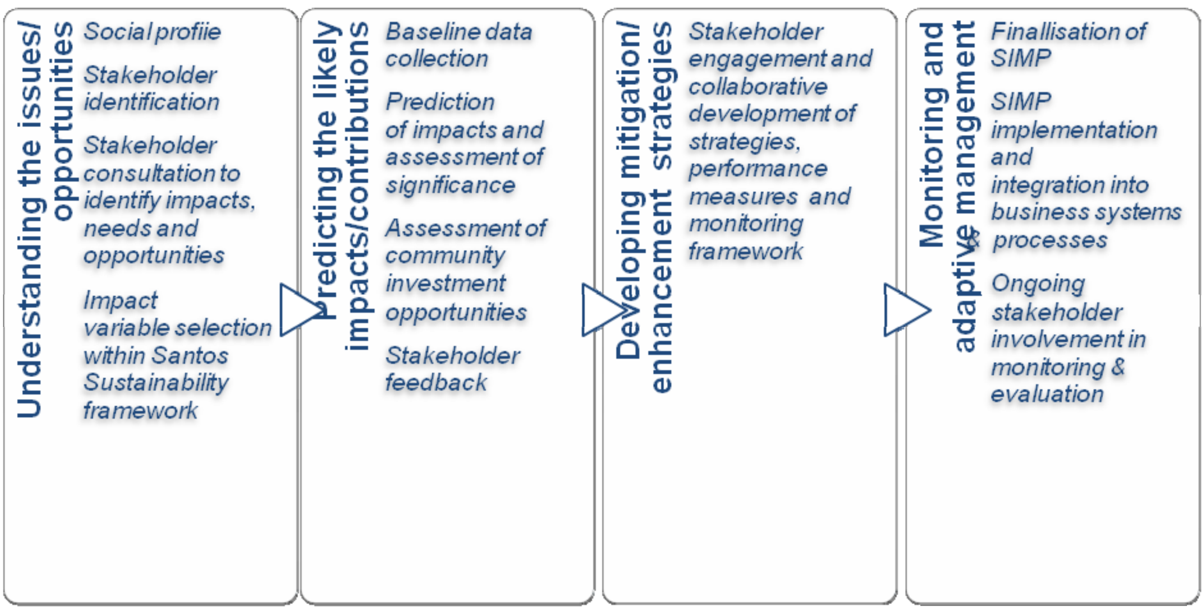


Figure 11.1 GLNG social impact assessment process

There are two main differentiators of the GLNG SIA process. Firstly, it has placed emphasis on a participatory approach to developing strategies. The stakeholder engagement program has gone beyond the traditional compliance-based SIA focus of identifying perceived impacts associated with project activity. Perceptions relating to issues affecting the future sustainability of the affected regions have been sought as well as suggestions for strategies that would benefit from GLNG, government and community partnerships. Interested stakeholders have been invited to input into strategy development and designing of performance measures for ongoing monitoring and review. Baseline assessment and consultation findings have been shared with stakeholders for validation, to promote transparency, openness and a willingness to work collaboratively.

Secondly, the assessment and resultant mitigation and social investment programs have been underpinned by the Santos Sustainability framework. This framework has guided the selection of impact variables and management plans, seeking to avoid the risks associated with literal interpretations of lists of impacts identified by stakeholders. Figure 11.2 illustrates the link between the five 'community' dimensions of the Santos Sustainability Framework, which effectively serves as an umbrella for the SIMP. Three of these dimensions - Community Wellbeing; Indigenous and Cultural Heritage; and Social Infrastructure – are addressed in the development of social context and social impact variables and GLNG performance measures. The dimensions relating to External Stakeholder Consultation and Transparency and Disclosure are addressed respectively in a Governance and Monitoring Plan and Community Engagement Plan.

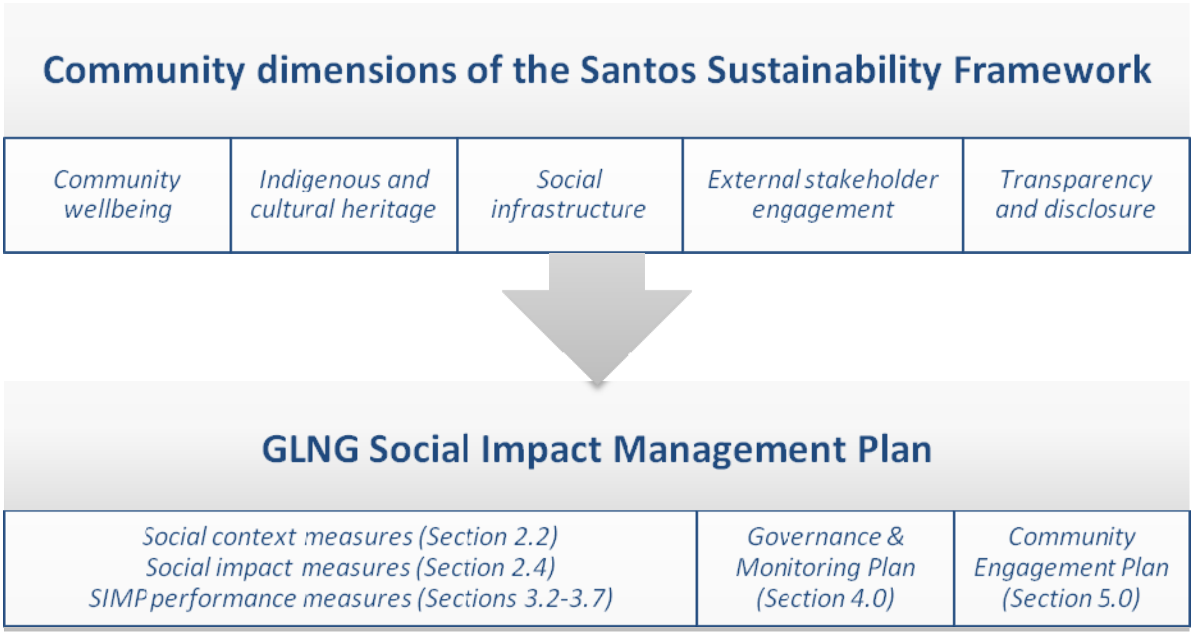


Figure 11.2 Relationship between the Santos Sustainability Framework and the GLNG SIMP

11.2.1 Description of regional study area

The regional study area is defined as the Fitzroy Statistical Division (SD 330). The statistical division covers an area of 122,966.5 km^2, and contains the two major centres of Rockhampton and Gladstone (refer Figure 11.3).

Figure 11.3 Regional study area

The Gladstone region has more recently been governed as individual Shires/Cities including Calliope Shire, Gladstone City and Miriam Vale Shire. As a result of Local Government reform undertaken by the Queensland Government, a new council was formed on 15 March 2008. The new Gladstone Regional Council (GRC) represents an amalgamation of the former Calliope Shire Council, Gladstone City Council, and Miriam Vale Shire Council.

The GRC consists of a publicly elected Mayor and eight Councillors which have an estimated operating budget of $84 M. The GRC covers an area of 10,488 km^2, containing an estimated resident population of 51,351 (in 2006) and has no internal council boundaries/divisions.

The Gladstone region comprises a number of townships, communities and islands. Within the region, the City of Gladstone functions as the major regional service centre for a hinterland that includes the towns of Boyne Island, Tannum Sands and Calliope, the smaller townships of Benaraby, Mount Larcom and Yarwun, and surrounding rural lands used for cropping, grazing, forestry and mining.

The City of Gladstone also comprises a significant light industrial hub complementing heavy industry and port related activities. The Gladstone Ports Corporation (GPC) land in Barney Point is largely committed to rail yards, freight activity and storage. Callemondah and the Hanson Road precinct (west of the Central Business District) are a focus for light industry with some additional light industry north of the airport.

11.2.2 Demographic profile

The demographic profile is based on data from the 2006 Census of Population and Housing. The data has been retrieved from the basic community profiles for each of the study areas (refer Table 11.2). The basic community profiles in the 2006 census are based on place of usual residence.

Table 11.2 depicts the local, regional and state study area populations from 1981 to 2010. Figure 11.4 shows the population change from the previous period. All study areas experienced a slowing growth in the five year period to 2001, and an increased growth after this period. However, the local study area experienced the strongest population change of the study areas in the period to 2006 (16%). The estimated 2010 populations of the local and regional study areas correspond to 1.2% and 4.9% of the state study area population respectively.

Table 11.2 Estimated residential population (1981 to 2010)

Study Area	1981	1986	1991	1996	2001	2006	2010
Local Study Area	32,275	33,290	36,113	40,149	41,885	48,483	54,249
Regional Study Area	146,562	160,120	168,368	178,028	181,747	200,385	223,516
State Study Area	2,345,208	2,624,595	2,960,951	3,338,690	3,628,946	4,090,908	4,513,850

Source Australia Bureau of Statistics, National Regional Profile 1981 – 2010

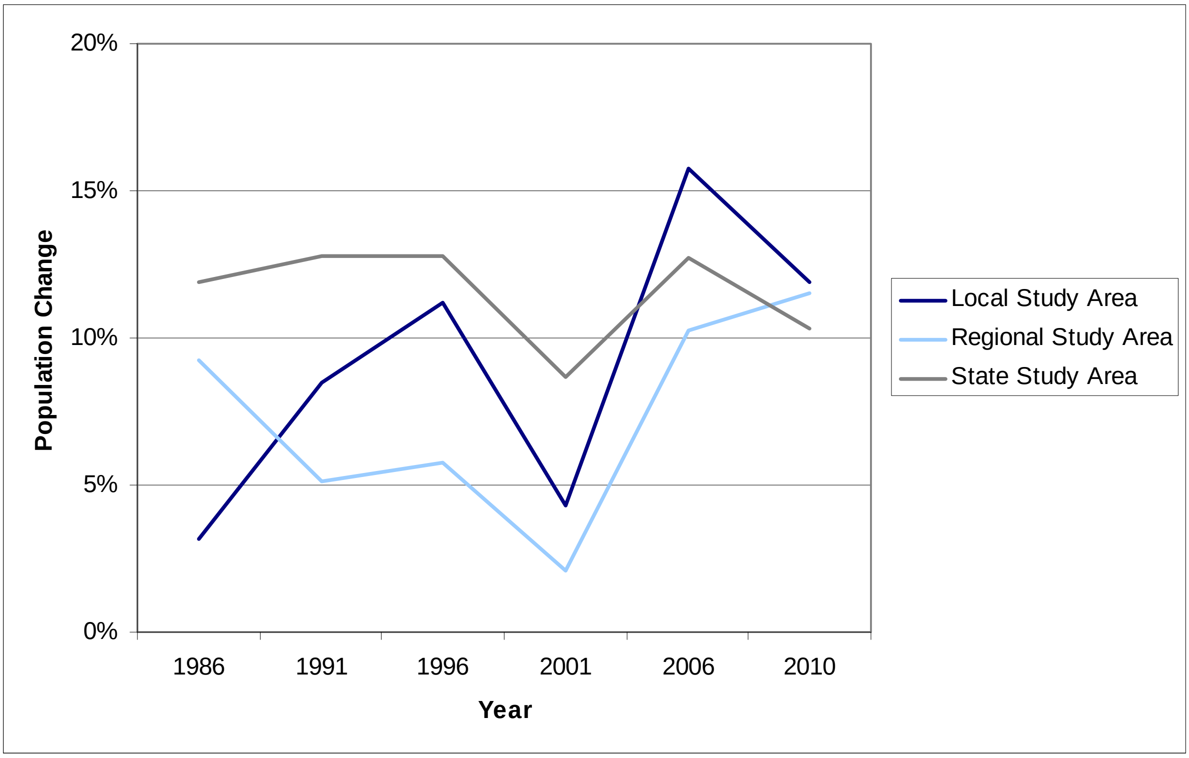


Figure 11.4 Population change from previous period

Source Australia Bureau of Statistics, National Regional Profile 1981 – 2010

Population projections

Table 11.3 and Figure 11.5 identify the projected population change for the local, regional and state study area (medium series). The local study area is projected to grow strongly to 2011 with an expected increase of 17% from 2006. After 2011 population growth is expected to slow down, but still remain between 10% and 12% per five year interval. Population growth is expected to follow a similar, although slightly slower, pattern in the regional and state study areas. The local study area is expected to be home to 86,174 people in 2031, a growth of 37,691 persons since 2006.

Table 11.3 **Projected population (medium series), 2006 to 2031**

Study Area	2006	2011	2016	2021	2026	2031
Local Study Area	48,483	56,639	63,449	70,622	78,419	86,174
Regional Study Area	200,385	224,753	243,492	262,703	283,248	303,793
State Study Area	4,090,908	4,567,713	5,040,325	5,478,715	5,884,389	6,273,885

Source Queensland Future Population 2008 edition, Appendix F Estimated resident population and projected resident population (medium series), Queensland's Statistical Divisions, pre-reformed Local Government Areas

Note The population figure for 2006 is estimated resident population. As such, it differs from the census data from the same year

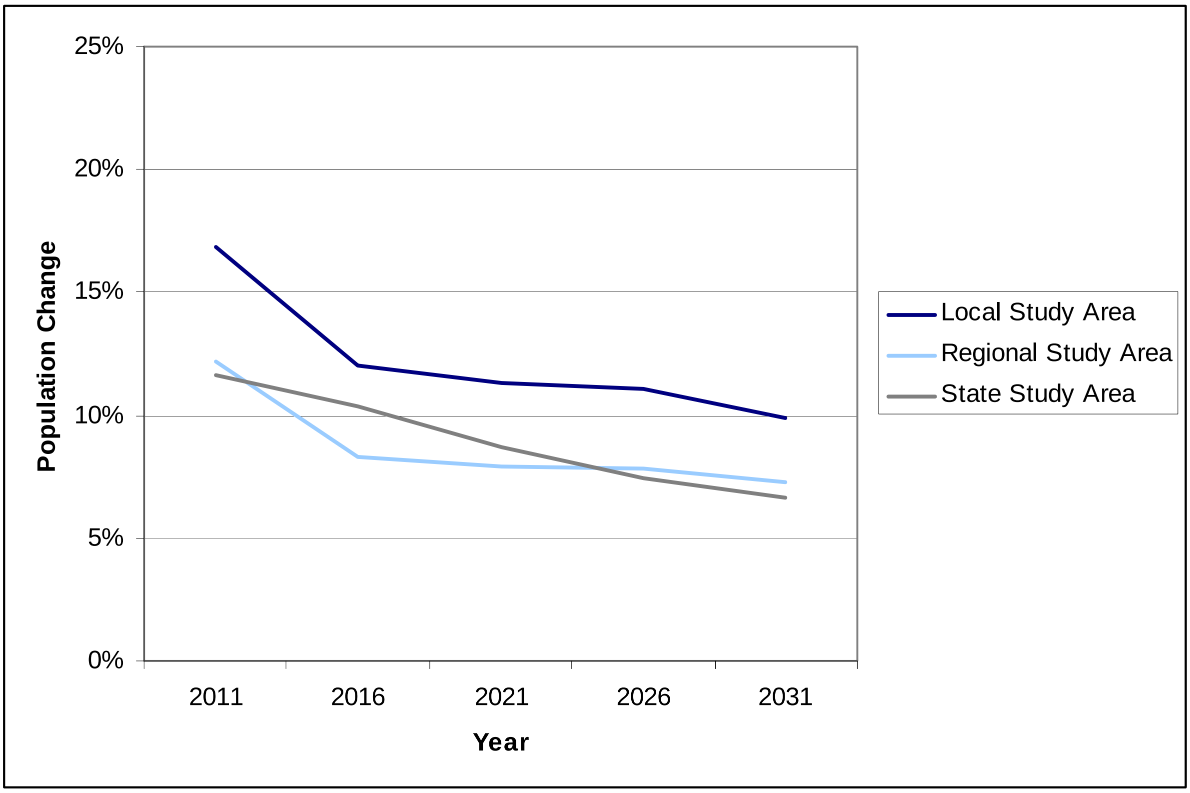


Figure 11.5 Projected population change (medium series), 2011 to 2031

Source Queensland Future Population 2008 edition, Appendix F Estimated resident population and projected resident population (medium series), Queensland's Statistical Divisions, pre-reformed Local Government Areas

11.2.3 Socio economic profile

This section provides a socio-economic profile for the local region. Australian Bureau of Statistics Census data is presented and analysed in relation to the local labour force profiles, income levels and education and general information is provided on local economic activity, particularly commercial fishing operations.

Gladstone region labour force profile

The local, regional and state study areas had similar levels of employment and unemployment at December 2010 (Table 11.4). However, the local study area had a higher proportion of labour force participation and a lower percentage of people not in the labour force compared to the regional and state study areas in December 2010.

More recent labour force data is published by the federal Department of Education, Employment and Workplace Relations in the quarterly publication Small Area Labour Markets. The most recent data available is from the December quarter 2010. Figure 11.6 shows the unemployment rates for the Statistical Local Areas (SLA) in the local study area. There is a trend towards increasing unemployment rates over the last year, although there appears to be a slight decrease between the September and December quarters 2010. In the December quarter 2010 unemployment rates in the local study area ranged between 5.0% and 7.1%.

Table 11.4 Labour force status

	Local Study Area		Regional Study Area		State Study Area	
	Total Number	**Percentage (%)**	**Total Number**	**Percentage (%)**	**Total Number**	**Percentage (%)**
Labour force	29,404	100%	118,736	100%	2,443,800	100%
Of which employed	27,925	95%	112,360	95%	2,308,800	94%
Of which unemployed	1,479	5%	6,376	5%	135,000	6%

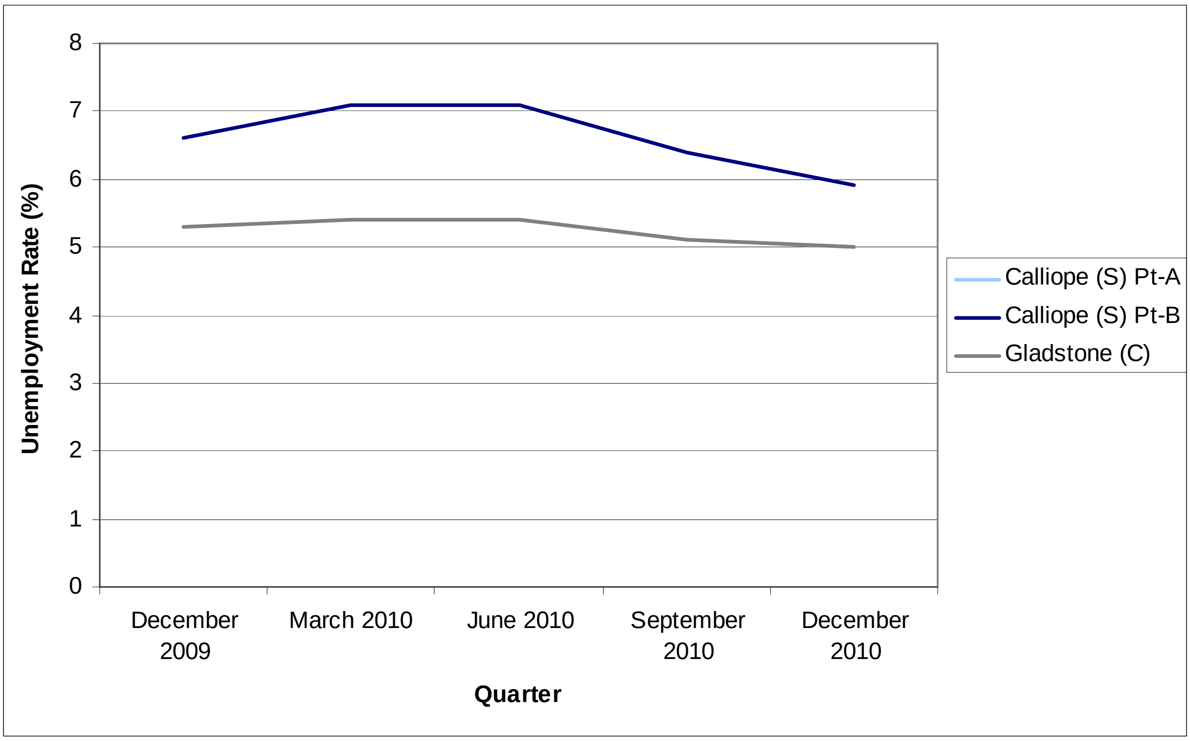


Figure 11.6 Unemployment rate for Statistical Local Areas within Local Study Area

Note The Unemployment Rates (%) for Calliope (S) Pt-A and Gladstone (C) are the same for these Quarters

Gladstone region economic profile

The GRC local government area has a history of strong economic growth based around industrial development, port facilities and extraction of natural resources (Calliope Shire Council 2004). The area is the most significant heavy industry area in Queensland, and prides itself as one of Australia's industrial 'powerhouses'. The regional area has extensive mineral deposits, and mining, mineral processing and service industries are important industries, both in Gladstone and the regional study area.

There is a broad range of infrastructure in place to support Gladstone's industrial development, with major projects implemented through associations with private entities, GRC and Queensland Government agencies such as Queensland Rail, the Department of Transport and Main Roads and the GPC. The port of Gladstone is Australia's largest multi-commodity port and it houses the world's fourth largest coal export terminal.

While heavy industry has been, and is likely to remain, a crucial economic driver for Gladstone, the economy has matured and diversified. Emerging industries include service based industries and tourism (Futureye 2008). Major heavy industrial projects located in Gladstone which are currently underway, committed and under investigation are listed in Table 11.5.

Table 11.5 Major heavy industrial projects located in Gladstone

Projects underway	Projects committed	Projects under investigation
Rio Tinto Alcan – Yarwun Alumina Refinery	Jemena Limited – Capacity building for Rio Tinto Aluminum's Yarwun expansion	Arrow Energy Limited and AGL Limited (Joint venture) – high pressure gas pipeline development
Cement Australia – New Cement Mill	Origin Energy – Walloon coal seam gas fields development	Gladstone Ports Corporation Limited – Berth expansion on 153 ha of reclamation adjacent to existing Fisherman's Landing
Boyne Smelters Limited – Construction of new baking furnace and upgrade of crane runway	Wiggins Island Coal Terminal – Stage 1	Arrow Energy Limited – Boyne River coal seam gas exploration and appraisal
	Gladstone Pacific Nickel Limited – Stage 1 laterite nickel ore processing plant	Transpacific Industries Group Limited – expansion of regional waste management facility
	Powerlink – infrastructure upgrades	Surat Basin Rail (SBR) ATEC DVR, Xstrata Coal Anglo Coal and QR – Dawson Valley railway development
	SANTOS GLNG – Curtis Island LNG production facility development	Queensland Rail – Moura Link – Aldoga Rail project
	QCLNG – Curtis Island LNG production facility development	Australian Inland Rail Expressway (AIRE) – inland railway to link
	Gladstone LNG Pty Ltd (LNG Ltd with Arrow Energy NL) – Fisherman's Landing LNG production facility development	Gladstone Area Water Board – Gladstone – Fitzroy Pipeline project
		Queensland Energy Resource Limited (QER) – Oil Shale technology development facility
		Boulder Steel Limited – Blast furnace based steel plant development

Projects underway	Projects committed	Projects under investigation
		Southern Cross LNG (LNG Impel) – Curtis Island LNG production facility development
		Project Sun LNG (Soiitz Corp) – Fisherman's Landing LNG production facility development

Tourism is also an important contributor to the economy in the Gladstone region. In 2006, 356,300 visitors travelled to Gladstone, 86% of these being Australians (Futureye 2008). Major tourist attractions include Heron Island, the historic Town of 1770 and easy access to the Great Barrier Reef.

In addition, the Gladstone region has extensive quality agricultural lands and agriculture is still one of the area's main industries. The region surrounding Gladstone supports a well established cattle industry, supplemented by dairying, grain, fruit and vegetable growing and timber production (Travel Australia 2008).

Various rural centres, such as Calliope, have gradually developed outside of Gladstone city. There is also a forestry industry in the region, based on softwood plantations.

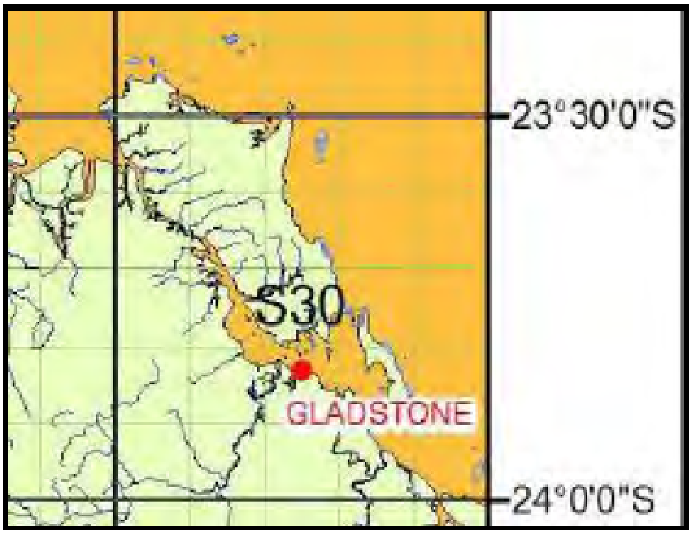
Commercial fishing in the Gladstone region

Gladstone supports a significant commercial fishing industry. The commercial fishing fleet operating out of Gladstone Harbour includes line fishers, net / crab fishers, trawl fishers and seasonal prawn fishers.

Commercial operators utilise various locations in and around Gladstone Harbour, Port Curtis and further off shore. Trawlers operate around and south of Gladstone Marina but are not allowed to trawl in various areas within Gladstone Harbour.

The Coastal Habitat Resources Information System (CHRIS) is a resource centre for Queensland coastal fish habitat, fisheries resources and environmental datasets (layers) developed by Queensland Primary Industries and Fisheries (QPIF) and other agencies. The CHRIS resource facilitates monitoring of the condition and trend of coastal fisheries habitats for the Commercial Fishers Information System (CFISH).

For reporting purposes, the Australian coastline is divided by a grid system, with large grid squares divided into smaller compartments. Figure 11.7 shows grid S30, which captures the Gladstone Harbour and broader Gladstone regional area.



Source: http://chrisweb.dpi.qld.gov.au/CHRIS. Accessed: 04 March 2009.

Figure 11.7 Commercial fishing log book data collection grid system under the Commercial Fishers Information

Table 11.6 Annual commercial catches in the S30 area

Year	Tonnes	Boats	Days	GVP (AUS$)
1988	97.6	71	1774	$809,400.00
1989	132.1	76	2050	$1,079,900.00
1990	127.9	96	2459	$1,300,000.00
1991	265.5	128	3458	$2,642,700.00
1992	237	118	3510	$2,319,700.00
1993	249.4	143	4041	$3,135,400.00
1994	159.9	108	3541	$1,425,300.00
1995	190.5	133	3674	$1,976,500.00
1996	227.2	127	3710	$1,847,900.00
1997	167.9	125	3757	$1,404,800.00
1998	210.8	105	3852	$1,955,000.00
1999	221.2	108	4343	$2,127,300.00
2000	224.2	114	4175	$2,019,200.00
2001	227.4	103	3223	$1,910,600.00
2002	287.5	82	3676	$2,332,000.00
2003	467.7	95	4842	$3,857,500.00
2004	527.5	85	4806	$3,990,800.00
2005	421.6	65	3772	$2,826,600.00

Source http://chrisweb.dpi.qld.gov.au/CHRIS. Accessed: 04 March 2009. Search results for Fishery Type = 'All (Listed)', Year = 'All', Month = 'All', Species = 'All Species', Selected Sites(s)/Grid(s) = ("S30")

Due to confidentiality agreements, QPIF do not provide data on smaller grid sites if the specific commercial fishing activity (i.e. line netting, pot crabbing or trawling) recorded for these sites involve five (5) or less individual operators. Table 11.6 provides a summary of annual commercial catches by all commercial fishing activities in the Grid S30 area.

Commercial activities operating in and around the Port of Gladstone include:

- Mud crabbing: conducted along the mainland coast north and south of the existing Fisherman's Landing facility
- Fish netting: commercial fishers do net 'shots' at various locations off the mainland coast adjacent to and north of the proposed Western Basin reclamation area. Specific sites are generally selected based on their ability to intercept coastal tidal flows on particular tide changes. Friend Point is a particularly productive site as it is generally highly turbid and can be fished on various tides due to the site's protection from the main currents
- Trawlers also use the Port of Gladstone. However, they are not allowed to trawl in the Port area and mainly use the port as a thoroughfare to access the ocean, The Narrows and northern Curtis Island areas

11.2.4 Utilities and municipal services

The major utility services operating in the Gladstone region include electricity and water. Lake Awoonga is the main water source for the Gladstone region (Travel Australia 2008). The Gladstone Area Water Board (GAWB) supplies raw and treated water for industrial purposes to Gladstone and surrounding areas by pipeline from Lake Awoonga. The major electricity generating facility in Gladstone is the NRG Gladstone Power Station. The station is one of the biggest in Queensland, with a large proportion of the electricity produced going to industrial use, particularly local refineries.

11.2.5 Sport and recreation

In the following section, particular attention is given to recreational fishing in the project area as dredging and reclamation activities from other projects are likely to have implications for recreational fishing in the area.

Recreational fishing and boating in the Gladstone region

Fishing is a major recreational activity throughout the entire Gladstone region, with Gladstone city having one of the highest rates of boat ownerships of any community in Australia (GAPDL 2008). Mud crabs are harvested from the rivers and estuaries during the summer months and prawns are fished offshore (Travel Australia 2008). Boat ramps are available at Gladstone Harbour, Boyne Island, Tannum Sands, Calliope River and The Narrows.

Popular fishing spots in close proximity to Gladstone include (Travel Australia 2008 and GAPDL 2008):

- Gladstone harbour (including Cement Australia Wharf, Auckland Point Wharf, Barney Point Wharf, Q. A. L Wharf and Boyne Smelter Wharf)
- Gladstone Power Station
- Barney Beach

Popular fishing spots in the broader Gladstone region include (Travel Australia 2008):

- Calliope River (offering barbecue facilities and 48 hour camping)
- Boyne River
- Wild Cattle Creek (at the southern end of Tannum Sands Main Beach)
- Gatcombe Head (at the south end of Facing Island and accessible by boat only)
- Farmers Point (at the northern end of Facing Island)
- South End (at the southern end of Curtis Island)
- Various estuaries
- Various offshore reefs, particularly Swains Reef and the Capricorn and Bunker Groups

- Lake Awoonga (offering Barramundi fishing assisted by the Gladstone Area Water Board which operates a fish hatchery breeding approximately 300,000 selected fish species for release each year)

11.2.6 Community facilities and services

Gladstone contains a broad range of services and facilities catering for local residents and surrounding communities. Community members generally travel to Gladstone or Rockhampton to access vital services, as there is a limited range of community services and facilities throughout the various regional towns and communities. The lack of any real hub of community services and facilities in the Yarwun and Targinie areas can mainly be attributed to the provision of these services in the Gladstone city area and additional specialist services and retail facilities provided in Rockhampton.

11.3 Potential adverse or beneficial impacts on social values (construction and operation)

The potential community and social impacts are anticipated to occur during construction and to a lesser extent the operational (decommissioning) phase.

The key social and community impacts associated with construction of the Curtis Island GTP primarily include the inconvenience to the community in the immediate and surrounding areas (i.e. on Curtis Island and Gladstone), and in particular any directly affected landholders and people that live on Curtis Island. To a lesser extent this includes people that use the port of Gladstone (The Narrows) and live in Gladstone City. Impacts to the community on Curtis Island are not expected to be significant as the Curtis Island GTP is located in a remote area away from populated areas.

Furthermore, the timing of construction is expected to be less than two months for the Curtis Island GTP and the duration of any community impacts will therefore be temporary and short term in nature.

11.3.1 Potential impact on demographic profile

Construction personnel (approximately 90 personnel) working on the Curtis Island GTP will be accommodated in a construction camp on the mainland located at Camp 4 Calliope (KP 355). It is anticipated that most of these personnel will not be locally hired and as such there is not expected to be a measureable change in the demographic profile of Gladstone or Curtis Island as a result of the Project.

11.3.2 Potential impact on employment

GLNG's policy aims to employ local residents wherever possible. For the construction of the Curtis Island GTP, this approach may be limited as the skills required for pipeline construction may not be readily available from the Gladstone regional community.

There may be opportunities for local employment for some components;

- traffic controllers
- earth moving equipment operators
- general labourers and the like

The potential for employment opportunities for local inhabitants for construction works will ultimately depend on the Contractor's requirements and in-house capabilities. GLNG will encourage the Contractor to employ locally whenever possible.

Unemployment levels for the Gladstone area ranges from 4.2% to 5.4%. Since the potential local employment opportunities are anticipated to be minor, there is not likely to be a measurable impact on the area's employment rates associated with construction of the Curtis Island GTP.

An outline of the Project's SIMP to address employment is included in Section 11.6.

11.3.3 Potential impact on income and affordability

The level of income for locals who successfully gain employment with the GLNG Project would likely increase, as the construction salaries are anticipated to be at or above the average incomes for Gladstone area. However due to the limited opportunities for employment offered by the Curtis Island GTP there is not likely to be an impact on the cost of living (affordability) within the Gladstone area as a whole.

An outline of the Project's SIMP to address income and affordability is included in Section 11.6.

11.3.4 Potential impact on housing and accommodation

Construction personnel for the Curtis Island GTP will be accommodated in a separate construction camp on the mainland outside Gladstone. It is therefore expected that the Curtis Island GTP will not contribute to housing or accommodation impacts within Gladstone or the Curtis Island areas.

11.3.5 Potential impact from mosquito and biting midges

There is the potential for a localised increase in the population of mosquitoes and biting midges during construction of the Curtis Island GTP, primarily due to the potential for increased areas of standing water during trenching activities. However to minimise this potential impact, a Mosquitoes and Biting Midge Management Plan (MBMMP) (refer Appendix F) will be developed and implemented prior construction. It is therefore unlikely that any temporary increase in the population of mosquitoes and biting midges will be experienced within Gladstone or at the Curtis Island GTP construction site.

An outline of the MBMMP is included in Section 11.6.

11.3.6 Potential impact on education and training

The construction personnel for the Curtis Island GTP will be skilled and are unlikely to require additional training or education for this phase of the GLNG Project. Operational personnel required for the operational phase will be trained by GLNG. As such construction of the Curtis Island GTP is no expected to create a demand on education and training facilities within the Gladstone area.

11.3.7 Potential impact on health and emergency services

First-aid facilities will be available at the Curtis Island GTP work site. The facilities will have the capacity to treat non-serious injuries and stabilise more serious injuries prior to transport to hospitals. Serious injuries would often be referred to larger hospitals in Gladstone.

The construction personnel for the Curtis Island GTP are not anticipated to have a significant demand on general health and medical services in the region. This could include fire, police and ambulance or flying doctor. Due to the on-site capabilities of the emergency services for the construction personnel, a request for local emergency services is considered unlikely. Should such services be required, it is unlikely that the temporary use of those services would adversely impact Gladstone health facilities.

GLNG will inform the local emergency services in the Gladstone area prior to undertaking construction activity as to the size of the workforce, on-site capabilities and emergency procedures.

An outline of the Project's SIMP to address health and emergency services is included in Section 11.6.

11.3.8 Potential impact on community facilities and services

Economic activity associated with the Curtis Island GTP construction will have a positive impact on local businesses, although this is not anticipated to be significant, due to the short construction duration, limited workforce size and self-contained construction camp.

GLNG will explore the potential for procuring supplies locally where possible in order to increase local economic and employment opportunities.

An outline of the Project's SIMP to address community facilities and services is included in Section 11.6.

11.3.9 Potential impact on community values and lifestyle

The impacts on the community values and lifestyle within Gladstone and Curtis Island associated with the Curtis Island GTP are expected to be minor due to the duration of construction, remoteness of the construction site itself and the minor local employment opportunities.

In addition, there is expected to be no impacts on community safety associated with the construction of the Curtis Island GTP due to the remoteness of the works to populated areas.

The delivery of plant, equipment and pipe materials will be undertaken with certification from the Gladstone Harbour Master, and as such, it is unlikely that there will be any negative impacts on the users of the marine environment.

An outline of the Project's SIMP to address community values and lifestyle is included in Section 11.6.

11.4 Operational impacts

The operational workforce is anticipated to be approximately 20 persons. Operational activities will include inspections along the Curtis Island GTP by vehicle and foot patrols to check on the condition of the GTP and associated infrastructure. Due to the low number of operational vehicles movements, infrequent maintenance activities and remoteness of the Curtis Island GTP social and community related impacts from these operational activities are not expected. This cumulative impact assessment is based on the impact scope, identification and scoring methodology described in Chapter 2 of this EM Plan.

11.5 Cumulative impacts

Curtis Island represents approximately 1% of the overall GLNG pipeline route. Examined in isolation social impacts for the Curtis Island GTPs are likely to be negligible in the context of the LNG projects and other developments in the Gladstone area. The cumulative social and community impacts that relate specifically to the impacts of the construction of the GTPs on Curtis Island are described below but these do not include the larger cumulative social impacts likely to be caused by development in the area.

Social and community (construction worker employment)

The Curtis Island GTP may have a potential positive but very temporary impact on employment, skills training and demand on local goods and services. However given the limited scale and duration of the works, and the very large scale of works associated with other components of the LNG projects, these impacts are likely to be minor.

Implementation of measures set out in this EM Plan will result in positive impacts on social and community (construction worker employment) from pipeline construction within the GSDA corridor on Curtis Island.

Social and community (local services and facilities)

Some additional demand for local services and facilities is likely to be generated, especially during the timeframe that construction of the pipelines occurs concurrently. However construction accommodation camps will be provided for workers and given the limited scale and duration of the works these impacts are likely to be minor.

Implementation of measures set out in this EM Plan will result in negligible impacts on social and community (local services and facilities) from pipeline construction within the GSDA corridor on Curtis Island.

Traffic and transport (boat movements/construction vehicle movements/construction pressure on local services)

As deliveries will arrive to and from the island by barge from Gladstone, the impact on local road traffic and transport will be negligible. Traffic may be generated to and from the barge loading and unloading point in Gladstone; however given the limited scale and duration of the works these impacts are likely to be minor.

Implementation of measures set out in this EM Plan will result in minor negative impacts on traffic and transport from pipeline construction within the GSDA corridor on Curtis Island.

Traffic and transport impacts

As movement to and from the island by barge from Gladstone, the impact on local road traffic and transport will be negligible. Traffic may be generated to and from the barge loading and unloading point in Gladstone, however given the limited scale and duration of the pipeline works on Curtis Island these impacts are likely to be minor.

The cumulative effects are subject to the Road Use Management Plan approved by DTMR and under negotiation with the local governments. Intersection and road corridor improvements are to be implemented with GLNG making proportional financial contributions. Traffic management is being implemented around Gladstone port facilities as well as the service roads.

Implementation of measures set out in this EM Plan will result in minor negative impacts on traffic and transport from pipeline construction within the GSDA corridor on Curtis Island.

Visual amenity (RoW construction) impacts

The construction of the Curtis Island GTP will affect a limited number of receptors, primarily recreational users of The Narrows. The cumulative effects will arise from an extended time frame of disturbance as the three projects are currently scheduled to be undertaken at separate times.

Impacts on visual amenity will result from:

- Dust plumes and settlement of dust on vegetation
- General construction activities

Visual impacts from dust during the construction phase on neighbouring human receptors are likely to be minimal given the remote location of the site.

The infrastructure RoW is not expected to be visible from the south i.e. Gladstone (location of the majority of receptors)

In the longer term, the infrastructure RoW will be rehabilitated and not constitute a long term change to the landscape of the area.

11.6 Environmental protection commitments, objectives and control strategies – social (construction and operation)

The conditions in Appendix 1, Part 3 of the CG Report impose requirements to manage the social impacts of the GLNG Project. In accordance with those conditions, measures are being taken to manage the social impacts of the GLNG Project (including the Curtis Island GTP).

Environmental protection commitments, objectives and control strategies proposed are presented in Table 11.7.

Table 11.7 Environmental protection commitments, objectives and control strategies – social

Item	Detail
Environmental protection objectives	• To minimise any social disruption to the local communities from the construction of the Curtis Island GTP
Specific objectives	• No warranted complaints from landholders and the community, and warranted complained responded to within two working days • To prevent the occurrence of potential mosquito and biting midge breeding sites and the presence of adult mosquitoes and biting midges
Control strategies	**Preconstruction phase** Prior to construction develop a Social Impact Management Plan (SIMP) to monitor and communicate social impacts associated with the construction of the Curtis Island GTP and work with local services and stakeholders to develop practical solutions. The SIMP will addresses the following: *Employment* • Prioritise local employment over non-local employment where possible and practical *Income and affordability* • Adopt local procurement policies in order to enhance local economic benefits • Where possible explore the potential to procure some supplies locally *Health* • Inform local health services prior to commencing activity in the area *Heritage* • Minimise social impacts on Indigenous persons in the project area by the implementation of the Proponents Aboriginal Engagement Plan

Item	Detail
	Emergency services, Strain on local facilities and services • Inform local emergency services prior to commencing construction on Curtis Island • Maintain an open dialogue with local service providers to understand the likely future demand for infrastructure and services *Community values, lifestyle* • Contribute to local liveability programs and initiate a community consultation and awareness campaign to promote project benefits to the community • Unless otherwise negotiated with the landholder, GLNG Operations will ensure that burial and placement of GTP will not adversely impact on existing landholder management practices *Consultation strategy* • Prior to construction GLNG Operations will liaise with relevant landholders, Gladstone Regional Council, Department of Environment and Resource Management (DERM), and other relevant authorities on the proposed construction activities and schedule **Construction phase** • Implement the SIMP developed during the preconstruction phase to monitor and communicate social impacts associated with the construction of the Curtis Island GTP and work with local services and stakeholders to develop practical solutions • Ongoing consultation with the community, agencies and representative groups to discuss the Curtis Island GTP construction program, operations, and decommissioning and rehabilitation • Implement the MMMP (refer Appendix F), which typically addresses the following: - Depressions in the ground surface (such as wheel ruts) will be filled as soon as practicable to prevent the ponding of water - Pools of stagnant water will be drained and/or the depressions filled - Storage containers capable of ponding water will be either discarded after use or stored in an inverted position (care will be taken to ensure that ponding does not occur in waste storage areas) - Erosion and washdown practices will be controlled to prevent the formation of standing water pools in natural water courses adjacent to the sites - Staff will be trained to recognise mosquito and biting midge breeding activity and the treatment of breeding sites - An assessment of work areas will be undertaken prior to works and on an ongoing informal basis to identify potential breeding sites - Insect repellent will be made available to personnel as required - Any required specific area control plans based on assessment of potential breeding sites will conform to the DERM's Mosquito Management Code of Practice for Queensland - Queensland Health and the relevant local councils will be contacted for assistance in choosing a suitable method of laviciding / eradication should this be necessary **Operational phase** Typical mitigation and controls for the operational phase of the Project will be detailed in the Operational Management Plan, which will be developed prior to construction.
Performance Indicators	• No warranted complaints from landholders and the community, and warranted complaints responded to within two working days

12. Cultural Heritage

12.1 Summary of existing cultural heritage values

- No Indigenous heritage places have been identified within the Curtis Island GTP RoW
- No non Indigenous heritage places have been identified within the Curtis Island GTP RoW

12.1.1 Summary of potential impacts to cultural heritage

- As no Indigenous or non Indigenous cultural heritage sites exist along the Curtis Island GTP RoW, no impacts have been identified
- Construction has the potential to impact upon undiscovered cultural heritage artefacts within the Curtis Island GTP RoW

12.1.2 Summary of proposed mitigation measures for cultural heritage management

To manage potential Indigenous or non Indigenous cultural heritage sites the measures in Table 12.1 will be implemented.

Table 12.1 Proposed mitigation measures for the management of cultural heritage

Item	Detail
Environmental protection objective	• To protect the cultural heritage values of the GTP RoW
Specific objectives	• Compliance with the requirements of the *Aboriginal Cultural Heritage Act 2003,* the Port Curtis Coral Coast CHMP and the relevant CHMPs • No disturbance of any place on the Queensland Heritage Register in accordance with the requirements of the *Queensland Heritage Act 1992*
Control strategies	• Refer Table 12.3 for cultural heritage mitigation measures that will be implemented during construction and operation of the Curtis Island GTP
Performance indicators	• Compliance with the requirements of the *Aboriginal Cultural Heritage Act 2003,* the Port Curtis Coral Coast CHMP and the relevant CHMPs • No disturbance of any place on the Queensland Heritage Register in accordance with the requirements of the *Queensland Heritage Act 1992* • Procedures for identifying and managing previously unidentified cultural heritage sites as described in Table 12.3 are being implemented

12.2 Description of environmental values

A search of the registers shown in Table 12.2 were undertaken to identify any heritage places within the Curtis Island GTP RoW.

Table 12.2 Search of heritage registers

Governing body	Database
DERM	Aboriginal and Torres Strait Islander Cultural Heritage Database and Register
DERM	Queensland Heritage Register (QHR)

In addition to the above searches, detailed on-site cultural heritage surveys were also undertaken along the GTP RoW to identify any additional heritage sites that may be found within the RoW over and above to what has been accounted for in both state and local databases. Further details regarding these surveys are provided throughout the remainder of this chapter.

12.2.1 Indigenous

The nature and distribution of many forms of Indigenous cultural heritage in a landscape is in part associated with environmental factors such as geology, climate and landforms which affect the availability of plants, animals and water, the location of suitable camping places and suitable surfaces upon which rock art could be created. Such environmental factors also affect the degree to which cultural remains have survived natural and human-induced processes. In addition, European land use practices often destroy or disturb artifacts from their original location and condition.

The extent of vegetation and the nature of erosion and deposition regimes affect the visibility of cultural remains and hence the chances of their detection during ground surveys. Likewise, non Indigenous land use practices can disturb artifacts from their original context of deposition.

Site specific heritage

A Cultural Heritage Management Plan (CHMP) has been negotiated with relevant Aboriginal Endorsed Parties for the Curtis Island GTP under the requirements of the *Aboriginal Cultural Heritage Act 2003* (ACHA). The Port Curtis Coral Coast CHMP has been approved under Part 7 of the ACHA. Cultural heritage surveys are currently underway, which define areas and sites of cultural significance that occur within the project area.

To date no Indigenous heritage places have been identified within the Curtis Island GTP RoW.

12.2.2 Non Indigenous

The geographical area covered by the proposed GTP RoW including the Curtis Island GTP includes a diverse landscape stretching from the coastal area of Gladstone, inland to the Coal Seam Gas (CSG) fields near Roma. The history of the area encompasses maritime and inland exploration, pastoralism and conflict with Indigenous occupants, a long period of gradual 'opening up' of the land and the development of towns and infrastructure.

Key industries such as cattle and mining have had a profound impact on the history of the region. In the late twentieth century, the city of Gladstone was transformed from a small coastal community dependent on a butter factory and a seasonally operational meatworks to the site of Queensland's largest power station and one of the world's largest alumina plants. The presence of a deep-water port and the development of port facilities helped drive the economic development of Gladstone and the region as a whole.

Many towns in the region have also experienced significant recent changes with the advent of large-scale coal mining, and gas exploration, mining, production and exportation.

To date no non Indigenous heritage places have been identified within the Curtis Island GTP RoW.

12.3 Potential adverse or beneficial impacts on cultural heritage (construction and operation)

12.3.1 Construction impacts

Indigenous

To date no Indigenous heritage places have been identified within the Curtis Island GTP RoW, and as such, there is likely to be no impacts to Indigenous heritage associated with the construction works.

In the event that cultural heritage items are identified during construction, work will cease at the location of the potential heritage items and reasonable efforts will be made to establish a buffer zone to avoid further disturbance. Consultation will be undertaken with the Traditional Owner groups identified (if any) by the cultural heritage unit in DERM and a qualified specialist to seek advice and agreement for further action, in accordance with duty-of-care guidelines.

Non Indigenous

Proposed works within the Curtis Island GTP RoW will not impact upon any known non Indigenous heritage sites. To date no non Indigenous heritage sites have been identified within the construction areas for the Curtis Island GTP. In the event that a site is identified during construction:

- It shall be demarcated
- Where construction works are close to the heritage site access will be restricted
- Archival recording will be undertaken by a qualified specialist
- DERM will be notified as per the relevant guidelines

GLNG Operations cultural heritage personnel participating in Aboriginal cultural heritage surveys have concurrently reviewed potential non Indigenous heritage impacts. Any impact to other sites of local significance will be minimised unless absolutely essential. In the case that a site of local significance will be impacted, archival recording by a qualified specialist will be undertaken in accordance with international standards.

DERM will be notified of the discovery of any archaeological artefact.

12.3.2 Operational impacts

Operational activities will typically include monthly inspections along the Curtis Island GTP by vehicle and foot patrols to check on the condition of the GTP and associated infrastructure. Maintenance of the Curtis Island GTP will be carried out by light vehicles and small maintenance crews on an annual basis, or as and when required. Potential cultural heritage (Indigenous and non Indigenous) related impacts from these operational activities will be minimal and will be managed in accordance with the CHMP and Operations Management Plan (OMP), which will be developed and implemented prior to the completion of the construction phase.

DERM will be notified of the discovery of any archaeological artefact.

12.4 Cumulative impacts

Cumulative cultural heritage impacts are described below. This cumulative impact assessment is based on the impact scope, identification and scoring methodology described in Chapter 2 of this EM Plan. No areas of cultural heritage significance have been identified in the pipeline RoW on Curtis Island; hence potential cumulative impacts are expected to be negligible.

Indigenous cultural heritage (disturbance to archaeological remains)

Although no cultural heritage sites are known within the GSDA corridor, the EIS indicates that there are extensive middens and artefact scatters on offshore islands including Curtis Island. There is a greater risk of finding and impacting indigenous cultural heritage given the extended activities that will occur in the area and the larger area of land subject to excavations.

Non Indigenous cultural heritage

No known non Indigenous heritage features are present in the RoW and hence cumulative impacts are not anticipated.

12.5 Environmental protection commitments, objectives and control strategies – cultural heritage (construction and operation)

Table 12.3 Proposed mitigation measures for the management of cultural heritage

Item	Detail
Environmental protection objective	• To protect the cultural heritage values of the GTP RoW
Specific objectives	• Compliance with the requirements of the *Aboriginal Cultural Heritage Act 2003,* the Port Curtis Coral Coast CHMP and the relevant CHMPs • No disturbance of any place on the Queensland Heritage Register in accordance with the requirements of the *Queensland Heritage Act 1992*
Control strategies	**Preconstruction phase** • Cultural heritage monitoring, identification and management will form part of the Construction Management Plan (CMP) and Operational Management Plan (OMP) and the completed CHMP and the employee training within those management plans • Measures for the reporting of finds will be included in the OMP • GLNG Operations will develop and implement CHMPs in consultation with the relevant Aboriginal Parties. Protection, management and mitigation measures will be agreed after cultural heritage surveys are complete, and will be incorporated in GLNG Operations cultural heritage management system • GLNG Operations will seek to gain relevant native title permissions for the pipeline via the negotiation and registration of Indigenous Land Use Agreements (ILUAs) or the grant of Ministerial permissions under the *Petroleum and Gas (Production and Safety) Act 2004* where ILUAs are not achievable • Infrastructure will be located to avoid known cultural heritage sites. All heritage sites shall be demarcated and access restricted where construction works are close to the heritage site • Where potential non-indigenous heritage material is identified and likely to be disturbed, GLNG Operations will determine the significance of the site in consultation with the DERM and undertake relocation / preservation of the material. A project specific conservation management plan will be prepared to establish mitigation, management and approval procedures • Include cultural heritage issues in the project induction program and involve representatives from the Aboriginal Parties in the development and implementation of such programs • Specific mitigation measures will be developed to minimise any impact on the site in consultation with relevant stakeholders including the DERM • GLNG Operations will educate its staff and contractors on the location and significance of the heritage sites to avoid disturbance

Item	Detail

	Construction phase
	
	• Fencing and signage of sensitive areas/sites
	• Development of cultural heritage management compliance handbook for contractors prior to construction, including procedures for site discoveries during construction. These will include details of:
	  - Specific cultural heritage management requirements (avoidance or monitoring) by site and by location in relation to:
	    - Cultural heritage sites
	    - Culturally sensitive areas
	    - Areas with potential for sub-surface cultural heritage
	  - Other cultural heritage management requirements including site inductions and post construction audits
	  - Procedures for previously unidentified sites located during construction
	  - A detailed description of roles, responsibilities and procedures associated with:
	    - Day-to-day communication with each group
	    - The delivery of site inductions
	    - Planning, mobilisation and supervision of cultural heritage officers undertaking monitoring or audits
	    - Any other aspects of engagement with the Aboriginal groups
	• GLNG Operations will educate its staff and contractors on the location and significance of the sites to avoid disturbance
	• Training of field workers will be undertaken as part of broader environmental awareness training and/or Workplace Health and Safety meetings
	• Training materials will inform the workers as to what archaeological material and cultural heritage sites may look like and provide clear instructions on what to do if they find anything
	• During construction, there will be monitoring of earthworks by group representatives in areas of high heritage sensitivity or where sub-surface archaeological deposits are likely
	• Representatives from each cultural heritage group will be given an opportunity to provide cultural heritage awareness inductions to GLNG Operations and contractor personnel prior to construction
	• If personnel discover what may be a cultural heritage site they are required to:
	  - Immediately cease any work that may disturb the site or artefact
	  - Do not touch or interfere with the possible site
	  - Notify Supervisor and a representative from the Cultural Heritage Team
	  - Fill out the ‘Discovery of Cultural Heritage Form’ and submit
	  - A buffer zone of 50 m is established around the site. Works may not commence in the buffer zone until the Cultural Heritage Team has provided an approval to do so
	  - Works may proceed outside of the 50 m buffer zone
	Operational phase
	
	• Typical mitigation and controls for the operational phase of the Project will be detailed in the Operational Management Plan, which will be developed prior to construction

Performance indicators	• Requirements of the *Aboriginal Cultural Heritage Act 2003,* the Port Curtis Coral Coast CHMP and the relevant CHMPs are being met • There is no disturbance of any place on the Queensland Heritage Register in accordance with the requirements of the *Queensland Heritage Act 1992* • Procedures for identifying and managing previously unidentified cultural heritage sites as described above are being implemented

13. Waste management

13.1 Chapter summary

13.1.1 Summary of existing environmental values

- Construction of the Curtis Island GTP is not expected to generate large quantities of waste materials
- Anticipated waste streams during construction of the Curtis Island GTP include:
  - General waste
  - Liquid waste
  - Hazardous waste
  - Regulated waste
- Minimal waste is expected to be generated from maintenance activities during operation of the Curtis Island GTP

13.1.2 Summary of potential impacts from waste generation

- Water (surface water and groundwater) contamination from unsuitable storage, handling, spills and disposal of solid and liquid wastes
- Land contamination from spills during handling and transportation of liquids and solid waste
- Increased occurrences of vermin due to unsuitable storage and handling of putrescible wastes
- Impact on visual amenity due to poor maintenance and housekeeping along the RoW
- Wasteful use of finite resources
- Adverse effects to flora and fauna

13.1.3 Summary of proposed mitigation measures for waste

Table 13.1 Environmental protection commitments, objectives and control strategies for waste

Item	Detail
Environmental protection objective	• To ensure that the transmission pipeline construction adheres to the waste management hierarchy of avoid, reduce, re-use and recycle. Where this is not possible, to dispose of waste in the most appropriate manner • The quality of local land and water resources during pipeline hydrotesting is protected. • Storage and handling of chemicals and dangerous goods does not cause environmental harm or harm to persons
Specific objectives	• No inappropriate disposal or management of waste • No contamination of soil, air or water as a result of waste handling • Petroleum activities do not result in the release or likely release of contaminants to the environment from the storage, conditioning, treatment and disposal of regulated waste materials • Appropriate permits obtained prior to drawing water • No existing water sources unsustainably depleted to provide hydrotesting water • No adverse impacts on soil or surface water as the result of discharging hydrotesting water • No hazardous goods contamination of the environment • Storage and handling procedures correct and appropriate • Chemicals stored in secure areas • All containment systems must be designed to minimise rainfall collection within the system
Control strategies	• Refer Table 13.7, Table 13.8 and Table 13.9 for waste mitigation measures to be implemented during construction and operation of the Curtis Island GTP

Item	Detail
Performance indicators	• Waste is being appropriately managed and disposed of • Waste handling is not resulting in the contamination of soil, air or water • Permits to draw water are in place • Hydrotesting water is not unsustainably depleting existing water sources • Discharge of hydrotesting water is not adversely impacting on soil or surface water • The environment is not being contaminated by hazardous goods • Correct and appropriate storage and handling procedures are in place • Chemicals are stored in secure areas • Collection of rainfall is minimised in all containment systems

13.2 Background

This chapter covers the waste management issues which relate to construction, operation and decommissioning of the Curtis Island GTP.

The information has been developed in accordance with the *Environmental Protection Act 1994* (EP Act), *Environmental Protection (Waste Management) Policy 2000* and the CG Report for the whole project. This information has then been documented for the following key areas:

- The types and amounts of waste which are expected to be generated including General waste and recyclables, chemical and hazardous materials, liquid wastes and hydrotest waters
- Proposed environmental protection commitments, objectives and control strategies for dealing with Curtis Island GTP wastes in accordance with the waste management hierarchy
- Potential impact on the environmental values
- The types and amounts of waste which are expected to be generated

13.3 Waste and resource management hierarchy

The management of all material generated as a result of activities of the Curtis Island GTP construction and operation will be in accordance with the principles of the waste and resource management hierarchy[1] as described in the *Queensland Waste Reduction and Recycling Strategy 2010 - 2020*.

The waste and resource management hierarchy as shown in Figure 13.1 depicts disposal as the least desired option for managing waste. The most desired options of reduction, reuse and recycling are located at the top of the hierarchy. The waste and resource management hierarchy principles are addressed in more depth in the Waste MP (refer Appendix F).

[1] Prior to publishing of the Queensland Waste Reduction and Recycling Strategy 2010 – 2020, the Waste and resource management hierarchy was referred to in Queensland Legislation and other government documents as the Waste Management Hierarchy comprising waste avoidance, waste reuse, waste recycling, energy recovery and waste disposal

Figure 13.1 Waste and resource management hierarchy

Source Queensland's Waste Reduction and Recycling Strategy 2010–2020 (DERM, 2010)

13.4 Waste inductions and training

All construction personnel associated with GTP construction will be required to complete an induction. The induction training should incorporate relevant aspects of the Waste MP (refer Appendix F) and cover an individual's personal obligations with regard to the management procedures for all waste items and materials. This training will outline the importance of managing waste materials in accordance the principle of the waste and resource management hierarchy as outlined above.

13.5 Potential adverse or beneficial impacts on values from the Curtis Island GTP

Existing environmental values that may be impacted by the generation of waste as a result of Curtis Island GTP construction activities include:

- Life, health and wellbeing of people and the community
- Diversity of ecology and associated ecosystems
- Land use capability, having regard to economic considerations
- Management of finite resources

The nature of the Project will create liquid, solid and gaseous wastes as a result of the construction, operation and decommissioning phases of the GTP. Typical wastes which will be generated include regulated, general, recyclable and inert waste.

The correct management of waste in accordance with the waste hierarchy and to the relevant State and Commonwealth legislation and standards, will reduce the risk of harm to staff, community and the environment. The potential impacts include the following:

- Water (surface water and groundwater) contamination from unsuitable storage, handling, spills and disposal of solid and liquid wastes
- Land contamination from spills during handling and transportation of liquids and solid waste
- Increased occurrences of vermin due to unsuitable storage and handling of putrescible wastes
- Impact on visual amenity due to poor maintenance and housekeeping along the RoW
- Wasteful use of finite resources
- Adverse effects to flora and fauna

Table 13.2 details the potential impacts of waste activities associated with construction of the Curtis Island GTP. Further details of the existing environmental values of the Curtis Island GTP that have the potential to be affected by waste are provided throughout this EM Plan.

Table 13.2 Summary of impacts on the environmental values associated with the construction of the Curtis Island GTP

Aspect/source/activity	Potential impacts
Inappropriate waste management and disposal	Soil, groundwater, surface and water contamination, ambient air quality impact
Disposal of liquid wastes from project-related sources (eg equipment washdown stations, work area amenities)	Reduced water quality (particularly suspended solids/ turbidity, nutrients and microbiological contaminants) with consequent reduction in: • Suitability of water for drinking • Aquatic habitat quality including fish resources • Temporary loss of land use for economic use • Potential contamination of surface water and/or groundwater • Loss or damage to local ecosystem
Spillage of oil/ fuel/ chemical during transport, storage, handling or refuelling	Loss of oil/ fuel/ other hazardous material to air, surface water, groundwater, soil and/or sediment with consequent adverse impacts on associated quality and beneficial values
Spillage of hazardous materials during transport, storage, handling and use	Loss of hazardous material to air, surface water, groundwater, soil and/or sediment with consequent adverse impacts on associated quality and beneficial values
Spill during transfer of liquid and solid waste on/off Barge	Release of hazardous material resulting in adverse environmental and health effects
Hydrotest water discharge	Adverse impacts on local water quality, surface water, drinking water, aquatic habitat quality, temporary loss of land use for economic use, excessive erosion

13.5.1 Summary of potential impacts on values from the Curtis Island GTP

Construction

It is considered that the potential impacts presented in Section 13.5 resulting from construction of the Curtis Island GTP are expected to be acceptable and manageable as construction works will be undertaken in accordance with the control strategies as outlined in Section 13.11 and the Waste MP (refer Appendix F).

Operation

It is considered that related impacts resulting from the operation of the Curtis Island GTP are expected to be acceptable and manageable due to the low volumes of waste produced and because operational activities will be undertaken in accordance with the Waste MP and an Operational Management Plan (OMP) that will be developed and implemented prior to the completion of the construction.

13.6 Waste generation

The construction of the Curtis Island GTP is not expected to generate large quantities of waste materials. The anticipated waste streams from the construction process generally fall into one of the following broad categories:

- General waste (putrescible waste)
  - Recyclable waste such as paper, cardboard, plastics, glass, scrap metals and timber
  - Medical and first-aid waste

- Liquid waste
  - Sanitary waste
  - Hydrotest water
- Hazardous and regulated waste

The Project will adopt the waste and resource management hierarchy principles for the optimal management of all wastes generated from the Curtis Island GTP.

13.7 Curtis Island GTP waste sources

13.7.1 Construction waste

The waste types and estimated quantities listed in Table 13.3 are expected to be generated as a result of the construction and operational activities of the approximate 5 km Curtis Island GTP.

All waste and recyclable material will be collected and transferred from Curtis Island by barge and road haulage from the Gladstone marine landing area (Auckland Point) to the Gladstone Logistic Base waste storage compound for separation into bins or containers for regulated waste, recyclable material and general waste. This material will then be collected by licensed waste contractors and hauled to suitable recycling or disposal destinations. Figure 13.2 and Figure 13.3 show the location of the GTP, the Gladstone Logistic Base, proposed waste haulage routes and local waste disposal facilities.

Portaloos or equivalent ablution facilities will be provided for Curtis Island GTP construction workers. Waste streams from these facilities will be collected and removed for treatment and disposal to a facility on the Mainland. No impact to surface or groundwater resulting from these construction facilities is expected. Incidents resulting in a spillage of effluent to ground during construction will be managed in accordance with the Emergency Response Procedures (refer Chapter 3).

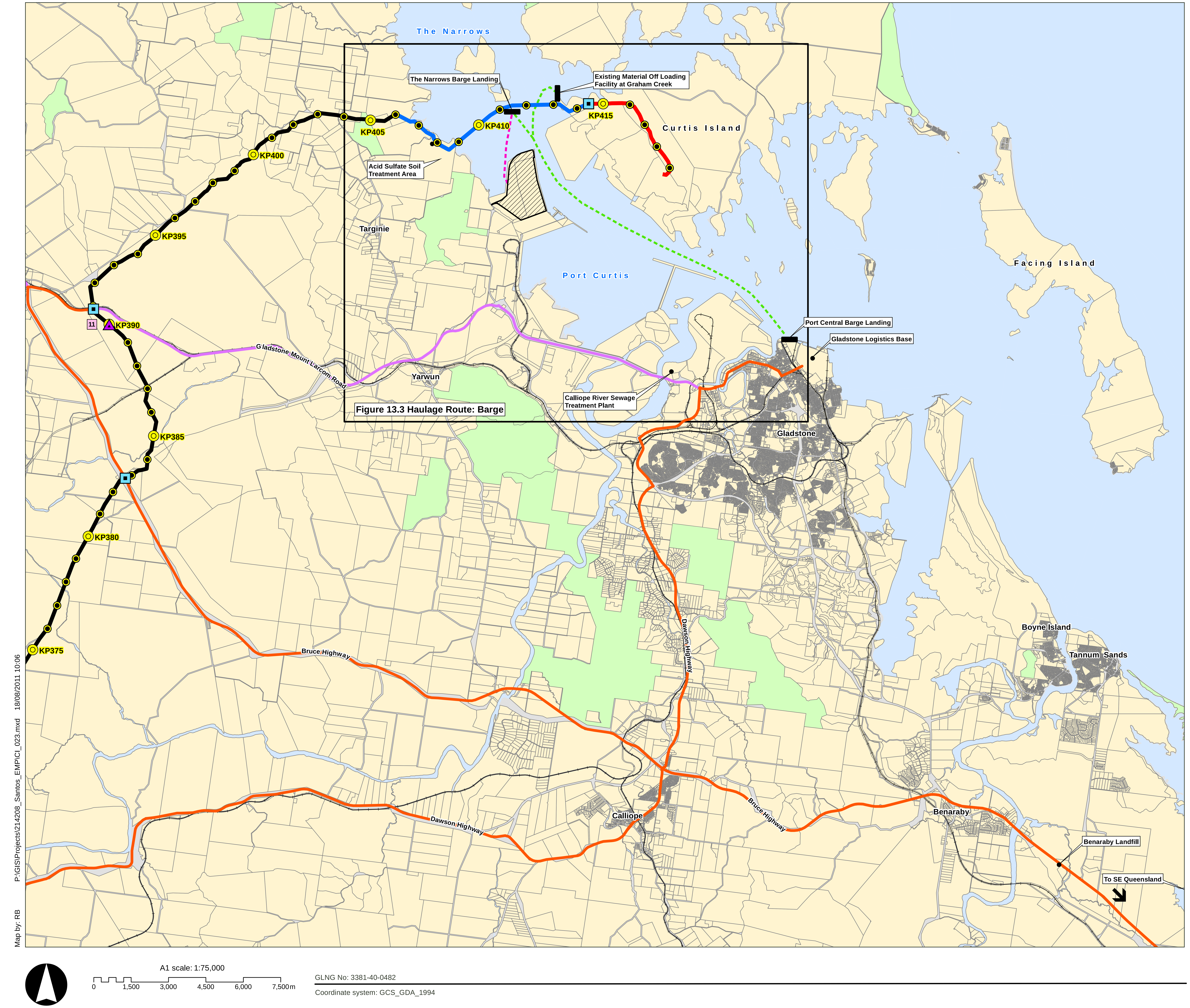
Table 13.3 Waste generated from the Curtis Island GTP construction area (5 km)

Curtis Island GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate of generation
Mobilisation activities			
Translocation of plants (refer Significant Species Management Plan (SSMP) refer Chapter 9)	Plastic pots Wooden stakes Packaging material	Recyclable material to recycling facility (where available) General waste to local licensed landfill Licensed contractor to transport regulated waste to an appropriately licensed recycling facility and residual material disposal at appropriately licensed regulated waste landfill	Less than 1 m^3 per week of general and recyclable waste during mobilisation activities
Weed control	Chemical containers and other consumables		
Delivery of plant, equipment and portable structures to site (ie vehicles, dongas, portable toilets, vehicle weed washdown facilities at RoW access points (1 within the Curtis Island GTP))	Packaging (ropes and strapping, cardboard), timber skids, wooden crates, fibre/nylon rope spacers, pallets, drums and scrap metals		
Construction			
Hard standing - import of hard standing materials for roadway or hardstand construction	Hard standing materials	Surplus clean material will be offered to local landowner for reuse or removed in accordance with the principles of the waste hierarchy	No waste materials are expected to be generated

Curtis Island GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate of generation
Weed washdown facility (1 washdown bay along the Curtis Island GTP RoW)	Wastewater Sludge	Water is filtered and reused in washdown facility Sludge disposed at local licensed landfill or WWTP	1 m^3 sludge per week per washdown facility
Clearing and grubbing of the RoW, pipe laydown areas (temporary pipe storage sites) and access tracks (clear and grade)	Green waste (felled vegetation and plant matter) Topsoil and excavated material (stockpiled for backfilling and application to RoW) Installation of temporary fencing and gates Construction of access tracks as required Steel post offcuts (from signage installation)	Stockpiled/windrowed vegetation will be reapplied during restoration/rehabilitation of RoW (additional detail in Chapter 15) All topsoil and excavated material reused for backfilling in RoW Any surplus fencing material will be offered to local landowner for reuse or removed in accordance with the principles of the waste hierarchy	Included in general waste in mobilisation activities
Construct pipe laydown areas (temporary pipe storage sites) – grading and levelled, hardstand, berm construction, and fencing where required	Polyethylene sheeting offcuts Cardboard or plastic tubes Plastic wrapping	Surplus clean material will be offered to local landowners for reuse or removed in accordance with the principles of the waste hierarchy	Included in general waste in pipe construction works
Erosion and Sediment Control installation and maintenance	Packaging material – cardboard, plastic wrapping, wooden pickets and geofabric sediment fencing Geofabrics "Bidim" A34 grade polyester filter off cuts	Sediment collected in devices stored in the RoW for respreading during rehabilitation works General waste to local licensed landfill	Quantities of waste dependent on climatic, site and topography conditions Included in general waste in mobilisation activities
Delivery of pipe construction materials and consumables to Curtis Island GTP	Neoprene plastic wrapping Nylon rope Rubber matting Packaging – timber dunnage, pallets and crates, plastic wrapping, metal and plastic strapping around consumables Ropes and strapping, cardboard, timber skids, fibre /nylon rope spacers, pallets, drums and scrap metals	Materials to be treated as per the waste hierarchy with general waste to local licensed landfill	Included in general waste in pipe construction works
Pipe construction works • Pipe stringing and bending • Pipe cutting and trimming • Pipe welding (up to 1000 m pipe strings) • Weld sandblasting	PVC or polyethylene pipe end caps (1,000 pipe end caps for Curtis Island GTP) 42" mild steel pipe off cuts and defective pipe; metal filings(less than 5 m of pipe for Curtis Island GTP)	PVC or polyethylene pipe end caps recycled Metal recycled Timber skids and sand bags reused General waste to local licensed landfill Licensed contractor to	9.2 t in total of pipe end caps (10 kg per pipe end) 1 t in total of steel pipe off cuts and defective pipe 1 t in total of metal filings General waste 0.5 t per

Curtis Island GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate of generation
• Tie-ins (above ground or in-the-trench) • Coating of field joints - application of rust proofing agent required to be applied when pipe is cut and a coating of epoxy-urethane over weld • Holiday detection survey and weld testing • Ducting for fibre optic cable	Timber skids and sand bags Off cuts – duct for future installation of fibre optic cable Marker tape Chemical containers (ie paint/epoxy coating cans, empty containers of rust proofing agents) Sandblasting grit (inert) Welding residue – welding rod scraps and electrode butts Polypropylene bags Waste cement and concrete Nylon rope	transport regulated waste to a licensed recycling facility and residual material disposal at licensed regulated waste landfill	week 10 L per week of regulated waste (spent chemicals and chemical container)
Trenching and bulk earthworks Foam trench breakers and foam pillows installation	Excavated material Excess Rigid Polyurethane foam (Aptane P220/Isocyanate B900) and hose washings Spent absorbent material Drums/plastic bags (polypropylene) PPE - Protective gloves and disposable overalls PVC conduit offcuts	All excavated material reused for backfilling in RoW or offered to local landowner for reuse All materials will be treated as per the waste hierarchy with general waste disposed of the local licensed landfill	Included in general waste in pipe construction works
Pipe cleaning and gauging Pipe testing – Hydrotesting and 24 hour leak test	Pipe cleaning waste (pigging grit - scale, rust, or other foreign material) Hydrostatic test water not treated with biocides, corrosion inhibitor and oxygen scavengers (assuming whole 5 km tested (approx 20 kL of water required))	Pigging grit - licensed contractor to transport regulated waste to a licensed regulated waste landfill Hydrotest water discharge to land (assume no chemical treatment of water is required as source is potable water)	2 m^3 pigging grit total (assume 500 L per km) 20 kL water
Infield servicing and maintenance of construction vehicles and equipment Fuel trucks, lubrication trucks and minor maintenance pick-ups provide on-site daily service and perform regular check ups on equipment Daily field servicing, safety checks and refuelling in the field to be undertaken in the RoW	Oily rags, spent absorbent material from infield servicing and maintenance Waste oil and greases, eg lube oil, hydraulic oil and engine oil Spent spill kit materials Packaging from replacement parts End of life vehicle parts (eg fan belts, hoses, other machinery parts) Tyres Batteries	Licensed contractor to transport regulated waste to a licensed recycling facility Residual material dealt with in accordance with the principles of the waste hierarchy	All waste generated from infield servicing will be returned to waste storage at Preventative Vehicle Maintenance Workshop (PVMW) at the Gladstone Logistic Base 250 kg regulated waste per week

Curtis Island GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate of generation
	Used chemicals – chemicals, used tins from solvents, degreasing agents, lubricants Waste associated with diesel generator operation and maintenance		
Site offices, crib room/s, site amenities (servicing of construction site amenities)	Office waste – paper, cardboard packaging Kitchen waste Rubbish bin waste in facilities (ie paper towels) First aid waste Kitchen and amenity wastewater	Recyclable material to recycling facility (where available) General waste to local licensed landfill	Recyclable material 50 kg per week 200 kg per week of general waste
Spill clean up	Hydrocarbon contaminated soil (small quantities) Contaminated absorbent material from RoW	Licensed contractor to transport regulated waste to a licensed recycling facility and residual material disposal a licensed regulated waste landfill	10 L per week of regulated waste
RoW rehabilitation			
Clean up and restoration: reinstatement of the RoW, removal of foreign material (construction material and waste), surface contouring, compaction, re-spreading topsoil, re-spreading felled vegetation(whole or mulched) and reseeding Removing any surplus materials, restoring services to their original condition, disposing of refuse, smoothing disturbed earth, removing temporary fills, culverts and bridges, and performing such work as may be necessary to restore RoW to original condition	Any recyclable or general waste items listed above Useable surplus line pipe will be delivered to a location designated by GLNG Operations	Clean hardstand material will be offered to local landowner or Gladstone Regional Council for reuse or removed for treatment or disposal in accordance with the principles of the waste hierarchy Useable surplus line pipe and other reusable materials stored at location designated by GLNG Operations Residual material dealt with in accordance with the principles of the waste and resource management hierarchy	20 t timber skids 10 t sand bags
Establishment of vegetation	Plastic pots Wooden stakes Packaging material Herbicides	Residual material dealt with in accordance with the principles of the waste hierarchy General waste to local licensed landfill Licensed contractor to transport regulated waste to an appropriately licensed recycling facility and residual material disposal at appropriately licensed regulated waste landfill	10 kg per week during vegetation establishment activities in the RoW Quantity dependent upon whether herbicides for weed control are required during establishment of vegetation



GLNG No: 3381-40-0482

Coordinate system: GCS_GDA_1994

Curtis Island GTP EM Plan

Gas Transmission Pipeline (GTP)
- Mainland GTP EM Plan
- Marine Crossing GTP EM Plan
- Curtis Island GTP EM Plan

Kilometre Post Distance Marker
- 5km
- 1km

Road Haulage Route
- Waste to Benaraby Landfill; regulated waste and recyclables to SE Qld
- Other GLNG haulage route

Barge Haulage Route
- All waste and materials
- Drill cuttings
- Barge Landing (Indicative Location Only)
- Vehicle Washdown and RoW Access Point (Indicative Location Only)
- Temporary Pipe Storage Site
- Fishermans Landing and Western Basin Reclamation Area
- Protected Area
- Rail
- Cadastre

Source:
Gas Transmission Pipeline (GTP): Santos, Jan 2011.
Aerial: Santos, 2011.
Fishermans Landing and Western Basin Reclamation Area, Aurecon, Feb 2011.
Protected Areas: Department of Environment and Resource Management, Feb 2011.
Cadastre: Department of Environment and Resource Management, Feb 2011.
Temporary Pipe Storage Site: GLNG Pipeline Logistics Study, GHD, Nov 2009.
Vehicle Washdown Point: Aurecon, Feb 2011.

Note:
Barge landing and routes are approximate only.

Waste and Recovered Material Haulage Route: Overview
Figure 13.2

Date: 18/08/2011 Version: 1

Curtis Island GTP EM Plan

Gas Transmission Pipeline (GTP)
- Mainland GTP EM Plan
- Marine Crossing GTP EM Plan
- Curtis Island GTP EM Plan

Kilometre Post Distance Marker
- 5km
- 1km

Road Haulage Route
- Waste to Benaraby Landfill; regulated waste and recyclables to SE Qld
- Other GLNG haulage route

Barge Haulage Route
- All waste and materials
- Drill cuttings
- Barge Landing (Indicative Location Only)
- Vehicle Washdown and RoW Access Point (Indicative Location Only)
- Fishermans Landing and Western Basin Reclamation Area
- Rail

Source:
Gas Transmission Pipeline (GTP): Santos, Jan 2011.
Aerial: Santos, 2011.
Fishermans Landing and Western Basin Reclamation Area, Aurecon, Feb 2011.
Vehicle Washdown Point: Aurecon, Feb 2011.

Note:
Barge landing and routes are approximate only.

Waste and Recovered Material Haulage Route:Barge
Figure 13.3

GLNG No: 3381-40-0483
Coordinate system: GCS_GDA_1994

Date: 08/04/2011 Version: 0

Map by: BS P:\GIS\Projects\214208_Santos_EMP\Cl_017.mxd 08/04/2011 09:49

13.7.2 Operational waste

It is not anticipated that significant quantities of waste will be generated during operation of the Curtis Island GTP. However waste will still be generated from maintenance activities. These wastes will include putrescible waste, recyclable wastes (including paper, cardboard, plastics, glass and aluminium) and sanitary waste.

The activities that are expected to be undertaken during operation of the Curtis Island GTP include maintenance and repairs of pipeline and weed/vegetation management along RoW access tracks. A list of the waste types and an estimate of the waste quantities generated from operational activities is detailed in Table 13.4.

Table 13.4 Waste generated from Curtis Island GTP operation

Curtis Island GTP operation activity	Waste generated	General management principle	Estimated waste quantity/rate of generation[2]
Maintenance of Curtis Island GTP	Filters (non-oily, oily and gas)	Collected and transported by a suitably licensed contractor for recycling or disposal to regulated waste landfill	Less than 5 kg per year (approx 0.8 kg/km/year based upon 30 kg per month for entire pipeline)
	Waste oils and greases	Collected and transported by a suitably licensed contractor for recycling where possible	50 L per year (about 10 L per km)
	Packaging	General waste for disposal a licensed landfill	20 kg per year (approx 3.6 kg/km/year based upon 30 kg per week for entire pipeline)
Cleaning of pipeline - pigging (if undertaken in the future)	Pipe cleaning waste (pigging grit - scale, rust, or other foreign material)	Pigging grit - Licensed contractor to transport regulated waste to a licensed regulated waste landfill	100 L of pigging grit per year (assume 20 L per km)

13.7.3 Decommissioning waste

The rehabilitation of the GLNG RoW including the Curtis Island GTP and associated infrastructure is not expected to generate large volumes of waste. The GTP is expected to be operational for a period of at least 42 years.

Prior to final decommissioning or abandonment of any facilities associated with the GTP, GLNG Operations will investigate potential environmental issues and impacts associated with decommissioning or abandonment. Infrastructure that is no longer required for the operation of the Curtis Island GTP will be decommissioned or abandoned in accordance with the regulatory requirements and accepted best management environmental practice of the day.

Prior to the decommissioning of the Curtis Island GTP, a detailed assessment of the types and quantities of waste materials which could be expected will be conducted. Typical waste materials which would require removal from the above ground facilities would comprise metal pipework and valves, and inert waste such as concrete and hard standing material from mainline valve stations.

[2] Estimated operational waste quantities are based upon proportions

It is likely that above ground materials such as signs and some fencing would be disposed of in accordance with the principles of the waste and resource management hierarchy. Refer to Chapter 2 for an outline of decommissioning and abandonment.

13.8 Chemical use and management

The GTP project construction and operation activities will require the use of chemicals and hazardous materials and generate waste chemicals and hazardous materials.

Chemical and hazardous materials associated with the GTP activities will be handled and stored in accordance with the applicable State or Commonwealth legislation (refer Chapter 1), Australian standards and guidelines (refer Appendix F). This will include the separate storage of waste chemicals in appropriate containers at designated storage areas to encourage reuse, recycling and enable correct transport, treatment and disposal.

Environmental protection commitments, objectives and control strategies for chemical and hazardous materials management have been developed, including flammable and combustible liquids these are detailed in Section 13.12.

Table 13.5 provides a list of the chemicals and hazardous materials to be stored and used during the GTP construction. A description of the relevant activity and the proposed storage location is listed.

Table 13.5 Summary of possible chemical and hazardous materials for use during construction

Chemical/hazardous material	Activity	Anticipated storage location
Diesel	Fuel for construction vehicles and machinery and diesel generators at construction camps and offices\	No storage location at Curtis Island GTP RoW, refuelling truck will collect diesel from the Gladstone Logistic Base for refuelling of vehicles in the RoW
Fuel dispenser pump and storage (gasoline); Fuel dispenser pump and storage (diesel);	Fuelling facilities for vehicles	Gladstone Logistic Base at Gladstone Port Central 50,000 L fuel tank for fuel filling station
Fertiliser	Translocation of plants and restoration of the RoW	Gladstone Logistic Base
Herbicides (chemicals registered for the specific weed to be controlled)	Chemical spraying of weeds	Gladstone Logistic Base
Rigid Polyurethane foam (Aptane P220/Isocyanate B900)	Foam trench breakers and foam pillows installation – to hold the pipe off the trench invert (alternative material - sand bags)	Specialist subcontractors will mobilise foam components to site in storage containers on vehicles. Subcontractors to provide documentation regarding storage, handling and disposal arrangements prior to bringing to site
Oils and greases	Infield preventative vehicle servicing and maintenance of construction vehicles and equipment Major repair and maintenance of construction equipment at the temporary maintenance workshop at the Gladstone Logistic Base	Gladstone Logistic Base area in suitably sized tanks within appropriately bunded compounds as per Australian Standards

Chemical/hazardous material	Activity	Anticipated storage location
Waste Oil	Minor repairs and maintenance of construction equipment at the Preventative Vehicle Maintenance (PVM) workshop within Gladstone Logistic Base	All waste oils will be collected and stored within appropriately sized and bunded storage containers within the Gladstone Logistic Base PVM workshop
Paint	Painting welds and pipe coating defects	Storage area at Gladstone Logistic Base
Fusion bond epoxy powder	Coating for welded field joints	Storage area at Gladstone Logistic Base
Polyurethane-tar coating compound	Field joint coating	Storage area at Gladstone Logistic Base
Oxygen scavenger	Chemical dosing during Hydrotesting	Storage area at Gladstone Logistic Base
Biocide	Hydrotesting	Storage area at Gladstone Logistic Base
Radioactive isotope/material/element within weld inspection device (pipe crawler)	Weld inspection activities	Contained in pipe crawler machine. Pipe crawler located at RoW or in equipment storage area at the Gladstone Logistic Base Specialist subcontractors will maintain documentation and certificates to bring such materials to site and are responsible for handling, storage requirements and identification of disposal methods
	Non-Destructive Testing (NDT) X-Ray films development for weld quality assurance	Darkroom, containing the necessary film processing equipment, will be located at the Gladstone Logistic Base. Specialist subcontractors will manage such materials on site and be responsible for handling, storage and disposal methods

Table 13.6 provides a list of the chemicals and hazardous materials to be stored and used during the GTP operation along with the relevant activity and the proposed storage location.

Table 13.6 Chemical and hazardous materials proposed for use during operation

Chemical/hazardous material	Activity	Storage location
Lubricants	Maintenance of mainline valve stations	GLNG GTP operations headquarters in Gladstone
Solvents	Cleaning pigging equipment and sumps	GLNG GTP operations headquarters in Gladstone
Oils and greases	Maintenance of equipment for pipeline maintenance	GLNG GTP operations headquarters in Gladstone

13.9 Continuous improvement

GLNG Operations will work closely with the Contractor to rectify any issues identified as a result of waste monitoring and auditing activities.

GLNG Operations will continue to investigate and implement actions to reduce impacts and deliver positive outcomes through the operation of the GTP in relation to waste management.

The results of inspections, audits and incident reports will be used to drive continuous improvement along with other associated internal environmental performance reviews conducted by the GTP management team.

Following any significant changes to the GTP design or operational processes the Waste MP (refer Appendix F) will be reviewed to determine if it should be updated to reflect the changes.

Following any environmental incidents resulting in environmental harm, the Waste MP will be reviewed and mitigation measures updated and improved to reduce the risk of incidents.

This Waste MP will be subject to annual review by GLNG Operations and its effectiveness in managing the waste streams associated with the GTP operations reported internally and to any relevant stakeholder.

13.10 Cumulative impacts

This cumulative impact assessment is based on the impact scope, identification and scoring methodology described in Chapter 2 of this EM Plan. Potential impacts may arise as a result of increased waste generation from multiple GLNG projects operating within the CICGSDA. These may include hydrotest water, generation of solid waste and vegetation waste.

Liquid waste (hydrotest disposal)

If all hydrotest water is either reused or disposed of to soak away, and it does not include chemical additives, it will not require disposal as a liquid waste.

Assuming waste is managed in accordance with proposed waste management plans, and given that hydrotest water from each project will be disposed of as a discrete, short term event, cumulative impacts from liquid waste disposal are expected to be minimal.

Implementation of measures set out in this EM Plan will result in minor negative impact on liquid waste from pipeline construction within the GSDA corridor on Curtis Island. No additional mitigation measures to the EM Plan are required.

Solid waste (creation of spoil material/vegetation waste, sanitary waste)

There are not anticipated to be significant volumes of spoil generated from the projects. Other cumulative solid waste streams may impact on local landfill capacity and will include construction materials, vegetation and general waste. Construction materials will be re-used and recycled where possible. Vegetation waste from RoW clearance is anticipated to be either used for timber or kept on site for use as mulch and is therefore not expected to be a significant volume.

Implementation of measures set out in this EM Plan will result in negligible impact on solid waste from pipeline construction within the GSDA corridor on Curtis Island.

13.11 Environmental protection commitments, objectives and control strategies – waste management (construction and operation)

Waste material generated as a result of construction and operation activities of the Curtis Island GTP will be managed in accordance with the principles of the waste and resource management hierarchy as described in the *Queensland Waste Reduction and Recycling Strategy 2010 - 2020*.

The following environmental protection commitments, objectives and control measures for each aspect of the Curtis Island GTP have been described for the following areas:

- Waste
- Hydrotest water
- Chemicals and hazardous materials

13.11.1 Waste Management

Table 13.7 details the environmental protection objectives, strategies, monitoring and reporting requirements for the management of construction waste.

Table 13.7 Environmental protection commitments, objectives and control strategies for waste management

Item	Detail
Environmental protection objective	• To ensure that the transmission pipeline construction adheres to the waste management hierarchy of avoid, reuse, re-use and recycle. Where this is not possible, to dispose of waste in the most appropriate manner
Specific objectives	• No inappropriate disposal or management of waste • No contamination of soil, air or water as a result of waste handling • Petroleum activities do not result in the release or likely release of contaminants to the environment from the storage, conditioning, treatment and disposal of regulated waste materials
Control strategies	**General** • Prior to commencement of works, the appropriate methods for disposal of waste will be determined by consultation with the relevant local governments and the Department of Environment and Resource Management • A waste management plan in accordance with the Environmental Protection (Waste) Policy 2000 on the following will be developed and implemented including: – The types and amounts of waste generated – How the waste will be dealt with, including a description of the types and amounts of waste that will be dealt with under each of the waste management practices mentioned in the waste management hierarchy (section 10 of the Environmental Protection (Waste Management) Policy 2000) – Procedures for dealing with accidents, spills and other incidents that may impact on waste management – How often the performance of the waste management practices will be assessed (i.e. at least annually) – The indicators or other criteria on which the performance of the waste management practices will be assessed • On completion of each section of pipeline, all waste material will be removed from the workplace. No wastes will be buried or disposed of on-site without local government and/or DERM approval • The Construction Contractor will advise designated disposal areas for each section of the RoW • All welding waste will be managed appropriately and removed from the RoW on an as required basis • General waste will be collected and transported generally to local council approved disposal sites • Food wastes will be collected, where practicable, considering health and hygiene issues, for disposal off-site • All waste/rubbish will be correctly disposed of and will not pose a risk to marine fauna. Plastic bags will be banned from all site offices and project areas within the coastal zone (intertidal and marine zones) • Refuse containers will be located at each worksite • Where practical, wastes will be segregated and reused / recycled (eg scrap metal) • All personnel will be instructed in project waste management practices and procedures as a component of the environmental induction process • Suppliers will be requested to minimise packaging where practicable • Emphasis will be placed on housekeeping and all work areas will be maintained in a neat and orderly manner • All equipment and facilities will be maintained in a clean and safe condition

Item	Detail
	Liquid Waste • Wastewater from construction, cleaning and testing operations will be treated and managed in accordance with the relevant environmental authorities • The treatment method will be selected in consultation with a relevant local authority and DERM and the relevant environmental authority obtained • Flammable and combustible liquids (including petroleum products and associated piping and infrastructure), must be stored, handled and maintained in accordance with the latest edition of Australian Standard 1940 - the Storage and Handling of Flammable and Combustible Liquids • Any liquids stored on site that have the potential to cause environmental harm must be stored in or serviced by an effective containment system that is impervious to the materials stored and managed to prevent the release of liquids to waters or land. Where no relevant Australian Standard is available, the following must be applied: – Storage tanks must be bunded so that the capacity and construction of the bund is sufficient to contain at least 110 per cent of a single storage tank or 100 per cent of the largest storage tank plus 10 per cent of the second largest storage tank in multiple storage areas; and – Drum storages must be bunded so that the capacity and construction of the bund is sufficient to contain at least 25 per cent of the maximum design storage volume within the bund **Hazardous Waste** • Chemical wastes will be collected in 200 litre drums (or similar sealed container) and appropriately labelled for safe transport to an approved chemical waste depot or collection by a liquid waste treatment service • Storage, transport and handling of all chemicals will be conducted in accordance with all legislative requirements • Containment bunds and/or sumps will be drained periodically to prevent overflow and subsequent pollution of the surrounding land and/or water body • All hazardous wastes will be appropriately stored in bunded areas away from watercourses and in accordance with legislative requirements • Where no Australian Standard is available, any liquid with potential to harm the environment must be: – Stored in impervious bunded tanks with bunded capacity at least 110% of a single storage tank or 100% of the largest storage tank plus 10% of the second largest storage tank in multiple storage areas – Impervious drum storage must have a bunded capacity to contain at least 25% of the maximum design storage volume within the bund • Hazardous wastes, such as solvents, rust proofing agents and primers will be managed in accordance with the requirements of relevant legislation and industry standards • A hazardous materials inventory will be prepared • Material Safety Data Sheets (MSDS) for hazardous materials will be available at all work sites • Hydrocarbon wastes, including lube oils, will be collected for safe transport off-site for reuse, recycling, treatment or disposal at approved locations • As soon as practicable remove and dispose of all regulated waste to a licensed waste disposal facility or recycling facility • All regulated waste removed from the site must be removed by a person who holds a current authority to transport such waste under the provisions of the Environmental Protection Act 1994 and sent to a facility licensed to accept such waste • When regulated waste is removed from within the boundary of the petroleum tenure and transported by the holder of this authority, a record must be kept of the following: – Date of waste transport – Quantity of waste removed and transported – Type of waste removed and transported – Route selected for transport of waste – Quantity of waste delivered – Any incidents (e.g. spillage) that may have occurred on route

Item	Detail
	• If a person removes regulated waste associated with activities within the operational land and disposes of such waste in a manner which is not authorised or is improper or unlawful then, as soon as practicable, the administering authority will be notified of all relevant facts, matters and circumstances known concerning the disposal • If a hazardous contaminant is released to waters or land the following steps must be taken: – Take immediate action to stop any further release and make sure that the area is safe – Take immediate action to contain the hazardous contaminant to the affected area, taking particular care to protect environmentally sensitive areas – Restore or rehabilitate the environment to its condition before the release occurred; and take necessary action to prevent a recurrence of the release • Ensure that all health risks associated with the disposal and reuse of treated sewerage is mitigated through appropriate primary and secondary treatment
Performance indicators	• Waste handling is conducted in a way that minimises contamination of soil, air or water

13.11.2 Hydrotest water

Table 13.8 details the environmental protection objectives, control strategies, monitoring and reporting requirements for the management of hydrotest water.

Table 13.8 Environmental protection commitments, objectives and control strategies for hydrotesting

Item	Detail
Environmental protection objective	• To protect the quality of local land and water resources during pipeline hydrotesting
Specific objectives	• Appropriate permits obtained prior to drawing water • No existing water sources unsustainably depleted to provide hydrotesting water • No adverse impacts on soil or surface water as the result of discharging hydrotesting water
Control strategies	• Relevant permits to draw water obtained • Hydrotest water will be re-used on multiple and adjacent pipeline sections as much as possible to reduce actual volumes used • Pipe sections crossing water bodies will be tested prior to installation • Inspection of all pipeline section welds, or hydrotesting of pipeline sections before installation under water bodies, will be performed in accordance with construction specifications/procedures • Biocides, where required, will be biodegradable • Where biocides are added, discharge water will be aerated • Prior to discharge, the Contractor shall provide a Hydrotest Water Management Plan (HWMP) prior to commencement of construction works for the Project. The HWMP will include: – A detailed assessment of impacts from hydrostatic test water along the pipeline route including source water quality data and characteristics of additives, particularly biocides – Proposed storage, treatment and disposal methods of hydrotest water – Site specific mitigation measures for management of hydrotest water including monitoring and reporting – Determination of whether testing of the hydrotest water is necessary and submit a plan for review to GLNG Operations. Where the water source and water quality is known, and no chemicals have been added, water quality testing may not be required

Item	Detail
	• Hydrostatic test water, including a detailed assessment of impacts from hydrostatic test water along the pipeline route, will be provided. Source water quality data and characteristics of additives, (particularly biocides) will be provided along with the proposed storage, treatment and disposal methods. The information will be used to determine the site specific mitigation measures including monitoring and reporting • Hydrotest water will be treated as necessary and then disposed of such that it does not enter into any watercourses or run in an uncontrolled manner onto open land. Where water cannot be discharged to ground, other options will be considered to ensure compliance with all regulations • Hydrotest water will be released at least 100 m from any watercourse such that vegetation and soil structure are not damaged or eroded and the quality of groundwater is not adversely impacted • Discharge of hydrotesting water will comply with all regulatory and landholder requirements • Where hydrostatic test water is proposed to be released to land, it will not exceed the water quality limits specified in Table 1: Water Quality Limits. Hydrostatic test water containing chemical additives must not be released to land without written consent from GLNG Operations and the administering authority
Performance indicators	• Permits to draw water are in place • Hydrotesting water is not unsustainably depleting existing water sources • Discharge of hydrotesting water is not adversely impacting on soil or surface water

Table 1 Water Quality Limits

Parameter	Maximum value
pH	6.5-8.5 (Range)
Arsenic (mg/L)	2.0
Cadmium (mg/L)	0.05
Chromium (mg/L)	1
Copper (mg/L)	5
Iron (mg/L)	10
Lead (mg/L)	5
Manganese	10
Zinc (mg/L)	5
Nitrogen (mg/L)	35
Phosphorus (mg/L)	10
Electrical Conductivity (uS/cm)	2000

13.11.3 Chemical and hazardous materials management

Table 13.9 details the environmental protection objectives, relevant control strategies, monitoring and reporting requirements for the management of chemical and hazardous materials.

Table 13.9 Environmental protection commitments, objectives and control strategies for chemical and hazardous materials management

Item	Detail
Operational Policy or Management Objective	• To ensure that storage and handling of chemicals and dangerous goods does not cause environmental harm or harm to persons
Performance Criteria	• Petroleum activities do not result in the release or likely release of a hazardous contaminant to the environment • Storage and handling procedures correct and appropriate • Chemicals stored in secure areas • All containment systems must be designed to minimise rainfall collection within the system

Item	Detail
Implementation Strategy	• Spill control procedures will be prepared and personnel trained • Dangerous goods will be stored and handled as per the requirements of relevant Australian Standards • Areas where contaminants or wastes are stored or handled will be minimised or roofed • Dangerous goods will, where appropriate (eg outside locations), be stored in bunded areas away from watercourses • Stormwater will be diverted around disturbed areas and areas where contaminants or wastes are stored or handled • All explosives, hazardous chemicals, corrosive substances, toxic substances, gases and dangerous goods must be stored and handled in accordance with the relevant Australian Standard • Explosives will be stored in magazines constructed and located as prescribed in AS 2187 • Where no Australian Standard is available, any liquid with potential to harm the environment must be – Stored in impervious bunded tanks with bunded capacity at least 110% of a single storage tank or 100% of the largest storage tank plus 10% of the second largest storage tank in multiple storage areas – Impervious drum storage must have a bunded capacity to contain at least 25% of the maximum design storage volume within the bund • Stormwater runoff and rainfall events will be collected, treated, reused or released in accordance with environmental and legal requirements • Material safety data sheets for chemicals and dangerous goods will be available on-site • Waste dangerous goods, which cannot be recycled, will be transported to a designated disposal site as approved by the local authority • Any spillage of hazardous waste or other contaminants that may cause environmental harm will be effectively contained and cleaned up as quickly as practicable. Such spillage must not be cleaned up by hosing, or otherwise thereby releasing such waste or contaminants to any land or waters • Spillages must be cleaned up using dry methods that minimise the release of wastes, contaminants or materials to any stormwater drainage system, roadside gutter or waters • Spills of dangerous goods will be rendered harmless and collected for treatment and disposal at a designated site, including cleaning materials, absorbents and contaminated soils • Hydrocarbon spillage from storage areas, diesel and chemical spills from construction equipment, and industrial waste spill will be contained, reported, and treated/remediated in accordance with appropriate legislative and regulatory agency requirements. Drainage will be reinstated • Absorbent and containment material (eg absorbent matting) will be available where hazardous materials are used and stored and personnel trained in their correct use • Protective clothing, appropriate to the materials in use, will be provided • Relevant permits will be held and conditions of permits met • Servicing of equipment/machinery will not be permitted on the RoW without prior authorisation from GLNG Operations. All planned services for all equipment is to occur in an approved workshop
Performance indicators	• The environment is not being contaminated by hazardous goods • Correct and appropriate storage and handling procedures are in place • Chemicals are stored in secure areas • Collection of rainfall is minimised in all containment systems

14. Water

14.1 Chapter summary

This section provides a summary of the existing environmental values, potential impacts and proposed mitigation measures detailed throughout this chapter.

14.1.1 Summary of existing water values

- The Curtis Island GTP RoW does not intersect any declared catchments as defined under the *Water Act 2000*
- The Curtis Island GTP RoW does not intersect any Wild Rivers as declared under the *Wild Rivers Act 2005*
- There are no major watercourses along the Curtis Island GTP RoW, with the watercourses ephemeral and defined as stream order 1 or 2
- Port Curtis and The Narrows, which are wetlands of national importance, are the main receiving environments. The Narrows, including Graham Creek is part of the Great Barrier Reef Coastal Marine Park and is zoned as habitat protection zone
- No lacustrine, palustrine or estuarine wetlands occur within the Curtis Island GTP RoW
- No water quality assessment of surface water has been carried out due to the ephemeral nature of the streams within the Curtis Island RoW
- Groundwater assessments have determined that the groundwater is highly saline and that groundwater from both shallow (<8 m) and deep (>20 m) aquifers is not suitable for discharge into fresh or marine water environments due primarily to the elevated heavy metal concentrations (ie above recognised trigger values)
- Shallow groundwater quality is suitable for livestock drinking water only
- There are no springs present within the Curtis Island GTP RoW

14.1.2 Summary of potential impacts to water values

Construction

The construction of the Curtis Island GTP has the potential to impact on water related environmental values including increased erosion and sediment movement, decreased surface water and groundwater quality due to chemical pollutants, changes to surface water flow and groundwater hydraulic characteristics, and deterioration in local water supply. In particular, soil erosion and sediment presents a slightly higher risk due to the moderate to high erosion potential of the soils within the Curtis Island GTP RoW. However, with the implementation of the recommended mitigation measures from Chapter 7, Section 14.6 and the Erosion and Sediment Control Management Plan (ESCP) (refer Appendix A), it is considered that the impacts of soil erosion and sediment are low and manageable.

The impacts to the surface water and groundwater quality as a result of chemical pollution are also considered to be low and manageable, as chemicals will be stored in accordance with the WM Plan (refer Appendix F), while hydrotest water will be treated to the approved water quality discharge limits. No construction camps will be constructed on the RoW and sewage will be collected and transported off site for treatment. Hydrotest water will also be reused (where possible) during the hydrotesting process to minimise impacts on local water supply.

Operation

Regular inspections will be carried out along the Curtis Island GTP RoW by vehicle and foot patrols to assess the condition of the GTP and associated infrastructure. Maintenance will typically be carried out by small maintenance crews in light vehicles on an annual basis, or as and when required.

It is considered that surface water quality impacts from operational activities are low and manageable due to the infrequent maintenance activities and vehicle movements during rainfall events. There are no anticipated groundwater impacts resulting from operational activities due to the shallow nature of the works.

Furthermore, all works associated with these operational activities will be undertaken in accordance with the ESCP (refer Appendix A), ASSMP (as presented in the Marine Crossing EM Plan) and Operational Management Plan (OMP) which will be developed prior to construction and implemented in all stages of the project, including construction, operation and decommissioning.

14.1.3 Summary of proposed mitigation measures

Table 14.1 Environmental protection commitments, objectives and control strategies - water

Item	Detail
Environmental protection objective	• To minimise the potential impacts associated with erosion, prevent the release of contaminants that may adversely affect downstream surface water quality, and protect the quality of the existing groundwater resource
Specific objectives	• Prevention of direct or indirect release of contaminants to surface waters • Minimisation of incidences of accelerated erosion as a result of construction activities • Groundwater quality will not be impacted by development activities • Spill containment facilities constructed in accordance with AS 1940 (2004) and AS 3780 (1994) • Environmental impacts are within authorised limits
Implementation strategy	Refer to Table 14.5 for surface, marine and groundwater control strategies to be implemented during construction and operation of the Curtis Island GTP
Performance indicators	• Control strategies outlined in the ESCP are being implemented • Groundwater quality is not being adversely impacted by development activities • Spill containment facilities are constructed in accordance with AS 1940 (2004) and AS 3780 (1994) • Environmental impacts are within authorised limits

14.2 Introduction

14.2.1 Project background

This chapter provides a summary of the existing environmental values and an assessment of the potential surface water and groundwater impacts for the construction phase of the Curtis Island GTP.

It also outlines the mitigation measures and management strategies for the protection of the existing environmental values.

14.2.2 Description of Curtis Island GTP

Surface water

Catchment

The Curtis Island GTP RoW is located within the Curtis Island Drainage Basin Area. However, this area is not recognised as declared catchment under the Water Act 2000.

The Curtis Island GTP RoW is primarily located within an unnamed subcatchment of Graham Creek. The works will also intersect a number of small unnamed catchments which drain predominately westerly into Port Curtis. The watercourses associated with these catchments are ephemeral and are categorised as stream order 1 or 2.

A desktop review of previous surface water studies undertaken within the Curtis Island Industrial Precinct found that there is a paucity of water quality data. This is attributed to the ephemeral nature of the creeks.

However APLNG, QCLNG and GLNG, for their respective Environmental Impact Statement (EIS), have all undertaken surface water studies within the areas proposed for their respective LNG facilities on Curtis Island. These areas (refer Figure 14.1) are all located immediately downstream of the Curtis Island GTP RoW. It is considered that information from these studies can be used to gain an understanding of the surface waters existing upstream (within the CPIC) and subsequently what environmental values these waters encompass.

APLNG Facility EIS

The APLNG EIS (March 2010) states that the APLNG Facility area is traversed by drainage lines comprising three ephemeral tributaries. A natural melaleuca wetland and a small farm dam were also located within the site. It was considered that both sites were degraded to the point that they possessed limited environmental values (APLNG 2010).

The study explains that the site had previously been used for cattle grazing and that runoff quality is expected to be similar to that for low intensity grazing. Toxic contamination of runoff was considered unlikely as no cattle dip or other sources of contamination were found on site. It was stated that the site is no longer used for grazing (APLNG 2010).

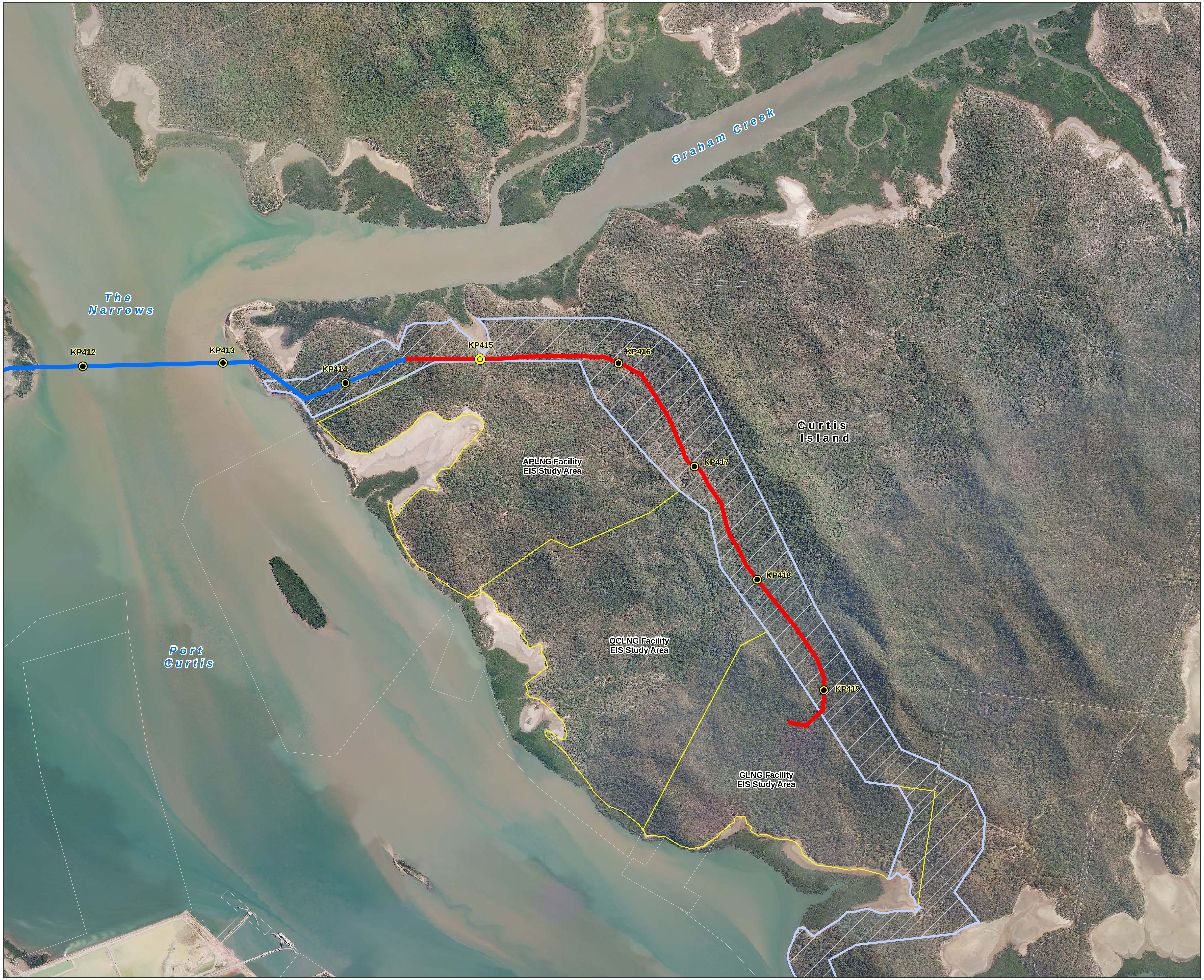
QCLNG Facility EIS

The QGC EIS (July 2009) of the proposed QCLNG facility area found there were two main watercourses observed during the fieldworks with several smaller perennial watercourses. The QGC EIS states that the creeks observed across the site generally range in width between 2 m and 5 m and typical depth of 0.5 m to 1.5 m, but ranging to more than 5 m in one ephemeral drainage line in the upper slopes of the site towards the eastern site boundary.

The QGC EIS states that once the flow in these ephemeral streams cease, they become a series of disconnected waterholes or ponds, and over time the waterholes in these smaller stream channels completely dry out (QGC Limited 2009).

It was found in this study that the watercourses demonstrated variable degrees of erosion, with the upper reaches exhibiting greater erosion effects than the lower reaches.

It is likely that the ‘major streams’ mentioned in the QCLNG EIS study above would have been observed soon after a significant rainfall event which explains the presence of water. It is unknown whether these water bodies were flowing or consisted of intermittent pools. Photographs included within the QCLNG EIS of these ‘major streams’ suggest the latter.



Map by: RB P:\GIS\Projects\214208_Santos_EMP\CI_006.mxd 18/08/2011 10:10

A1 scale: 1:15,000

0 250 500 750 1,000 1,250m

GLNG No: 3381-40-0484

Coordinate system: GCS_GDA_1994

LNG

Curtis Island GTP EM Plan

Gas Transmission Pipeline (GTP)
- Mainland GTP EM Plan
- Marine Crossing GTP EM Plan
- Curtis Island GTP EM Plan

Kilometre Post Distance Marker
- 5km
- 1km

LNG Facility EIS Study Area

Proposed GSDA Materials, Transportation and Services Corridor

Cadastre

Source:
Gas Transmission Pipeline (GTP): Santos, Jan 2011.
Aerial: Santos, Feb 2011.
Cadastre: Department of Environment, Resource and Management, Jun 2011
LNG Facility EIS Study Area: GLNG 138c Rev 1
Gladstone State Development Area Precincts: Santos, Feb 2011.

LNG Facility EIS study areas adjacent to the proposed GTP Figure 14.1

Date: 18/08/2011 Version: 1

GLNG Facility EIS

The EIS (2009) found that water features in the GLNG facility area were limited to drainage features containing water only during and immediately after rain events.

The EIS of the GTP construction for GLNG did not investigate water quality within the Curtis Island RoW due to the lack of major waterways on the island. However an aquatic survey was undertaken within the RoW as part of this study which provides the only observation of surface water features within the CPIC as a whole.

The EIS states no permanent freshwater bodies are present within the Curtis Island RoW study area. No water was present within the ephemeral waterways during the study (URS 2009). Even at times of flow, the waterways within the study area would not be expected to support an assemblage of fish species as there are no core populations present in the locality to act as sources for migration and reintroduction of species. Semi-aquatic fauna such as frogs would be present to utilise ponds in the waterways for breeding (URS 2009). This statement corresponds to the other studies in that the drainage lines within the Curtis Island GTP RoW are completely ephemeral in nature and hold little environmental value except for intermittent stock watering and semi-aquatic breeding habitat.

Wetlands and springs

The directory of Important Wetlands in Australia (DIWA) lists four nationally important wetlands in the wider area (DEW 2005):

- Great Barrier Reef Marine Park
- Northeast Curtis Island
- Port Curtis
- The Narrows

The works will not occur within these areas, however these areas are the main receiving environments. It should be noted that a portion of The Narrows, including Graham Creek, is zoned as a habitat protection area under the Great Barrier Reef Coastal Marine Park.

The Curtis Island GTP RoW does not intersect any palustrine, estuarine or lacustrine wetlands. However, there is a small area of Estuarine Wetland located in proximity to the Curtis Island GTP RoW at kilometre point (KP) 415 which is illustrated in Figure 14.3. This figure also shows that the RoW at KP 415 is located within 'Areas that May Include Wetlands (1 to 50%).

As discussed above no wetlands are intercepted by the GTP RoW. However the works will occur within a Wetland Protection Area (WPA) associated with a referable wetland (refer Figure 14.2).

Referable Wetlands need not be referred to the Department of Environment and Resource Management (DERM) as the Project is exempt from the *Sustainable Planning Regulation 2009*. However, the CSG Guidelines for preparing an EM Plan define Referable Wetlands as Category C ESAs which must be addressed.

According to DERM's wetland maps, there are no springs located within or in proximity to the Curtis Island GTP RoW.

Hydrotest water

The integrity of the Curtis Island GTP pipeline will be verified via hydrostatic testing. This testing is a key component of the commissioning phase for the Project with details of the hydrostatic testing process having been described in Chapter 2.

Curtis Island GTP EM Plan

Gas Transmission Pipeline (GTP)
- Mainland GTP EM Plan
- Marine Crossing GTP EM Plan
- Curtis Island GTP EM Plan

Kilometre Post Distance Marker
- 5km
- 1km

Referable Wetlands
- Wetland Management Area
- Wetland Management Area Trigger
- Watercourse

Source:
Gas Transmission Pipeline (GTP): Santos, Jan 2011.
Referable Wetlands: DERM, 2010.
Watercourses: Department of Environment, Resource and Management, 2009.
Aerial: Santos, Feb 2011.

Referable Wetlands and Watercourses
Figure 14.2

Date: 08/04/2011 Version: 0

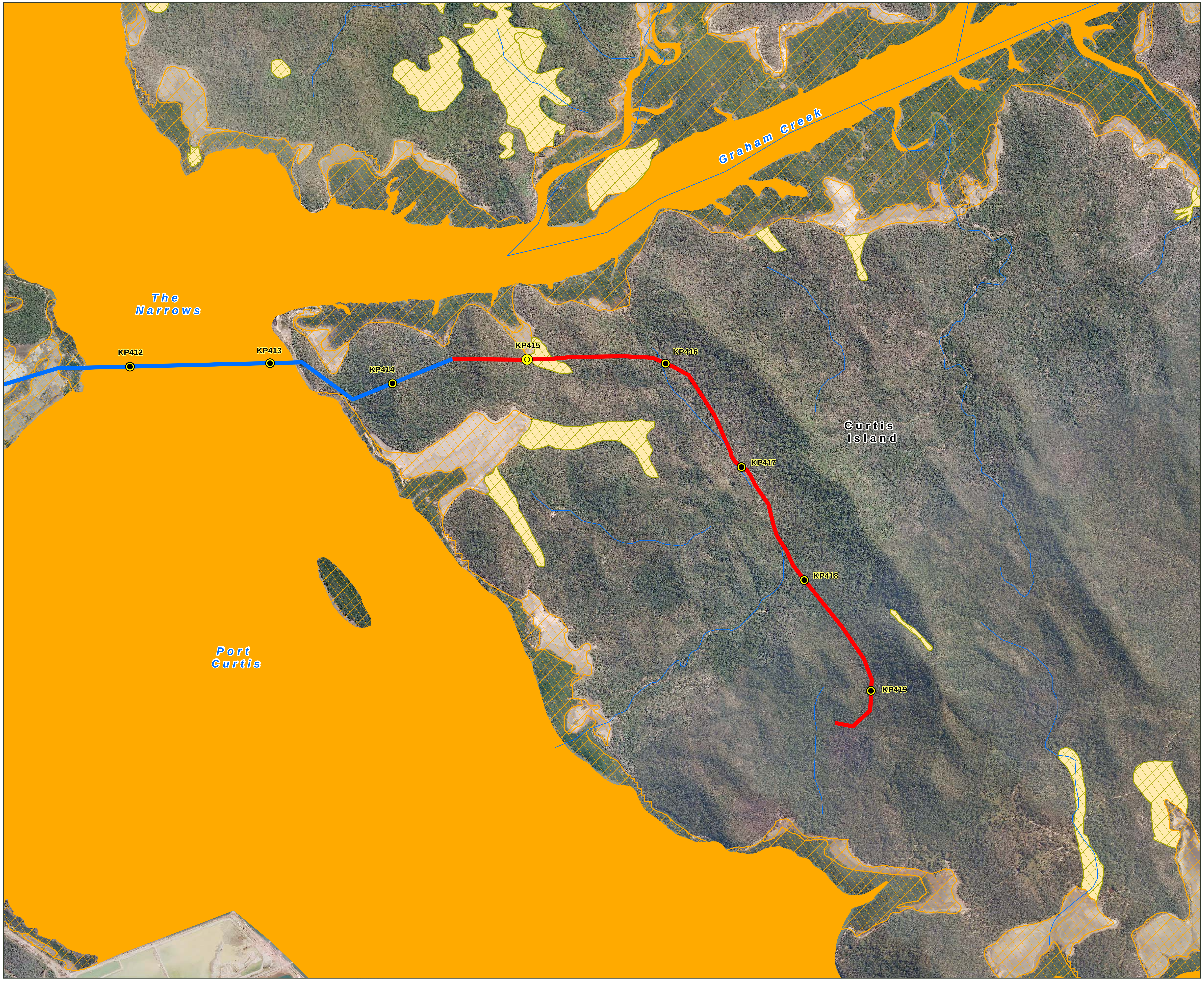
A1 scale: 1:15,000

0 250 500 750 1,000 1,250m

GLNG No: 3381-40-0485

Coordinate system: GCS_GDA_1994

Map by: RB P:\GIS\Projects\214208_Santos_EMP\CI_003.mxd 08/04/2011 09:58



Curtis Island GTP EM Plan

Gas Transmission Pipeline (GTP)
- Mainland GTP EM Plan
- Marine Crossing GTP EM Plan
- Curtis Island GTP EM Plan

Kilometre Post Distance Marker
- 5km
- 1km

Wetland Systems
Wetland Regional Ecosystem
- Estuarine

Water Body
- Estuarine

Areas that May Include Wetlands
- 1-50% wetland
- Watercourse

Source:
Gas Transmission Pipeline (GTP): Santos, Jan 2011.
Aerial: Santos, Feb 2011.
Water Bodies and Wetland Regional Ecosystems: Queensland Wetland Data v1.2, Department of Environment and Resource Management, 2008.
Watercourses: Department of Environment and Resource Management, 2009.

Wetland Systems
Figure 14.3

A1 scale: 1:15,000
0 250 500 750 1,000 1,250 m

GLNG No: 3381-40-0486
Coordinate system: GCS_GDA_1994

Date: 08/04/2011 Version: 0

Map by: RB P:\GIS\Projects\214208_Santos_EMP\CI_015.mxd 08/04/2011 09:59

Groundwater and aquifers

A search of DERM's Groundwater Database found that two sub-artesian groundwater bores (registration numbers 91325 and 91326) are registered within 2 km of the Curtis Island GTP RoW. The locations of these bores are illustrated in Figure 14.4. Other characteristics of the two bores are also listed in the Table 14.2 below.

Table 14.2 Characteristics of boreholes 91325 and 91326

Borehole registration number	Top of bed (m)	Bottom of bed (m)	Standing water level	Quality notes	Yield	Formation name
91325	22.22	27.27	- 10.6	Conductivity: 12,000 µScm^{-1}	3.00	Wandilla Formation
91326	15.00	30.30	-10.6	Salty	0.52	Wandilla Formation

Source Department of Environment and Resource Management Groundwater Database

14.3 Description of environmental values

14.3.1 Relevant legislation and guidelines

Water Quality Guidelines

Water quality indicators are assessable against two water quality guidelines: *Queensland Water Quality Guidelines* (QWQG) (DERM formerly EPA 2009) and ANZECC *Water Quality Guidelines* (ANZECC 2000). Where guideline values for specific parameters are not available from the QWQG the ANZECC guidelines should be adopted. Adopting these guidelines potentially minimises any negative impacts associated with the Project, particularly during the construction phase.

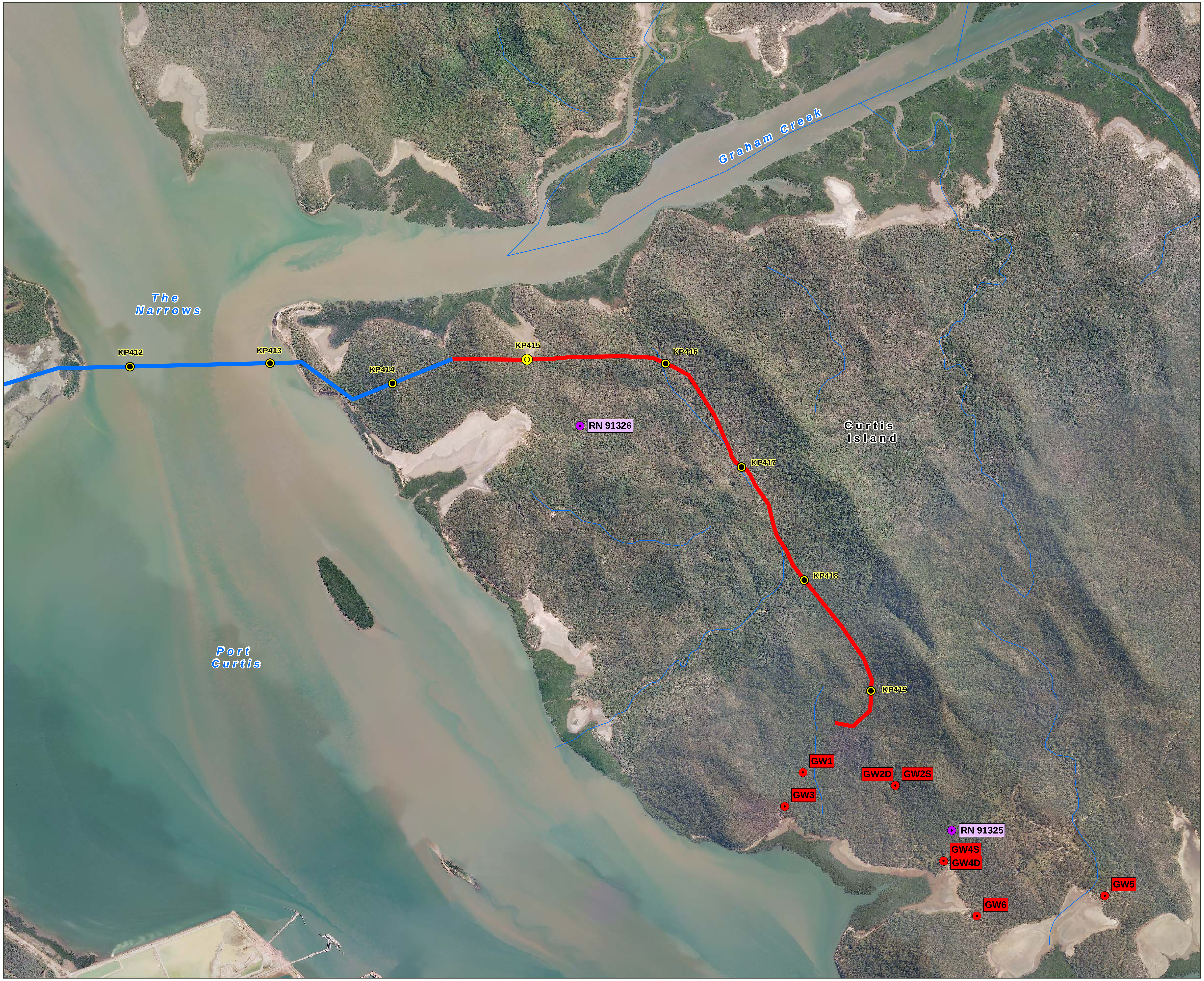
ANZECC 2000 Guidelines

The Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC 2000) have been prepared as part of Australia's National Water Quality Management Strategy (NWQMS). The NWQMS is a joint strategy developed by two ministerial councils, namely ANZECC and the Agriculture and Resources Management Council of Australia and New Zealand (ARMCANZ).

The ANZECC guidelines have been developed to:

- Protect and manage environmental values supported by water resources
- Outline the management framework recommended for applying the water quality guidelines to the natural and semi-natural marine and freshwater resources in Australia and New Zealand
- Provide advice on designing and implementing water quality monitoring and assessment programmes

The ANZECC (2000) guidelines provide trigger values or descriptive statements for different indicators of water quality to protect aquatic ecosystems and human uses of water (eg primary recreation, human drinking water, agriculture, stock watering). The ANZECC (2000) guidelines are a broad scale assessment and it is recommended where applicable, locally relevant guidelines are adopted.



Curtis Island GTP EM Plan

Gas Transmission Pipeline (GTP)
- Mainland GTP EM Plan
- Marine Crossing GTP EM Plan
- Curtis Island GTP EM Plan

Kilometre Post Distance Marker
- 5km
- 1km
- Groundwater Monitoring Bore (DERM)
- Groundwater Monitoring Bore (URS)

Source:
Gas Transmission Pipeline (GTP): Santos, Jan 2011.
Groundwater Monitoring Bore (DERM): Groundwater Database, v6, The State of Queensland (Department of Natural Resources, Mines and Water), 2006.
Groundwater Monitoring Bore (URS): Santos, March 2011.
Watercourses: Department of Environment and Resource Management
Aerial: Santos, Feb 2011.

Groundwater Monitoring Bores Figure 14.4

A1 scale: 1:15,000

0 250 500 750 1,000 1,250 m

GLNG No: 3381-40-0487

Coordinate system: GCS_GDA_1994

Date: 08/04/2011

Version: 0

Map by: RB P:\GIS\Projects\214208_Santos_EMP\CI_016.mxd 08/04/2011 10:03

Queensland Water Quality Guidelines 2009

DERM's *Queensland Water Quality Guidelines 2009* (QWQG) are intended to address the need identified in the ANZECC (2000) guidelines by:

- Providing guidance values (numbers) that are tailored to Queensland Regions and water types
- Providing a process/framework for deriving and applying local guidelines for waters in Queensland (ie more specific guidelines than those in the ANZECC (2000) guidelines)

For the purpose of determining Water Quality Objectives (WQOs) for the project area "Curtis Island GTP RoW", the Central Coast region has been adopted from the QWQG.

The waterways within the RoW are considered to be lowland freshwater streams. In the ANZECC (2000) guidelines, lowland freshwater streams are defined as all streams or stream sections below 150 m or more specifically "*larger third, fourth and fifth order or greater), slow-flowing and meandering streams and rivers. Gradient very slight. Substrates rarely cobble and gravel, more often sand, silt or mud*".

14.3.2 Site based environmental values (EVs)

Curtis Coast (receiving waters)

The *Environmental Protection (Water) Policy 1997* (EPP Water) seeks to protect and/or enhance the suitability of Queensland's waters for various beneficial uses. The policy identifies environmental values for waters within Queensland and guides the setting of water quality objectives to protect the environmental values of any water resource. The environmental values include the biological integrity of the aquatic ecosystem and recreational, drinking water supply, agricultural and/or industrial uses.

There are no named watercourses within the Curtis Island GTP RoW. However, receiving environments such as Graham Creek[1] (to the north of the Curtis Island GTP RoW) and waters surrounding Curtis Island will be protected under the EPP Water, including the "The Narrows" and the Great Barrier Coastal Marine Park.

Local government, industry and the Gladstone Port Corporation are involved in a collaborative project as part of the Gladstone Harbour Protection and Enhancement Strategy that has identified preliminary environmental values for some waterways in the Curtis Coast region.

Environmental values adopted for the GLNG Facility have been identified through the Strategy's preliminary environmental values (BCC, 2002) and data gathered from URS site assessment and are summarised in Table 14.3. These environmental values are considered to be similar to the Curtis Island GTP RoW due to the similarities in surface water flow characteristics and groundwater quality.

[1] The Graham Creek will not be impacted by the Project as no part of the Curtis Island GTP RoW is located within the Graham Creek catchment.

Table 14.3 Environmental values for the watercourses and receiving environment of the GLNG facility

Environmental values	Relevance to Curtis Coast region
Protection of high ecological value aquatic habitat	✓
Protection of slightly to moderately disturbed aquatic habitat	✓
Protection of highly disturbed aquatic habitat	X
Suitability for human consumers of aquatic food	✓
Suitability for primary contact recreation (eg swimming)	✓
Suitability for secondary recreation (eg boating)	✓
Suitability for visual (no contact) recreation	✓
Protection of cultural and spiritual values	✓
Suitability for industrial use (including manufacturing plants, power generation)	✓
Suitability for aquaculture (eg red claw, barramundi)	✓
Suitability for drinking supplies	X
Suitability for crop irrigation	X
Suitability for stock watering	✓
Suitability for farm use	✓

Table Notes
✓: River basin is suitable for the environmental value
X: River basin is not suitable for the environmental value
Source URS 2009

14.3.3 Site based water quality objectives (WQOs)

WQOs are defined in Schedule 1 documents of the EPP (Water) as:

WQOs are long-term goals for water quality management. They are numerical concentration levels or narrative statements of indicators established for receiving water to support and protect the designated EVs for those waters. They are based on scientific criteria or water quality guidelines but may be modified by other (eg social, cultural, economic) inputs (refer Section 14.3.1).

Curtis Island is located within the Central Coast Region under the QWQG. The water quality objectives WQOs for the Central Coast Region are presented in Table 3.2.1a of the QWQG and are summarised in Table 14.4.

Table 14.4 Water quality objectives

Environmental value	Water quality objective
Aquatic ecosystems	Refer Table 3.2.1a of the QWQG
Primary contact recreation	Objectives as per ANZECC guidelines and Queensland Harmful Algal Bloom Operational Procedures (Department of Natural Resources and Mines, 2004), including: • Median faecal coliforms <150 organisms per 100 mL or median enterococci organisms <35 per 100 mL • Secchi >1.2 m (measured vertically)

Environmental value	Water quality objective
Secondary and visual recreation	Objectives as per ANZECC guidelines, including: • Median faecal coliforms <1,000 organisms per 100 mL or median enterococci <230 organisms per 100 mL • Water being free from: - floating debris, oil, grease and other objectionable matter - substances that produce undesirable colour, odour, taste or foaming undesirable aquatic life, such as algal blooms, or dense growths of attached plants or insects
Protection of the human consumer	Objectives as per ANZECC guidelines and *Food Standards Code,* Australian New Zealand Food Authority 1996 and updates
Cultural and spiritual values	Protect or restore Indigenous and no-Indigenous cultural heritage consistent with relevant policies and plans
Industrial use	No objectives are provided in ANZECC guidelines. (Some objectives were given in ANZECC Guidelines 1992 but objectives vary according to the industry and this value is usually protected by other values, such as intrinsic value of a modified aquatic ecosystem)
Stock watering	Objectives as per ANZECC guidelines
Farm use	Objectives as per ANZECC guidelines

Table Note These WQO are based on the ANZECC Guidelines 2000 and reference site values from QWQG (EPA 2009)

14.3.4 Existing water quality

Surface water

Water quality assessment

No water quality assessment of surface water has been carried out due to the ephemeral nature of the streams within the Curtis Island RoW.

Document review

There are no studies on existing water quality within the Curtis Island GTP RoW available.

Wetlands

Water quality assessment

There has been no water quality assessment undertaken in the vicinity of the WPAs or the small area of estuarine wetland system located within the Curtis Island GTP RoW.

Document review

There are no studies on existing water quality of wetlands available in the Curtis Island GTP RoW.

Groundwater

Water quality assessment

The groundwater quality of the two groundwater bores is considered to be relatively poor as indicated by the database quality notes listed in Table 14.2.

Document review

A more thorough investigation of the groundwater resources was undertaken by URS (2009) in the proposed location of the GLNG Facility (refer Figure 14.4).

This assessment of the shallow groundwater quality found that in general, groundwater is suitable for livestock drinking water only. The concentrations of dissolved arsenic, manganese exceeded the ANZECC guidelines for freshwater aquatic environments in all but one of the bores sampled for arsenic while dissolved cadmium, chromium, manganese, nickel and zinc exceeded ANZECC guidelines for freshwater aquatic environments in some of the bores sampled. In some bores the concentrations of chromium, copper, lead, nickel and zinc exceeded ANZECC guidelines for marine environments. Elevated concentrations of dissolved solids, sodium, chloride, and sulphate were recorded in the majority of the groundwater samples above the QWQG guideline values.

This report also recommended that the groundwater, from both shallow (< 8 m) and deep (> 20 m) boreholes, is not suitable for discharge into the fresh or marine water environments.

Existing water quality and environmental values

Overall, it is considered that the groundwater in the vicinity of the Curtis Island GTP RoW exhibits low environmental values. The groundwater is marginally suitable for stock watering in some bores and would require processing/treatment and disposal of wastes to improve water to a standard suitable for industrial use. However this level of processing decreases the value of this resource for industrial use. A review of other LNG proponents in the Curtis Island Industry Precinct found that groundwater would not be used for water supply (instead reverse-osmosis techniques would be utilised) and the focus for groundwater would be on avoiding further contamination from their construction and operational activities.

14.4 Potential adverse or beneficial impacts on water (construction and operation)

14.4.1 Surface and groundwater

Sediment exposure and mobilisation/erosion

Construction activities associated with the Curtis Island GTP in the vicinity of ephemeral drainage lines can mobilise sediment, altering flow characteristics and surface water quality. These activities typically include:

- Removal of vegetation
- Top soil removal and stockpiling
- Trenching
- Construction of the lay down areas for pipe and equipment storage

There is the potential for sediment during construction of the Curtis Island GTP to mobilise within these ephemeral drainage lines and impact surface water quality. Chapter 7 identified the erosion potential and proposed appropriate mitigation measure to address the risk of erosion and sediment. These measures, in combination with the ESCP (refer Appendix A) mitigate risks to surface water values from erosion and sediment during GTP construction and operation.

Chemical pollution

Potential sources of onsite chemical pollution during the construction of the Curtis Island GTP are predominantly associated with the storage/use of diesel and other petroleum-based fuels/lubricants used by excavation and construction machinery.

Potential waste streams include oily wastewater; contaminated runoff from chemical storage areas; potentially contaminated drainage from fuel/oil storage areas and general washdown water.

Contamination of the ground and the ephemeral drainage lines within the RoW from accidental spillage has the potential to impact surface and groundwater quality.

Mitigation measures to control the risks associated with fuel storage include the implementation of existing CG conditions relating to bunding, emergency response procedures, controls in the Environmental Management System (refer Chapter 3) and the Waste Management (refer Chapter 13).

Hydrotest water

The water from hydrotesting will be reused along the length of the Curtis Island GTP to minimise the volume of water used. Hydrotest water will be transferred from one test section to another by opening and closing valves. Additional chemicals (eg oxygen scavengers or biocides) are not proposed to be used, but this will be confirmed in the HTMP prepared before construction. Hydrotest discharge will be managed as per the Hydrotest Water Management Plan (HTMP) No impact to surface and groundwater quality from hydrotest water is expected.

Sewage treatment and disposal

Construction of the Curtis Island GTP will incorporate temporary storage of sewage or liquid from ablutions facilities. Waste streams from these facilities will be collected and removed for treatment and disposal to a facility on the mainland. No impact to surface or groundwater resulting from these construction facilities is expected. Incidents resulting in a spillage of effluent to ground during construction will be managed in accordance with the Emergency Response Procedures (refer Chapter 3).

Operation

Inspections will be carried out along the Curtis Island GTP by vehicle and foot patrols to check on the condition of the GTP and associated infrastructure. Typically maintenance on the Curtis Island GTP will be carried out by light vehicles and small maintenance crews on an annual basis, or as and when required.

14.4.2 Wetlands

Similar to the impacts that may be experienced in surface water, there is also the potential for wetlands to be impacted through sediment exposure and mobilisation and chemical pollution.

Minimal impacts to wetlands from the construction of the Curtis Island GTP are expected as works will be undertaken in accordance with the control strategies as outlined in Chapter 7 and the ESCP (refer Appendix A).

Mitigation measures proposed in this EMP are designed to prevent impacts on surface waters or wetlands.

14.4.3 Summary of potential impacts

Construction

The construction of the Curtis Island GTP has the potential to impact on water related environmental values including increased erosion and sediment movement, decreased surface water and groundwater quality due to chemical pollutants, changes to surface water flow and groundwater hydraulic characteristics, and deterioration in local water supply. In particular, soil erosion and sediment presents a slightly higher risk due to the moderate to high erosion potential of the soils within the Curtis Island GTP RoW. However, with the implementation of the recommended mitigation measures from Chapter 7, Section 14.6 and ESCP (refer Appendix A) it is considered that the impacts of soil erosion and sediment are low and manageable.

The impacts to the surface water and groundwater quality as a result of chemical pollution are also considered to be low and manageable, as chemicals will be stored in accordance with the WM Plan (refer Appendix F), while hydrotest water will be treated to the approved water quality discharge limits and sewage will be treated to relevant standards and appropriately managed. Hydrotest water will also be reused (where possible) during the hydrotesting process to minimise impacts on local water supply.

Operation

Regular inspections will be carried out along the Curtis Island GTP RoW to assess the condition of the GTP and associated infrastructure. Maintenance will typically be carried out by small maintenance crews in light vehicles on an annual basis, or as and when required.

It is considered that surface water quality impacts from operational activities are low and manageable due to the infrequent maintenance activities and low volume of vehicle movements during rainfall events. There are no anticipated groundwater impacts resulting from operational activities due to the shallow nature of the works.

Furthermore, all works associated with these operational activities will be undertaken in accordance with the ESCP (refer Appendix A), ASSMP (as presented in the Marine Crossing EM Plan) and Operational Management Plan (OMP).

14.5 Cumulative impacts

Cumulative impacts on water are described below. This cumulative impact assessment is based on the impact scope, identification and scoring methodology described in Chapter 2 of this EM Plan. Cumulative impacts to surface water and groundwater are expected to be of minor significance as a result of the GTP construction on Curtis Island. Cumulative impacts to water through surface water run off, acid sulfate soils or groundwater seepage may occur, however the application of appropriate environmental management plans will result in minor negative cumulative impacts.

Surface water

Impacts on surface water quality may result from:

- Altered hydrology and hydrogeology - There are no permanent watercourses likely to be altered by the RoWs on Curtis Island. However the drainage of multiple pipeline easements and alteration to landforms and hydrogeology may result in altered hydrology with unanticipated impacts on patterns of discharge
- Acid sulfate soil forming conditions do not occur within the area of this EM Plan. Acid sulfate soils which may exist in the vicinity of Point H will be managed in accordance with the ASSMP presented in the Marine Crossing GTP EM Plan. Based on this cumulative impacts are considered negligible
- Hydrotest water - Impacts from hydrotest water will largely depend on the nature of additives as some of these can be toxic to marine life. However, the three projects will not be discharging hydrotest water at the same time, and will each be discharged to a soak away on land limiting the impact any water quality
- Fuel spills - Spills of fuel, oil etc may impact on water quality. However assuming practice accords with the Curtis Island EM Plan, there is unlikely to be a measureable impact
- Increased turbidity and sedimentation – As discussed in Chapter 7, erosion and runoff control may possibly have a cumulative impact. If management measures are not coordinated between the RoWs, an increase in suspended sediment in water draining to the Narrows and to wetlands along Graham Creek may be experienced

Cumulatively, over an extended period of time, minor water quality impacts may have localised adverse impacts. The indirect impacts of any reduced water quality on ecology are discussed in Chapter 9.

Implementation of measures set out in this EM Plan will result in minor negative impact on surface water from pipeline construction within the GSDA corridor on Curtis Island.

Groundwater

Cumulative impacts on groundwater may result from:

- Altered hydrogeology - The excavation of the trenches may alter pathways for groundwater movements in the area, particularly where there are steep topographic gradients
- Acid sulfate soil forming conditions do not occur within the area of this EM Plan. Acid sulfate soils which may exist in the vicinity of Point H will be managed in accordance with the acid sulfate soil management plan presented in the Marine Crossing GTP EM Plan
- Hydrotest water –Hydrotest water will be tested to ensure that it is compliant, prior to release, in accordance with the conditions of the CG Report on the GLNG project. The effect on groundwater from release of hydrotest waters released in accordance with the CG conditions is considered negligible
- Fuel spills - Spills of fuel oil are not anticipated to significantly impact on groundwater Assuming practice accords with the EM Plans, there is unlikely to be an impact

These are most likely to be additive in nature and not have a cumulative dimension.

Mitigation measures set out in the Curtis Island EM Plan will result in negligible impact on groundwater from pipeline construction within the GSDA corridor on Curtis Island.

14.6 Environmental protection commitments, objectives and control strategies – water (construction and operation)

Environmental protection commitments, objectives and control strategies proposed are outlined in Table 14.5. These control strategies were developed to ensure that the pipeline is designed and constructed in accordance with AS 2885.1 – 2007 Pipelines – Gas and Liquid Petroleum as well as other applicable standards and regulations, including the Australian Pipeline Industry Association (APIA 2009) *Code of Environmental Practice*.

Table 14.5 Environmental protection commitments, objectives and control strategies - water

Item	Detail
Environmental protection objective	• To minimise the potential impacts associated with erosion, prevent the release of contaminants that may adversely affect downstream surface water quality, and protect the quality of the existing groundwater resources
Specific objectives	• Prevention of direct or indirect release of contaminants to surface waters • Minimisation of incidences of accelerated erosion as a result of construction activities • Groundwater quality will not be impacted by development activities • Spill containment facilities constructed in accordance with AS 1940 (2004) and AS 3780 (1994) • Environmental impacts are within authorised limits
Control strategies	**Pre construction phase** • A detailed assessment of aquatic values (including animal breeding places) along the pipeline route must be conducted. Site specific data must be included that accurately and comprehensively describes the environmental values and ecological condition at each aquatic site. The information must be used to determine the location of each watercourse or wetland crossing and site specific mitigation measures to protect the values identified • Detailed watercourse crossing plans will be prepared once the crossing methodology has been selected • Findings of engineering and geotechnical studies will be utilised in the design of crossings to ensure that the hydrological flow regimes are maintained • The design of all creek crossings and waterway barrier works must take account of the matters discussed in Waterway barrier works development approvals (Fish Habitat Management Operational Policy FHMOP 008, DPI&F, July 2009), including Protection of flora and fauna during construction and operation, reduction or disruption to habitat. Particular mention must be made of any potential disruption to Koala or endangered species habitats and scheduling of construction to protect the breeding and nesting seasons of the endangered Fitzroy and White Throated Snapping Turtles where applicable **Construction phase** • The holder of this authority must ensure that: - hydrostatic test water is not released to waters - hydrostatic test water containing chemical additives is not released to land without written consent from the administering authority - hydrostatic test water released to land does not exceed the water quality limits specified in Schedule C – Table 1 **Table 1 Water quality discharge limits** Parameter: Maximum value pH: 6.5-8.5 (Range) Arsenic (mg/L): 2.0 Cadmium (mg/L): 0.05 Chromium (mg/L): 1 Copper (mg/L): 5

Item	Detail
	Iron (mg/L) — 10; Lead (mg/L) — 5; Manganese — 10; Zinc (mg/L) — 5; Nitrogen (mg/L) — 35; Phosphorus (mg/L) — 10; Electrical Conductivity (uS/cm) — 2000

Iron (mg/L)	10
Lead (mg/L)	5
Manganese	10
Zinc (mg/L)	5
Nitrogen (mg/L)	35
Phosphorus (mg/L)	10
Electrical Conductivity (uS/cm)	2000

- The release of hydrostatic test water authorised as per Condition (C4 (3)) must be located at least 100 m from the nearest watercourse and carried out in a manner that ensures that:
  - vegetation is not damaged
  - soil erosion and soil structure damage is avoided
  - the quality of groundwater is not adversely impacted
  - hydrotest water does not migrate outside the nominated land discharge areas
- Works in watercourses will only be undertaken where necessary for construction and no reasonable alternative location is feasible
- Watercourse crossing points will be selected to, where practicable:
  - Minimise the extent of clearing of riparian vegetation
  - Avoid unstable and/or steep incised banks
  - Avoid bends in the channel and confluence with other channels
  - Avoid permanent and semi-permanent waterholes, and artesian springs
- Horizontal directional drilling (HDD) will be used on selected watercourses, where practicable, taking into account environmental, engineering, logistical and geotechnical issues and advice from the drilling operator
- Where HDD techniques are used, drilling mud will be treated as a hazardous substance and treated appropriately. Potential escape of drilling mud will be minimised by careful geotechnical investigation prior to drilling to ensure that geological fractures are avoided
- Relevant approvals and permits will be obtained for crossings prior to construction
- Crossings will, where practicable, be constructed in no-flow or low-flow conditions, and rehabilitation completed prior to the next wet season
- The crossings will typically be at right angles to the direction of water flow to minimise scour potential
- The disturbance corridor for the bed, bank and approaches to watercourses will be the narrowest practicable for safe construction
- Additional work areas may be required at crossing locations for equipment operation and stockpiling of excavated material. These will be located outside the riparian area
- No refuelling of plant, equipment or vehicles will occur within 50 m of any watercourse
- All construction vehicles shall carry spill clean-up kits, commensurate with the size and type of vehicle
- The maintenance and cleaning of any vehicles, plant or equipment must not be carried out in areas from which contaminants can be released into any waters, roadside gutter or a stormwater drainage system.
- Regional weather conditions and river flow levels will be monitored during construction to pre-empt changes in weather patterns and flow regimes to minimise impacts
- Storage and loading/decanting areas for fuels and chemicals will be bunded and located outside the floodplain of the stream channels (i.e. approximately 50 m away from the top bank)
- The staging areas will be limited to the narrowest area feasible and located outside the stream channel and riparian area
- Large mature trees will be retained where practicable and trees will be trimmed in preference to removal to retain the root stock for stabilisation of the banks
- Clearing of the slopes leading to the watercourses will be delayed until the construction of the crossing is imminent. Where this is not possible, other soil protection measures will be applied

Item	Detail

	• All stockpiles (vegetation, watercourse bed material, watercourse bank material) will be stockpiled and stored separately in areas above the top of the bank and outside the riparian area where it will not be buried or damaged (ie free from traffic)
	• Stream bed material consisting of rocks, pebbles or course gravel overlaying finer material will be stockpiled separately for replacement during restoration
	• Erosion sediment control measures will be located on the lower side of topsoil and bed and bank stockpiles and installed between the watercourse and the construction area to minimise sediment releases
	• Temporary freshwater drainage measures such as diversion channels, pipes and bunding must be installed where required
	• Soils will be graded away from the watercourse, not towards it
	• Sediment and erosion control measures will be installed as required on watercourse approaches and banks to prevent any runoff from entering watercourses
	• Diversion banks will be used at the crest of, and on the slopes of, approaches to stream crossings to divert sheet flow away from backfilled trenches
	• Each diversion bank will have a stabilised outlet to safely disperse channelised flows
	• Watercourse crossings will be rapidly stabilised following construction
	• The bed and bank of watercourses will be restored as near as practical to the original profile and banks compacted to ensure stability
	• Access tracks across watercourses will be stable (ie rock lined) and level with the bed of the watercourse (not elevated)
	• Where an access track is required to be raised above the bed of the watercourse, appropriately sized pipes will be installed to ensure no interference with natural water flow
	• Topsoil will be respread over the area from where it was removed
	• Where required, sandbags, gabion or other scour protection measures will be installed, ensuring these are placed to conform as far as possible with existing natural contours.
	• Where required and agreed by landholders, access to the crossings will be restricted (ie by fencing or barriers)
	• Where required, terracing or surface water diversion berms will be placed along the top and intermediate points down the bank slope to encourage runoff to discharge on to stable (ie vegetated) areas or via sediment settling basins and not directly to the watercourse
	• Erosion sediment control measures will be installed on slopes to filter surface runoff water even if the watercourse is dry
	• Watercourses will be stabilised (eg rock gabion, jute matting) as required
	• All works in a watercourse bed will be completed within 24 hours unless prior approval is obtained from GLNG Company
	• All works in watercourses, wetlands or springs must be for a maximum period of 10 days in order of the following preference:
	  - Conducting work in times of no flow
	  - Using all reasonable and practical measures to reduce impacts in times of flow
	  - Horizontal directional drilling will be used for the construction of the pipeline across the Dawson River, unless the construction occurs in times of no flow or an alternative construction methodology is agreed with the administering authority in writing
	• All dewatering must be through erosion and sediment control devices
	• Activities or works resulting in significant disturbance to the bed or banks of a watercourse or wetland, or a spring must:
	  - Only be undertaken where necessary for the construction and/or maintenance of roads, tracks and pipelines that are essential for carrying out the authorised petroleum activities and no reasonable alternative location is feasible
	  - Be no greater than the minimum area necessary for the purpose of the significant disturbance
	  - Be designed and undertaken by a suitably qualified and experienced person taking

Item	Detail
	into account the matters listed in Section 5 (Planning Activities) and Section 6 (Impact Management During Activities) of DERM's *Guideline – Activities in a watercourse, lake or spring associated with mining operations* (dated April 2008), or more recent editions as such become available - Upon cessation of the activities or works, commence rehabilitation immediately such that the final rehabilitation is to a condition that will ensure the ongoing physical integrity and the natural ecosystem values of the site • Sufficient distance away from watercourses and mindful of potential to damage vegetation. There will be no release or dewatering of contaminants with potential to cause environmental harm to waters, land or groundwater • All flammable and combustible liquids and dangerous goods will be stored, handled, used and transported in accordance with relevant Australian and Company standards • Hydrocarbon spillage from storage areas, diesel and chemical spills from construction equipment, and industrial waste spill will be contained, reported, and treated/remediated in accordance with appropriate legislative and regulatory agency requirements. Drainage will be reinstated • Wastewater from construction, cleaning and testing operations will be treated and managed in accordance with the relevant environmental authorities • Management of hydrotest water will be in accordance with the environmental authority • A water supply strategy will be developed for the provision of water for the pipeline's construction. All necessary approvals will be sought from the relevant authorities • The Contractor must ensure that all potable water consumed on site, and at worker's accommodation complies with the *Australian Drinking Water Guideline 2004* • Routine, regular and frequent visual monitoring must be undertaken while carrying out construction work and/or any maintenance of completed works in a watercourse, wetland or spring. If, due to the petroleum activities, water turbidity increases in the watercourse, wetland or spring outside contained areas, works must cease and the sediment control measures must be rectified to limit turbidity before activities recommence • Petroleum activities must not be carried out in River Improvement Trust Asset Areas without the approval of the relevant River Improvement Trust. Locations and details of River Improvement Trust Asset Areas can be obtained from the relevant River Improvement Trust. A list of the relevant River Improvement Trusts will be provided by DERM **Operational phase** • Typical mitigation and controls for the operational phase of the Project will be detailed in the Operational Management Plan, which will be developed post construction
Performance indicators	• Control strategies outlined in the ESCP are being implemented • Groundwater quality is not being adversely impacted by development activities • Spill containment facilities are constructed in accordance with AS 1940 (2004) and AS 3780 (1994) • Environmental impacts are within authorised limits

15. Rehabilitation

15.1 Rehabilitation objective

The key objective of landscape and rehabilitation works is to ensure that all statutory requirements pertaining to rehabilitation and landscaping are met and that the GTP RoW is re-established to a safe, non-polluting, stable and self-sustaining state.

15.2 Rehabilitation methodology

GLNG Operations has prepared a Landscape Rehabilitation Management Plan (LRMP) (refer Appendix G) which has been developed to provide details of rehabilitation management measures to be implemented during both construction and operational phases of the Curtis Island GTP works. The LRMP has been designed to act as a tool to guide GLNG Operations and the construction Contractor with information about the regulations and guidelines applicable to the Project.

The LRMP is a live document and will be updated as required during all phases of the Project. It is designed to:

- Minimise the area of overall disturbance
- Create a stable landscape
- Guide a program of comprehensive revegetation and rehabilitation for all disturbed areas
- Ensure revegetation and rehabilitation is undertaken in a timely manner
- Preserve downstream receiving environments
- Ensure compliance with relevant approval conditions specified by the Coordinator-General (CG), DERM, Queensland Primary Industries and Fisheries (QPIF) and DSEWPC
- Ensure compliance with commitments under the EIS and SEIS

Table 15.1 below identifies the landscaping and rehabilitation works proposed that are relevant for the Curtis Island GTP in order to meet the rehabilitation objective described above.

Table 15.1 Proposed mitigation and management measures for the Curtis Island GTP

Item	Detail
Environmental protection objective	Rehabilitate the RoW to a safe, non-polluting, stable and self-sustaining level and ensure that all statutory requirements pertaining to rehabilitation and landscaping are met
Control strategies	**Pre-construction phase** • A detailed rehabilitation plan will be developed prior to commencing the Project in order to account for the collection of seeds over the year prior to clear and grade. The plan will detail site specific rehabilitation methods, plans and monitoring programmes demonstrating compliance with GLNG Operations LRMP and EM Plan, all legal and regulatory conditions and soils management procedures. Seed collection will be planned to occur during the optimal times of the year for each significant species and grass to be collected • Prior to clearing activities, fixed photo points at appropriate locations will be established and recorded on a map. These photo points will assist to - Determine the pre-clearing vegetation condition - Monitor and assess the rehabilitation success throughout the Route
	Construction and Operational phase • Progressive rehabilitation of disturbed areas will commence as soon as practicable following the completion of any construction or operational works associated with the

Item	Detail
	authorised petroleum activities on the relevant petroleum authority • All land significantly disturbed by petroleum activities will be rehabilitated to: - A stable landform with a self-sustaining vegetation cover with same species and density of cover to that of the surrounding undisturbed areas, except over the area that must be maintained free of large flora species for pipeline integrity and access, and in cases where approval is sought in accordance with Condition E30 of Appendix 3, Part 4 of the CG Report - Ensure that all land is reinstated to the pre-disturbed land use and suitability class - Ensure that the maintenance requirements for rehabilitated land are no greater than that required for the land prior to its disturbance by petroleum activities • For areas of native vegetation, revegetation must use seed sourced from local provenance native species • Subsoil will be respread and compacted over the trench, with crown development, and used for the construction of contour banks on steep slopes and above banks at water crossings • Areas of the RoW will be deep ripped prior to topsoil spreading in consultation with the landholder • The RoW will be re-profiled to original or stable contours, re-establishing surface drainage lines and other land features • Topsoil application will only take place after subsoil respreading and compaction and will be evenly spread and left with a slightly rough surface • Driving vehicles on freshly topsoiled RoW will be prohibited • Subsoil displaced by the pipe, and not utilised in backfill, may be stockpiled in locations approved by the landholder for use during operations • Imported topsoil, of an appropriate quality and weed free, may be required for RoW repairs, and will only be used with landholder approval • Flagging used to identify clearing boundaries and sensitive features will be removed • Erosion and sediment control measures will be installed. Existing soil erosion measures will be reinstated to a condition at least equal to the pre-existing state • Where agreed to by the landholder, cleared native vegetation will be respread over the RoW to assist in the distribution of seed stock and provide shelter for fauna • Distribution of vegetation will be controlled to ensure that any erosion or subsidence that may occur will not be hidden from view during subsequent monitoring inspections • Native groundcover and shrubs will be encouraged to revegetate to minimise habitat barrier effects in significant habitat areas • Operation safety requirements must be considered when determining rehabilitation criteria. Trees with large root balls (such as *Ficus sp*.) pose a risk to the structural integrity of buried infrastructure. To ensure compliance with AS2885 (part 3, section 6.4.4), vegetation will be restricted to allow free passage along the pipeline route. Vegetation who roots may damage the anti-corrosion coating of the pipeline shall not be permitted in the vicinity if the pipeline. • In order to ensure operational safety, vegetation species used to rehabilitate the RoW will be limited to species less than 10 to 12 m in height. In areas where RE communities are to be rehabilitated, understorey species and mid-level species of pre-disturbance RE communities will be returned to the RoW. • Trees will be permitted to grow back on the RoW except in proximity to the pipeline and on the travel lane • Environmental features such as rocks and dead timber will be replaced in the RoW where appropriate • A reseeding plan based on soil types, existing local vegetation characteristics and landholder preferences will be developed • Seeding will be utilised in areas where rapid restoration is required e.g. watercourse crossings and areas of high erosion potential • Where disturbed areas are to be re-planted or reseeded, preference will be given to local native species. However, non-native and non-invasive grass seed stock may be used where approved by the landholders to stabilise temporary banks/stockpiles and will be removed and re-established as native vegetation post construction. • Rehabilitation must encourage the maximum re-establishment of native vegetation including the shrubby understorey and ground cover • Where applicable, any imported topsoil that is required for use in rehabilitation works will be of a similar quality to the topsoil it is replacing and will be weed and pest free • Locally sourced species and intensive planting for rehabilitation will be used in riparian areas

Item	Detail
	• Rehabilitation works will incorporate the use of habitat/fodder trees for koalas and other key significant fauna species in the species selection • On completion of construction on land identified as GQAL, all temporary access tracks will be removed, land management and erosion control measures will be implemented and disturbed areas will be lightly ripped, topsoil replaced and surfaces returned to preconstruction land use condition
	• Trees and shrubs will be allowed to regenerate naturally on cleared areas not required to be kept tree free for pipeline protection and maintenance • In areas proposed for revegetation, seed will be evenly dispersed over the entire disturbed area • Fertilisers and soil supplements will be used only as necessary with the agreement of landholders and authorities • Permanent pipeline warning signs will be erected along the easement • All waste materials and equipment will be removed from the RoW once backfilling and tie-ins are completed • Temporary access roads will be closed and rehabilitated to pre-disturbance condition, compatible with the surrounding land use or as agreed with the landholder • Where access routes are to be retained, but are not public access, the entry will be disguised (e.g. by dog-legging, brush spreading) • Disused erosion sediment control measures will be removed • Fences or other barriers will be installed where appropriate and where approved by the landholder to minimise unauthorised access • Weather permitting, rehabilitation of areas containing Least Concern (including Type A) plants will begin within 3 months of completion of pipeline construction. Revegetation will be consistent with the plant density, floristic composition and distribution of the surrounding regional ecosystem types and within the province of the vegetation being cleared • For clearing impacts that result in permanent loss of least concern native plants (cannot be re-established within three (3) years of clearing or floristic modification), the Contractor must provide GLNG Operations with a written detailed report of permanent vegetation loss, including the area, species affected and mapping of affected areas, within 12 months of completion of the pipeline construction • Pasture areas will be resown with seed mix agreed by GLNG Operations • Maintenance of seeded areas shall continue until: - At least an equivalent amount of ground cover has been achieved as in adjacent land over 95% of disturbed areas - Weed content is equivalent to or better than adjacent areas undisturbed by construction • Revegetation of cropland will generally not be required as landholder will have received compensation including resowing of disturbed areas • Areas vegetated with trees or shrubs on agricultural land will be revegetated with similar vegetation mix or with pasture as agreed with landowner • Roadside areas will be replanted in accordance with Department of Transport and Main Roads/Local Authority requirements and to the pre-construction standard or better • Bushland areas will be revegetated with like species from commercially available seed mixes or seeds collected in adjacent areas. Seed collection will be undertaken as per the Seed Collection Plan and in accordance with seed collection guideline document: *Model Code of Practice, Florabank Guideline 6: Native Seed Collection Methods*, Available at http://www.florabank.org.au/ 5 Feb 2012'. • Highly sensitive areas as identified on the Alignment Sheets and watercourse crossings will require rehabilitation with local provenance seed stock • For pasture areas rehabilitation will be undertaken so as: - An equivalent amount of ground cover to adjacent land has been achieved over 95% of disturbed areas - Weed content is less than adjacent areas undisturbed by construction • For native vegetation and stream areas rehabilitation will be undertaken so as: - Trees and shrubs are viable without further maintenance - Weed content is less than adjacent areas undisturbed by construction • Maintenance of rehabilitated areas will take place to ensure and demonstrate: - Stability of landforms - Erosion control measures remain effective - Stormwater runoff and seepage from rehabilitated areas does not negatively affect the environmental values of any waters - Plants show healthy growth and recruitment is occurring

Item	Detail
	- Declared pest plants are controlled on rehabilitated areas to a level consistent with the surrounding property and prevented from spreading to unaffected areas through authorised petroleum activities • Rehabilitation can be considered successful when the site can be managed for its designated land-use (either similar to that of surrounding undisturbed areas or as otherwise agreed in a written document with the landowner/holder and administering authority) without any greater management input than for other land in the area being used for a similar purpose and there is evidence that the rehabilitation has been successful for at least 3 year • As noted above, large species (i.e. greater than 10 m) will be restricted from the RoW in order to protect the structural integrity of the buried pipeline.

15.3 Proposed decommissioning works

The overall rehabilitation objective at decommissioning is to rehabilitate land to a level consistent with the pre-use activity.

As previously discussed in Chapter 2, decommissioning of the pipeline will be undertaken using the "in place" abandonment method, as this method has the least adverse environmental impact and will be undertaken in accordance with policies at the time of decommissioning and in line with best practice at the time. The various "in place" abandonment options that will be considered are:

- Abandon by air/inert gas displacement
- Abandon by water fill displacement
- Abandon by right-of-way and above ground facilities

As the "in-place" abandonment options identified above result in minimal intrusive works during the decommissioning of below ground infrastructure, it is not envisaged that there will be large amounts of rehabilitation works required to be undertaken.

Any removal of above ground infrastructure will be subject to the rehabilitation works, indicators and completion criteria proposed for the post-construction phase. Details regarding these are described throughout the remainder of this chapter.

During the decommissioning phase of the pipeline, vegetation with large root balls (i.e. trees greater than 10 m) will be re-established within the RoW. This type of vegetation will be restricted during the operational phase to protect the structural integrity of the pipeline. Revegetation of these species may be undertaken through passive (i.e. allow for the natural encroachment of the species) or active (i.e. planting/seeding) methods depending on best practice at the time of rehabilitation.

15.4 Rehabilitation completion criteria

Due to the variability in complexity of vegetation communities across the Curtis Island GTP RoW, it is difficult to set criteria for determining when a site has been completely rehabilitated. In addition, the completion criteria will be dependent on the land use prior to clearing, pre-existing health and integrity of the landscape and landholder requirements.

However, the aim is to rehabilitate impacted environs to their pre-existing condition (as a minimum). This is a particular prerequisite for all significant ecological communities, protected areas and other sensitive areas identified within the Curtis Island GTP RoW.

In determining whether the completion criterion is met the following factors will be used:

- The similarity between the rehabilitated landforms and the natural landforms in adjacent areas
- The stability of the landform and its resistance to erosion
- Whether appropriate drainage patterns have been developed, either naturally or through shaping activities during the rehabilitation programme
- The degree to which the surface conditions are conducive to plant establishment
- Whether the site conditions and existing habitat components provide resources, including for fauna movement, foraging habitat and/or shelter
- Compliance with the relevant standards
- Public safety issues (eg signage, fencing etc)

Table 15.2 below provides a high level overview of the rehabilitation goals, objectives, indicators and completion criteria proposed for the Curtis Island GTP RoW. These will be further expanded upon by the Contractor in the Contractor's LRMP and prior to the commencement of construction activities.

Table 15.2 Rehabilitation goals, objectives, indicators and completion criteria

Rehabilitation goal	Rehabilitation objective	Indicators	Completion criteria
Safe	Site safe for humans	Landform similar to adjacent natural landforms	Land has been rehabilitated to its predevelopment stability condition
Non-polluting	No adverse impact to land and water quality values	All erosion and sediment control features implemented and functional Surface water monitoring	Erosion controlled and limited to that associated with natural processes Water quality monitoring meets release limits
Stable	Minimise erosion and sediment movement	Landform similar to adjacent natural landforms Vegetation cover	No subsidence or areas of major erosion After 2 years the average crown covers is approximately 50%
Self-sustaining	Construction areas are rehabilitated to a self-sustaining level	Surface conditions are conducive to plant establishment	At the end of year 2: A minimum of 80% of planted stock have survived Fast growing shrubs have achieved an average height of 1.0 m Slow to medium growing shrubs have achieved an average height of 0.7 m A minimum of 70% of mulched planting areas are free of weeds

15.5 Inspections and reporting

The following inspection schedules are proposed for the Curtis Island GTP RoW:

- Once rehabilitation has commenced, regular inspections will be carried out to monitor watering requirements within rehabilitation areas for a period of three months. Weekly inspections will then commence for a further period of six months
- Where applicable, weekly inspections will also be conducted to monitor and record the success of planting regimes for a period of six months after plantings have commenced
- Bi-monthly photographs will be taken from monitoring points to determine the success or otherwise of the landscaping and rehabilitation works. These will be included in the monthly environmental report. This will be carried out for a minimum of three years after plantings have commenced

A monitoring and evaluation report will be prepared and will include details on species survival, natural recruitment, percentage coverage of the rehabilitation area and percentage and species of weeds in the rehabilitated areas. In addition the following will also be recorded:

- Planning and impact assessment details
- Activity site location and site access details
- Commencement and completion dates
- The area of native vegetation removed, and the amounts of material excavated and fill placed
- The disposal location/s and quantity of spoil material removed
- The disposal location/s and quantity of native vegetation removed
- Impact management and rehabilitation details
- Before, during and post activity photographs of the site
- Any incidents of unanticipated failure of management methods and subsequent remedial action
- Any notable fauna activity will also be recorded

Where there is a permanent loss of native vegetation (cannot re-establish within three years), a written detailed report of permanent vegetation loss, including the area, individuals species affects and mapping of affected areas will be provided to DERM.

The Contractor will be responsible for developing and implementing an LRMP in accordance with the measures identified within GLNG Operations LRMP (refer Appendix G). The Contractor's LRMP will set out specific details of rehabilitation goals, objectives, rehabilitation methodologies, indicators and completion criteria.

15.6 Offsets

The GLNG Offset Strategy will be approved and implemented prior to commencing construction.

15.7 Financial assurance

Proposed amounts of financial assurance for rehabilitation works (as per the phases outlined in Chapter 4) are provided in Table 15.3.

Table 15.3 Financial assurance for rehabilitation

Phase	Period	Rehabilitation cost
1	Q1/Q2 2013	$1,221,540
2	Q3/Q4 2013	$1,221,540
3	2014	$122,039
	2015	$116,241
	2016	$119,273
4	2017	$117,854

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Appendix A
Erosion and Sediment Control Plan

GLNG
Gas Transmission Pipeline

Erosion and Sediment Control Plan

Document Number: 3380-GLNG-4-1.3-0010

PREPARED BY:

Title	Name	Signature	Date

ENDORSED BY:

Title	Name	Signature	Date

APPROVED BY:

Title	Name	Signature	Date

DATE	REV	REASON FOR ISSUE	AUTHOR	ENDORSED	APPROVED
25.02.11	2	DRAFT PROGRESS REPORT	AW		
07.03.11	3	DRAFT	AW		
07.03.11	4	80% DRAFT FOR RPS REVIEW AND INTERNAL REVIEW/VERIFICATIONS	AW		
05.04.11	7	95% DRAFT FOR GLNG COMMENT	AW		
15.04.11	8	FINAL DRAFT FOR LEGAL REVIEW	CM		
30.06.11	9	LEGAL COMMENTS ADDRESSED	CC		
15.07.11	10	FOR AGENCY REVIEW	CC		

Contents

Abbreviations

ARI	Average recurrence interval
ASRIS	Australian Soil Resource Information System
ASS	Acid Sulfate Soil
BoM	Bureau of Meteorology
CIC	Callide Infrastructure Corridor
CSG	Coal Seam Gas
DERM	Department of Environment and Resource Management
dS/m	deci-Siemens per meter
EC	Electrical Conductivity
EIS	Environmental Impact Statement
ESC	Erosion and Sediment Control
ESCP	Erosion and Sediment Control Plan
GLNG	Gladstone Liquefied Natural Gas
GTP	Gas Transmission Pipeline
HDD	Horizontal Directional Drilling
HDPE	High Density Polyethylene
KP	Kilometre Point
LNG	Liquefied Natural Gas
LRMP	Landscape Rehabilitation Management Plan
km	Kilometer
QGP	Queensland Gas Pipeline
~	Approximately
m	Metres
Mm	Millimeters
RoW	Right of Way

1. INTRODUCTION

1.1 Overview

Erosion and sediment control is a key factor for consideration prior to, and execution during, the construction of the GTP.

1.2 Purpose and Objective of this Document

This Erosion and Sediment Control Plan (ESCP) is part of the Development Approval documentation required for the project to assist the regulator to assess the key issues. It may assist the contractor to prepare the site-specific ESCP that is required under the contract with GLNG Operations Pty Ltd.

The report outlines the minimum standards that will be utilised to minimise erosion through the life of the pipeline project. This involves consideration of the environments through which the pipeline will be constructed, operated, and decommissioned, including topography, climate, soils, and receiving waters.

It is intended that this document will highlight areas and circumstances of elevated erosion risk and provide mitigation options for designers, constructors, estimators, and decision-makers to consider.

The information used to develop this document is based on a desktop review of previous studies, in particular the Environmental Impact Statement (EIS) (URS, 2009), and other soils databases. It also considers relevant guidelines for erosion and sediment control in Queensland and Australia.

1.3 Relevant Guidelines

Guidelines relevant to soil management for this Project are:

- AS 4970-2009 Protection of Trees on Development Sites
- APIA, 2009. Code of Environmental Practice – Onshore Guidelines. The Australian Pipeline Industry Association Pty Ltd. March 2009
- IECA, 2008. Best Practice Erosion and Sediment Control. International Erosion Control Association (Australasia) (IECA)
- Landcom, 2004. Managing Urban Stormwater: Soils and Construction. NSW Government
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- DECC, 2008b. Managing Urban Stormwater: Soils and Construction. Volume 2C. Unsealed Roads. Department of Environment and Climate Change (DECC) NSW
- DMR 2002. Road Drainage Design Manual. Department of Main Roads (DMR) QLD

1.4 Relevant Legislation

A person or persons conducting land-disturbing development must conduct such development in accordance with the requirements of relevant legislation.

The State Planning Policy (SPP) for Healthy Waters provides the planning to ensure new development delivers its requirements of the EPP (Water). The SPP refers to a companion document that outlines design objectives for:

a) Erosion and sediment control
b) Stormwater quality
c) Waterway stability

d) Frequent flows

1.4.1 Environmental Protection Act 1994

All persons have a legal duty under the Environmental Protection Act 1994 (s319) to take all reasonable and practicable measures to minimise or prevent environmental harm.

Under s443 of the Environmental Protection Act 1994 a person must not cause or allow a contaminant to be placed in a position where it could reasonably be expected to cause serious or material environmental harm or environmental nuisance (e.g. placing a stockpile adjacent to a waterway).

In addition, people who are concerned with management in a corporation have an additional duty under the Environmental Protection Act 1994 to ensure their corporation complies with the Act. This means supervisors need to take reasonable and practicable steps to ensure that the people under their control do not breach environmental laws.

People who become aware of environmental harm in association with their work (e.g. loss of sediment from their site into a watercourse) have a legal duty under the Environmental Protection Act 1994 to notify their employer. The employer must then rectify the problem, and if significant, to notify the Department of Environment and Resource Management (DERM).

1.4.2 Environmental Protection (Water) Policy 2009

This policy sits under the Environmental Protection Act 1994. The Environmental Protection (Water) Policy 2009 provides environmental values and water quality objectives for Queensland waters. These are utilised when determining environmental harm and to inform other statutory and non-statutory decisions. The water quality objectives assist in identifying whether the environmental values are protected. These values and objectives should be utilised when determining risk of environmental harm from water releases or run off, and the appropriate erosion and sediment controls to be implemented.

2. PROJECT DESCRIPTION

The gas transmission pipeline (GTP) has been divided into three sections based on major geographic boundaries. There are:

- Mainland GTP EM Plan: Fairview Gas Fields to the west of the Kangaroo Island Wetlands (KP0 to KP406)
- Marine Crossing GTP EM Plan: West of Kangaroo Island Wetlands to Curtis Island (KP406 to KP414.5)
- Curtis Island GTP EM Plan: Curtis Island to gate of LNG Facility

Separate environmental management plans have been prepared for each section described above; however, this erosion and sediment control plan addresses concerns for the entire length of the alignment.

2.1 Route

The Mainland GTP will extend from the gas fields at Fairview to Point A on Port Curtis, and span a distance of approximately 406km. Figure 2.1 illustrates the route alignment and shows the extent of the three GTP EM Plans.

The proposed Mainland GTP corridor is closely aligned with the existing Queensland Gas Pipeline (QGP) for much of its length with the exception of the section north of Injune where the corridor will run up the western side of the Arcadia Valley. The Mainland GTP will approach Gladstone from the southwest and will pass through the Gladstone State Development Area (GSDA) before crossing Port Curtis to Curtis Island.

By locating the Mainland GTP adjacent to the existing QGP RoW for approximately 300 km of the corridor from south of Rolleston to Gladstone, the area of land disturbed and the impact on existing land use and infrastructure will be reduced. However there are sections along the Mainland GTP corridor where due to land use, environmental or topographical constraints the proposed Mainland GTP will by necessity deviate from the QGP RoW.

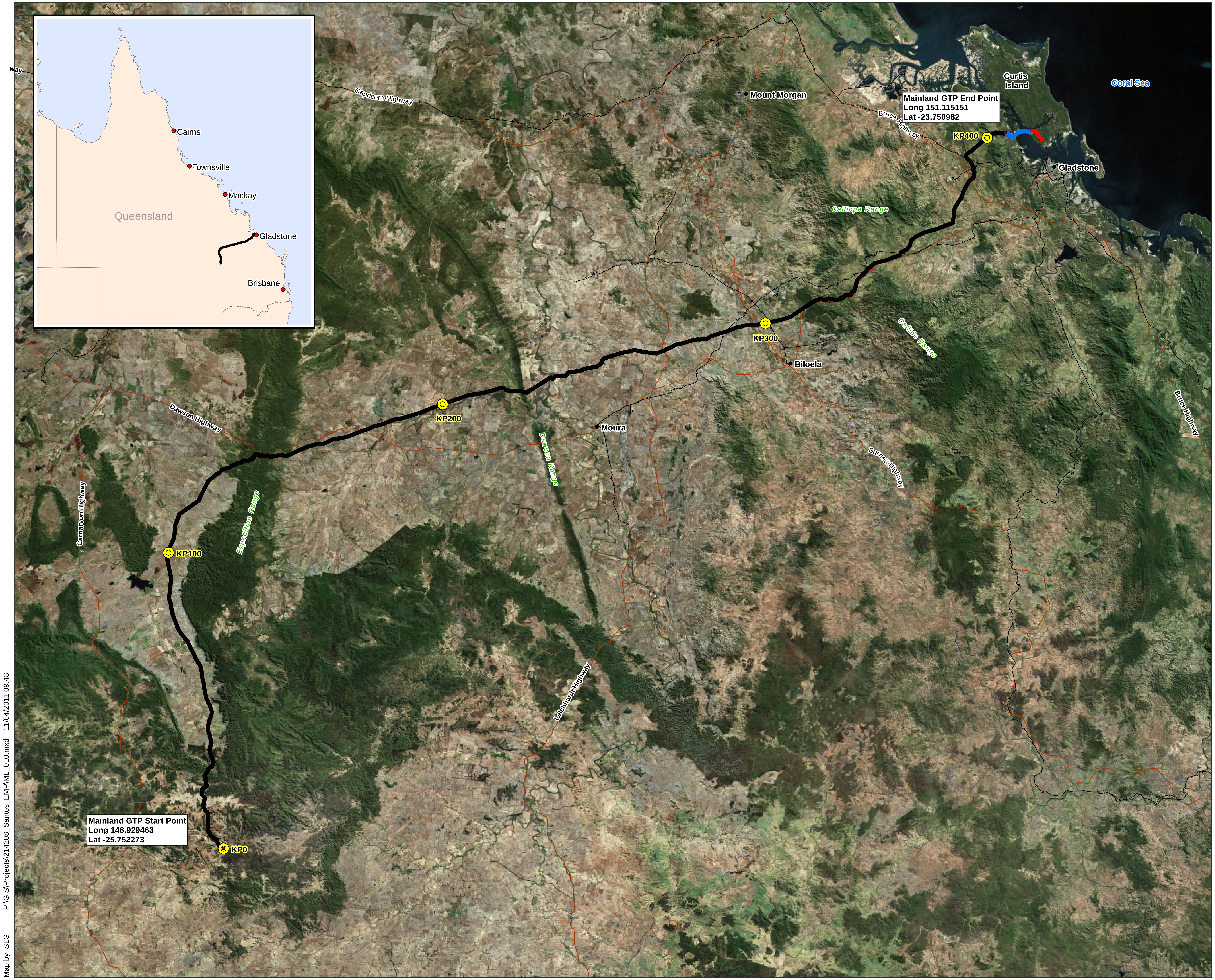
From the gas fields at Fairview, the Mainland GTP will traverse mostly rural land and numerous ranges. The route departs Fairview in a northerly direction continuing north through the Arcadia Valley. It then turns easterly and crosses the Expedition Range, the Dawson Range, and then a wide section of the Dawson River. The pipeline continues easterly, crossing the Callide and Calliope Ranges. After crossing the Calliope Range, the pipeline crosses the Bruce Highway and terminates at the Queensland Energy Resources (QER) land-bridge at Point A on Port Curtis, where from here the Marine Crossing section of the GTP commences (referred to as the Marine Crossing GTP; see Figure 2.2). From this point, the Marine Crossing GTP crosses the Kangaroo Island Wetlands (south of Kangaroo Island) to Friend Point at which point it crosses the Narrows waterway and lands on Curtis Island at Laird Point. From Laird Point, the Marine GTP tracks inland to Point H. From here the Curtis Island GTP commences, continuing in an easterly direction, before turning south and finishing at the GLNG LNG Facility gate.

2.2 Pipeline Details

The GTP will be a buried, high-pressure steel pipeline. It will be designed in accordance with the requirements of Australian Standard 2885 (AS 2885) Pipelines - Gas and Liquid Petroleum and constructed in accordance with the Australian Pipeline Industry Association's Code of Environmental Practice (APIA, 2009).

In accordance with AS 2885 the design considerations include:

- Risk assessment – route selection, land use conflict, future development, land stability, and flooding
- Pipeline design – material selection, wall thickness, coating requirements, corrosion protection, burial depth, and remote monitoring



Map by: SLG P:\GIS\Projects\214208_Santos_EMP\ML_010.mxd 11/04/2011 09:48

A1 scale:1:600,000

0 10 20 30 40 50 km

GLNG No: 3381-40-0400

Coordinate system: GCS_GDA_1994

Mainland GTP EM Plan

Gas Transmission Pipeline (GTP)
- Mainland GTP EM Plan
- Marine Crossing GTP EM Plan
- Curtis Island GTP EM Plan
- Kilometre Post Distance Marker (km)
- Rail
- Major Road

Source:
Gas Transmission Pipeline (GTP): Santos, Jan 2011.
Aerial: BING, Feb 2011.

Note:
Lat/Long given in GDA94

Locality Plan
Figure 2.1

Date: 11/04/2011 Version: b

Reference Point	KP (km)
A	406
B	406.5
B1	408.5
C	409
D	410.5
E	411
F	411.5
G	413
G1	413.5
H	414.5

Reference Points and Associated KPs

Marine Crossing GTP EM Plan

Gas Transmission Pipeline (GTP)
- Mainland GTP EM Plan
- Marine Crossing GTP EM Plan
- Curtis Island GTP EM Plan
- GTP Marine Crossing Reference Point
- Indicative Project Footprint
- Stringing Location
- Other Proponents Pipeline RoW

Source:
Gas Transmission Pipeline (GTP): Santos, Jan 2011.
Aerial: Santos, Feb 2011.
Indicative Project Footprint: Aurecon, GLNG May, 2011.
Other Proponents Pipeline RoW: GLNG, March 2011.

Marine Crossing Section
Figure 2.2

A1 scale: 1:15,000

0 250 500 750 1,000 1,250 m

GLNG No: 3381-40-0433

Coordinate system: GCS_GDA_1994

Date: 23/05/2011

Version: d

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3. CONSTRUCTION METHODOLOGY

Construction methodologies to be utilised during the construction of the GTP consist of open trenching and Horizontal Directional Drilling (HDD). Construction of all terrestrial GTP sections, including the entire Mainland GTP and the Curtis Island GTP will be by open trenching. HDD will be utilised in the Marine Crossing GTP in the area of the Kangaroo Island Wetlands and the Narrows from Points C to F (see Figure 2.2). Construction activities relevant to erosion and sediment control are described below.

3.1 Terrestrial GTP construction (Mainland and Curtis Island GTP)

3.1.1 Clear and grade

Clear and grade will be carried out along the GTP alignment to allow for the development of a construction Right-Of-Way (RoW) for plant, equipment and vehicular movement. The RoW for the terrestrial GTP section will generally be 40 m wide, and narrowed to 30 m wide for areas defined as an Environmental Sensitive Area (ESA). A typical 30 m and 40 m RoW layout is presented in Figures 3.1 and 3.2.

Clearing of the RoW shall include the removal as required of trees, brush, stumps and other obstacles, and the grubbing, or removal otherwise, of stumps in the way of the trench line and in trafficked areas. All cut timber and other vegetation shall be stockpiled along the right-hand edge of the RoW.

The seed bank – typically the top 50mm – will be stripped from both sides of the proposed trench line, and stockpiled along the edge of the RoW. Then the topsoil will be stripped to a depth not more than 200 mm, and stockpiled as windrows along the edge of the RoW.

Openings in trench spoil banks will be provided to allow normal drainage of the area and to prevent surface water from ponding.

Subsoil from the levelling of the RoW will be stockpiled separately from vegetation and topsoil. It will be placed to assist with restoring original contours. In rock areas surplus excavated rock material and surface boulders within the RoW will be stockpiled separately for re-use.

3.1.2 Stringing and bending

Pipe stringing involves laying the pipe out in lengths in preparation for welding. Pipe will be transported to the Mainland GTP RoW to temporary pipe storages areas adjacent to the RoW on trucks.

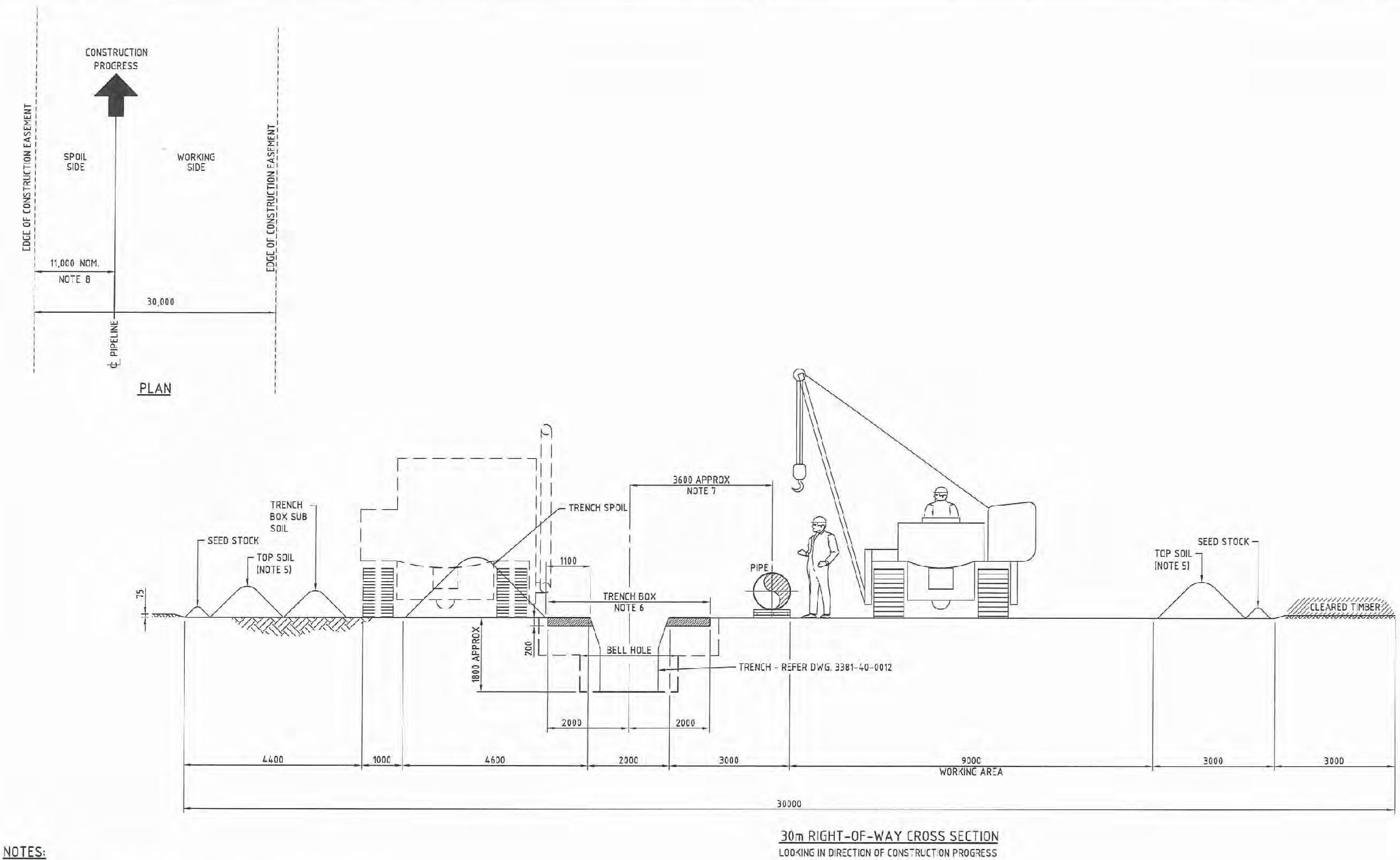
The pipes will be placed on wooden skids in order to elevate the pipe from the ground surface, standing water and mud.

3.1.3 Trenching

Trenching will be undertaken either prior to, during or after pipe stringing, and will depend upon the project schedules, terrain and other logistical factors. Plant and equipment used to undertake trenching is listed below.

The trench will typically be 2.0 m deep and 1.5 m wide and may vary dependent on soil and topography. It is proposed that the Mainland GTP trench be opened in sections to minimise the risk of surface water entering the trench.

Trench spoil will be windrowed beside the trench allowing gaps at regular intervals for access tracks and for surface drainage.



NOTES:

1. DELETED
2. DELETED
3. MINIMUM SPACING OF 1m BETWEEN BOX TOPSOIL AND TRENCH SPOIL MUST BE MAINTAINED.
4. BENCHING FOR TRENCH BOX TO BE DONE TO 200mm MAXIMUM DEPTH. REFER TO ALIGNMENT SHEETS FOR ROW WIDTH.
5. TOP SOIL FROM ENTIRE ROW IF REQUIRED TO BE REMOVED. REFER TO CONSTRUCTION SPECIFICATION.
6. TRENCH AND BOX DIMENSIONS MAY BE VARIED WITH GLNG APPROVAL IF EXCAVATORS/BLASTING IS USED.
7. DIMENSION ON HOLD PENDING ADVICE ON GLNG REQUIREMENT TO WELD BEFORE TRENCHING.
8. MAY VARY IN ORDER TO FIT PIPE INTO EASEMENT AT BEND LOCATION.
9. DELETED
10. FLAG BOUNDARIES PRIOR TO GRADING AND CLEARING. ADDITIONAL FLAGGING MAY BE REQUIRED AT ENVIRONMENTALLY SENSITIVE AREAS eg. WETLANDS.
11. RIGHT OF WAY DETAIL TO BE HEAVILY REVISED FOR WATERWAY / WETLAND CROSSINGS AND OTHER SENSITIVE AREAS.

PRELIMINARY

GHD CLIENTS | PEOPLE | PERFORMANCE
Level 4, 201 Charlotte St Brisbane QLD 4000 Australia
GPO Box 668 Brisbane QLD 4001
T 61 7 3316 3000 F 61 7 3316 3333
E bnemail@ghd.com W www.ghd.com
GHD Job No: 41-21336

No	DATE	DRN	CHKD	ENG	Q.A.	PROJ	ACC	DESCRIPTION
AA	19/11/09	GHD						ISSUED FOR APPROVAL - 42 INCH
A1	29/10/09	GHD	CEJ			TM		ISSUED FOR INTERNAL REVIEW

REVISIONS

DRG No. | SUBJECT
REFERENCE DRAWINGS

DRN: GHD
DATE: 23/10/09
SCALE: NTS
CHKD:
ENG:
Q.A.:
PROJ:
ACC:
A.B.N. 80 007 550 923

GLNG GAS PIPELINE
30m RIGHT-OF-WAY LAYOUT
PIPELINE STANDARD

DRAWING No. 3381-40-0151 REV AA

AUTOCAD

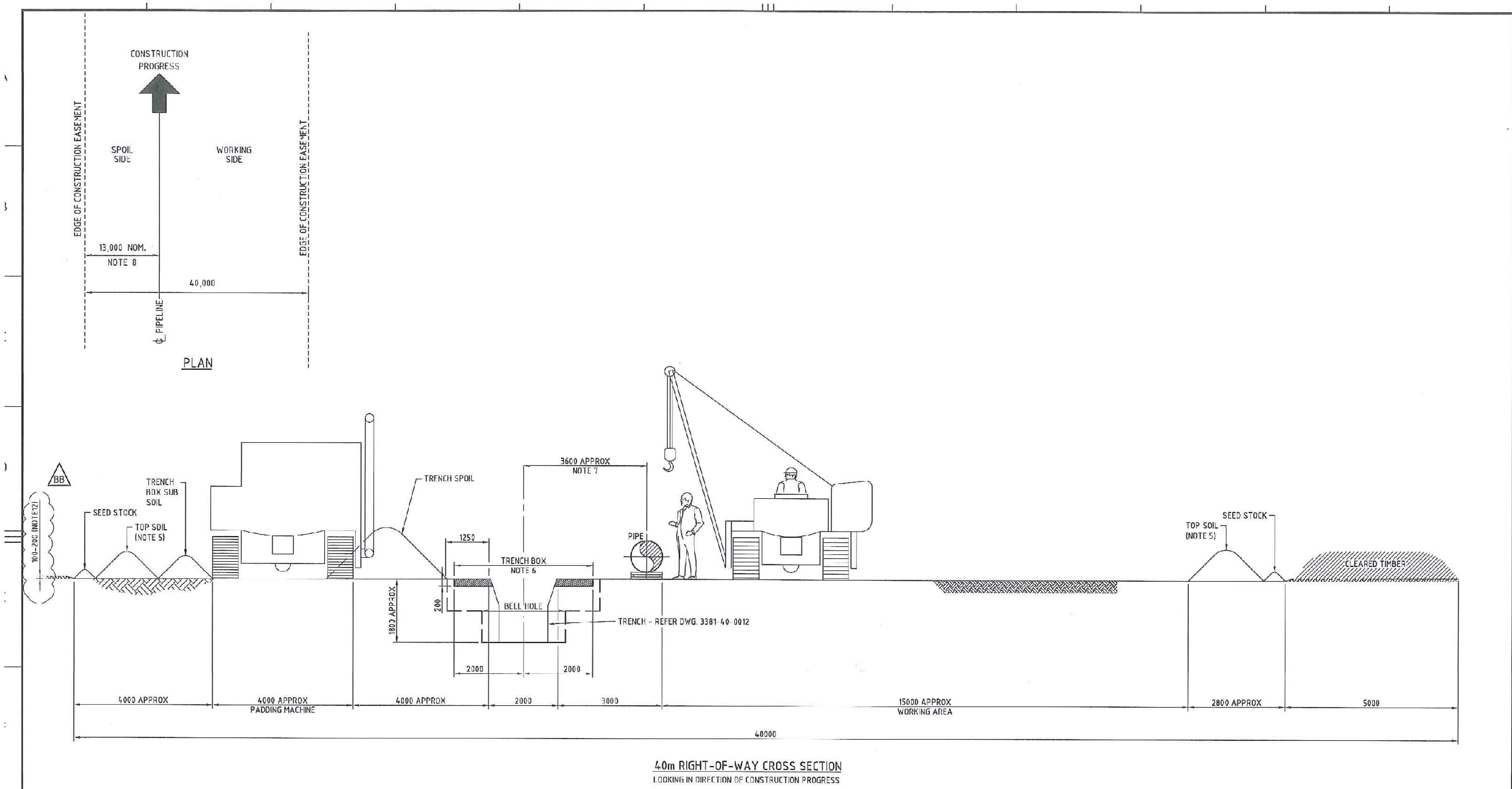
STD DRAWING : 30m RIGHT-OF-WAY LAYOUT A1SHEET

CADFILE No. - 3381-40-0151_AA

Map by: SLG P:\GIS\Projects\214208_Santos_EMP\MC_029.mxd 11/04/2011 09:30

Date: 11/04/2011 Version: b
Source: GHD, 2009. GLNG No: 3381-40-0435

Marine Crossing GTP EM Plan
Typical RoW 30m Layout: Figure 3.1



40m RIGHT-OF-WAY CROSS SECTION

LOOKING IN DIRECTION OF CONSTRUCTION PROGRESS

NOTES:

BB

1. DELETED
2. REFER TO 3381-GHD-3-3.3-0186 FOR TOPSOIL REMOVAL.
3. ~~MINIMUM SPACING OF 1m BETWEEN BOX TOPSOIL AND~~ TRENCH SPOIL MUST BE MAINTAINED.
4. BENCHING FOR TRENCH BOX TO BE DONE TO 200mm MAXIMUM DEPTH. REFER TO ALIGNMENT SHEETS FOR ROW WIDTH.
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BB

PRELIMINARY

No	DATE	DRN	CHKD	ENG	Q.A.	PROJ	ACC	DESCRIPTION
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C	29/10/09	GHD	CEJ			TM		PADDER ADDED
B	27.08.09	GHD						ISSUED FOR GLNG REVIEW
A1	24.05.09	GHD						ISSUED FOR INTERNAL REVIEW

REVISIONS

DRG No.	SUBJECT

REFERENCE DRAWINGS

DRN: GHD
DATE: 24/06/09
SCALE: NTS
CHKD:
ENG:
Q.A.:
PROJ:
ACC:
A.B.N. 83 007 550 923

GLNG GAS PIPELINE
40m RIGHT-OF-WAY LAYOUT
PIPELINE STANDARD

DRAWING No. 3381-40-0050
REV BB

CADFILE No. - 3381-40-0050_AA

Map by: SLG P:\GIS\Projects\214208_Santos_EMP\MC_027.mxd 11/04/2011 09:34

Date: 11/04/2011 Version: b
Source: GLNG, 2010. GLNG No: 3381-40-0436

Marine Crossing GTP EM Plan

Typical RoW 40m Layout: Figure 3.2

3.1.4 Lowering and backfilling

Typically, the pipe shall be placed directly on the trench bottom without bedding beneath it.

The pipe will be lowered into the trench using side-booms with roli-cradles.

The trench backfilling shall be compacted by rubber-tyred wheel rollers. Backfill soils will be compacted to a level consistent with surrounding soils, with the aim of preventing trench subsidence and water ponding.

Any subsidence that occurs, including any subsidence occurring during the contract maintenance period, shall be rectified. Surplus excavated material will be spread across the RoW subject to its suitability for this purpose.

3.1.5 Hydrostatic testing

During hydrostatic testing (hydro-testing) the pipe will be filled with clean water sourced from nearby dams or town. The location and source of water supplied for testing will be determined prior to commencing construction, but will be of potable water quality standard. The pipeline once capped and filled is then pressurised. A 24-hour leak test then follows. The water will be re-used along the length of the pipe and then discharged to land in a non-erosive manner.

3.1.6 Blasting

Blasting may be required to form the trench in areas of rock which is not excavated by mechanical methods (such as an excavator with rock hammer).

Details of the blast parameters and design required are not available at this stage, however it is assumed drill and blast techniques incorporating confined blasting (ie blasting of hole/trench on open ground) will be employed.

3.1.7 Crossings

Road crossings

Road crossing construction methods will be selected based on the road formation type. Crossing design and construction methods will vary according to road function, road design and the size and quantity of vehicles that use the road. The types of road crossing methods to be considered are summarised below, along with the relevant road types:

- Open cut: unformed and formed tracks, gravel roads and some bitumen roads
- Bored (cased or uncased): some major highways and some bitumen roads
- Directional drill (cased or uncased): some major highways

Bored rail crossings

Bored rail crossings shall be installed and constructed in accordance with the alignment sheets and construction drawings, responsible authority, requirements of the asset owners and approval conditions.

Bored road crossings

Bored road crossings shall be installed and constructed in accordance with the alignment sheets and construction drawings, responsible authority, requirements of the asset owners and approval conditions.

Watercourse crossings

The crossing of approximately 13 rivers or creeks, and 90 minor watercourses are required for the Mainland GTP. These will be constructed in accordance with the alignment sheets and construction drawings, responsible authority, requirements of the asset owners, and approval conditions.

Three alternative methods may be used for watercourse crossings. These are:

- Open trench. The majority of watercourse crossings are expected to be constructed using standard open trenching construction. This technique is most suited to the dry or low flow conditions which will be preferred for the construction phase
- Open trench with flow diversion. Flow diversion is a modification to the standard open trench method employed where higher water volumes and flows are present (typically up to 1,000 L/s). In this way the risk of erosion and interference with construction activities is reduced
- HDD is generally used to cross major watercourses where standard open cut methods are not feasible or to avoid environmentally sensitive features. The feasibility of using HDD is limited by site conditions such as soil stability, slope, access, available workspace and the nature of subsurface strata

It is anticipated that the majority of the watercourse crossings will be constructed using standard open trench methods, and where possible, construction activities will be scheduled for dry or low flow periods to enable open trench methods to be used.

Clear and grade operations at waterways will be restricted to the minimum necessary for construction purposes and shall be performed in a manner which will minimise the reinstatement requirements.

On completion of works the beds of the stream and watercourse will be restored, and obstructions resulting from construction of the pipeline will be removed and disposed. The banks of each watercourse crossing shall be restored by grading to the natural contours, or to the natural angle of repose of the stream bank material, whichever is less steep.

3.1.8 Rehabilitation after GTP construction

On completion of Mainland GTP construction, the RoW will where required be re-contoured to match the surrounding ground and existing landform. During this process, erosion and sediment controls will be installed when required to ensure the long-term stability of the previously disturbed areas and to minimise secondary impacts upon areas outside of the project boundaries.

Rehabilitation of the RoW will be undertaken in accordance with the Landscape Rehabilitation Management Plan (LRMP).

3.2 Marine Crossing GTP Construction Methodology

The Marine Crossing section will utilise all of the techniques outlined in the Mainland GTP construction section, and the additional measures described in this section.

The terrestrial pipe construction activities within the marine crossing section extend between Point A (KP 406) and C (KP 409) on the Mainland and between Point G (KP 411.5) and H (KP 414) on Curtis Island (see Figure 2.2). In particular:

Terrestrial Section: Point A to Point B (0.6 km) (KP 406) to (KP 406.5)

From the exit of the Queensland Energy Resources (QER) land-bridge, the route runs southeast within the boundaries of the Northern Infrastructure Corridor (NIC). For this portion of the route, the GTP Marine Crossing will run parallel to the other LNG Pipelines as it does for the remainder of the NIC. This section of pipeline will be installed using conventional onshore trenching construction techniques.

Terrestrial Section: Point B to Point C (1.8 km) (KP 406.5) to (KP 409))

The route then runs on the eastern side of the QER oil shale mining lease area and above the high water mark (HWM) to the southernmost edge of the intertidal mudflats. This section of pipeline will be installed using conventional onshore construction techniques.

Terrestrial Section: Point G to Point H (1.235 km) (KP 413) to (KP 414)

The route runs from the winch site to a point where the GTP Marine Crossing alignment re-joins the Curtis Island GTP Marine Crossing section.

3.3 HDD construction within the marine crossing

3.3.1 Location

The marine crossing will be constructed using HDD in three stages (refer Figure 3.3). The HDD works will occur outside of the Great Barrier Reef Coast Marine Park area.

The HDD construction footprint will be approximately 265 ha.

3.3.2 Description of the overall HDD construction process

The HDD pads will be constructed from earth material and will occupy an area of disturbance 100 m by 100 m (ie 1 ha). They will contain a HDD rig, drilling pipe storage, tanks for fuels, oils, and drilling muds (typically bentonitic clay). The stage involves a small diameter pilot hole drilled along the designed directional path. Next, this pilot hole is enlarged to a diameter that will accommodate the pipeline (a process referred to as reaming).

The material removed during drilling (pilot holes and reaming) and the HDD mud is then removed from the site by truck and transferred to a barge and disposed at the Western Basin reclamation facility that is operated and managed by Gladstone Ports Corporation.

Once the hole is completed the pipe string will be pulled through the hole and sealed using bentonite.

The pipe stringing will be prepared on a working area of approximately 900 m by 20 m. It is proposed to form the working areas using bog mats or a similar product. These are typically high density polyethylene mats that interlock to provide an even weight distribution for vehicles, or construction activities on surfaces such as mudflats. The mats are low profile and do not interrupt tidal flow patterns. The bog mats do not require additional material (such as road base) to be placed on them and once pipeline construction is completed, the bog mats are removed and reused or recycled.

The key typical stages of the HDD process are presented in Figure 3.3.

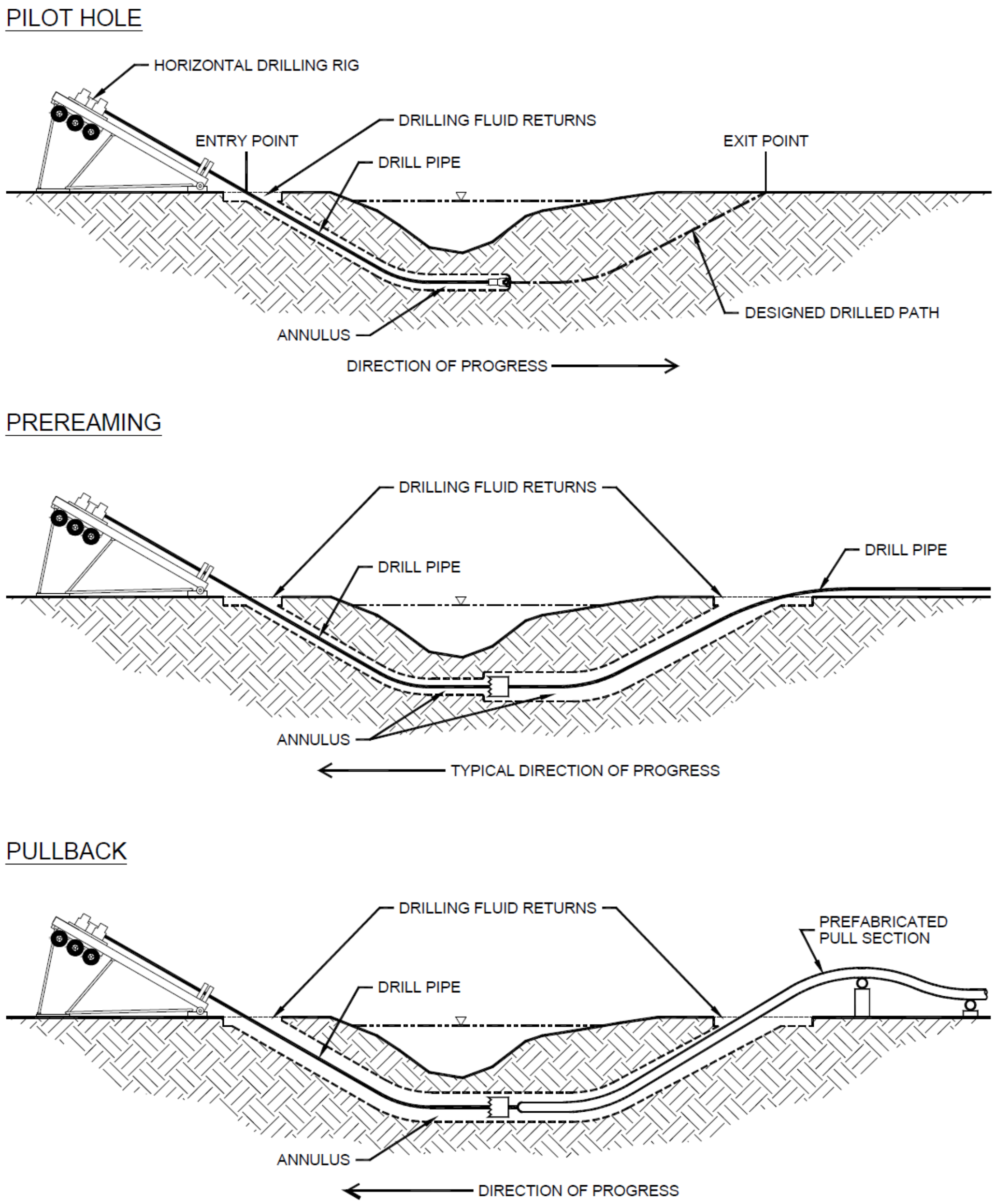

Figure 3.3 Typical stages of the HDD process

3.3.3 Access and pad construction for HDD

All HDD plant and equipment for the Kangaroo Island Wetland intertidal or wetland areas will be transported from Port of Gladstone via barge to a temporary spud barge landing facility on Friend Point, and will then be transported across the spud barge landing facility, which will consist of three 70 m X 20 m spud barges linked together to provide all-tide access.

Matting will be utilised to facilitate vehicular access to the HDD drill pads over soft soils, mud, and environmentally sensitive areas. Each mat weighs 477kg and is made out of recycled plastic. Measuring 2.5 metres by 4 metres and approximately 100mm thick, the mats are interlocked together and can be easily removed with little or no damage to the land underneath.

HDD spoil quantity will be approximately 20,000 m^3. The HDD spoil will be transferred from the HDD pads to trucks. The truck will then be transferred to barge for final disposal within the Western Basin reclamation operated and managed by Gladstone Ports Corporation (GPC).

3.3.4 Rehabilitation after HDD construction

Once the HDD process is completed, the associated infrastructure will be relocated to the next pad, the HDD pads will be removed, and the HDD contractor will reinstate and rehabilitate areas disturbed by HDD works in accordance with the LRMP.

3.4 Ancillary Project Infrastructure

3.4.1 Construction camps

General

Construction camps are required to house and accommodate the construction personnel for the Mainland GTP. These construction camps will be sized to accommodate approximately 450 persons at main camps and 200 persons at behind and advanced camps. An area of approximately 8 ha will be required for each camp.

Construction camp locations

Construction camp sites have been positioned to minimise travel distance for work crews and have been located near a water source.

Four camp sites have been defined and have been located to minimise the travel distance to the work sites. The construction camps will be located at the following locations:

- Camp 1 – Bundaleer – KP 75
- Camp 2 – Bauhinia – KP 180
- Camp 3 – Banana – KP 275
- Camp 4 – Calliope KP – 355

Construction camp installation

The mobilisation schedule of construction camps is based on the logistic and construction priorities as required for the project implementation.

In preparation of camp installation, the proposed site will be filled, compacted, and graded to an adequate elevation above the existing ground level to allow for the proper slope for drainage.

3.4.2 Transportation and storage of pipe

The pipe for the Project will be shipped from overseas in 12 m lengths. It will be received by the Contractor at the Port of Gladstone and Port Alma, from December 2011 to September 2012.

The pipes western and eastern sections of the Mainland GTP will be transported via road to one of eleven temporary pipe storage sites. The size of each temporary pipe storage site will typically be 8 ha (200 m X 400 m) and will be able to accommodate a maximum of 60,000 pipes, and will be located adjacent to the RoW.

Construction of the temporary pipe storage sites will typically be on land which is flat and stable and provided with drainage features/sediment controls. An access road will be constructed around and in-between stacks to facilitate loading/offloading activities.

These sites will be reinstated in accordance with the LRMP once the entire pipe has been delivered to the RoW for stringing and there is no longer a need to retain the temporary pipe storage site.

3.4.3 Transport along the Mainland GTP RoW and access tracks

Access tracks will be prepared in a similar fashion to the RoW. Topsoil will be stripped and stockpiled for reinstatement.

Access tracks will be maintained during construction and rehabilitated to the pre-existing state following completion of construction activities (where on-going operational access is not required) and in accordance with landholder requirements.

It is estimated that up to 700 vehicles will move along the RoW per day with consequent impacts upon soil structure including soil breakdown, compaction, and wind erosion.

3.4.4 Plant wash-down facilities

All access to and from the RoW, which will include the access tracks and hauls roads, will be via dedicated wash down facilities. These have been located throughout the project area. These dedicated wash down facilities are primarily to control pest and weeds, however will also minimise tracking of dirt onto public roads.

4. EROSION CONSIDERATIONS

4.1 Soil Characteristics

Soil Groups occurring along the length of the GTP have been identified in the relevant Land Management chapters of each of the three EM Plans (ie Mainland, Marine Crossing and Curtis Island). The EIS assessment undertaken by URS (2009) indicated soils across the length of the GTP RoW can be separated into nine broad groups.

Group 1: Skeletal, rocky or gravelly soils (>60% coarse fragments) with sandy, silty, loamy or clayey soil matrix
Group 2: Sand soils, includes stratified alluvial soils, residual sand soils, earthy sands
Group 3: Coarse to medium-textured soils
Group 4: Medium-textured sandy, sandy loam or silt to clay
Group 5: Sand, loamy sand, sandy loam or loamy surface duplex soils
Group 6: Fine sandy, silty or clay loamy surface duplex soils
Group 7:Shallow uniform often gravelly fine-textured soils
Group 8: Shallow to medium to deep uniform fine-textured (cracking) clay soils
Group 9: Deep to very deep, very soft, uniform gradational or weak duplex soil

Detail of the properties of these soils and their typical constraints are provided in chapter 7 of the relevant EM Plans.

Characteristics which will influence the erosion and sedimentation are described below.

4.1.1 Soil Erodibility

Soil erodibility for water erosion reflects the susceptibility to detachment and transport by water. It is influenced by soil texture and the stability of soil aggregates i.e. the strength of bonds between soil particles. Soils with low infiltration rates have higher run off rates and are therefore more erodible. Soil with weak bonding between soil particles will be very susceptible to erosion i.e. loamy soils and dispersive sodic soils. (Hazelton and Murphy, 2007).

Highly erodible soils are those with weak bonds between soil particles and an abundance of soil particles that are easily disturbed by water. If these soil properties are combined with low infiltration then soil erodibility is very high. Typical qualities of erodible soils include:

- Dispersible clay soils (usually sodic)
- Soils high in silt and fine sand that have low organic matter levels (loams to silty clay loams)
- Clay soils with shrink-swell properties

These include Soil Groups 4 to 8 as described in the EM Plans.

4.1.2 Dispersible Clay Soils

A soil is considered sodic when sodium reaches a concentration where it starts to affect soil structure, which in Australian soils is commonly at exchangeable sodium percentage (ESP) of > 6 % (Isbell, et al 1983). When sodic soils are wetted the sodium weakens the bonds between soil particles resulting in clay swelling causing slaking or dispersion. (Rengasamy and Walters, 1994). Such dispersion may occur in sodic soils without any disturbance at all. The dispersed clay particles can be easily moved by water or wind and can migrate through the soil clogging soil pores thereby reducing infiltration and drainage and causing higher runoff. Dispersed clay particles may also be entrained in water and can contribute to water pollution. This may lead to a range of problems for construction sites including high water run-off and erosion rates, water pollution, tunnel formation, reduced workability, difficulty with vegetation establishment, and reduced vegetation growth due to low water holding capacity and root penetration (Raine and Loch, 2003).

However, it is important to note that not all sodic soils are dispersive and not all dispersive soils are sodic. Other factors such as salinity, texture, clay mineralogy, and organic matter can all influence the dispersibility of a soil. Dispersive soils are problematic for construction and maintenance activities and should be identified so that their constraints can be addressed in project planning.

A review of the Australian Soil Resource Information System (ASRIS) in conjunction with data gathered from the EM Plan preparation, indicates that Sodic duplex soils(Sodosols), mapped as Soil Groups 5 and 6 occur along the pipeline route including areas between Gladstone to Mount Alma, Biloela, Bauhina, Arcadia Valley, Biloela and Injune. Sodosols are characterised as being texture contrast soils (i.e. the topsoil is of a lighter texture than the subsoil) in which the subsoil is sodic and not strongly acidic.

Sodic soils are not limited to Sodosols. Soils with sodic properties were identified along the majority of the pipeline route, with the exception being the soils of the Calliope Range, Callide Range, and Dawson Range. Of the sodic soils, topsoils tend to be marginally sodic to sodic with ESP’s mostly between 5 % and 15 % with a few occurrences of strongly sodic soil (ESP’s 15 % to 25 %). In the subsoils, sodicity is much greater tending to be strongly sodic with vast areas of soils with ESP’s that exceed 25 %.

Key management practices to reduce the impacts of sodic soils include: the management of surface water flows and minimisation of the potential for localised ponding, the use of compaction within the soil profile to reduce infiltration and minimise changes in the soil electrolytes which lead to spontaneous dispersion and tunnelling, and the use of amendments (e.g. gypsum, organic matter, polyacrylamides) to modify either the ESP or directly influence aggregate stability (Rained and Loch, 2003).

4.1.3 Soils High in Silt and Fine Sand

Soil texture is an important property contributing to soil’s erodibility. Soils with a high content of silt, very fine sand (0.05 to 0.10 mm in diameter), or expanding clay minerals tend to have high erodibility. Erodibility is low for clay soils with a low shrink-swell capacity because these clay particles mass together into larger aggregates that resist detachment and transport. Sandy soils with large amounts of fine, medium, or coarse sand particles (0.10 to 2.0 mm in diameter) also have low erodibility. Sand particles lack the ability to aggregate together, but because most sandy soils are highly permeable, water runoff is low, hence erosion is often slight. In addition, the large grain size of sandy soils means that it takes more energy to transport its particles than those of finer-textured soils. Medium-textured soils (loamy soils) tend to be most erodible because they have high amounts of silt and very fine sands. These soils tend to have moderate to low permeability and low resistance to particle detachment. If disaggregated, small particles (silts and clays) are easily transported. Rock fragments can also prevent erosion by protecting the soil from raindrop impact (O’Geen, 2006).

Soils that are considered to be highly erosive include the following textures (Landcom, 2004):

- Loam and Fine sandy loam, (~25 % clay)
- Silty loam (~25 % clay and > 25 % silt)
- Sandy Clay loam (20 % to 30 % clay)
- Silty clay loam (30 % to 35 % clay and > 25 % silt)

A review of the ASRIS and soils information gathered in the EM Plan indicates loam, silty loam, or sandy clay loam are uncommon along the alignment , however relatively small areas have been noted in the topsoils in the vicinity of the following locations:

- East of Dungree
- Dawson Range
- Sections along Arcadia Valley Road
- Surrounding Biloela

4.1.4 Clay Soils with Shrink-Swell Properties

Soils with expanding clay minerals tend to have high erodibility. Vertosols (described within Soil Group 8 in the EM Plan) are clay soils with shrink-swell properties that exhibit strong cracking when dry and at depth (Isbell, 1996), and often exhibit gilgai micro-relief. These can be structurally unstable to raindrop impact and rapid wetting and frequently produce readily detachable and transportable soil particles resulting in high soil erodibility.

Soil Group 8 was identified west of the Calliope Range at a number of locations (Biloela and Bauhinia in particular) and are indicated as having highly sodic subsoils. These Vertosols are commonly adjoined with highly erosive Sodosols.

4.1.5 Salinity

Soils with elevated electrical conductivities (EC) were identified as occurring in a number of areas. Soil EC is used as a measure of soil salinity and is commonly used because it is simple to measure. The relationship between EC and the salinity effect to plant growth is also strongly influenced by soil texture, in particular clay content. The greater the clay content then the higher EC will need to be before it has saline impacts on plant growth i.e. the EC concentrations that severely inhibit vegetation growth in sandy soils may cause little adverse growth effects on in heavy clay soils.

A brief review of the ASRIS identified that soils with elevated EC’s (0.95 dS/m) in the subsoil were present along the alignment between Biloela and Bauhinia, which is rated as having a very high salinity rating for soils of these light to medium clay textures.

4.1.6 Acidity and Alkalinity

The optimal pHw1:5 range in soil is 5.5 to 8.5. Outside of these ranges plant growth tends to be retarded mostly due to changes in the soil chemistry resulting in nutrients becoming either unavailable or toxic to plants. Areas of extreme acidity (pH < 4.5) and alkalinity (pH > 9.0) were not identified in the alignment. The majority of the soils range between moderately acidic to moderately alkaline with the exception of strongly acidic soils (both topsoil and subsoil) with pH 4.8 to 5.5 being identified in the vicinity of Calliope and Expedition Ranges, as well as areas around Beilba and Injune.

4.1.7 Soil Characteristics Summary

The following key points relate to the erodibility of soils along the alignment.

- The majority of the soils along the alignment are considered to have high erodabilities
- Sodic soils are indicated along the majority of the pipeline route with the exception being the soils of the Calliope Range, Callide Range, and Dawson Range. The topsoil tends to be marginal to sodic, whilst the subsoils are considered highly sodic
- Erodible swelling clay soils (Vertosols) with highly sodic subsoils are present at various locations west of the Calliope Range and are prominent from Biloela and Bauhinia

- Surface soils with high erosion potentials are indicated to be present east of Dungree; Dawson Range; along sections of Arcadia valley Rd; and surrounding Biloela
- It is highly likely that subsoils with very high salinity potential to be present between Biloela and Bauhinia. Acidic soils are indicated to present in the vicinity of Calliope and Expedition Ranges, as well as areas around Beilba and Injune

Inversion of these soils during reinstatement may result in on-going reinstatement maintenance issues and costs. Bringing sodic subsoils to the surface could result in highly erodible surfaces with surface crusting and hard setting issues effecting vegetation establishment and growth. Reinstatement of acidic or saline soils is also likely to be problematic to vegetation establishment and surface stabilisation.

4.1.8 Soil Testing

Further information will be obtained to characterise the soils along the route and the remediation required to treat aggressive soils that are prevalent along the alignment. The Coordinator Generals' Conditions (Schedule E) states:

> *4. establish baseline soils information for areas to be disturbed including soil depth, pH, electrical conductivity (EC), chloride, cations (calcium, magnesium and sodium), exchangeable sodium percentage (ESP), particle size, and soil fertility (including nitrogen, phosphorous, potassium, sulphur and micronutrients)*

The field programme will also make observations of similar works along the alignment and the success or otherwise in remediating those areas.

The sampling programme will identify high-risk soils. Potential for remediation includes the addition of gypsum or lime, or limiting macro-nutrients; or deep burial of soils with highly adverse properties. This work will be undertaken prior to construction, so that detailed information regarding application rates of ameliorants can be obtained prior to site works.

4.2 Topography

The erosion risk is of concern whenever water concentrates, and where there is a combination of long and steep slopes. Consequently, the erosion risk due to these factors is generally low across the site, but will be high through the ranges and possibly near the watercourses.

The Environmental Impact Statement (EIS) completed by URS for GLNG (2009) identifies two key basins in the project area, the Fitzroy basin, and Calliope basin.

The Fitzroy Basin is characterised by large variations in river flows. Most of the region's rainfall occurs during October to April, and the prolonged dry periods in winter mean that many of the waterways are ephemeral.

URS (2009) indicates that there are large seasonal variations in flow with notable high flows between October and April. The watercourses with the highest flows were Dawson River and Calliope River with little flow occurring in Bell Creek. This is consistent with their respective upstream catchment sizes.

4.3 Climate

4.3.1 Overview

The climate across the pipeline route passes is subtropical, and characterised as having moderately dry winters. Rainfall is highest near the coast ranging from 750 mm to 800 mm per year and decreases west of the Calliope Range from 650 mm to 700 mm per year.

Further west, total rainfall decrease slightly with comparable total rainfalls at Rolleston and Injune of 600 mm to 650 mm per year.

Monthly rainfall is similar along the route and is characterised by having summer dominant rainfall. In the cooler months from April to September rainfalls are approximately 20 mm per month. Highest rainfalls occur in late spring and summer from November through to February. From Gladstone to Biloela summer rainfall tends to be between 80 and 100 mm per month, whilst in the western region (Rolleston to Injune) rainfall rarely exceeds 70 mm to 80 mm per month (shown in Figures 4.1 to Figures 4.6).

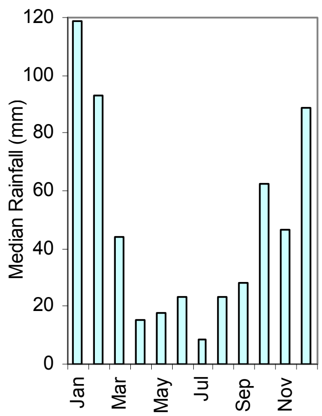

Figure 4.1 Gladstone: monthly median rainfall

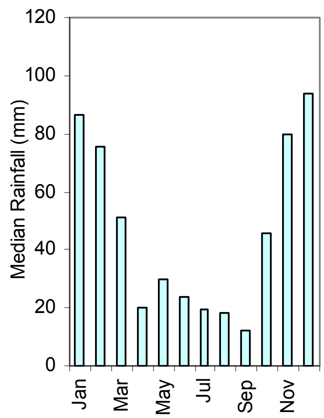

Figure 4.2 Biloela: monthly median rainfall

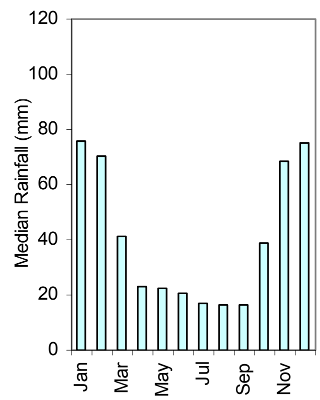

Figure 4.3 Injune: monthly median rainfall

The number of rain days per month can be used as an indicator of how often the potential for erosion may occur. The Bureau of Meteorology (BOM) has readily available climate information, including monthly rainfall data of depths that occur greater than (>) 1 mm, and greater or equal to (≥) 10 mm and 25 mm days per month. Storms less than 10 mm are considered to have little potential to cause substantial erosion, however the data provides an indication as to how rainfall is distributed throughout the month.

Rainfall between Gladstone and the Calliope Range is common throughout the summer months (6 to 9 days per month), however the majority of these are showers of less than 10 mm. For two to three days per month rainfall of 10 mm to 25 occurs, with half of these being ≥ 25 mm.

West of Calliope Range, rainfall occurs slightly less often over summer months, with the main variation being the incidence rainfalls ≥ 25 mm, which decreases to once or less per month. In the cooler months between May and September, winter months rainfall is relatively consistent across the route from Gladstone to Injune with most rainfalls being < 10 mm (2 to 3 times per month), with daily rainfalls between 10 mm and 25 mm occurring on average 1 day per month of which approximately one third exceed 25 mm per day.

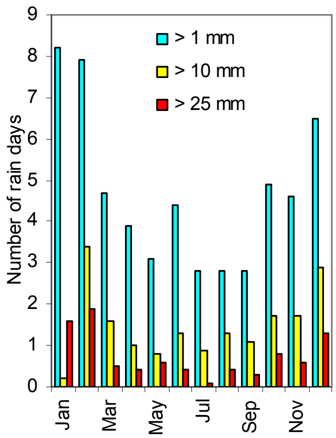

Figure 4.4 Gladstone: number of days with rain ≥10 mm and ≥ 25 mm per month.

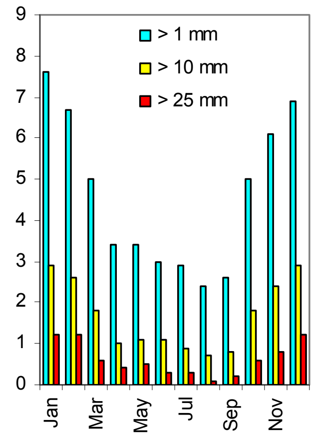

Figure 4.5 Biloela: number of days with rain ≥10 mm and ≥ 25 mm per month.

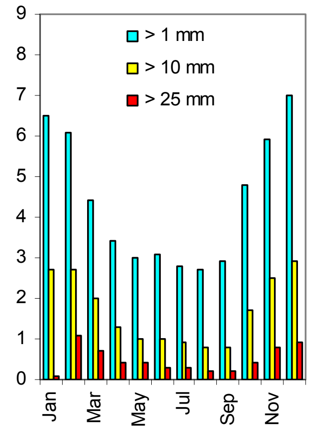

Figure 4.6 Injune: number of days with rain ≥10 mm and ≥ 25 mm per month.

Note that this data is presented as averages, and the weather is relatively inconsistent across the project area. In some years there is little rainfall while in others it may rain in particular locations. In recent years, rainfall in parts of the project area has been relative dry for the whole year.

The Gladstone area is subject to cyclones, which bring severe flooding to low laying areas and cause rivers to run. Cyclonic disruptions and the associated effects can laste up to one month. The frequency for Gladstone has an average of 0.2 cyclones per year, or one cyclone every five years.

4.3.2 Rainfall Erosivity

Rainfall erosivity is a measure of the ability of rainfall to cause erosion. It is a product of the total energy and the maximum intensity for each storm. When other factors are constant, the potential for soil disturbance from rainfall are directly proportional to the product of the total kinetic energy of the storm, times its maximum 30-minute intensity. Rainfall erosivity is an indication of the two most important characteristics of a storm determining its erosivity being the amount of rainfall; and peak intensity sustained over an extended period.

Climatic erosion risk ratings based on monthly rainfall erosivity intensities are published in IECA, 2008. The closest locations to the pipeline route included in the publication are for Rockhampton, Emerald, and Roma.

The erosion potential from rainfall is dependant upon ground conditions, and if already wet then there will be an accumulative effect. Generally 10 mm of rain in one event will start to cause erosion. There are on average 20 days per year that experience rainfall ≥ 10 mm and 6 to 9 days with ≥ 25 mm.

Table 4.1 Climatic erosion risk ratings based on monthly rainfall

	Rockhampton	Emerald	Roma
Jan	High	High	High
Feb	High	High	Medium
Mar	High	Medium	Medium
Apr	Medium	Low	Low
May	Medium	Low	Low
Jun	Low	Low	Low
Jul	Low	Very Low	Low
Aug	Low	Very Low	Very Low
Sep	Very Low	Very Low	Very Low
Oct	Medium	Low	Medium
Nov	Medium	Medium	Medium
Dec	High	High	Medium

4.4 Erosion Risk Ratings

Vegetation clearing and earthworks along the GTP easement will expose the land to varying levels of erosion due to the combined effects of surface slope and form, soil type, surface run-on/run-off potential and wind erosion over time. A qualitative assessment of erosion potential was conducted based on published land resource information as part of the EIS (URS, 2009). This classified the erosion potential of units of land where disturbance and construction will occur as low (L), medium (M) or high (H). A summary of the cumulative distances of land erosion potential as cited in the EIS (URS, 2009) is included in Table 4.2.

Table 4.2. Cumulative distances of land erosion potential

Erosion Potential Rating	Percentage of gas transmission pipeline	Description
Low (L) or low to moderate (L-M)	6 %	Low level of potential environmental impact. Intersected over a total distance of 25 km (6 %) of the total pipeline corridor
Moderate (M)	52 %	Moderate level of potential environmental impact. Intersected over a total distance of 220 km (52 %) of the total pipeline corridor
Moderate to high (M-H) or high (H)	42 %	High level of potential environmental impact. Intersected over a total distance of 181 km (42 %) of the total pipeline corridor

The erosion potential due to construction activities in the project area as a result of clearing and/or surface disturbance is as follows:

- Low (L) – The combination of surface slope, run-on/run-off and soil erodability is such that no appreciable erosion damage is anticipated.
- Moderate (M) – Significant short-term erosion is likely to occur due to the combination of slope, soil erodibility factors and extent of run-on/run-off. Erosion control can be achieved using structural works, topsoiling and re-vegetation techniques and other site-specific

intensive soil conservation works. Some slightly dispersive soil layers may be present in the profile
- High (H) – High to very high erosion/sediment losses are likely, due to the steepness of slopes, surface condition, soil texture, erodibility factors and surface runoff conditions. Intensive soil conservation works will be required to minimise the effects of erosion. Moderately high to highly dispersive soil layers are usually present within the soil profile

N.B. These erosion potential ratings which were developed as part of the EIS (URS, 2009) are based on available desktop information and tend to steer towards the conservative side. It is possible that the areas rated with moderate or moderate to high ratings are much smaller than indicated in the table. Field investigations are required to confirm these desktop findings. Noteworthy locations that have existing erosion problems include:

- Dawson River escarpment (Kp 37.5 in Alignment Rev A or approx. 25°31'55" S 148°53'22"E)
- Dawson River (Kp 38 in Alignment Rev A or approx. 25°31'41" S 148°53'35"E)
- Clematis Creek (Kp 117 in Alignment Rev A or approx. 24°51'2" S 148°47'43"E)

Site-specific erosion plans will be required to ensure that the soil characteristics, handling methods, and construction issues are understood prior to any works being undertaken. This is essential to minimise erosion during the construction process, and to ensure the success of the rehabilitation strategy to minimise erosion in the long-term.

4.5 Summary

Detailed background information on climate, topography, and soil relevant to the project is summarised in Table 4.3.

Table 4.3 Summaries of Climate, Topography and Soil Information

Topic	Background Data
Climate	• The project area experiences subtropical climate that is characterised by having predominantly wet summers with moderately dry winters • High-energy rainfall intensities with *high* erosivities occur in the summer months; but are more prevalent east of the Calliope Range. In the winter months rainfall is infrequent and is considered to have *low* to *very low* erosivity ratings • Rainfall is highest near the coast, and commences to continually decline to the west of Calliope Range. Rainfall is lowest between Rolleston and Injune • There are on average 20 days per year that experience rainfall ≥10 mm and 6 to 9 days with ≥ 25 mm. As a general guide, rainfall events of less than 10 mm have a low potential to cause erosion. The erosion potential from rainfall is dependant upon ground conditions and if already wet then there will be an accumulative effect
Topography	• The GLNG pipeline extends from Fairview in the Carnarvon Range near Injune to a LNG plant on Curtis Island. Key topographic features associated with the overall route are crossing of five mountain ranges, 13 rivers or creeks, 90 minor watercourses and one marine area. A combination of long and steep slopes has the highest potential for erosion

Topic	Background Data
Soil	• The majority of the soils along the alignment are considered to have *moderate -high* erosion potentials. It is generally the subsoils that have higher erosion potential than the topsoil horizons. Refer to Appendix A. • Sodic soils are indicated along the majority of the pipeline route with the main exceptions being the soils of the Calliope, Callide and Dawson Ranges. Of these sodic soils the subsoils are considered *highly sodic*, whilst the topsoil tends to be *marginal* to *sodic* • Erodible swelling clay soils (Vertosols) with highly sodic subsoils are present at various locations west of the Calliope Range and are prominent from Biloela and Bauhinia • Surface soils with *high* erosion potential are indicated to be present east of Dungree, Dawson Range, along sections of Arcadia Valley Rd, and surrounding Beilba • It is highly likely that subsoils with *very high* salinity potentials are present between Biloela and Bauhinia. Acidic soils are indicated to be present in the vicinity of Calliope and Expedition Ranges, as well as areas around Beilba and Injune • Acid Sulfate Soils are present within the upper levels of the estuarine sediments along the pipeline corridor. These estuarine sediments occur along the coastal fringe of The Narrows, both on the mainland coast south of Friend Point and along the western coastline of Curtis Island between Graham Creek and Laird Point

5. MANAGEMENT AND MITIGATION MEASURES

5.1 General Measures for Sediment and Erosion Control

5.1.1 Erosion Control

Erosion is the detachment and movement of soil or rock by water, wind, or other factors such as ice and gravitational creep (SSSA, 1984). Whilst erosion is a natural process, man-made disturbances can result in accelerated erosion and cause rapid detrimental effects to the receiving environment. Land clearing, earthworks, and alterations to hydrology can cause gross loss of soil resulting in sediment accumulation in undesirable places (e.g. drainage lines, waterways, other land), and water pollution. It can also threaten the integrity of the pipeline.

Water erosion of landforms is dependant upon a number of factors including:

- Climate, in particular rainfall frequency, intensity, and duration
- Topography, including slope and hydrological conditions of the land form (run-on and run-off)
- Soil erodability and cover

The primary aim is the protection of the soil surface against raindrop impact.

The main techniques utilised for erosion control are minimising the period of exposure - i.e. only clearing that which needs to be cleared and rehabilitating such areas as quickly as possible. Other techniques include providing temporary cover in the form of mulch, or applying specific chemicals as soil stabilisers. These may include products that effectively glue the soil surface, or cause the fines to coagulate, effectively increasing their size and making them less erodible and quicker to settle.

5.1.2 Sediment Control

This includes techniques that are applied to settle the mobilised soil particles. These primarily slow the water and allow the influence of gravity to settle the particles. Some soils, particularly dispersive soils, require chemicals to accelerate, or effect flocculation.

5.1.3 Drainage Control

This is the transfer of water so as not to cause erosion. Predominantly this requires keeping velocities below that of the drain lining, and diverting the water regularly so as to keep catchments to manageable levels.

Appropriate planning and installation of erosion and sediment control measures is required to ensure that significant detrimental impacts on the surrounding environment do not occur as a result of the land disturbances associated with the gas transmission corridor, ancillary pipeline facilities, access tracks, and construction sites. Erosion along the GTP project generally cannot be eliminated completely, however implementation measures will minimise erosion and reduce sediment loss from disturbed areas to levels commensurate with the qualities of the receiving environment.

5.1.4 Pipeline Construction

Pipeline construction processes are well developed, and generally minimise the erosion issues through the speed of construction. Pipe-laying rates of approximately 1.5km/day are expected on this project.

However concerns are usually associated with poor practices that unnecessarily disturb new ground and fail to promptly rehabilitate the alignment. On this project there are particular concerns with regard to aggressive soil properties including sodicity, acidity, and salinity. These will need to be considered and management strategies developed by the contractor prior to disturbing such areas.

Erosion control procedures outlined below will be implemented where necessary to minimise the potential effects of erosion during construction. Technical notes and expected standard requirements for typical erosion and sediment controls are found in IECA 2008, and APIA, 2009.

Erosion control activities must be considered for the following stages of the construction process.

- Clear and Grade
- Access Tracks
- Trenching
- Longer-term disturbed areas such as construction camps and lay-down areas
- Reinstatement
- Rehabilitation

5.2 Clear and Grade

5.2.1 Staging of Works

The most effective means to minimise erosion, and the one over which the contractor has the most control is ground cover. Hence the most effective erosion mitigation strategy is to reduce the time between clearing and the re-establishment of a stable surface cover. Thus, areas should not be disturbed until necessary for the following works.

Construction activities need to consider climatic erosion risk ratings and soil erosion potential when scheduling works and considering appropriate erosion controls. Areas with high–moderate soil erosion potentials will need a more elevated level of planning control than those with low erosion potentials. In a similar manner, seasonality and periods of moderate high-moderate climate erosion risk ratings will also need a greater degree of controls than those with low climatic risk ratings.

It is recommended that when construction timeframes are being developed the maximum exposure periods be determined with consideration to the soil erosion potential and climatic erosion risk ratings. In this regard the following periods are proposed in Table 5.1 that indicate maximum periods between clearing vegetation from the soil surface, and seeding for primary revegetation.

Table 5.1 Suggested bare soil exposure periods

Soil Erosion Potential	Climatic Erosion Risk Rating		
	High	Medium	Low – Very low
High	2 months	3 months	4 months
Moderate	3 months	4 months	5 months
Low	4 months	5 months	6 months

This table reflects and confirms the preference for works to take place during the dry season where climatic erosion risk rating is low to very low. It is noted that key areas requiring close attention to loss of soil include the Expedition and Callide ranges, and Arcadia Valley.

Progressive rehabilitation should be prioritised in areas of moderate to high erosion risk. In particular, any required chemical treatment of sodic or acidic soils should preferably be undertaken during the earthworks phase to maximise the incorporation of these materials into the soil profile and to minimise the secondary impacts associated with erosion of these soils.

5.2.2 Minimise the area of disturbance

Whilst the pipeline construction processes are well developed, and the footprint is generally minimised, there needs to be a general awareness that there are costs associated with both erosion control and rehabilitation for all disturbed areas. Consequently, excessive disturbance should be avoided. i.e. the gap between grading the surface cover and rehabilitation should be minimised.

Temporary stabilisation effectively minimises the unstable areas. The most useful controls on this project are likely to be soil stabilising chemicals.

Sealing or gravelling sections of high-usage roads may reduce soil loss through dust and decrease maintenance costs. Chemical stabilisation is also likely to be cost-effective.

5.2.3 Retain vegetation

Cleared vegetation should be mulched and/or retained for uses such as erosion control and rehabilitation. Trees and shrubs mulched in situ may be retained as a soil blanket to protect from erosion until grading and topsoil stripping occurs.

In creek crossings and drainage lines, vegetation clearing should be delayed until immediately before trenching (as far as practical) so as to reduce the potential for stream bank destabilisation from rainfall events in the catchment. Potential rainfall events must be monitored to ensure any works within creek crossings and drainage lines are complete prior to the event.

In areas where sodic subsoils are present the merits of not grading topsoil the full width of the RoW either side of the trench should be considered as this will substantially reduce the risk to erosion where dispersive and sodic subsoils are present.

In areas of remnant native bushland, topsoil stockpiles should be no greater than 2 m deep to maintain microbial and seed viability.

5.2.4 Topsoil and vegetation storage

Selected trees, timber, and vegetation will be stockpiled on the working side of the RoW for re-use during rehabilitation to optimise re-growth and RoW reinstatement.

Existing water flows across the RoW will be maintained during clearing and grading, where necessary by the use of temporary drainage structures

Subsoil from the levelling of the RoW will be stockpiled separately from vegetation and topsoil.

In rock areas, surplus excavated rock material and surface boulders will be stockpiled separately within the RoW.

5.3 Access Roads and Tracks

The construction and usage of unformed access roads will be required to construct and maintain the pipeline with the potential for substantial erosion. The pipeline route largely governs the location of access roads, and there is likely to be little opportunity to avoid areas that would be typically problematic to unformed roads. However, from an erosion and sediment control perspective, the following principles should be considered in the construction of new unformed roads (DECC, 2008c):

- The catchment area above the road or track may be reduced by locating the road along a ridge or as high as possible on side slopes
- Unformed roads and tracks should have at least a slight cross-sectional grade to allow free surface drainage and to avoid excessive ponding in wheel tracks
- The longitudinal grade of an unformed road or track should ideally be less than 10 degrees (18 %). However, short lengths of steeper grade may be needed subject to topography and geotechnical survey
- Where grades of unformed roads are between 3% and 20% then easily trafficable diversion banks should be used to prevent scouring. Where higher grades occur then gravelling and more sophisticated road drainage will be required (eg turn outs)
- Where table drains need to be established, they will be constructed to a broad dish shape, seeded and fertilised or lined appropriately, to prevent erosion. Table-drains will be slashed periodically to ensure vegetation growth is not restricting drainage flow
- Approaches on service tracks to gully and creek crossings should be as flat as practicable. The track should be sloped to direct runoff to a table-drain. In some vulnerable areas, it may be necessary to spread and compact coarse aggregate appropriately around / along the approaches to the crossing to provide stable access and to reduce erosion
- Cut and fill batters associated with service tracks will be formed to a safe slope and stabilised by groundcover vegetation, mulch, stone and rock armouring, or by the use of geo-fabric where appropriate
- Minimise the number of watercourse and drainage line crossings
- Avoid areas of riparian vegetation where possible, and maintain buffer strips between the road and any watercourse
- Where provision of access in gullies or creeks causes disturbance of vegetation, re-vegetation and stabilisation work should be undertaken
- All temporary construction tracks and associated disturbed areas will be stabilised / or revegetated when construction is completed
- Minimise disturbance to soil and vegetation

5.4 Camp Sites and Lay-down Area

Collectively these areas require a significant disturbance of land, and for an extended period. For this reason, erosion and sediment controls will be required for these sites in particular. A combination of soil stabilisers, temporary drainage structures, and sediment basins may be warranted at these locations.

Rehabilitation will require particular attention to de-compaction and topsoil re-spreading.

The requirement for disturbance of the subsoils for drainage and other utilities means that areas with underlying dispersive soils should be avoided. Where this cannot occur, the advice from a suitably qualified soil scientist should be sought as to appropriate methodologies.

5.5 Trenching

5.5.1 Trenching Across Grade

Where the trench runs parallel with the surrounding contours, excavated soil should be placed and compacted on the uphill side of the trench to form a diversion bank. The intention is to divert run-on water away from disturbed areas of the site and channel water such that it is discharged in a controlled manner. The diversion banks should be placed and formed so that they do not trap pools of water at their bases, nor cause erosion at their outlets.

5.5.2 Trenching Down Grade

Trenches that run perpendicular to the surrounding contours (up or down grade) should have adequate measures to ensure that sediment-laden waters do not leave the site. Excavated soil stockpiled beside the trench will require controls to mitigate erosion and may include diversion banks, drains, and sediment fences. At the base of the slope, sediment-trapping devices such as sediment fencing or sediment basins may be required. If the potential for erosion from the trench appears high, check dams may be required in the trenches.

Where the trench runs perpendicular to the surrounding contours (up or down grade), adequate measures should be taken to prevent scouring of trenches and sediment-laden waters entering waterways. Plugs, collars, or trench stops may be required where gradients are considered steep enough to warrant them (eg < 3%), or where soils are dispersive and moderately to highly erodible.

On sloping ground, and in particular on slopes to drainage lines where surface runoff or sub-surface drainage along the pipeline trench may erode the backfill material, trench-breakers (vertical barriers to flow) should be installed at regular intervals to reduce flow along the trench and promote seepage to the groundwater. This is important where sodic and/or dispersive soils occur. The locations of the trench-breakers must be identified and submitted to GLNG Operationsprior to backfilling of the trench.

5.5.3 Trenching Obliquely Across Grade

Where the trench runs obliquely across the grade, excavated soil should be heaped on the uphill side of the trench to form a diversion bank. Depending on the grade and potential soil loss the aforementioned measures for trenches running across the grade and down the grade may also be required.

5.5.4 Stream or Water Crossings

Where the pipeline crosses watercourses there is significant potential for environmental degradation:

- Where the pipeline crosses waterways measures may need to be undertaken to divert water, maintain flow and avoid upstream flooding while the pipeline is being installed. (Note an approval may be required for altering the flow of a waterway)
- Where water crossings are necessary bridge crossings or under-boring should be considered
- If a bridge crossing is required to allow construction access or for maintenance requirements, then the structure should be designed so that it does not become a channel constriction that may cause backup of flow or washouts during periods of high stream flow or cause any under cutting of structure, bed or bank of creek
- Where appropriate excavation and trenching through the streambed with water in it may be acceptable as the process can be quick, often completed within a day, resulting in waterway disturbance occurring as a pulse

- Works in and around all streams and waterways should meet all statutory and other requirements of regulatory authorities for works in waterways. Procedures developed for works in waterways should describe methods to minimise erosion, water quality impacts and other impacts

A risk assessment will be undertaken for each watercourse and drainage line crossing to identify the risk of flows occurring during construction, taking into account time of year, tidal characteristics and catchment characteristics. For streams where there are permanent flows or a risk of flows during construction, a dedicated crossing method shall be applied that:

- Minimises the area of disturbance
- Minimises the overall length of time for disturbance, and in particular, the length of time that trenches will remain open in the bed and banks
- Provides for preservation of the sediment/soil profile
- Provides for prompt stabilisation of the bed and banks following pipe placement
- Provides for special reinstatement techniques to restore aquatic ecosystems and prevent scouring and/or pipeline exposure and damage by subsequent flows
- A diversion strategy will be developed and implemented that addresses flow management and fish passage. For tidal watercourses, this shall address flows and fish passage in both directions

Clear and grade operations at waterways will be restricted to the minimum necessary for construction purposes and shall be performed in a manner which will minimise the reinstatement requirements. Where trees and vegetation cannot be preserved aboveground, stabilising root material shall be undisturbed wherever possible.

The width of cut in the RoW in the vicinity of the waterway crossings will be minimised and topsoil removed from the banks and approaches to the crossing will be conserved.

After vegetation and topsoil removal, the bed and bank material will be separately stockpiled in a location that will not obstruct the watercourse or reasonable flood plain. Banks will be backfilled with bank material compacted and stabilised.

On completion of works the beds of the stream and watercourse will be restored and obstructions resulting from construction of the pipeline will be removed and disposed of. The banks of all watercourse crossings will be restored by grading to the natural contours, or to the natural angle of repose of the stream bank material, whichever is less steep.

5.5.5 Soil and Stockpile Management

Measures to minimise erosion and sediment release should be implemented before stripping or stockpiling of any material. Stockpiles should be:

- Constructed at least 2 m (preferably 5 m) from hazard areas and likely areas of concentrated water flows, e.g. waterways, roads, slopes steeper than 10 %, etc. Where rainfall events within the catchment are likely to cause the waterway to swell then this distance may need to be increased up to 50 m
- No greater than 2 m high if the stockpile material is topsoil. This is to avoid excessive heat being generated and composting conditions that will degrade soil health
- Protected from run-on water by installing water diversion structures upslope
- Formed with sediment fences placed immediately downslope to protect other lands and waterways from pollution
- Stabilised if they are expected to be in-situ for extended periods and receive extended periods of potentially erosive rain they should be stabilised (eg sprayed with a chemical stabiliser; covered, grassed, etc)

- Soil/spoil materials with appreciable fines contents that are windrowed or stockpiled beside near sensitive receptors (eg waterways, water bodies, wetlands, etc) and pose a pollution risk following a rainfall event should be stabilised

If excavated materials potentially contain acid sulfate or other contamination, these should be treated in accordance with the ASS Management Plan.

The HDD operations associated with the marine crossings will produce considerable quantities of spoil that will initially be stockpiled on the pads for removal by truck. Controls suitable to prevent the release of sediment to the nearby marine areas will be required. It is likely that this will be addressed through the controls required for the expected ASS from this operation.

5.6 Reinstatement

Backfilling and reinstatement should be conducted to return the land to as close as, or better than, prior to disturbance. The following principles are required to mitigate erosion:

- Treatment of aggressive soils
- Drainage controls such as diversion banks to channel water off disturbed areas into stable areas or sediment control structures. All temporary drainage structures will be removed when no longer required
- An appropriate allowance for settling of uncompacted backfill material needs to occur
- Scarify the ground surface along the line of the contour to break any compacted and/or smooth materials. Scarifying the ground helps bind topsoil and substrate layers reducing the possibility of sheet erosion and/or creep or slump of topsoil; and enhances water infiltration to the upper subsoil layers, increasing moisture storage within the root zone
- Topsoil should be replaced to match surrounding ground levels and revegetated as soon as possible. Any excess or unsuitable spoil from the site should be removed or managed to avoid erosion
- Respread mulched vegetative material to provide soil stability on bare areas and particularly those areas where landscape tree planting or bushland is to be established after works are complete
- On completion of the respreading process, leave disturbed lands with a scarified surface to inhibit soil erosion, encourage water infiltration and help with keying topsoil later. Leaving surfaces in a glazed condition with hard, smooth surfaces is not acceptable, as seed strike and infiltration will be reduced

On steeper slopes permanent drainage control may be required to divert water from the alignment. In such cases push banks are generally preferred..

5.7 Rehabilitation

Rehabilitation of the site should be considered throughout the project. Rehabilitation is to be conducted progressively and in two stages; those being Primary Rehabilitation and Secondary Rehabilitation.

5.7.1 Primary Rehabilitation

The function of Primary Rehabilitation is to stabilise the soil surface. Stabilisation can be achieved with vegetation, mulching, armouring, or any other way that will reduce soil exposure. The better practices are those that reduce both the soil exposure to raindrop impact and the erosive effects of run-off. In general a soil surface cover of greater than 70% is required to provide a stable soil surface.

Primary revegetation with vegetation includes the use of groundcover species, in particular pasture grasses with a cover crop. The cover crop is a quick germinating and fast growing annual (eg Japanese millet or annual rye) intended to provide some initial soil protection as fast as possible whilst the groundcovers are establishing. Preferences in groundcover species should be to perennial grasses that are stoloniferous or rhizomatous in habit as these will provide a greater level of soil protection and surface cover than tussocky grasses.

The following principles are required to mitigate erosion:

- Soil surfaces should be stabilised as soon as possible after reinstatement occurs. The timeframes for stabilising soils are dependant upon the Erosion Potential Rating and Climatic Erosion Hazard as detailed in Table 3
- Soil surfaces that are to be vegetated should be stabilised with a suitable cover to achieve a minimum of 70 % ground cover, over 95 % of disturbed areas
- Select plant species that are consistent with the altered soil conditions at the site with preference for stoloniferous and rhizomiferous species that provide better soil cover and erosion protection. Plant selection may also be subject to landowner preferences/requirements
- Temporary erosion and sedimentation control works need to be retained until areas of revegetation have been established or the site has stabilised. Once stabilised the temporary measures should be removed
- In areas of low rainfall, placing a time period of achieving vegetative cover is generally unfeasible. However, the intention is to stabilise the soil surface as soon as is practicable

5.7.2 Secondary Rehabilitation

The function of Secondary Rehabilitation is to promote the land to its post construction land use. This includes any native tree plantings, landscaping works, or vegetation associated with landowner agreements.

It is recommended that Secondary Rehabilitation occurs once pipeline construction and hydro testing is complete (basically when everyone is out of the way) and after the primary rehabilitation is well established and the erosion potential has been reduced. This time lag will also allow any areas where aggressive soils are occurring to be identified and ameliorated prior to investing in tree plantings etc.

During Secondary Rehabilitation, any defunct erosion controls (e.g. sediment fences) that were left during Primary Rehabilitation can be removed. Also any areas where erosion controls are insufficient may be addressed.

6. MONITORING

Maintain a regular monitoring and maintenance program to ensure that the erosion control measures implemented are effective. This program must refer to the provided standard erosion and sediment control requirements

A monitoring programme needs to be put in place that includes both short and long-term inspections during the construction phase. The former should be undertaken following significant rain events so that erosion problems can be addressed whilst equipment is nearby and can be quickly and cost-effectively mobilised for repairs. Consideration may also need to be given to the option of undertaking such work when the site has dried sufficiently to minimise the impacts of accessing the site whilst the soils are wet and prone to disturbance and/or compaction.

The inspection should take particular notice of the high-risk soils for erosion (sodic soils) and revegetation success (acidic and saline) soils.

Remediation must be undertaken in a timely manner, particularly where loss of topsoil is an issue, and for dispersive soils.

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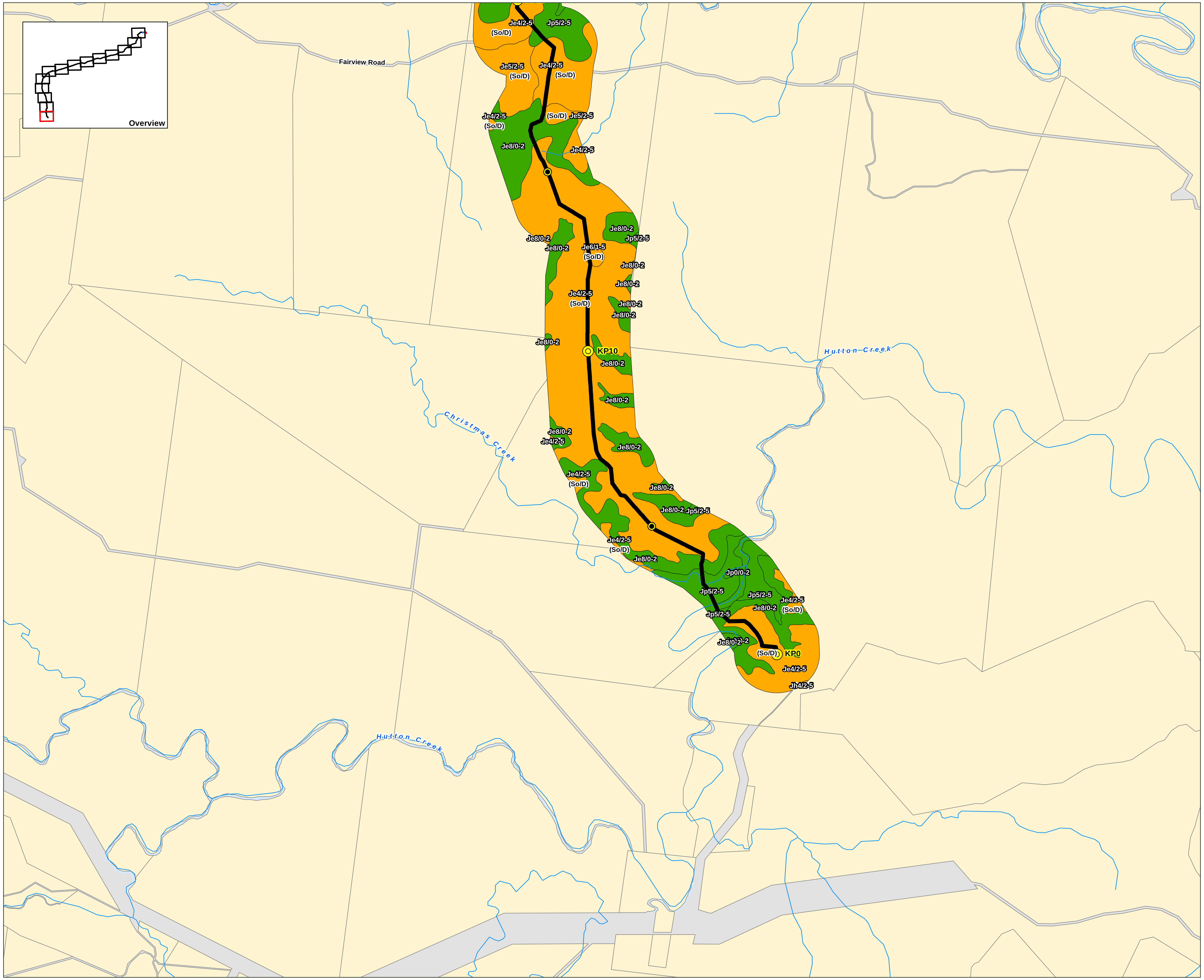
APPENDIX A

Problem Soil



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GLNG No: 3381-40-0410

Coordinate system: GCS_GDA_1994

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Map by: RB

Mainland GTP EM Plan

Gas Transmission Pipeline (GTP)

- Mainland GTP EM Plan
- Marine Crossing GTP EM Plan
- Curtis Island GTP EM Plan

Kilometre Post Distance Marker

- 10km
- 5km
- Cadastre
- Rail
- Watercourse

Problem Soils

- High
- Moderate - High
- Moderate
- Low - Moderate
- Low

Description:

R
Soil Reactivity
L - Nil or low soil
R1 - Moderately reactive soils
R2 - Shallow or medium deep, highly reactive (cracking) clay soils
R3 - Deep, highly reactive (cracking) clay soils

Sa
Soil Salinity
L - Nil to Low Salinity
M - Medium Salinity
H - High to Very High Salinity

So
Sodicity (ESP)
N - Very low or non Sodic, ESP <6%
Rating 1 - Sodic, ESP 6-14%
Rating 2 - Strongly Sodic, ESP >14-25%
Rating 3 - Very strongly Sodic, ESP >25%

D
Dispersion Class
N - Non-dispersive
Sl - Slightly Dispersive
M - Moderately Dispersive
H - Strongly Dispersive

ASS
Acid Sulfate Soils

Note: All figures should be reviewed in conjunction with Table 7.1 *"Generic Key to the identification of Terrain Units", URS 2009.*

Source:
Gas Transmission Pipeline (GTP): Santos, Jan 2011.
Cadastre: Department of Management and Resource Management, Feb 2011.
GLNG Terrain Units: Supplementary EIS, URS, 2009.

Soil Constraints: Problem Soils

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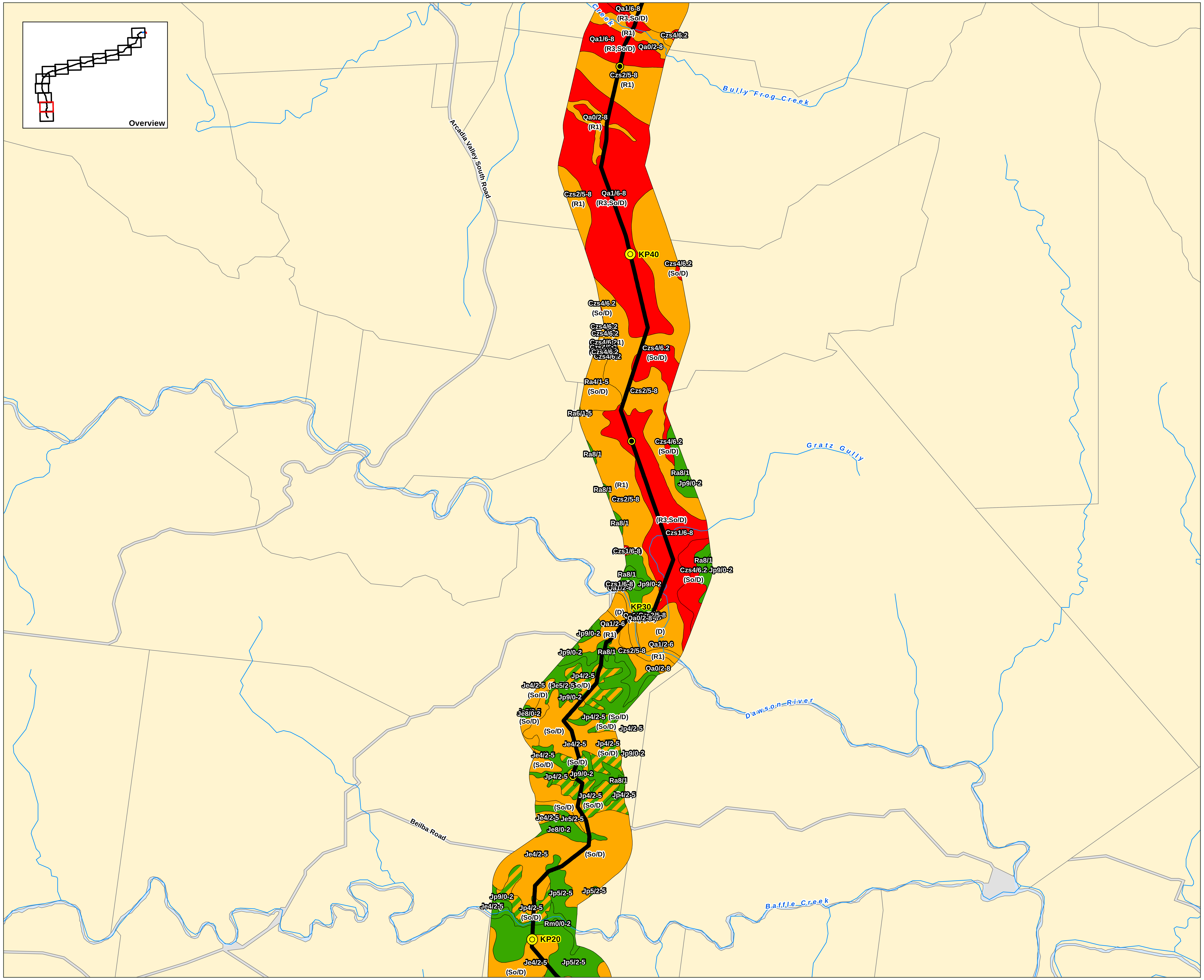
Date: 11/04/2011

Version: b



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GLNG No: 3381-40-0410

Coordinate system: GCS_GDA_1994

Mainland GTP EM Plan

Gas Transmission Pipeline (GTP)

- Mainland GTP EM Plan
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Sa
Soil Salinity
L - Nil to Low Salinity
M - Medium Salinity
H - High to Very High Salinity

So
Sodicity (ESP)
N - Very low or non Sodic, ESP <6%
Rating 1 - Sodic, ESP 6-14%
Rating 2 - Strongly Sodic, ESP >14-25%
Rating 3 - Very strongly Sodic, ESP >25%

D
Dispersion Class
N - Non-dispersive
Sl - Slightly Dispersive
M - Moderately Dispersive
H - Strongly Dispersive

ASS
Acid Sulfate Soils

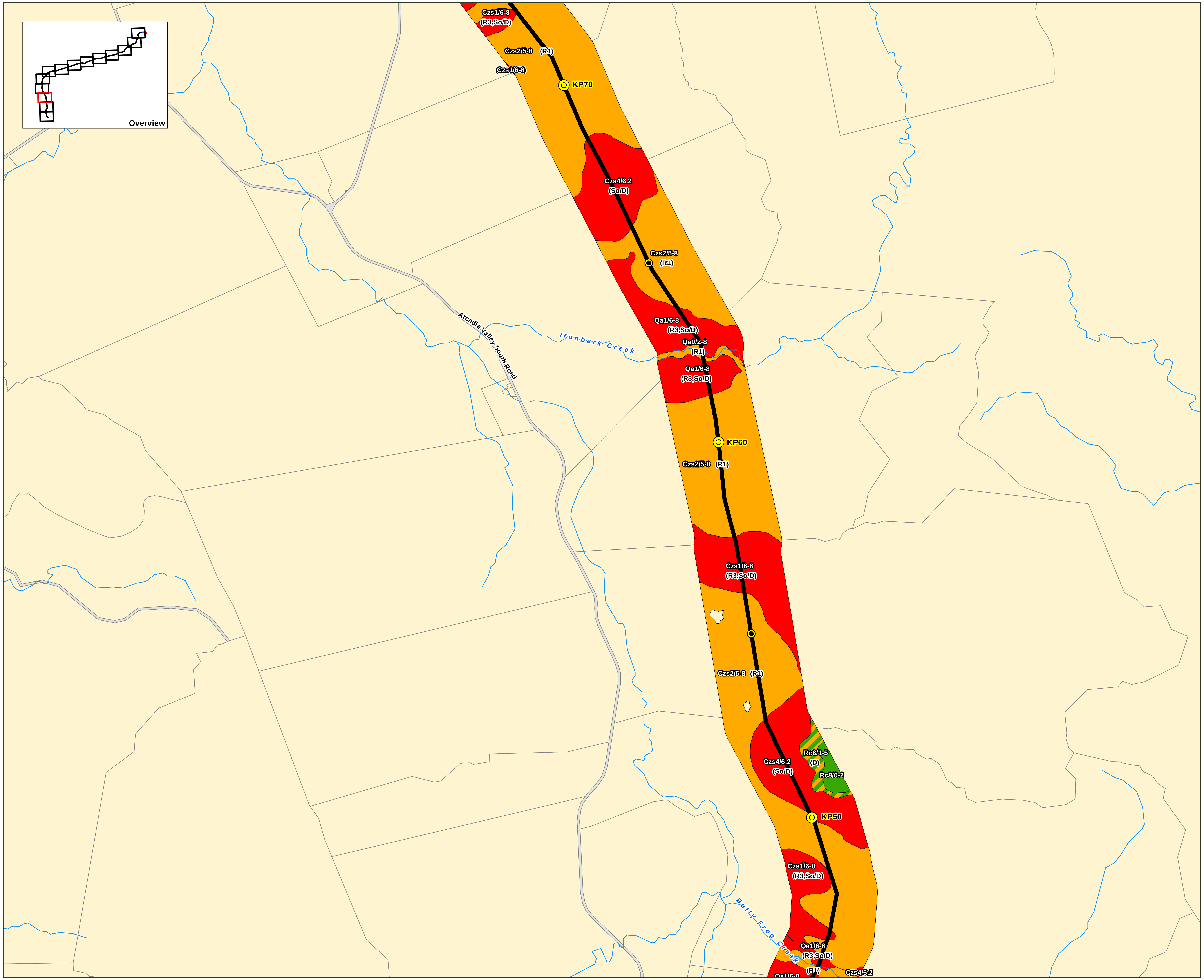
Note: All figures should be reviewed in conjunction with Table 7.1 *"Generic Key to the identification of Terrain Units", URS 2009.*

Source:
Gas Transmission Pipeline (GTP): Santos, Jan 2011.
Cadastre: Department of Management and Resource Management, Feb 2011.
GLNG Terrain Units: Supplementary EIS, URS, 2009.

Soil Constraints: Problem Soils Appendix A (Page 2 of 15)

Date: 11/04/2011

Version: b



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A1 scale: 1:50,000

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GLNG No: 3381-40-0410

Coordinate system: GCS_GDA_1994

Mainland GTP EM Plan

Gas Transmission Pipeline (GTP)

- Mainland GTP EM Plan
- Marine Crossing GTP EM Plan
- Curtis Island GTP EM Plan

Kilometre Post Distance Marker

- 10km
- 5km
- Cadastre
- Rail
- Watercourse

Problem Soils

- High
- Moderate - High
- Moderate
- Low - Moderate
- Low

Description:

R
Soil Reactivity
L - Nil or low soil
R1 - Moderately reactive soils
R2 - Shallow or medium deep, highly reactive (cracking) clay soils
R3 - Deep, highly reactive (cracking) clay soils

Sa
Soil Salinity
L - Nil to Low Salinity
M - Medium Salinity
H - High to Very High Salinity

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Sodicity (ESP)
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Dispersion Class
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ASS
Acid Sulfate Soils

Note: All figures should be reviewed in conjunction with Table 7.1 *"Generic Key to the identification of Terrain Units", URS 2009.*

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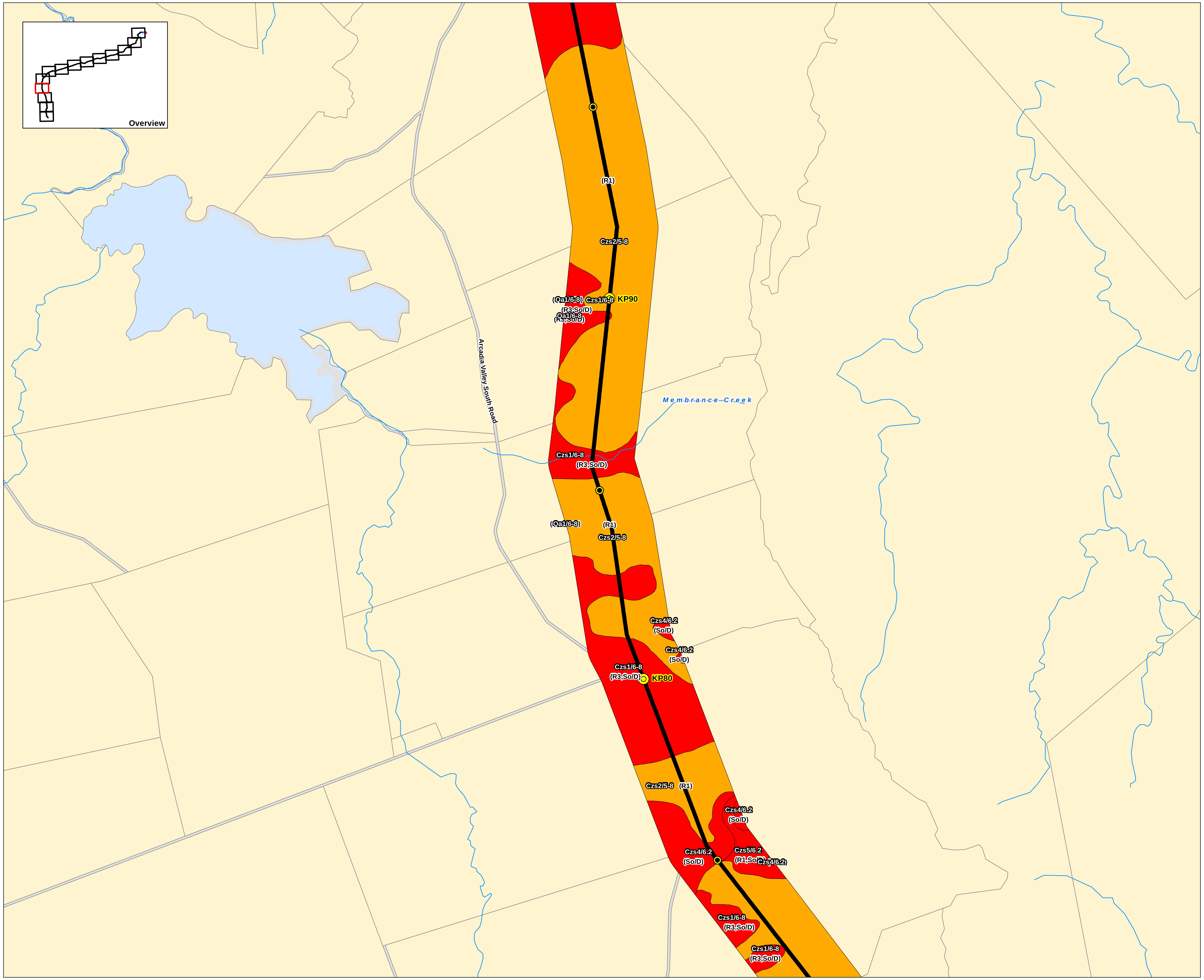
Cadastre: Department of Management and Resource Management, Feb 2011.
GLNG Terrain Units: Supplementary EIS, URS, 2009.

Soil Constraints: Problem Soils Appendix A (Page 3 of 15)

Date: 11/04/2011

Version: b



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GLNG No: 3381-40-0410

Coordinate system: GCS_GDA_1994

Mainland GTP EM Plan

Gas Transmission Pipeline (GTP)

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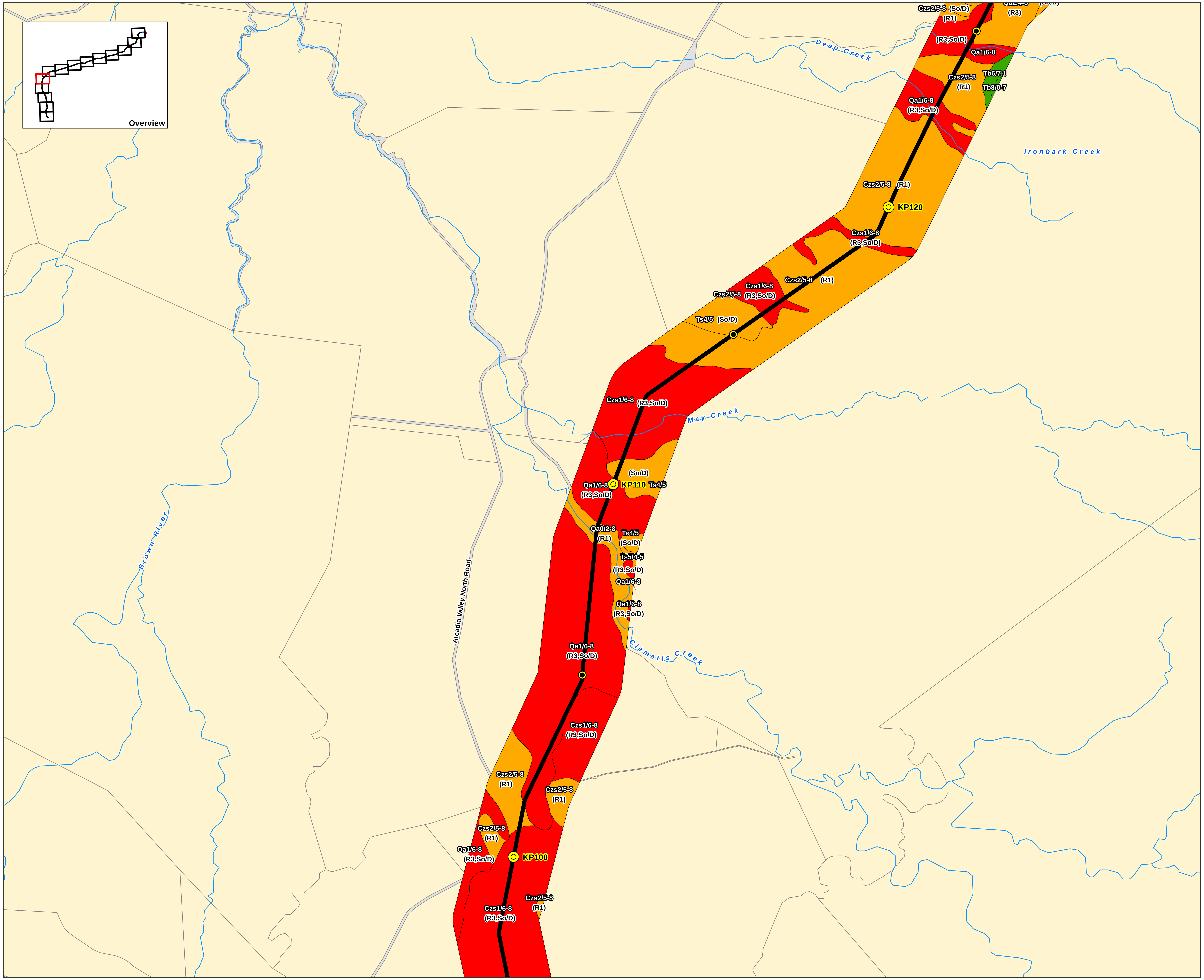
GLNG Terrain Units: Supplementary EIS, URS, 2009.

Soil Constraints: Problem Soils
Appendix A (Page 4 of 15)

Date: 11/04/2011   Version: b



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GLNG No: 3381-40-0410

Coordinate system: GCS_GDA_1994

LNG

Mainland GTP EM Plan

Gas Transmission Pipeline (GTP)

- Mainland GTP EM Plan
- Marine Crossing GTP EM Plan
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Kilometre Post Distance Marker

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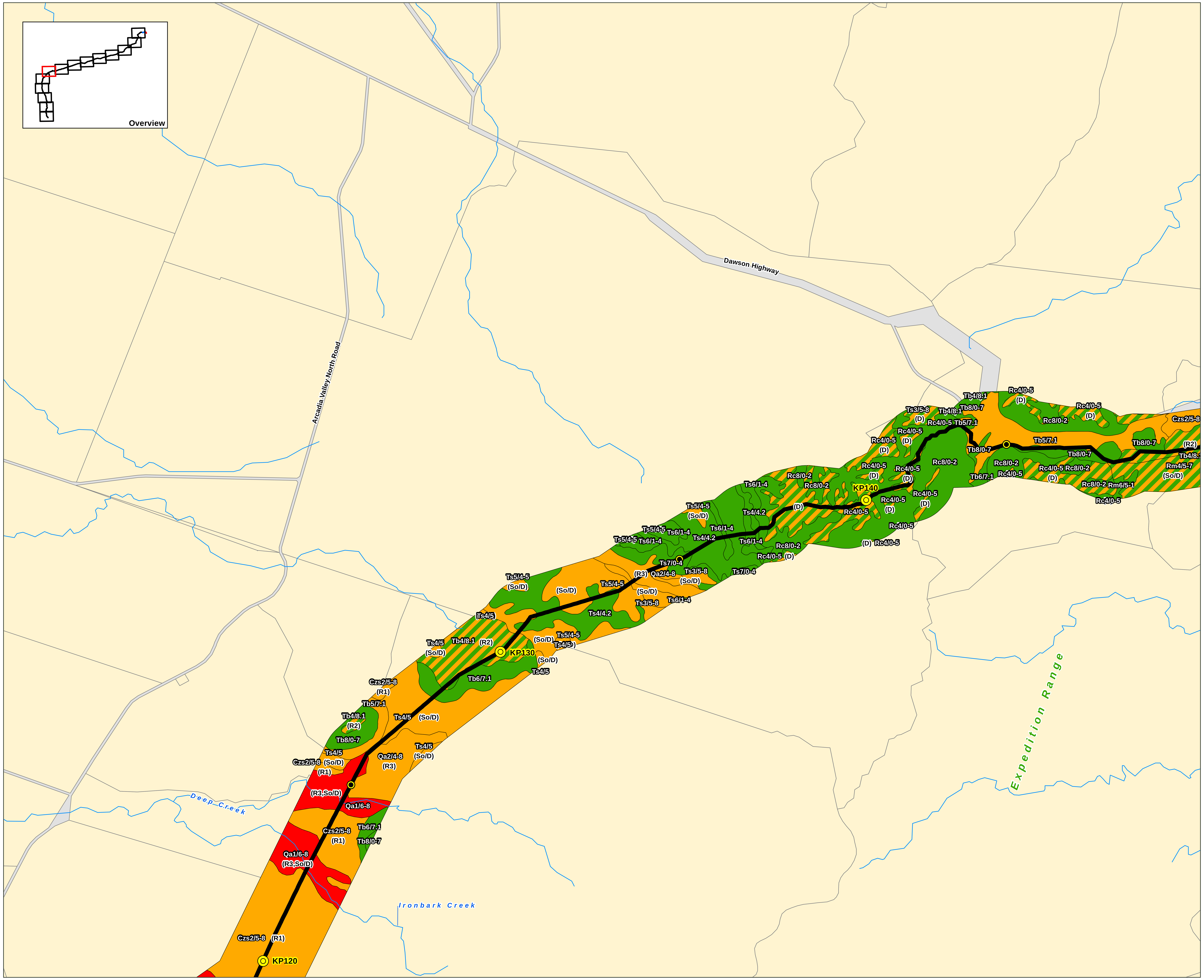
Soil Constraints: Problem Soils Appendix A (Page 5 of 15)

Date: 11/04/2011

Version: b



Mainland GTP EM Plan

Gas Transmission Pipeline (GTP)
- Mainland GTP EM Plan
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- Curtis Island GTP EM Plan

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Soil Constraints: Problem Soils
Appendix A (Page 6 of 15)

A1 scale: 1:50,000

0 1,000 2,000 3,000 4,000 5,000m

GLNG No: 3381-40-0410

Coordinate system: GCS_GDA_1994

Date: 11/04/2011

Version: b

Map by: RB

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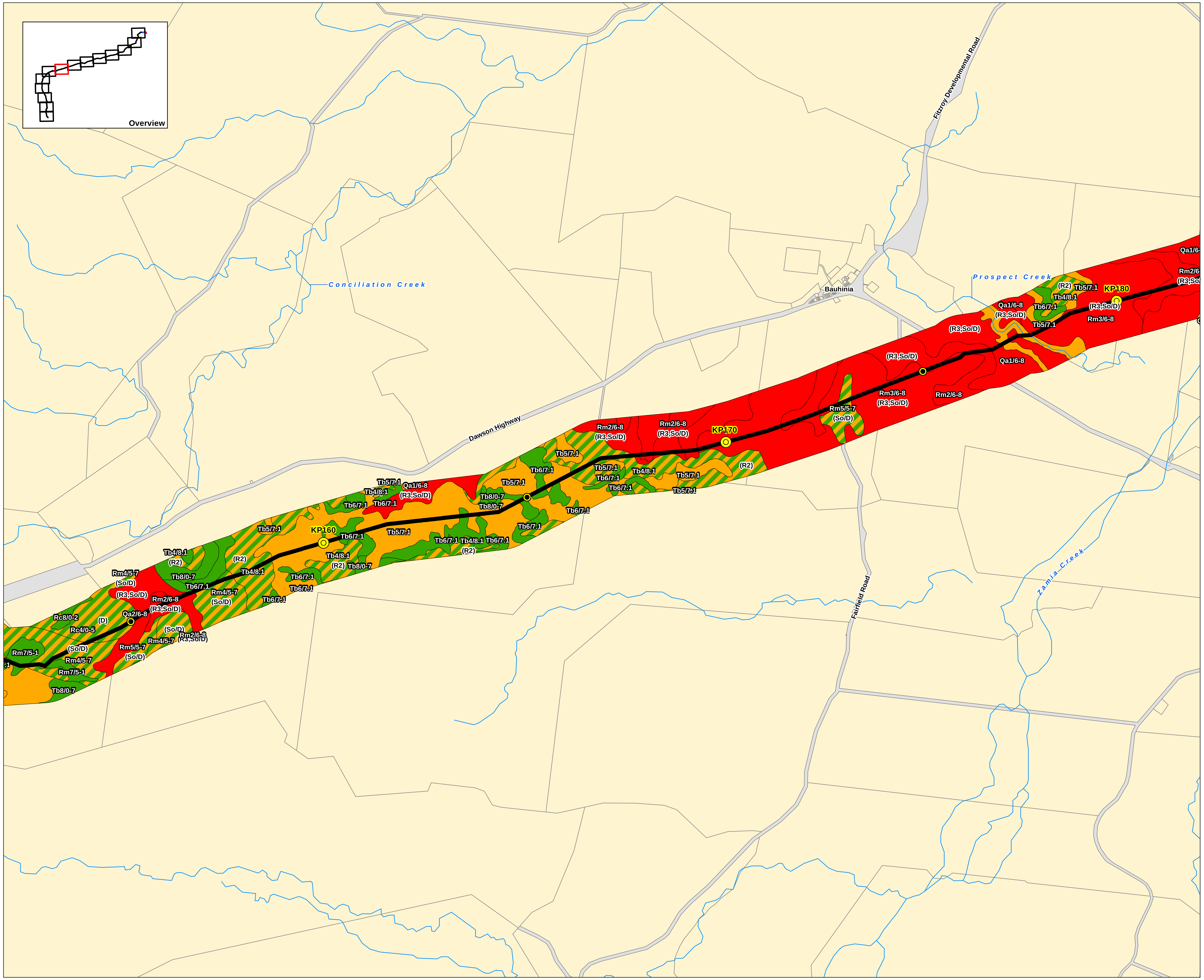

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A1 scale: 1:50,000

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GLNG No: 3381-40-0410

Coordinate system: GCS_GDA_1994

Mainland GTP EM Plan

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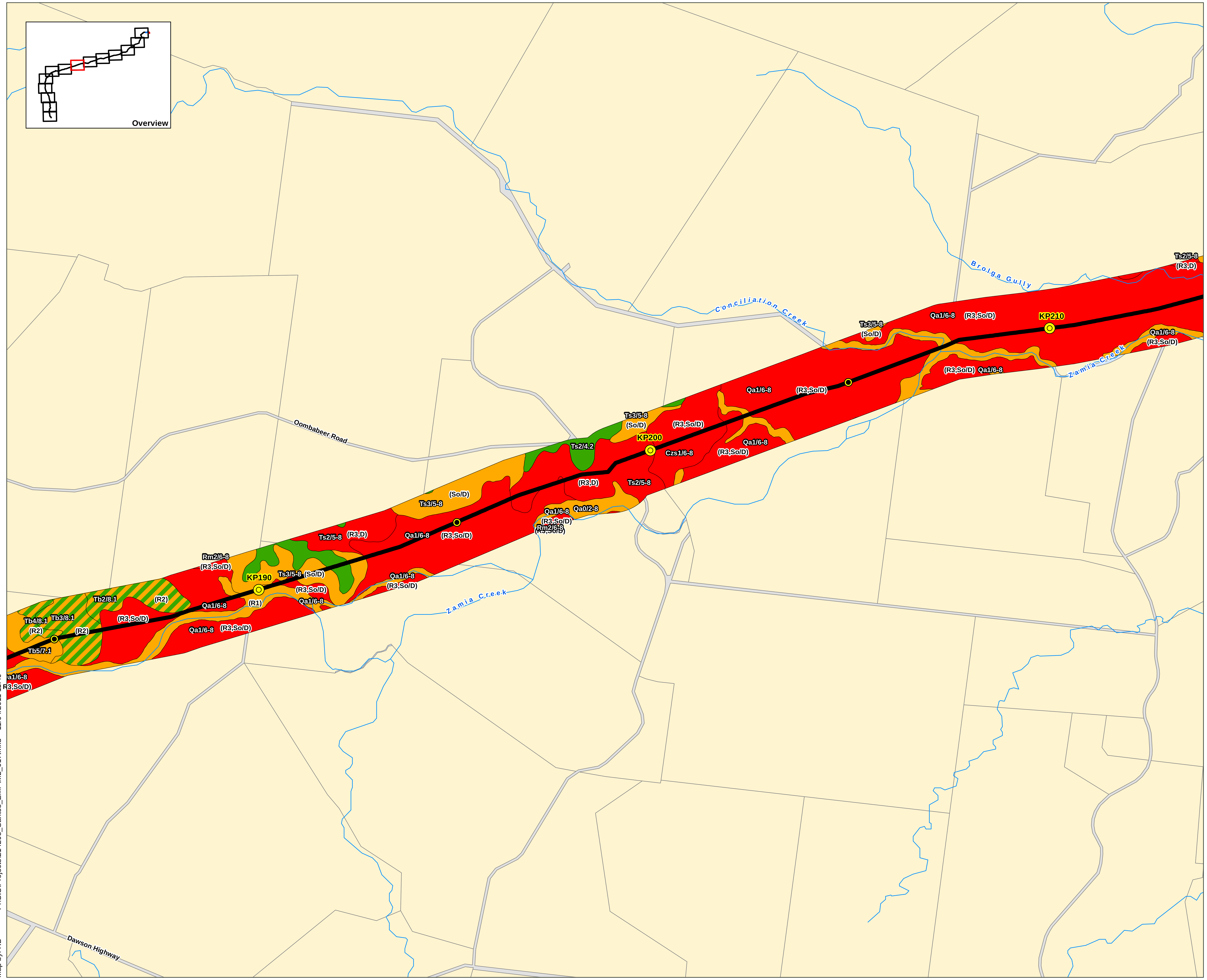
Soil Constraints: Problem Soils Appendix A (Page 7 of 15)

Date: 11/04/2011

Version: b



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A1 scale: 1:50,000

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GLNG No: 3381-40-0410

Coordinate system: GCS_GDA_1994

Mainland GTP EM Plan

Gas Transmission Pipeline (GTP)

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ASS
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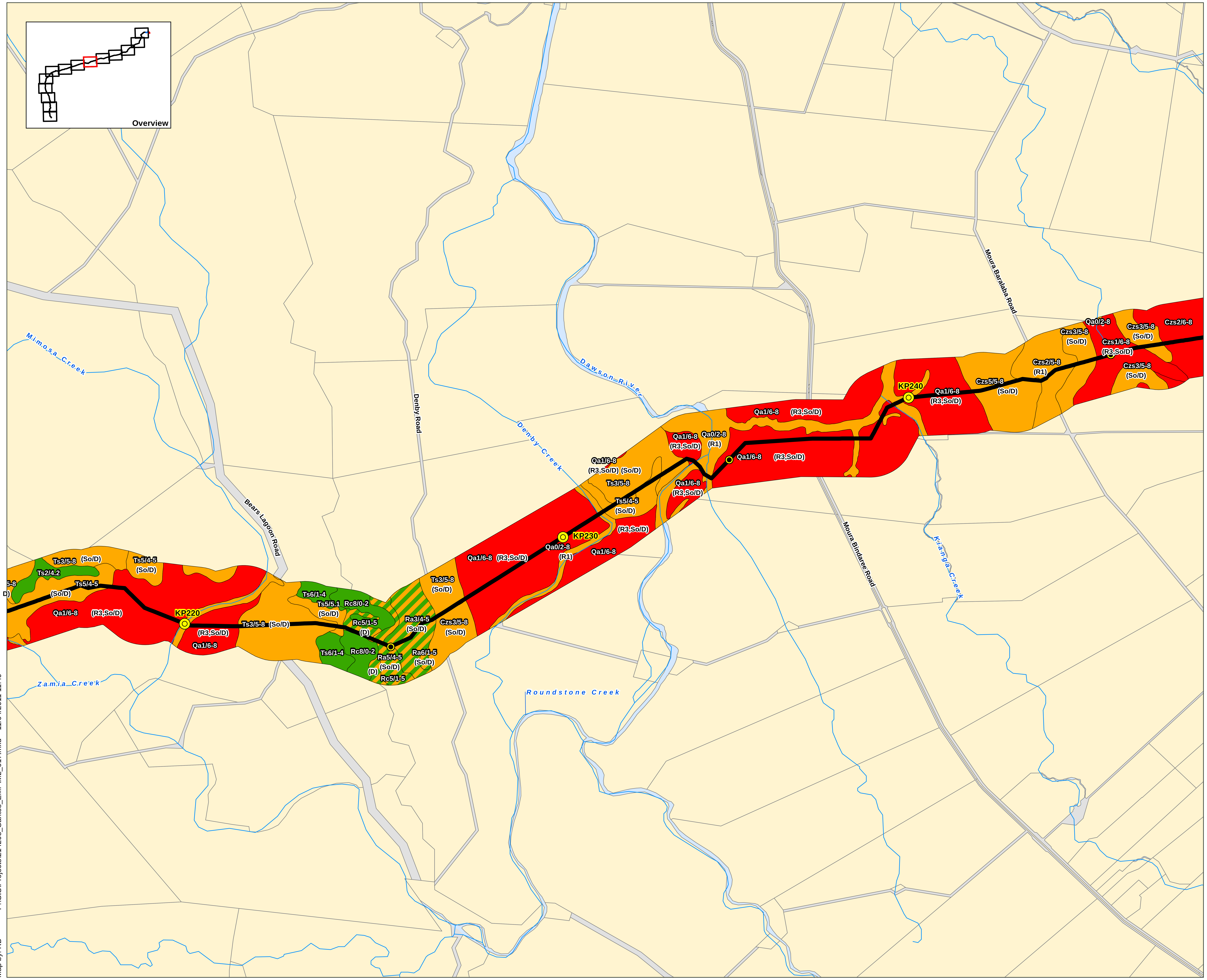
Soil Constraints: Problem Soils

Appendix A (Page 8 of 15)

Date: 11/04/2011   Version: b



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GLNG No: 3381-40-0410

Coordinate system: GCS_GDA_1994

LNG

Mainland GTP EM Plan

Gas Transmission Pipeline (GTP)

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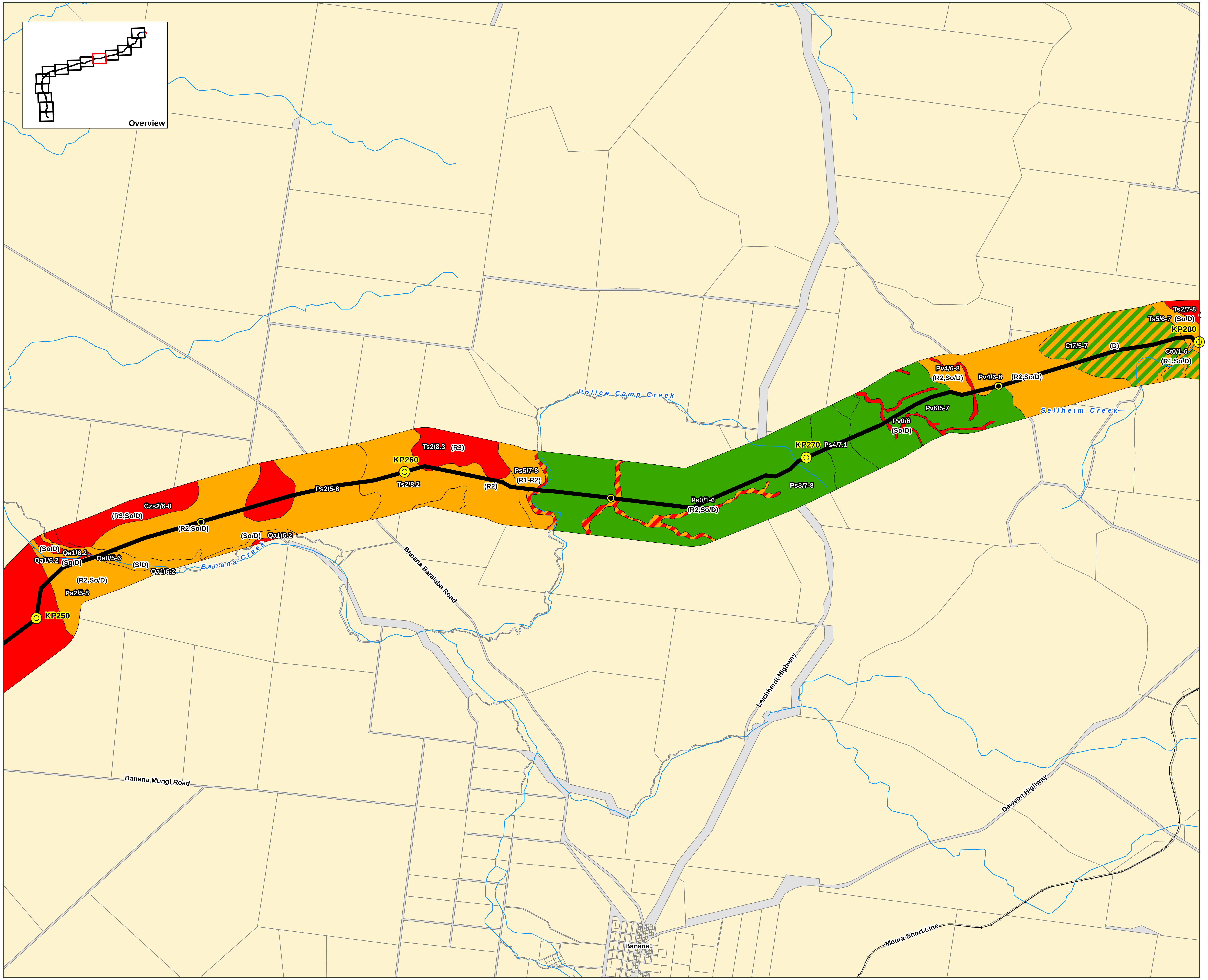
Soil Constraints: Problem Soils Appendix A (Page 9 of 15)

Date: 11/04/2011

Version: b



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A1 scale: 1:50,000

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GLNG No: 3381-40-0410

Coordinate system: GCS_GDA_1994

LNG

Mainland GTP EM Plan

Gas Transmission Pipeline (GTP)

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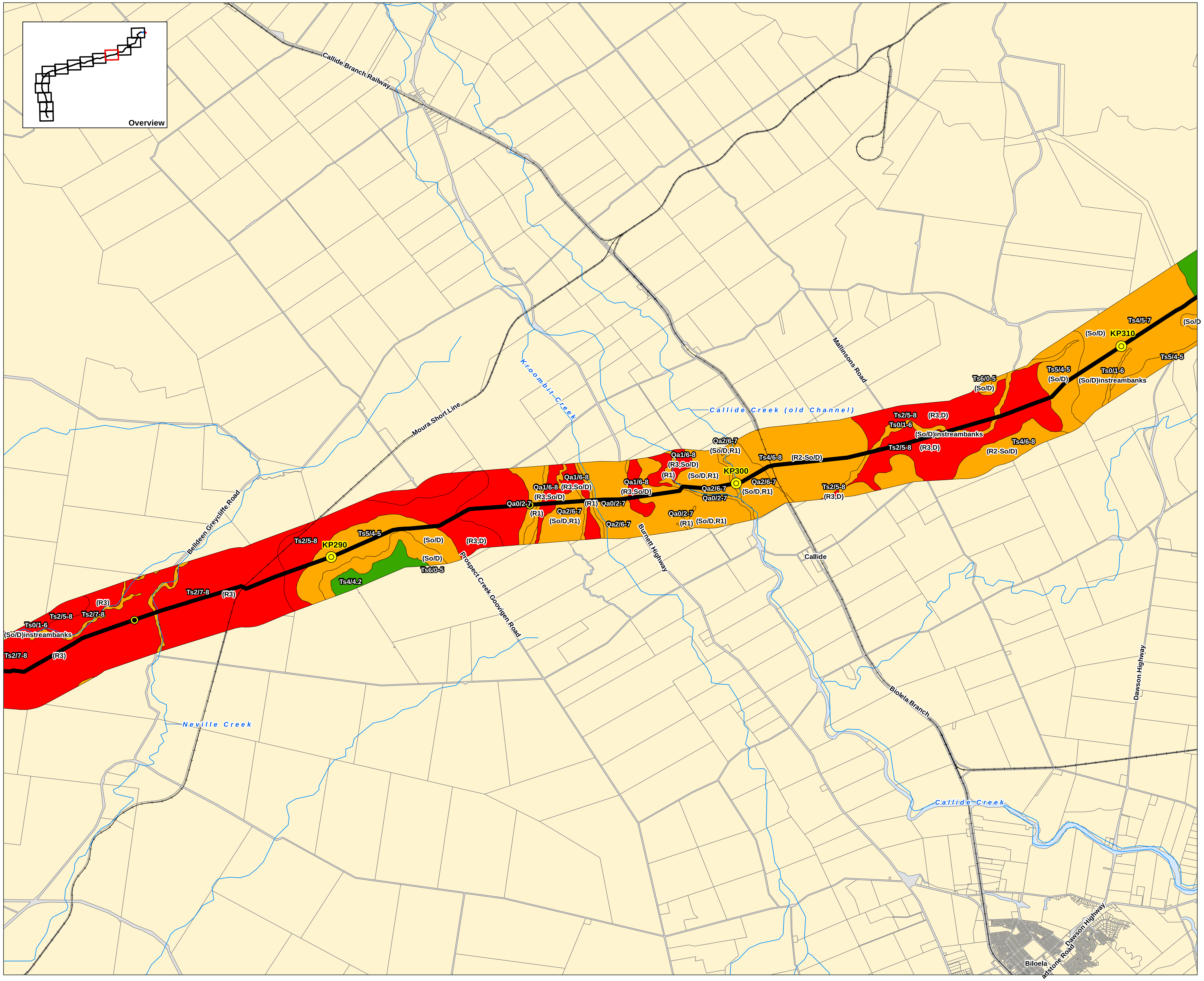
Soil Constraints: Problem Soils

Appendix A (Page 10 of 15)

Date: 11/04/2011 Version: b



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GLNG No: 3381-40-0410

Coordinate system: GCS_GDA_1994

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Mainland GTP EM Plan

Gas Transmission Pipeline (GTP)
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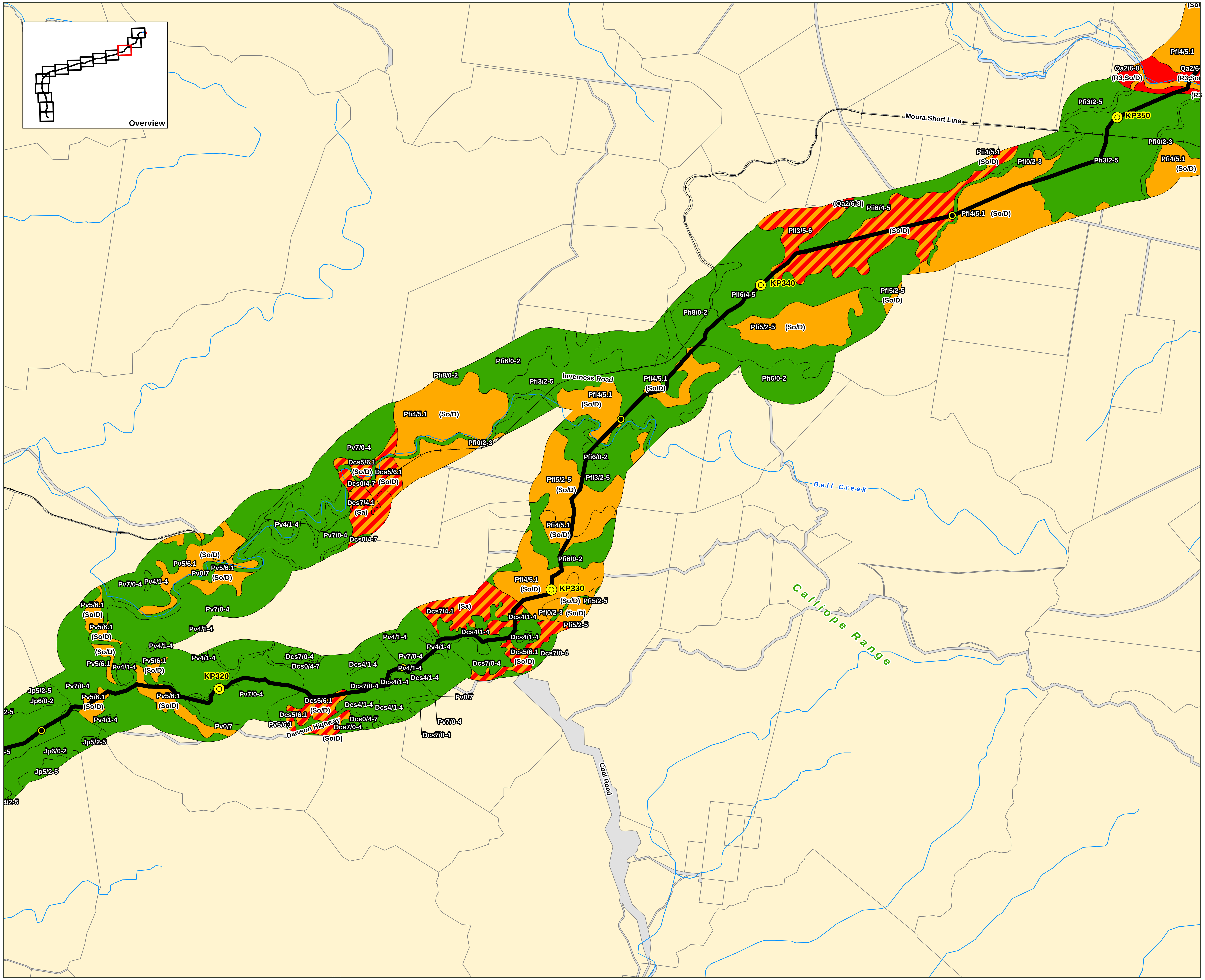
Soil Constraints: Problem Soils
Appendix A (Page 11 of 15)

Date: 11/04/2011 Version: b



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Mainland GTP EM Plan

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Soil Constraints: Problem Soils Appendix A (Page 12 of 15)

A1 scale: 1:50,000

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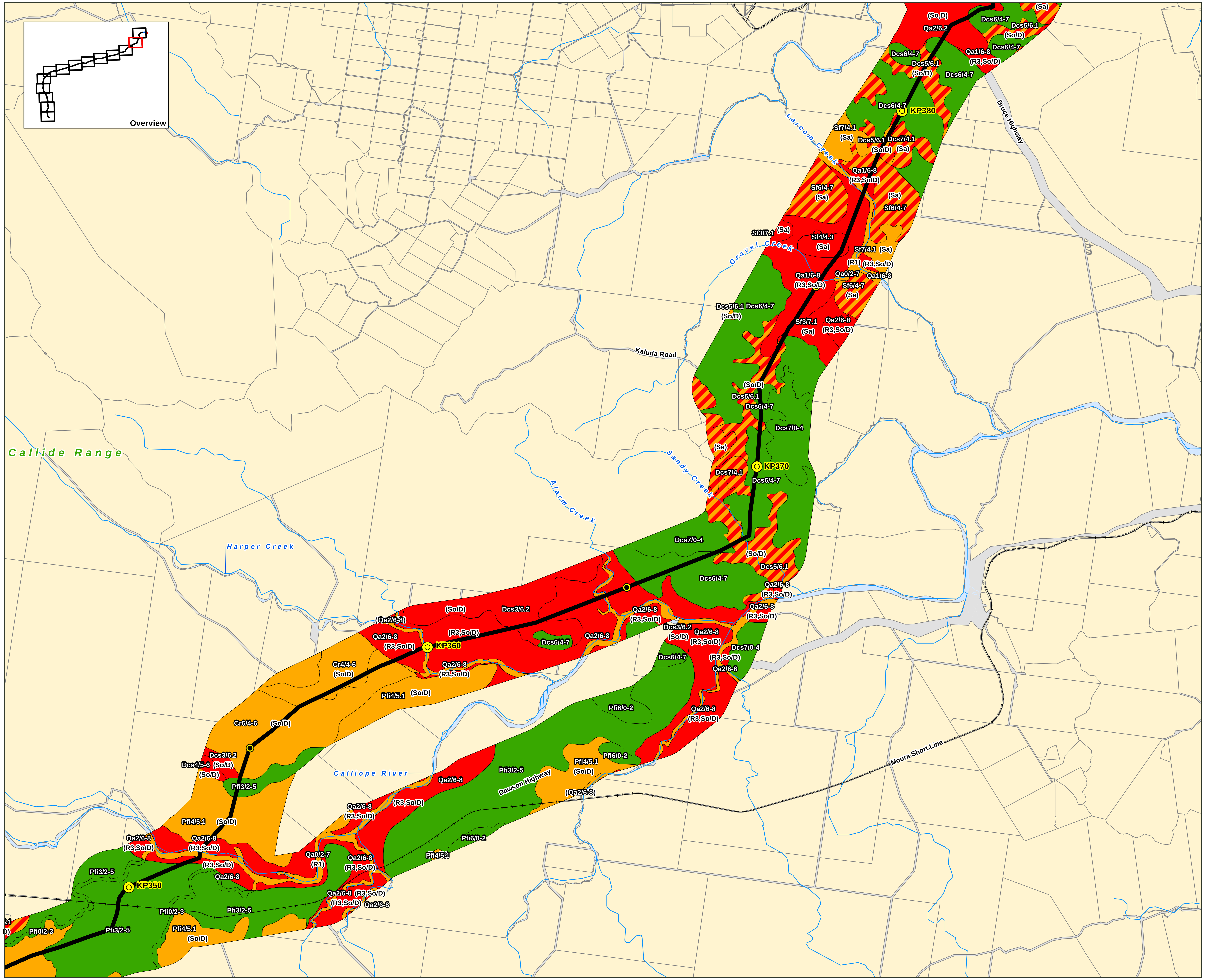
GLNG No: 3381-40-0410

Coordinate system: GCS_GDA_1994

Date: 11/04/2011

Version: b



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GLNG No: 3381-40-0410

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Mainland GTP EM Plan

Gas Transmission Pipeline (GTP)

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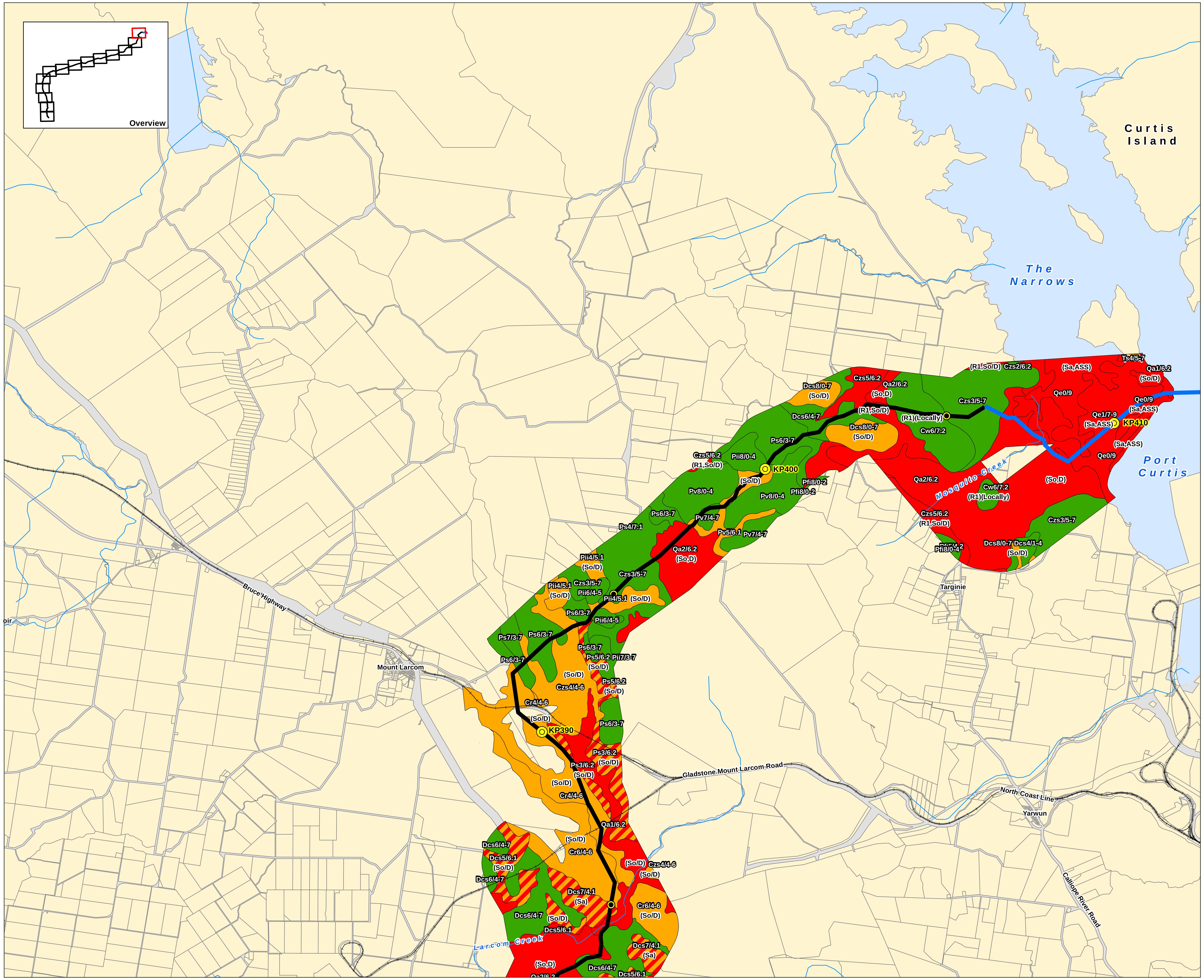
Soil Constraints: Problem Soils

Appendix A (Page 13 of 15)

Date: 11/04/2011 Version: b



Mainland GTP EM Plan

Gas Transmission Pipeline (GTP)
- Mainland GTP EM Plan
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Kilometre Post Distance Marker
- 10km
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Soil Constraints: Problem Soils
Appendix A (Page 14 of 15)

A1 scale: 1:50,000

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GLNG No: 3381-40-0410
Coordinate system: GCS_GDA_1994

Date: 11/04/2011 Version: b

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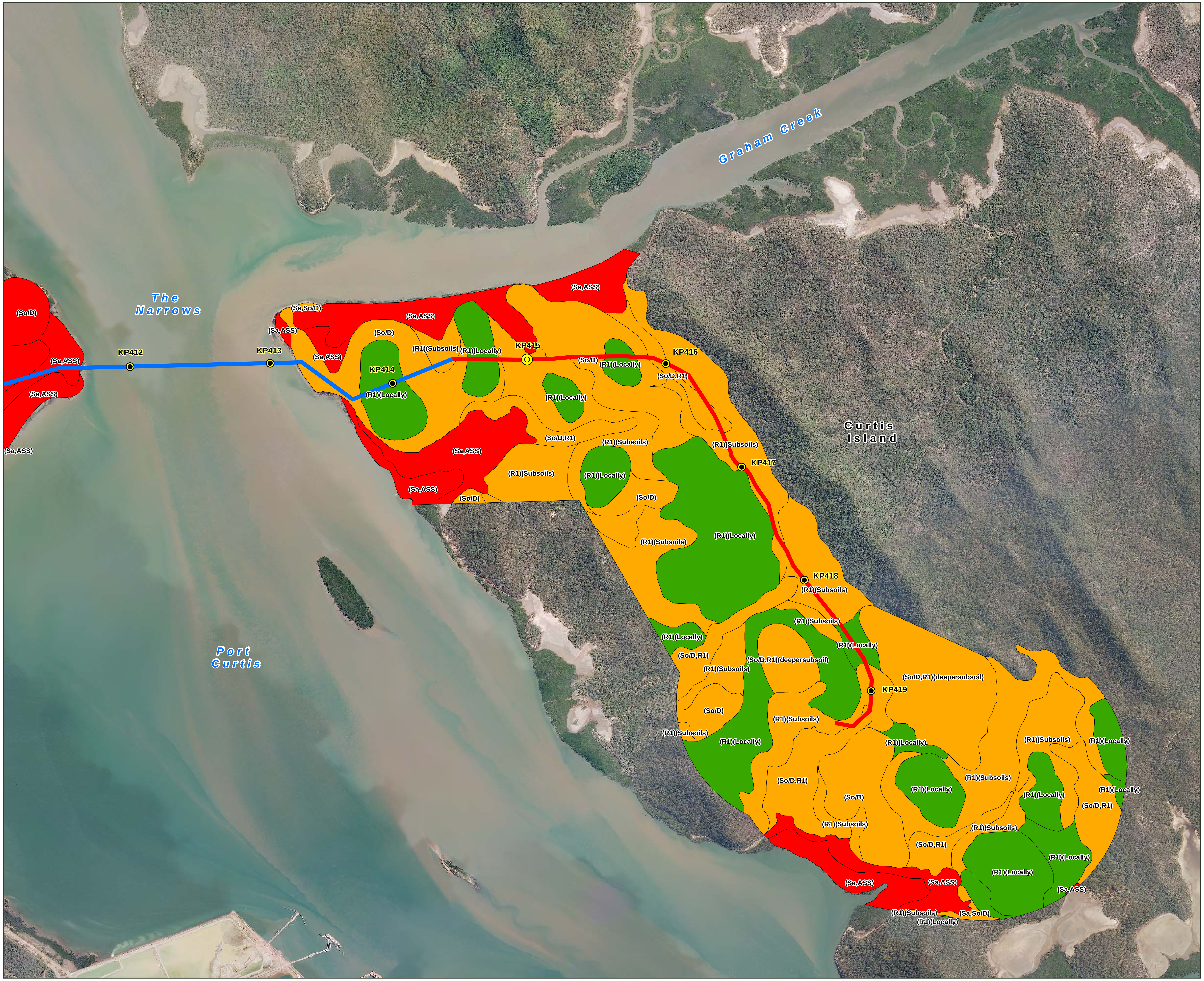

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GLNG No: 3381-40-0472

Coordinate system: GCS_GDA_1994

Curtis Island GTP EM Plan

Gas Transmission Pipeline (GTP)
- Mainland GTP EM Plan
- Marine Crossing GTP EM Plan
- Curtis Island GTP EM Plan

Kilometre Post Distance Marker
- 5km
- 1km

Problem Soil
- High
- Moderate
- Low

Description:

R
Soil Reactivity
L - Nil or low soil
R1 - Moderately reactive soils
R2 - Shallow or medium deep, highly reactive (cracking) clay soils
R3 - Deep, highly reactive (cracking) clay soils

Sa
Soil Salinity
L - Nil to Low Salinity
M - Medium Salinity
H - High to Very High Salinity

So
Sodicity (ESP)
N - Very low or non Sodic, ESP <6%
Rating 1 - Sodic, ESP 6-14%
Rating 2 - Strongly Sodic, ESP >14-25%
Rating 3 - Very strongly Sodic, ESP >25%

D
Dispersion Class
N - Non-dispersive
SI - Slightly Dispersive
M - Moderately Dispersive
H - Strongly Dispersive

ASS
Acid Sulfate Soils

Note: All figures should be reviewed in conjunction with Table 7.1 "Generic Key to the identification of Terrain Units", URS 2009.

Source:
Gas Transmission Pipeline (GTP): Santos, Jan 2011.
Aerial: Santos, Feb 2011.
GLNG Terrain Units: Supplementary EIS, URS, 2009.

Soil Constraints: Problem Soils

Appendix A (15 of 15)

Date: 08/04/2011   Version: 0

Appendix B
Species Management Plan

The Species Management Plan is now a standalone document (Document Number: 3380-GLNG-3-1.3-0036) and does not form part of this EM Plan.

Appendix C

Significant Species Management Plan

The Significant Species Management Plan is now a standalone document (Document Number: 3380-GLNG-3-1.3-0031) and does not form part of this EM Plan.

Appendix D

Pest and Weed Management Plan

GLNG
Gas Transmission Pipeline

Pest and Weed Management Plan

Document Number: 3380-GLNG-3-1.3-0006

PREPARED BY:

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DATE	REV	REASON FOR ISSUE	AUTHOR	CHECKED	APPROVED
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29/03/12	5	Revised for SEWPaC Review	AW	BF	NC
16/05/12	6	Revised for SEWPaC Second Review	AW	BF	NC

TABLE OF CONTENTS

Attachments

1. Introduction

1.1 Purpose

The purpose of this Pest and Weed Management Plan (PWMP) is to detail the requirements for the management of weeds associated with the construction of the GLNG Gas Transmission Pipeline (GTP). The PWMP is applicable to GLNG Operations (the Company) employees, Contractors and all personnel associated with the planning and construction of the pipeline.

1.2 Scope

The scope of this document is to outline the pest and weed management protocols for the various stages of the GLNG GTP and to provide the Contractor with a baseline set of weed data and management strategies to assist the Contractor in developing an acceptable CPWMP.

Pre-construction:

Clearly define the boundaries and procedures throughout the Project Area to ensure all preconstruction activities (surveys, landholder access, site visits, infrastructure upgrades and preparation) to not transfer Class 1 or 2 weeds from areas currently infested to new “clean” areas.

Construction

To provide the physical and procedural parameters and boundaries to the EPC Contractor from which they can develop their project specific ‘Contractors Pest and Weed Management Plan’. Together, these plans will provide the procedures and guidelines on how the spread of weeds throughout the Project Area will be prevented and compliance with this document will be maintained.

Post Construction

To establish the boundaries and procedures for weed management along the Pipeline for all monitoring and maintenance procedures for the Project life.

This document has been prepared in accordance with the EIS and SEIS for the GLNG Project, as well as the Project Environmental Management Plans

1.3 Objectives and Performance Criteria

The objectives and performance criteria for the PWMP (Pest and Weed Management Plan), as detailed in the GLNG Project EIS, are:

Objective

- To prevent the introduction and spread of weed and pest species throughout areas associated with the construction of the GLNG Transmission pipeline

Performance Criteria

- No new weed infestations in the Project Area (pipeline, access tracks and ancillary Project Areas (laydown areas, camps, water points, quarries etc) as a result of construction activities
- No spread of weeds from infested areas to previously weed free areas
- No mature or seeding weeds located within the Project Area during construction

- Right of Way (ROW) restored to a state that minimises the potential for weed colonisation of disturbed areas
- No net increase in the abundance or distribution of pest animal species in the Project Area

1.4 Definitions

Term	Definition
Certified Clean	Washed down vehicle Certified clean by Weed Inspector
Class 1 Declared Plant or Declared Animal	A plant or animal that: • Is not commonly present in Queensland and, if introduced, would cause an adverse economic, environmental or social impact • Are subject to eradication from the state Landowners must take reasonable steps to keep land free of Class 1 pests It is a serious offence to introduce, keep or supply a Class 1 pest without a permit issued by the Department of Primary Industries and Fisheries
Class 2 Declared Plant or Declared Animal	A plant or animal that: • Is established in Queensland and have, or could have, an adverse economic, environmental or social impact • Requires coordination and are subject to programs led by local government, community or landowners Landowners must take reasonable steps to keep land free of Class 2 pests It is a serious offence to introduce, keep or supply a Class 2 pest without a permit issued by the Department of Primary Industries and Fisheries
Class 3 Declared Plant[1] or Declared Animal	A plant or animal that: • Is established in Queensland and has, or could have, a substantial adverse economic, environmental or social impact Landowners may be required to manage Class 3 weeds in or near environmentally significant areas such as protected areas, important habitats for threatened species or areas of interest only
Declared Pest	A live animal or plant confirmed to be a declared pest under the *Land Protection (Pest and Stock Route Management) Act 2002*
Infested Area	An area infested with a declared pest. These areas can be defined by local council, the regulatory body or local landholders – depending on the size of the infestation
Inspection	Inspection carried out by a trained Weed Inspector in compliance with the Queensland Government *Queensland Checklist for Inspection Procedures*

[1] This class has been inserted for information purposes only as weed surveys to date have not included Class 3 plants. However, as noted, Class 3 plants may need to be managed within environmentally significant areas and it is recommended that pre-construction surveys record the locations of such species in such areas.

Term	Definition
Project Area	Includes the pipeline ROW, access tracks and ancillary Project Areas (laydown areas, camps, water points, quarries)
Washdown Log	Log of washdowns completed for a specific vehicle/plant/equipment. The Log is maintained by the vehicle/equipment operator
Washdown	Washdown carried out, using the provisions of the Queensland Government *Queensland Checklist for Cleandown Procedures* as a Guideline, to remove organic matter and material from vehicles and equipment that may lead to the introduction or spread of weed species
Washdown Register	Washdown Facility specific Register of all washdowns completed at the particular Washdown Facility. The Register is maintained by the Weed Inspector for the particular facility
Weed Inspector	Person who has completed Weed Inspector Training and is trained in the following nationally recognised units: • RTD2312A Inspect Machinery of Plan Animal and Soil Material • RTD2313A Clean Machinery of Plant Animal and Soil Material OR Person accepted by the Company as having the appropriate training to undertake the role as outlined in the PWMP e.g. nominated Environmental Officer(s)
Weed Management Zones	The Project Area has been divided into Weed Management Zones to assist with the implementation of this PWMP. Refer to Section 2.2.1

1.5 Abbreviations

ACDC Act	Agricultural Chemicals Distribution Control Act 1966
CICSDA	Callide Infrastructure Corridor State Development Area
CPWMP	Contractor Weed Management Plan
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EPC	Engineering, Procurement and Construction
GLNG	Gladstone Liquefied Natural Gas
GRT	Giant Rats Tail Grass
GSDA	Gladstone State Development Area
GTP	Gas Transmission Pipeline
ROW	Right of Way
WMP	Weed Management Plan (this document)

2. Background

2.1 Identification of Key Risks

2.1.1 Weed Survey

Weed surveys of the pipeline route and associated Project Area have been completed. Further weed surveys will be completed by the Contractor to further refine the nature and extent of weeds within the Project Area, such that the information is current at the time construction activities commence.

In addition to consultation with local authorities and landholders, weed surveys undertaken during 2009, 2010 and a field revision in 2011 have identified the following weeds to be of major concern within the Project Area and surrounds:

- *Parthenium hysterophorus* (Parthenium) – Class 2 weed
- *Sporobolus pyramidalis* (Giant rats tail grass) – Class 2 weed
- *Eragrostis curvula* (African love grass) – major concern to landholders

Details of all species identified during the field surveys along with their location are provided as Attachment D.

2.1.2 Pest animal survey

Fauna surveys of the pipeline route and associated Project Area were undertaken between 2008 and 2010 with the following pest animals were recorded:

Canis lupus dingo and *Canis familiaris* (Dingo and wild dog) – Class 2 pest animals
Vulpes vulpes (red fox) – Class 2 pest animal
Sus scrofa (feral pig) – Class 2 pest animal
Felis catus (feral cat) – Class 2 pest animal
Oryctolagus cuniculus (rabbit) – Class 2 pest animal
Rhinella marinus (cane toad) – not a declared pest animal

Note The National Management Group, Australia´s key decision-making body on emergency pests, has officially declared that red imported fire ant has been eradicated from the area, following a successful eradication and pest freedom verification program carried out by Biosecurity Queensland. This means that the movement restrictions on high-risk materials can now been lifted. This is a big win for the fire ant eradication program and the Yarwun community. However, fire ants still pose a threat and restrictions remain in place in South East Queensland. Fire ants are easily spread in soil, mulch, plants and landscaping equipment, so movement controls must be adhered to in order to reduce the risk of further spread.

Source http://www.dpi.qld.gov.au/4790_18539.htm

2.1.3 Review of Activities

A review has been undertaken of the pipeline construction activities. Activities considered to pose the highest risk of introducing or spreading weeds and pest animals are listed below and will be subject to specific controls:

- Pre-construction route field studies (eg geotechnical studies, route review with landholders, route inspection with contactors)
- Activities on pipeline route prior to clearing and grading of the ROW
  - Survey Crew

- Fencing Crew
- Clear and grade activities
- First arrival of construction vehicles, equipment and supplies
- Accessing ROW and travelling back to camps
- Movement of vehicles between crews/activities
- Deliveries of materials to the ROW
- Travelling away from Project Area after accessing the ROW

2.2 Overview of Management Strategies

The Company's strategy is controls focused on preventing the introduction and/or spread of weed and pest animal species during the construction of the GLNG GTP. The Company has determined that the controls to prevent the introduction and/or spread of Parthenium and Giant Rats Tail Grass (GRT) will also be effective in controlling the introduction and/or spread of the other weed species.

There are numerous strategies available for weed management however it must be noted that individually, they cannot adequately manage or control the spread of weeds. The effective management of weed will only be attained through the combination of a series of weed management strategies. (i.e. vehicle washdowns will not get every seed off a vehicle). Weed spraying will not kill every plant and there is no chemical that kills seeds effectively. Isolating certain vehicles to certain areas is effective, however this relies on the integrity of project personnel, which is not a factor that this project is going to rely on. In addition, the pest animal species detected in the Project Area are widespread and established across the region, so their management will require an integrated, catchment-scale approach.

2.2.1 Weed Management Zones

It will be the responsibility of the Contractor to determine appropriate weed management zones for the Project Area and manage the zones accordingly. However as a minimum, the information and mapping provided in Attachment D should be used to determine 'clean' and 'dirty' locations and develop appropriate weed management protocols.

2.2.2 Summary of Strategies

The major strategies to be implemented in the PWMP to control the identified risks are:

a) Ongoing weed surveys and weed spraying
b) Training of personnel in the requirements of this PWMP
c) Establishment of weed management zones
d) **Control vehicle and equipment movements** between zones via a sticker identification system
e) Establishment of weed washdown facilities staffed by appropriately qualified and experienced Weed Inspectors
f) Ensuring all vehicles, equipment and supplies brought to the Project Area and departing are **certified clean**
g) Implementation of inspection and monitoring protocols
h) Post-construction weed monitoring and control strategy

Note The weed control strategies outlined in this PWMP are based upon weed surveys completed during 2009, 2010 and 2011. Upon completion of any additional surveys, the weed control strategies may be further revised

Pest animals

- Ensure all vehicles, equipment and supplies brought to the Project Area are free of pest animals
- Report all sightings of pest animals and monitor changes in abundance or distribution within the Project Area
- Secure waste organic material (eg food scraps) to deter scavenging by pest animals
- Avoid creating artificial water sources (eg depressions) that provide a source of drinking water to vertebrate pests or breeding habitat to invertebrate pests
- Support a broad scale, integrated pest management approach as identified in regional and state pest management strategies

3. General provisions

3.1 Responsibilities

Company – Implementation of the PWMP up to the point of the issue of the EPC contractor. The Company is also responsible for review and acceptance of the Contractor's CPWMP, monitoring compliance of the Contractor to the requirements of the WMP and CEMP, and management of the EPC contract which contains KPI's associated with implementation of this PWMP.

Contractor – Development and implementation of a Contractor Weed Management Plan (CPWMP) to comply with the PWMP. This will include (but not limited to) completion of pre-construction survey(s) and pre-construction weed control, training of personnel (see below), provision and maintenance of equipment, facilities and associated services and consumables and the monitoring of compliance to the CPWMP[2].

Supervisors (Contractors and the Company) – establishment of a best practice culture and monitoring, and enforcement of the requirements of this PWMP and the CPWMP. This will include ensuring that all sub-Contractors are aware of the requirements of the CPWMP prior to entering the Project.

Plant / vehicle operators – ensuring plant/equipment is certified as clean prior to arrival to the Project Area, undertaking washdown at required locations, maintaining a Washdown Log and ensuring activities are completed in accordance with WMP and CPWMP.

Weed/Pest inspector – inspection of vehicles, certification to cleanliness, administer weed zone stickers, maintain Washdown Register for the facility and ensure serviceability of washdown equipment on site.

Note The CPWMP will be designed to demonstrate the Contractors systems and procedures by which they will ensure compliance with this document. Where the CPWMP or any other contractual document refers to the PWMP, this will imply compliance with the Company PWMP through the complete implementation of the CPWMP. A breach of the CPWMP will be a breach of the PWMP and will imply a failure to meet a Key Performance Indicator.

3.2 Training

The Company and the Contractor are responsible for ensuring that the following training is completed.

Weed/Pest Inspector(s) – Completed Weed Inspector Training and is trained in the following nationally recognised units.

- RTD2312A Inspect Machinery of Plan Animal and Soil Material
- RTD2313A Clean Machinery of Plant Animal and Soil Material
- Alternate training and/or experience accepted by the Company (refer to Section 1.4)

All personnel – inducted to requirements of the PWMP including:

- Identification of key weed species and pest animal species
- Washdown requirements (on specific vehicles and where to clean)
- Access protocols (between the specified zones)
- Certification process (stickers, Washdown Log, Washdown Register, Weed Inspector)

[2] Records of all induction and training completed shall be maintained to demonstrate compliance with this PWMP. The CPWMP will be designed *to demonstrate the Contractors systems and procedures by which they will ensure compliance with this document. Where the CPWMP or any other contractual document refers to the PWMP, this will imply compliance with the GLNG PWMP through the complete implementation of the CPWMP. A breach of the CPWMP will be a breach of the PWMP and will imply a failure to meet a Key Performance Indicator.*

4. Company Pre-Construction Weed and Pest Animal Management

This section applies to all activities undertaken by the Company and associated Contractors or consultants prior to award of the EPC contract.

Upon award of the contact and approval of the CPWMP by the Company, all Project personnel shall comply with the requirements of the CPWMP.

4.1 Weed Identification and Control

4.1.1 Requirements

Weed Identification

- Weed surveys of the Project Area (including ROW, access tracks and any known ancillary areas) were undertaken by trained personnel/contractors in June and September of 2009 (dry season) and February and June of 2010 (post wet season). An additional review has been undertaken in April 2011 and the results have been attached in the update plans and material
- Weeds identified were recorded and have been mapped accordingly (refer Attachment D)
- The Company personnel will continue to liaise closely with local Council officers and landholders for existing weed information
- Survey findings will be utilised by Project personnel and Contractors to define the specific weed control measures for construction and the targeted weed control program

Weed Control

- Prior to the appointment of the Contractor, weed control of the Project Area (ROW, camps, storage areas, access) will be undertaken by appropriately qualified and experienced contractors who are appropriately licensed under the *Agricultural Chemicals Distribution Control Act 1966* (ACDC Act)
- Where possible, weed control will be scheduled to occur prior to weed seeding
- Prior to weed spraying, relevant land holders will be consulted
- Significant weed infestation areas will be monitored after treatment and repeat treatment undertaken as required

4.1.2 Performance Indicators

- Weed surveys undertaken during at least one dry and one wet season.
- Weed outbreaks recorded in GIS
- Weed control completed and recorded
- Weed zones established, monitored and marked on project maps (updated as applicable)
- No mature weeds or seeding plants within Project Area

4.2 Pre-Construction Access to Project Area

This section applies to all vehicles accessing the Project Area and travelling off sealed public roads.

4.2.1 Requirements

- Planning for access to the Project Area will include:
  - Identification of existing vehicle washdown facilities and planning work around the location of washdown facilities (refer to Attachment A for a list of public facilities)
- If applicable, fixed washdown facilities and washdown procedures shall comply with:
  - *Queensland Guideline for the Construction of Vehicle and Machinery Washdown facilities* (refer to Section 8)
  - *Queensland Government Checklist for Clean-down* (refer to Section 8)
- When moving between 'dirty' and 'clean' areas, within the Project Area, vehicles, plant and/or equipment will:
  - Be washed down and certified clean
  - Provide/be issued with a Weed Hygiene Declaration Form
  - All vehicles/equipment/plant shall have a Washdown Log (refer to Attachment B for an example of a washdown log) that must be maintained by the vehicle operator. This includes washdowns that require certification and washdowns completed by the vehicle operator. Washdown Logs are auditable and shall be provided upon request
- Vehicle operators:
  - Shall remain on designated access tracks and avoid driving through weeds as far as possible
  - Must not drive though flowering or seeding plants
- The location of any mature and/or seeding weed species is to be reported to the Company Pipeline Environmental Manager within 24 hrs

4.2.2 Performance Indicators

- Weed locations marked on Project maps
- Washdown Logs implemented and maintained
- Washdown Logs demonstrate washdown occurring to coincide with vehicle/equipment/plant movements
- Washdown facilities are available at all times (mobile/temporary units are available prior to establishment of fixed facilities)
- Weed Inspectors present at active washdowns
- No driving through seeding or flowering weed plants

5. EPC Contractor Pre-Construction Weed and Pest Animal Management

This section applies to all activities undertaken by the EPC Contractor prior to the commencement of construction. The only field activities that may be carried out under this section prior to the establishment of washbays and other weed control infrastructure will be weed surveys, or weed management work and/or work associated with the establishment of fixed weed washdown facilities.

5.1 Project Establishment

5.1.1 Requirements

Development of Construction Weed Management Plan

- CPWMP shall:
  - Be prepared by the Contractor and submitted to the Company for approval <u>prior to any work under the EPC contract commencing</u>
  - Comply with the requirements of this PWMP
  - Establish a system to control the movement of vehicles and equipment between weed management zones (refer to Section 2.2.1)
  - Provide the procedures that detail how compliance will be implemented
  - Establish a system to monitor and report on pest animal abundance and distribution
  - Identify the control measures that will be adopted to manage the impacts of existing pest animals within the Project area

Weed Zones

- Weeds management zones will be developed and implemented by the Contractor
- The construction area will be divided into weed management zones for the purpose of defining and preventing the unrestricted movement of vehicles from ‘dirty’ to ‘clean’ zones
- The zones shall be clearly identified both in the CPWMP and on the ground and work programs and flow designed around the zones
- Zones shall be clearly marked on construction drawings and within the field

Establishment of Washdown Facilities

- The location of project specific weed washdown facilities will be determined in consultation with weed management zone maps
- These washdown facilities shall be established to enable the efficient movement of vehicles between the weed zones whilst ensuring material that may facilitate the introduction or spread of weeds is removed. This may include the use of mobile washdown facilities where appropriate
- As a minimum, these washdown facilities shall be installed at the following locations:
  - At each construction camp
  - Boundaries of each weed zone
  - Major access points to the ROW, corresponding with weed zone boundaries
- Additional washdown facilities shall be constructed/resourced as required
- Each active washdown facility that is established for certification of vehicles shall be permanently staffed by an appropriately experienced and qualified Weed Inspector (when works are not occurring in that area there will be no need for an

inspector, however arrangements will be required to be made for an inspector to certify the vehicle if movement through the facility is required)

- Washdown facilities shall:
  - Be sized and equipped to facilitate the quick movement of vehicles and equipment within the Project Area whilst ensuring compliance with the CPWMP or this PWMP
  - *Comply with Queensland Guideline for the Construction of Vehicle and Machinery Washdown facilities* (refer to Section 8)
  - Include equipment to remove material from within the vehicle
- The location of Washdown Facilities shall be recorded in the project GIS, clearly marked on project maps and included in the inspection and monitoring program

Location of Infrastructure and Access routes

- It is recommended that construction camps be established such that crews can work within a defined zone and travel to and from camp without crossing a zone
- The location of construction access routes, delivery areas, stockpiles and laydown areas shall take into consideration the location of these zones and weed management strategies outlined in this PWMP
- Access routes shall be planned to achieve the following:
  - Vehicles operate in such a manner as to limit crossing of weed zone boundaries
  - Vehicles start in clean areas and then move into the dirty areas
  - Vehicles do not drive though or contact any seeding or flowering weeds
  - Vehicles are subject to washdown and certification to move between zones

5.1.2 Performance Indicators

- CPWMP developed and approved by the Company prior to entry to the field (HOLD POINT)
- Weed zones established and marked on project maps
- Project specific weed washdown facilities are immediately established and identified on project maps
- Weed Inspectors are present at designated washdown facilities

5.2 Weed and Pest Animal Identification and Control

5.2.1 Requirements

Weed Identification

- Prior to construction, regular weed surveys of the Project Area (including ROW, access tracks and any known ancillary areas) shall be undertaken
- Weed surveys shall be:
  - Undertaken by trained personnel or Contractors
  - Scheduled for times of high weed growth ie within 2 weeks or as soon as possible after first significant rainfall event and/or after periods of high rainfall
- Weeds identified shall be recorded in project GIS and included in project mapping

Pest animal identification

- Prior to construction, regular pest animal surveys of the Project Area (including ROW, access tracks and any known ancillary areas) shall be undertaken;
- Pest animal surveys shall be: Undertaken by appropriately qualified and experienced personnel or Contractors. Scheduled for both night (spotlight

searches) and day. Undertaken incidentally dependent on environmental conditions (eg pest predator populations may irrupt following periods of high rainfall):
  - Incidental sightings of pest animals should be recorded and included in weekly Environmental Reports
  - Pest animals identified shall be recorded in project GIS and included in project mapping

Weed Control

- Prior to construction, weed control of the Project Area (ROW, camps, storage areas, access) shall be undertaken by appropriately qualified and experienced Contractors who are appropriately licensed under the ACDC Act
- Weed control shall be scheduled to occur prior to weed seeding
- Prior to any weed spraying, permission shall be obtained from the Company
- Significant weed infestation areas shall be monitored after treatment and repeat treatment undertaken as required

Pest animal control

- If deemed necessary (ie where infestations occur), prior to construction, pest animal control of the Project Area (ROW, camps, storage areas, access) shall be undertaken by appropriately qualified and experienced Contractors who are authorised persons under the *Land Protection (Pest and Stock Route Management) Act 2002*
- Pest animal control shall be humane, strategic, integrated and adopt best practice principles as outlined in the following publications:
  - NSW Department of Primary Industries Humane Pest Animal control: Code of Practice and Standard Operating Procedures and related Model Codes of Practice for the Humane Control of Vertebrate Pests which are available at the following link http://www.feral.org.au/tag/COP/
  - The Animal Care and Protection Act 1994 specifically in relation to the appropriate treatment and euthanasia of pest animals. Any euthanasia will be undertaken in accordance with the Australian Code of Practice for the Care of Animals for Scientific Purposes, 7th Edition, 2004
  - Threat Abatement Plans for key species. GLNG will act within the requirements of threat abatement plans. Specifically the plans require a property management plan; in this case the pest and weed management plan will fulfil this requirement. The threat abatement plan requires input to local and regional databases for pest animal distribution. GLNG will collect data on pest species captured and will make this data available for reporting
  - The QLD government pest animal fact sheets
- The approach will be to manage pests encountered within the RoW during trenching activities. The Fauna Handler is to euthanise the animal as per the Fauna Handling Procedure. Where pest numbers are a concern to human safety (e.g. high numbers of feral pigs), a suitably qualified vertebrate pest field officer is to be contacted to implement a mitigation strategy (i.e. culling activities).Prior to any pest animal control, permission shall be obtained from GLNG
- Significant pest animal infestation areas shall be monitored after treatment and repeat treatment undertaken as required

5.2.2 Performance Indicators

- Weed and pest animal surveys monthly or more frequently after rain events
- New weed outbreaks recorded in GIS

- Weed control completed and recorded
- No flowing or seeding weeds within Project Area
- Company approval obtained prior to spraying
- Incidental sightings of pest animals recorded

6. Project Weed Management

6.1 Management of Access to the Project Area

6.1.1 Requirements

The Contactor shall establish a system for the control of vehicles within and between weed management zones and this system shall be documented in the CPWMP submitted to the Company for approval. The minimum requirements are outlined below.

- Prior to entering or leaving the Project Area vehicles, plant and/or equipment shall:
  - Be washed down and certified clean
  - Provide/be issued with a Weed Hygiene Declaration Form
- Additional washdown and certification will be required:
  - When travelling from a 'dirty' weed management zone to a 'clean' weed management zone (refer to Section 2.2.1). Vehicles will require the old sticker to be removed and a new one issued
  - All vehicles shall display the appropriate sticker(s) to define the zone they are approved to access and travel within
  - Different stickers shall represent authorisation for different zones and each sticker shall be numbered
  - Signage shall be installed at key points within the Project Area clearly outlining the Zone and certification requirements for entry and exit
  - Site specific washdown facilities shall be established in accordance with Section 5.1 and operated in accordance with Section 6.3
  - Boundary fence lines shall be marked both on alignment sheets and in the field, and crews shall not transfer anything across these lines unless authorised by the relevant Supervisor
  - No organic material shall be moved between zones
  - No haybales or equivalent materials shall be used on the project

Clear and Grade Crew

- Clear and grade crew will be subject to additional washdown at defined locations along the ROW where the specific weed infestation changes occur (eg Prickly Acacia, Mother of Millions and Rubber Vine)
- This will apply between specified properties within relevant zones
- The location of additional washdown points shall be clearly identified both on alignment sheets and in the field
- Washdowns in this situation shall be recorded by the Environmental Officer or the Weed Inspector in the relevant Washdown Log

6.2 Road Vehicles and Deliveries

The protocols for access to the Project Area outlined in Section 6.1 shall apply to all vehicles, including delivery vehicles, buses etc, even if they are only travelling on sealed public roads. The Contractor may propose an alternate system (must be approved by the Company prior to implementation) that includes the following requirements:

- Vehicles that are limited to travel on public roads must not leave a public road unless it is washed down and certified again prior to re-entering that public road

- Delivery vehicles travelling off sealed public roads must wash down and be certified for all travel from a 'dirty' to a 'clean' zone

6.3 Operation of Washdown Facilities

6.3.1 Requirements

- Site specific weed facilities shall be established in accordance with Section 5.1
- Stickers designating vehicle cleanliness and zone authorisation shall only be administered:
  - By a Weed Inspector
  - Once a vehicle is certified clean
  - For the zone where access is required
- Stickers may only be removed by a Weed Inspector
- Procedures for the washdown and inspection of vehicles shall:
  - Be established and documented in the CPWMP
  - Comply with the *Queensland Government Checklist for Clean-down and Inspections* (refer to Section 8)
- The vehicle/plant/equipment operator shall maintain the Washdown Log for all washdowns completed (refer to Attachment B)
- The Weed Inspector shall maintain a Washdown Register of all washdowns and vehicle/plant/equipment certifications completed at their allocated facility (refer to Attachment C for an example of a washdown register)
- Stickers shall be numbered and the corresponding number recorded on the Washdown Logs and Washdown Registers
- Upon departure from the Project Area, all stickers shall be removed by a Weed Inspector

Both a washdown log and washdown register are shown in Attachments B and C respectively. The washdown log is for the vehicles and is carried around in each piece of machinery. Signoff will be by the person operating the machinery. The washdown register is for the washdown bays themselves and will have signoff by a certified inspector.

6.3.2 Performance Indicators

- Washdown Registers and Washdown Logs consistent and correspond to vehicle movements
- Vehicles displaying correct stickers
- Weed Inspectors present and certifying to appropriate standard at active washdowns
- Washdown facilities are maintained and fully operable
- No mature weeds in flower or seed throughout the ROW and Ancillary works areas

6.4 Inspection and Monitoring

The Contractor shall establish an Inspection and Monitoring Program defining the scope, the interval and responsibility. The program shall be documented within the CPWMP.

As a minimum, the inspection and monitoring program shall include:

- Random checks on cleanliness of vehicles/plant/equipment and completion of Washdown Logs

- Daily inspection of vehicles within each zone to ensure correct stickers are displayed
- Weekly inspection/monitoring of Project Area for evidence of weeds
- Spraying of weed infestations by licensed Contractors (as approved by the Company)
- Random inspection of Washdown Logs and facility Washdown Registers – for consistency and correspond to vehicle movements
- Inspection of facility Washdown Registers and random cross checking of Washdown Registers versus Vehicle Washdown Logs

Corrective Action

- Equipment/vehicles failing inspections will be subject to be rewashed prior to certification
- Weed spraying of weed outbreaks
- Incident report or non-conformance report raised for non-compliances identified
- Contractor will assume responsibility for future management of weeds in an area of non-compliance
- Repeated non-compliance will result in stop-work, recertification of equipment and retraining of individuals

6.5 Records to be Maintained

The Contractor shall document within the CPWMP, the records that will be maintained to demonstrate compliance with this PWMP. This shall include the title, responsible person and the storage location for that record. As a minimum, this shall include:

- Washdown Logs for vehicles/plant/equipment
- Washdown Registers for facilities
- Records of Inspections completed as outlined in Section 6.4
- Induction and Training Records
- Incident Reports
- Non-compliance reports
- Audit Reports
- Evidence of weed surveys and monitoring activities
- Records of weed control activities

7. Project Pest Management

7.1 Prevent establishment of pest animals

7.1.1 Requirements

Pest animals known to occur in the Project Area are listed in section 2.1.2. Any new pest animals detected are to be reported immediately to Company and recorded in the Project GIS.

7.1.2 Performance indicators

- Pest animals are not proliferated in the Project Area

7.2 Management of existing pest animals

7.2.1 Monitoring

Spotlight and diurnal surveys

The Contractor will establish a regular monitoring program of nocturnal (spotlight) and diurnal ground pest animal surveys. These surveys shall:

- Occur at least every two months
- Be either on foot or by slow moving vehicle
- Be representative of all regions of Project Area (ROW, camps, storage areas, access)
- Be undertaken by appropriately qualified and experienced personnel
- Follow accepted survey methodology for transect surveys of ground-dwelling vertebrate fauna (see for example, EPA (1999) and Eyre et.al (1997))
- Be recorded in the Project GIS

Incidental and opportunistic sightings

All staff shall report all sightings of the pest animal species listed in section 2.1.2 to the Environmental Manager (see Attachment E to aid identification), which will be included in weekly environmental reporting and recorded in the Project GIS. 'Sightings' include:

- Seeing the actual animal
- Tracks and scats
- Indicative habitat disturbance (eg digging/uprooting by pigs)
- Evidence of habitat use (eg Den sites of foxes, rabbit burrows)

Indirect evidence of incidental pest animal sightings should be confirmed by appropriately qualified and experienced personnel wherever possible.

Regular monitoring will be used to estimate relative abundance and distribution of pest animals, and identify areas that may require control measures.

7.2.2 Performance indicators

- Regular transect surveys are undertaken and reported in the Project GIS
- Incidental sightings are reported and recorded in the Project GIS and weekly environmental reports. Relative abundance and distribution of pest species is closely monitored to detect increases and/or areas requiring control measures

7.3 Pest animal control

7.3.1 Legislative definitions and requirements

The pest animals listed in section 2.1.2. are declared as class 2 pests under schedule 2 of the *Land Protection (Pest and Stock Route Management) Regulation 2003,* with the exception of the cane toad (*Bufo marinus*) which is not a declared pest. Class 2 pests are defined under section 38 of the *Land Protection (Pest and Stock Route Management) Act 2002* (LP Act), as:

> "Established in the State and (is) causing, or has the potential to cause, an adverse economic, environmental or social impact in the State".

Under section 77 of the LP Act, landowners must take reasonable steps to keep their land free of Class 2 pests.

Under The *Pest Management Act 2001*, any pest control or fumigation activity must be carried out by an appropriately qualified and licensed technician.

Section 42 of the *Animal Care and Protection Act 2001* instructs that any act to control a pest animal must be done in a way that causes the animal as little pain as is reasonable. The Australian Government Department of Sustainability, Environment, Water, Population and Communities provide model codes of practice for the humane control of each of the class 2 pests listed in section 2.1.2., which may be accessed at the following links:

http://www.environment.gov.au/biodiversity/invasive/publications/humane-control.html

This Department has also published threat abatement plans for rabbits, feral cats and foxes, available here:

http://www.environment.gov.au/biodiversity/threatened/tap-approved.html

and has drafted a threat abatement plan for cane toads, which may be accessed here:

http://www.environment.gov.au/biodiversity/threatened/tap-drafts.html

The Queensland Government Department of Employment, Economic Development and Innovation publish operational guidelines for the management of each of the class 2 pests listed in section 2.1.2., which may be accessed here:

http://www.dpi.qld.gov.au/4790_8422.htm

This list of legislative requirements is not exhaustive, and there are many other pieces of State and Commonwealth legislation that may influence pest animal management in Queensland.

Pests and Weeds will be managed throughout the life of the project (including both operational and decommissioning phases) in accordance with the legislative requirements and guidelines listed above.

7.3.2 Pest management planning framework

A range of pest management planning instruments exist at the National, State, Regional and Local Government level. Those that relate to pest animal management in the Project Area are listed in Table 1.

Table 1 Pest Management Planning Framework

National	State	Regional	Local Government
Australian Pest Animal Strategy 2007	Qld Pest Animal Strategy 2002-2006	Capricorn Pest Management Group Regional Pest Management Strategy 2004-2009	Calliope Shire Council Pest Management Plan 2005-2008*
Threat Abatement Plan for Competition and Land Degradtion by Rabbits 2008	Wild Dog Management Stratgey 2010-2015 (Consultation Draft		Gladstone City Council Pest Management Plan 2005-2008
Threat Abatement Plan for Predation by European Red Fox 2008	Feral Pig Management Strategy 2004		Bananna Shire Council Pest Management Plan 2005-2009
Threat Abatement Plan for Predation by European Feral Cats	Rabbit Management Strategy 2001-2006		
	Pest Management Plan Areas Managed by Qld Parks and Wildlife Service July 2003-2008		

**Calliope Shire Council and Gladstone City Council amalgamated in 2008 to form Gladstone Regional Council*

This PWMP is consistent with the principles of the relevant planning instruments outlined above. The contractor will ensure that the CPWMP is also aligned with these principles.

7.3.3 Active control of pest animals

Effective control of pest animals may include any or a combination of the following methods:

- Killing/removal (eg trapping, baiting)
- Exclusion (eg fencing)
- Habitat manipulation (eg rabbit warren ripping)

Control of the pest animal species listed in Section 2.1.2 will occur according to the legislative instruments in Section 7.3.1 and the planning documents in Section 7.3.2. Permission must be sought from The Company before undertaking any of the control methods in this section.

Killing/removal

Only to be undertaken by authorised personnel as prescribed by the relevant Acts (see section 7.3.1) where outbreaks are known to have occurred and control is mandatory under the legislation listed in section 7.3.1.

Exclusion

All areas that contain organic waste material (e.g. food scraps) will be fenced or otherwise adequately secured to prevent scavenging by pest animals.

All areas of significant water ponding that are created during the course of construction will be enclosed by temporary fencing to prevent access by pest animals.

Habitat manipulation

Wherever practicable, and subject to the approval of the Company and compliance with all relevant legislation, any rabbit warrens or fox dens that are encountered will be destroyed.

7.3.4 Performance Indicators

All relevant legislation is complied with :

- CPWMP is consistent with Commonwealth, state, regional and local pest management planning instruments
- Pest animal control methods adhere to recommended guidelines and best practice principles according to the documents in Section 7.3.1
- Pest animal outbreaks are contained and managed effectively and in a timely manner
- All pest animal control actions are recorded in the Project GIS and reporting tools
- The distribution and abundance of pest animals in the Project Area does not increase

8. Post Construction

8.1 Monitoring and Control Program

Pests and Weeds will be managed as required throughout the life of the project, including during operational and decommissioning phases of the pipeline.

Monitoring will determine the success of management measures or requirements for further actions. Any pest or weed species identified during site inspections and audits will be recorded, and appropriate management measures will be employed in response to the presence of these species.

A Weed Monitoring and Control Program (to be included as part of the CPWMP) will be development and implemented and will include (but not limited to):

- The rate of monitoring and control post completion will be as follows:
  - Post rain event – once a month for three months
  - Otherwise, once every two months
  - In response to landholder or operator request
- Weed monitoring and control activities shall include all Project Areas (eg tracks, ROW, camps, laydown and storage areas)
- Weed control shall be undertaken by appropriately qualified and experienced Contractors who are appropriately licensed under the ACDC Act

Weed monitoring and subsequent weed control will continue under the control of the Contractor for 2 years after completion of pipeline construction. During pipeline operation and decommissioning this responsibility will be handed to the Pipeline Operator.

Queensland Checklist for Clean Down Procedures

http://www.dpi.qld.gov.au/documents/Biosecurity_EnvironmentalPests/IPA-Cleandown-Procedures.pdf

Queensland Checklist for Inspection Procedures
http://www.dpi.qld.gov.au/documents/Biosecurity_EnvironmentalPests/IPA-Inspection-Procedures.pdf

Queensland Guideline for the Construction of Vehicle and Machinery Washdown facilities
http://www.dpi.qld.gov.au/documents/Biosecurity_EnvironmentalPests/IPA-Washdown-Fac-Guidelines.pdf

Weed Hygiene Declaration Form
http://www.dpi.qld.gov.au/documents/Biosecurity_EnvironmentalPests/IPA-Weed-Hygiene-Declaration.pdf

2009 Pipeline Weed Survey
GLNG Pipeline FEED – Weed Survey Report August 2009, prepared by GHD., GLNG DOC No. 3380-GHD-3-3.3-0323.

2010 Weed Survey Report June 2010
GLNG Pipeline FEED – Weed Survey Report June 2010, prepared by GHD.DOC No. 21386-D-RP-012 REV A.

Coordinator-General's Evaluation Report for an EIS May 2010 – Appendix 3 Gas Transmission Pipeline – Part 4 Schedule E – Pest and Weed Management Conditions (E37) a, b and c

DSEWPC – EPBC Approval No2008/4096, Conditions (3) f and g.

Attachments

Attachment A Existing Washdown Facilities

Taken from
http://www.dpi.qld.gov.au/cps/rde/dpi/hs.xsl/4790_8243_ENA_HTML.htm

Baralaba **Landmark**: near showground and old saleyards **Address**: Rannes Road **Contact**: Banana Shire Council **Telephone**: (07) 4992 9512 Maximum vehicle size: machinery Height limit: no Hose detail: high pressure; high volume hose Cost: $2 for 15 minutes Surface: concrete slab with tilt Hours: n/a	**Biloela** **Landmark**: adjacent to water treatment plant **Address**: Quarry Road **Contact**: Gordon Twiner, Banana Shire Council **Telephone**: 0427 148783 Maximum vehicle size: road train Height limit: no Hose detail: high pressure; high volume hose Cost: $2 for 15 minutes Surface: concrete slab with tilt Hours: n/a
Bingegang **Landmark**: near substation and pump station **Address**: Mackenzie River Capella Road Maximum vehicle size: semitrailer Height limit: no Hose detail: high pressure hose Cost: free Surface: concrete slab Hours: 24 hours	**Calliope** **Landmark**: Country Club turnoff **Address**: Stowe Road **Contact**: Gladstone Regional Council **Telephone**: (07) 4975 8100 Maximum vehicle size: semitrailer Height limit: no Hose detail: high volume hose Cost: tokens ($2 for 15 minutes) available from Choice Service Station: Calliope Cross Roads CQP service station Gladstone Regional Council Surface: concrete slab/bitumen
Injune **Landmark**: saleyards **Address**: Roma Road, Injune **Contact**: Steve Murray, Roma Regional Council **Telephone**: (07) 4622 1144 Mobile: 0428 261290 Maximum vehicle size: body truck and car (side-by-side); road trains or headers Height limit: no Hose detail: high pressure water; high pressure air and Town pressure Cost: 50 cents per minute Surface: cement slab with ramp Hours: 7 am - 5 pm with key access operational 24 hours	**Gladstone** **Landmark**: Gladstone Superwash **Address**: 154 Goondoon Street **Telephone**: (07) 4972 9202 Maximum vehicle size: cars and 4WDs Height limit: n/a Hose detail: high pressure spray Cost: $1 for 2 minutes Surface: n/a Hours: n/a

Moura **Landmark**: west of town near water treatment plant **Address**: Dawson Highway **Contact**: Gordon Twiner, Banana Shire Council **Telephone**: 0427 148783 Maximum vehicle size: road train (also has a facility for smaller vehicles) Height limit: no Hose detail: high pressure; high volume hose Cost: $2 for 15 minutes Surface: concrete slab with tilt Hours: n/a	**Rolleston** **Landmark**: near sports ground; cattle dip and old saleyards **Address**: One Mile Road **Contact**: Central Highlands Regional Council **Telephone**: (07) 4984 1166 Maximum vehicle size: semitrailer with prime mover Height limit: no Hose detail: high pressure low volume hose 20 L per minute Cost: $2 per 30 minutes Surface: 23 m concrete slab Hours: 24 hours

Attachment B – Example Washdown Log for Vehicles/Plant/Equipment

Vehicle / Plant and Rego/ID Number : ____

Date	Driver	Washdown Location	Sticker Number Added	Sticker Number Removed	Authorised Signature
			eg Zone 2 #234	eg Zone 1 #123	

Attachment C – Example Washdown Register

Washdown Facility Name : ____

	Vehicle/Plant	Rego/ID No	Sticker number Added	Sticker number Removed	Authorised officer's Name and Signature

Attachment D – Weed Management Plans

CLIENTS PEOPLE PERFORMANCE

GLNG Pipeline FEED

Report for

Weed Survey Report - June 2010

[GHD DOC No.: 21386-D-RP-012 REV A]

[GLNG DOC No.: 3381-GHD-3-3.3-0628]

Rev	Date	Description of Revision	Author	Reviewer	Approved	GLNG Approved
A	18/062010	Issue to GLNG	G Muller	A. Fals	Tony Mills PP JME	

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B Weed Management Plan Overview Maps

1. Introduction

GLNG Operations Pty Ltd is planning the development of a liquid natural gas (LNG) processing facility on Curtis Island in the Gladstone port precinct. A high pressure gas pipeline, of approximately 435 km length, will transport coal seam gas (CSG) to the LNG plant from existing and future fields in the Roma, Fairview and Arcadia Valley area. Preliminary route selection indicates that the pipeline will closely follow the route of the existing Queensland Gas Pipeline (QGP) from Wallumbilla to Gladstone.

1.1.1 Existing Environment

The gas transmission pipeline is predominantly located within the Brigalow Belt Bioregion with only a small portion of the northern section located within the Southeast Queensland Bioregion. The proposed pipeline will traverse a number of alluvial valleys (including the Arcadia Valley) separated by the Calliope, Dawson, Expedition and Carnarvon Ranges. Within the alluvial valleys a number of ephemeral and a limited number of perennial creeks and rivers are present and will be required to be traversed by the pipeline. Two major river crossings of the Calliope and Dawson Rivers will be required. The pipeline will also traverse four railway lines, the Dawson, Leichhardt, Burnett and Bruce Highways, as well as a number of sealed and unsealed roads and tracks (including Fairview Road and the Anglo Coal Haul Road).

The terrain traversed by the pipeline includes farmland, forest, and grassland and will involve the crossing of over 140 stakeholder and landholder properties. Field surveys carried out by URS Pty Ltd during 2008 along the proposed pipeline alignment identified that approximately 83% of the pipeline route is situated within land that has been cleared for cropping or grazing. Remnant vegetation is mainly restricted to mountain ranges and major waterways that the pipeline crosses. A number of weed species, including those declared under the Queensland *Land Protection (Pest and Stock Route Management) Act 2002* (LP Act), are present along the pipeline alignment.

1.2 Scope of Works

GHD was commissioned by GLNG to carry out weed surveys to provide background weed information and verification of weeds located on properties affected by the GLNG pipeline alignment. The aim of the weed surveys were to establish the location of Class 1, Class 2 and Class 3 weeds declared under the LP Act and to provide maps indicating the distribution of declared weed species.

Separate weed surveys have been conducted over different periods of growth during the dry season of 2009 and the post wet season of 2010. The deliverables of the weed survey completed to date have included the following:

- Recording locations of all Class 1 and Class 2 declared plants under the LP Act;
- Recording locations of Class 3 declared plants under the LP Act and other non-declared environmental weeds identified by landholders or local government officers as of concern;
- Compilation of additional weed information from communication with landholders, council officers, State Government officers and GLNG Land Agents; and

- Preparation of reports, results tables and mapping detailing the findings of the weed surveys completed in 2009 (GHD document number: 21386-D-RP-006_D.pdf, November 2009) and 2010; and
- Preparation property scale maps indicating the distribution of declared weed species identified during the weed surveys and background information collation.

1.3 State of Declared Weeds

Weeds (both declared and non-declared) are considered detrimental to landholders as they establish rapidly, spread easily and compete with plants used for pasture and cropping. A weed is defined as any plant that requires some form of action to reduce its harmful effects on the economy, the environment, human health and amenity (Natural Resource Management Ministerial Council, 2006). There are two types of invasion: introduction of exotic plants and movement of native species into new areas well outside their native range. Weeds have an adverse effect on an area's environmental values and ecological functioning for the following reasons:

- Competition with native species;
- Change in the structure of a plant community through addition or removal of strata;
- Suppress recruitment of native species;
- Change the natural fire fuel characteristics, which can change the natural fire regime to the detriment of native species, often resulting in the loss of native species;
- Change the food sources and habitat values available to native fauna, reducing some and increasing others;
- May change geomorphological processes such as erosion; and
- May lead to changes in the hydrological cycle.

Under the LP Act, introduced species that represent a threat to primary industries, natural resources and the environment can be declared as Class 1, 2 or 3 Pests. The categories of declared plants in Queensland are outlined in the table below.

Table 1 Categories of Declared Plants in Queensland

Priority Class	Description
Class 1	A Class 1 pest is one that is not commonly present in Queensland, and if introduced would cause an adverse economic, environmental or social impact. Class 1 pests established in Queensland are subject to eradication from the state. Landowners must take reasonable steps to keep land free of Class 1 pests.
Class 2	A Class 2 pest is one that is established in Queensland and has, or could have, a substantial adverse economic, environmental or social impact. The management of these pests requires coordination and they are subject to local government, community or landowner-led programs. Landowners must take reasonable steps to keep land free of Class 2 pests.

Priority Class	Description
Class 3	A Class 3 pest is one that is established in Queensland and has or could have a substantial adverse economic, environmental or social impact. Its impact or potential impact is however considered to be less significant than that of a Class 2 pest. Landowners may be required under the LP Act to manage Class 3 pests in or near environmentally significant areas, such as protected areas, important habitats for threatened species or areas of interest, but landowners are not required to manage Class 3 pests elsewhere.

2. Methodology

Weed surveys were conducted over different periods of active weed growth, the dry season of 2009 and the post wet season of 2010. As such, the two weed surveying events will herein be referred to the dry season field survey and the post wet season field survey respectively.

2.1 Dry Season Field Survey

A combination of both desktop background information searches and field investigations were adopted to assess the distribution of declared weeds along the GLNG pipeline alignment. Background weed information was compiled for the dry season field survey included reviews of the following information sources:

- GLNG Environmental Impact Statement;
- Queensland Herbarium HERBRECS database;
- Regional council weed information;
- Initial ecological field surveys along the GLNG alignment;
- GLNG Land Agent information; and
- Landholder feedback.

Dry season field surveys were conducted on accessible properties intersected by the GLNG pipeline alignment between the months of June and September 2009. Field surveys were conducted over the suboptimal dry cooler months when plant growth was low and most species were not flowering, or were in a period of dieback.

Details of the full methodology and results of the background information searches and field investigations from the dry season field survey during 2009 are located in the GLNG Pipeline FEED Weed Survey Report – November 2009 (GHD document number: 21386-D-RP-006_D.pdf).

2.2 Post Wet Season Field Survey

The main aims of the post wet season field survey were to:

- Verify existing weed recordings from the results of the background information searches and dry season field surveys; and
- To record new infestations of declared and of concern environmental weeds along the GLNG pipeline alignment, with particular focus on previously clean properties and properties with weeds stated in the background information but none recorded during dry season field surveys.

Background weed information had been compiled from all available information sources during the dry season field survey. As no updates had been made to regional council weed management plans, no additional background information was required for the post wet season field survey.

Post wet season field surveys were conducted by GHD ecologists on properties intersected by the GLNG pipeline alignment over four field survey events between the months of February and June 2010. Field surveys involved regular communication with GLNG Land Agents to negotiate best access to areas of the pipeline alignment on each property. Field surveys aimed to cover as much of the pipeline alignment as possible either by walking or vehicular travel (if possible). However, due to weather and ground conditions, poor access to some areas, distances between access points and limited time given to complete field surveys, some areas of the pipeline alignment could not be surveyed. Where field access was difficult, representative samples of each property were surveyed and areas with greater potential for weed infestations were targeted, for example, creeklines and areas with distinct changes in vegetation characteristics. Due to difficulty with access and time restrictions, the GLNG pipeline alignment on Curtis Island was not surveyed during the post wet season field survey period.

As a result of cyclonic activity, monsoonal troughs brought heavy rains to much of the GLNG pipeline alignment and surrounding areas between mid summer and early autumn of 2010. The towns of Injune and Biloela, nearby to the GLNG pipeline alignment, received over 300 mm of rain between January and March 2010. Rolleston and Gladstone both received over 580 mm rain over the same time period (BOM 2010). As a result, moderate flooding occurred over a period of several weeks throughout much of the region. It is likely that such high volumes of water moving over the landscape provided favourable conditions for greater dispersal of weed seeds in the region. As a result of late wet season rains and extreme weather events in early 2010, post wet season field surveys were conducted during periods of optimal weed growth in the months following this large weather event.

3. Results

3.1 Declared Weeds

Along the length of the GLNG pipeline alignment, 14 weeds declared as either Class 2 or Class 3 weeds under the LP Act were recorded during the dry season and post wet season field surveys. No Class 1 weeds were encountered. The following weeds were recorded:

Class 1

- No Class 1 weeds observed during field surveys.

Class 2

- *Acacia nilotica* (prickly acacia);
- *Bryophyllum delagoense* (mother-of-millions);
- *Cryptostegia grandiflora* (rubber vine);
- *Harrisia martinii* (harrisia cactus) – formerly *Eriocereus martinii*;
- *Opuntia* spp. (prickly pear) – including *O. stricta* and *O. tomentosa;*
- *Parthenium hysterophorus* (parthenium); and
- *Sporobolus pyramidalis* (giant rat's tail grass).

Class 3

- *Anredera cordifolia* (Madeira vine);
- *Aristolochia elegans* (Dutchman's pipe);
- *Cascabela thevetia* (yellow oleander);
- *Celtis sinensis* (Chinese celtis);
- *Lantana camara* (lantana);
- *Lantana montevidensis* (creeping lantana); and
- *Macfadyena unguis-cati* (cat's claw creeper).

3.2 Environmental Weeds

Non-declared environmental weeds, listed as of concern by landholders and local government agencies, that were also recorded during weed surveys included the following 10 species:

- *Alternanthera pungens* (khaki burr);
- *Bidens pilosa* (cobbler's pegs);
- *Chloris virgata* (feathertop rhodes grass);
- *Eragrostis curvula* (African love grass);

- *Praxelis clematidea* (praxelis);
- *Sclerolaena birchii* (galvanised burr – a native burr);
- *Senecio pinnatifolius* (native fireweed);
- *Themeda quadrivalvis* (grader grass);
- *Xanthium occidentale* (noogoora burr); and
- *Xanthium spinosum* (Bathurst burr).

Additional environmental weeds to those listed above were encountered during weed field surveys. The locations of the distribution of any additional environmental weeds to those stated above were not recorded for the purposes of these weed surveys.

Results of the weeds identified on each property intersected by the GLNG pipeline alignment during dry season and post wet season surveys are listed in the GLNG Weed Survey Results Table in Appendix A. Data captured by GHD during these weed surveys is represented on the Weed Management Plan Overview Maps, located in Appendix B, which have been created externally by GLNG.

The following photos depict examples of some declared weeds recorded during field surveys.

giant rat's tail grass

parthenium

mother-of-millions and rubber vine

prickly pear

3.3 Parthenium and giant rat's tail grass

Although the recording of all declared weeds are important for weed management along the GLNG pipeline alignment, parthenium and giant rat's tail grass have been identified by landholders and GLNG personnel as the two declared weeds of most concern for control and the reduction of spread along the GLNG pipeline alignment during construction and operational phases of the project.

The following sections (section 3.3.1, 3.3.2, 3.3.3 and 3.3.4) provide a breakdown of the results for parthenium and giant rat's tail grass in terms of distinguishing properties with dense infestations of parthenium or giant rat's tail grass to those with only minor infestations or properties where these weeds were not recorded at all.

The density and size of infestations of parthenium and giant rat's tail grass may determine different management actions for the control and spread of these weeds within and between the different properties that the GLNG pipeline alignment intersects. Plate 1 depicts photos of dense infestations of parthenium and giant rat's tail grass compared to minor infestations, shown in Plate 2, of the same weeds on different properties.

3.3.1 Properties with dense infestations of parthenium or giant rat's tail grass

Results of the dry season and post wet season field surveys identified 20 properties as containing dense infestations of parthenium or giant rat's tail grass. For the purposes of this survey, a dense infestation has been characterised as:

- Where the listed weed scored a cover/abundance rank of Plentiful, with cover between 5-25% or greater, relative to the surrounding area during field surveys; and/or
- The weed appeared to dominate the surrounding groundcover vegetation in multiple locations throughout the property during field surveys.

Dense infestations of parthenium were recorded on properties between the Expedition Range and the Dawson River (approximately between KP 140 and KP 243). All infestations of giant rat's tail grass were recorded along the GLNG pipeline alignment within the western portion of the GSDA from the Bruce

Highway to Cullens Road (approximately between KP 393 and KP 405). Properties identified as containing dense infestations of parthenium or giant rat's tail grass are outlined in Table 2.

Plate 1: Examples of dense infestations of parthenium on properties T-076 and T-100

Table 2 Properties with dense infestations of parthenium or giant rat's tail grass as identified from dry season and/or post wet season field surveys

Property Parcel Number	Weed		Notes
	Giant Rat's Tail Grass	Parthenium	
CI-013	✓	-	◗ Grass tufts scattered throughout property
CI-014	✓	-	◗ Grass tufts scattered throughout property
T-075.6	-	✓	◗ Large infestations throughout property
T-076	-	✓	◗ Large infestations throughout property ◗ Parthenium infestations along property access track
T-078	-	✓	◗ Large infestations throughout property ◗ Pasture and stock management has helped reduce infestations in some areas of the property
T-080.1	-	✓	◗ Large infestations throughout property ◗ Parthenium infestations along property access tracks
T-080.2	-	✓	◗ Large infestations throughout property ◗ Parthenium infestations along property access tracks
T-081	-	✓	◗ Large infestations throughout property
T-082	-	✓	◗ Large infestations throughout property ◗ Parthenium infestations along property access track

Property Parcel Number	Weed		Notes
	Giant Rat's Tail Grass	Parthenium	
			◗ Land management and spraying of parthenium has reduced infestations within areas of cultivation
T-083	-	✓	◗ Infestations scattered throughout property ◗ Land management and spraying of parthenium has reduced infestations within areas of cultivation
T-086	-	✓	◗ Large infestations throughout property ◗ Parthenium infestations along property access track and boundary fence lines
T-087	-	✓	◗ Infestations scattered throughout property ◗ Land management and spraying of parthenium has reduced infestations within areas of cultivation
T-088	-	✓	◗ Infestations scattered throughout property
T-089	-	✓	◗ Large infestations throughout property ◗ Parthenium infestations along property access tracks ◗ Land management and spraying of parthenium has reduced infestations within areas of cultivation
T-091	-	✓	◗ Large infestations throughout property ◗ Parthenium infestations along property access tracks ◗ Parthenium infestations also present in adjacent road reserves of the Dawson Highway and Fairview Road
T-092	-	✓	◗ Large infestations throughout property ◗ Parthenium infestations also present in adjacent road reserve of the Dawson Highway
T-095	-	✓	◗ Large infestations throughout property ◗ Parthenium infestations along property access tracks
T-097	-	✓	◗ Large infestations throughout property ◗ Parthenium infestations along property access tracks
T-098	-	✓	◗ Large infestations throughout property ◗ Parthenium infestations along property access tracks
T-100	-	✓	◗ Large infestations throughout property ◗ Parthenium infestations along property access tracks

Weed management recommendations: these properties containing dense infestations of parthenium or giant rat's tail grass should be strictly managed to control weed spread or be isolated from properties containing little or no weed infestations.

3.3.2 Properties with small infestations of parthenium

Results of the dry season and post wet season field surveys identified 15 properties as containing small infestations of parthenium. For the purposes of this survey, a small infestation has been characterised as:

- Parthenium occurrences which scored a cover/abundance rank of Sparsely Present, with cover between 5-25% or less, relative to the surrounding area during field surveys; and/or
- The weed was observed as a single plant or a small number of plants at one or a small number of locations within the property (i.e. not abundantly scattered throughout the property) during field surveys.

Properties identified as having small infestations of parthenium were located between the Dawson River and Police Camp Creek (approximately between KP 243 and KP 272). Properties identified as containing small infestations of parthenium are outlined in Table 3.

Plate 2: Examples of small infestations of parthenium on properties T-075 and T-101

Table 3 Properties with small infestations of parthenium as identified from dry season and/or post wet season field surveys

Property Parcel Number	Number of infestations	Size of infestations^	Location of infestations	Landholder control measures used?`
T-001	One infestation recorded along GLNG alignment at Larcom Creek	1 juvenile plant	56 K 295923, 7352992	Unknown
T-006	Two infestations recorded along GLNG alignment	1. 50 m x 70 m triangle 2. small patch within riparian vegetation of Gravel Creek	1. 56 K 293957, 7348830 to 56 K 293974, 7348806 to 56 K 293932, 7348782 2. 56 K 294986, 7350779	Unknown
T-063.1	One linear infestation recorded along GLNG alignment	300 m long infestation from Police Camp Creek to paddock fenceline, worst infestations are within 20 m of northern property boundary fenceline	56 J 206163, 7302372 to 56 J 205889, 7302390	Unknown
T-066.1	One infestation recorded in small creekline on GLNG alignment and adjacent Jemena easement	20 m x 20 m patch	56 J 198494, 7301472	Yes Landholder controls parthenium by spraying
T-066.2	Four infestations recorded along GLNG alignment	1. 5 mature plants 2. 5 m x 5 m patch 3. 2 m x 2 m patch 4. Mature plants scattered around dam	1. 56 J 196822, 7300881 2. 56 J 196763, 7300852 3. 56 J 196730, 7300841 4. 56 J 196193, 7300550	Yes Landholder controls parthenium by spraying

Property Parcel Number	Number of infestations	Size of infestations^	Location of infestations	Landholder control measures used?`
T-068	Three infestations recorded along GLNG alignment	1. 1 mature plant 2. 5 m x 5 m patch 3. 200 m long patch surrounding a gully	1. 55 J 804188, 7300341 2. 55 J 804188, 7300375 3. 55 J 803582, 7300083 to 55 J 803790, 7300202	Unknown
T-070	One infestation recorded	2 mature plants	55 J 802346, 7298321	Yes Landholder sprays any outbreaks
T-071	Seven infestations recorded along GLNG alignment	All seven infestations are 10 m x 10 m patches around gilgais or water sources	1. 55 J 801654, 7297825 2. 55 J 801670, 7297771 3. 55 J 801652, 7297756 4. 55 J 801537, 7297728 5. 55 J 801501, 7297723 6. 55 J 801496, 7297695 7. 55 J 801448, 7297683	Unknown
T-072	Five infestations recorded along GLNG alignment and potential access tracks	1. Scattered along access track as mature individuals and small 2 m x 2 m patches 2. 10 m x 50 m patch 3. Scattered plants around water sources (50 m x 100 m patch) 4. Scattered plants around water sources (50 m x 100 m patch) 5. Scattered mature plants	1. 55 J 801260, 7297635 to 55 J 801740, 7297586 2. 55 J 798132, 7296859 3. 55 J 798252, 7297056 4. 55 J 798282, 7297071 5. 55 J 798114, 7297025	Yes Land management

Property Parcel Number	Number of infestations	Size of infestations^	Location of infestations	Landholder control measures used?`
T-072.6	Four infestations recorded near Kianga Creek	1. 3 mature plants 2. 1 m x 1 m patch 3. 2 mature plants 4. 2 m x 2 m patch	1. 55 J 793673, 7296113 2. 55 J 793734, 7296123 3. 55 J 793761, 7296109 4. 55 J 793899, 7296133	Yes Pasture and stock management and spraying has restricted Parthenium to western side of property only
T-075	Nine infestations recorded. Larger infestations occur around the Dawson River and Kianga Creek as a result of recent flood events, very isolated distribution elsewhere on property	1. Many scattered individuals around Kianga Creek 2. 3 mature plants 3. 2 mature plants 4. 2 mature plants 5. 3 mature plants 6. 2 mature plants 7. 3 mature plants 8. 30 m x 300 m patch from Back Creek to Dawson River	1. 55 J 793271, 7295938 2. 55 J 792915, 7295354 3. 55 J 792819, 7295186 4. 55 J 792658, 7295148 5. 55 J 789658, 7295043 6. 55 J 789390, 7295006 7. 55 J 789371, 7294996 8. 55 J 789282, 7294964	Yes Pasture and stock management and spraying has helped restrict infestations to around the Dawson River and Kianga Creek
T-075.3	One infestation recorded	3 mature plants	55 J 792096, 7295126	Yes Landholder sprays any outbreaks
T-099	Four patches and scattered mature plants recorded along GLNG alignment and within property#	1. 3 patches of 4 m x 4 m 2. One 10 m x 10 m patch 3. Scattered mature plants 4. 3 mature plants	1. 55 J 709044, 7271620; 55 J 708833, 7271614; 55 J 708767, 7271600 2. 55 J 705135, 7272397 3. 55 J 705213, 7272740	Unknown

Property Parcel Number	Number of infestations	Size of infestations^	Location of infestations	Landholder control measures used?`
			4. 55 J 705151, 7272653	
T-101	Three infestations recorded along GLNG alignment and potential access track	1. 4 mature plants 2. 2 m x 2 m area 3. 1 mature plant	1. 55 J 689868, 7262145 2. 55 J 690421, 7263253 3. 55 J 691374, 7266283	Yes Landholder sprays any outbreaks
T-109	Scattered within banks of Clematis Creek and some small patches on high banks of creek	1. Clematis Creek banks are approximately 15 m wide 2. 1 m x 1 m patch on creek high bank	1. 55 J 681337, 7250446 2. 55 J 681286, 7250427	Yes Landholder sprays to contain Parthenium to Clematis Creek only

- The entire GLNG pipeline alignment through property T-099 was not traversed so these results are an indication only from what was observed during field surveys. As T-099 is surrounded by properties with dense infestations of parthenium, this property is likely to have larger infestations than what was recorded during field surveys.

^ - size of infestations is a best estimate only

` - information obtained from dry season field survey background information

Weed management recommendations: Properties where only small infestations of parthenium exist are still considered 'dirty' in terms of the presence of parthenium. Weed management of these properties should however be considered differently to those properties with dense infestations of parthenium, listed in Section 3.3.1. This will minimise the occurrence of dense parthenium infestations establishing as a result of GLNG pipeline activities. Small infestations of parthenium can be controlled and most landowners have implemented measures to try and control parthenium outbreaks on their properties. Recommendations for the management of parthenium along the GLNG alignment on these properties could include early weed control through pre-construction spraying of parthenium and ongoing monitoring to ensure dense infestations of parthenium have not established.

3.3.3 Properties where parthenium and/or giant rat's tail grass were not identified

From the results of the dry season and post wet season field surveys, 87 properties recorded no infestations of parthenium and/or giant rat's tail grass. These properties were generally located within the Arcadia Valley (approximately between KP 0 and KP 115) and from the Leichhardt Highway to Mount Alma Road (approximately between KP 275 and KP 380). No infestations of parthenium and/or giant rat's tail grass have been recorded on the GLNG pipeline alignment on Curtis Island. The details of properties where no infestations of parthenium and/or giant rat's tail grass were recorded during dry season and post wet season field surveys are outlined in the GLNG Weed Survey Results Table in Appendix A.

3.3.4 Verification of background information results

Table 4 lists the properties that were stated as having parthenium, giant rat's tail grass and/or African lovegrass during the background information gathering process prior to the dry season field surveys, however these weeds were not recorded along the GLNG pipeline alignment or associated access tracks during dry season or post wet season field surveys.

Details of the methodology behind the background information gathering process and findings are outlined in the GLNG Pipeline FEED Weed Survey Report – November 2009 (GHD document number: 21386-D-RP-006_D.pdf).

As these weeds were not recorded during field surveys, for the purposes of this report, properties listed in Table 4 are now classified as 'clean' from either parthenium, giant rat's tail grass and/or African lovegrass stated as occurring on the property from the background information. Additional weeds listed as occurring from the background information may still be present on the properties. Results of weed species recorded during dry season and post wet season field surveys are listed in the GLNG Weed Survey Results Table in Appendix A of this report. Results of the background information are outlined in the GLNG Pipeline FEED Weed Survey Report – November 2009 (GHD document number: 21386-D-RP-006_D.pdf).

Table 4 Properties where suspected parthenium, giant rat's tail grass and/or African lovegrass infestations from background information were not identified during dry season or post wet season field surveys

Property Parcel Number	Suspected weed infestations from background information
CI-009	giant rat's tail grass
CI-010	giant rat's tail grass
CI-011	giant rat's tail grass
CI-012	giant rat's tail grass
T-012	parthenium
T-016	parthenium and African lovegrass
T-017	parthenium
T-018	parthenium
T-021	parthenium and African lovegrass
T-029	African lovegrass
T-030	parthenium
T-032	parthenium and African lovegrass
T-032.5	parthenium
T-032.9	parthenium
T-034.71	African lovegrass
T-034.72	African lovegrass
T-036	African lovegrass
T-044	parthenium
T-053	parthenium
T-054	parthenium
T-055.1	parthenium
T-055.2	parthenium
T-058	parthenium
T-061	parthenium
T-063.2	parthenium
T-064	parthenium, giant rat's tail grass and African lovegrass
T-144	parthenium

Weed management recommendations: Properties where parthenium and giant rat's tail grass were not recorded during field surveys will require vigilance and careful management to ensure weed infestations do not become apparent. Weed management could include ongoing weed surveys within these properties along the GLNG alignment and associated access tracks at yearly intervals during peak growing conditions to record the presence of any new weed outbreaks not previously recorded so appropriate management strategies can be developed.

4. Conclusion

This weed survey was conducted to form baseline data for populations of weed species occurring along the GLNG pipeline alignment. The results presented in this report, attached results table and supporting mapping depict the weeds present at surveyed locations within each property intersected by the GLNG pipeline alignment at the time of survey.

Field surveys were conducted over different seasons and growth cycles to capture optimal growth periods for a number of different weed species. Detailed methodologies and results of the 2009 dry season weed surveys are located in the GLNG Pipeline FEED Weed Survey Report – November 2009 (GHD document number: 21386-D-RP-006_D.pdf) and results are also incorporated into this report.

As a result of time limitations in the field and poor ground conditions of some properties surveyed, not all of the GLNG pipeline alignment or property access tracks could be surveyed on all properties, therefore additional weeds or infestations to those listed in this report, associated results table and supporting mapping may occur. Despite best efforts to record all declared weed species and the locations of minor weed infestations occurring on each property, additional weed infestations may also occur at locations not recorded in this report as a result of different growth cycles of some weed species. Ongoing landholder weed management practices may also provide additional controls to some minor weed infestations that were previously recorded.

The information gathered in this survey will form the basis for decision making regarding weeds and will form an overview of information for the preparation of the GLNG Pipeline Weed Management Plan. The information outlined in this report should be regarded as baseline information. Ongoing weed surveys and monitoring will be required after disturbance events, such as vegetation clearing, and during construction activities to further add to this baseline information and allow sound weed management of the GLNG pipeline to be achieved.

5. References

Bureau of Meteorology. 2010. Daily Weather Observations for Queensland. Available at: http://www.bom.gov.au/climate/dwo/IDCJDW0400.shtml accessed 17/06/10.

Natural Resource Management Ministerial Council (2006). Australian Weed Strategy – A national strategy for weed management in Australia. Australian Government Department of the Environment and Water Resources, Canberra ACT.

Appendix A

GLNG Weed Survey Results Table

Last updated: 17 June 2010

GLNG Weed Survey Results Table

Last updated: 17 June 2010

Property Parcel Number	Lot on Plan	Tenure	Landholder	Weed Names	Weeds Identified During Field Surveys: Dry Season (2009)	Weeds Identified During Field Surveys: Post Wet Season (2010)	Notes
Curtis Island	28DS220	LL	The State of Queensland (DIP)	*Lantana camara* (lantana)	✓	-	Date of dry season survey: 11-12 May 2009
				Opuntia spp. (prickly pear)	✓	-	Property not surveyed during post wet season
				Cryptostegia grandiflora (rubber vine)	✓	-	
Curtis Island	11DS220	LL	The State of Queensland (DIP)	*Lantana camara* (lantana)	✓	-	Date of dry season survey: 11-12 May 2009
				Opuntia spp. (prickly pear)	✓	-	Property not surveyed during post wet season
				Cryptostegia grandiflora (rubber vine)	✓	-	
Curtis Island	10DS220	LL	The State of Queensland (DIP)	*Lantana camara* (lantana)	✓	-	Date of dry season survey: 11-12 May 2009
				Opuntia spp. (prickly pear)	✓	-	Property not surveyed during post wet season
				Cryptostegia grandiflora (rubber vine)	✓	-	
Curtis Island	7DS220	LL	The State of Queensland (DIP)	*Lantana camara* (lantana)	✓	-	Date of dry season survey: 11-12 May 2009
				Opuntia spp. (prickly pear)	✓	-	Property not surveyed during post wet season
				Cryptostegia grandiflora (rubber vine)	✓	-	
not advised	1RP612108	FH	not advised	*Opuntia spp.* (prickly pear)	-	✓	Property not surveyed during dry season. Date of post wet season survey: 15-17 February 2010
not advised	137FTY1831	SF	not advised	*Lantana camara* (lantana)	-	✓	Property not surveyed during dry season. Date of post wet season survey: 15-17 February 2010
CI-001A	92DS654	LL					Property not surveyed due to time restrictions
CI-002A	401DT4026	FH	Wells Butler C & B				Property not surveyed due to time restrictions
not advised	2MPH34582	FH	not advised	*Bryophyllum delagoense* (mother-of-millions)	-	✓	Property not surveyed during dry season
				Lantana camara (lantana)	-	✓	Date of post wet season survey: 15-17 February 2010
				Lantana montevidensis (creeping lantana)	-	✓	
not advised	2RP897093	FH	not advised	*Lantana camara* (lantana)	-	✓	Property not surveyed during dry season. Date of post wet season survey: 15-17 February 2010
CI-009	2DS725	FH	The Coordinator-General	*Bryophyllum delagoense* (mother-of-millions)	-	✓	Property not surveyed during dry season
				Lantana camara (lantana)	-	✓	Date of post wet season survey: 15-17 February 2010
CI-010	3MPH14076	FH	The Coordinator-General	*Lantana camara* (lantana)	-	✓	Property not surveyed during dry season
				Opuntia spp. (prickly pear)	-	✓	Date of post wet season survey: 15-17 February 2010
				Cryptostegia grandiflora (rubber vine)	-	✓	
CI-010	1MPH14076	FH	The Coordinator-General	*Lantana camara* (lantana)	-	✓	Property not surveyed during dry season
				Opuntia spp. (prickly pear)	-	✓	Date of post wet season survey: 15-17 February 2010
				Cryptostegia grandiflora (rubber vine)	-	✓	
CI-010	86DS636	FH	The Coordinator-General	*Lantana camara* (lantana)	-	✓	Property not surveyed during dry season
				Opuntia spp. (prickly pear)	-	✓	Date of post wet season survey: 15-17 February 2010
				Cryptostegia grandiflora (rubber vine)	-	✓	
CI-011	1SP108915	FH	The Coordinator-General	*Lantana camara* (lantana)	-	✓	Property not surveyed during dry season
				Opuntia spp. (prickly pear)	-	✓	Date of post wet season survey: 15-17 February 2010
				Cryptostegia grandiflora (rubber vine)	-	✓	
CI-011	2SP108915	FH	The Coordinator-General	*Lantana camara* (lantana)	-	✓	Property not surveyed during dry season
				Opuntia spp. (prickly pear)	-	✓	Date of post wet season survey: 15-17 February 2010
				Cryptostegia grandiflora (rubber vine)	-	✓	
CI-012	45RP894241	FH	The Coordinator-General	*Lantana camara* (lantana)	-	✓	Property not surveyed during dry season
				Opuntia spp. (prickly pear)	-	✓	Date of post wet season survey: 15-17 February 2010
				Cryptostegia grandiflora (rubber vine)	-	✓	
CI-013	1DT4044	FH	The Minister for Industrial Relations	*Sporobolus pyramidalis* (giant rat's tail grass)	-	✓	Property not surveyed during dry season
				Lantana camara (lantana)	-	✓	Date of post wet season survey: 15-17 February 2010
				Opuntia spp. (prickly pear)	-	✓	
CI-013	2SP157677	FH	The Minister for Industrial Relations	*Sporobolus pyramidalis* (giant rat's tail grass)	-	✓	Property not surveyed during dry season

Property Parcel Number	Lot on Plan	Tenure	Landholder	Weed Names	Weeds Identified During Field Surveys Dry Season (2009)	Post Wet Season (2010)	Notes
				Lantana camara (lantana)	-	✓	Date of post wet season survey: 15-17 February 2010
				Opuntia spp. (prickly pear)	-	✓	
CI-014	8SP200847	FH	The Minister for Industrial Relations	*Sporobolus pyramidalis* (giant rat's tail grass)	-	✓	Property not surveyed during dry season. Date of post wet season survey: 15-17 February 2010
CI-014	9SP200837	FH	The Minister for Industrial Relations	*Sporobolus pyramidalis* (giant rat's tail grass)	-	✓	Property not surveyed during dry season
				Cryptostegia grandiflora (rubber vine)	-	✓	Date of post wet season survey: 15-17 February 2010
CI-014	2SP147877	FH	The Minister for Industrial Relations	*Sporobolus pyramidalis* (giant rat's tail grass)	-	✓	Property not surveyed during dry season
				Cryptostegia grandiflora (rubber vine)	-	✓	Date of post wet season survey: 15-17 February 2010
CI-014	6SP101558	FH	The Minister for Industrial Relations	*Sporobolus pyramidalis* (giant rat's tail grass)	-	✓	Property not surveyed during dry season. Date of post wet season survey: 15-17 February 2010
CI-014	4RP620657	FH	The Minister for Industrial Relations	*Sporobolus pyramidalis* (giant rat's tail grass)	-	✓	Property not surveyed during dry season
				Lantana camara (lantana)	-	✓	Date of post wet season survey: 15-17 February 2010
				Opuntia spp. (prickly pear)	-	✓	
CI-015	525CL40243	FH	Rideout BR, DE, IL & RA	*Bryophyllum delagoense* (mother-of-millions)	✓	-	Date of dry season survey: 7-8 September 2009
				Lantana camara (lantana)	✓	-	Date of post wet season survey: 26-30 April 2010
				Lantana montevidensis (creeping lantana)	-	✓	
CI-015	3RP801363	FH	Rideout BR, DE, IL & RA	*Bryophyllum delagoense* (mother-of-millions)	✓	-	Date of dry season survey: 7-8 September 2009
				Lantana camara (lantana)	✓	-	Date of post wet season survey: 26-30 April 2010
				Xanthium occidentale (noogoora burr)	-	✓	
				Praxelis clematidea (praxelis)	-	✓	
CI-015	67CL40347	FH	Rideout BR, DE, IL & RA	*Bryophyllum delagoense* (mother-of-millions)	✓	-	Date of dry season survey: 7-8 September 2009
				Lantana camara (lantana)	✓	-	Date of post wet season survey: 26-30 April 2010
T-001	525CL40243	FH	Rideout BR, DE, IL & RA	*Parthenium hysterophorus* (parthenium)	✓	-	Date of dry season survey: 7-8 September 2009
				Bryophyllum delagoense (mother-of-millions)	✓	-	Date of post wet season survey: 26-30 April 2010
				Lantana camara (lantana)	✓	-	
T-001	524CL40243	FH	Rideout BR, DE, IL & RA	*Parthenium hysterophorus* (parthenium)	✓	-	Date of dry season survey: 7-8 September 2009
				Bryophyllum delagoense (mother-of-millions)	✓	-	Date of post wet season survey: 26-30 April 2010
				Lantana camara (lantana)	✓	-	
				Cryptostegia grandiflora (rubber vine)	-	✓	
				Xanthium occidentale (noogoora burr)	-	✓	
				Themeda quadrivalvis (grader grass)	-	✓	
T-006	479CL40215	FH	Chapman TR & LC	*Parthenium hysterophorus* (parthenium)	-	✓	Date of dry season survey: 7-8 September 2009
				Lantana camara (lantana)	✓	✓	Date of post wet season survey: 26-30 April 2010
				Lantana montevidensis (creeping lantana)	✓	-	
				Opuntia spp. (prickly pear)	✓	-	
				Praxelis clematidea (praxelis)	-	✓	
				Xanthium occidentale (noogoora burr)	-	✓	
				Bidens pilosa (cobbler's pegs)	-	✓	
T-006	48CTN512	FH	Chapman TR & LC	*Parthenium hysterophorus* (parthenium)	-	✓	Date of dry season survey: 7-8 September 2009
				Lantana camara (lantana)	✓	-	Date of post wet season survey: 26-30 April 2010
				Lantana montevidensis (creeping lantana)	✓	✓	
				Opuntia spp. (prickly pear)	✓	-	
				Praxelis clematidea (praxelis)	-	✓	
T-009	49CTN512	FH	JM White	*Lantana montevidensis* (creeping lantana)	-	✓	Date of dry season survey: 7-8 September 2009
				Praxelis clematidea (praxelis)	-	✓	Date of post wet season survey: 26-30 April 2010
T-009.5	4RP860093	FH	Reynolds JA & JK	no declared weeds recorded			Date of post wet season survey: 15-17 February 2010
T-010	6CTN812615	FH	Dingle DR & JA	no declared weeds recorded			Date of post wet season survey: 26-30 April 2010
T-010	218CL4081	FH	Dingle DR & JA	*Lantana camara* (lantana)	✓	✓	Date of dry season survey: 7-8 September 2009
				Lantana montevidensis (creeping lantana)	✓	✓	Date of post wet season survey: 15-17 February and 26-30 April 2010
				Cryptostegia grandiflora (rubber vine)	✓	✓	

Property Parcel Number	Lot on Plan	Tenure	Landholder	Weed Names	Weeds Identified During Field Surveys		Notes
					Dry Season (2009)	Post Wet Season (2010)	
				Celtis sinensis (Chinese celtis)	✓	-	
				Macfadyena unguis-cati (cat's claw creeper)	✓	-	
				Xanthium occidentale (noogoora burr)	✓	✓	
				Praxelis clematidea (praxelis)	-	✓	
				Bidens pilosa (cobbler's pegs)	-	✓	
T-010	477CL40223	FH	Dingle DR & JA	*Lantana camara* (lantana)	-	✓	Property not surveyed during dry season
				Opuntia spp. (prickly pear)	-	✓	Date of post wet season survey: 26-30 April 2010
				Praxelis clematidea (praxelis)	-	✓	
T-010	269CL4095	FH	Dingle DR & JA	*Lantana camara* (lantana)	✓	✓	Date of dry season survey: 7-8 September 2009
				Lantana montevidensis (creeping lantana)	-	✓	Date of post wet season survey: 15-17 February and 26-30 April 2010
				Cryptostegia grandiflora (rubber vine)	✓	✓	
				Aristolochia elegans (Dutchman's pipe)	-	✓	
				Praxelis clematidea (praxelis)	-	✓	
				Xanthium occidentale (noogoora burr)	-	✓	
				Bidens pilosa (cobbler's pegs)	-	✓	
T-010	217CL4081	FH	Dingle DR & JA	*Lantana camara* (lantana)	✓	✓	Date of dry season survey: 7-8 September 2009
				Lantana montevidensis (creeping lantana)	-	✓	Date of post wet season survey: 26-30 April 2010
				Opuntia spp. (prickly pear)	✓	-	
T-010	1CL4032	FH	Dingle DR & JA				Property not surveyed due to time restrictions
T-012	219CL40301	FH	Farmer EC	*Lantana camara* (lantana)	✓	✓	Date of dry season survey: 7-8 September 2009
				Lantana montevidensis (creeping lantana)	✓	✓	Date of post wet season survey: 26-30 April 2010
				Cryptostegia grandiflora (rubber vine)	-	✓	
				Celtis sinensis (Chinese celtis)	✓	-	
				Xanthium occidentale (noogoora burr)	-	✓	
				Bidens pilosa (cobbler's pegs)	-	✓	
T-014	7RP609065	FH	Galletly JS	*Lantana camara* (lantana)	-	✓	Date of dry season survey: 7-8 September 2009
				Eragrostis curvula (African love grass)	-	✓	Date of post wet season survey: 15-17 February and 26-30 April 2010
				Opuntia spp. (prickly pear)	✓	✓	
T-014	1RP865974	FH	Galletly JS				Property not surveyed due to time restrictions
T-016	16CTN344	FH	Kiora Pastoral Company Pty Ltd	*Lantana camara* (lantana)	-	✓	Property not surveyed during dry season
				Lantana montevidensis (creeping lantana)	-	✓	Date of post wet season survey: 26-30 April 2010
				Cryptostegia grandiflora (rubber vine)	-	✓	
				Xanthium occidentale (noogoora burr)	-	✓	
				Bidens pilosa (cobbler's pegs)	-	✓	
				Praxelis clematidea (praxelis)	-	✓	
T-017	1RP616641	FH	Quinn DE	*Opuntia spp.* (prickly pear)	✓	-	Date of dry season survey: 7-8 September 2009. Property not surveyed during post wet season
T-017	13SP199384	FH	Quinn	*Opuntia spp.* (prickly pear)	✓	-	Date of dry season survey: 7-8 September 2009. Property not surveyed during post wet season
T-017	12SP199383	FH	Quinn	*Opuntia spp.* (prickly pear)	✓	-	Date of dry season survey: 7-8 September 2009, Date of post wet season survey: 26-30 April 2010
T-018	18CTN344	FH	Redshirt Pastoral Company Pty Ltd	no declared weeds recorded			Date of dry season survey: 7-8 September 2009. Property not surveyed during post wet season
T-018	412CL40158	FH	Redshirt Pastoral Company Pty Ltd	*Lantana camara* (lantana)	✓	-	Date of dry season survey: 7-8 September 2009. Property not surveyed during post wet season
				Opuntia spp. (prickly pear)	✓	-	
T-018	12CTN301	FH	Redshirt Pastoral Company Pty Ltd	*Lantana camara* (lantana)	✓	-	Date of dry season survey: 7-8 September 2009. Property not surveyed during post wet season
				Opuntia spp. (prickly pear)	✓	-	

Property Parcel Number	Lot on Plan	Tenure	Landholder	Weed Names	Weeds Identified During Field Surveys		Notes
					Dry Season (2009)	Post Wet Season (2010)	
T-018	19CTN345	FH	Redshirt Pastoral Company Pty Ltd	*Lantana camara* (lantana)	✓	✓	Date of dry season survey: 7-8 September 2009
				Lantana montevidensis (creeping lantana)	-	✓	Date of post wet season survey: 26-30 April 2010
				Opuntia spp. (prickly pear)	✓		
				Cryptostegia grandiflora (rubber vine)	✓	✓	
				Cascabela thevetia (yellow oleander)	-	✓	
				Xanthium occidentale (noogoora burr)	-	✓	
				Bidens pilosa (cobbler's pegs)	-	✓	
T-018	13CTN301	FH	Redshirt Pastoral Company Pty Ltd	*Lantana camara* (lantana)	✓	✓	Date of dry season survey: 7-8 September 2009
				Lantana montevidensis (creeping lantana)	-	✓	Date of post wet season survey: 15-17 February and 26-30 April 2010
				Opuntia spp. (prickly pear)	✓	✓	
				Cryptostegia grandiflora (rubber vine)	-	✓	
				Eragrostis curvula (African love grass)	-	✓	
				Xanthium occidentale (noogoora burr)	-	✓	
				Praxelis clematidea (praxelis)	-	✓	
				Bidens pilosa (cobbler's pegs)	-	✓	
T-018.5	25CTN406	RE	GRC	*Lantana camara* (lantana)	✓	-	Date of dry season survey: 7-8 September 2009
				Lantana montevidensis (creeping lantana)	✓	-	Date of post wet season survey: 26-30 April 2010
				Opuntia spp. (prickly pear)	✓	-	
				Bidens pilosa (cobbler's pegs)	-	✓	
T-021	23CTN1233	FH	Wilson ARL	*Lantana camara* (lantana)	✓	✓	Date of dry season survey: 7-8 September 2009
				Lantana montevidensis (creeping lantana)	✓	-	Date of post wet season survey: 15-17 February 2010
				Cryptostegia grandiflora (rubber vine)	✓	✓	
T-021	6CP907492	LL	Wilson ARL	*Lantana camara* (lantana)	-	✓	Property not surveyed during dry season
				Lantana montevidensis (creeping lantana)	-	✓	Date of post wet season survey: 26-30 April 2010
				Opuntia spp. (prickly pear)	-	✓	
T-029	2RN1093	LL	Neilsen FK, VJ, WK & PM	*Acacia nilotica* (prickly acacia)	✓	-	Date of dry season survey: 15-19 June 2009
				Lantana camara (lantana)	✓	-	Date of post wet season survey: 26-30 April 2010
				Opuntia spp. (prickly pear)	✓	-	
				Xanthium occidentale (noogoora burr)	-	✓	
				Bidens pilosa (cobbler's pegs)	-	✓	
T-030	41RN800347	FH	Tarry WL, KM & DE, Foote DL	*Acacia nilotica* (prickly acacia)	✓	-	Date of dry season survey: 15-19 June 2009
				Lantana camara (lantana)	✓	✓	Date of post wet season survey: 26-30 April 2010
				Lantana montevidensis (creeping lantana)	✓	-	
				Cryptostegia grandiflora (rubber vine)	✓	✓	
				Opuntia spp. (prickly pear)	✓	✓	
				Eragrostis curvula (African love grass)	-	✓	
				Bidens pilosa (cobbler's pegs)	-	✓	
				Praxelis clematidea (praxelis)	-	✓	
T-030.5	1RP843125	FH	Bond CH & AA	*Lantana camara* (lantana)	✓	-	Date of dry season survey: 15-19 June 2009.
				Lantana montevidensis (creeping lantana)	✓	-	Property not surveyed during post wet season
				Opuntia spp. (prickly pear)	✓	-	
T-031	2RP843125	FH	Baker MJ & McFadden KL	*Acacia nilotica* (prickly acacia)	✓	-	Date of dry season survey: 15-19 June 2009.
				Lantana camara (lantana)	✓	-	Property not surveyed during post wet season
				Lantana montevidensis (creeping lantana)	✓	-	
				Opuntia spp. (prickly pear)	✓	-	
T-031.5	3RP843125	FH	Pickering TF & CA	*Lantana camara* (lantana)	✓	✓	Date of dry season survey: 15-19 June 2009
				Lantana montevidensis (creeping lantana)	-	✓	Date of post wet season survey: 26-30 April 2010
				Opuntia spp. (prickly pear)	-	✓	
T-032	5RP843128	FH	Ferry WGJ & DE	*Lantana camara* (lantana)	✓	-	Date of dry season survey: 15-19 June 2009.
				Opuntia spp. (prickly pear)	✓	-	Property not surveyed during post wet season

Property Parcel Number	Lot on Plan	Tenure	Landholder	Weed Names	Weeds Identified During Field Surveys		Notes
					Dry Season (2009)	Post Wet Season (2010)	
T-032.5	4RP843125	FH	Curtis JF & KA	*Lantana camara* (lantana)	✓	-	Date of dry season survey: 15-19 June 2009
				Lantana montevidensis (creeping lantana)	✓	-	Property not surveyed during post wet season
				Opuntia spp. (prickly pear)	✓	-	
T-032.9	8RN1580	LL	Tarry WL & Schloss WF	*Acacia nilotica* (prickly acacia)	✓	-	Date of dry season survey: 15-19 June 2009
				Lantana camara (lantana)	✓	✓	Date of post wet season survey: 26-30 April 2010
				Lantana montevidensis (creeping lantana)	✓	✓	
				Cryptostegia grandiflora (rubber vine)	✓	-	
				Opuntia spp. (prickly pear)	✓	✓	
				Bryophyllum delagoense (mother-of-millions)	✓	-	
				Anredera cordifolia (Madeira vine)	✓	-	
				Bidens pilosa (cobbler's pegs)	-	✓	
T-033	6RP843128	FH	Lipsys AP & BJ	*Acacia nilotica* (prickly acacia)	✓	-	Date of dry season survey: 15-19 June 2009
				Lantana montevidensis (creeping lantana)	✓	-	Property not surveyed during post wet season
T-033.5	7RP843126	FH	Filer ER & W				Property not surveyed due to time restrictions
T-033.9	170FTY1843	TR	State of Queensland (DERM)	*Lantana camara* (lantana)	✓	-	Date of dry season survey: 15-19 June 2009
				Bryophyllum delagoense (mother-of-millions)	✓	-	Property not surveyed during post wet season
T-034	8RP843126	FH	Knight SW & JM	*Lantana montevidensis* (creeping lantana)	✓	✓	Date of dry season survey: 15-19 June 2009
				Opuntia spp. (prickly pear)	✓	✓	Date of post wet season survey: 26-30 April 2010
T-034.1	9RP843126	FH	Kuprynski LS (nee Reid)	*Lantana camara* (lantana)	✓	-	Date of dry season survey: 15-19 June 2009
				Cryptostegia grandiflora (rubber vine)	✓	-	Property not surveyed during post wet season
				Opuntia spp. (prickly pear)	✓	-	
				Anredera cordifolia (Madeira vine)	✓	-	
T-034.35	1RP618390	FH	Paul V Higgins & Sus	*Opuntia spp.* (prickly pear)	✓	-	Date of dry season survey: 15-19 June 2009. Property not surveyed during post wet season
T-034.5	83RN426	FH	Dudarko NP				Property not surveyed due to time restrictions
T-034.5	84RN426	FH	Dudarko NP	no declared weeds recorded			Date of dry season survey: 15-19 June 2009, Date of post wet season survey: 26-30 April 2010
T-034.5	76RN425	FH	Dudarko NP	no declared weeds recorded			Date of dry season survey: 15-19 June 2009, Date of post wet season survey: 26-30 April 2010
T-034.6	122SP108702	LL	Anglo Coal (Calliade) Pty Ltd	*Bryophyllum delagoense* (mother-of-millions)	✓	-	Date of dry season survey: 15-19 June 2009
				Lantana camara (lantana)	✓	-	Property not surveyed during post wet season
T-034.71	1RP616095	FH	Stewart H	*Bryophyllum delagoense* (mother-of-millions)	✓	-	Date of dry season survey: 15-19 June 2009
				Opuntia spp. (prickly pear)	✓	✓	Date of post wet season survey: 26-30 April 2010
T-034.72	77SP163782	FH	Stewart HE	*Bryophyllum delagoense* (mother-of-millions)	✓	-	Date of dry season survey: 15-19 June 2009
				Opuntia spp. (prickly pear)	✓	✓	Date of post wet season survey: 26-30 April 2010
				Macfadyena unguis-cati (cat's claw creeper)	-	✓	
T-036	64RN373	FH	Bell HM & Stewart HE	*Bryophyllum delagoense* (mother-of-millions)	✓	-	Date of dry season survey: 15-19 June 2009, Date of post wet season survey: 26-30 April 2010
T-036	63RN1330	FH	Bell HM & Stewart HE	no declared weeds recorded			Date of dry season survey: 15-19 June 2009, Date of post wet season survey: 26-30 April 2010
T-036.5	62RN1330	FH	Hutchings LJ	*Opuntia spp.* (prickly pear)	✓	-	Date of dry season survey: 15-19 June 2009, Date of post wet season survey: 26-30 April 2010
T-038.5	49RN350	FH	Zimmermann MH & KM	*Opuntia spp.* (prickly pear)	✓	-	Date of dry season survey: 15-19 June 2009
				Senecio pinnatifolius (native fireweed)	✓	-	Date of post wet season survey: 26-30 April 2010
				Xanthium occidentale (noogoora burr)	-	✓	
T-039	50RP620969	FH	Johnston AJ	*Opuntia spp.* (prickly pear)	✓	-	Date of dry season survey: 15-19 June 2009
				Senecio pinnatifolius (native fireweed)	✓	-	Date of post wet season survey: 26-30 April 2010
				Lantana montevidensis (creeping lantana)	-	✓	
T-040	1RP620969	FH	Benson Pastoral Pty Ltd	*Bryophyllum delagoense* (mother-of-millions)	✓	-	Date of dry season survey: 15-19 June 2009
				Opuntia spp. (prickly pear)	✓	-	Date of post wet season survey: 26-30 April 2010

Property Parcel Number	Lot on Plan	Tenure	Landholder	Weed Names	Weeds Identified During Field Surveys Dry Season (2009)	Post Wet Season (2010)	Notes
T-041	35RN1155	FH	MILLER	*Opuntia spp.* (prickly pear)	✓	-	Date of dry season survey: 15-19 June 2009, Date of post wet season survey: 26-30 April 2010
T-041.1	138RN976	FH	Miller RG	*Opuntia spp.* (prickly pear)	✓	-	Date of dry season survey: 15-19 June 2009, Date of post wet season survey: 26-30 April 2010
T-041.1	31RN349	FH	Miller RG	*Opuntia spp.* (prickly pear)	✓	-	Date of dry season survey: 15-19 June 2009, Date of post wet season survey: 26-30 April 2010
T-041.1	139RN350	RE	Miller RG	*Opuntia spp.* (prickly pear)	✓	-	Date of dry season survey: 15-19 June 2009, Date of post wet season survey: 26-30 April 2010
T-042	32RN1155	FH	Zischke LN & JGR	*Opuntia spp.* (prickly pear)	✓	-	Date of dry season survey: 15-19 June 2009
				Bryophyllum delagoense (mother-of-millions)	-	✓	Date of post wet season survey: 26-30 April 2010
T-043	23RN347	FH	Heid WK	no declared weeds recorded			Date of dry season survey: 29 June - 3 July 2009, Date of post wet season survey: 26-30 April 2010
T-044	24RN347	FH	Heid LK	*Opuntia spp.* (prickly pear)	✓	-	Date of dry season survey: 29 June - 3 July 2009
				Macfadyena unguis-cati (cat's claw creeper)	✓	✓	Date of post wet season survey: 26-30 April 2010
				Cryptostegia grandiflora (rubber vine)	✓	✓	
				Senecio pinnatifolius (native fireweed)	✓	-	
				Xanthium occidentale (noogoora burr)	✓	✓	
T-044	25RN347	FH	Heid LK	*Cryptostegia grandiflora* (rubber vine)	✓	✓	Date of dry season survey: 29 June - 3 July 2009
				Xanthium occidentale (noogoora burr)	-	✓	Date of post wet season survey: 26-30 April 2010
T-044.2	11RP618897	FH	Urquhart AD	no declared weeds recorded			Date of dry season survey: 29 June - 3 July 2009, Date of post wet season survey: 26-30 April 2010
T-046	1RN347	FH	Heid WL	*Opuntia spp.* (prickly pear)	✓	✓	Date of dry season survey: 29 June - 3 July 2009
				Senecio pinnatifolius (native fireweed)	✓	✓	Date of post wet season survey: 2-6 June 2010
T-047	75PM207	FH	Carige JW & BM	*Opuntia spp.* (prickly pear)	✓	✓	Date of dry season survey: 29 June - 3 July 2009
				Sclerolaena birchii (galvanised burr)	-	✓	Date of post wet season survey: 2-6 June 2010
T-048	84PM207	FH	Carige JM & GL	*Opuntia spp.* (prickly pear)	✓	✓	Date of dry season survey: 29 June - 3 July 2009
				Senecio pinnatifolius (native fireweed)	✓	✓	Date of post wet season survey: 2-6 June 2010
T-050	82PM222	FH	De Landelles KLS & PM, Muller GM & MJ	*Opuntia spp.* (prickly pear)	✓	✓	Date of dry season survey: 29 June - 3 July 2009
				Senecio pinnatifolius (native fireweed)	✓	✓	Date of post wet season survey: 2-6 June 2010
T-051	81PM222	FH	De Landelles PM	*Opuntia spp.* (prickly pear)	✓	✓	Date of dry season survey: 29 June - 3 July 2009
				Chloris virgata (feathertop rhodes grass)	✓		Date of post wet season survey: 2-6 June 2010
				Senecio pinnatifolius (native fireweed)	✓		
				Xanthium occidentale (noogoora burr)	-	✓	
T-052	91PM224	FH	Thompson BR	*Bryophyllum delagoense* (mother-of-millions)	✓	✓	Date of dry season survey: 29 June - 3 July 2009
				Opuntia spp. (prickly pear)	✓	-	Date of post wet season survey: 2-6 June 2010
				Xanthium occidentale (noogoora burr)	-	✓	
				Chloris virgata (feathertop rhodes grass)	✓	-	
				Senecio pinnatifolius (native fireweed)	✓	-	
T-053	61PM224	FH	Howard IM, VA and Estate of Howard NJ	*Chloris virgata* (feathertop rhodes grass)	✓	-	Date of dry season survey: 29 June - 3 July 2009
				Senecio pinnatifolius (native fireweed)	✓	-	Date of post wet season survey: 2-6 June 2010
T-054	59PM224	FH	Howard VA	*Opuntia spp.* (prickly pear)	✓	-	Date of dry season survey: 29 June - 3 July 2009
				Senecio pinnatifolius (native fireweed)	✓	-	Date of post wet season survey: 2-6 June 2010
T-055.1	58PM229	FH	Howard JG	*Opuntia spp.* (prickly pear)	✓	✓	Date of dry season survey: 29 June - 3 July 2009
				Senecio pinnatifolius (native fireweed)	✓	-	Date of post wet season survey: 2-6 June 2010
				Xanthium occidentale (noogoora burr)	-	✓	
				Bidens pilosa (cobbler's pegs)	-	✓	
				Praxelis clematidea (praxelis)	-	✓	
T-055.2	57PM83	LL	Howard JG	*Opuntia spp.* (prickly pear)	✓	✓	Date of dry season survey: 29 June - 3 July 2009
				Senecio pinnatifolius (native fireweed)	✓	✓	Date of post wet season survey: 2-6 June 2010

Property Parcel Number	Lot on Plan	Tenure	Landholder	Weed Names	Weeds Identified During Field Surveys Dry Season (2009)	Post Wet Season (2010)	Notes
				Xanthium spinosum (bathurst burr)	-	✓	
T-058	34RP621029	FH	Hobson GV	*Bryophyllum delagoense* (mother-of-millions)	✓	-	Date of dry season survey: 29 June - 3 July 2009
				Opuntia spp. (prickly pear)	✓	✓	Date of post wet season survey: 2-6 June 2010
				Xanthium occidentale (noogoora burr)	-	✓	
				Sclerolaena birchii (galvanised burr)	-	✓	
				Senecio pinnatifolius (native fireweed)	✓	-	
T-058	2SP122586	FH	Hobson GV	*Bryophyllum delagoense* (mother-of-millions)	✓	-	
				Opuntia spp. (prickly pear)	✓	✓	
				Xanthium occidentale (noogoora burr)	-	✓	
				Senecio pinnatifolius (native fireweed)	✓	-	
				Bidens pilosa (cobbler's pegs)	-	✓	
T-061	4FN6	FH	Calungba Pty Ltd	*Bryophyllum delagoense* (mother-of-millions)	✓	-	Date of dry season survey: 29 June - 3 July 2009
				Opuntia spp. (prickly pear)	✓	✓	Date of post wet season survey: 2-6 June 2010
				Chloris virgata (feathertop rhodes grass)	✓	-	
				Senecio pinnatifolius (native fireweed)	✓	-	
				Xanthium occidentale (noogoora burr)	✓	✓	
				Sclerolaena birchii (galvanised burr)	-	✓	
				Bidens pilosa (cobbler's pegs)	-	✓	
T-061	20FN491	FH	Calungba Pty Ltd	*Bryophyllum delagoense* (mother-of-millions)	✓	-	Date of dry season survey: 29 June - 3 July 2009
				Opuntia spp. (prickly pear)	✓	✓	Date of post wet season survey: 2-6 June 2010
				Chloris virgata (feathertop rhodes grass)	✓	-	
				Senecio pinnatifolius (native fireweed)	✓	-	
T-061	3FER4025	FH	Calungba Pty Ltd	*Bryophyllum delagoense* (mother-of-millions)	✓	-	Date of dry season survey: 29 June - 3 July 2009
				Opuntia spp. (prickly pear)	✓	✓	Date of post wet season survey: 2-6 June 2010
				Chloris virgata (feathertop rhodes grass)	✓	-	
				Senecio pinnatifolius (native fireweed)	✓	-	
				Xanthium occidentale (noogoora burr)	✓	✓	
T-063.1	5FN10	LL	Hills Family Property Pty Ltd	*Parthenium hysterophorus* (parthenium)	✓	✓	Date of dry season survey: 29 June - 3 July 2009
				Opuntia spp. (prickly pear)	-	✓	Date of post wet season survey: 2-6 June 2010
				Xanthium occidentale (noogoora burr)	-	✓	
				Sclerolaena birchii (galvanised burr)	-	✓	
				Senecio pinnatifolius (native fireweed)	✓	✓	
				Bidens pilosa (cobbler's pegs)	-	✓	
T-063.2	22FN301	FH	Hills Family Property Pty Ltd	*Opuntia spp.* (prickly pear)	✓	✓	Date of dry season survey: 29 June - 3 July 2009
				Senecio pinnatifolius (native fireweed)	✓	✓	Date of post wet season survey: 2-6 June 2010
				Xanthium occidentale (noogoora burr)	✓	-	
T-064	25FN302	FH	Galletly JS	*Opuntia spp.* (prickly pear)	✓	✓	Date of dry season survey: 29 June - 3 July 2009
				Chloris virgata (feathertop rhodes grass)	✓	-	Date of post wet season survey: 2-6 June 2010
T-064.5	26FN302	LL	Littleton	no declared weeds recorded			Date of post wet season survey: 2-6 June 2010
T-065	21FN306	FH	Dingle WB & KL	*Opuntia spp.* (prickly pear)	✓	-	Date of dry season survey: 29 June - 3 July 2009
				Chloris virgata (feathertop rhodes grass)	✓	-	Date of post wet season survey: 2-6 June 2010
				Xanthium occidentale (noogoora burr)	✓	-	
				Senecio pinnatifolius (native fireweed)	-	✓	
T-066.1	40FN305	FH	Palmtree Wetaru Aboriginal Corporation for Land & Culture	*Parthenium hysterophorus* (parthenium)	✓	✓	Date of dry season survey: 29 June - 3 July 2009
				Opuntia spp. (prickly pear)	✓	✓	Date of post wet season survey: 2-6 June 2010
				Chloris virgata (feathertop rhodes grass)	✓	-	
				Senecio pinnatifolius (native fireweed)	✓	✓	
				Xanthium occidentale (noogoora burr)	✓	✓	
T-066.2	39FN305	LL	Palmtree Wetaru Aboriginal Corporation for Land & Culture	*Parthenium hysterophorus* (parthenium)	✓	✓	Date of dry season survey: 29 June - 3 July 2009

Property Parcel Number	Lot on Plan	Tenure	Landholder	Weed Names	Weeds Identified During Field Surveys		Notes
					Dry Season (2009)	Post Wet Season (2010)	
				Opuntia spp. (prickly pear)	✓	✓	Date of post wet season survey: 2-6 June 2010
				Chloris virgata (feathertop rhodes grass)	✓	-	
				Senecio pinnatifolius (native fireweed)	✓	-	
				Xanthium occidentale (noogoora burr)	✓	✓	
T-068	49FN352	LL	Muller KJ, CL, DW & NG	*Parthenium hysterophorus* (parthenium)	✓	✓	Date of dry season survey: 29 June - 3 July 2009
				Opuntia spp. (prickly pear)	✓	✓	Date of post wet season survey: 2-6 June 2010
				Senecio pinnatifolius (native fireweed)	✓	✓	
				Xanthium occidentale (noogoora burr)	-	✓	
T-070	2FN197	LL	Gillis AJ & RW	*Parthenium hysterophorus* (parthenium)	✓	-	Date of dry season survey: 29 June - 3 July 2009
				Opuntia spp. (prickly pear)	✓	✓	Date of post wet season survey: 2-6 June 2010
				Chloris virgata (feathertop rhodes grass)	✓	-	
				Senecio pinnatifolius (native fireweed)	✓	-	
T-071	10FN207	FH	Rider RG	*Parthenium hysterophorus* (parthenium)	-	✓	Property not surveyed during dry season
				Opuntia spp. (prickly pear)	-	✓	Date of post wet season survey: 2-6 June 2010
				Senecio pinnatifolius (native fireweed)	-	✓	
T-072	3FN207	LL	Swan SJ & JW	*Parthenium hysterophorus* (parthenium)	✓	✓	Date of dry season survey: 29 June - 3 July 2009
				Opuntia spp. (prickly pear)	✓	✓	Date of post wet season survey: 2-6 June 2010
				Chloris virgata (feathertop rhodes grass)	✓	-	
				Senecio pinnatifolius (native fireweed)	✓	✓	
				Xanthium occidentale (noogoora burr)	-	✓	
T-072.6	12CP895590	LL	Swan JW	*Parthenium hysterophorus* (parthenium)	✓	✓	Date of dry season survey: 15-19 June 2009
				Cryptostegia grandiflora (rubber vine)	✓	-	Date of post wet season survey: 2-6 June 2010
				Bryophyllum delagoense (mother-of-millions)	✓	-	
				Opuntia spp. (prickly pear)	✓	✓	
				Xanthium occidentale (noogoora burr)	✓	-	
				Senecio pinnatifolius (native fireweed)	✓	✓	
T-075	37FN506	FH	Price G & LM	*Parthenium hysterophorus* (parthenium)	✓	✓	Date of dry season survey: 15-19 June 2009
				Cryptostegia grandiflora (rubber vine)	-	✓	Date of post wet season survey: 2-6 June 2010
				Opuntia spp. (prickly pear)	✓	✓	
				Xanthium occidentale (noogoora burr)	-	✓	
				Senecio pinnatifolius (native fireweed)	-	✓	
T-075	1RP901793	FH	Price G & LM	*Parthenium hysterophorus* (parthenium)	✓	✓	Date of dry season survey: 15-19 June 2009
				Opuntia spp. (prickly pear)	✓	✓	Date of post wet season survey: 2-6 June 2010
				Xanthium occidentale (noogoora burr)	-	✓	
				Senecio pinnatifolius (native fireweed)	-	✓	
				Bidens pilosa (cobbler's pegs)	-	✓	
T-075	16FN506	FH	Price G & LM	*Parthenium hysterophorus* (parthenium)	-	✓	Date of dry season survey: 15-19 June 2009
				Opuntia spp. (prickly pear)	✓	✓	Date of post wet season survey: 2-6 June 2010
				Xanthium occidentale (noogoora burr)	-	✓	
				Senecio pinnatifolius (native fireweed)	-	✓	
				Bidens pilosa (cobbler's pegs)	-	✓	
T-075.3	38FN506	FH	Morris BA	*Parthenium hysterophorus* (parthenium)	-	✓	Date of dry season survey: 15-19 June 2009
				Opuntia spp. (prickly pear)	✓	-	Date of post wet season survey: 2-6 June 2010
				Xanthium occidentale (noogoora burr)	-	✓	
				Senecio pinnatifolius (native fireweed)	-	✓	
T-075.6	8KM87	FH	Feddersen GC & CL	*Parthenium hysterophorus* (parthenium)	✓	✓	Date of dry season survey: 15-19 June 2009
				Opuntia spp. (prickly pear)	✓	✓	Date of post wet season survey: 2-6 June 2010
T-076	7KM142	FH	MacLean LA	*Parthenium hysterophorus* (parthenium)	✓	✓	Date of dry season survey: 15-19 June 2009
				Opuntia spp. (prickly pear)	✓	✓	Date of post wet season survey: 2-6 June 2010
				Chloris virgata (feathertop rhodes grass)	✓	-	
				Senecio pinnatifolius (native fireweed)	✓	✓	

Property Parcel Number	Lot on Plan	Tenure	Landholder	Weed Names	Weeds Identified During Field Surveys		Notes
					Dry Season (2009)	Post Wet Season (2010)	
T-078	4KM74	FH	Hood AGB	*Parthenium hysterophorus* (parthenium)	✓	✓	Date of dry season survey: 15-19 June 2009
				Bryophyllum delagoense (mother-of-millions)	✓	✓	Date of post wet season survey: 2-6 June 2010
				Cryptostegia grandiflora (rubber vine)	✓	-	
				Opuntia spp. (prickly pear)	✓	✓	
				Bidens pilosa (cobbler's pegs)	-	✓	
T-080.1	5KM65	FH	Dahl JP & JJ	*Parthenium hysterophorus* (parthenium)	✓	✓	Date of dry season survey: 15-19 June 2009
				Opuntia spp. (prickly pear)	✓	-	Date of post wet season survey: 2-6 June 2010
				Senecio pinnatifolius (native fireweed)	✓	-	
T-080.2	4KM152	FH	Dahl DO & JJ	*Parthenium hysterophorus* (parthenium)	✓	✓	Date of dry season survey: 15-19 June 2009
				Opuntia spp. (prickly pear)	✓	-	Date of post wet season survey: 2-6 June 2010
				Senecio pinnatifolius (native fireweed)	✓	-	
T-081	1SP197365	FH	Dales PD	*Parthenium hysterophorus* (parthenium)	✓	✓	Date of dry season survey: 15-19 June 2009
				Lantana camara (lantana)	✓	-	Date of post wet season survey: 2-6 June 2010
				Opuntia spp. (prickly pear)	✓	-	
				Xanthium occidentale (noogoora burr)	✓	-	
T-082	10BH223	FH	Hood EE & McBryde DK	*Parthenium hysterophorus* (parthenium)	✓	✓	Date of dry season survey: 15-19 June 2009
				Opuntia spp. (prickly pear)	✓	✓	Date of post wet season survey: 2-6 June 2010
				Bryophyllum delagoense (mother-of-millions)	-	✓	
				Senecio pinnatifolius (native fireweed)	-	✓	
T-083	13RP620842	FH	Fairweather LR & D	*Parthenium hysterophorus* (parthenium)	✓	✓	Date of dry season survey: 15-19 June 2009
				Opuntia spp. (prickly pear)	✓	-	Date of post wet season survey: 2-6 June 2010
				Chloris virgata (feathertop rhodes grass)	✓	-	
				Senecio pinnatifolius (native fireweed)	✓	-	
T-086	1SP136872	FH	Stephenson GJ	*Parthenium hysterophorus* (parthenium)	✓	✓	Date of dry season survey: 15-19 June 2009
				Opuntia spp. (prickly pear)	✓	-	Date of post wet season survey: 2-6 June 2010
				Chloris virgata (feathertop rhodes grass)	✓	-	
				Senecio pinnatifolius (native fireweed)	✓	-	
T-087	9BH97	FH	Simmonds CH, Byriel RJ & JP	*Parthenium hysterophorus* (parthenium)	✓	✓	Date of dry season survey: 15-19 June 2009
				Opuntia spp. (prickly pear)	-	✓	Date of post wet season survey: 2-6 June 2010
T-088	5BH138	LL	Nobbs SA	*Parthenium hysterophorus* (parthenium)	✓	✓	Date of dry season survey: 15-19 June 2009, Date of post wet season survey: 2-6 June 2010
T-089	28RP911528	FH	Simmonds CH	*Parthenium hysterophorus* (parthenium)	✓	✓	Date of dry season survey: 15-19 June 2009
				Opuntia spp. (prickly pear)	✓	-	Date of post wet season survey: 2-6 June 2010
				Bryophyllum delagoense (mother-of-millions)	✓	-	
				Chloris virgata (feathertop rhodes grass)	✓	-	
T-089	14BH207	FH	Simmonds CH	*Parthenium hysterophorus* (parthenium)	✓	✓	Date of dry season survey: 15-19 June 2009
				Opuntia spp. (prickly pear)	✓	-	Date of post wet season survey: 2-6 June 2010
				Bryophyllum delagoense (mother-of-millions)	✓	-	
				Chloris virgata (feathertop rhodes grass)	✓	-	
				Xanthium occidentale (noogoora burr)	-	✓	
T-091	28BH244	FH	Mars CR & FJ	*Parthenium hysterophorus* (parthenium)	✓	✓	Date of dry season survey: 15-19 June 2009
				Opuntia spp. (prickly pear)	✓	-	Date of post wet season survey: 2-6 June 2010
T-091	15BH243	FH	Mars CR & FJ	*Parthenium hysterophorus* (parthenium)	✓	✓	Date of dry season survey: 15-19 June 2009
				Opuntia spp. (prickly pear)	✓	-	Date of post wet season survey: 2-6 June 2010
T-091	27RP911528	FH	Mars CR & FJ	*Parthenium hysterophorus* (parthenium)	✓	✓	Date of dry season survey: 15-19 June 2009
				Opuntia spp. (prickly pear)	✓	✓	Date of post wet season survey: 2-6 June 2010
				Bryophyllum delagoense (mother-of-millions)	-	✓	
T-092	36BH278	FH	Crowther SAR	*Parthenium hysterophorus* (parthenium)	✓	✓	Date of dry season survey: 15-19 June 2009
				Opuntia spp. (prickly pear)	-	✓	Date of post wet season survey: 2-6 June 2010
T-095	16BH269	FH	Carter DA	*Parthenium hysterophorus* (parthenium)	✓	✓	Date of dry season survey: 15-19 June 2009
				Opuntia spp. (prickly pear)	✓	-	Date of post wet season survey: 2-6 June 2010

Property Parcel Number	Lot on Plan	Tenure	Landholder	Weed Names	Weeds Identified During Field Surveys Dry Season (2009)	Post Wet Season (2010)	Notes
T-095	2RP912777	FH	Carter DA	*Parthenium hysterophorus* (parthenium)	✓	✓	Date of dry season survey: 15-19 June 2009
				Opuntia spp. (prickly pear)	✓	-	Date of post wet season survey: 2-6 June 2010
T-097	1BH240	LL	Scott AA	*Parthenium hysterophorus* (parthenium)	✓	✓	Date of dry season survey: 15-19 June 2009
				Opuntia spp. (prickly pear)	✓	-	Date of post wet season survey: 2-6 June 2010
				Chloris virgata (feathertop rhodes grass)	✓	-	
				Senecio pinnatifolius (native fireweed)	✓	-	
T-098	4SP142673	LL	Tyson LJ & AD	*Parthenium hysterophorus* (parthenium)	✓	✓	Date of dry season survey: 15-19 June 2009
				Opuntia spp. (prickly pear)	✓	-	Date of post wet season survey: 2-6 June 2010
T-099	29FTY1847	SF	State of Queensland (DERM)	*Parthenium hysterophorus* (parthenium)	-	✓	Date of dry season survey: 15-19 June 2009
				Opuntia spp. (prickly pear)	✓	✓	Date of post wet season survey: 2-6 June 2010
				Chloris virgata (feathertop rhodes grass)	✓	-	
T-099	7SP142673	SF	State of Queensland (DERM)	*Parthenium hysterophorus* (parthenium)	-	✓	Date of dry season survey: 15-19 June 2009
				Opuntia spp. (prickly pear)	✓	✓	Date of post wet season survey: 2-6 June 2010
T-100	7CUE91	LL	Clark RC, JM, DJ & RPC	*Parthenium hysterophorus* (parthenium)	-	✓	Property not surveyed during dry season
				Opuntia spp. (prickly pear)	-	✓	Date of post wet season survey: 10-14 May 2010
				Xanthium occidentale (noogoora burr)	-	✓	
T-101	1CUE95	LL	Magowra Pastoral Company Pty Ltd	*Parthenium hysterophorus* (parthenium)	-	✓	Property not surveyed during dry season
				Opuntia spp. (prickly pear)	-	✓	Date of post wet season survey: 10-14 May 2010
				Senecio pinnatifolius (native fireweed)	-	✓	
				Xanthium occidentale (noogoora burr)	-	✓	
				Bidens pilosa (cobbler's pegs)	-	✓	
				Xanthium spinosum (bathurst burr)	-	✓	
T-109	2CUE92	LL	Mulcahy ED & Riethmuller KG	*Parthenium hysterophorus* (parthenium)	-	✓	Property not surveyed during dry season
				Opuntia spp. (prickly pear)	-	✓	Date of post wet season survey: 10-14 May 2010
				Senecio pinnatifolius (native fireweed)	-	✓	
				Xanthium occidentale (noogoora burr)	-	✓	
				Bidens pilosa (cobbler's pegs)	-	✓	
T-109.5	15CUE93	LL	Mulcahy, Riethmuller & Hickson	*Opuntia spp.* (prickly pear)	-	✓	Property not surveyed during dry season
				Senecio pinnatifolius (native fireweed)	-	✓	Date of post wet season survey: 10-14 May 2010
T-110	13CUE94	LL	Hickson ML	*Opuntia spp.* (prickly pear)	✓	✓	Date of dry season survey: 15-19 June 2009
				Senecio pinnatifolius (native fireweed)	-	✓	Date of post wet season survey: 10-14 May 2010
T-111	6TR34	FH	O'Sullivan ST & GP	*Opuntia spp.* (prickly pear)	✓	✓	Date of dry season survey: 15-19 June 2009, Date of post wet season survey: 10-14 May 2010
T-112	5TR33	FH	Saal TN & E	*Opuntia spp.* (prickly pear)	✓	✓	Date of dry season survey: 15-19 June 2009
				Sclerolaena birchii (galvanised burr)	✓	✓	Date of post wet season survey: 10-14 May 2010
				Xanthium occidentale (noogoora burr)	-	✓	
				Senecio pinnatifolius (native fireweed)	-	✓	
				Xanthium spinosum (bathurst burr)	-	✓	
				Bidens pilosa (cobbler's pegs)	-	✓	
T-113	4TR32	FH	Crowther SAR	*Opuntia spp.* (prickly pear)	✓	✓	Date of dry season survey: 15-19 June 2009
				Alternanthera pungens (khaki burr)	✓	-	Date of post wet season survey: 10-14 May 2010
				Xanthium occidentale (noogoora burr)	-	✓	
				Senecio pinnatifolius (native fireweed)	-	✓	
				Xanthium spinosum (bathurst burr)	-	✓	
T-114.1	2TR30	FH	McLoughlin JK	*Opuntia spp.* (prickly pear)	✓	✓	Date of dry season survey: 15-19 June 2009
				Xanthium occidentale (noogoora burr)		✓	Date of post wet season survey: 10-14 May 2010
				Senecio pinnatifolius (native fireweed)		✓	
				Sclerolaena birchii (galvanised burr)		✓	
T-115.1	3TR31	FH	Earle Graze Pty Ltd	*Opuntia spp.* (prickly pear)	✓	✓	Date of dry season survey: 15-19 June 2009
				Xanthium spinosum (bathurst burr)	✓		Date of post wet season survey: 10-14 May 2010
				Sclerolaena birchii (galvanised burr)	✓		

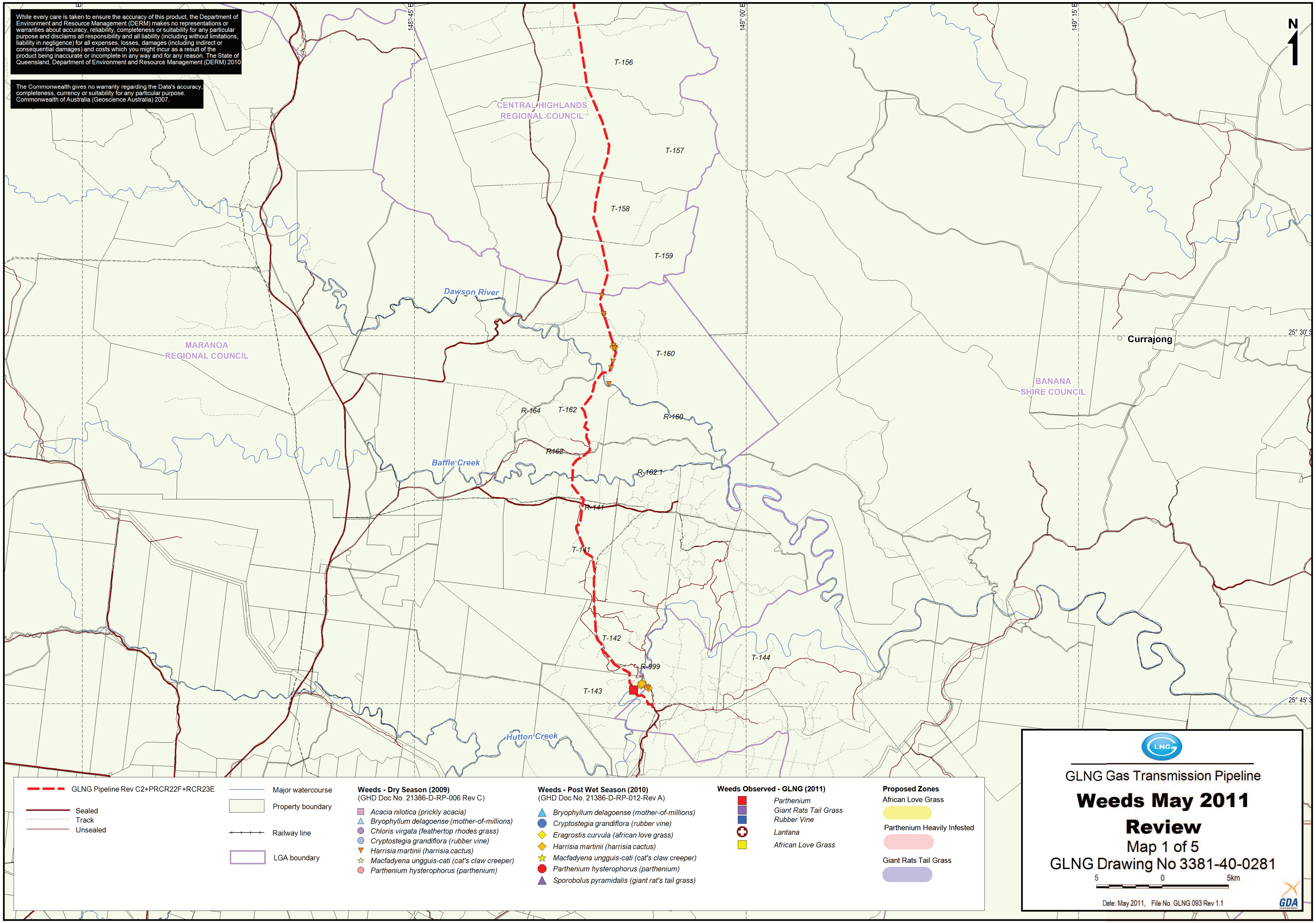
Property Parcel Number	Lot on Plan	Tenure	Landholder	Weed Names	Weeds Identified During Field Surveys Dry Season (2009)	Post Wet Season (2010)	Notes
T-141	4WT217	LL	Ward DL	*Opuntia spp.* (prickly pear)	✓	✓	Date of dry season survey: 15-19 June 2009
				Xanthium spinosum (bathurst burr)	✓	-	Date of post wet season survey: 10-14 May 2010
				Senecio pinnatifolius (native fireweed)	-	✓	
				Bidens pilosa (cobbler's pegs)	-	✓	
T-142	20WT32	LL	Warrian RH	*Opuntia spp.* (prickly pear)	✓	✓	Date of dry season survey: 15-19 June 2009
				Xanthium occidentale (noogoora burr)	-	✓	Date of post wet season survey: 10-14 May 2010
				Senecio pinnatifolius (native fireweed)	-	✓	
				Sclerolaena birchii (galvanised burr)	✓	-	
				Alternanthera pungens (khaki burr)	✓	-	
T-143	13WT18	FH	Warrian GHN	*Opuntia spp.* (prickly pear)	✓	✓	Date of dry season survey: 15-19 June 2009
				Sclerolaena birchii (galvanised burr)	✓	-	Date of post wet season survey: 10-14 May 2010
				Harrisia martinii (harrisia cactus)	-	✓	
				Xanthium occidentale (noogoora burr)	-	✓	
T-144	8AB200	FH	Doce Pty Ltd	*Harrisia martinii* (harrisia cactus)	✓	✓	Date of dry season survey: 15-19 June 2009
				Opuntia spp. (prickly pear)	✓	✓	Date of post wet season survey: 10-14 May 2010
				Sclerolaena birchii (galvanised burr)	✓	-	
T-151	6TR11	FH	O'Sullivan ST & GP	*Opuntia spp.* (prickly pear)	✓	✓	Date of dry season survey: 15-19 June 2009
				Alternanthera pungens (khaki burr)	✓	-	Date of post wet season survey: 10-14 May 2010
				Sclerolaena birchii (galvanised burr)	✓	✓	
				Xanthium occidentale (noogoora burr)	-	✓	
				Senecio pinnatifolius (native fireweed)	-	✓	
				Xanthium spinosum (bathurst burr)	-	✓	
T-153	7TR39	FH	Ratcliffe RL	*Opuntia spp.* (prickly pear)	✓	✓	Date of dry season survey: 15-19 June 2009
				Xanthium occidentale (noogoora burr)	✓	-	Date of post wet season survey: 10-14 May 2010
				Alternanthera pungens (khaki burr)	✓	-	
				Senecio pinnatifolius (native fireweed)	-	✓	
				Sclerolaena birchii (galvanised burr)	-	✓	
				Xanthium spinosum (bathurst burr)	-	✓	
T-154	8TR15	FH	Hardenley Pty Ltd	*Opuntia spp.* (prickly pear)	✓	✓	Date of dry season survey: 15-19 June 2009
				Sclerolaena birchii (galvanised burr)	✓	✓	Date of post wet season survey: 10-14 May 2010
T-155	9TR17	LL	Benn OK & DK	*Opuntia spp.* (prickly pear)	✓	✓	Date of dry season survey: 15-19 June 2009
				Sclerolaena birchii (galvanised burr)	✓	-	Date of post wet season survey: 10-14 May 2010
				Senecio pinnatifolius (native fireweed)	-	✓	
T-156	5TR18	LL	Peart WJ	*Opuntia spp.* (prickly pear)	✓	✓	Date of dry season survey: 15-19 June 2009
				Sclerolaena birchii (galvanised burr)	✓	-	Date of post wet season survey: 10-14 May 2010
				Xanthium occidentale (noogoora burr)	-	✓	
T-157	6TR20	FH	Groat MC & KC	*Opuntia spp.* (prickly pear)	✓	✓	Date of dry season survey: 15-19 June 2009
				Sclerolaena birchii (galvanised burr)	✓	-	Date of post wet season survey: 10-14 May 2010
				Xanthium occidentale (noogoora burr)	-	✓	
				Bidens pilosa (cobbler's pegs)	-	✓	
				Xanthium spinosum (bathurst burr)	-	✓	
T-158	7TR22	FH	Winter CJ	*Opuntia spp.* (prickly pear)	✓	✓	Date of dry season survey: 15-19 June 2009
				Senecio pinnatifolius (native fireweed)	✓	-	Date of post wet season survey: 10-14 May 2010
				Sclerolaena birchii (galvanised burr)	✓	-	
				Xanthium occidentale (noogoora burr)		✓	
T-159	8TR23	FH	Price AW	*Opuntia spp.* (prickly pear)	✓	✓	Date of dry season survey: 15-19 June 2009
				Xanthium occidentale (noogoora burr)	✓	✓	Date of post wet season survey: 10-14 May 2010
				Senecio pinnatifolius (native fireweed)	✓	-	
				Sclerolaena birchii (galvanised burr)	✓	-	
T-160	807PH1979	SL	State of Queensland (DERM)	*Harrisia martinii* (harrisia cactus)	✓	✓	Date of dry season survey: 15-19 June 2009
				Opuntia spp. (prickly pear)	✓	✓	Date of post wet season survey: 10-14 May 2010

Property Parcel Number	Lot on Plan	Tenure	Landholder	Weed Names	Weeds Identified During Field Surveys Dry Season (2009)	Post Wet Season (2010)	Notes
				Senecio pinnatifolius (native fireweed)	✓	✓	
				Xanthium occidentale (noogoora burr)	-	✓	
				Bidens pilosa (cobbler's pegs)	-	✓	
T-162	1WT37	FH	Peterson JG	*Opuntia spp.* (prickly pear)	✓	✓	Date of dry season survey: 15-19 June 2009
				Xanthium occidentale (noogoora burr)	-	✓	Date of post wet season survey: 10-14 May 2010
				Senecio pinnatifolius (native fireweed)	-	✓	
				Bidens pilosa (cobbler's pegs)	-	✓	

Appendix B

Weed Management Plan Overview Maps

Data for the Weed Management Plan Overview Maps has been provided by GHD from the results of the 2009 dry season and 2010 post wet season weed field surveys along the GLNG pipeline alignment. Mapping of this data has been produced externally by GLNG



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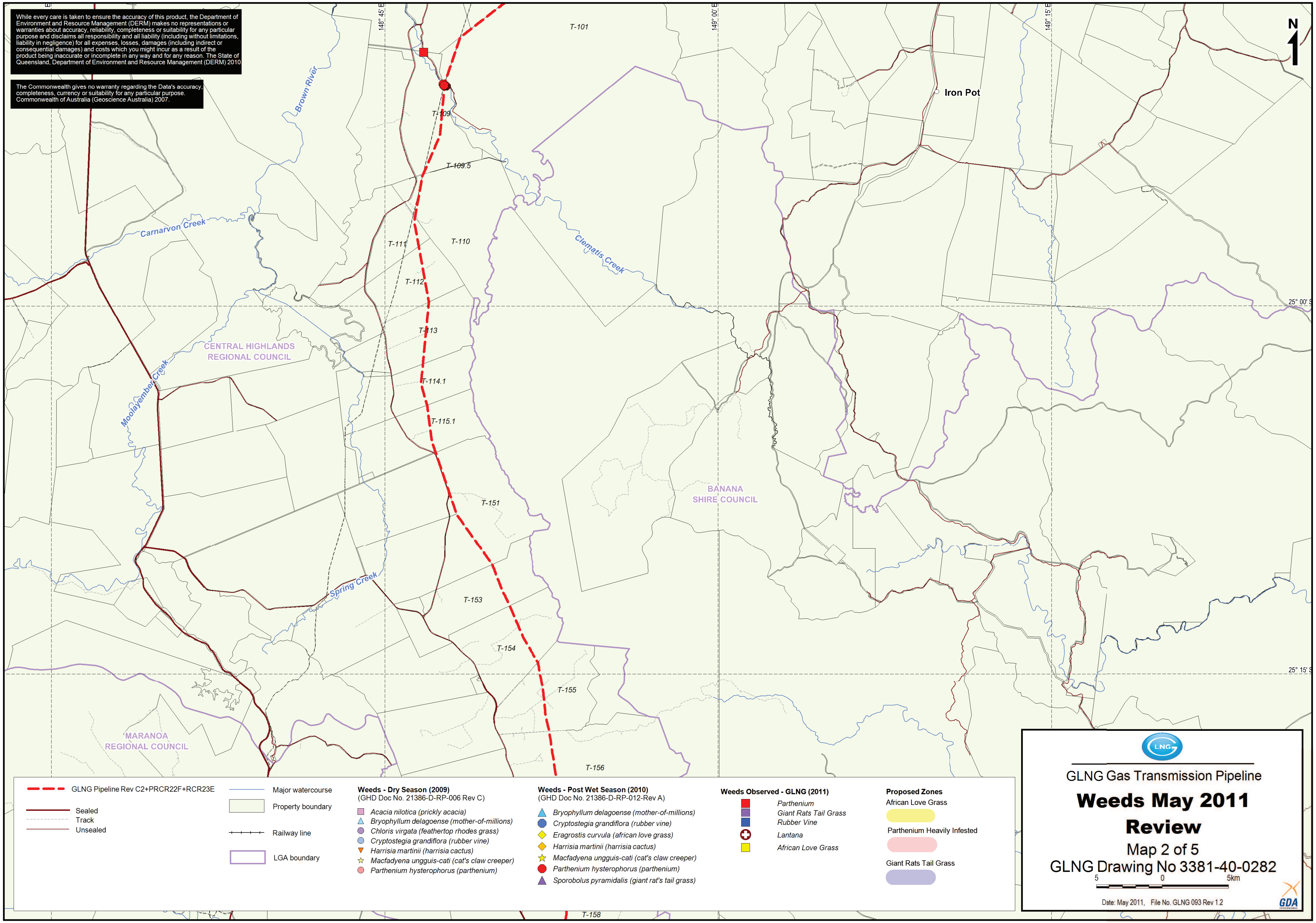
The Commonwealth gives no warranty regarding the Data's accuracy, completeness, currency or suitability for any particular purpose. Commonwealth of Australia (Geoscience Australia) 2007.
148° 45' E
149° 00' E
149° 15' E
N
25° 30' S
25° 45' S
CENTRAL HIGHLANDS REGIONAL COUNCIL
MARANOA REGIONAL COUNCIL
BANANA SHIRE COUNCIL
Currajong
Dawson River
Baffle Creek
Hutton Creek
T-156
T-157
T-158
T-159
T-160
T-162
R-164
R-160
R162
R-162.1
R-141
T-141
T-142
T-144
R-999
T-143
GLNG Pipeline Rev C2+PRCR22F+RCR23E
Sealed
Track
Unsealed
Major watercourse
Property boundary
Railway line
LGA boundary
Weeds - Dry Season (2009)
(GHD Doc No. 21386-D-RP-006 Rev C)
Acacia nilotica (prickly acacia)
Bryophyllum delagoense (mother-of-millions)
Chloris virgata (feathertop rhodes grass)
Cryptostegia grandiflora (rubber vine)
Harrisia martinii (harrisia cactus)
Macfadyena unguis-cati (cat's claw creeper)
Parthenium hysterophorus (parthenium)
Weeds - Post Wet Season (2010)
(GHD Doc No. 21386-D-RP-012-Rev A)
Bryophyllum delagoense (mother-of-millions)
Cryptostegia grandiflora (rubber vine)
Eragrostis curvula (african love grass)
Harrisia martinii (harrisia cactus)
Macfadyena unguis-cati (cat's claw creeper)
Parthenium hysterophorus (parthenium)
Sporobolus pyramidalis (giant rat's tail grass)
Weeds Observed - GLNG (2011)
Parthenium
Giant Rats Tail Grass
Rubber Vine
Lantana
African Love Grass
Proposed Zones
African Love Grass
Parthenium Heavily Infested
Giant Rats Tail Grass
LNG
GLNG Gas Transmission Pipeline
Weeds May 2011
Review
Map 1 of 5
GLNG Drawing No 3381-40-0281
5
0
5km
Date: May 2011, File No. GLNG 093 Rev 1.1
GDA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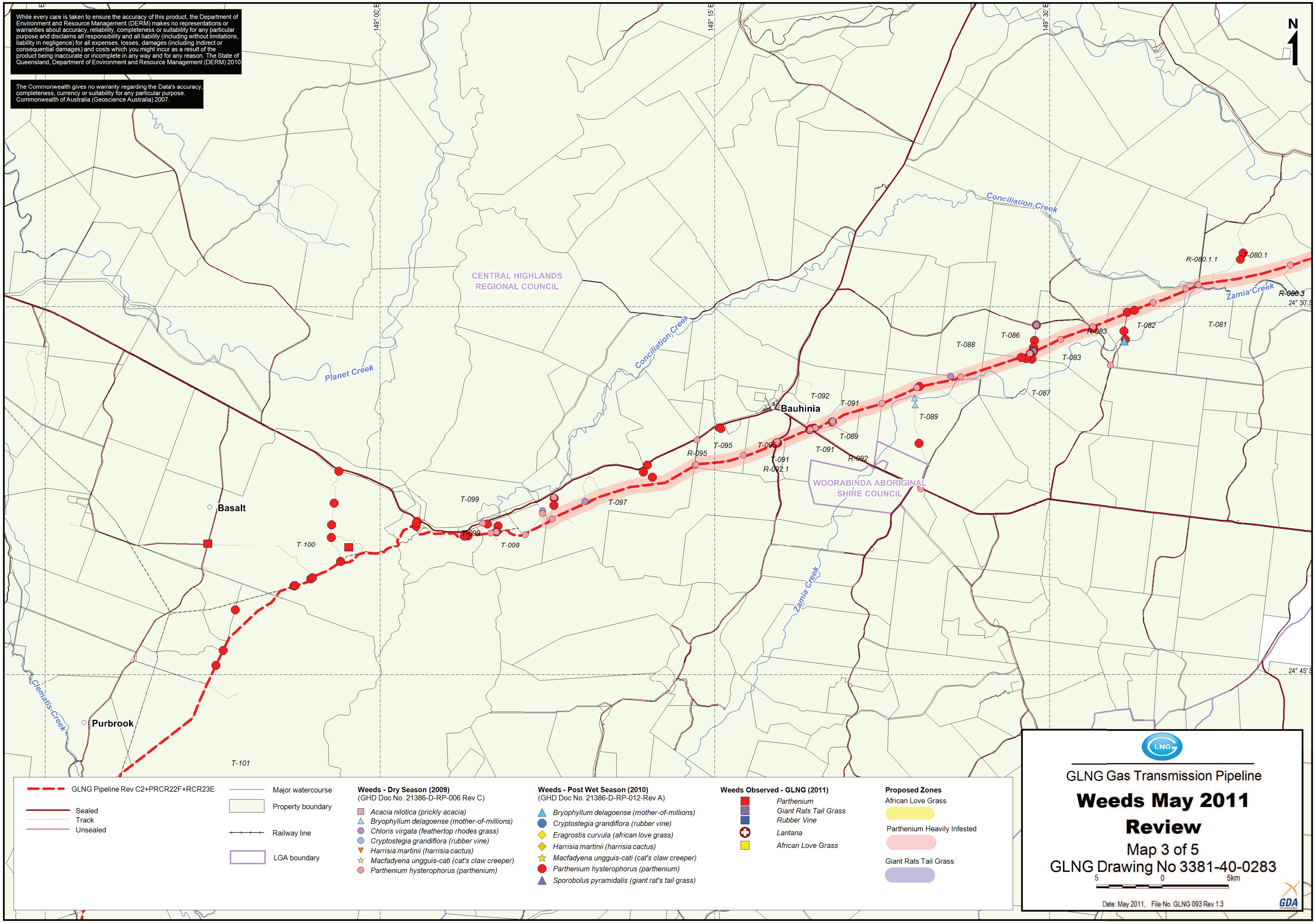
148° 45' E
149° 00' E
149° 15' E
25° 00' S
25° 15' S
N
T-101
T-109
T-109.5
T-110
T-111
T-112
T-113
T-114.1
T-115.1
T-151
T-153
T-154
T-155
T-156
T-158
Iron Pot
Brown River
Carnarvon Creek
Clematis Creek
Moolayember Creek
Spring Creek
CENTRAL HIGHLANDS REGIONAL COUNCIL
BANANA SHIRE COUNCIL
MARANOA REGIONAL COUNCIL
GLNG Pipeline Rev C2+PRCR22F+RCR23E
Sealed
Track
Unsealed
Major watercourse
Property boundary
Railway line
LGA boundary
Weeds - Dry Season (2009)
(GHD Doc No. 21386-D-RP-006 Rev C)
Acacia nilotica (prickly acacia)
Bryophyllum delagoense (mother-of-millions)
Chloris virgata (feathertop rhodes grass)
Cryptostegia grandiflora (rubber vine)
Harrisia martinii (harrisia cactus)
Macfadyena unguis-cati (cat's claw creeper)
Parthenium hysterophorus (parthenium)
Weeds - Post Wet Season (2010)
(GHD Doc No. 21386-D-RP-012-Rev A)
Bryophyllum delagoense (mother-of-millions)
Cryptostegia grandiflora (rubber vine)
Eragrostis curvula (african love grass)
Harrisia martinii (harrisia cactus)
Macfadyena unguis-cati (cat's claw creeper)
Parthenium hysterophorus (parthenium)
Sporobolus pyramidalis (giant rat's tail grass)
Weeds Observed - GLNG (2011)
Parthenium
Giant Rats Tail Grass
Rubber Vine
Lantana
African Love Grass
Proposed Zones
African Love Grass
Parthenium Heavily Infested
Giant Rats Tail Grass
GLNG Gas Transmission Pipeline
Weeds May 2011
Review
Map 2 of 5
GLNG Drawing No 3381-40-0282
5
0
5km
Date: May 2011, File No. GLNG 093 Rev 1.2
GDA



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N
149° 00' E
149° 15' E
149° 30' E
24° 30' S
24° 45' S
CENTRAL HIGHLANDS REGIONAL COUNCIL
WOORABINDA ABORIGINAL SHIRE COUNCIL
Conciliation Creek
Planet Creek
Zamia Creek
Clematis Creek
Bauhinia
Basalt
Purbrook
T-080.1
R-080.1.1
R-080.3
T-081
T-082
R-083
T-083
T-086
T-087
T-088
T-089
T-091
T-092
T-095
R-095
R-091
R-092
R-092.1
T-097
T-098
T-099
T-100
T-101
GLNG Pipeline Rev C2+PRCR22F+RCR23E
Sealed
Track
Unsealed
Major watercourse
Property boundary
Railway line
LGA boundary
Weeds - Dry Season (2009)
(GHD Doc No. 21386-D-RP-006 Rev C)
Acacia nilotica (prickly acacia)
Bryophyllum delagoense (mother-of-millions)
Chloris virgata (feathertop rhodes grass)
Cryptostegia grandiflora (rubber vine)
Harrisia martinii (harrisia cactus)
Macfadyena unguis-cati (cat's claw creeper)
Parthenium hysterophorus (parthenium)
Weeds - Post Wet Season (2010)
(GHD Doc No. 21386-D-RP-012-Rev A)
Bryophyllum delagoense (mother-of-millions)
Cryptostegia grandiflora (rubber vine)
Eragrostis curvula (african love grass)
Harrisia martinii (harrisia cactus)
Macfadyena unguis-cati (cat's claw creeper)
Parthenium hysterophorus (parthenium)
Sporobolus pyramidalis (giant rat's tail grass)
Weeds Observed - GLNG (2011)
Parthenium
Giant Rats Tail Grass
Rubber Vine
Lantana
African Love Grass
Proposed Zones
African Love Grass
Parthenium Heavily Infested
Giant Rats Tail Grass
LNG
GLNG Gas Transmission Pipeline
Weeds May 2011
Review
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Date: May 2011, File No. GLNG 093 Rev 1.3
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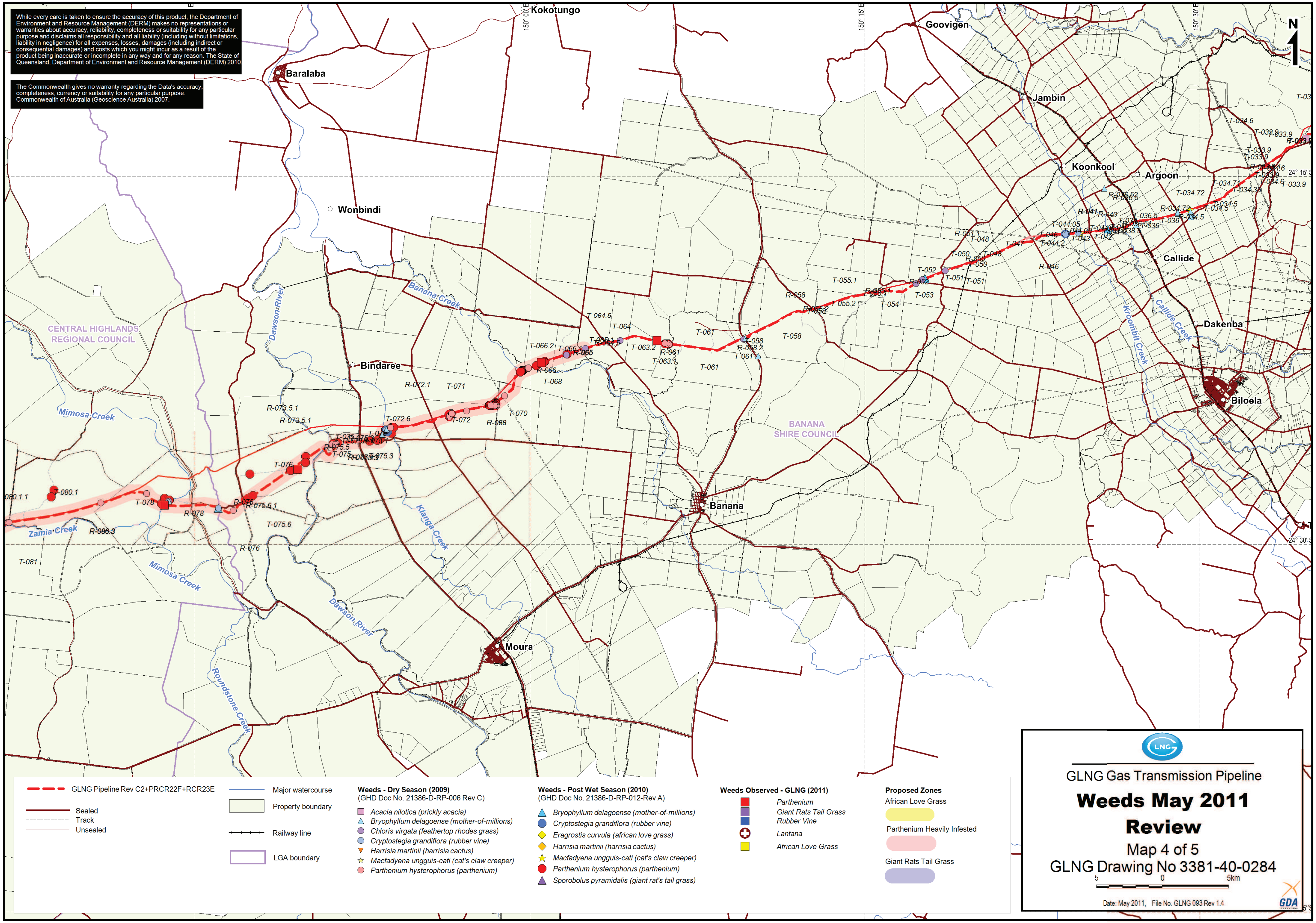

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N
Kokotungo
Goovigen
Baralaba
Jambin
Koonkool
Argoon
Wonbindi
Callide
Dakenba
Bindaree
Biloela
Banana
Moura
CENTRAL HIGHLANDS REGIONAL COUNCIL
BANANA SHIRE COUNCIL
Dawson River
Banana Creek
Mimosa Creek
Zamia Creek
Kianga Creek
Roundstone Creek
Kroombit Creek
Callide Creek
150° 00' E
150° 15' E
150° 30' E
24° 15' S
24° 30' S
GLNG Pipeline Rev C2+PRCR22F+PRCR23E
Sealed
Track
Unsealed
Major watercourse
Property boundary
Railway line
LGA boundary
Weeds - Dry Season (2009)
(GHD Doc No. 21386-D-RP-006 Rev C)
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African Love Grass
Proposed Zones
African Love Grass
Parthenium Heavily Infested
Giant Rats Tail Grass
GLNG Gas Transmission Pipeline
Weeds May 2011
Review
Map 4 of 5
GLNG Drawing No 3381-40-0284
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Date: May 2011, File No. GLNG 093 Rev 1.4
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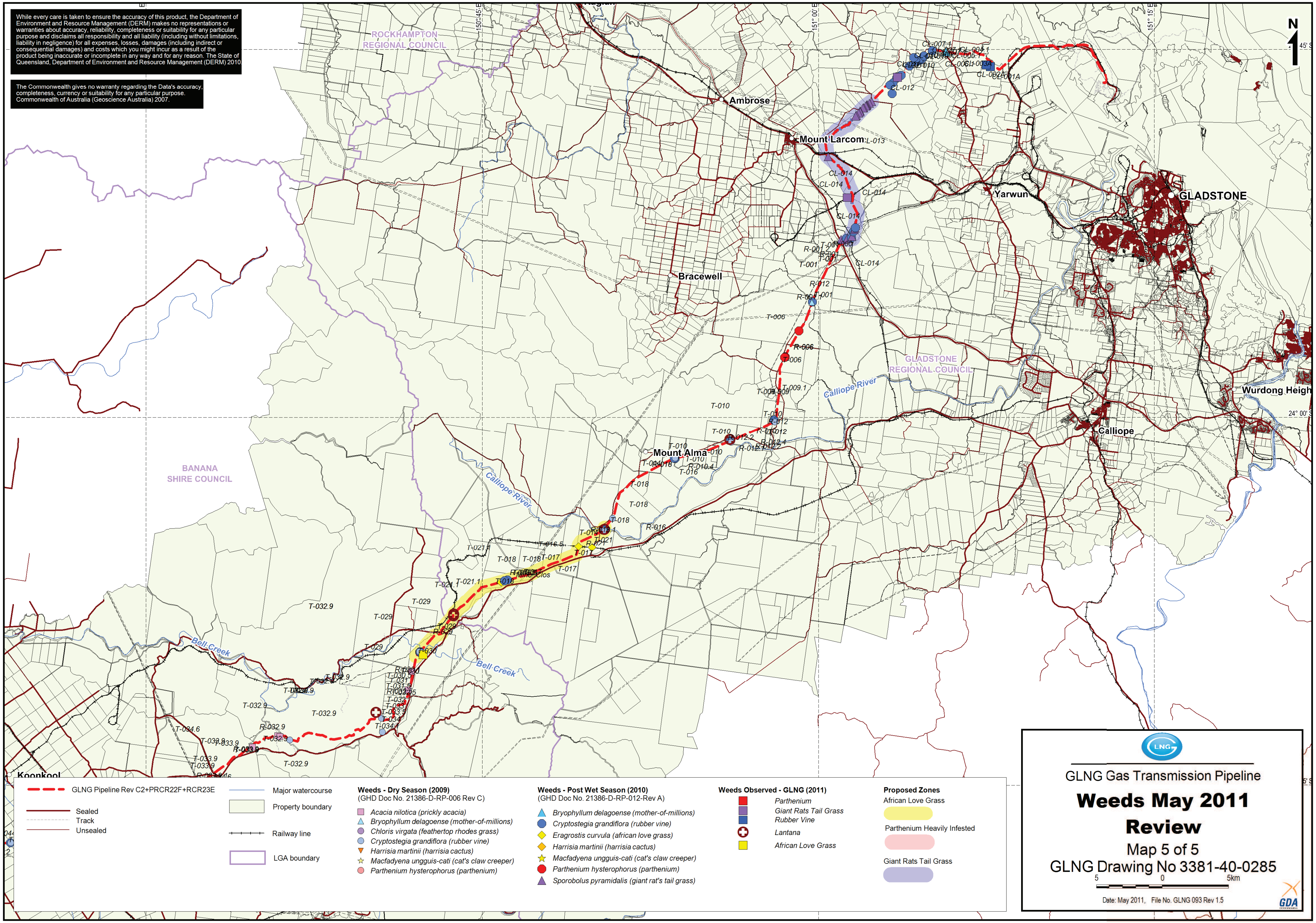
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The Commonwealth gives no warranty regarding the Data's accuracy, completeness, currency or suitability for any particular purpose. Commonwealth of Australia (Geoscience Australia) 2007.
N
ROCKHAMPTON REGIONAL COUNCIL
GLADSTONE REGIONAL COUNCIL
BANANA SHIRE COUNCIL
Ambrose
Mount Larcom
Yarwun
GLADSTONE
Bracewell
Wurdong Heigh
Calliope
Mount Alma
Koonkool
Calliope River
Bell Creek
GLNG Pipeline Rev C2+PRCR22F+RCR23E
Sealed
Track
Unsealed
Major watercourse
Property boundary
Railway line
LGA boundary
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(GHD Doc No. 21386-D-RP-006 Rev C)
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Lantana
African Love Grass
Proposed Zones
African Love Grass
Parthenium Heavily Infested
Giant Rats Tail Grass
GLNG Gas Transmission Pipeline
Weeds May 2011 Review
Map 5 of 5
GLNG Drawing No 3381-40-0285
5 0 5km
Date: May 2011, File No. GLNG 093 Rev 1.5
GDA

GHD

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Attachment E – Pest Animal Profiles

Declared Species

Species Name: *Canis lupus* / *Canis familiaris* (*Dingo* / Wild dog)
Status: Class 2 pest (LP Act)
Description: The dominant coat colours are red, ginger and sandy-yellow, although they can also be pure white, black and tan or solid black. Dingoes have a more heavily boned skull and larger teeth (especially the canine) than domestic dogs of similar size. They are naturally lean with large ears pricked,a white tip on the tail and white socks (DPIF 2007a). Adults can reach up to 60cm in height, with females weighing approximately 12kg and males 15kg (DPIF 2007a)
Wild dogs refers collectively to dingoes, hybrid dingoes and domestic dogs that have escaped or been deliberately released
Distribution: Although thought to have arrived between 3,500-4000 years ago, it is not part of the ancestral fauna of Australia (DPIF 2007a)

Source: (EPA 2007a)

Dingoes/wild dogs are present in all parts of Queensland however the distribution of the wild dog in relation to purebred dingoes varies
Impact: Dingoes/wild dogs can carry diseases such as distemper and parvovirus. Their majority of their diet consists of native species such as kangaroos, wallabies, rabbits and possums (DPIF 2007a). However, wild dogs can kill, harass or maim livestock and other native fauna
Management Requirements: The operational objectives for the management of wild dogs include reducing their numbers throughout the Project Area
Monitoring Process: Report any dingo/wild dog sightings in the weekly Environmental Report
Control Actions: Fauna exclusion fencing to be utilised where necessary. If required, recommended active control methods include baiting, trapping and ground shooting

Species Name: *Felis catus* (Feral cat) Status: Class 2 pest (LP Act) Description: A feral cat is one that is not fed and kept by someone. The word ‘kept’ specifically means that is cat is housed in a domestic situation The feral cat differs little in appearance from its domestic counterpart, however when in good condition is displays overall muscle development, particularly noticeable around the head, neck and shoulders (DPIF 2007d) Feral cats are predominantly short-haired with coat colour range including ginger, tabby, tortoiseshell, grey and black. Males weigh between 3-6 kg and females 2-4 kg depending on condition. Feral cats are most active at night, with peak hunting activity occurring soon after sunset and in the early hours before sunrise (DPIF 2007d). During the day it will rest in any number of den sites including hollow logs, dense clumps of grass, piles of debris, rabbit burrows and hollow limbs of standing trees (DPIF 2007d)	Source: (DPIF 2008b, Invasive Animals CRC 2007b) 

Distribution: The feral cat is now present Australia-wide in a variety of habitats
Impact: Feral cats are opportunistic predators of small mammals, birds, reptiles, amphibians, insects and fish (DPIF 2007d). They can be particularly harmful in island situations and have caused the extinction of a number of species. Feral cats also compete for prey with native predatory species such as quolls, eagles, hawks and reptiles
Feral cats may contain a parasite (toxoplasmosis) that can be particularly harmful to marsupials, causing blindness, respiratory disorders, paralysis and loss of offspring (DPIF 2007d)
Management Requirements: The operational objective for the management of feral cats is to reduce their numbers throughout the Project Area.
Monitoring: Reporting all cat sightings in the weekly Environmental Report
Control Actions: Fauna exclusion fencing to be utilised where necessary. If required, recommended active control methods include trapping and ground shooting

Species Name: ***Vulpes vulpes*** **(European red fox)**
Status: Class 2 pest (LP Act)
Description: Foxes have pointed muzzles, a flattened and slender skull, large ears and long bushy tails (DPIF 2007c). Adult males weigh approximately 6kg and females approximately 5 kg
Foxes are usually active at night and rest during the day in an earth den, thicket, hollow log or stick-rake pile. However, in winter when less food is available, foxes may hunt and scavenge during the day
Distribution: The most common and widespread of the world's fox species, the European red fox has adapted to a variety of habitats ranging from deserts to urban environments. However, they are not found in tropical areas of Australia (DPIF 2007c). Competition with dingoes, climatic preferences and food supply are thought to determine their distribution (DPIF 2007c)
Impact: Foxes are considered to be the greatest threat to the long-term survival of many small mammal species in Australia and play a major role in the decline of ground-nesting birds, critical weight mammals and reptiles such as the green turtle (DPIF 2007c). The European red fox is also thought to have caused a severe reduction in populations of many other threatened species throughout Australia

Source: (EPA 2008 and Invasive Animals CRC 2007a)

Management Requirements: The operational objective for the management of European foxes is to reduce their numbers throughout the Project Area
Monitoring: Report all fox sightings in the weekly Environmental Report
Control Actions: Fauna exclusion fencing to be utilised where necessary. If required, recommended active control methods include baiting, trapping, ground shooting and den fumigation
.

Species Name: *Sus scrofa* (Feral pig)
Status: Class 2 pest (LP Act)
Description: Feral pigs are predominantly black, buff-coloured or spotted black and white, while juveniles can be striped. Mature boars have a large head and shoulders and a raised and prominent back bone which slopes steeply down to small hams and short hind legs (DPIF 2007e)
Feral pigs are smaller, leaner and more muscular than domestic pigs, with well-developed shoulders and neck and smaller, shorter hindquarters (2007e). Feral pigs have sparser,longer and coarser hair than domestic pigs and have longer, larger snouts and tusks, straight tails, smaller mostly pricked ears and narrower backs (DPIF 2007e)
Feral pigs are generally nocturnal, spending daylight hours sheltered in dense cover. They are shy animals and will avoid human contact
Distribution: Feral pigs inhabit approximately 40% of Australia and are found in all habitat types in Queensland (DPIF 2007e).
Estimations of numbers range up to 24 million with the greatest concentrations of feral pigs found in the larger drainage basins and swamp areas of the coast and inland (DPIF 2007e)
Impact: Feral pigs impact the environment through predation on native animal species, consumption of native flora and damage to watercourses and wetlands. They can also carry many infectious diseases and internal and external parasites. Many of these diseases can spread to humans and livestock (DPIF 2007e)

Source: (DPIF 2008c, EPA 2006, IACRC 2007)

Management Requirements: The operational objective for the management of feral pigs is to reduce their numbers throughout the Project Area
Monitoring: Report all pig sightings in the weekly Environmental Report
Control Actions: Fauna exclusion fencing to be utilised where necessary. If required, recommended active control methods include trapping, baiting and ground shooting

Species Name: *Bufo marinus* (Cane toad) Status: The cane toad is not a declared pest in Queensland and such there is no legal requirement to control them Description: In comparison with the native frog and toad species, adult cane toads have a distinctive head and face and are large, heavily built creatures (DPIF 2007f). A high angular bony ridge extends from the eyes to the nose (DPIF 2007f). Adult cane toads have large glands that carry toxin on the shoulder behind the tympanum (ear opening) (DPIF 2007f). The hands and feet are relatively small and lack webbing between the fingers but is present between the toes (DPIF 2007f). In comparison to native frogs, cane toads assume an upright, rigid posture Colouring of cane toads on the upper surface may be brown, olive-brown or reddish-brown with the underneath surface varying from white to yellow with mottled brown (DPIF 2007f). The surface of the skin is warty (DPIF 2007f) Distribution: Cane toads currently inhabit at least four of the mainland Australian states including Queensland and generally occur wherever there is water (DPIF 2007f)	Source: (DPIF 2008d)  
Impact: Cane toads produce highly toxic venom from glands in its skin that can cause death if ingested by domestic and most native animals. The Cane toad consumes a wide variety of insects, frogs, small reptiles, mammals and birds. They also compete with native frogs for breeding habitat (DPIF 2007f) Management Requirements: It is recommended that Cane toads be managed in order to reduce their abundance across the Project Area, particularly where water and native frogs are found Control Actions: Fencing is recommended to keep toads out of ponds intended for native fish and frogs, with a height of 50 cm being sufficient (DPIF 2007f). Freezing is considered a humane form of disposal, as a reaction to the cold causes the animal to initiate dormancy and dies while senseless (DPIF 2007f) Monitoring Process: Report all sightings and relative abundance in the weekly Environmental Report	

Species Name: ***Oryctolagus cuniculus*** **(European rabbit)** Status: Class 2 pest (LP Act) Description: They are usually grey-brown with a pale belly, black or ginger can also be common, with long hind legs, short front legs, long ears and large eyes (DPIF 2007b). Rabbits usually weigh between 1.3-2.3 kg Distribution: Rabbits occur across Australia and have spread throughout Queensland with the largest populations found in the granite belt, south-western Darling Downs, Maranoa, southern Warrego and the far south-west (DPIF 2007b). Moderate populations are located in the north-western Darling Downs and North Burnett and low populations in the remainder of the state (DPIF 2007b) Impact: Rabbits compete with native wildlife for food and shelter and increase the exposure of native wildlife to the dangers of predators such as cats and foxes (DPIF 2007b). Rabbits are implicated in the local extinction of some native species, as well as many native species, such as the Bilby (now threatened)	Source: (DPIF 2008a)  

Management Requirements: The operational objectives for the management of rabbits include reducing their numbers throughout the Project Area
Monitoring: Report all rabbit sightings in the weekly Environmental Report
Control Actions: Fauna exclusion fencing to be utilised where necessary. If required, recommended active control methods include baiting, trapping, ground shooting, warren destruction and/or fumigation and biological control

Appendix E
Mosquito and Midge Management Plan

GLNG
Gas Transmission Pipeline

Mosquito and Midge Management Plan

Document Number: 3380-GLNG-4-1.3-0009

PREPARED BY:

Title	Name	Signature	Date

ENDORSED BY:

Title	Name	Signature	Date

APPROVED BY:

Title	Name	Signature	Date

DATE	REV	REASON FOR ISSUE	AUTHOR	ENDORSED	APPROVED
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30.03.11	2	Final	CS	SJM	
08.04.11	3	Amended Final	CS	CC	
15.04.11	4	Final for Legal review	CS		
30.05.11	5	LEGAL COMMENTS ADDRESSED	CC		
15.07.11	6	FOR AGENCY REVIEW	CC		

Table of contents

1. Introduction

This Mosquito and Midge Management Plan (MMMP) has been developed to manage mosquitoes and midges for the purpose of public health, community well-being and for on-site workers for the Gas Transmission Pipeline (GTP) (henceforth referred to as the Project area). Mosquitoes pose a risk to human health as mosquitoes are vectors for many serious diseases, such as Ross River Virus and Barmah Forest Virus. Midges, although a nuisance, do not pose any serious risk to human health. For this reason and the fact that there are limited control measures for midges, this MMMP largely focuses on mosquito management. Therefore, midges have been removed from further discussion in the Management Plan.

This MMMP aims to meet the goal of Integrated Pest Management (IPM) by combining a variety of reasonable, practical, effective and economical pest control measures to reduce population numbers and the disease risk from mosquitoes, while having minimal impact on the environment. This MMMP provides a framework for identifying and monitoring mosquito populations as well as outlining procedures for implementing management strategies during the construction and operation phases of the Project.

2. Legal Requirements

Relevant legislation and policies associated with the management and control of mosquito and midge populations within the Project area include:

- *Public Health Act 2005 / Public Health Regulation 2005*
- *Environmental Protection Act 1994* (EP Act)
- *Fisheries Act 1994*
- *Sustainable Planning Act 2009* (SPA).
- *Agricultural Chemicals Distribution Control Act 1966* (ACDC Act)
- *Chemical Usage (Agricultural and Veterinary) Control Act 1998*
- *Nature Conservation Act 1992* (NC Act)
- *Marine Parks Act 2004*
- *Transport Infrastructure Act 1994*

3. Mosquito and Midge initial survey and monitoring program

3.1 Initial survey

There has been no monitoring of mosquito numbers or species within the Project area. Therefore, an initial survey and monitoring programme prior to the commencement of construction will be required. The program will involve monitoring species' diversity and density of adult mosquitoes near potential breeding sites. The monitoring program will be used to identify each potential breeding site according to methodologies outlined in the Gladstone Regional Council Mosquito Management Plan (GRCMMP). The GRCMMP identifies the use of light traps conducted weekly during the main breeding period. Data obtained during this phase is to be used as baseline data that will be used to tailor the subsequent monitoring and management programs. Information that will be gathered as part of the initial survey will include:

- Average number of mosquitoes per trap per night
- Species which bite humans
- Species which are vectors of disease (female mosquitoes)

Once this initial survey monitoring program has been completed, broad baseline thresholds of mosquito numbers for each species common to the site will be established to enable the effective implementation of management strategies. Subsequent on-going surveys will use the baseline thresholds to identify significant increases in mosquito densities which will trigger management actions.

3.2 Likely midge breeding areas

Areas of mangroves and estuarine areas with sandy beaches are potential breeding grounds for midges. Midge population numbers peak monthly and are associated with tidal patterns and also peak seasonally with the summer months. However, as breeding sites for these species are generally outside of the Project area, and these species do not present a significant health risk (eg do not carry human disease causing pathogens) they will not be the subject of this MMMP. However, if significant midge breeding areas are located within, or adjacent to the Project area, notification regarding the location of these areas will be given to Gladstone Regional Council (GRC). This information may them be used by GRC to tailor management programs for these species.

3.3 Likely mosquito species and breeding areas

This MMMP outlines the mosquito species likely to be significant within the Project area based on vector capability, nuisance value and seasonal variation. While there are likely to be many mosquito species present within the greater Gladstone area, there are some species that are of greater importance because of their ability to transmit disease or to be significant pests. Mosquitoes may be broadly divided into freshwater and intertidal species. Mosquitoes within both of these categories have the potential to become disease vectors and are therefore outlined within this MMMP.

Potential on-site freshwater habitats for mosquitoes include:

- Stormwater drainage systems
- Pooled water in bunded areas, containers or other vessels
- Low lying areas temporarily flooded by high rainfall
- Areas created during construction works (trenches)

In addition, intertidal species are likely to utilised mangrove habitats as well as saltwater marshland as breeding sites.

The mosquito species likely to be significant pests within the Project area, are briefly described in the Sections 3.3.1 and 3.3.2.

3.3.1 Freshwater habitat mosquito species

A number of mosquito species are associated with breeding in freshwater pools. Theses species include:

- ***Aedes aegypti*** - a container breeding species. This species is a major vector for Dengue fever, Yellow fever and a potential vector of Murray Valley encephalitis and Ross River virus

- ***Culex annulirostris*** - is a vector of Ross River virus, Barmah Forest virus, Japanese Encephalitis and Kunjin virus. Preferred breeding habitats include freshwater wetlands and low lying grassy areas that are commonly inundated following rain, as well as irrigation areas having heavy organic effluent component

- ***Culex quinquefasciatus*** - utilises containers, troughs and drainage channels as breeding sites

- ***Ochlerotatus vittiger*** - the preferred breeding sites of this species consist of depressions filled by summer rain

- ***Ochlerotatus notoscriptus*** – breeds in artificial containers. This species is a suitable vector for Barmah Forest and Ross River Virus

3.3.2 Intertidal wetlands mosquito to species

Intertidal wetlands are located within and adjacent to the proposed marine GTP route. In particular the mangrove areas are likely to provide ideal grounds for breeding. Mosquito species that are associated with intertidal wetlands include:

- ***Ochlerotatus alternans*** - can reach relatively high pest levels following extended periods of rain. Breeding can occur in temporary brackish pools and marshes on the coast. This species is an aggressive biter, especially in and around mangroves and will attack throughout the day and night and can travel 5-8 km from breeding sites in search of food. This species may continue to be a pest from one to three weeks after breeding areas are inundated.

- ***Ochlerotatus vigilax*** - is the primary coastal vector of Ross River virus, Barmah Forest virus and other arboviruses in Queensland. This species will feed on humans and animals during the day or night and can travel up to 40 km from breeding sites. This species utilises a variety of saline habitats, including salt marshes, mudflats and temporary brackish pools.

- ***Culex sitiens*** – this species is a vector of Ross River virus and has the ability to travel long distances from breeding habitat. Breeding sites utilised by this species include temporary brackish pools and salt marshes filled as a result of tidal inundation.

- ***Verrallina funerea*** - may be a major pest where residential housing is in close proximity to breeding sites. This species can breed in both fresh and slightly brackish water. This species is not considered to be a major pest as it does not readily disperse from its breeding habitat.

3.4 Treatment triggers

Triggers for treatment will largely depend upon the target environment, the terrain, accessibility and location of breeding sites, the mosquito species involved, tidal flows and the weather conditions. Considerations for intertidal species may include:

- Tides
- Adult and Larval mosquito numbers.

It is difficult to predict a definitive level of rainfall that will necessitate treatment. A number of variables such as duration and amount of rainfall received, the period since the last rainfall event, barometric air pressure, wind velocity and temperature may all combine in different combinations, with different outcomes. The variability of these elements precludes the ability to consistently place definitive measurement on such elements.

This MMMP will be updated following the completion of the initial survey monitoring program outlined in Section 3.1 and will aim to specify treatment thresholds. Guidance will also be sought from Gladstone Regional Council (GRC) for evaluation of trigger conditions and when it is considered that a major mosquito event is imminent.

4. Ongoing Surveillance Program

4.1 Mosquito and midge population monitoring

To determine the on-going prevalence and distribution of mosquito and larvae and to enable timely control activities the following monitoring will be undertaken during the peak mosquito breeding season (December to March):

1. Visual inspections – visual inspection of the site for pooled water and larvae

2. Sampling of mosquito larvae - surveys of mosquito larvae will be conducted at the project sites. Mosquito larvae will be surveyed by sampling using a scoop/ladle/net.

Standardised collecting techniques of sample adult and larval mosquitoes will be undertaken at fixed sites as detailed below in Table 4.1. Sampling techniques for adult mosquitoes are to include light traps, and light traps with CO_2 lures. Sampling of mosquito larvae should be undertaken using the dip-net/scoop technique. All monitoring is to be part of standardised sampling design to ensure equal sampling effort between sites to facilitate site comparisons. This on-going monitoring program will be reviewed following the outcomes of the initial survey outlined in Section 2.1.

Table 4.1 Ongoing monitoring program during peak breeding season

Monitoring sites	Frequency
Pooled water and containers around the site	
Visual inspection	Weekly
Pooled water Visual inspection	Weekly
Sampling of mosquito larvae	Monthly
Stormwater drainage systems	
Visual inspection	Weekly
Sampling of mosquito larvae	Monthly
Areas with pooled water Visual inspection	Weekly
Thrust Pit Pads	
Visual inspection	Weekly
Sampling of mosquito larvae	Monthly
Areas with pooled water Visual inspection	Weekly
Sampling of mosquito larvae	As required
Low lying areas	
Visual inspection	Weekly following heavy rain events
Sampling of mosquito larvae	As required

In addition to this monitoring, close liaison with GRC and Queensland Health (QH) will occur to obtain results of any previous surveys undertaken within the area, and to be notified of major mosquito events within the Project area.

4.2 Notification of vector borne disease

A register will be maintained of any construction personnel member infected by the following vector borne diseases:

- Ross River Virus
- Japanese Encephalitis
- Malaria (unspecified and other)
- Malaria Falciparum
- Malaria Malariae
- Malaria Ovale
- Malaria Vivax
- Barmah Forest Virus
- Dengue Fever

Data on vector borne disease numbers for the region can be requested from QH if deemed necessary. However, these records are not always indicative of the mosquito problem as records only show those who have been diagnosed by a doctor and do not link the result to the area of transmission.

4.3 Complaint register

A complaint register will be maintained and each complaint investigated to assess mosquito and midge prevalence is to be document within this register.

5. Management Plan

To achieve environmentally sustainable outcomes, the aim of this MMMP is to focus on indirect management controls; personal protection and design controls, with the use of direct management controls, such as chemicals, habitat modification regarded as the least preferred methods.

5.1 Goals

The objectives of this MMMP are aligned with the GRC Mosquito Management Plan and include:

- Identifying triggers for treatments and types of treatment options currently available
- Complying with the Local Government Association of Queensland (LGAQ) Mosquito Management Code of Practice 2002
- Developing control measures that are environmentally sound, effective and cost efficient
- Examining environmental considerations and ensuring compliance with legislative requirements.
- Identifying suitable surveillance procedures and treatment efficacy

5.2 Performance indicators

The performance indicators for this plan are:

- No environmental harm from mosquito management controls
- No outbreaks of mosquito borne disease within the project area

5.3 Responsibility

The persons responsible for compliance with this plan during the construction period and operational phase and their responsibilities are summarised below.

5.3.1 Construction phase

During the construction period, the Construction Contractor will be responsible and will undertake the following:

- Retain a copy of the MMMP on-site for reference by appropriate personnel and provide a copy to contractors and sub-contractors
- Ensure compliance with the MMMP
- Ensure that contractors and sub-contractors engaged in the construction are advised of their responsibilities to undertake their activities in accordance with the MMMP
- Ensure that contractors and sub-contractors engaged in the construction activities within the Project area are advised of their responsibilities regarding mosquito management
- Ensure that an auditing/monitoring program is implemented
- Ensure appropriate records are kept and maintained
- Prepare incident reports and implement corrective actions
- Recommend additions or changes to the MMMP based on experience gained from implementation of the MMMP

5.3.2 Operational phase

During the operational phase and subsequent de-commissioning period, GLNG will be responsible and will undertake the following:

- Retain a copy of the MMMP

- Ensure compliance with the MMMP
- Ensure appropriate records are kept and maintained on-site
- Ensure that the monitoring program is implemented on an as needed basis
- Prepare incident reports and implement corrective actions as required

5.4 Training and awareness

All construction personnel will be made aware of the MMMP. A register of training will be maintained.

5.5 Continual improvement

This MMMP will be reviewed annually to ensure industry standards are met and make any necessary changes to improve this plan.

5.6 Management strategies

The following is a list of management strategies to be applied for the GTP during construction activities.

5.6.1 Personal protection

- Personnel will wear hats, socks, and loose fitting, light coloured clothing with long pants and long sleeves when outdoors. Head nets and gloves will also be worn, if required. Head nets with meshes are recommended. Sleeves and collars will be kept buttoned and trousers tucked into boots. In severe cases clothing may be impregnated with pyrethrum
- Where practicable, personnel will avoid peak biting times; specifically at dusk
- Personnel will be educated on the mosquito and midge problem on-site and educated in management strategies and responsibilities for their own health (through induction, regular communication and posters throughout the construction site)
- The workforce will be notified if there is a mosquito or biting midge problem and individuals will take appropriate personal protection
- When required, personnel will use tropical strength mosquito repellents

5.6.2 Design

- Yellow or red lights will be used in personnel areas, where possible, to prevent attracting midges. White lights will be used away from non-personnel areas to divert the midges.
- All on-site work offices and day accommodation for the CIGTP section will be air-conditioned and screened. Screens will be the correct mesh size, fit tightly and be in good repair. All screen doors on buildings should open outward and have automatic closing devices. Where required, Bifenthrin barrier treatments around personnel areas will be implemented to reduce adult biting midge numbers.

5.6.3 Source Reduction

Container breeding

Management actions for container and vessel breeding include:

- The creation of areas and structures in which water could be retained for more than five days will be avoided (i.e. potential mosquito breeding habitat)
- The Project area will be inspected weekly for all containers and vessels capable of holding water (including bunded areas) to prevent water pooling. These areas will be drained and treated as required

Drainage systems

Drains will be constructed in a manner that does not lead to the creation of new mosquito breeding sites. The design of drainage systems will consider the following design features:

- Erosion control measures will be installed on drain batters to prevent silting
- Any plant species selected to stabilise slopes will be terrestrial and not be likely to invade water bodies and create breeding grounds for mosquitoes
- Drainage design will prevent the accumulation of silt and debris that may create pooling of water
- All maintenance of drains will be carried-out in accordance with procedures which ensure that further habitats for mosquitoes or midges are not created by wheel ruts
- Drains will be maintained free of siltation and debris
- Drains will be inspected as per the monitoring program in Table 4.1

Sewerage systems and wastewater disposal

Sewer systems and wastewater disposal will be managed in accordance with the following:

- Sewer systems and wastewater disposal will be operated in a manner to avoid ponding of water
- Wastewater will be collected on site for treatment and disposal on the mainland
- Temporarily flooded areas will be managed through filling depressions and draining pooling areas

Construction

Construction activities may create mosquito/biting midge breeding sites. In order to minimise the problem the following actions will be followed:

- Access roads will be fitted with culverts where necessary, in order to prevent water ponding upstream, and thus prevent mosquito breeding.
- Reinstated sites will be re-contoured to the original surface profiles to prevent ponding.
- Thrust pads will be installed with devices (eg soak-wells) to prevent mosquito access to excess water until such time as it can drain away.

5.6.4 Controls

Habitat modification

For the purpose of this MMMP habitat modification refers to the manipulation of wetlands to reduce breeding sites. Runnelling is the most commonly used means of modifying saltmarsh areas to reduce mosquito numbers. Runnelling is the linking of pools by shallow (less than 30 cm) spoon-shaped channels (runnels) which increase tidal flushing and access by fish and other predatory species. Because there are potential environmental consequences from runnelling (disturbances to marine plans and the increased inundation of substrates), implementation of runnelling programs for this site is not preferred. Permits are required from the DEEDI and DERM before any modification of wetland areas.

Chemical controls

If necessary, areas that cannot be managed with other management controls (eg planning methods) will be treated as required with a control agent. Relatively few chemicals can be recommended for use in wetlands, whether natural or constructed (usually flow into natural water systems), because of environmental concerns. The importance of pre-inspection activities is further reinforced when considering the selection of the most suitable treatment chemical. The effectiveness of the various 'acceptable' agents depends on appropriate formulations and local conditions and the target mosquito species is of critical concern.

Consultation will be undertaken with GRC and QH prior to the planning of and implementation of this management option.

If chemical controls are to be used the following management actions will be adhered to:

- A suitably qualified consultant will be engaged to develop a treatment program that meets the Mosquito Management Code of Practice

- A licensed and experienced operator will be engaged to undertake the chemical treatment
- Chemicals used will be registered and used in accordance with manufacturer's instruction
- Treatments will not be undertaken prior to a breeding event
- Areas identified for treatment will consider environmentally sensitive areas and buffer zones will be designated
- A treatment register will be maintained and include:
  - Areas treated
  - Date and time of treatment
  - Equipment
  - Pilot/operator
  - Insecticide dose
  - Insecticide batch measure
  - Result

Larviciding

Larviciding is the control of mosquito larvae prior to their metamorphosis into adult flying mosquitos. Several products are available for use in larvacidal applications and selection of these products will be confirmed prior to construction.

It should be noted chemicals should only be used after full assessment of potential adverse affects, consideration of the receiving environment and on-site risk/benefit analysis.

Adulticiding

Adulticiding is the control of adult, mature mosquitoes following their metamorphosis from the larval form. This stage of the lifecycle constitutes the pest stage. Several products are available for use in adulticidal applications and selection of these products will be confirmed prior to construction.

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Appendix F
Waste Management Plan

Waste Management Plan - Gas Transmission Pipeline (Mainland, Marine Crossing (The Narrows) and Curtis Island Sections)

Santos GLNG Pty Ltd, Petronas Australia Pty Ltd and Total E&P Australia

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Contents

1. Introduction

1.1 Project overview

The Gladstone Liquid Natural Gas (GLNG) Project has the following major components:

- Coal seam gas fields
- Gas transmission pipeline (GTP)
- LNG liquefaction and export facility (LNG facility)

1.2 Scope

This Waste Management Plan (WM Plan) addresses the waste management issues relating to construction, operation and decommissioning of the GLNG GTP. It has been developed in accordance with the Environmental Protection (Waste) Policy 2000 and other relevant State and Commonwealth legislative, guidelines, standards and covers the following key areas:

- The types and amounts of waste expected to be generated during construction and operation including chemical and hazardous materials, liquid wastes and hydrotest water. It also stipulates how the wastes will be dealt with in accordance with the principles of the waste and resource management hierarchy (formerly the waste management hierarchy)
- Mitigation measures for dealing with accidents, spills and other incidents that may impact on the environment as a result of waste management during construction and operation

This WM Plan also seeks to address the specific project approval conditions and items which have been raised as a result of the Coordinator General's and Department of Infrastructure and Planning comments in relation to the GLNG EMP and EIS documents.

1.3 Objectives

The objectives of this WM Plan are:

- No contaminants or wastes are discharged to land or water on the project site
- No unauthorised discharges of contaminants or waste to land or water offsite
- Minimise the quantity of wastes generated and disposed to a landfill during construction and operation
- Maximise the amount of material recovered for reuse or recycling during construction and operation
- Dispose of all waste in accordance with all State and Commonwealth legislation and guidelines
- No complaints relating to the management of waste during construction and operation

1.4 Project description

The Project includes the construction, operation and decommissioning of a 420 km GTP network to link the coal seam gas fields near Roma, Emerald, Injune and Taroom in Queensland to the proposed LNG Facility located on Curtis Island.

This WM Plan has been prepared to address all three sections of the GTP, including the:

- Mainland section
- Marine Crossing section

- Curtis Island section

It is anticipated that the GTP will have an operational lifespan of 25 years followed by a period associated with the decommissioning of the GTP and associated infrastructure.

Mainland GTP section

The Mainland section of the GTP runs from the gas fields at Fairview to Port Curtis, traversing a distance of approximately 406 km.

Marine Crossing GTP section

The Marine Crossing GTP will connect the Mainland GTP to Curtis Island GTP section (9 km) by spanning The Narrows utilising horizontal directional drilling (HDD). This section will also encompass a section of open trenching on the Mainland section above the intertidal zone.

Curtis Island GTP section

The GTP on Curtis Island is 5 km long commencing at Laird Point and running through to the proposed LNG Facility. This section is a terrestrial section and will be constructed using open trench construction.

A detailed outline of the project description has been provided in Section 4.

1.5 Roles and responsibilities

GLNG Operation's personnel and contractors will be responsible for implementing this WM Plan in a manner which complies with relevant environmental standards, adheres to legislative requirements and ensures that environmental objectives associated with construction and operation are achieved.

Contract documents will include the necessary environmental specifications and commitments, and require compliance with the Environmental Authority (which this WM Plan is used to support), construction specifications, technical drawings and the general environmental duty.

All personnel are responsible for the environmental performance of their activities and for complying with the General Environmental Duty as outlined in the *EP Act*. Section 319(1) of the *EP Act* states that '*a person must not carry out any activity that causes, or is likely to cause, environmental harm unless the person takes all reasonable and practicable measures to minimise the harm*'. Specific environmental responsibilities are detailed in Table 1.1.

Table 1.1 Specific environmental responsibilities

Position	Overview
GLNG Operations Pipeline Project Manager	The GLNG Operations Pipeline Project Manager is ultimately responsible for the standard of management, including environmental management. To assist in fulfilling this responsibility, the GLNG Operations Pipeline Project Manager is supported by a series of specialised personnel
Construction Manager	The Construction Manager is responsible for all construction activities including planning, procedure's approvals and execution of works. The Construction Manager is also responsible for ensuring that adequate provision is made for compliance activities

Position	Overview
Engineering Manager	The Engineering Manager is responsible for generating the design drawings and specifications consistent with the EM Plan and AS2885 – the Australian Pipeline Standard
Pipeline Construction Superintendent	The Pipeline Construction Superintendent will direct work in a manner that complies with all relevant environmental procedures; adheres to all legislative requirements and ensures that all environmental objectives associated with the Project are achieved. The Construction Superintendent has “stop task” and “stop work” authority
Environmental Manager	The Environmental Manager is responsible for monitoring and reporting the implementation of the EM Plan and for the continual measurement of the environmental performance of personnel and equipment. The Environmental Manager has “stop task” and “stop work” authority
Construction Contractor	Ensuring compliance with the EM Plan and the development and implementation of a contractor specific EM plan. This will include training of personnel (see below), provision and maintenance of equipment, facilities and associated services and consumables, and the monitoring of compliance to the EM Plan

Source Aurecon (2011) EM Plan (Mainland)

1.6 Limitations of this WM Plan

This document provides guidance related to chemical and hazardous materials storage, spill management and clean up (containment and remediation), however it does not address health and safety aspects. This will be addressed in relevant GLNG Operations guidelines including the EHSMS and inductions process.

This WM Plan should be viewed as a living document that will be progressively updated with additional information throughout the construction and operational phases.

2. Waste Management Legislation

2.1 General legislative structure

There area a number of Queensland and Commonwealth statutory environmental requirements, policies and guidelines that affect the Project and have been taken into consideration during the preparation of this WM Plan. These statutory requirements are summarised in Table 2.1

Table 2.1 Key legislation

Waste management legislation	Key requirement of legislation
Environmental Protection Act 1994	Environmental Protection Regulation which includes licensing and approval of all Environmentally Relevant Activities (ERAs) Establishing a general environmental duty Process to prepare Environmental Management Plans (EMPs) Issuing environmental protection policies
Environmental Protection Regulation 2008	Defines regulated waste and waste disposal management
Environmental Protection (Waste Management) Policy 2000	Waste management hierarchy and principles, and environmental management decisions concerning waste
Environmental Protection (Waste Management) Regulation 2000	Waste tracking requirements
National Environmental Protection (Movement of Controlled Waste between States and Territories) Measure as varied (2004)	Movement of Controlled Waste between States and Territories
Queensland's Waste Reduction and Recycling Strategy 2010- 2020	Sets targets to halve landfill volumes, double the recycling rate of MSW, and increase the rates for commercial and industrial building waste. Introduction of a levy on waste to landfill excluding MSW
Dangerous Goods Safety Management Act 2001	Storage and handling of dangerous goods and combustible liquids as well as the operation of major hazard facilities
Dangerous Goods Safety Management Regulation 2001	Prescription of dangerous goods location; major hazard facility or possible major hazard facility Safety obligations Flammable and combustible liquids licensing

2.1.1 Queensland legislation

The relevant legislation which will impact on the GTP includes, but is not limited to:

Environmental Protection Act 1994

The Queensland *Environmental Protection Act 1994* (EP Act) and its regulations and policies were developed to protect Queensland's environment, while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends. The EP Act is administered by the Department of Environment and Resource Management (DERM) formerly Queensland Environmental Protection Agency (EPA).

The EP Act utilises a number of mechanisms to achieve its objective including:

- Environmental Protection Regulation which includes licensing and approval of all Environmentally Relevant Activities (ERAs)
- Establishing a general environmental duty
- Process to prepare Environmental Management Plans (EMPs)
- Issuing environmental protection policies

The EP Act establishes a duty of care for all persons to take reasonable and practicable measures to prevent and minimise environmental harm.

The EP Act allows for the establishment of Environmental Protection Policies (EPPs) which allow for the Queensland Government to declare and implement its aims and objectives for environmental protection. In regards to waste management; waste generators, transporters and receivers must comply with the following policy and regulations:

- Environmental Protection (Waste Management) Policy 2000 (EPP Waste)
- Environmental Protection (Waste Management) Regulation 2000 (EP Waste Regulation)

The EPP (Waste) combined with the EP Waste Regulation aim to co-ordinate and clarify waste management practices in Queensland and to provide a framework for improved environmental safeguards.

Environmental Protection (Waste Management) Policy 2000

The EPP (Waste) co-ordinates and clarify waste management practices in Queensland and provides improved environmental safeguards to achieve “ecologically sustainable development”. It does this by the adoption of the waste management hierarchy along with several management principles these include:

- “Polluter pays principle” – All costs associated with waste management should, where possible, be borne by the waste generator
- “User pay principle” – All costs associated with the use of a resource should, where possible, be included in the price of goods and services developed from the resource
- “Product stewardship principle” – The producer or importer of a product should take all reasonable steps to minimise environmental harm from the production, use and disposal of the product

The above three principles form a hierarchy and provide a basis for waste management programs under ERAs. The waste and resource management hierarchy includes the following management principles (in order of priority) (DERM 2010).

- Reduce
- Reuse
- Recycling
- Other recovery
- Treat
- Dispose

Environmental Protection Regulation 2008

This Regulation, replaces the *Environmental Protection Regulation 1998*, supports the environmental impact statement process, and identifies environmentally relevant activities (ERAs) prescribed under the Environmental Protection Act 1994.

The *Environmental Protection Regulation 2008 (*EP Regulation) defines regulated waste and regulated waste disposal management. It also provides the statutory basis for implementing the National Environment Protection Measure for the National Pollutant Inventory.

Environmental Protection (Waste Management) Regulation 2000

The Environmental Protection (Waste Management) Regulation 2000 sets specific requirements for the management of regulated waste, waste disposal facilities, waste management by local government, and littler control such as:

- Offences for littering, waste dumping and unlawful activities at waste facilities
- A waste tracking system within Queensland and interstate (National Environment Protection Measure for the National Pollutant Inventory)
- Requirements for premises generating clinical and related waste
- A procedure for approval of wastes for beneficial reuse
- Approval processes for beneficial use of wastes
- Design rules for waste equipment

2.1.2 Commonwealth legislation

National Environmental Protection (Movement of Controlled Waste between States and Territories) Measure

The *National Environment Protection (Movement of Controlled Waste between States and Territories) Measure* (NEPM) aims to ensure that controlled wastes which are moved between States and Territories are properly identified, transported and handled in an environmentally sound manner, and that they reach licensed or approved facilities for treatment, recycling, storage and/or disposal. The NEPM provides a framework for developing and integrating systems for the movement of controlled waste between States and Territories which includes:

- Tracking systems, which provide information to assist agencies and emergency services and ensure that controlled wastes are directed to appropriate facilities
- Prior notification systems, which provide participating States and Territories with access to information to assess the appropriateness of proposed movements of controlled wastes in terms of transportation and facility selection
- Systems for licensing transporters and the regulating of generators and facilities so that tracking and notification functions are compatible between States and Territories
- Provision for mutual recognition by States and Territories of each other’s transport licences (QLD EPP 2008 legislation)

2.1.3 Waste definitions

Under the EP Act “waste” is defined as anything that is:

- Left over, or an unwanted by-product, from an industrial, commercial, domestic or other activity
- Surplus to the industrial, commercial, domestic or other activity generating wastes

The EP Regulation defines “general waste” as waste other than regulated waste. Regulated wastes are defined in Schedule 9 of the EP Regulation as ‘non-domestic’ waste. A list of all defined regulated wastes is outlined in Schedule 7 of the EP Regulation. Appendix A provides a glossary of additional definitions relevant to this WM Plan.

2.1.4 Environmentally Relevant Activities (ERA's) – Environmental Protection Regulation 2008

The Project has the potential to trigger a number of Environmentally Relevant Activities (ERA's) during the construction and operation of the GTP.

The ERAs are prescribed under the *Environmental Protection Regulation 2008* and the GTP construction works may include the following ERAs:

- Environmentally Relevant Activity (ERA) 8: chemical storage
- ERA 17: Abrasive Blasting
- ERA 21: Motor Vehicle workshop operation
- ERA 38: Surface Coating
- ERA 56: Regulated waste storage
- ERA 57: Regulated waste transport
- ERA 60: Regulated waste disposal
- ERA 63: Sewage treatment
- ERA 64: Water treatment

If any GTP construction activity triggers an ERA then approval under the *Environmental Protection Act 1994* shall be sought by the Contractor prior to construction and the activity commencing.

2.1.5 License requirements

GTP license requirements regarding waste management are described within this WM Plan. All regulated wastes are to be disposed of to a licensed waste disposal facilities or recycling facilities and transported by authorised companies or personal. Designated personnel who will be required to collected, treat, transport or dispose of waste or recyclable materials will need to document their operational capacity in accordance with relevant State and Commonwealth legislation.

2.1.6 Records and data management

It is a legal requirement that records will be kept in regards to regulated waste (defined under the EP Regulation 2008). The EP Regulations require all persons or business involved with the production or transportation of trackable wastes to record detailed information about the waste as defined in the EP Waste Regulation. These include the requirement to complete a Waste Transport Certificate for all deemed trackable waste. The *Environmental Protection (Waste Management) Regulation 2000* details the regulatory procedures.

2.2 Summary of standards and guidelines

Table 2.2 is a summary of Australian Standards and guidelines which provide guidance about waste management in relation to construction and operation of the GTP.

Table 2.2 Summary of standards and guidelines

Standard/guideline	Key requirements
AS1940	The storage and handling of flammable and combustible liquids
DNRMW On-Site Sewerage Code	Technical requirements for the management, site and soil evaluation, design, installation and operation of on-site sewerage facilities
DNRMW Guidelines for Vertical and Horizontal Separation Distance	Details acceptable vertical and horizontal separation distances from buildings, watercourses, bores etc
Standards Australia AS/NZS 1547 On-Site Domestic Wastewater Management	Australian standard for on-site wastewater management
AS 3833	Australian standard for storage and handling of mixed classes of dangerous goods, in packages and intermediate bulk containers
AS3780	Australian standard for storage and handling of corrosive substances
AS 2187 Explosives	Australian standard for the storage and prescribed licenses and permits. (Specialist Contractor)
AS 2885.3 & APIA Code of Environmental Practice – Onshore pipeline	Code of practice for onshore pipelines - gas and liquid petroleum - operation and maintenance
Material Safety Data Sheets	Compliance with OH&S and legislative obligations related to the storage and handling of chemicals chemical registers (inventories).
Guide to the Dangerous Goods Safety Management Act 2001	This Queensland Department of Emergency services document outlines the obligations, and provides definitions and information to help explain requirements under the Dangerous Goods Safety Management Act

2.3 Regulatory approvals

In addition to the legislative requirements detailed in Section 2.1 this WM Plan has sought to address the specific project approval conditions and items, which have been raised as a result of the regulators comments in relation to the GLNG EIS. These include:

- The conditions within the Coordinator General’s Report related to waste management and the storage and handling of chemicals, flammable and combustible liquids. In particular the Part 4 Environmental Authority Conditions – Gas Pipeline, Schedule D – Waste Management, Condition D8 and D9
- The Department of Infrastructure and Planning comments related to waste management as documented in *Report for Crossing of the Narrows – Review of the GLNG EMP*
- The Department of Environment and Resource Management’s Guideline *Preparing an EM Plan for CSG activities* related to waste generated by the proposed petroleum activities

3. Waste Management Principles

3.1 Overview

The management of waste material generated as a result of GTP construction, operation and decommissioning will be dealt with in accordance to the principles of the waste and resource management hierarchy[1] (refer Figure 3.1) as described in the Queensland Waste Reduction and Recycling Strategy 2010 - 2020.

Source Queensland's Waste Reduction and Recycling Strategy 2010–2020 (DERM, 2010)

Figure 3.1 Waste and resource management hierarchy

The GTP waste and resource recovery hierarchy principles are outlined in Section 3.2.

3.2 Waste and resource management hierarchy principles

3.2.1 Waste avoidance

Waste avoidance will be targeted through adoption of alternative products and implementation of procurement processes which include the provision of contracts with companies which have documented sustainable waste management practices.

During delivery and transportation, the pipe sections will be protected with a coating applied during manufacture off-shore that reduces damage and subsequent wastage during the GTP construction process. All pipeline sections will be ordered and delivered to meet the detailed design requirements. This will reduce the quantities of some waste streams associated with the construction phase, including scrap steel.

[1] Prior to publishing of the Queensland Waste Reduction and Recycling Strategy 2010 – 2020, the Waste and resource management hierarchy was referred to in Queensland Legislation and other government documents as the Waste Management Hierarchy comprising waste avoidance, waste reuse, waste recycling, energy recovery and waste disposal

3.2.2 Waste reduction

Where possible, contracts will be established with companies that minimise waste through their production process, maximise recycling of waste produced and maximise recycling opportunities for the used end product and associated packaging waste. Procurement of pre-fabricated materials will be encouraged to reduce the quantity of waste generated on site.

3.2.3 Waste re-use

The re-use of waste will be achieved through identifying at the earliest opportunity materials which can be re-used during the construction period. Items such as timber skids, sand bags, timber pallets and hydrotest water are examples of materials that will be targeted for reuse.

To maximise re-use opportunities, materials will be segregated within the designated waste storage areas along the GTP RoW. The environmental protection commitments, objectives and control strategies described in Section 8 provide recommendations on how re-use could be implemented for the Project.

3.2.4 Waste recycling

The collection of waste materials for recycling will be integral to the management of waste during construction of the GTP. A proportion of the materials created as a result of construction will be recycled, an example of some of the materials are:

- Dry recyclables like paper, cardboard, plastic and glass
- Ferrous and non ferrous metals generated from the pipe welding and cutting process
- Oils generated from plant and equipment maintenance
- Timber generated from pallets, skids and off cuts (once reused)

Other potentially recyclable materials will be treated in accordance with the principles of the waste and resource management hierarchy where opportunities exist.

3.2.5 Other recovery and treatment of waste

This includes capturing the energy available in discarded products and treating the waste prior to disposal to reduce the hazardous characteristics of the waste.

Energy recovery facilities are generally not available in Central Queensland and are not likely to be an option for project waste. Some regulated waste from the Project may need to be sent to licensed treatment facilities to reduce the hazardous characteristics of the waste prior to disposal.

3.2.6 Waste disposal

The construction and operation of the GTP will adopt suitably licensed waste management and recycling contractors that will provide bins and collection/transportations services for specified waste to be hauled to licensed waste management facilities.

Disposal options for wastes generated by the construction and operation of the GTP depend on the characteristics of the waste. The following section presents the waste disposal options that have been considered for the construction and operation of the GTP.

Landfill

Although most towns in Maranoa Regional Council, Central Highlands Regional Council and Banana Shire Council have a local waste disposal facility, many facilities only accept domestic waste for disposal. The waste facilities that accept waste for disposal from commercial operators are listed in Table 3.1. No other waste disposal facilities may be used for disposal of project waste without prior approval of GLNG Operations.

Table 3.1 Waste disposal facilities closest to GLNG GTP RoW

Licensed waste facility	Allowable annual capacity as per site environmental authority	Comments
Gracemere Landfill, Allen Road, Gracemere	20,000 t per annum for disposing of general waste or limited regulated waste	Contractor to investigate if Rockhampton Regional Council will accept waste to the Gracemere Landfill from the Port Alma temporary pipe receiving area
Benaraby Landfill, Bruce Highway Benaraby (south of Gladstone)	50,000 t per annum	NIL
Trap Gully Landfill, Forestry Road, near Biloela	Less than 2,000 t per annum for disposing of general waste or limited regulated waste	Limited capacity to accept waste materials for disposal. Contractor to investigate if Banana Shire Council will accept waste at the Trap Gully Landfill from the project
Rolleston Landfill, Rolleston	Unconfirmed	Contractor to investigate if Council will accept waste at the Rolleston Landfill from the project
Roma Landfill, Short Street, Roma	Unconfirmed	Contractor to investigate if Council will accept waste at the Roma Landfill from the project
Injune Landfill, Injune	Unconfirmed	Contractor to investigate if Council will accept waste at the Injune Rolleston Landfill from the project

Sewage treatment plants

The waste contractor is to contact the relevant local authority to determine the location of suitable STPs and arrangements to receive wastewater from the construction camps.

3.3 Waste and resource management hierarchy initiatives

The Project will aim to achieve positive outcomes by targeting the source of the waste and adopting the resource management hierarchy.

Table 3.2 outlines potential opportunities for waste and recycling service for implementation in the Project.

Table 3.2 Waste and resource management hierarchy opportunities

Waste hierarchy	Opportunity	GTP initiative
Waste avoidance/ Waste reduction	Excavated material and topsoil	All excavated material and topsoil is to be used for backfill and respread along the RoW during restoration
	Hardstand material and rock	Clean hardstand material from areas to be restored to their original condition will be provided to local landowners for use on their properties ie roadways
	Temporary fencing and gates	Temporary fencing and gates constructed along the boundary of the RoW are likely to remain after completion of restoration as many of the landowners have indicated that they would like to keep this fencing
	Pipe	Minimum length of pipe cut permitted is 2 m. These cut lengths are to be used within the pipeline
	Offsite construction	Where possible packaging materials used to deliver pipe and materials will be reusable or recyclable
Waste re-use	Green waste (felled vegetation and plant matter)	Green waste where possible will be reapplied during RoW restoration. Whole felled and mulched vegetation will be used in rehabilitation and soil stabilisation of RoW (refer Ecolocia (2010) Landscape Rehabilitation Management Plan)
	Timber skids	Timber skids used during pipe stringing will be collected and transferred along the RoW for reuse in pipe stringing further along the corridor
	Wastewater effluent (treated wastewater) re-use	Explore whether treated wastewater from construction camps is suitable for use for dust suppression or use in vehicle wash down facilities
	Hydrotest water re-use	Where possible hydrotesting will be reused
Waste recycling	Waste oil and hydrocarbons	A waste oil contractor would be used for recycling waste oil
	Steel and metal, cabling	Waste steel and other metals will be recycled by a steel and metal merchant
	Batteries	Batteries will be recycled with a battery recycler
	Tyres	A licensed contractor will be engaged to transport tyres to a tyre recycler
	Waste paper and cardboard	Investigate if recyclable materials can be sent to the CQ's Rockhampton MRF for recycling
		Banana Shire Council operates a small waste paper and cardboard bailing plant in Biloela. Contactor to investigate the opportunity to recycle source separated waste paper and cardboard at Banana Shire Council's Calvale Road facility in Biloela

Waste hierarchy	Opportunity	GTP initiative
Energy recovery	There are no energy recovery facilities in Central Queensland. There is a potential opportunity for some waste material to be used as a fuel for the cement kiln at Aldoga, Gladstone	Contractor to investigate if any waste materials have value and are suitable for use as a fuel/feed stock in the cement kiln at Aldoga, Gladstone

4. Project Description

4.1 Project overview

An underground 420 km GTP will feed CSG from the CSG fields at Fairview through to the proposed LNG Facility on Curtis Island. The GTP route is shown on Figure 1 – GTP Waste and Recovered Material Haulage Route. The Project activities occur in 3 phases - construction, operation and decommissioning phases. The following is an overview of the various activities which will be undertaken during each phase and a description of the project components.

During the construction phase three distinct work areas are proposed referred to as the Mainland GTP section which is approximately 406 km in length, the Marine Crossing GTP section which is 9 km long and the Curtis Island GTP section which is 5 km in length. The construction activities provided below is a summary and details for each section is provided in the each EMP.

4.2 Construction

Pipeline materials will be imported via ship to the Port of Gladstone or Port Alma, transported via road and stored in temporary locations called 'temporary pipe storage sites' along the pipeline RoW. A peak workforce of approximately 900 construction personnel are required for the pipeline construction, working 12 hours each day on a 28 days on, 9 days off roster. A summary of the construction program is as follows:

- Commences in late December 2011 with delivery of the first shipments of line pipe
- ROW clearing activities and rock exposure and blasting commence in January 2012
- Trenching, stringing and bending activities commence in April 2012
- Welding, lowering and backfilling commence in May 2012
- Clean up and RoW restoration commence in June 2012 through to February 2013

4.2.1 Mainland GTP construction activities

Construction workforce and camps

Construction personnel will be accommodated in construction camps. Four construction camp locations have been identified (Bundaleer, Bauhinia, Banana and Calliope (refer Figure 1 – GTP Waste and Recovered Material Haulage Route)). Temporary work site facilities such as vehicle refuelling facilities, waste storage area, site offices, warehouse and lay-down area, maintenance workshop, prefabrication workshop, vehicle parking area, vehicle washdown facilities and associated infrastructure such as water storage tanks, diesel generators and portable sewage treatment facilities will be located within the construction camps. These construction camps will use sectional trailers and modular structures joined together to provide the required buildings. The workshops and other facilities will be relocatable and will be moved to follow the Mainland GTP construction as it progresses along the RoW.

The construction camps will require potable and non-potable water for domestic use during construction. It is estimated that the overall usage of potable water during construction and will be approximately 200 L/person/day.

A temporary equipment maintenance workshop, which is mostly containerised, will be mobilised at each construction camp for the purpose of undertaking maintenance and repairs of construction plant and equipment.

It is proposed that fuel trucks, lubrication trucks and small maintenance vehicles with roving mechanics will be on site daily to service and perform maintenance on plant and equipment. Plant and equipment requiring major repair will be brought to the construction camp's equipment workshop.

It is proposed that emergency vehicle maintenance will be provided for the following services:

- Towing of stalled vehicle to workshop
- Tyre repair
- Changing fan belts, replacing hoses and other repairs requiring 3 hours or less

The prefabrication workshop will be provided for fabrication of main line valves and end of loops piping.

General GTP construction activities

Pipe will be imported via ships, which will be unloaded at pipe receival areas. Approximately 11 pipe shipments will be received at Port Alma and 5 pipe shipments at Gladstone Port Central. Prior to transport from the port to the temporary pipe receiving areas, the pipe will be inspected for compliance with the specification. Many of the construction vehicles, equipment and materials which are required for the pipeline construction will be sourced from the contractor's fleet and stores located outside Australia. The contractor's fleet, equipment and materials which are imported into Australia will arrive and be unloaded either at Gladstone Port Central or the Port of Brisbane and transported via road to the construction camp or work area of the RoW.

Pipe arriving at Port Alma will be transferred to the temporary pipe receiving area located at Lot 96 on DS186 on the Toonda Port Alma Rd, Bajool. The pipe will be stored on Lot 96 until scheduled for dispatch to the temporary pipe storage sites adjacent to the GTP RoW.

Similarly, pipe arriving at Gladstone Port Central will be transferred to the temporary pipe receiving area at the Gladstone Logistic Base. The pipe will be stored at the Logistic Base until scheduled for dispatch to the temporary pipe storage sites adjacent to the Mainland RoW or transported via barge to Curtis Island. This Logistic Base is to be established to support the pipeline construction activities near Gladstone and will be operational for the duration of the Project. Vehicle refuelling facilities, waste storage area, site offices, warehouse and lay-down area, maintenance workshop, prefabrication workshop will also be located at the Gladstone Logistics Base.

Up to 11 temporary pipe storage sites (pipe laydown areas) are to be constructed at various locations adjacent to the Mainland RoW for temporary storage of pipe prior to transferring the pipe to the RoW during stringing works (Refer Figure 1 – GTP Waste and Recovered Material Haulage Route). Each temporary pipe storage site will typically be 8 ha in area to accommodate temporary storage of up to 60,000 pipes.

To prevent spread of weeds by construction vehicles, RoW access will be strictly controlled so that vehicles can not travel from a weed infested area into a weed free area without passing through a vehicle washdown facility. It is proposed to install 12 RoW access points with vehicle washdown facilities along the Mainland RoW. Weed management and control associated with vehicle washdown and weed zones is addressed in the Weed and Pest Management Plan, which states that access routes shall be planned to achieve the following:

- Vehicles operate in such a manner as to limit crossing of weed zone boundaries
- Vehicles start in clean areas and then move into the dirty areas
- Vehicles do not drive though or contact any seeding or flowering weeds
- Vehicles are subject to washdown and certification to move between zones

It is understood that the following pipeline construction activities are likely to generate waste:

- Early works
  - Weed control along the RoW
  - Construction of platforms for pipe storage at the temporary pipe storage sites
- Contractor plant and equipment receival in Gladstone and Brisbane ports
- Pipe receival at temporary pipe receiving areas at Port Alma and Gladstone Logistic Base
- Mobilisation
  - Construction of temporary facilities – Temporary receiving pipe areas, 11
  - Transport and delivery of plant and equipment
  - Transport and delivery of pipe to temporary pipe storage sites
  - Progressive installation of construction camps - 4 mobile construction camps for worker accommodation, relevant to the work area of the construction workers
- Clearing and grubbing pipeline corridor and access tracks
- Erosion and sediment control maintenance
- Restoration and maintenance of existing roads, RoW access tracks and haul roads
- Trenching
- Drilling and blasting
- Pipe Installation – welding and weld checking called holiday testing
- Pipe cleaning (pigging) and testing (hydrotesting and leak detection testing)
- Infield servicing of equipment and mobile plant
- Mobile refuelling of construction equipment
- Construction of inlet station and mainline valve stations
- Rehabilitation – pipe backfilling and pipeline corridor restoration
- Decommissioning and relocation of construction camps

4.2.2 Marine Crossing section construction activities

The Marine Crossing GTP is a 9 km section that traverses the tidal area of The Narrows and wetlands to reach Curtis Island. A section of the Marine Crossing GTP will be constructed using HDD, which entails drilling a continuous borehole beneath The Narrows and then pulling the pipeline and other utility components including a fibre optic cable through the borehole, leaving the surface undisturbed. A section of marine Crossing section will be constructed by open trench. Details relating to the HDD construction process is included in the Marine Crossing EMP.

The HDD activity will generate drill cuttings which will be temporarily stored in a cuttings settlement pit (or a water tight container) located on the HDD drill pad. Drilling mud slurry (bentonitic drilling fluid) will also be stored in containment pits (or a water tight container) at the drill entry and exit points.

Drill cuttings that comply with Gladstone Port Corporation GPC's approval conditions will be disposed of within the Western Basin Reclaim Area. Drill cuttings that potentially contain Acid Sulfate Soil (ASS) will be transported to an ASS treatment area for treatment in accordance with the Acid Sulfate Soil Management Plan (ASSMP). Treated material will then be transferred to the Western Basin Reclaim Area for disposal. Material that doesn't comply will be disposed to landfill.

At completion of drilling operations, remaining drilling fluids (bentonite slurry – mixture of water and bentonite) that comply wit h CGP approval conditions will be dewatered and transported to an authorised location for disposal (Benaraby Landfill or the Western Basin Reclaim Area).

Upon completion of the Marine Crossing GTP section, the HDD drill pad, access bog mats and associated pipe stringing and welding platforms will be removed and the Kangaroo Island Wetland will be rehabilitated in accordance with the Land Rehabilitation Management Plan (LRMP).

Waste and recyclable material from the Marine Crossing GTP section will be transported via barge to the Gladstone Logistic Base for aggregation and sorting in the waste storage area. A licensed waste contractor will transport waste and recyclable material to a disposal or recycling facility.

Refer Figure 2 and 3 (Appendix B).

4.2.3 Curtis Island section construction activities

The Curtis Island GTP section that joins the Marine Crossing GTP section to the proposed LNG Facility will be constructed using trenching (as described for the Mainland GTP section refer Figures 2 and 3 in Appendix B).

Waste and recyclable materials generated from the Curtis Island GTP will be transported via barge to the Gladstone Logistic Base for aggregation and sorting in the waste storage area. A licensed waste contractor will transport waste and recyclable material to a disposal or recycling facility.

4.3 Operation

The operational phase involves activities associated with:

- Structural integrity monitoring
- Maintaining and repairing the pipeline, valves and metering stations
- Cleaning the pipeline (pigging)
- Maintenance to operational access tracks such as weed control and vegetation management
- Monitoring the performance of the cathodic protection system and anti-corrosion initiatives
- Monitoring the gas transmission

Waste and recyclable materials likely to be generated from the operational phase are detailed in Section 5.2.

4.4 Decommissioning

Decommissioning will occur in accordance with regulatory requirements as set out in the EM Plans.

5. Waste Generation

Waste will be generated as a result of GTP construction activities. Three distinct construction work areas identified and outlined in Section 4 will generate waste; these include the Mainland section, the Marine Crossing section and Curtis Island section.

The estimated waste streams from the construction and operation of the GTP fall into one of the following broad categories:

- General waste
  - Recyclable waste such as paper, cardboard, plastics, glass, aluminium and timber
  - Putrescible waste
  - Medical and first-aid waste
  - Scrap metals
- Liquid waste
  - Sanitary waste
  - Hydrotest water
  - HDD fluids
- Hazardous and regulated waste

The waste materials likely to be generated from construction and operation of the GTP have been described in Section 5.1 to Section 5.3. The quantities of waste are estimates only.

5.1.1 Mainland section

Table 5.1 to Table 5.3 list the expected wastes to be generated from the construction activities from the Mainland GTP section. The waste generation lists have been compiled relative to the key activity areas:

- Temporary pipe receiving area at the Gladstone Logistic Base and at Port Alma
- Mainland RoW including temporary pipe storage sites and RoW access points
- Construction camps including plant and equipment workshops

Temporary pipe receiving areas

Table 5.1 Waste generated at temporary pipe receiving area at the Gladstone Logistic Base and Port Alma

GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
Delivery of plant and equipment to site (ie light vehicles and construction vehicles, dongas, portable toilets)	Packaging (ropes and strapping, cardboard), timber skids, fibre/nylon rope spacers, pallets, drums and scrap metals	Materials treated as per waste hierarchy with general waste disposed to local licensed landfill	Negligible
Delivery of pipe at port to temporary pipe receiving area	Pipes with irreparable defects or specification non-conformity or damage Pipe will arrive with PVC or polyethylene end caps and 3 pieces of nylon rope tied around each end and in the centre. These will remain on the pipe until stringing and welding is undertaken within the RoW	All dunnage and damaged pipe sections will remain on ship	Negligible
Site office	General waste, waste paper	General waste to local licensed landfill Recyclable material to recycling facility (where available)	General waste 240 L per week
Prefabrication workshop valve assemblies, pipe supports and light structures (not applicable to Port Alma)	Waste materials such as pipe spools, various off cuts and grindings, paint containers, welding waste	Recycle metals General waste to local licensed landfill	Pipe off cuts and waste steel 0.5 t per week (approx one 12 m length of pipe per week) General industrial waste 0.5 t per week

Temporary pipe storage sites and RoW access points

Table 5.2 Waste generated from the Mainland RoW construction area and temporary pipe storage sites

Mainland GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
Mobilisation activities			
Translocation of plants	Plastic pots Wooden stakes Packaging material	All existing fencing removed from the ROW during the construction phase will be offered to local landowners for reuse. Any remaining items will be removed in accordance with the principles of the waste hierarchy Recyclable material to recycling facility (where available)	10 m^3 per week of general and recyclable waste during fencing works
Weed control	Chemical containers and other consumables		
Delivery of plant, equipment and portable structures to site (ie vehicles, dongas, portable toilets, vehicle weed washdown facilities at RoW access points)	Packaging (ropes and strapping, cardboard), timber skids, wooden crates, fibre/nylon rope spacers, pallets, drums and scrap metals		

Mainland GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
Installation of fencing and gates (temporary and permanent) and removal of existing fencing as per Landholder agreements	Damaged fencing, fencing wire off cuts, timber post off cuts Temporary fencing that can not be reused	General waste to local licensed landfill	
Construction			
Hardstand - import of hard standing materials for roadway or hardstand construction	Hardstand materials	Surplus clean material will be offered to local landowners for reuse or removed in accordance with the principles of the waste hierarchy	No waste materials are expected to be generated
Weed washdown facilities	Wastewater and sludge	Water is filtered and reused in washdown facility. Sludge disposed at local licensed landfill or WWTP	1 m^3 sludge per week per washdown facility
Clearing and grubbing of the pipeline corridor, temporary pipe storage sites and access tracks (clear and grade)	Green waste (felled vegetation and plant matter) Topsoil and excavated material (stockpiled for backfilling and application to RoW) Installation of temporary fencing and gates Construction of access tracks as required Steel post offcuts (from signage installation)	Stockpiled/windrowed vegetation will be reapplied during restoration/rehabilitation of RoW All topsoil and excavated material reused for backfilling in RoW Any surplus fencing material will be offered to local landowners for reuse or removed in accordance with the principles of the waste hierarchy	Included in general waste in mobilisation activities
Construction of temporary pipe storage sites – grading and levelling, hardstand, berm construction, and fencing where required	Hardstand materials	Surplus clean material will be offered to local landowners for reuse or removed in accordance with the principles of the waste hierarchy	Included in general waste in pipe construction works
Erosion and sediment control installation and maintenance	Packaging material – cardboard, plastic wrapping, wooden pickets and geofabric sediment fencing Geofabrics "Bidim" A34 grade polyester filter off cuts	Sediment collected in devices stored in the ROW for respreading during rehabilitation works General waste to local licensed landfill	Quantities of waste dependent on climatic, site and topography conditions Included in general waste in mobilisation activities
Drilling and blasting	Packaging – cardboard, plastic wrapping	Specialist contractors will manage all waste associated with the handling and storage of explosives in accordance with relevant legislation and standards AS2187	No waste materials are expected be generated

Mainland GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
Delivery of pipe construction materials and consumables to temporary pipe storage sites	Neoprene plastic wrapping Nylon rope Rubber matting Packaging – timber dunnage, pallets and crates, plastic wrapping, metal and plastic strapping around consumables Ropes and strapping, cardboard, timber skids, fibre/nylon rope spacers, pallets, drums and scrap metals	Materials will be recycled where possible General waste to local licensed landfill	Included in general waste in pipe construction works
Pipeline construction works Pipe stringing and bending Pipe cutting and trimming Pipe welding (up to 1000 m pipe strings) Weld sandblasting Tie-ins (above ground or in-the-trench) Coating of field joints - application of rust proofing agent required to be applied when pipe is cut and a coating of epoxy-urethane over weld Holiday detection survey and weld testing Ducting for fibre optic cable River/waterway crossings	PVC or polyethylene pipe end caps (68,000 pipe end caps for pipeline) 42” mild steel pipe off cuts and defective pipe; metal filings(less than 100 m of pipe for pipeline) Timber skids and sand bags (reuse on each 30 km section) Off cuts – duct for future installation of fibre optic cable Marker tape Chemical containers (ie paint/epoxy coating cans, empty containers of rust proofing agents) Sandblasting grit (inert) Welding residue – welding rod scraps and electrode butts Polypropylene bags Waste cement and concrete Nylon rope	PVC or polyethylene pipe end caps recycled Metal recycled Timber skids and sand bags reused General waste to local licensed landfill Licensed contractor to transport regulated waste to an appropriately licensed recycling facility and residual material disposal at appropriately licensed regulated waste landfill	17.5 t per week of pipe end caps (10 kg per pipe end) 0.6 t per week of steel pipe off cuts and defective pipe 1.7 t per week of metal filings 8 t per week of general waste 100 L per week of regulated waste (spent chemicals and chemical container)
Trenching Foam trench breakers and foam pillows installation	Excavated material Excess rigid polyurethane foam (Aptane P220 / Isocyanate B900) and hose washings Spent absorbent material Drums/plastic bags (polypropylene) PPE - Protective gloves and disposable overalls PVC conduit offcuts	All excavated material reused for backfilling in RoW or offered to local landowners for reuse All materials will be managed as per the waste and resource management hierarchy with general waste disposed to the local licensed landfill	Included in general waste in pipe construction works

Mainland GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
Pipe cleaning and gauging Pipe testing – Hydrotesting 24 hour leak test	Pipe cleaning waste (pigging grit - scale, rust, or other foreign material) Hydrostatic test water not treated with biocides, corrosion inhibitor and oxygen scavengers (estimated 25 km tested at a time (90 kL water required), used 4 times before discharge)	Pigging grit - Licensed contractor to transport regulated waste to a licensed regulated waste landfill Hydrotest water discharge to land (assume no chemical treatment of water is required as source is potable water)	200 m^3 pigging grit total (assume 0.5 m^3 per km) 360 kL water
Infield servicing and maintenance of construction plant and equipment Fuel trucks, lubrication trucks and minor maintenance pick-ups provide on-site daily service and perform regular check ups on equipment Daily field servicing, safety checks and refuelling in the field to be undertaken in the RoW	Oily rags, spent absorbent material infield servicing and maintenance Waste oil and greases eg lube oil, hydraulic oil and engine oil Spent spill kit materials Packaging from replacement parts End of life vehicle parts (eg fan belts, hoses, other machinery parts) Tyres Batteries Used chemicals – chemicals, used tins from solvents, degreasing agents, lubricants Waste associated with diesel generator operation and maintenance	Licensed contractor to transport regulated waste to a licensed recycling facility Residual material dealt with in accordance with the principles of the waste hierarchy	All waste generated from infield servicing will be returned to the waste storage area at the at the construction camps
Site offices, crib room/s, site amenities (servicing of construction site amenities)	Office waste – paper, cardboard packaging etc Kitchen waste Rubbish bin waste in facilities (ie paper towels etc) First aid waste Wastewater	Recyclable material to recycling facility (where available) General waste to local licensed landfill Wastewater hauled via vacuum truck and disposed at construction camp's WWTP	Recycling and general waste quantities included in the construction camp per person kg per week Wastewater volumes included in construction camps quantities per person per day
Spill clean up	Hydrocarbon contaminated soil (small quantities) Contaminated absorbent material from RoW	Licensed contractor to transport regulated waste to a licensed recycling facility and residual material disposal at a licensed regulated waste landfill	Up to 160 L per week of regulated waste across Mainland GTP activities
RoW rehabilitation			
Clean up and restoration: reinstatement of the RoW, removal of foreign material	Any recyclable or general waste items listed above Useable surplus pipe will be	Clean hardstand material will be offered to local landowners or	100 t timber skids 50 t sand bags (assume timber skids and sand

Mainland GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
(construction material and waste), surface contouring, compaction, re-spreading topsoil, re-spreading felled vegetation(whole or mulched) and reseeding Removing any surplus materials, restoring services to their original condition, disposing of refuse, smoothing disturbed earth, removing temporary fills, culverts and bridges, and performing such work as may be necessary to restore RoW to original condition	delivered to a location designated by GLNG Operations	local council for reuse or removed for treatment or disposal in accordance with the principles of the waste hierarchy Useable surplus pipe and other reusable materials stored at location designated by GLNG Operations General waste to local licensed landfill	bags are reused approximately 15 times over the length of the pipeline ie assume reuse on each 30 km section)
Reinstatement of temporary pipe storage sites/pipe storage yards and other non RoW areas such as haul roads, spoil storage and other such areas requiring restoration	Polyethylene sheeting from pipe storage area	Reused or recycled where possible. Will be offered to local landowners for reuse General waste to local licensed landfill	80 t of polyethylene sheeting from temporary pipe storage sites
Establishment of vegetation	Plastic pots Wooden stakes Packaging material Herbicides	Residual material dealt with in accordance with the principles of the waste hierarchy Items will be recycled where possible if no option available then waste will be disposed of to a local licensed landfill General waste to local licensed landfill Licensed contractor to transport regulated waste to an appropriately licensed recycling facility and residual material disposal at appropriately licensed regulated waste landfill	50 kg per week during vegetation establishment activities in the RoW Quantity dependent upon whether herbicides for weed control are required during establishment of vegetation

Construction camps

Table 5.3 Waste generated from construction camps

Mainland GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
Mobilisation, construction and commissioning of construction camps	Site clearance green waste, topsoil and excavated material (stockpiled for backfilling and application to construction camps)	Stockpiled/windrowed vegetation will be reapplied during restoration/rehabilitation of RoW All topsoil and excavated material stockpiled along RoW for backfilling and spreading during site restoration	Nil
	Construction materials, concrete, scrap metal, timber, plastics, plumbing, electrical wiring etc	The construction methodology will aim to limit the amount of waste produced on the construction site and ensure that wherever possible, waste materials are re-used or recycled General waste to local licensed landfill	20 m^3 per week general and recyclable waste per construction camp during construction camp set up activities
Operation of construction camps – cleaning, catering, site offices, accommodation areas, RoW, temporary pipe storage sites, construction areas, temporary storage, and residential blocks within construction camps	General waste (including putrescible and non-hazardous waste) Recyclables (dry recyclables, cardboard, packaging materials and offices wastes)	Recyclable material to recycling facility (where available) General waste to local licensed landfill	6 kg per person per week recyclable material 13 kg per person per week general waste
	Metals - aerosol, aluminium cans, steel chemical containers, copper and aluminium (other than cans), steel drums (damaged), steel drums (good condition), scrap steel, steel chemical containers, bulk food containers		
	Food waste - Putrescible waste, metal, plastic, plastic and other associated food packaging		
	Chemicals - Cleaning and maintenance of camp buildings chemicals		
	Cardboard – Bulk food packaging and plant and equipment maintenance storage		

Mainland GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
	Cooking oils – Food production activities	Waste cooking oil will be securely stored by the catering contractor and removed by the supplier for recycling where practicable	Recycling and general waste quantities included in the per person kg per week
	Wood (pallets) bulk deliveries of food	All pallets will be collected by suppliers and returned for reuse	
	Clinical, medical, sanitary waste, first-aid station waste, medical waste	Waste material dealt with in accordance with the principles of the waste hierarchy	Minimal quantities expected to be produced and have been included in the per person general waste quantities
	Wastewater treatment plant effluent	Discharge to mobile sewage treatment plants – irrigation beds/absorption beds	200 L per person per day - effluent
	Sludge from wastewater treatment plant	Licensed landfill or wastewater treatment plant	5 L sludge per person per week at 2% solids
Site mowing and vegetation maintenance	Green organic waste (woody garden waste, grass)	Stockpiled/windrowed vegetation will be reapplied during restoration / rehabilitation of construction camp	No waste expected to be generated
Office waste, construction materials and equipment store	Spent toner and printer cartridges, electronic and electrical equipment, white goods, computers, office equipment, mobile phones, batteries (dry cell)	Equipment will be reused by returning items to Brisbane	Minimal – each office will only be operational 6 to 9 months Recycling and general waste quantities included in the kg per person per week
	Spent lamps and fluorescent tubes	Recyclable material to recycling facility (where available) General waste to local licensed landfill	Recycling and general waste quantities included in the kg per person per week
	Paper – Office paper, other sources of packaging		
	General non recyclable - synthetic material waste Fibre insulation filters (activated carbon) filters (air, dust, paper)		
	Wood (pallets) construction materials and other equipment	Pallets will be collected by suppliers during subsequent deliveries	

Mainland GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
Plant and equipment maintenance service areas / workshops			
Vehicle wash down	Wastewater and sludge	Water will be reused at the vehicle wash facilities Sludge disposed at local licensed landfill or WWTP	0.5 m^3 sludge per week per construction camp wash down facility
Delivery of bulk equipment and supplies	Packaging (ropes and strapping, cardboard), timber pallets, fibre/nylon rope, drums and scrap metals	All packaging materials such as pallets will be collected by suppliers and returned for reuse or dealt with on site as per the principles of the waste and resource management hierarchy General waste to local licensed landfill	0.5 t per week of packaging material
	Explosives	Specialist contractors will manage all waste associated with the handling and storage of explosives in accordance with relevant legislation and standards AS2187	No waste materials are expected to be generated Included in Mainland – RoW
Refuelling – diesel generators	Absorbent material	All waste will be stored in accordance with Australian Standards AS 1940 in bunded areas	No waste expected to be generated (absorbent material listed below)
Diesel refuelling area for construction vehicles - fuel storage up to three 30 kL tanks at construction camps for refuelling construction vehicles	Absorbent material	All waste will be stored in accordance with Australian Standards in bunded areas	
Plant and equipment maintenance workshop	Filters (oil) filters (air, dust, paper)	Collected and transported by a licensed contractor for recycling where possible	100 kg per week oil and air filters
	Batteries (wet lead acid)	Collected and transported by a licensed contractor for recycling where possible	Up to 50 batteries are expected for the duration of the Project
	Oils and oil contaminated waters - waste oil, oily absorbents, oily rags, oily sludges, sump oils, grease traps	Collected and transported by a licensed contractor for recycling or disposal to regulated waste landfill	Up to 3,000 L per week of waste oil 160 L per week of oily rags and absorbent material
	Rubber – tyres	Collected and transported by a licensed contractor for recycling	Up to 20 tyres per week

Mainland GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
Prefabrication workshop valve assemblies, pipe supports and light structures	Waste materials such as pipe spools, various off cuts and grindings, paint containers, welding waste	Recyclable material to recycling facility (where available) General waste to local licensed landfill	Pipe off cuts and waste steel 0.5 t per week General industrial waste 0.5 t per week
Restoration and rehabilitation (decommissioning of construction camps)	Construction materials, concrete, scrap metal, timber, plastics, plumbing, electrical wiring	On decommissioning any remaining material will be offered to local landowners for reuse or removed for treatment or disposal in accordance with the principles of the waste hierarchy	Waste produced during construction of the construction camps will aim to encourage re-use or recycle wherever possible

5.1.2 Marine Crossing section

Table 5.4 lists the waste types and estimated quantities that are expected from construction activities of the Marine Crossing GTP section.

Some waste and recyclable material will be collected and transferred to the Gladstone Logistic Base waste storage area for separation into bins or containers for regulated waste, recyclable material and general waste. The material will be collected by waste contractors from the Gladstone Logistic Base and hauled to a recycling or disposal destination.

Where logistically more efficient (ie when waste quantities equate to a full hook lift or front lift bin), general waste may be hauled directly from the Marine Crossing RoW waste storage area via road to Benaraby Landfill for disposal. Likewise recyclable material may be collected and hauled from the Marine Crossing RoW waste storage area direct to the contractor's recycling yard. Figures 2 and 3 (Appendix B) show the location of the GTP, the Gladstone Logistic Base, proposed waste haulage routes and local waste and sewage disposal facilities.

Table 5.4 Waste generated from construction activity – Marine Crossing GTP section

Marine crossing GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
Delivery of plant and equipment	Packaging (ropes and strapping, cardboard), timber skids, fibre/nylon rope spacers, pallets, metal and plastic drums	Local licensed landfill	Negligible
Weed washdown facilities	Wastewater Sludge	Water is filtered and reused in washdown facility Sludge disposed at local licensed landfill or WWTP	1 m^3 sludge per week per washdown facility

Marine crossing GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
Clearing and grubbing pipeline corridor and access tracks	Green waste, topsoil and excavated material (stockpiled for backfilling and application to RoW)	Stockpiled/windrowed vegetation will be reapplied during restoration/rehabilitation of RoW All topsoil and excavated material reused for backfilling in RoW	Nil
RoW, access / service roads and string area preparation	Hardstand materials	All material used including any surplus will be offered to local landowners for reuse or removed in accordance with the principles of the waste and resource management hierarchy	Nil
Erosion and sediment control installation and maintenance	Packaging material – cardboard, plastic wrapping, wooden pickets and geofabric sediment fencing Geofabrics "Bidim" A34 grade polyester filter off cuts	Sediment collected in devices stored in the RoW for respreading during rehabilitation works	Quantities of waste dependent on climatic, site and topography conditions
Trenching Foam trench breakers and foam pillows installation	Excavated material Excess Rigid Polyurethane foam (Aptane P220/Isocyanate B900) Spent absorbent material Drums/plastic bags Polypropylene PPE - Protective gloves and disposable overalls PVC conduit off cuts	Excavated material (all reused for backfilling in RoW). Surplus excavated material if suitable will be disposed to the Western Basin Reclaim Area General waste to local licensed landfill	Included in general waste in pipe construction works
HDD	Drilling spoil	Drilling spoil transported by barge for disposal at Western Basin Reclaim Area in accordance with Western Basin Reclamation Area approval	20,000 m^3
	Drilling fluids and drill cuttings (drilling fluids, muds or chemical additives)	Non-toxic drilling fluids and cuttings will be dried either in pits at the well head and remain at the site or will be contained in mud tanks on the drill rig Surplus material if suitable will be disposed to the Western Basin Reclaim Area or if not suitable, then will be disposed at Benaraby landfill	Nil

Marine crossing GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
	Drilling fluids and drill cuttings (drilling fluids, muds with chemical additives)	Licensed contractor to transport regulated waste for disposal at a licensed landfill	Nil
	Oily rags, spent absorbent material from HDD drilling rig	Licensed contractor to transport regulated waste to a licensed recycling facility and residual material for disposal at a licensed regulated waste landfill	Up to 160 L per week of regulated waste from drilling activities
	Used chemicals and oils – eg lube oil, chemicals, used tins from solvents, rust proofing agents or primer	Licensed contractor to transport regulated waste to a licensed recycling facility and residual material disposal at a licensed regulated waste landfill	Included in general waste in pipe construction works
Delivery of pipe construction materials and consumables to Marine Crossing temporary pipe storage sites (road transport from Port Alma or Gladstone Logistic Base to the pipe lay down locations on the Marine Crossing RoW)	Neoprene plastic wrapping Nylon rope Rubber matting Packaging – timber dunnage, pallets and crates, plastic wrapping, metal and plastic strapping around consumables Ropes and strapping, cardboard, timber skids, fibre/nylon rope spacers, pallets, drums and scrap metals	All waste will be collected and transferred to the nearest construction camp for collection by waste contractors for treatment in accordance with the waste and resource management hierarchy	Included in general waste in pipe construction works
Pipeline construction works Pipe stringing and bending Pipe cutting and trimming Pipe welding (up to 1000 m pipe strings) Weld sandblasting Tie-ins (above ground or in-the-trench) Coating of field joints - application of rust proofing agent required to be applied when pipe is cut and a coating of epoxy-urethane over weld Holiday detection survey and weld testing Ducting for fibre optic cable River/waterway crossings	PVC or polyethylene pipe end caps (1,500 pipe end caps for pipeline) 42" mild steel pipe off cuts and defective pipe; metal filings (less than 5 metres of pipe for pipeline) Timber skids and sand bags Offcuts – duct for future installation of fibre optic cable Marker tape Chemical containers (ie paint/epoxy coating cans, empty containers of rust proofing agents) Sandblasting grit (inert) Welding residue – welding rod scraps and electrode butts Polypropylene bags Waste cement and concrete Nylon rope	PVC or polyethylene pipe end caps recycled Metal recycled Timber skids and sand bags reused General waste to local licensed landfill Licensed contractor to transport regulated waste to a licensed recycling facility and residual material disposal at a licensed regulated waste landfill	15 t in total of pipe end caps 1 t in total steel pipe off cuts and defective pipe 1.5 t in total of metal filings 0.5 t per week of general waste 10 L per week of regulated waste (spent chemicals and chemical container)

Marine crossing GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
Pipe cleaning and gauging Pipe testing – Hydrotesting 24 hour leak test	Pipe cleaning waste (pigging grit - scale, rust, or other foreign material) Hydrostatic test water not treated with biocides, corrosion inhibitor and oxygen scavengers (assuming whole 9 km tested (approximately 30kL water required))	Pigging grit - Licensed contractor to transport regulated waste to an licensed regulated waste landfill Hydrotest water discharge to land (assume no chemical treatment of water is required as source is potable water)	2.5 m^3 pigging grit in total over construction period (assume 0.5 m^3 per km) 30 kL water
Infield servicing and maintenance of construction vehicles and equipment Fuel trucks, lubrication trucks and minor maintenance pick-ups provide on-site daily service and perform regular maintenance on plant and equipment Daily field servicing, safety checks and refuelling in the field to be undertaken in the RoW	Oily rags, spent absorbent material infield servicing and maintenance Waste oil and greases eg lube oil, hydraulic oil and engine oil Spent spill kit materials Packaging from replacement parts End of life vehicle parts (eg fan belts, hoses, other machinery parts) Tyres Batteries Used chemicals – chemicals, used tins from solvents, degreasing agents, lubricants Waste associated with diesel generator operation and maintenance	Licensed contractor to transport regulated waste to a licensed recycling facility Residual material for disposal at a licensed landfill	All wastes generated from infield servicing at the Marine Crossing RoW be returned to the Logistic Base in Gladstone 250 kg regulated waste per week
Site offices, crib room/s, site amenities (servicing of construction site amenities)	Office waste – paper, cardboard packaging etc Kitchen waste Rubbish bin waste in facilities (ie paper towels etc) First aid waste Kitchen and amenity wastewater	Recyclable material to recycling facility (where available) General waste to local licensed landfill Wastewater from crib rooms and amenities will be hauled via vacuum truck and disposed at a local WWTP in Gladstone	Recyclable material 50 kg per week 200 kg per week of general waste 20 L wastewater per person per day
Spill clean up	Contaminated soil and absorbent material	Licensed contractor to transport regulated waste to an a licensed recycling facility and residual material for disposal at a licensed regulated waste landfill	40 L per week of regulated waste across Marine Crossing GTP activities

Marine crossing GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
RoW rehabilitation			
Clean up and restoration: reinstatement of the RoW, removal of foreign material (construction material and waste), surface contouring, compaction, re-spreading topsoil, re-spreading felled vegetation(whole or	Recyclable or general waste items listed above Useable surplus pipe will be delivered to a location designated by GLNG Operations Hardstand material	Hardstand material will be offered to GPC for reuse or removed for treatment or disposal in accordance with the principles of the waste hierarchy Useable surplus pipe	30 t timber skids 15 t sand bags
mulched) and reseeding Removing any surplus materials, restoring services to their original condition, disposing of refuse, smoothing disturbed earth, removing temporary fills, culverts and bridges, and performing such work as may be necessary to restore RoW to original condition Reinstatement of storage areas and other off RoW areas such as haul roads, spoil storage and other such areas requiring restoration		and other reusable materials stored at location designated by GLNG Operations General waste to local licensed landfill	

5.1.3 Curtis Island section

Table 5.5 Waste generated from the Curtis Island section

Curtis Island GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
Mobilisation activities			
Translocation of plants	Plastic pots Wooden stakes Packaging material	Recyclable material to recycling facility (where available) General waste to local licensed landfill	Less than 1m^3 per week of general and recyclable waste during mobilisation activities
Weed control	Chemical containers and other consumables		
Delivery of plant, equipment and portable structures to site (ie vehicles, dongas, portable toilets, vehicle weed washdown facilities at RoW access points	Packaging (ropes and strapping, cardboard), timber skids, wooden crates, fibre/nylon rope spacers, pallets, drums and scrap metals		
Installation of fencing and gates and removal of existing fencing	Damaged fencing, fencing wire off cuts, timber post off cuts Temporary fencing that can not be reused	Recyclable material to recycling facility (where available) General waste to local licensed landfill	No fences or gates to be installed or removed from the Curtis Island RoW

Curtis Island GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
Construction			
Hard standing - import of hard standing materials for roadway or hardstand construction	Hardstand materials	Surplus clean material will be offered to local landowners for reuse or removed in accordance with the principles of the waste hierarchy	No waste materials are expected to be generated
Weed washdown facility	Wastewater Sludge	Water is filtered and reused in washdown facility Sludge disposed at local licensed landfill or WWTP	1 m^3 sludge per week per washdown facility
Clearing and grubbing of RoW, temporary pipe storage sites and access tracks (clear and grade)	Green waste (felled vegetation and plant matter) Topsoil and excavated material (stockpiled for backfilling and application to RoW) Installation of temporary fencing and gates Construction of access tracks as required Steel post off cuts (from signage installation)	Stockpiled/windrowed vegetation will be reapplied during restoration/rehabilitation of RoW All topsoil and excavated material reused for backfilling in RoW	Included in general waste in mobilisation activities
Construct of temporary pipe storage sites – grading and levelled, hardstand, berm construction, and fencing where required	Polyethylene sheeting off cuts Cardboard or plastic tubes Plastic wrapping	Minimise surplus clean material in accordance with the principles of the waste hierarchy	Included in general waste in pipe construction works
Erosion and sediment control installation and maintenance	Packaging material – cardboard, plastic wrapping, wooden pickets and geofabric sediment fencing Geofabrics "Bidim" A34 grade polyester filter off cuts	Sediment collected in devices stored in the RoW for respreading during rehabilitation works General waste to local licensed landfill	Quantities of waste dependent on climatic, site and topography conditions Included in general waste in mobilisation activities
Delivery of pipe construction materials and consumables to the Curtis Island GTP RoW	Neoprene plastic wrapping Nylon rope Rubber matting Packaging – timber dunnage, pallets and crates, plastic wrapping, metal and plastic strapping around consumables Ropes and strapping, cardboard, timber skids, fibre /nylon rope spacers, pallets, drums and scrap metals	Materials to be treated as per the waste hierarchy with general waste to local licensed landfill	Included in general waste in pipe construction works

Curtis Island GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
Pipe construction works • Pipe stringing and bending • Pipe cutting and trimming • Pipe welding (up to 1000 m pipe strings) • Weld sandblasting • Tie-ins (above ground or in-the-trench) • Coating of field joints - application of rust proofing agent required to be applied when pipe is cut and a coating of epoxy-urethane over weld • Holiday detection survey and weld testing • Ducting for fibre optic cable • River/waterway crossings	PVC or polyethylene pipe end caps (1,000 pipe end caps for Curtis Island GTP) 42" mild steel pipe off cuts and defective pipe; metal filings(less than 5m of pipe for Curtis Island GTP) Timber skids and sand bags Off cuts – duct for future installation of fibre optic cable Marker tape Chemical containers (ie paint/epoxy coating cans, empty containers of rust proofing agents) Sandblasting grit (inert) Welding residue – welding rod scraps and electrode butts Polypropylene bags Waste cement and concrete Nylon rope	PVC or polyethylene pipe end caps recycled Metal recycled Timber skids and sand bags reused General waste to local licensed landfill Licensed contractor to transport regulated waste to a licensed recycling facility and residual material disposal at a licensed regulated waste landfill	9.2 t in total of pipe end caps (10 kg per pipe end) 1 t in total of steel pipe off cuts and defective pipe 1 t in total of metal filings General waste 0.5 t per week 10 L per week of regulated waste (spent chemicals and chemical container)
Trenching Foam trench breakers and foam pillows installation	Excavated material Excess Rigid Polyurethane foam (Aptane P220/ Isocyanate B900) and hose washings Spent absorbent material Drums/plastic bags (polypropylene) PPE - protective gloves and disposable overalls PVC conduit off cuts	All excavated material reused for backfilling in RoW to be spread across RoW All materials will be treated as per the waste hierarchy with general waste disposed to local licensed landfill	Included in general waste in pipe construction works
Pipe cleaning and gauging Pipe testing – hydrotesting 24 hour leak test	Pipe cleaning waste (pigging grit - scale, rust, or other foreign material) Hydrostatic test water not treated with biocides, corrosion inhibitor and oxygen scavengers (assuming 5 km tested at a time (20 kL water required)	Pigging grit - licensed contractor to transport regulated waste to a licensed regulated waste landfill Hydrotest water discharge to land (assume no chemical treatment of water is required as source is potable water)	2 m^3 pigging grit in total (assume 0.5 m^3 per km) 20 kL water

Curtis Island GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
Infield servicing and maintenance of construction vehicles and equipment Fuel trucks, lubrication trucks and minor maintenance pick-ups provide on-site daily service and perform regular check ups on equipment Daily field servicing, safety checks and refuelling in the field to be undertaken in the RoW	Oily rags, spent absorbent material infield servicing and maintenance Waste oil and greases eg lube oil, hydraulic oil and engine oil Spent spill kit materials Packaging from replacement parts End of life vehicle parts (eg fan belts, hoses, other machinery parts) Tyres Batteries Used chemicals – chemicals, used tins from solvents, degreasing agents, lubricants Waste associated with diesel generator operation and maintenance	Licensed contractor to transport regulated waste to an a licensed recycling facility. Residual material dealt with in accordance with the principles of the waste hierarchy	All waste generated from infield servicing will be returned to the waste storage area at the Gladstone Logistic Base 250 kg regulated waste per week
Site offices, crib room/s, site amenities (servicing of construction site amenities)	Office waste – paper, cardboard packaging Kitchen waste Rubbish bin waste in facilities (ie paper towels) First aid waste Kitchen and amenity wastewater	Recyclable material to recycling facility (where available) General waste to local licensed landfill Wastewater hauled via vacuum truck and disposed at a local WWTP in Gladstone (Calliope River STP)	Recyclable material 50 kg per week 200 kg per week of general waste 20 L wastewater per person per day
Spill clean up	Hydrocarbon contaminated soil (small quantities) Contaminated absorbent material from RoW	Licensed contractor to transport regulated waste to a licensed recycling facility and residual material disposal at a licensed regulated waste landfill	10 L per week of regulated waste across the Curtis Island GTP activities
RoW rehabilitation			
Clean up and restoration: reinstatement of the RoW, removal of foreign material (construction material and waste), surface contouring, compaction, re-spreading topsoil, re-spreading felled	Useable surplus pipe will be delivered to a location designated by GLNG Operations	Clean hardstand material will be offered to Gladstone Regional Council for reuse or removed for treatment or disposal in accordance with the	20 t timber skids 10 t sand bags

Curtis Island GTP construction activity	Material used/ waste generated	General management principle	Estimate of waste quantity/rate
vegetation (whole or mulched) and reseeding Removing any surplus materials, restoring services to their original condition, disposing of refuse, smoothing disturbed earth, removing temporary fills, culverts and bridges, and performing such work as may be necessary to restore RoW to original condition		principles of the waste hierarchy Useable surplus line pipe and other reusable materials stored at location designated by GLNG Operations Residual material dealt with in accordance with the principles of the waste hierarchy	
Establishment of vegetation	Plastic pots Wooden stakes Packaging material Herbicides	Residual material dealt with in accordance with the principles of the waste hierarchy General waste to local licensed landfill Licensed contractor to transport regulated waste to an appropriately licensed recycling facility and residual material disposal at appropriately licensed regulated waste landfill	10 kg per week during vegetation establishment activities in the RoW Quantity dependent upon whether herbicides for weed control are required during establishment of vegetation

5.2 Operational waste

A list of the waste types and an estimate of the waste quantities generated from operational activities is detailed in Table 5.6, Table 5.7 and Table 5.8.

Table 5.6 Waste generated from Mainland GTP section operation

GTP construction activity	Waste generated	General management principle	Estimate of waste quantity/rate
Maintenance of pipeline valves, delivery and metering stations	Filters (non-oily, oily and gas)	Collected and transported by a licensed contractor for recycling or disposal to regulated waste landfill	Less than 350 kg per year (approximately 0.8 kg/km/year based upon 30 kg per month for entire pipeline)
	Waste oils and greases	Collected and transported by a licensed contractor for recycling where possible	5 m^3 per year (estimate 10 L per km)
	Packaging	General waste for disposal at a licensed landfill	1,500 kg per year (approximately 3.6 kg/km/year based upon 30 kg per week for entire pipeline)

GTP construction activity	Waste generated	General management principle	Estimate of waste quantity/rate
Cleaning of pipeline - pigging (if undertaken in the future)	Pipe cleaning waste (pigging grit - scale, rust, or other foreign material)	Pigging grit - licensed contractor to transport regulated waste to a licensed regulated waste landfill	8 m^3 pigging grit per year (approximately 20 L per km)
Spills of hydrocarbon based material	Potential hydrocarbon contaminated soil from spills oils and greases	Remediation in situ for small quantities. Advice sought from DERM regarding treatment options for larger spills (eg >200 L). Removal of soil under disposal permit for remediation or disposal at suitably licensed facility	No waste materials are expected be generated
Offices, crib room/s, site amenities along pipeline	Office waste – paper, cardboard packaging etc Kitchen waste Rubbish bin waste in facilities (ie paper towels etc) First aid waste Kitchen and amenity wastewater	Recyclable material to recycling facility (where available) Residual material local licensed landfill Wastewater from crib rooms and amenities will be hauled via vacuum truck and disposed at a local WWTP	Recyclable material and general waste very small quantities – less than 30 kg per week Very small quantities of wastewater are expected. Amenities to be serviced weekly when in use

Table 5.7 Waste generated from Marine Crossing GTP section operation

GTP operation activity	Waste generated	General management principle	Estimate of waste quantity/rate
Maintenance of pipeline valves, delivery and metering stations	Filters (non-oily, oily and gas)	Collected and transported by a licensed contractor for recycling or disposal to regulated waste landfill	Less than 10 kg per year (approximately 0.8 kg/km/year based upon 30 kg per month for entire pipeline)
	Waste oils and greases	Collected and transported by a licensed contractor for recycling where possible	100 L per year (estimate 10 L per km)
	Packaging	General waste for disposal at a licensed landfill	30 kg per year (approximately 3.6 kg/km/year based upon 30 kg per week for entire pipeline)
Cleaning of pipeline - pigging (if undertaken in the future)	Pipe cleaning waste (pigging grit - scale, rust, or other foreign material)	Pigging grit - licensed contractor to transport regulated waste to a licensed regulated waste landfill	200 L of pigging grit per year (approximately 20 L per km)

GTP operation activity	Waste generated	General management principle	Estimate of waste quantity/rate
Spills of hydrocarbon based material	Potential hydrocarbon contaminated soil from spills oils and greases	Remediation in situ for small quantities. Advice sought from DERM regarding treatment options for larger spills (eg >200 L) Removal of soil under disposal permit for remediation or disposal at suitably licensed facility	No waste materials are expected be generated
Offices, crib room/s, site amenities along pipeline	Office waste – paper, cardboard packaging etc Kitchen waste Rubbish bin waste in facilities (ie paper towels etc) First aid waste Kitchen and amenity wastewater	Recyclable material to recycling facility (where available) Residual material local licensed landfill Wastewater from crib rooms and amenities will be hauled via vacuum truck and disposed at a local WWTP	30 kg per year recyclable material and general waste (approximately 3.6 kg/km/year based upon 30 kg per week for entire pipeline) Small quantities of wastewater are expected. Portable amenities to be serviced weekly when in use

Table 5.8 Waste generated from Curtis Island GTP section operation

GTP operation activity	Waste generated	General management principle	Estimate of waste quantity/rate
Maintenance of Curtis Island GTP section	Filters (non-oily, oily and gas)	Collected and transported by a licensed contractor for recycling or disposal to regulated waste landfill	Less than 5 kg per year (approximately 0.8 kg/km/year based upon 30 kg per month for entire pipeline)
	Waste oils and greases	Collected and transported by a licensed contractor for recycling where possible	50 L per year (estimate 10 L per km)
	Packaging	General waste for disposal at a licensed landfill	20 kg per year (approximately 3.6 kg/km/year based upon 30 kg per week for entire pipeline)
Cleaning of pipeline - pigging (if undertaken in the future)	Pipe cleaning waste (pigging grit - scale, rust, or other foreign material)	Pigging grit - licensed contractor to transport regulated waste to a licensed regulated waste landfill	100 L of pigging grit per year (approximately 20 L per km)

GTP operation activity	Waste generated	General management principle	Estimate of waste quantity/rate
Spills of hydrocarbon based material	Potential hydrocarbon contaminated soil from spills oils and greases	Remediation in situ for small quantities. Advice sought from DERM regarding treatment options for larger spills (eg >200 L) Removal of soil under disposal permit for remediation or disposal at suitably licensed facility	No waste materials are expected be generated
Offices, crib room/s, site amenities along pipeline	Office waste – paper, cardboard packaging etc Kitchen waste Rubbish bin waste in facilities (ie paper towels etc) First aid waste Kitchen and amenity wastewater	Recyclable material to recycling facility (where available) Residual material local licensed landfill Wastewater from crib rooms and amenities will be hauled via vacuum truck and disposed at a local WWTP	20 kg per year recyclable material and general waste (approximately 3.6 kg/km/year based upon 30 kg per week for entire pipeline) Small quantities of wastewater are expected. Portable amenities to be serviced weekly when in use

5.3 Decommissioning waste

The rehabilitation of the GLNG RoW and associated infrastructure is not expected to generate large volumes of waste. The GTP is expected to be operational for a period of 25 years.

Prior to final decommissioning or abandonment of any facilities associated with the GTP, GLNG Operations will investigate potential environmental issues and impacts associated with decommissioning or abandonment. Infrastructure that is no longer required for the operation of the GTP works will be decommissioned or abandoned in accordance with the regulatory requirements and accepted management environmental practice of the day.

Prior to the decommissioning of the GTP, a detailed assessment of the types and quantities of waste materials which could be expected will be conducted. Typical waste materials which would require removal from the above ground facilities would comprise metal pipework and valves and inert waste such as concrete and hard standing material from mainline valve stations.

6. Environmental Values and Potential Impacts

6.1 Environmental values

Existing environmental values that may be impacted by the generation of waste as a result of the GTP construction and operation include:

- Life, health and wellbeing of people and the community
- Diversity of ecology and associated ecosystems
- Land use capability, having regard to economic considerations
- Management of finite resources

The nature of the Project will create liquid, solid and gaseous wastes as a result of the construction, operation and decommissioning phases of the GTP. Typical wastes which will be generated include regulated, general, recyclable and inert waste.

6.2 Potential adverse or beneficial impacts associated with waste management

Table 6.1 details the major activities associated with waste management during construction and operation of the Mainland, the Marine Crossing and the Curtis Island GTP sections and the potential impacts on environmental values as result of construction and operation of the GTP.

Table 6.1 Summary of impacts on the environmental values associated with the construction of the GTP

Aspect/source/activity	Potential impacts
Construction camps wastewater disposal	Habitat degradation to wetlands or waterways. Soil, groundwater and surface water contamination, health and safety
Disposal of treated wastewater effluent, wastewater and other liquid wastes from project-related sources (eg construction camps, equipment washdown stations)	Reduced water quality (particularly suspended solids/ turbidity, nutrients and microbiological contaminants) with potential reduction in: • Suitability of water for drinking • Potential contamination of surface water and/or groundwater
Spillage of oil/ fuel/ chemical during transport, storage, handling or refuelling	Loss of oil/ fuel/ other hazardous material to air, surface water, groundwater, soil and/or sediment with consequent adverse impacts on associated quality and beneficial values
Spillage of hazardous materials during transport, storage, handling and use	Loss of hazardous material to air, surface water, groundwater, soil and/or sediment with consequent adverse impacts on associated quality and beneficial values
Hydrotest water discharge	Adverse impacts on local water quality, surface water, drinking water, aquatic habitat quality, temporary loss of land use for economic use, excessive erosion
Drilling fluids and cuttings from HDD at marine crossing	Soil, groundwater, marine environment and surface water contamination, health and safety
Spill during transfer of liquid and solid waste on/off barge	Release of hazardous material resulting in adverse environmental and health effects
Hydrotest water discharge	Adverse impacts on local water quality, surface water, drinking water, aquatic habitat quality, temporary loss of land use for economic use, excessive erosion

7. Activity Specific Waste Management Requirements

7.1 Temporary pipe receiving areas

A waste management area will be allocated at the Port Alma temporary pipe receiving area for storage of waste and recyclable material. On an as needs basis, waste and recyclable material will be collected by the waste contractor for off site recycling and disposal.

7.2 Temporary pipe storage sites

The temporary pipe storage sites will be primarily used for pipe and some equipment storage. Waste materials at these locations will be stored in refuse containers and this waste will be collected by a waste contractor for transfer to a construction camp waste storage area.

Portable site amenities at these sites will be provided and these will be serviced on a regular basis. Wastewater from the portable amenities will either be hauled to the nearest construction camp wastewater treatment plant for treatment or a local WWTP if approved by the relevant local authority.

7.3 RoW

A waste contractor will be responsible for collecting bulky solid waste materials from the RoW and temporary pipe storage sites on a regular basis and transporting the waste materials to the waste and recyclables storage area at the construction camps.

Refuse containers will also be provided at each worksite. At the construction camps the waste contractor will sort the waste materials into bins for recyclable materials such as metals and plastics, regulated waste or general waste.

Green waste and excavated material will be re-used within the RoW during rehabilitation. Steel pipe off-cuts, packaging and general waste will be collected by the waste contractor and transported to the nearest waste management area in the RoW for segregation and storage. On a regular basis the waste and recyclables from the waste management areas will be transported off-site by the waste contractor either for transfer to the construction camps for aggregation with other waste materials or collected by a licensed waste contractor and transported to a disposal facility in accordance with the principles of the waste and resource management hierarchy.

7.4 Vehicle wash down facilities

It is anticipated that there will be 11 access points from public roads provided to the GTP RoW. The RoW access points will be located to optimise vehicle movements and to meet the requirements of the Pest and Weed Management Plan.

A vehicle wash down facility will be located at each of these access points for the purpose of removing mud and weed seeds as part of weed management control measures. It is anticipated that on average 1 m^3 of mud and silt material will accumulated in each sump per week.

A licensed waste contractor will remove the wash down facility sludge and dispose to a licensed facility.

7.5 Hydrotesting

The water from hydrotesting testing will be reused along the length of pipeline to reduce the amount of water to be managed. Given that potable water will be used, it is considered unlikely that any additional chemicals (eg oxygen scavengers or biocides) will be added. If chemicals are used, they shall be biodegradable. Chemicals that are unsuitable for the discharge to land will not be used. Hydrotest water will be transferred from one test section to another via a break tank.

The preferred method to dispose of the hydrotest water is directly to land and away from watercourses. All hydrotesting water released to land will be tested and will comply with discharge limits as per the Environmental Authority Conditions for the Gas Pipeline – Schedule C, Table 1 (Refer Section Table 8.1). Hydrotest water will be tested and managed as described in Section 8. The hydrotest water management procedures will aim to maximise the efficiency of testing, taking into consideration the timing of construction and commissioning, and will follow good environmental practice. Disposal to land will only occur where an assessment of water quality meets relevant criteria and relevant approvals have been obtained.

Hydrotest water will be disposed of at locations in accordance with the relevant environmental authority conditions. Written consent of the administering authority must be obtained if hydrostatic test water containing chemical additives is proposed to be released to land.

7.6 Construction camps

These construction camps will generate general putrescible wastes along with recyclables, sewage, grey water and other wastes.

An area at each of the construction camps will be set aside for storage of waste materials which are to be recycled or reused. The waste storage area will receive waste and recyclable material from the:

- Accommodation and kitchen facilities
- Offices
- Vehicle workshop
- Prefabrication workshop
- Warehouse
- RoW and temporary pipe storage sites

All bins will be serviced by the waste contractor. Separate bins will be provided for general waste, waste metal, oily waste (rags and absorbent material), batteries, tyres, regulated waste and for recycling. Likewise an area will be set aside for a bunded waste oil tank.

7.6.1 Wastewater treatment plants in construction camps

Each construction camp will have a wastewater treatment system installed capable of treating the maximum amount of effluent generated from the construction camp and associated workshops and offices.

Emphasis will be placed on the reduction and reuse of effluent on site. Each construction camp will adopt the principles of the waste and resource management hierarchy to minimise the wastewater quantities generated (where possible) through education and adoption of water efficient equipment and machinery.

Wastewater collection systems will segregate the wastes. Sanitary waste from various sources will be directed to a wastewater treatment plant. Once the wastewater has been treated to the relevant effluent standard, it will be used for irrigation or disposed of to a licensed facility. If the effluent is to be irrigated to land a disposal system will consist of a fenced (sediment fencing and bund), vegetated area, where treated effluent will be irrigated above-ground. Sludge from wastewater treatment facilities will be removed as required to a licensed facility.

7.7 Horizontal directional drilling

HDD produces waste associated with operation of the drilling rig such as oily wastes, drill cuttings and drilling muds. A waste storage area at the HDD drilling pad will be provided for storage of general waste and any regulated waste.

A HDD cuttings settlement pit and drilling mud containment pit will be located at the HDD drilling pad. No discharge of water or drill cuttings to surface water will be allowed during stockpiling, drying and transportation. Drill cuttings generated from the drilling operations will be stockpiled in a water-tight pit in a manner that prevents their release into the water or surrounding area.

The HDD cuttings will be temporarily stored in a cuttings settlement pit located in the HDD drill pad and periodically transported by barge for disposal at Western Basin Reclaim Area (WBRA) in accordance with WBRA approval. Prior to transfer to the WBRA, samples of HDD cuttings will be collected and submitted for laboratory analysis to confirm whether the cuttings comply with the WBRA approval conditions.

7.8 Transport of project related waste

Traffic movements associated with waste contractor vehicles have been addressed in the Transport and Traffic Management Plan.

Waste and recyclable materials will be moved on a daily basis from all areas along the RoW during construction and operation. Waste materials will be collected from the point of generation and transported to the closest waste storage areas located within the construction camps.

From there the waste material will be consolidated prior to collection for recycling or disposal. The existing network of state and regional council controlled roads, as well as the RoW will be used by waste collection vehicles to collect and transport the waste and recyclables.

The waste management contractor shall identify the proposed haulage routes and potential issues associated the collection and haulage of waste and recyclable materials. A haulage route and site access plan will be prepared in order to minimise impacts, this will be developed with regard to the project’s Transport and Traffic Management Plan. This plan will also detail the proposed destination for the disposal of waste and recyclable materials. All waste vehicles travelling to and from the project sites will follow dedicated heavy vehicle routes to avoid built-up areas. The waste contractor where practicable will limit vehicle movements to daytime working hours.

Waste deemed as regulated or dangerous will be transported along preferred routes in accordance with the *Australian Code for the Transport of Dangerous Goods by Road and Rail*, and in accordance with the *Queensland Transport Operations (Road Use Management – Dangerous Goods) Regulation 1998* and the *Transport Infrastructure Act 1994* and the *Environmental Protection (Waste Management) Regulations 2008*.

7.8.1 Waste tracking

Regulated waste which is transported by road and water is required to be accompanied by a Waste Transport Certificate stating the nature of the waste and any associated hazard in accordance with the *Environmental Protection (Waste Management) Regulations 2000*. A licensed waste contractor will collect and transport the project waste. The following requirements will be implemented for the project waste-tracking system:

- Provide tracking of wastes of environmental concern from production to disposal, with the aim of ensuring that the waste is disposed in an environmentally appropriate manner
- Ensure that only those facilities that have adequate treatment and disposal methods receive wastes
- Promote responsibility to reduce the risk of illegal dumping and establish a system of accountability

The types of trackable wastes and instructions for completing the Waste Transport Certificate are outlined in *Environmental Protection (Waste Management) Regulation 2000*.

7.8.2 Non-trackable waste

Non-trackable waste associated with GTP construction activities will be identified and basic waste shipment information will be recorded for the purpose of recording project waste quantities and monitoring compliance with this WM Plan.

This information will be stored by the waste contractor for the purposes of recording project waste quantities and monitoring compliance with this WM Plan. Table 7.1 provides an example of basic information to be collected for non-regulated/non-trackable waste shipments.

Table 7.1 Example of waste shipment record

Information to be recorded on each waste shipment	
Type of waste	
Date waste collected	
Quantity of waste (litres, kg, number of bags, size of container)	
Waste transportation certificate number (only if trackable waste)	
Waste collection contractor name	
Vehicle driver name	
Vehicle transporting waste from project site	
Destination of waste	
Recipient names (company or site)	
Other details or comments	
Transporters signature	

7.9 Waste inductions and training

All construction personnel associated with GTP construction will be required to complete an induction. The induction training should incorporate relevant aspects of this WM Plan and cover an individual's personal obligations with regard to the management procedures for all waste items and materials. This training will outline the importance of managing waste materials in accordance the principle of the waste and resource management hierarchy.

7.10 Waste chemical and hazardous materials management

The construction and operation of the GTP will require the use of chemicals and hazardous materials and will therefore generate waste chemicals and hazardous waste.

Chemical and hazardous wastes associated with the construction and operation of the GTP will be handled and stored in accordance with the State and Commonwealth legislation (refer Table 2.1) and Australian standards and guidelines (refer Table 2.2). This will include the separate storage of waste chemicals in containers at designated storage areas. Table 7.2 provides a list of likely chemicals and hazardous materials to be used during the GTP construction including relevant activity and likely storage location.

Table 7.2 Likely chemical and hazardous materials during construction

Chemical/hazardous material	Activity	Likely storage location
Diesel	Fuel for construction vehicles and machinery and diesel generators at construction camps and offices	Storage tanks located at construction camps Up to a total storage capacity 90,000 L at each construction camp (3 x T30 fuel tanks (30,000 L each))
Fuel dispenser pump and storage (unleaded) Fuel dispenser pump and storage (diesel)	Fuelling facilities for vehicles at the Marine Crossing GTP section and the Curtis Island GTP section	Gladstone Logistic Base at Gladstone Port Central 30 000 L fuel tank for generators 50 000 L fuel tank for fuel filling station
Diesel	Fuel for HDD rig generator and associated equipment	HDD drilling pad
Fertiliser	Translocation of plants and restoration of the RoW	Construction camps storage area and Gladstone Logistic Base
Herbicides (chemicals registered for the specific weed to be controlled)	Chemical spraying of weeds	Construction camps storage area and Gladstone Logistic Base
Rigid Polyurethane foam (Aptane P220/Isocyanate B900)	Foam trench breakers and foam pillows installation – to hold the pipe off the trench invert (alternative material - sand bags)	Specialist subcontractors will mobilise foam components to site in storage containers on vehicles. Subcontractors to provide documentation regarding storage, handling and disposal arrangements prior to bringing to site
Oils and greases	In field vehicle servicing and maintenance of construction vehicles and equipment Major repair and maintenance of construction equipment at the temporary maintenance workshop at each of the construction camps. HDD	Construction camp and Gladstone Logistic Base storage area in suitably sized tanks within appropriately bunded compounds as per Australian Standards HDD drilling pad

Chemical/hazardous material	Activity	Likely storage location
Waste oil	Minor repairs and maintenance of construction equipment at the maintenance workshop within construction camps and Gladstone Logistic Base	Waste oils will be collected and stored within bunded storage containers within the workshops
Emulite (bottom charge)	Blasting	Specialist subcontractors mobilise blasting materials to site. Handling, storage requirements and disposal methods to be documented by the blasting contractor ie Australian Standards 2187
Prillite (column charge)		
Nonel U175 or U500 detonators, Nonel UB,42 UB17, UB25		
Paint	Painting welds and pipe coating defects	Storage area at construction camps/Gladstone Logistic Base
Fusion bond epoxy powder	Coating for welded field joints	Storage area at construction camps/Gladstone Logistic Base
Polyurethane-tar coating compound	Field joint coating	Storage area at construction camps/Gladstone Logistic Base
Oxygen scavenger	Chemical dosing during Hydrotesting	Storage area at construction camps/Gladstone Logistic Base
Biocide	Hydrotesting	Storage area at construction camps/Gladstone Logistic Base
Radioactive isotope/ material/ element within weld inspection device (pipe crawler)	Weld inspection activities	Contained in pipe crawler machine. Pipe crawler located (RoW) or parked in equipment storage area at the construction camp/Gladstone Logistic Base Specialist subcontractor will maintain documentation and certificates to transport these materials to site and be responsible for handling, storage requirements and identification of disposal methods
	Non-destructive testing (NDT) X-ray films development for weld quality assurance	Darkroom, containing the necessary film processing equipment, will be located at the construction camps/Gladstone Logistic Base Specialist subcontractor will maintain documentation and certificates to transport these materials to site and be responsible for handling, storage requirements and identification of disposal methods
Drilling additives - polymers	HDD	HDD drilling pad in secure containers as per Australian Standards
Wastewater treatment plant chemicals	Construction camp wastewater treatment	Storage area at construction camps as per Australian Standards

Table 7.3 provides a list of likely chemicals and hazardous materials to be used during the GTP operation including relevant activity and likely storage location.

Table 7.3 Likely chemical and hazardous materials during operation

Chemical/hazardous material	Activity	Likely storage location
Lubricants	Maintenance of mainline valve stations	GLNG GTP operations facility in Gladstone
Solvents	Cleaning pigging equipment and sumps	GLNG GTP operations facility in Gladstone
Oils and greases	Maintenance of equipment for pipeline maintenance	GLNG GTP operations facility in Gladstone

7.11 Specialist pipe weld inspections

The Contractor will be responsible for the inspecting the weld integrity of each pipe weld prior to operation. The Contractor will use specialised Ultrasonic or X-ray equipment that involves the use of radioactive isotopes for inspection of each weld. The Contractor will be licensed to handle, store and use the weld inspection equipment. If isotopes are to be used then they will be stored in specially constructed and secure containers. Depleted isotopes will be disposed of in accordance with regulatory waste disposal requirements.

8. Proposed environmental protection commitments, objectives and control strategies

8.1 Waste management control strategies

Table 8.1 to Table 8.3 identify the control strategies and performance indicators for the waste management objectives detailed in Section 6 above.

General waste

Table 8.1 Environmental protection commitments, objectives and control strategies for general waste

Item	Detail
Environmental protection objective	• To ensure that the transmission pipeline construction adheres to the waste management hierarchy of avoid, reuse, re-use and recycle. Where this is not possible, to dispose of waste in the most appropriate manner
Specific objectives	• No inappropriate disposal or management of waste • No contamination of soil, air or water as a result of waste handling • Petroleum activities do not result in the release or likely release of contaminants to the environment from the storage, conditioning, treatment and disposal of regulated waste materials
Control strategies	**General** • Prior to commencement of works, the appropriate methods for disposal of waste will be determined by consultation with the relevant local governments and the Department of Environment and Resource Management • A waste management plan in accordance with the Environmental Protection (Waste) Policy 2000 on the following will be developed and implemented including: – The types and amounts of waste generated – How the waste will be dealt with, including a description of the types and amounts of waste that will be dealt with under each of the waste management practices mentioned in the waste management hierarchy (section 10 of the Environmental Protection (Waste Management) Policy 2000) – Procedures for dealing with accidents, spills and other incidents that may impact on waste management – How often the performance of the waste management practices will be assessed (ie at least annually) – The indicators or other criteria on which the performance of the waste management practices will be assessed • On completion of each section of pipeline, all waste material will be removed from the workplace. No wastes will be buried or disposed of on-site without local government and/or DERM approval • The Construction Contractor will advise designated disposal areas for each section of the RoW • All welding waste will be managed appropriately and removed from the RoW on a daily basis • General waste will be collected and transported generally to local council approved disposal sites • Food wastes will be collected, where practicable, considering health and hygiene issues, for disposal off-site • All waste/rubbish will be correctly disposed of and will not pose a risk to marine fauna. Plastic bags will be banned from all site offices and project areas within the coastal zone (intertidal and marine zones) • Refuse containers will be located at each worksite • Where practical, wastes will be segregated and reused / recycled (eg scrap metal) • All personnel will be instructed in project waste management practices and

Item	Detail

procedures as a component of the environmental induction process

- Suppliers will be requested to minimise packaging where practicable
- Emphasis will be placed on housekeeping and all work areas will be maintained in a neat and orderly manner
- All equipment and facilities will be maintained in a clean and safe condition

Liquid waste

- Wastewater from construction, cleaning and testing operations will be treated and managed in accordance with the relevant environmental authorities
- Sewage or grey water will either be collected for treatment and disposal off-site or treated via an on-site treatment system and disposed of to effluent absorption beds or irrigation fields, with treated sewage effluent generally to be disposed of by irrigation
- The treatment method will be selected in consultation with a relevant local authority and DERM and the relevant environmental authority obtained
- Prior to commencement of works, the Contractor must determine from all relevant local governments, any additional upgrades of sewerage or waste disposal facilities required as a result of this project's requirements for workers' accommodation and meet any costs associated with these upgrades
- Prior to discharge of wastewater to land, the Contractor must submit a copy of the WIMP to GLNG Operations within a sufficient timeframe to obtain approval from the administering authority allowing for review and comment and having due regard to that comment in the finalisation of the plan
- The release of contaminants from the sewage treatment plant to land must comply, at the sampling and in situ monitoring point(s) with each of the limits specified in Table 1 for each quality characteristic

Table 1 Release quality characteristics for discharge to land

Quality characteristics	Release limit	Limit type	Monitoring frequency
Total-N	3 mg/l	50 percentile Compliance	Weekly
Total-N	10 mg/l	Maximum	Weekly
Total-P	0.1 mg/l	50 percentile Compliance	Weekly
Total-P	1 mg/l	Maximum	Weekly
Ammonia-N	1 mg/l	50 percentile Compliance	Weekly
5-day Biochemical Oxygen Demand	<5 mg/l	80 percentile Compliance	Weekly
Suspended Solids	<5 mg/l	80 percentile Compliance	Weekly
pH	6.5 – 8.0	Range	Daily
Faecal Coliforms	5 colonies per 100ml sample	Geometric Mean	Weekly

- The effluent released must not have any properties nor contain any organisms or contaminants in concentrations which are capable of causing environmental harm or an environmental nuisance
- Signage must be placed around the land irrigation area and irrigation equipment

Item	Detail
	warning the public that the area and equipment has been set aside for irrigation by treated effluent, which is not to be used for drinking purposes. The signs must be maintained in a visible and legible condition • Any treated effluent irrigation area must not be used for: – Recreational activities or as a traffic thoroughfare during irrigation – Any activity which may involve members of the public or employees without appropriate personal protective equipment coming in contact with treated wastewater during irrigation periods and for at least four hours after irrigation has ceased or until irrigated vegetation has dried • Sufficient wet weather storage should be provided for a 3 month period • When weather conditions or soil conditions preclude the irrigation of treated effluent, the treated effluent must only be discharged at nomination locations as per environmental authority • Treated sewage effluent must not be irrigated when weather or soil conditions would cause run-off or ponding of any irrigated wastewater • The amount of treated sewage effluent irrigated must be matched to the water requirements of the vegetation irrigated, without exceeding a reasonable estimation of the field capacity of the soil, in the root zone, in the irrigation area • The rate of application of treated sewage effluent to the release area must not exceed the capacity of the soil in the contaminant release area to absorb it • The irrigation of treated effluent must be carried out with a sufficient buffer distance to comply with all environmental conditions and requirements (eg contaminants release, Air quality) • Treated effluent will not be released to other parties for irrigation without written permission from GLNG Operations. The quality of the treated effluent released to other parties for the purpose of irrigation must comply, at the sampling point specified, with each of the release limits specified in Table 2 • Copies of agreements to supply treated sewage effluent from the Sewage Treatment Plant for the purpose of irrigation must be forwarded to GLNG Operations in a sufficient timeframe to be approved by administering authority • The Contractor must prepare a Wastewater Irrigation Management Plan (WIMP) as part of the EMP. The WIMP is to be developed in accordance with the “Interim Guidelines for the Reuse of Reclaimed Wastewater in Queensland, 1996” produced by the Department of Natural Resources or the “Draft National Guidelines for Sewerage Systems: Reclaimed Water” endorsed by NH and MRC in 2000. The WIMP should address at least, but not be limited to, the following matters: – The measurement of the quantity and quality of treated effluent produced by the activity – An assessment of the suitability of the area of land available for wastewater irrigation – The definition and clear identification of areas to be used for wastewater irrigation – Carrying out daily time step modelling (using MEDLI or similar) to estimate at least wastewater irrigation application rates, the wastewater irrigation area required and the volume of wet weather storage required, taking into account at local tropical climatic conditions, soils in the wastewater irrigation area and the vegetation grown in the wastewater irrigation area – An assessment of surface waters, including stormwater, that may be affected – An assessment of the characteristics of the soils in the wastewater irrigation area including assessment of nutrient and salt levels of the soils in the disposal area and how soils will be managed – An assessment of the potential impacts of odour resulting from wastewater irrigation – Management of human and fauna health issues associated with the irrigation of wastewater • Sewage treatment plants associated with temporary workers’ accommodation must be located above Q50 flood levels • The plant and equipment used for sewage treatment or disposal will be installed, maintained and operated in a proper and efficient manner by a suitably qualified

Item	Detail
	and experienced person • Sewage effluent absorption beds and/or irrigation fields will be selected and designed to ensure that: – Sensitive areas are avoided – Soil erosion and soil structure damage is avoided to the extent possible – There is no ponding or runoff of effluent – The receiving environment has the capacity to assimilate the contaminants – There will be no discharge of treated effluent from wet weather storage to any waters • Flammable and combustible liquids (including petroleum products and associated piping and infrastructure), must be stored, handled and maintained in accordance with the latest edition of Australian Standard 1940 - the Storage and Handling of Flammable and Combustible Liquids • Any liquids stored on site that have the potential to cause environmental harm must be stored in or serviced by an effective containment system that is impervious to the materials stored and managed to prevent the release of liquids to waters or land. Where no relevant Australian Standard is available, the following must be applied: – Storage tanks must be bunded so that the capacity and construction of the bund is sufficient to contain at least 110 per cent of a single storage tank or 100 per cent of the largest storage tank plus 10 per cent of the second largest storage tank in multiple storage areas; and – Drum storages must be bunded so that the capacity and construction of the bund is sufficient to contain at least 25 per cent of the maximum design storage volume within the bund **Hazardous waste** • Chemical wastes will be collected in 200 litre drums (or similar sealed container) and appropriately labelled for safe transport to an approved chemical waste depot or collection by a liquid waste treatment service • Storage, transport and handling of all chemicals will be conducted in accordance with all legislative requirements • Containment bunds and/or sumps will be drained periodically to prevent overflow and subsequent pollution of the surrounding land and/or water body • All hazardous wastes will be appropriately stored in bunded areas away from watercourses and in accordance with legislative requirements • Where no Australian Standard is available, any liquid with potential to harm the environment must be: – Stored in impervious bunded tanks with bunded capacity at least 110% of a single storage tank or 100% of the largest storage tank plus 10% of the second largest storage tank in multiple storage areas – Impervious drum storage must have a bunded capacity to contain at least 25% of the maximum design storage volume within the bund • Hazardous wastes, such as solvents, rust proofing agents and primers will be managed in accordance with the requirements of relevant legislation and industry standards • A hazardous materials inventory will be prepared • Material Safety Data Sheets (MSDS) for hazardous materials will be available at all work sites • Hydrocarbon wastes, including lube oils, will be collected for safe transport off-site for reuse, recycling, treatment or disposal at approved locations • As soon as practicable remove and dispose of all regulated waste to a licensed waste disposal facility or recycling facility • All regulated waste removed from the site must be removed by a person who holds a current authority to transport such waste under the provisions of the Environmental Protection Act 1994 and sent to a facility licensed to accept such

Item	Detail
	waste • When regulated waste is removed from within the boundary of the petroleum tenure and transported by the holder of this authority, a record must be kept of the following: – Date of waste transport – Quantity of waste removed and transported – Type of waste removed and transported – Route selected for transport of waste – Quantity of waste delivered – Any incidents (e.g. spillage) that may have occurred on route • If a person removes regulated waste associated with activities within the operational land and disposes of such waste in a manner which is not authorised or is improper or unlawful then, as soon as practicable, the administering authority will be notified of all relevant facts, matters and circumstances known concerning the disposal • If a hazardous contaminant is released to waters or land the following steps must be taken: – Take immediate action to stop any further release and make sure that the area is safe – Take immediate action to contain the hazardous contaminant to the affected area, taking particular care to protect environmentally sensitive areas – Restore or rehabilitate the environment to its condition before the release occurred; and take necessary action to prevent a recurrence of the release – Ensure that all health risks associated with the disposal and reuse of treated sewerage is mitigated through appropriate primary and secondary treatment
Performance indicators	• No inappropriate disposal or management of waste • No contamination of soil, air or water as a result of waste handling

Hydrotest water

Table 8.2 Environmental protection commitments, objectives and control strategies for hydrotesting

Item	Detail
Environmental protection objective	• To protect the quality of local land and water resources during pipeline hydrotesting
Specific objectives	• Appropriate permits obtained prior to drawing water • No existing water sources unsustainably depleted to provide hydrotesting water • No adverse impacts on soil or surface water as the result of discharging hydrotesting water
Control strategies	• Relevant permits to draw water obtained • Hydrotest water will be re-used on multiple and adjacent pipeline sections as much as possible to reduce actual volumes used • Pipe sections crossing water bodies will be tested prior to installation • Inspection of all pipeline section welds, or hydrotesting of pipeline sections before installation under water bodies, will be performed in accordance with construction specifications/procedures • Biocides, where required, will be biodegradable • Where biocides are added, discharge water will be aerated • Prior to discharge, the Contractor shall provide a Hydrotest Water Management Plan (HWMP) prior to commencement of construction works for the Project. The HWMP will include: – A detailed assessment of impacts from hydrostatic test water along the pipeline route including source water quality data and characteristics of additives, particularly biocides – Proposed storage, treatment and disposal methods of hydrotest water – Site specific mitigation measures for management of hydrotest water including monitoring and reporting – Determination of whether testing of the hydrotest water is necessary and submit a plan for review to GLNG Operations. Where the water source and water quality is known, and no chemicals have been added, water quality testing may not be required • Hydrostatic test water, including a detailed assessment of impacts from hydrostatic test water along the pipeline route, will be provided. Source water quality data and characteristics of additives, (particularly biocides) will be provided along with the proposed storage, treatment and disposal methods. The information will be used to determine the site specific mitigation measures including monitoring and reporting • Hydrotest water will be treated as necessary and then disposed of such that it does not enter into any watercourses or run in an uncontrolled manner onto open land. Where water cannot be discharged to ground, other options will be considered to ensure compliance with all regulations • Hydrotest water will be released at least 100 m from any watercourse such that vegetation and soil structure are not damaged or eroded and the quality of groundwater is not adversely impacted • Discharge of hydrotesting water will comply with all regulatory and landholder requirements • Where hydrostatic test water is proposed to be released to land, it will not exceed the water quality limits specified in Table 1: Water Quality Limits. Hydrostatic test water containing chemical additives must not be released to land without written consent from GLNG Operations and the administering authority

<table>
<tr><th>Item</th><th>Detail</th></tr>
<tr><td></td><td>Table 1 Water quality limits
<table>
<tr><th>Parameter</th><th>Maximum value</th></tr>
<tr><td>pH</td><td>6.5-8.5 (Range)</td></tr>
<tr><td>Arsenic (mg/L)</td><td>2.0</td></tr>
<tr><td>Cadmium (mg/L)</td><td>0.05</td></tr>
<tr><td>Chromium (mg/L)</td><td>1</td></tr>
<tr><td>Copper (mg/L)</td><td>5</td></tr>
<tr><td>Iron (mg/L)</td><td>10</td></tr>
<tr><td>Lead (mg/L)</td><td>5</td></tr>
<tr><td>Manganese</td><td>10</td></tr>
<tr><td>Zinc (mg/L)</td><td>5</td></tr>
<tr><td>Nitrogen (mg/L)</td><td>35</td></tr>
<tr><td>Phosphorus (mg/L)</td><td>10</td></tr>
<tr><td>Electrical Conductivity (uS/cm)</td><td>2000</td></tr>
</table></td></tr>
<tr><td>Performance indicators</td><td>• Appropriate permits are obtained prior to drawing water
• No existing water sources unsustainably depleted to provide hydrotesting water
• No adverse impacts on soil or surface water as the result of discharging hydrotesting water</td></tr>
</table>

Chemical and hazardous materials

Table 8.3 Environmental protection commitments, objectives and control strategies for chemical and hazardous materials management

Item	Detail
Operational policy or management objective	• To ensure that storage and handling of chemicals and dangerous goods does not cause environmental harm or harm to persons
Performance criteria	• Petroleum activities do not result in the release or likely release of a hazardous contaminant to the environment • Storage and handling procedures correct and appropriate • Chemicals stored in secure areas • All containment systems must be designed to minimise rainfall collection within the system
Control strategies	• Spill control procedures will be prepared and personnel trained • Dangerous goods will be stored and handled as per the requirements of relevant Australian Standards • Areas where contaminants or wastes are stored or handled will be minimised or roofed • Dangerous goods will, where appropriate (eg outside locations), be stored in bunded areas away from watercourses • Stormwater will be diverted around disturbed areas and areas where contaminants or wastes are stored or handled • All explosives, hazardous chemicals, corrosive substances, toxic substances, gases and dangerous goods must be stored and handled in accordance with the relevant Australian Standard • Explosives will be stored in magazines constructed and located as prescribed in AS 2187

Item	Detail
	• Where no Australian Standard is available, any liquid with potential to harm the environment must be – Stored in impervious bunded tanks with bunded capacity at least 110% of a single storage tank or 100% of the largest storage tank plus 10% of the second largest storage tank in multiple storage areas – Impervious drum storage must have a bunded capacity to contain at least 25% of the maximum design storage volume within the bund • Stormwater runoff and rainfall events will be collected, treated, reused or released in accordance with environmental and legal requirements • Material safety data sheets for chemicals and dangerous goods will be available on-site • Waste dangerous goods, which cannot be recycled, will be transported to a designated disposal site as approved by the local authority • Any spillage of hazardous waste or other contaminants that may cause environmental harm, will be effectively contained and cleaned up as quickly as practicable. Such spillage must not be cleaned up by hosing, or otherwise thereby releasing such waste or contaminants to any land or waters • Spillages must be cleaned up using dry methods that minimise the release of wastes, contaminants or materials to any stormwater drainage system, roadside gutter or waters • Spills of dangerous goods will be rendered harmless and collected for treatment and disposal at a designated site, including cleaning materials, absorbents and contaminated soils • Hydrocarbon spillage from storage areas, diesel and chemical spills from construction equipment, and industrial waste spill will be contained, reported, and treated/remediated in accordance with appropriate legislative and regulatory agency requirements. Drainage will be reinstated • Absorbent and containment material (eg absorbent matting) will be available where hazardous materials are used and stored and personnel trained in their correct use • Protective clothing, appropriate to the materials in use, will be provided • Relevant permits will be held and conditions of permits met • Servicing of equipment/machinery will not be permitted on the RoW without prior authorisation from GLNG Operations. All planned services for all equipment is to occur in an approved workshop
Performance indicators	• No hazardous goods contamination of the environment • Storage and handling procedures are correct and appropriate • Chemicals are stored in secure areas • All containment systems are designed to minimise rainfall collection within the system

8.2 Waste management record keeping, auditing and monitoring

This section addresses the recording and monitoring requirements which will be undertaken as part of this WM Plan. Waste streams, quantities and management practices (including chemical and hazardous materials) will be monitored during the construction and operational phases to ensure compliance with State and Commonwealth legislation, approval conditions and Australian Standards.

The key objectives of auditing the waste management and chemical management activities are to:

- Monitor and review wastes and chemical handling, usage, storage and disposal
- Monitor and review transportation records
- Monitor and review compliance with legislation, approval conditions and standards
- Assess the wastes quantities and streams compared to the predicted levels
- Recommend and implement actions to improve waste management practices
- Monitoring performance against the key performance indicators

8.2.1 Record keeping

Information generated from auditing and monitoring will be stored by the Waste Contractor to enable corrective actions identified during the inspection / auditing process to be recorded, tracked and finalised. The information will be made available to the relevant regulatory authorities as required. The Waste Contractor will keep the following key records:

- Regulated waste records
- Waste register including hazardous and dangerous materials
- Other records prescribed by DERM or government agencies through the licensing and permitting of these activities
- Copies of relevant waste management licences
- Environmental training and induction
- Complaints and incidents
- Inspection and audit details including findings
- Corrective actions

8.2.2 Auditing

The Waste Contractor to will be required to comply with the following auditing requirements:

- During construction the Waste Contractor will be required to report on environmental compliance on a weekly and monthly basis
- During construction undertake internal audits to verify that all work is proceeding in accordance with this WM Plan
- A post-construction audit of the RoW and other related infrastructure will be conducted annually for two years following construction to ensure all waste materials have been removed from the RoW
- The audit report will identify the segment of the Project being audited, the conditions that were activated during the period, and a compliance/non-compliance table. A description of the evidence to support the compliance table will be provided. The audit report shall also contain recommendations on any non-compliance or other matter to improve compliance. The third party auditor must certify the findings of the audit report

- The Waste Contractor will immediately act upon any recommendations arising from the audit report and investigate any non-compliance issues identified
- As soon as practicable, implement measures or take necessary action to ensure compliance
- When first becoming aware of a non-compliance, the Waste Contractor will:
  - Undertake action to bring the matter into compliance within an effective time frame
  - Report the non-compliance and remedial action to GLNG Operations within the specified timeframe

8.2.3 Monitoring

Table 8.4 to Table 8.8 outline the recommended auditing requirements along with the monitoring activities and inspection frequencies.

Table 8.4 WM Plan auditing and monitoring activities – general waste

Inspection and monitoring activity*	Frequency
Inspect waste handling activities and storage areas to check processes effectively handle, store and securely contain wastes as per the project WM Plan ie lids are closed, no spillages or leaks from liquid or solid waste tanks or containers that could cause nuisance or harm to water or the environment.	Weekly
Review waste disposal records/transport receipts to confirm use of licensed waste management facilities and transport contractors to ensure wastes are appropriately collected, transported and disposed of	Weekly
Check all waste contractors have correct and up to date licenses and permits as required to conduct the waste transport and disposal activity	Weekly / monthly/ annually
Check MSDS and a dangerous goods register is available and easily accessible and contains MSDS for each stored chemical	Weekly
Check that spill containment and remediation process equipment is in place and unused Check construction personnel effectively implement the required procedures for spill response and the storage, handling and disposal of hazardous waste	Weekly
Check the training and induction/awareness program records to check all personnel have undertaken awareness training in their responsibilities with regard to waste management.	Weekly
Any findings where a breach of license conditions has been identified, are to be reported to the designated GTP Management group or relevant external stakeholders ie DERM	Monthly / annually
Review waste handling, storage and sorting practices to ensure all materials are being dealt with in accordance with the Waste and Resource Management Hierarchy	Weekly / monthly/ annually
Conduct a post-construction audit of the construction camp and RoW and other related infrastructure to check all waste materials have been removed from the RoW	Annually for two years following construction

*Note These suggested monitoring actions and frequencies are not comprehensive, detailed monitoring and auditing schedules should be developed by the Waste Contractor

Table 8.5 WM Plan auditing and monitoring activities – liquid waste

Inspection and monitoring activity*	Frequency
Record the quantity of effluent treated on a daily basis as required in the approval conditions	Daily
Conduct treated effluent quality monitoring as required in the approval conditions	Weekly

Check that any environmental incidents or accidents that have occurred are reported in accordance with EHSMS	As required
Inspect the construction camp wastewater storage/s and irrigation area in accordance with Wastewater Irrigation Management Plan (WIMP)	Weekly
Inspect the hydrotest water discharge areas in accordance with HWMP	Weekly / monthly/ annually
Inspect waste handling activities and storage areas to check processes effectively handle, store and securely contain wastes as per the project Waste MP and relevant Australian Standards ie lids are closed, no spillages or leaks from liquid or solid waste tanks or containers that could cause nuisance or harm to water or the environment	As required
Check MSDS and a dangerous goods register is available and easily accessible and contains MSDS for each stored chemical	As required
Review liquid waste disposal records/transport receipts to confirm use of licensed waste management facilities and transport contractors to ensure liquid wastes are correctly collected, transported and disposed of	Weekly
Review the waste auditing and monitoring process to ensure the process is effectively achieving objectives	As required
Check that spill containment and remediation process equipment is in place and unused Check project workers effectively implement the required procedures for spill response and associated storage, handling and disposal of hazardous waste	As required
Check the training and induction/awareness program records to check all personnel have undertaken awareness training in their responsibilities with regard to waste management	As required
Check copies of agreements (if any) to supply treated sewage effluent from the wastewater treatment plant for the purpose of irrigation have been forwarded to administering authority	Monthly/ annually
Review waste handling, storage and sorting practices to ensure all materials are being dealt with in accordance with the Waste and Resource Management Hierarchy	Weekly / monthly/ annually
Check WIMP against its objectives such as discharge quality, rates or application area and erosion	Monthly
Conduct a post-construction audit of the construction camp and RoW and other related infrastructure to check all waste materials have been removed from the RoW	Annually for two years following construction

*Note These suggested monitoring actions and frequencies are not comprehensive, detailed monitoring and auditing schedules should be developed by the contractor

Table 8.6 WM Plan auditing and monitoring activities – vehicles and machinery

Inspection and monitoring activity*	Frequency
Check vehicles, plant and equipment are maintained as per maintenance schedules to ensure no leaks or damage which could result in spills or leaks	Daily
Inspect waste handling and storage processes to check waste is effectively handled, stored and securely contained as per this WM Plan and Australian Standards ie no spillages, leaks from liquid or solid waste tanks or containers that could cause damage to water or the environment.	As required
Check the training and induction/awareness program records to check all personnel have undertaken awareness training in their responsibilities with regard to waste management.	As required

Check all waste contractors have appropriate and up to date licenses and permits as required to conduct the waste transport and disposal activity	Weekly / monthly/ annually
Review waste handling, storage and sorting practices to check all materials are being dealt with in accordance with the Waste and Resource Management Hierarchy	Weekly / monthly/ annually

*Note These suggested monitoring actions and frequencies are not comprehensive, detailed monitoring and auditing schedules should be developed by the contractor

Table 8.7 WM Plan auditing and monitoring activities – hazardous waste and chemical storages monitoring

Inspection and monitoring activity*	Frequency
Inspect hazardous wastes handling activities and storage areas to check hazardous waste is stored in sealed containers, bunded areas, correctly labelled as per the WM Plan and Australian Standards and Legislation ie lids are closed, no spillages, leaks from liquid or solid waste tanks or containers that could cause nuisance or harm to water or the environment	As required
Inspect containment bunds and/or sumps to check integrity of bund and to maintain storage capacity to reduce risk of overflow and subsequent pollution of the surrounding land and/or water body (ie captured sump liquid to extracted periodically when required – noting that extracted liquid will need to be handled and disposed correctly)	As required
Review waste disposal records/transport receipts to confirm use of licensed waste management facilities and transport contractors to ensure wastes are correctly collected, transported and disposed of	Weekly
Check regulated waste tracking paperwork to ensure the process accurately records all necessary details with regard to waste	Weekly / monthly/ annually
Check all waste contractors have correct and up to date licenses and permits as required to conduct the waste transport and disposal activity	Weekly / monthly/ annually
Review hazardous materials inventory with stored items to check all items are recorded, stored and treated correctly	Weekly / monthly/ annually
Check MSDS and a dangerous goods register is available and easily accessible and contains MSDS for each stored chemical	Weekly
Check that spill containment and remediation process equipment is in place and unused Check project workers effectively implement the required procedures for spill response and associated storage, handling and disposal of hazardous waste	Weekly
Check the training and induction/awareness program records to check all personnel have undertaken awareness training in their responsibilities with regard to waste management	As required
Review waste handling, storage and sorting practices to ensure all materials are being dealt with in accordance with the Waste and Resource Management Hierarchy (Review waste and recyclable quantities and check dispatched to correct destination)	Weekly / monthly/ annually
Any findings of auditing and monitoring where a breach of license conditions has been identified, are to be reported to the designated GTP Management group or relevant external stakeholders ie DERM	As required

*Note These suggested monitoring actions and frequencies are not comprehensive, detailed monitoring and auditing schedules should be developed by the contractor

Table 8.8 Waste MP auditing and monitoring activities – HDD

Inspection and monitoring activity*	Frequency

Review drill cutting laboratory results to check cuttings comply with WBRA approval requirements	As required
Review waste disposal records/transport receipts to confirm use of a licensed waste management facilities and licensed transport contractors to check wastes are correctly collected, transported and disposed of	As required
Check HDD equipment is maintained as per maintenance schedules to check for leaks or damage which could result in spills or leaks	Daily
Inspect waste handling and storage processes to check appropriate and effective handling, storage and secure containment of HDD wastes as per project WM Pan and Australian Standards ie no spillages, leaks from liquid or solid waste tanks or containments (ie drill cuttings or drill fluids pits) that could cause nuisance or harm to water or the environment	Daily
Check MSDS and a dangerous goods register is available and easily accessible and contains MSDS for each stored chemical	As required
Check the training and induction/awareness program records to check all personnel have undertaken awareness training in their responsibilities with regard to waste management	As required
Check all waste contractors have appropriate and up to date licenses and permits as required to conduct the waste transport and disposal activity	As required
Review waste handling, storage and sorting practices to check all materials are being dealt with in accordance with the Waste and Resource Management Hierarchy	As required
Conduct a post-construction audit of the Marine Crossing RoW and other related infrastructure to ensure all waste materials have been removed from the RoW	Annually for two years following construction

*Note These suggested monitoring actions and frequencies are not comprehensive, detailed monitoring and auditing schedules should be developed by the contractor

8.2.4 Continuous improvement

GLNG Operations will work closely with the Contractor to rectify any issues identified as a result of WM Plan monitoring and auditing activities.

GLNG Operations will continue to investigate and implement actions to reduce impacts and deliver positive outcomes through the operation of the GTP in relation to waste management.

The results of inspections, audits and incident reports will be used to drive continuous improvement along with other associated internal environmental performance reviews conducted by the GTP management team.

Following any significant changes to the GTP design or operational processes the WM Plan will be reviewed to determine if it should be updated to reflect the changes.

Following any environmental incidents resulting in environmental harm, this WM Plan will be reviewed and mitigation measures updated and improved to reduce the risk of incidents.

This WM Plan will be subject to annual review by GLNG Operations and its effectiveness in managing the waste streams associated with the GTP operations reported internally and to any relevant stakeholder.

8.2.5 Complaints response

Complaints which are received from internal or external stakeholders should be recorded and investigated in accordance with the Complaints Response Procedures.

Refer to the proposed management objectives and strategies as detailed in Section 8 for more details on the complaints procedure.

9. Emergency Response Management

Emergency response management for spills and incident involving waste and hazardous materials will be undertaken in accordance with the requirements stipulated in Chapter 3 of the EMP.

10. References

Australian Standard 2885.3-2001: Pipelines – Gas and liquid petroleum Part 3: Operation and Maintenance

Aurecon (2011) GLNG Gas Transmission Pipeline Environmental Management Plan in Support of an Environmental Authority for Mainland

Aurecon (2011) GLNG Gas Transmission Pipeline Environmental Management Plan in Support of an Environmental Authority for Marine Crossing

Aurecon (2011) GLNG Gas Transmission Pipeline Environmental Management Plan in Support of an Environmental Authority for Curtis Island

Canadian Association of Petroleum Producers (2004) Guideline Planning Horizontal Directional Drilling for Pipeline Construction

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Ecologica Consulting (2010) Landscape Rehabilitation Management Plan for the GLNG Gas Transportation Pipeline Corridor, Brisbane.

Department of Environment and Resource Management (2010) Queensland's Waste Reduction and Recycling Strategy 2010-2020

GTP (no date) O&M Procedures – Pipeline Abandoning Document

GLNG (no date) Pipeline – GLNG Project Environmental Management Plan (3380-GLNG-3-1.3-0007)

GLNG (no date) Gas Transmission Pipeline Operations and Maintenance Procedures

International Erosion Control Association (IECA) (2008) Best Practice Erosion and Sediment Control

MAE Mid-Atlantic Express, LLC (2007) Mid-Atlantic Express Pipeline Project HDD Monitoring and Contingency Plan. Available at http://www.docstoc.com/docs/23405017/Formal-Report

Queensland Government (May 2010) Coordinator-General's evaluation report for an environmental impact statement, Gladstone Liquefied Natural Gas-GLNG project

Queensland Government, Environmental Protection Agency (December 2005) Queensland Water Recycling Guidelines

Santos (2007) Environment, Health and Safety Management Guide Accessed [online] February 2011, Available at. http://www.glng.com.au/library/EIS/Appendices/BB3_Health%20and%20Safety%20FINAL%20PUBLIC.pdf

Santos Petronas (2010) GLNG Gas Transmission Pipeline Weed Management Plan (Document Number: 3380-GLNG-3-1.3-0006-DOC)

URS (2009) Final Report GLNG Environmental Impact Statement – Waste Management Plan (Ref 42626220)

URS (2009) GLNG Project – Environmental Impact Statement

The Australian Pipeline Industry Association (APIA): Code of Environmental Practice – Onshore Pipelines, March 2009

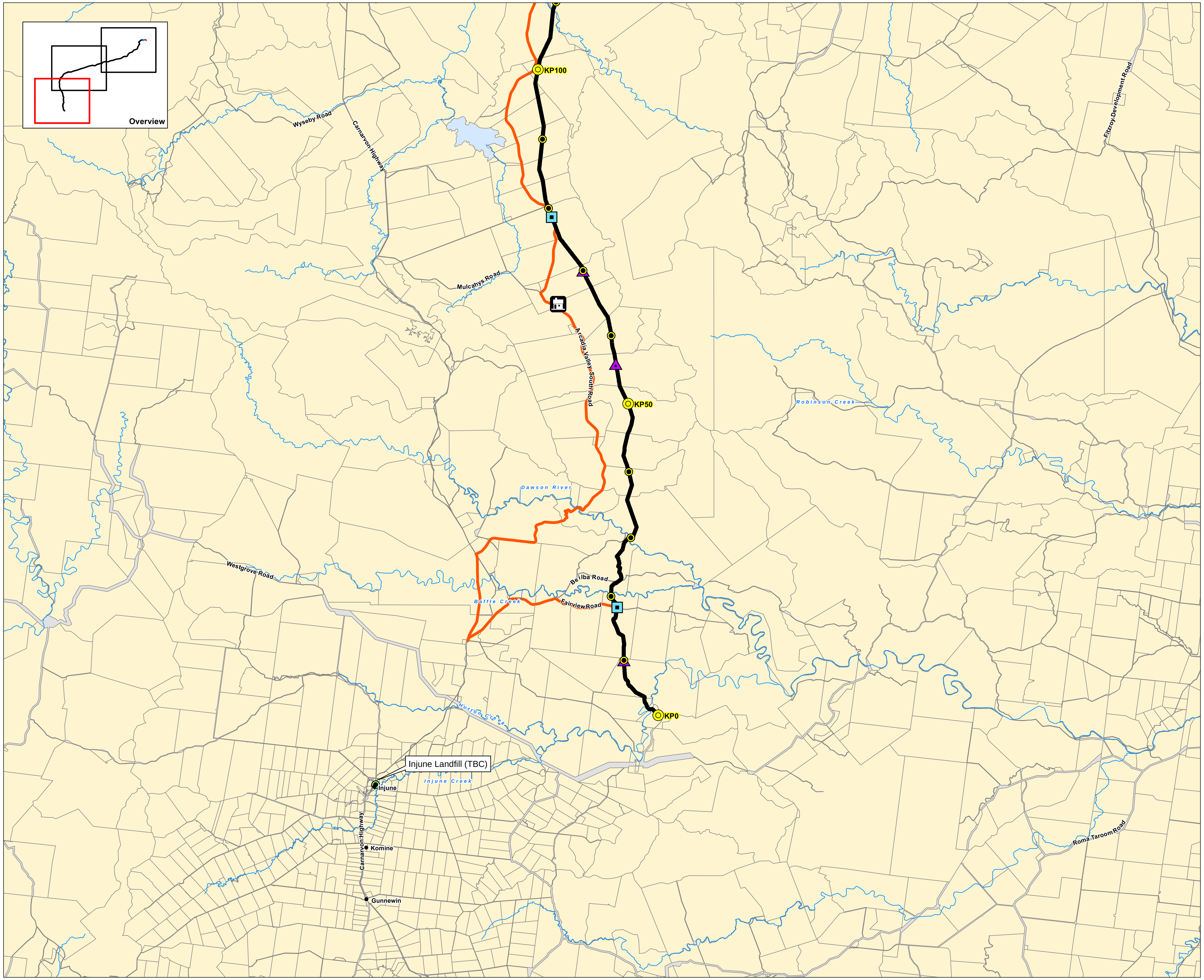
Appendix A
Abbreviations

Appendix A

Abbreviation	Description
AIM	Audit and Inspection Manager
APIA Code	Australian Pipeline Industry Association Code of Environmental Practice for Onshore Pipelines
APLNG	Australia Pacific Liquefied Natural Gas
AS	Australian Standard
AS/NZS	Australian Standard/New Zealand Standard
ASS	Acid Sulfate Soil
ASSMP	Acid Sulfate Soils Management Plan
CEMP	Construction Environmental Management Plan
CG	Coordinator General
CMP	Construction Management Plan
CSG	Coal Seam Gas
C&I	Construction and Industrial
DERM	Department of Environment and Resource Management
DMP	Dredge Management Plan
DNRMW	Department of Natural Resources, Mines and Water
EA	Environmental Authority
EHSMS	Environment Health and Safety Management System
EHS&S	Environmental, Health, Safety & Security
EIS	Environmental Impact Statement
EM Plan	Environmental Management Plan
EP Act	*Environmental Protection Act 1994*
EPP Waste	Environmental Protection (Waste Management) Policy 2000
EP Waste Regulation	Environmental Protection (Waste Management) Regulations 2008
ERA	Environmentally Relevant Activity
ERP	Emergency Response Plan
FEED	Front End Engineering Design
GLB	Gladstone Logistics Base
GLNG	Gladstone Liquefied Natural Gas
GPC	Gladstone Port Corporation
GTP	Gas Transmission Pipeline
HDD	Horizontal Directional Drilling
HDPE	High Density Polyethylene
HWMP	Hydrotest Water Management Plan
IECA	International Erosion Control Australasia
IMS	Incident Monitoring System
LNG Facility	Liquefied Natural Gas Facility

Abbreviation	Description
MEDLI	Model for effluent disposal using land irrigation
MRF	Material Recovery Facility
MSDS	Material Safety Data Sheet
MSW	Municipal Solid Waste
Mtpa	Million Tonnes per Annum
NEPM	National Environment Protection Measures
NPI	National Pollution Inventory
N/A	Not Applicable
Pigging	Pipe Cleaning Activities
PPE	Personal Protective Equipment
PVM	Preventative Vehicle Maintenance
PVMW	Preventative Vehicle Maintenance Workshops
PWMP	Pest and Weed Management Plan
QCLNG	Queensland Curtis Liquefied Natural Gas
Qld	Queensland
RMP	Road use Management Plan
RoW	Right-of-Way
SSMP	Significant Species Management Plan
STP	Sewage Treatment Plant
TPRA	Temporary Pipe Receival Area
TPSA	Temporary Pipe Storage Area
WBRA	Western Basin Reclaim Area
Waste MP	Waste Management Plan
WIMP	Wastewater Irrigation Management Plan
WWTP	Wastewater Treatment Plant
Weed MP	Weed Management Plan

Appendix B
Figures



Mainland GTP EM Plan

Gas Transmission Pipeline (GTP)
- Mainland GTP EM Plan
- Marine Crossing GTP EM Plan
- Curtis Island GTP EM Plan

Kilometre Post Distance Marker
- 50km
- 10km

Road Haulage Route
- Waste to Landfill; regulated waste and recyclables via approved route to SE Qld
- Other GLNG haulage route
- Port Alma Temporary Pipe Receiving Area
- Landfill
- Sewage Treatment Plant
- Temporary Pipe Storage Site
- Construction Camp
- Vehicle Washdown and RoW Access Point (Indicative Location Only)
- Barge Haulage Route
- Cadastre
- Rail
- Watercourse
- Major Road

Source:
Gas Transmission Pipeline (GTP): Santos, Jan 2011.
Fishermans Landing and Western Basin Reclamation Area, Aurecon, Feb 2011.
Protected Areas: Department of Environment and Resource Management, Feb 2011.
Cadastre: Department of Environment and Resource Management, Feb 2011.
Temporary Pipe Storage Site: GLNG Pipeline Logistics Study, GHD, Nov 2009.
Vehicle Washdown Points: Aurecon, Feb 2011.
Construction Camps: GLNG Pipeline Logistics Study, GHD, Nov 2009.

Waste and Recovered Material Haulage Route
Appendix A Figure 1 (Page 1 of 3)

A1 scale:1:275,000

0 5 10 15 20 25 km

GLNG No: 3381-40-0425

Coordinate system: GCS GDA 1994

Date: 29/03/2011

Version: b

Map by: BS

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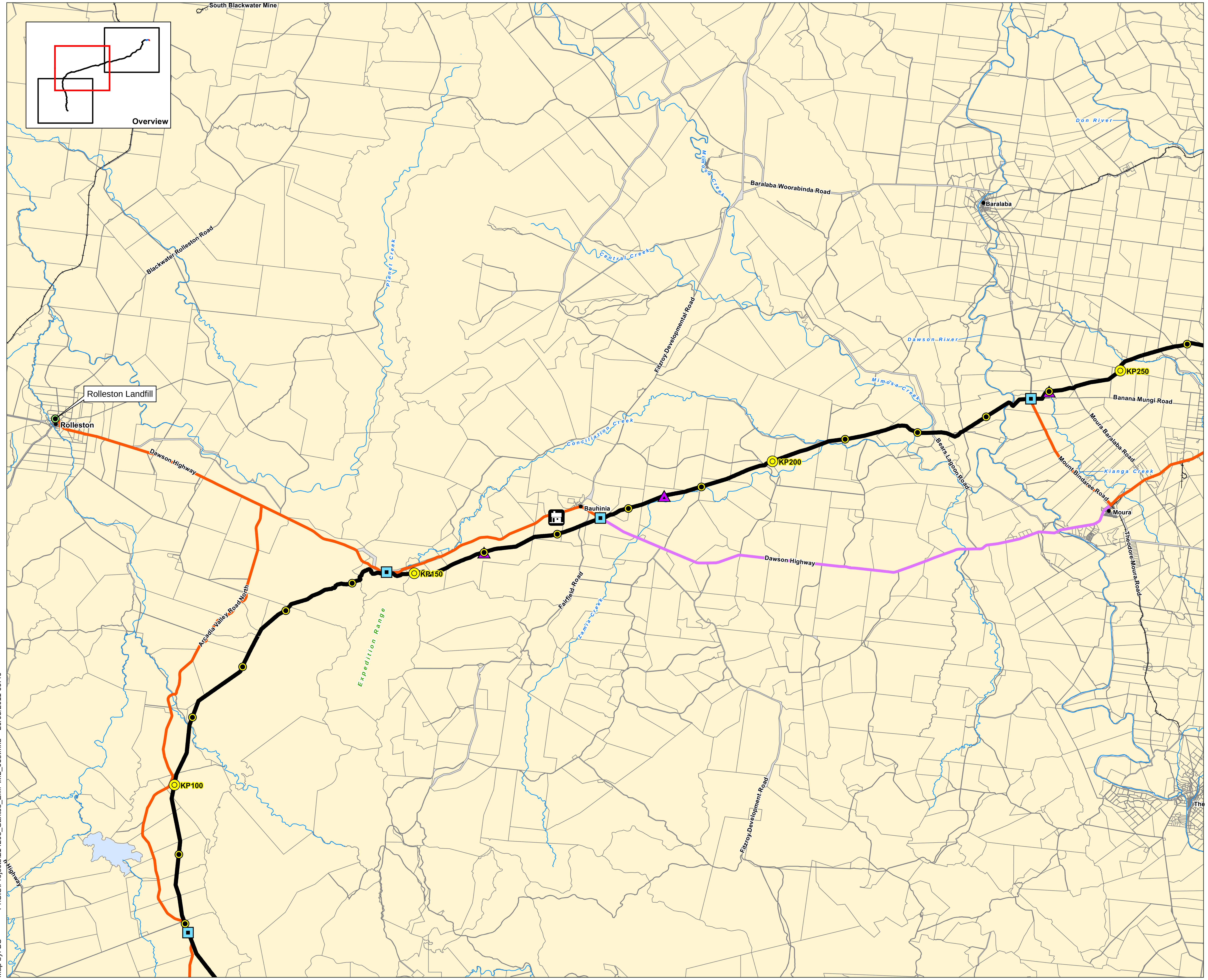

Mainland GTP EM Plan

Gas Transmission Pipeline (GTP)
- Mainland GTP EM Plan
- Marine Crossing GTP EM Plan
- Curtis Island GTP EM Plan

Kilometre Post Distance Marker
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Gas Transmission Pipeline (GTP): Santos, Jan 2011.
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Protected Areas: Department of Environment and Resource Management, Feb 2011.
Cadastre: Department of Environment and Resource Management, Feb 2011.
Temporary Pipe Storage Site: GLNG Pipeline Logistics Study, GHD, Nov 2009.
Vehicle Washdown Points: Aurecon, Feb 2011.
Construction Camps: GLNG Pipeline Logistics Study, GHD, Nov 2009.

Waste and Recovered Material Haulage Route
Appendix A Figure 1 (Page 2 of 3)

Date: 29/03/2011

Version: b

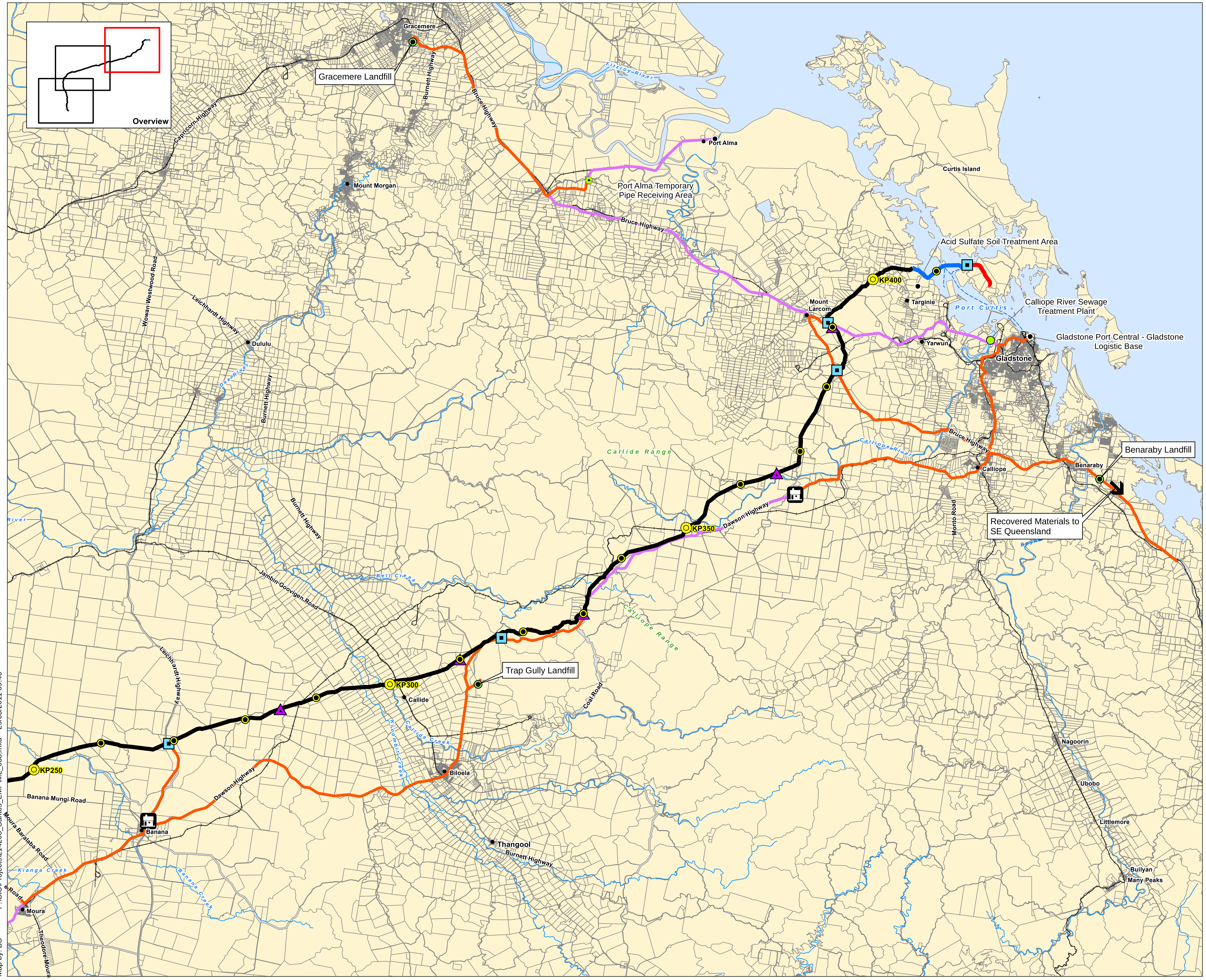
A1 scale:1:275,000

0 5 10 15 20 25km

GLNG No: 3381-40-0425

Coordinate system: GCS GDA 1994

Map by: BS P:\GIS\Projects\214208_Santos_EMP\ML_038.mxd 29/03/2011 09:46



A1 scale:1:275,000

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GLNG No: 3381-40-0425

Coordinate system: GCS GDA 1994

Map by: BS   P:\GIS\Projects\214208_Santos_EMP\ML_038.mxd   29/03/2011 09:46

Mainland GTP EM Plan

Gas Transmission Pipeline (GTP)
- Mainland GTP EM Plan
- Marine Crossing GTP EM Plan
- Curtis Island GTP EM Plan

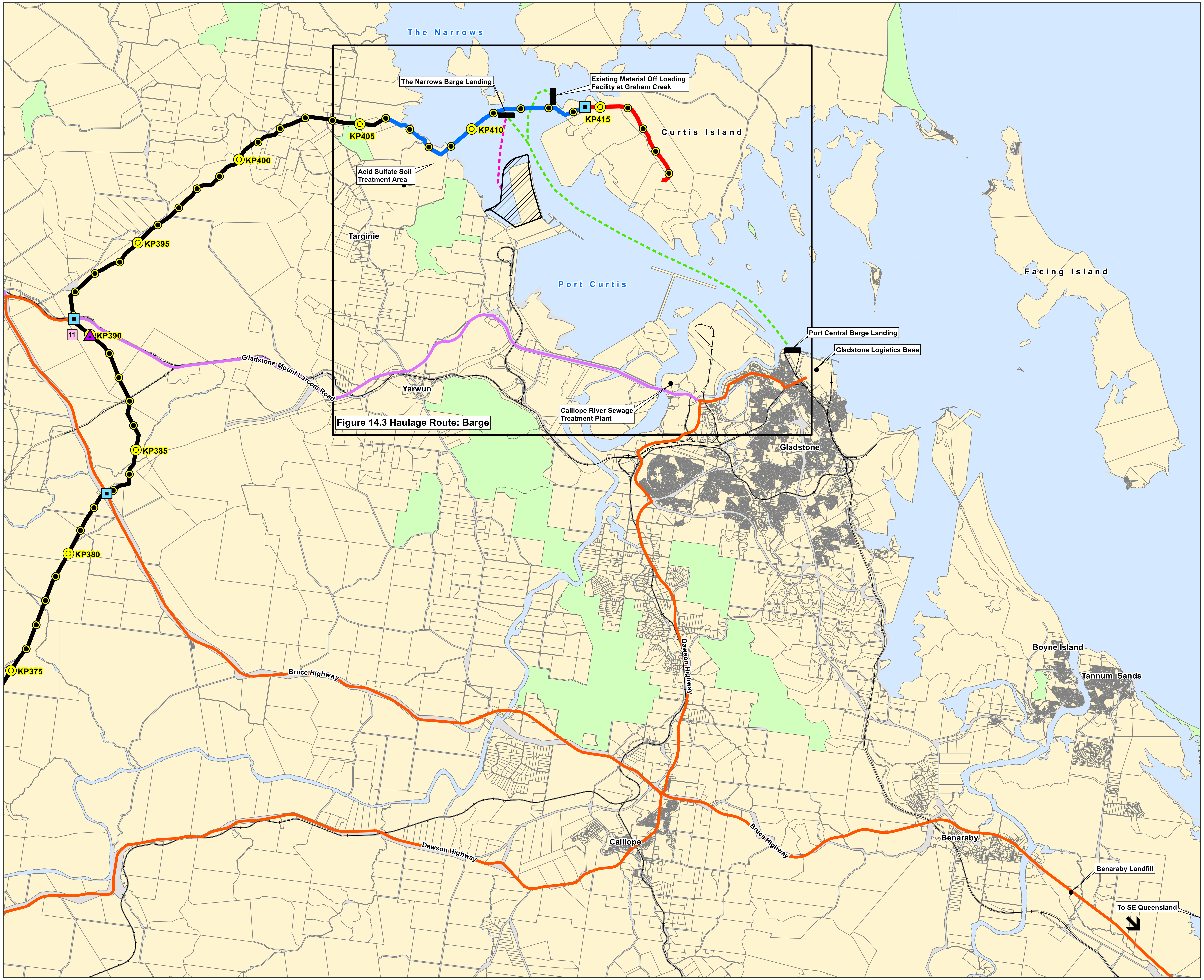
Kilometre Post Distance Marker
- 50km
- 10km

Road Haulage Route
- Waste to Landfill; regulated waste and recyclables via approved route to SE Qld
- Other GLNG haulage route
- Port Alma Temporary Pipe Receiving Area
- Landfill
- Sewage Treatment Plant
- Temporary Pipe Storage Site
- Construction Camp
- Vehicle Washdown and RoW Access Point (Indicative Location Only)
- Barge Haulage Route
- Cadastre
- Rail
- Watercourse
- Major Road

Source:
Gas Transmission Pipeline (GTP): Santos, Jan 2011.
Fishermans Landing and Western Basin Reclamation Area, Aurecon, Feb 2011.
Protected Areas: Department of Environment and Resource Management, Feb 2011.
Cadastre: Department of Environment and Resource Management, Feb 2011.
Temporary Pipe Storage Site: GLNG Pipeline Logistics Study, GHD, Nov 2009.
Vehicle Washdown Points: Aurecon, Feb 2011.
Construction Camps: GLNG Pipeline Logistics Study, GHD, Nov 2009.

Waste and Recovered Material Haulage Route
Appendix A Figure 1 (Page 3 of 3)

Date: 29/03/2011   Version: b



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Map by: BS

Marine Crossing GTP EM Plan

Gas Transmission Pipeline (GTP)
- Mainland GTP EM Plan
- Marine Crossing GTP EM Plan
- Curtis Island GTP EM Plan

Kilometre Post Distance Marker
- 5km
- 1km

Road Haulage Route
- Waste to Benaraby Landfill; regulated waste and recyclables to SE Qld
- Other GLNG haulage route

Barge Haulage Route
- All waste and materials
- Drill cuttings
- Barge Landing (Indicative Location Only)
- Vehicle Washdown and RoW Access Point (Indicative Location Only)
- Temporary Pipe Storage Site
- Fishermans Landing and Western Basin Reclamation Area
- Protected Area
- Cadastre
- Rail

Source:
Gas Transmission Pipeline (GTP): Santos, Jan 2011.
Aerial: Santos, 2011.
Fishermans Landing and Western Basin Reclamation Area, Aurecon, Feb 2011.
Protected Areas: Department of Environment and Resource Management, Feb 2011.
Cadastre: Department of Environment and Resource Management, Feb 2011.
Temporary Pipe Storage Site: GLNG Pipeline Logistics Study, GHD, Nov 2009.
Vehicle Washdown Point: Aurecon, Feb 2011.

Note:
Barge landing and routes are approximate only.

A1 scale: 1:75,000

0 1,500 3,000 4,500 6,000 7,500 m

GLNG No: 3381-40-0458

Coordinate system: GCS_GDA_1994

Waste and Recovered Material Haulage Route: Overview
Figure 2

Date: 11/04/2011

Version: b

Reference Point	KP (km)
A	406
B	406.5
B1	408.5
C	409
D	410.5
E	411
F	411.5
G	413
G1	413.5
H	414.5

Reference Points and Associated KPs

Marine Crossing GTP EM Plan

Gas Transmission Pipeline (GTP)
- Mainland GTP EM Plan
- Marine Crossing GTP EM Plan
- Curtis Island GTP EM Plan
- GTP Marine Crossing Reference Point

Road Haulage Route
- Waste to Benaraby Landfill; regulated waste and recyclables to SE Qld
- Other GLNG haulage route

Barge Haulage Route
- All waste and materials
- Drill cuttings
- Barge Landing (Indicative Location Only)
- Vehicle Washdown and RoW Access Point (Indicative Location Only)
- Fishermans Landing and Western Basin Reclamation Area
- Rail

Source:
Gas Transmission Pipeline (GTP): Santos, Jan 2011.
Aerial: Santos, 2011.
Fishermans Landing and Western Basin Reclamation Area, Aurecon, Feb 2011.
Vehicle Washdown Point: Aurecon, Feb 2011.

Note:
Barge landing and routes are approximate only.

Waste and Recovered Material Haulage Route:Barge Figure 3

A1 scale: 1:30,000

0 500 1,000 1,500 2,000 2,500 m

GLNG No: 3381-40-0459

Coordinate system: GCS_GDA_1994

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Appendix G
Landscape Rehabilitation Management Plan

Santos
GLNG Project

GLNG Project

Landscape Rehabilitation Management Plan for the GLNG Gas Transmission Pipeline Corridor

Document Number: 3380-GLNG-3-1.3-0037

PREPARED BY:

Title	Name	Signature	Date
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ENDORSED BY:

Title	Name	Signature	Date
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APPROVED BY:

Title	Name	Signature	Date
Compliance Manager – Pipeline	Andrew Brier		17.5.12

DATE	REV	REASON FOR ISSUE	AUTHOR	ENDORSED	APPROVED
Jun 2010	1	Draft	AW	BF	
Nov 2010	2	Revised Draft	AW	BF	
Mar 2012	3	Revised Draft for SEWPaC Review	AW	IB	AB
May 2012	4	Revised Draft for SEWPaC Second Review	AW	IB	AB

Table of Contents

1. Introduction

1.1 Background and context

The GLNG project involves the development of coal seam gas resources in the Bowen and Surat Basins around Roma, construction of a pipeline from the gas fields to the coast, and construction of up to three processing trains at a liquefied natural gas (LNG) plant and export facility on Curtis Island, off Gladstone.

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

Following the preparation of the EIS and the SEIS, the CG Report for the GLNG Project was issued in May 2010, and the approvals of the four relevant referred components were granted under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (Cth) in October 2010.

This Landscape Rehabilitation Management Plan (LRMP) has been prepared in accordance with the following conditions outlined in the CG Report, the EPBC Act approval and the DERM Environmental Authority.

<u>CG Report conditions</u>

- Appendix 3 - Gas Pipeline, Part 2 – General Conditions
  - Condition 3
  - Condition 17
- Appendix 3 – Gas Pipeline, Part 3 & 4 – Environmental Conditions
  - Condition 1(d)
  - Condition 3(d)
  - Condition 4(f-g)
  - Condition 5(a & e)
  - Schedule E14.7, E30-E36
  - Schedule J

<u>EPBC Act approval conditions</u>

- Condition 3a
- Condition 3d
- Condition 8(e)i

<u>DERM Environmental Authority No.: PEN102664411</u>

- Schedule E30 – E36
- Schedule H
- Schedule J22-J24

1.2 Purpose of this plan

This LRMP is applicable to the Gas Transmission Pipeline (GTP) component of the Project which commences approximately 40km east of Injune, then travels north along the eastern side of Arcadia Valley. The GTP will approach Gladstone from the south-west through the Callide Infrastructure Corridor State Development Area (CICSDA) and the Gladstone State Development Area (GSDA) before crossing Port Curtis between Friend Point and Laird Point to Curtis Island and the proposed LNG Facility. A number of associated ancillary sites comprising accommodation camps and stockpile facilities, in addition to access tracks and roads will be constructed and are also addressed within this LRMP.

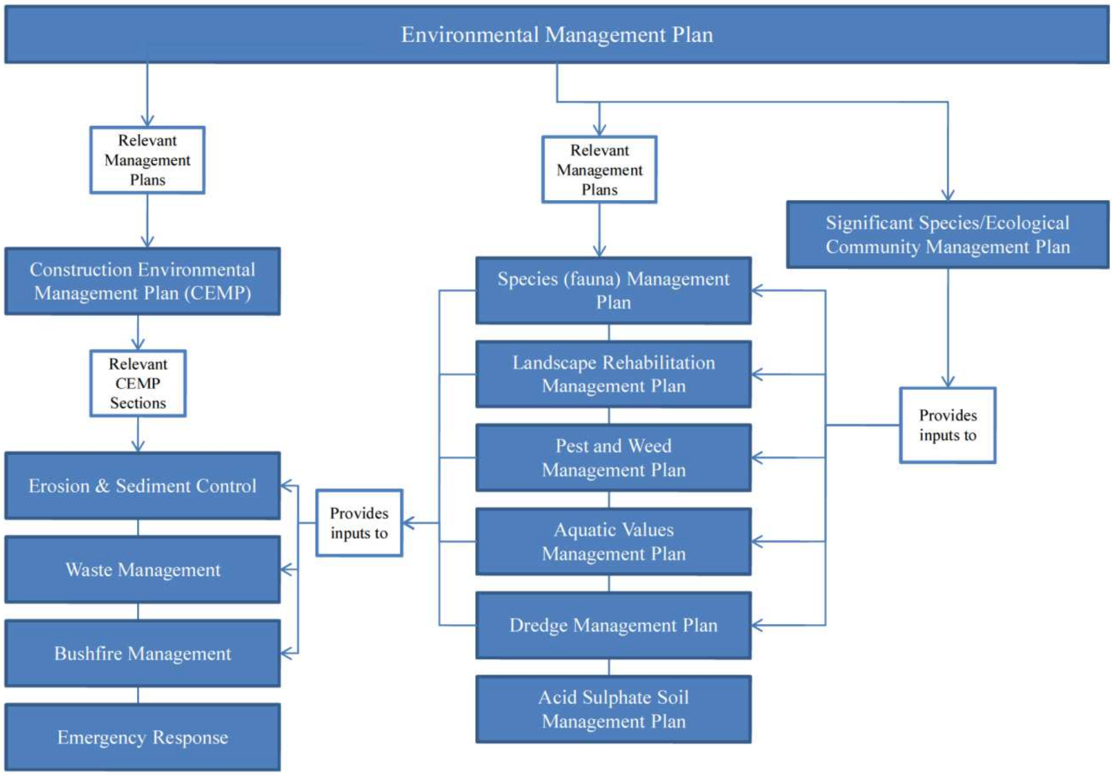
The purpose of this LRMP is to provide management measures to be implemented during and post construction of the GTP Corridor to rehabilitate the GTP Right of Way (ROW) to meet relevant approval conditions.

The LRMP will act as a tool to assist both the proponent and the Principal Contractor in determining the extent of compliance required by Principal Contractor's staff and sub-contractors with regards to the regulations and guidelines applicable to the GLNG pipeline project.

The LRMP is a live document and will be updated as required during construction of the Project. It is designed to:

- Minimise area of overall disturbance;
- Create a safe, stable and non-polluting landform;
- Undertake a comprehensive revegetation and rehabilitation program of all disturbed areas;
- Revegetation and rehabilitation undertaken in a timely manner;
- Preservation of downstream receiving environments;
- Ensure compliance with relevant approval conditions specified by the Coordinator-General, the Department of Environment and Resource Management (DERM), Queensland Primary Industries and Fisheries (QPIF) and DSEWPC; and
- Ensure compliance with commitments under the EIS and SEIS.

1.2.1 Relationship between this plan and other GTP Corridor Management Plans



2. Legislative and Regulatory Framework

It should be noted that the information provided in this plan regarding relevant legislation, policies, regulations, standards and guidelines might not be a complete representation of all statutory requirements relevant to landscaping and rehabilitation practices. It is the responsibility of Contractors to determine all statutory and other requirements relevant to their package of works.

2.1 Applicable Legislation

The rehabilitation and landscaping of disturbed areas are not legislated under any one specific Act. However, it is enforced by the Department of Sustainability, Environment, Water, Population and Communities (DSEWPC)[1], Department of Environment and Resource Management (DERM)[2] and the Department of Employment, Economic Development and Innovation (DEEDI)[3], often as a condition outlined in approvals for the disturbance and/or clearing of native vegetation.

Key environmental legislation relating to the LRMP includes the following:

- *Environment Protection and Biodiversity Conservation Act 1999*
- *Nature Conservation Act 1992*
- *Nature Conservation (Wildlife) Regulation 2006*
- *Nature Conservation (Protected Plants) Conservation Plan 2000*
- *Nature Conservation (Protected Areas) Regulation 1994*
- *Nature Conservation (Koala) Conservation Plan 2005*
- *Nature Conservation (Forest Reserves) Regulation 2000*
- *Fisheries Act 1994*
- *Fisheries Regulation 2008*
- *Land Protection (Pest and Stock Route Management) Regulation 2003*
- *Great Barrier Reef Marine Park Act 1975*
- *Great Barrier Reef Marine Park Amendment Act 2007*
- *Animal Care and Protection Act 2001*
- *Coastal Protection and Management Act 1995*
- *Environmental Protection Act 1994*
- *Marine Parks Act 1982*
- *Water Act 2000*
- *Vegetation Management Act 1999*
- *Petroleum and Gas (Production and Safety) Act 2004*
- *Land Protection (Pest and Stock Route Management) Act 2002*

2.1.1 Policies, Standards and Guidelines

Activities will be undertaken in consideration of the relevant components of the following industry Codes of Practice:

- Australian Petroleum Production and Exploration Association's (APPEA) Code of Environmental Practice (2008); and
- Australian Pipeline Industry Association's (APIA) Code of Environmental Practice (Operations) (2005).

Relevant standards include:

- Australian Standard 4801:2000 Occupational Health and Safety Management Systems – Specification with guidance for use, and AS/NZS ISO 14001:1996 Environmental Management Systems;
- AS2885.1-1997 Gas and Liquid Petroleum - Design and Construction;
- Road Landscape Manual (Department of Main Roads (DMR), 2004) available for download from http://www.mainroads.qld.gov.au/. Consultation with the Project civil engineers and landscape architects is recommended when referring to this document;
- Ergon Energy has requirements pertaining to the amount of clearance required both under and directly adjacent to existing powerlines. This information is available for download at http://www.ergon.com.au/;
- These guidelines will be followed as a minimum around all powerlines regardless of ownership;
- Riparian Land Management Technical Guidelines Volumes 1 and 2 (Lovett & Price 2002);
- A Rehabilitation Manual for Australian Streams Volumes 1 And 2 (Rutherford *et al*. 2000);
- Guidelines for Protecting Australian Waterways (Bennett *et al*. 2002);
- Principles of Riparian lands Management (Lovett & Price 2007); and
- Code of Environmental Practice – Onshore Pipelines (APIA 2005).

[1] Formerly the Department of Environment, Water, Heritage and the Arts.
[2] Formerly the Environmental Protection Agency and the Department of Natural Resources and Water.
[3] Formerly the Department of Primary Industries and Fisheries.

- Soil Erosion and Sediment Control - Engineering Guidelines for Queensland Construction Sites (Institution of Engineers Australia 1996)
- Saltwater Wetland Rehabilitation Manual (Department of Environment and Climate Change 2008)
- Wetland Rehabilitation Guidelines for the Great Barrier Reef catchment (WetlandCare Australia 2008)
- Santos EHSMS Standards as per the CEMP.

2.2 EIS Commitments and Approval Conditions

In addition to the commitments outlined within the EIS and SEIS, this Plan will need to adopt any relevant statutory approval conditions. As of November 2010, this Plan has addressed all commitments within the EIS/SEIS and all relevant approval conditions determined by the Co-ordinator General.

2.2.1 Approvals, Licenses and Permits

A Coordinator-General's Report was provided for the Project in May 2010. Additional approvals/permits applicable to LRMP are as follows:

- Permit to collect seed / cuttings from a threatened species outside the corridor (NC Act);
- Permit to clear native vegetation (NC Act);
- Permit to clear marine plants (Fisheries Act);
- Licence to construct a waterway barrier within a defined watercourse;
- Environment Authority for the Pipeline Licence; and
- EPBC Act Approval.

2.3 Offsets Package

An Environmental Offset proposal for the GLNG Project has been developed by Ecofund Queensland on behalf of the Proponent. The proposal outlines the environmental offset requirements for each component of the Project under both Queensland and Australian Government offset policies. The extent of offsets was based on information contained in the EIS and SEIS. The Package also included options for offset delivery and examples of properties that may be suitable to meet the identified offset requirements.

3. Environmental Management Framework

3.1 Santos Environment Health, Safety and Management System (EHSMS)

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

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

3.2 Overall EHSMS Structure

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

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

3.3 EHSMS Management Standards

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

3.4 EHSMS Hazard Standards

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

4. Existing Environment

4.1 Flora

The design of the GTP RoW has considered the ecological values of the vegetation communities and habitat within and adjacent to the footprint. This has been achieved by positioning the GTP in areas which have already been historically cleared for agricultural activities or, where possible, co-positioning the GTP adjacent to existing linear infrastructure, such as the existing Jemena Gas Pipeline where it traverses remnant vegetation communities.

State Forests and Timber Reserves directly impacted by the GTP include the Expedition State Forest, Callide Timber Reserve and Targinie State Forest (refer to mapping provided within the SSMP for specific locations).

4.1.1 Species

As part of the GLNG EIS process, flora assessments of the mainland component of the GTP RoW were undertaken in 2008. The surveys identified the presence of approximately 320 flora species within the GTP RoW.

Additional surveys undertaken in 2010 targeted significant flora species (EPBC Act and *Nature Conservation Act 1992* [NC Act] listed Endangered, Vulnerable, Near Threatened [EVNT]; and NC Act Type A Restricted Plants) and ecological communities (including *Vegetation Management Act 1999* [VM Act] listed Endangered and Of Concern Regional Ecosystems [REs] and EPBC listed Threatened Ecological Communities [TECs]). These surveys resulted in the detection of an additional 14 significant plant species.

The majority of the species identified from the GTP RoW during the 2008/2010 survey periods are listed as Least Concern under the provisions of the NC Act and are not listed under the provisions of the EPBC Act. However, a number of conservation significant flora (ie Type A restricted plants and EVNT species), including *Cycas megacarpa* (Cycad), *Gonocarpus urceolatus* (Raspweed), *Acacia gittinsii* (Gittin's wattle) and *Solanum johnsonianum* (NCN) are known to occur within the Project footprint.

The EIS and SEIS surveys also noted a number of introduced weed species, of which 10 are declared species under the *Queensland Land Protection (Pest and Stock Route Management) Act 2002* (LP Act). Three of the species observed (*Cryptostegia grandiflora* [Rubber vine], *Lantana camara* [Lantana] and *Parthenium hysterophorus* [Parthenium weed] are also listed as Weeds of National Significance (WONS) under the provisions of the EPBC Act.

A summary of the vegetation communities, associated habitats and identified flora present within the GTP RoW is available in the EIS, SEIS, SSMP and the Weed Management Plan (WMP).

4.1.2 Regional Ecosystems

The majority of the Project area (approximately 80%) has been historically cleared for agriculture, and as such, a large portion of the GTP is considered pastoral grazing land (Fairview, Arcadia Valley and Calliope) or irrigated cropping (Zamia, Mimosa and Dawson catchments).

However, the GTP RoW also intercepts areas mapped as remnant vegetation under DERM's RE Mapping (approximately 60 RE communities). This includes REs which are also listed as TECs under the provisions of the EPBC Act. Table 1 outlines RE communities present within the GTP RoW.

Table 4.1 Regional Ecosystems within the GTP ROW

RE Code	RE Description
11.1.2	Very sparse samphire forbland on marine clay plains.
11.1.4	Mid-dense mangrove forest/woodland on marine clay plains.
11.3.1/11.3.2	Mid-dense *Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains and sparse *Eucalyptus populnea* woodland on alluvial plains.
11.3.2	Sparse *Eucalyptus populnea* woodland on alluvial plains.
11.3.2/11.3.4/11.3.25	Sparse *Eucalyptus populnea* woodland on alluvial plains, sparse *E.tereticornis* and/or *Eucalyptus* spp. tall woodland on alluvial plains and mid-dense *E. tereticornis* or *E. camaldulensis* woodland fringing drainage lines.
11.3.2/11.3.25	Sparse *Eucalyptus populnea* woodland on alluvial plains and mid-dense *E. tereticornis* or *E. camaldulensis* woodland fringing drainage lines.
11.3.2/11.3.39	Sparse *Eucalyptus populnea* woodland on alluvial plains and sparse *E.melanophloia* +/- *E. chloroclada* open-woodland on undulating plains and valleys with sandy soils.
11.3.3/11.3.4	Sparse *E.coolabah* woodland on alluvial plains and sparse *E.tereticornis* and/or *Eucalyptus* spp. tall woodland on alluvial plains.
11.3.4/11.3.25	Sparse *E.tereticornis* and/or *Eucalyptus* spp. tall woodland on alluvial plains and mid-dense *E. tereticornis* or *E. camaldulensis* woodland fringing drainage lines.
11.3.4/11.3.26	Sparse *E.tereticornis* and/or *Eucalyptus* spp. tall woodland on alluvial plains and mid-dense *E.moluccana* or *E.microcarpa* woodland to open forest on margins of alluvial plains.
11.3.4/11.3.26/11.11.15	Sparse *E.tereticornis* and/or *Eucalyptus* spp. tall woodland on alluvial plains, mid-dense *E.moluccana* or *E.microcarpa* woodland to open forest on margins of alluvial plains and sparse *E.crebra* woodland on deformed and metamorphosed sediments and interbedded volcanics.
11.3.4/11.8.4	Sparse *E.tereticornis* and/or *Eucalyptus* spp. tall woodland on alluvial plains and sparse *E.melanophloia* woodland on Cainozoic igneous rocks (hillsides).
11.3.17	Sparse *E.populnea* woodland with *Acacia harpophylla* and/or *Casuarina cristata* on alluvial plains.
11.3.25	Mid-dense *E. tereticornis* or *E. camaldulensis* woodland fringing drainage lines.
11.3.25/11.11.4/11.11.15	Mid-dense *E. tereticornis* or *E. camaldulensis* woodland fringing drainage lines, sparse *E.crebra* woodland on old sedimentary rocks with varying degrees of metamorphism and folding. Coastal ranges and sparse *E.crebra* woodland on deformed and metamorphosed sediments and interbedded volcanics.
11.3.26	Mid-dense *E.moluccana* or *E.microcarpa* woodland to open forest on margins of alluvial plains.
11.4.8	Mid-dense *E.cambageana* woodland to open forest with *Acacia harpophylla* or *Acacia argyrodendron* on Cainozoic clay plains.
11.4.9	Mid-dense *Acacia harpophylla* shrubby open forest to woodland with *Terminalia oblongata* on Cainozoic clay plains.
11.5.2	Sparse *E.crebra*, *Corymbia* spp., with *E. moluccana* on lower slopes of Cainozoic sand plains/remnant surfaces.
11.5.2/11.9.1	Sparse *E.crebra*, *Corymbia* spp., with *E. moluccana* on lower slopes of Cainozoic sand plains/remnant surfaces and mid-dense *Acacia harpophylla*-*E.cambageana* open forest to woodland on fine-grained sedimentary rocks.
11.5.5	Sparse *E.melanophloia*, *Callitris glaucophylla* woodland on Cainozoic sand plains/remnant surfaces (deep red sands).
11.8.4	Sparse *E.melanophloia* woodland on Cainozoic igneous rocks (hillsides).
11.8.4/11.10.1	Sparse *E.melanophloia* woodland on Cainozoic igneous rocks (hillsides) and mid-dense *Corymbia citriodora* open forest on coarse-grained sedimentary

RE Code	RE Description
	rocks.
11.9.1/11.9.5	Mid-dense *Acacia harpophylla-E.cambageana* open forest to woodland on fine-grained sedimentary rocks and mid-dense *Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks.
11.9.5/11.10.1	Mid-dense *Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks and mid-dense *Corymbia citriodora* open forest on coarse-grained sedimentary rocks.
11.9.5	Mid-dense *Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks.
11.10.1	Mid-dense *Corymbia citriodora* open forest on coarse-grained sedimentary rocks.
11.10.1/11.10.13	Mid-dense *Corymbia citriodora* open forest on coarse-grained sedimentary rocks and mid-dense *Eucalyptus* spp. and/or *Corymbia* spp. open forest on scarps and sandstone tablelands.
11.10.13	Mid-dense *Eucalyptus* spp. and/or *Corymbia* spp. open forest on scarps and sandstone tablelands.
11.11.3/11.11.15/11.11.18	Mid-dense *Corymbia citriodora, E.crebra, E.acmenoides* open forest on old sedimentary rocks with varying degrees of metamorphism and folding (coastal ranges), sparse *E.crebra* woodland on deformed and metamorphosed sediments and interbedded volcanics and dense semi-evergreen vine thicket on old sedimentary rocks with varying degrees of metamorphism and folding.
11.11.4/11.11.15	Sparse *E.crebra* woodland on old sedimentary rocks with varying degrees of metamorphism and folding. Coastal ranges and sparse *E.crebra* woodland on deformed and metamorphosed sediments and interbedded volcanics.
11.11.15/11.11.18	Sparse *E.crebra* woodland on deformed and metamorphosed sediments and interbedded volcanics and dense semi-evergreen vine thicket on old sedimentary rocks with varying degrees of metamorphism and folding.
11.12.1/11.12.6	Sparse *E.crebra* woodland on igneous rocks and mid-dense *Corymbia citriodora* open forest on igneous rocks (granite).
12.1.3	Dense mangrove shrubland to low closed forest on marine clay plains and estuaries.
12.3.3/12.3.7	Mid-dense *E.tereticornis* woodland to open forest on alluvial plains and mid-dense *E.tereticornis, Melaleuca viminalis, Casuarina cunninghamiana* fringing forest.
12.3.7/12.3.11	Mid-dense *E.tereticornis, Melaleuca viminalis, Casuarina cunninghamiana* fringing forest and mid-dense *E. tereticornis, E.siderophloia, Corymbia intermedia* open forest on alluvial plains near coast.
12.11.6	Mid-dense *Corymbia citriodora, E.crebra* open forest on metamorphics +/- interbedded volcanics.
12.11.6/12.11.14	Mid-dense *Corymbia citriodora, E.crebra* open forest on metamorphics +/- interbedded volcanics and sparse *E.crebra, E. tereticornis* woodland on metamorphics +/- interbedded volcanics.

Refer to the SSMP for detailed information on significant ecological communities present within the GTP ROW as well as mapping highlighting the location of each RE and its status within the GTP ROW.

4.2 Fauna

As part of the EIS process, fauna assessments of the mainland component of the GTP RoW were undertaken in 2008. During the survey periods, a total of 98 native and 8 introduced fauna species were identified from the GTP RoW. Additional surveys undertaken in 2010 detected an additional 220 native and 4 introduced fauna species within, and adjacent to, the GTP RoW.

The majority of the fauna species identified from the GTP RoW are listed as Least Concern under the provisions of the NC Act, and are not listed under the provisions of the EPBC Act. However, there are a number of EVNT fauna species known within the Project footprint, including the Powerful owl (*Ninox strenua*), Squatter pigeon

(*Geophaps scripta scripta*), Golden-tailed gecko (*Strophurus taenicauda*) and Brigalow scaly-foot (*Paradelma orientalis*).

Further detail regarding the EVNT species known or likely to occur within the GTP RoW is provided in the EIS, SEIS, SMP and SSMP.

4.3 Watercourse and wetlands

The project area encompasses the catchment areas of Dawson, Comet and Calliope Rivers, and extends into tidal creeks and wetlands of Port Curtis.

Within these three catchments, the proposed corridor traverses 183 watercourses. DERM has assigned each watercourse a Stream Order (SO) number from 1 to 8, based on its position within the catchment. The major watercourses intersected include the Dawson River (SO 8 and 5) and Calliope River (SO 5) and Hutton (SO 6), Clematis (SO 5), Callide (SO 5), Baffle (SO 4) and Larcom (SO 3 and 4) Creeks.

The GTP RoW also intersects the estuarine environs of Targinie and Humpy Creek and the intertidal wetlands (including seagrass, mangrove and saltmarsh communities) of Port Curtis (e.g. Kangaroo Island and Curtis Island).

4.3.1 Environmentally sensitive areas

To assist in minimising the impacts on the existing environmental values of the area, the Environmentally Sensitive Areas (ESAs) have been mapped. The ESAs within and adjacent to the GTP RoW include:

- TECs under the EPBC Act;
- Areas known to support EVNT species under the provisions of the EPBC Act and/or NC Act;
- Areas mapped as Endangered or Of concern REs under the provisions of the VM Act;
- Areas mapped as Essential Habitat under the provisions of the VM Act;
- Areas protected under the provisions of the NC Act and/or Forestry Act; and
- Riparian zones of watercourses with a Stream Order equal to or greater than 3.

Where possible, these areas will be avoided, or measures will be implemented, prior to and during construction, to minimise potential impacts (e.g. a maximum clearing footprint of 30 m).

Specific management measures for ESAs are outlined in the SSMP.

4.3.2 Agricultural Land Use

An assessment of the agricultural land capability of the area was conducted during the EIS (URS, 2009) to provide a benchmark of existing/potential agricultural land use. Land within the study area was identified in accordance with State Planning Policy 1/92: Development and the Conservation of Agricultural Land. The assessment was based on the four class system for defining Good Quality Agricultural Land (GQAL) as detailed in the Planning Guidelines - Department of Primary Industries (DPI) and the Department of Housing Local Government and Planning (DPI/DHLGP - 1993).

All Class A land is considered to be GQAL. In some areas, Class B land (where agricultural land is scarce) and better quality Class C land (C1) (where pastoral industries predominate), are also considered to be GQAL. For the Mainland GTP RoW, Classes A, B and C1 are considered to be GQAL.

The Mainland GTP RoW traverses GQAL land classes A through to D. Significant lengths of Class A and B land is traversed in the Arcadia Valley and East of the Dawson Highway to North of Burnett Highway. The majority of land intercepted by the Mainland GTP RoW is classified as Class C.

It has been calculated that approximately 7.4% of the GTP RoW will pass through Class A land; approximately 9.6% will pass through Class B land; and approximately 77.6% will pass through Class C land (with 34.9% of that being Class C1). The remaining mainland GTP RoW will pass through Class D non-agricultural land.

5. Impacts

The construction of the GTP ROW will create a linear disturbance across several landscape types. The GLNG EIS and SEIS identify the adverse and beneficial impacts associated with the construction and operation of the GTP ROW. Key examples of the short and long term impacts pertaining to landscaping and rehabilitation within and adjacent the GTP ROW are summarised in table 2 below.

Table 5.1 Impacts

Aspect	Impacts
Negative Impacts	
Vegetation clearing as a result of bulk earthworks (e.g. excavation, clearing quarrying etc.).	• Potential to alter the biodiversity, distribution and dynamics of the existing environment through: - Fragmentation of vegetation communities - Loss of habitat and microhabitats (flora and fauna) - Loss of local faunal and floral populations, including threatened and significant species - Loss of riparian vegetation - Establishment of pest and weed species in sensitive environs (increase in weed proliferation) - Loss of topsoil and increased erosion - Sedimentation into waterways resulting in a decrease in water quality - Subsequent salinity issues or a rise in the watertable - Increase in likelihood of disturbing acid sulphate soils - Reduction in buffering capacity particularly in or adjacent sensitive areas.
Topsoil removal and/or loss as a result of bulk earthworks (e.g. excavation, clearing etc.).	• Loss of soil seed bank. • Sedimentation into waterways resulting in a decrease in water quality. • Increase in likelihood of disturbing acid sulphate soils.
Chemical use	• An increase in chemical use (i.e. pesticides) may reduce food sources for some fauna species (i.e. moth/insects and other invertebrates). • Potential for bioaccumulation within the food chain. • Impact on local pollinators which are required to help maintain ecosystem function.
Positive Impacts	
Propagation of endemic species for rehabilitation activities (e.g. revegetation, seeding, weeding etc.)	• Potential to enhance the local biodiversity of the area through: - Strategic revegetation of and provision of artificial fauna furniture, such as glider poles, bat boxes and nests in potential corridors (to re-create linkages) - Recreating vegetation communities lost as a result of construction clearing - The enhancement of habitat and associated foraging resources for native fauna.
General landscape works (revegetation, seeding, weeding etc.)	• The use of locally native plant species to minimise the risk of introducing 'problem' species. - Enhance soil stability and structure - Enhance water retention in soils to encourage water table stability - Improve aesthetic/visual value to the area - Improve air quality.

6. Pipeline operational and decommissioning phase rehabilitation objectives

Australian Standard AS2885, Part 3: Vegetation on or near the pipeline states:
Unless approved, vegetation shall be restricted to allow free passage along the pipeline route. Vegetation, whose roots may damage the anti-corrosion coating of the pipeline, shall not be permitted in the vicinity of the pipeline.

The APIA Code of Environmental Practice – Onshore Pipelines states: *Vegetation management – Environmental management; Management Measures: Regrowth vegetation on the pipeline easement shall be maintained to ensure root systems do not create a safety risk to the pipeline. The width of vegetation removal (i.e. the distance cleared on either side of the pipeline centreline) should be the minimum extent reasonable necessary to ensure the safe operation of the pipeline.*

In line with the Australian Standard and APIA Code of Environmental Practice requirements stated above, rehabilitation following construction of the pipeline must allow for the protection of the pipeline integrity and ensure permanent access to the pipeline for monitoring and maintenance purposes whilst it is in operation. Subsequently rehabilitation objectives for the operational phase will restrict vegetation growth to allow for understorey species and mid-level species to return within 10m of the pipeline.

On decommissioning of the pipeline, rehabilitation to pre-clearance conditions will be undertaken within all previously restricted vegetation growth areas, in accordance with EPBC Act Approval Condition 3d.

7. Implementation and Management Strategy

A rehabilitation strategy has been developed and is detailed below. The strategy ensures that rehabilitation objectives are met for the range of land uses and disturbance levels for the lifespan of the pipeline.

7.1 Pre-clearance Survey

Prior to construction, a pre-clearance survey will be undertaken in accordance with EPBC Act Approval Condition 3(a). During the pre-clearance survey, information to document the condition and value of a site prior to disturbance, including habitat resources, species composition and level of disturbance will be collected.

7.2 Benchmark Guidelines

A range of benchmarks will be selected to guide rehabilitation for broad ecosystems, including pasture grasses, identified in the RoW. Benchmark guidelines provide a summary of the key condition indicators of a range of vegetation and grazing communities.

Benchmarks provide information on the best condition on offer for each broad ecosystem, and are considered to be the minimum target for rehabilitation. This information is designed to be supplemented by the pre-clearance survey, and provide a means to rehabilitate disturbance areas to better than pre-clearance condition.

The pre-clearance survey includes methods to select the appropriate benchmark guideline.

7.3 Operational Safety requirements

In accordance with Australian Standard AS25884, Part 3 and The APIA Code of Environmental Practice – Onshore Pipelines (Refer to Section 6) operation safety requirements must be considered when determining rehabilitation criteria. Trees with large root balls (such as *Ficus sp.*) pose a risk to the structural integrity of buried infrastructure. To ensure compliance with AS2885 (Part 3, Section 6.4.4), vegetation will be restricted to allow free passage along the pipeline route. Vegetation who roots may damage the anti-corrosion coating of the pipeline shall not be permitted in the vicinity if the pipeline during the operational phase of the pipeline.

In order to ensure operational safety, vegetation species used to rehabilitate the RoW will be limited to species less than 10 to 12 m in height. In areas where RE communities are to be rehabilitated, understorey species and mid level species of pre-disturbance RE communities will be returned to the RoW.

To ensure compliance with EPBC Act Approval Condition 3d, pre-clearance conditions will be rehabilitated within these restricted areas on decommissioning of the pipeline.

7.4 Landholder Rehabilitation requirements

A Construction Line List (CLL) has been prepared detailing a number of commitments which GLNG has made to Landholders whose property is intersected by the GTP RoW (and/or ancillary sites). A number of the CLL commitments relate to specific site rehabilitation actions, which fall in to the following broad groups:

- Vegetation: Re-seeding (seed mix type); arrangements for relocation of cycads, grass trees and orchids, weed prevention;
- Disturbed soils: Restoration of land condition; prevention of soil erosion; soil compaction; soil inversion; soil subsidence; sink holes; surface disruption; provision of contour banks/whoo boys;
- Infrastructure: Fencing and gates; installation of Cathodic Protector posts; construction of water tank pad, relocation of dam) and
- Stockpiling of materials: Excess excavated materials and timber for reuse by landowner.

All CLL commitments must be actioned within the relevant land tenures prior to transferring decommissioned areas to Landholders. Where landholders have not specified additional rehabilitation requirements, land will be restored to its pre-disturbance land use.

7.5 Rehabilitation Schedules

Rehabilitation schedules will be developed based on benchmark guidelines for each disturbance type and broad land use (vegetation or agriculture), and include specific objectives and performance criteria to ensure disturbed sites are rehabilitated to a pre-disturbed condition.

The rehabilitation schedules will include performance measures and related monitoring actions to assess site rehabilitation, as well as provisions for reporting on the implementation of the LRMP including monitoring and performance to a standard which can be independently audited.

Rehabilitation schedules will include site remediation measures by stage of development (e.g. pre-construction, construction, post-construction, and decommissioning), as well as the inclusion of timeframes and standards for conducting rehabilitation activities.

The schedules will provide practical rehabilitation measures to support recovery of EVNT species habitat and recovery of TEC, in line with the SSMP, as well as recovery plans provided by SEWPaC and DERM.

7.5.1 Performance criteria

Performance criteria will be developed for each rehabilitation schedule in order to meet the overarching rehabilitation objectives of providing a safe, stable and non-polluting landform.

In order to comply with the EPBC Act Approval, CG Conditions and EA Conditions, standard performance criteria for vegetated sites (including TEC, RE and HVR vegetation) include the representativeness of species richness and diversity for the appropriate benchmark. Specific criteria to support the recovery of TEC, RE and significant species habitat will also be included within each rehabilitation schedule.

Standard performance criteria within agricultural sites across the Project area include:

- Plant survival, height, recruitment and richness;
- Stability of landform;
- No declared weeds occurring;
- Pasture species richness representative of pre-disturbed condition;

- The preservation of inherent GQAL agricultural land use classes; and
- Pasture diversity, quality and productivity rehabilitated to pre-disturbance benchmarks.

8. Management Requirements

While the rehabilitation schedules will determine the detailed management measures, the following general measures will be incorporated to the guidelines:

Table 7.1 Mitigation and Management Measures relevant to Landscape and Rehabilitation Works

Actions	Timing
• All landscaping and rehabilitation works will comply with relevant statutory conditions and guidelines (e.g. EPBC and NC Act approval).	At all times
• Where applicable, all landscaping and rehabilitation works will be consistent with measures outlined in the SSMP and SMP.	At all times
• Landscaping and rehabilitation personnel will be suitably qualified and experienced to undertake the works.	At all times
• Landscaping rehabilitation personnel will be educated on potential risks to native wildlife which may inhabit the area as per the SMP and SSMP.	Prior to and during works
• A pre-clearing survey of the GTP ROW will be undertaken to document the existing condition of the vegetation communities to be impacted as a result of clearing works. The survey will document (including photologging) all environments relevant to the landscape and rehabilitation works, including: - Topsoil and landforms - Drainage - Vegetation - Environmentally Sensitive Areas • The survey will also include undertaking cross sections to record existing surface level and contours.	Prior to works commencing
• Development of any Special Area plans will be undertaken in consultation with Councils, landowners, DERM, DTMR, DEEDI as necessary.	Prior to works commencing
• Consultation with the design civil engineers and landscape architects prior to finalising planting design will be undertaken where applicable.	Prior to works commencing
• Where applicable, compliance with the Road Landscaping Guidelines (DMR, 2004) will be undertaken within rehabilitation works within a road reserve.	At all times
• Where applicable, compliance with other stakeholder requirements including local government authorities (local government controlled roads), Energex and/or Powerlink and QR National (rail corridors) will be undertaken.	At all times
• The Principal shall organise for Type A flora pursuant to the NC Act to be translocated or salvaged. This may involve the relocation of specimens to an interim area (e.g. for orchids a bushhouse facility) until rehabilitation works are mature enough to accommodate translocated individuals.	Prior to works commencing
• The Principal Contractor will be responsible for organising the collection of any seeds and/or propagules from locally native flora (least concern) within the project area for use in the rehabilitation works. This includes flora associated with threatened ecological communities present within the GTP ROW. The Proponent will be responsible for the collection of any significant flora seeds and/or propagules for any translocation, offset and management works (those protected under the NC Act). Seed collection will be undertaken in accordance with seed collection guideline document: Model Code of Practice, Florabank Guideline 6: Native Seed Collection Methods.	Prior to works commencing
• All growing facilities must adhere to Australian phytosanitary standards and guidelines.	At all times
• Where enhancement plantings are required, a planting and/or seeding plan	Prior to works commencing

Actions	Timing
will be developed based on the geology, soil description, pre-existing and existing floristic composition and vegetation characteristics and landholder preferences.	
• Monitoring points will be strategically located and set up prior to rehabilitation works commencing. This will include but not be limited to the establishment of permanent photologging points for monitoring purposes. Monitoring and photologging stations will be set up at locations that include the locations where photos and data were collected prior to disturbance.	Prior to works commencing
• Clearing is a last resort. The retention of vegetation, selective clearing, trimming and fauna spotting is the first priority.	Construction Phase
Stockpiling of topsoil for reuse during rehabilitation works is to be undertaken. Ensure that stockpiles are separated from subsoils and covered as appropriate, or that appropriate erosion and sediment controls are in place to avoid erosion and sediment runoff.	Construction Phase
• Topsoil stockpiles shall preferably be no more than 2 m high and 50 m wide. Variation to this standard is subject to approval by the Environment Manager.	Construction Phase
• Topsoil that is stockpiled for greater than Six (6) months must be managed to minimise erosion.	Construction Phase
• Topsoil stockpiles shall be seeded if left for more than 12 months.	Construction & Operational Phases
• Relocate tree hollows and other microhabitats (e.g. rocky outcrops) to suitable sites outside the clearing footprint. This is to be determined in consultation with an ecologist and where necessary, landholders.	Prior to and during works
• Weather permitting, rehabilitation and reconsolidation of impacted watercourses shall commence immediately after the pipeline has been lowered in and backfilled. This will include early rehabilitation of riparian buffers will occur in order to restore natural stream functions and aquatic habitats	Construction & Operational Phases
• Where appropriate, rehabilitation of the bed and bank structure such that original dimensions and shape of the creek or spring are achieved. Bank re-contouring should include stabilisation methods (crib walls or soil wraps).	Construction & Operational Phases
• Where possible, promote a heterogeneous substrate in watercourse crossings, including : - Replace large woody debris to stabilise banks and also to provide in-stream complexity; and - Use a combination of rocks, gravel and/or cobbles, etc. in the stream bed. • The use of large rocks and logs to moderate flows.	Construction & Operational Phases
• Salvaging of existing bed material prior to the construction and placing it back into the creek or spring at completion of construction. If the existing bed material is unable to be salvaged, a comparable sediment sized material is recommended to cover the bed and should be approximately 10 cm thick. If the sediment is fine (mud/silt), it is recommended that the bed material be replaced with sand to prevent future erosion. If the sediment is coarser (gravel, cobble, pebbles), new material must be washed prior to placing in the creek (as usually, new coarse substrate is covered in a fine dust, which will become suspended in the water).	Construction & Operational Phases
• Soils will be graded away from the watercourses, not towards it. Graded soil shall not be stockpiled where it has the potential to result in sedimentation or acidification of land or surface water (e.g. on slopes which drain immediately to a watercourse).	Construction & Operational Phases
• Weather permitting, rehabilitation of the GTP ROW shall commence within 3 months from the completion of the pipeline construction. Revegetation shall be consistent with the plant density, floristic composition and distribution of the adjacent remnant communities and where possible, should encourage the	Construction & Operational Phases

Actions	Timing
natural re-establishment of significant species and ecological communities into the disturbed areas.	
• The GTP ROW will be re-profiled to original or stable contours, including re-establishing watercourses, wetlands, overland flow paths and other topographic features, immediately after the pipeline has been lowered in and backfilled.	Construction & Operational Phases
• Erosion and sediment control measures will be implemented in accordance with the Erosion and Sediment Control Plan.	At all times
• Activities will be conducted in accordance with EHS04 (*Waste Management*) to ensure appropriate mitigation measures are implemented in the management of waste.	At all times
• Areas of the GTP ROW may be deep ripped prior to reapplying topsoil.	Construction & Operational Phases
• Subsoil will be respread over the GTP ROW and compacted over the trench, including contouring works, immediately after the pipeline has been lowered in and backfilled.	Construction & Operational Phases
• After subsoil respreading and compaction, topsoil will be respread over the GTP ROW and left with a slightly rough surface.	Construction & Operational Phases
• Cleared native vegetation will be respread over the GTP ROW to assist in seed stock distribution. This action will be undertaken in a manner which does no promote erosion or subsidence.	Construction & Operational Phases
• Native woody debris, which is not to be used in habitat rehabilitation works, will be mulched and respread across the GTP ROW. The mulch material will be used to filter out sediments and also in planting works.	Construction & Operational Phases
• Where necessary imported topsoil, which is of appropriate quality and weed and fire ant free, will only be used with landholder approval.	Construction & Operational Phases
• Where necessary, fertilisers and soil supplements will be only be used with approval from local landholders and authorities.	Construction & Operational Phases
• A maximum of 10 m will be maintained along the GTP ROW for access. No planting of deep-rooted trees within 3 m of the pipe will occur to maintain pipe integrity (Refer to Section 6 & 7). • Within 10m of the pipeline, rehabilitation objectives for the operational phase will allow vegetation growth of understorey species and mid-level species to return.	Operational Phase
• Re-establish or enhance the habitat of a significant species known or likely to occur within the GTP ROW prior to clearing activities (especially where the construction clearing activities have affected such habitat (Refer SSMP)).	Construction & Operational Phases
• Preserve specific European and indigenous heritage that has been registered for the site (note that these values are managed under other legislation).	Construction & Operational Phases
• The natural regeneration of native species will be encouraged (in particular, groundcover and shrub species). However, seeding will be utilised in areas where rapid restoration is required (e.g. watercourse crossings and areas of high erosion potential).	Construction & Operational Phases
• Reseeding will be undertaken using native species only for areas of high value regrowth and regional ecosystems. Reseeding using non-native species may be used on pastoral grasslands and cropping land only and within these areas reseeding will be undertaken as per the landholder's requirements.	Construction & Operational Phases
• Where natural regeneration is not successful, establish vegetation communities to a condition at least equivalent to the ROW condition prior to commencement (especially where native vegetation is the proposed land use), taking into consideration the constraints.	Construction & Operational Phases
• Maintain a mosaic vegetation structure, including planting of different aged plants.	Operational Phase

Actions	Timing
• Any 'temporary'[4] vegetation is to be locally native. If this is not achievable, other native plants from the bioregion are to be used. Any proposed species substitutes are to be approved by the Principal prior to planting.	Construction & Operational Phases
• Vegetated buffers are to be established at sufficient height and width to provide a wind break and visual screening along the boundaries between stockpiles and sensitive receptors.	Construction & Operational Phases
• Use foraging and habitat tree species in planting works for fauna such as koalas, gliders and Glossy-black cockatoos.	Operational Phase
• Place artificial nest and/or bat boxes in suitable sites outside the clearing footprint and within rehabilitated areas.	Construction & Operational Phases
• In consultation with an ecologist, erect glider poles and other measures (e.g. timber poles to allow semi-arboreal and arboreal species to escape predators) in the GTP ROW (especially in areas of remnant vegetation adjoining the Jemena Pipeline) to facilitate fauna movement (e.g. Expedition Range).	Construction & Operational Phases
• Re-establish large woody debris and rocky outcrops within rehabilitated areas to create stepping stones for fauna and also microhabitats.	Construction & Operational Phases
• Planting of frangible species, where required, to comply with safety requirements will be undertaken.	At all times
• Where applicable, maintain adjacent high tide banks with intertidal species.	At all times
• It is considered that the most appropriate method to regenerate large areas of intertidal wetlands is through natural regeneration. This should be achieved through regular weed control, maintaining existing tidal regimes, and mitigating issues with ASS.	Construction & Operational Phases
• If natural re-colonisation of intertidal communities does not occur within 12 months, manual planting may be required. This will be subject to consultation from DEEDI.	Operational Phase
• Watering of revegetated areas shall be carried out to maintain soil moisture content to no less than PAW[5] during the establishment period.	Construction & Operational Phases
• Weed species will be managed as per the Weed and Pest Management Plan. However, as a general rule, weed management should occur prior to and during the rehabilitation planting to encourage rehabilitation success.	At all times
• All waste materials and equipment will be removed from the GTP ROW and associated laydown areas once construction is completed. This includes disused sediment fences.	Construction & Operational Phases
• Rehabilitated areas shall be clearly marked with appropriate signage, "Revegetation Area No Unauthorised Access".	Construction & Operational Phases
• Vehicles will be confined to designated maintenance access tracks within GTP ROW.	At all times
• Where appropriate, rehabilitation areas will be fenced to exclude cattle and other threatening processes. Fencing will only be undertaken with landholder approval.	Construction & Operational Phases
• Avoid the use of barb wire when erecting any Project related fencing. Where barb wire fencing is unavoidable the top strand will be high tensile steel (non-barbed wire) to avoid fauna getting caught and tangled in the barbs.	At all times
• Driving vehicles on freshly topsoiled sections of the GTP ROW will be prohibited.	Construction & Operational Phases
• Temporary access tracks have been selected to minimise or eliminate the need for any clearing, and are all based on the route of existing	Operational Phase

[4] 'Temporary' vegetation will be used to stabilise temporary banks/stockpiles and will be removed and re-established as native vegetation post construction.
[5] Plant available water. The portion of water in a soil that can be readily absorbed by plant roots. That soil moisture held in the soil between field capacity and permanent wilting point (DMR 2008).

Actions	Timing
tracks. Where a previously cleared alternative feasible route to a portion of an access track was identified as representing a lesser impact (e.g. around a patch of significant vegetation), this was selected in preference to the original route. The selection process for temporary access tracks has minimised any requirement for clearing of remnant vegetation in particular, by utilising alternative existing tracks where practicable, or by selecting routes which have previously been cleared. Where clearing is required, this is likely to be minimal, in the order of 0.5 m to 1.0 m width of clearing. Where clearing is required for the construction or maintenance of temporary access tracks, reinstatement and rehabilitation to pre-clearance conditions will be undertaken or, for cropping and pastoral land, as agreed with the landholder. Rehabilitation actions will consist of stabilisation of soils and reseeding, ensuring that the track is left in a stable condition. Where minor clearing of remnant or high value regrowth is necessary, any cleared areas will be revegetated with equivalent vegetation using locally collected seed.	Operational Phase
• Where non-public access routes are to be retained, the entrance will be disguised.	Construction & Operational Phases
• Monitoring the success of rehabilitation strategies will be undertaken as per the Principal Contractors LRMP with the findings reported to Principal. Monitoring and reporting should occur at the same time each month for the first 2 years.	Construction & Operational Phases
• Ongoing monitoring of the fauna measures implemented during construction to facilitate fauna movement and colonisation. This includes checking the nest and bat boxes, the success of gliders poles and the colonisation of fauna in rehabilitation areas.	Operational Phase
• Implement corrective actions where necessary if the performance objectives are not being achieved. This will include replanting of species which have not survived, installation of additional controls if erosion is occurring etc.	Operational Phase
• In accordance with EA condition E36, rehabilitation can be considered successful when the site can be managed for its designated land-use without any greater management input and there is evidence that the rehabilitation has been successful for at least 3 years.	Operational Phase
• A further review will be undertaken at the time of decommissioning to determine an appropriate rehabilitation policy in accordance with best practice at the time.	Decommissioning Phase
• On decommissioning, land will be rehabilitated to a level consistent with the pre-clearance condition.	Decommissioning Phase
• On decommissioning, the Pipeline will remain in situ and all above ground infrastructure will be removed by cutting at ground level. The decommissioned Pipeline will be inert and at atmospheric pressure, thus presenting negligible environmental impact and low environmental risk.	Decommissioning Phase
• During decommissioning phase rehabilitation, vegetation with large root balls (i.e. trees greater than 10 m) will be re-established within the RoW. This type of vegetation will be restricted during the operational phase to protect the structural integrity of the pipeline. Revegetation of these species may be undertaken through passive (i.e. allow for the natural encroachment of the species) or active (i.e. planting/seeding) methods depending on best practice at the time of rehabilitation.	Decommissioning Phase
• Risks and impacts during decommissioning of the pipeline will be limited to weed, vegetation and waste impacts. • Impacts will be managed in accordance with the Project Pest and Weed Management Plan and Waste Management Plan. • Should there be a requirement to clear vegetation to access the RoW to	Decommissioning Phase

Actions	Timing
remove above ground infrastructure, areas of impact will be rehabilitated to pre-clearance condition in accordance with the rehabilitation management plan. • Management plans will be reviewed and amended at the time of decommissioning to adopt current best practice.	

It should be noted that failure to comply with the mitigation measures outlined in this plan will result in the Principal Contractor being responsible for any and all mitigation costs associated with that non-conformance.

9. Constraints

Rehabilitation of the GTP ROW will vary between areas depending on the level of clearing, the vegetation and habitat complexity and composition within each area, landholder requirements as well as the ongoing operation and maintenance requirements.

In addition, there are several constraints that will influence the rehabilitation works along the GTP ROW. These constraints are outlined in Table 8.1 below.

Table 8.1 Constraints and Actions

Constraint	Action
Weather	The success of the rehabilitation strategy will be dependent on weather conditions during and post construction (e.g. recent flooding in the last year along sections of GTP ROW and prior to this the extended drought conditions).
Land Owner Negotiations/ Requirements.	Interference to landholder activities will vary according to the level of impact caused by the construction of the pipeline, type of activities being undertaken and the duration of the work on a landholder's property. Each landholder will be consulted prior to the works being undertaken to identify specific requirements and outcomes. Temporary provisions, such as fencing, driveways or stock access to water, will be discussed with each landholder. Reinstatement of cropping and pastoral grasslands will be as required by landowners. However rehabilitation of all Regional Ecosystems, high value regrowth areas and native vegetation not classified as either of these categories will be restored to its pre-disturbance condition during the decommissioning phase, in accordance with 3d of the EPBC Act conditions. Every effort will be made to minimise the impacts to landholders by limiting the area of works, using existing tracks which avoid homesteads and minimising the amount of time the trench is left open.
Off-set Distances from Pipeline (operational phase)	The Operator of the pipeline will need to ensure that the structural integrity of the pipeline is maintained (Refer to Section 6.3). In this regard, planting in close proximity to the pipeline must consider the root system of the chosen plant species. While trees and deep-rooted vegetation cannot be re-established directly across the pipeline (due to potential damage to the corrosion protection systems), grassland re-establishment and return of native understory/ mid level species will be undertaken. Habitat will be re-established as much as practicable through installation of glider poles, nest boxes, woody debris, logs, hollows etc.,
Other infrastructure	The GTP ROW intersects other linear infrastructure, including power lines, roads and rail lines. Rehabilitation in these areas will need to be in accordance with the relevant stakeholders requirements for operations and maintenance.

Fencing/ Property Boundaries	Dependent on the outcomes of discussion with relevant landholders. However, preference will be to use wire (non-barbed) fencing with a plain wire strand on the top.
Weed Infestation Areas	Some areas along and adjacent the GTP ROW are heavily infested with weeds. The level of rehabilitation will be assessed in site-specific rehabilitation plans to ensure no spread of infestation.
Maintenance Tracks	An access track will be required along the pipeline route within the ROW for ongoing operations and maintenance. Some additional works may be required to access the ROW - these will be determined as construction works progress.

10. Rehabilitation completion criteria

Rehabilitation completion criteria will be dependent on the vegetation communities and land uses prior to clearing, pre-existing health and integrity of the landscape and landholder requirements. Therefore specific completion criteria for determining when a site has been completely rehabilitated will be specified within specific rehabilitation schedules.

However, the overall aim of the rehabilitation works is to rehabilitate impacted environs to as a minimum, their pre-existing condition. This is a particular prerequisite for all significant ecological communities, protected areas and other sensitive areas identified within the GTP ROW.

General guidelines on heights, canopy cover and potential complexity have been briefly discussed below to provide direction for desired outcomes.

Barrier plantings
The objective of the barrier plantings is to minimise weed infiltration into areas of considerable conservation value. The width of these plantings should be a minimum of 20m with a minimum density of 70% foliage cover.

Riparian zone
The vegetation within the riparian zone of a watercourse should achieve high densities, particularly in the lower stratum in order to keep weed infiltration to a minimum. The upper stratum in some instances may take on the structure of an open or closed forest community.

Samphire and mangrove communities
Optimum outcome for these communities is to be free of introduced weed species and to be further enhanced through natural regeneration. The structural formation of a closed samphire community would consist of approximately >80% foliage and surface cover (Attiwill and Wilson 2003).

Woodland
The structural formation of woodland generally consists of approximately 10-30% foliage cover and 20-50% foliage cover in the canopy (Confinas and Creighton 2001). The species complexity of woodland communities is highly variable due to factors such as aspect, rainfall and soil type. However as a guide, sclerophyllus woodlands containing an acacia understorey are likely to achieve the 30% foliage cover if fire and other disturbance factors are maintained.

Open forest
The structural formation of an open forest generally consists of approximately 30-70% foliage cover, 50-80% crown cover in the canopy and tree heights ranging between 10-30m (Confinas and Creighton 2001).

Closed forest
The structural formation of a closed forest generally consists of approximately 70-100% foliage cover, 80-100% crown cover in the canopy and heights of <30m (Confinas and Creighton 2001).

Landforms

Pre-existing surface levels will be reinstated.

Open Areas and Agricultural Areas
The level of rehabilitation within these areas will be determined in consultation with the individual landholders. It is likely that rehabilitation will involve normal agricultural seeding, hydro-seeding or basic hydromulching techniques to return the pre-existing ground cover (or an appropriate or preferred replacement) to the site.

Habitat Rehabilitation
Habitat rehabilitation will be implemented along the GTP ROW to facilitate fauna movement and re-colonisation of the ROW. The following habitat features will be considered:

- Replacement of hollows, large woody debris in adjacent habitats and within the GTP ROW (subject to landholder permission);
- Placement of artificial structures, including bat and nest boxes and glider poles, at key locations to facilitate fauna movement and recolonisation;
- Bee hives for native bees dependent on the existing distribution and abundance; and
- Feeder and/or habitat trees for key species and migratory birds.

In determining whether the completion criterion is met, the following factors will be used:

- The similarity between the rehabilitated landforms and the natural landforms in adjacent areas;
- The stability of the landform and its resistance to erosion;
- Whether appropriate drainage patterns have been developed either naturally or through shaping activities during the rehabilitation programme;
- The degree to which the surface conditions are conducive to plant establishment;
- Whether the site conditions and existing habitat components provide resources, including for fauna movement, foraging habitat and/or shelter;
- Compliance with the relevant standards; and
- Public safety issues (e.g. signage, fencing etc.).

11. Training and awareness

11.1 Project Personnel induction

In accordance with Santos Management Standard EHSMS06, all personnel and visitors are required to undertake appropriate environmental training and induction programs.

As part of the training programme, all project personnel[6] are required to complete site specific environmental awareness training which is to be conducted by the EO. As a minimum, the training will consist of a presentation and an assessment questionnaire. The site induction will address the following.

- Fauna and flora likely to be present within the corridor, including significant species (awareness training);
- Location of sensitive areas (e.g. wetlands and habitat trees);
- Landholder constraints;
- Vegetation protection areas and no go zones;
- Procedures and actions associated with encountering fauna;
- Threatened species habitat areas;
- Weed identification and control; and
- Responses and reporting of environmental issues.

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

[6] Project personnel include all staff, contractors and consultants that may undertake onsite works.

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

12. Monitoring and Maintenance

A rehabilitation monitoring and maintenance plan will be developed to complement each rehabilitation schedule. Monitoring of the rehabilitated GTP RoW is required every 20 days for the first 120 days, and annually for the first five (5) years following completion of rehabilitation, in accordance with the EA, Schedule J22-J24. The monitoring and maintenance plan is designed to be flexible to allow adaptations for natural disasters such as fire, drought and flood.

All monitoring will be undertaken by a suitably qualified person (EA Schedule H12).

Monitoring periods may require extension in the case of ineffective rehabilitation or natural disasters impeding rehabilitation efforts. Where monitoring extensions are required, it will be recorded and implemented by GLNG.

Specific monitoring criteria will be outlined within each rehabilitation schedule, reflective of the performance criteria. Generally, the following indicators will be monitored:

- Indicators of growth and survival of all plantings;
- Plant height;
- Native species richness;
- Evidence of recruitment;
- Native species cover;
- Weed control – extent of declared and environmental weeds and adequacy of treatment, as well as any secondary weed responses to treatments;
- Indicators of the presence of EVNT species and / or key habitat features (as per SSMP);
- Adequacy of site preparation, mulching, tree (and plant) protection and maintenance; and
- Landform stability – evidence of soil erosion as per the Soil MP and ESCM.

Monitoring will consist of vegetation surveys and photologging, monitoring locations established within representative areas of the GTP RoW and for each ancillary site. Monitoring locations are to be determined by the suitably qualified ecologist using BioCondition assessment methods (Nelder et al. 2011). This will include but not be limited to the establishment of permanent photologging points for monitoring purposes. Monitoring and photologging stations will be set up at locations that include the locations where photos and data were collected prior to disturbance. Where possible, monitoring plots will be established within the core of rehabilitation areas to avoid edge effects. Monitoring will take the impacts from seasonal variation into consideration.

Performance criteria to monitor the progress of each rehabilitation site will comprise of a combination of pre-clearing data and benchmark guidelines. It is noted that while three (3) years is insufficient time for rehabilitation to meet the benchmark guidelines, it is sufficient to ensure that rehabilitation is well established and regenerating, and an improvement in BioCondition scoring should be clearly evident. The progression and improvement of key rehabilitation indicators such as species composition and diversity, weed cover, and plant densities will be evident over a three (3) year period.

All monitoring results and records will be compiled and stored for a minimum of five (5) years and made available for inspection upon request, in accordance with CG Condition, Appendix 3, Part 4, Schedule J3.

13. Reporting and Record Keeping

A monitoring and evaluation report will include details on species survival, natural recruitment, percentage coverage of the rehabilitation area and percentage and species of weeds in the rehabilitated areas. In addition the following will also be recorded:

- Planning and impact assessment details;
- Activity site location and site access details;
- Commencement and completion dates;
- The area of native vegetation removed, and the amounts of material excavated and fill placed;
- The disposal location/s and quantity of spoil material removed;
- The disposal location/s and quantity of native vegetation removed;
- Impact management and rehabilitation details;
- Before, during and post activity photographs of the site;
- Any incidents of unanticipated failure of management methods and subsequent remedial action; and
- Any notable fauna activity will also be recorded.

In accordance with EA condition E36, rehabilitation can be considered successful when the site can be managed for its designated land-use without any greater management input and there is evidence that the rehabilitation has been successful for at least 3 years.

The Coordinator General Conditions, Appendix 3, Part 3, Condition 4g, state that:

For clearing impacts that result in permanent loss of least concern native plants (cannot be re-established within three (3) years of clearing or floristic modification), the permit holder must provide DERM with a written detailed report of permanent vegetation loss, including the area, species affected and mapping of affected areas, within twelve (12) months of completion of the pipeline construction (Note: this is in addition to the required Return of Operations).

In addition to complying with the above requirement, GLNG shall undertake a review of unsuccessful vegetation areas and provide management measures and revised timeframes to rectify issues and allow pre-clearance conditions to be achieved.

Species of Conservation Interest (SOCI) logbook
Species of conservation interest encountered during the landscape and rehabilitation works will be recorded in the Species of Conservation Interest (SOCI) logbook and mapped in the supporting ecological GIS database. The information collated in the SOCI will include:

- Location of the community or species;
- Person reporting the sighting;
- Habitat type the species was inhabiting or adjoining the area where;
- Total area cleared and time f the clearing works;
- Where necessary, where the species was relocated or translocated to;
- Incidents; and
- Remedial actions.

The records will also be made available to the DSEWPC and DERM upon request.

Annual Environmental Return
This information will support the Annual Environmental Return, which will be submitted to DSEWPaC electronically, within 20 business days of each anniversary date from the date of Commonwealth approval. The Annual Environmental Return will document the following information:

- Addresses compliance with these conditions;
- Detail any rehabilitation work undertaken in connection with any unavoidable impact on MNES;
- Detail all non-compliances with these conditions; and
- Detail any amendments needed to plans to achieve compliance with these conditions.

Any other landscape and rehabilitation related reporting will be conducted in accordance with the relevant approval conditions.

Incidents

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

Revision

All environmental management plans, including the LRMP will be reviewed and updated as required during the life of the Project. When the LRMP is updated, the reviewed plans will be submitted to SEWPaC for approval (EPBC Act Condition 31). Updates to the LRMP may be required due to:

- Changes in EVNT flora and fauna species;
- Changes in TECs;
- Updates to related plans, including the SSMP, SMP, and ESCM;
- Revisions to databases and datasets, including data provided by DERM such as REs, High Value Regrowth (HVR), and Wildlife Online records;
- Amendments to EAs;
- Amendments to legislation;
- At the request of the State or Commonwealth Governments; and
- Following periodic internal review of the LRMP.

Data collected as part of rehabilitation monitoring will be used to satisfy the reporting requirements of the EPBC Act, EA and CG approval requirements. The information collected as part of monitoring will be assessed and summarised to provide an overview of rehabilitation progress within the GTP. Additionally, assessment of collected data will be used to identify any amendments required to the LRMP.

Table 12.1 outlines a review and reporting program for the LRMP document. The program includes provision for periodic review and revision as required. A revision register has been included at the beginning of this document to ensure all amendments are documented. Reporting timeframes will be tracked by GLNG.

Table 13.1 LRMP Review and Reporting Program

Timing	Requirement	Responsibility
Review		
Annual	Revision of LRMP framework, benchmark guidelines and schedules to ensure: • additional requirements / amendments to conditions are updated • changes in 'best practice' methods are included • feedback from rehabilitation successes and failures are reflected in the LRMP to ensure effective methods are highlighted	• GLNG • Suitably Qualified Restoration Ecologist
As requested by SEWPaC	• SEWPaC may request in writing for revisions to made to the LRMP	• As per SEWPaC request
Reporting		
Annual Environmental Return (AER) as per EPBC Act Approval (2008/4096) (Condition 62)	• Address compliance with the conditions • Include record of any unavoidable adverse impacts on Matters of National Environmental Significance (MNES), mitigation measures applied to avoid adverse impacts on MNES, and any rehabilitation work undertaken in connection with unavoidable adverse impact on MNES • Identify all non-compliance with the conditions and provide details regarding complaints • Identify any amendments needed to plans to achieve compliance with the conditions	• GLNG

Timing	Requirement	Responsibility
Annual Return for EA Conditions to DERM (Schedule J, Condition 8)	• Summary of rehabilitation actions, including monitoring and maintenance completed	• GLNG • Suitably Qualified Restoration Ecologist (or similar), that is either 'independent', or an 'other expert approved by SEWPaC
DERM Permanent Vegetation Loss report (CG Conditions: Appendix 3, Part 3, Condition 4(g))	• Where pipeline construction will result in the permanent loss of vegetation, a detailed report must be provided to DERM within twelve (12) months of the completion of pipeline construction	• GLNG • Suitably Qualified Restoration Ecologist (or similar), that is either 'independent', or an 'other expert approved by SEWPaC

14. Correction and Prevention

14.1 Preventative Actions

Preventative actions will be managed as follows.

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

14.2 Non-conformance

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

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

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

Where the issue impacts on a 3rd party (i.e. is outside the project area or in breach of regulatory conditions) the relevant EO will also issue an Incident Report. In addition to the above, where an issue of a more serious nature has been identified, the following will apply.

- Stop work;
- Implement an immediate action to rectify the incident and stop further damage;
- Report the incident;
- Identify corrective and preventative actions;

- If the incident impacts upon state or commonwealth interests, the incident report will also be forwarded to the relevant authority;
- The incident will be reported in monthly management reports; and
- Associated environmental issues and corrective actions will be tracked.

14.3 Contingency measures

The Proponent recognises that contingency measures and adjustments to the management strategies may need to be considered in the event that a detrimental impact is recorded, and/or performance measures or targets are not met. Where this occurs, DSEWPC, DERM and/or DEEDI will be consulted and contingency measures determined and implemented (where required).

14.4 Environmental incidents and Corrective Actions

All incidents in breach of state or commonwealth policy/regulations will be reported to the relevant regulatory authority within 5 business days.

Non-specific environmental incidents are discussed in detail in Section 9.5 of the relevant EMP. The incident reporting form will be located in the EMP.

Detailed below are actions that will be taken should an event relating to directly to flora and fauna occur.

14.4.1 Flora

If vegetation outside the approved GTP ROW is incorrectly cleared the following actions must occur:

- The EO must be notified immediately and a stop work must occur until the situation has been assessed and is given approval to proceed by the proponent;
- The Spotter catcher(s) will conduct a search for any injured or orphaned wildlife; and
- If native vegetation was impacted a report will be provided to DERM and management measures agreed.

14.4.2 Fauna

If a native animal is injured on site and where it is safe for staff and the animal, the animal will be bundled in a dry warm blanket or jacket and taken to a vet or approved wildlife carer (do not attempt to handle marine animals or platypus). If it is unsafe or not possible to bundle the animal then:

- The location of the injured animal will be identified/ marked so it can be found again. If the animal is moving, a note will be made of the direction in which it was headed;
- The species of animal will be identified if possible and its approximate size determined;
- The type of injury sustained will be identified if possible (without handling or causing the animal further stress); and
- The relevant EO will be contacted immediately to capture or organise the possible capture of the animal for transportation to a specialist veterinarian or wildlife carer.

The relevant EO shall immediately contact the following organisations listed in Table 7.1 and provide details of the last known location of the injured/dead animal.

Table 14.1 Contact Details in the Event of an Injury to or Death of Native Wildlife (incl. marine)

Organisation	Contact Details
The Proponent PEM	07 3838 3666
QPWS Gladstone Office or DERM	(07) 4971 6500 or 1300 130 372 (Option 3)

Following the capture/recovery of the animal, an investigation into the cause of the event will be undertaken within 72 hours including an assessment of the effectiveness of corrective and preventative actions currently in place.

Any corrective and preventative actions identified will be implemented. The risk register, relevant procedures and documentation (including this plan) will be reviewed and revised as is necessary.

In the event that a control measure appears to be ineffective, the measure will be adjusted in consultation with the DEWHA and/or DERM. This Plan will be updated if necessary to reflect any significant changes to control measures.

Prior to construction a list of suitably licensed and experienced wildlife carers, hospital and/or vets local to the project area will be developed and included within the SMP.

14.5 Emergency preparedness and response

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

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

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

15. Compliance and Evaluation

The compliance component of this Plan will be developed in accordance with the CEMP and State and Commonwealth Approvals.

15.1 Monitoring (Landscape and Rehabilitation)

Upon completion of the Management (monitoring) Strategy by the Principal Contractor, compliance and evaluation measures will be developed and incorporated into this Plan.

15.1.1 Inspection and surveillance

The monitoring of the landscaping and rehabilitation works will be ongoing from the first planting. Visual inspections will be undertaken regularly during construction and operational phases of the Project.

Following construction monitoring will be undertaken on a quarterly basis over the first 2 years of the Project and the monitoring will focus on key performance criteria developed for project and where necessary specific areas, including but not limited to:

- The physical stability of the rehabilitated areas;
- The biological structure of the vegetation community in rehabilitated areas (including the establishment of weed species);
- Water drainage from the site;
- Any public safety aspects;
- Non-conformances; and
- Monitoring of the rehabilitated areas shall ensure that any areas requiring remedial work are identified.

The rehabilitation programme shall be modified, as required, to address any conditions of approval and/or depending upon the findings of the monitoring programme results, including remedial works to action any non-conformances.

15.2 Ecological performance auditing

All monitoring required under this Plan will be compliant with relevant section of the CEMP and will be conducted by suitably qualified person, as per the Coordinator-General's Report.

The Proponent will conduct internal compliance audits of the implementation of Project environmental management commitments during the construction and operational phases, including.

- On-site audits of compliance with this management plan;
- Audits of contractors environmental management; and
- Work area inspections and monitoring.

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

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

15.2.1 External audits

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

The external auditors report must document the following:

- The components of the project being audited;
- The conditions that were activated during the period covered by the audit;
- A compliance/non-compliance table;
- A description of the evidence to support audit findings of compliance or noncompliance;
- Recommendations on any non-compliance or other matter to improve compliance;
- A response by the proponent to the recommendations in the report (or, if the proponent does not respond within 20 business days of a request to do so by the auditor, a statement by the auditor to that effect); and
- Certification by the independent auditor of the findings of the audit report.

Audits or summaries of audits carried out under these conditions, or under section 458 of the EPBC Act, may be posted on the Department's website. The results of such audits may also be publicised through the general media.

If during the auditing process, any non-compliance with the Commonwealth conditions are identified, DSEWPC will be provided with written advice within 20 business days of the audit report. The written advice will outline:

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

15.3 Non-compliance

Where non-compliance occurs with regard to the Commonwealth or any State conditions of approval, a report must be submitted to DSEWPC within 5 business days. The report will outline the type of non-compliance and the remedial actions taken to ensure that the matter is resolved within a reasonable time frame. The time frame will be specified in writing by DSEWPC.

Where non-compliance occurs with regard to the other relevant conditions of approval (e.g. NC Act), a report must be submitted to the relevant governing agency within the designated timeframe. The report will outline the type of non-compliance and the remedial actions taken to ensure that the matter is resolved within a reasonable time frame. The time frame will be specified in writing by the relevant agency.

15.4 Variations to the LRMP

Once the LRMP has been approved by the relevant state and commonwealth agencies, a revised plan will need to be submitted for approval, if the works are to be undertaken other than in accordance with the approved plans and governing conditions. This will include any changes to the LRMP requested by the Commonwealth and/or the State.

For any revision to the approved LRMP, ensure the relevant assessment agencies are provided at least 20 business days for review and consideration of the revised plan, unless otherwise agreed in writing between the proponent and the agencies.

- Until the revised LRMP is re-approved, works must continue in accordance with the original LRMP. Once the revised LRMP is approved, this plan will supersede the original LRMP.

16. References

Animal Care and Protection Act 2001 (Queensland) Reprint No. 3A [Online] Accessed. June 2010, Available at: http://www.legislation.qld.gov.au/acts_sls/Acts_SL_A.htm

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