Australia Pacific LNG Project

Volume 3: Gas Pipeline

Chapter 3: Project Description

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3. Project description

3.1 Overview

Australia Pacific LNG proposes to develop a world class coal seam gas (CSG) to liquefied natural gas (LNG) project in Queensland. This includes the development of the Walloons gas fields, the construction of a high pressure gas transmission pipeline (the gas pipeline) from the gas fields to Curtis Island near Gladstone and a LNG facility on Curtis Island. The 30-year Australia Pacific LNG Project (the Project) being assessed in this environmental impact statement (EIS) includes the following three project elements:

- Gas fields
- Gas pipeline
- LNG facility.

This chapter describes the design, construction, operational and decommissioning phases involved in developing the gas pipeline element of the Project.

The gas pipeline will be approximately 450km long and will transport dehydrated and compressed CSG from the gas fields to the LNG facility. As the proposed LNG development of four LNG production trains will require a significant volume of gas to be transported from the gas fields to Gladstone, a gas pipeline dedicated to the needs of this project is warranted.

The location of the proposed gas pipeline system, the Walloons Gas Field and the LNG facility are shown on Figure 3.1, which gives the regional context. Figure 3.2 to Figure 3.5 illustrate the gas pipeline corridor.

The gas pipeline will span three local government areas, including the Western Downs and Gladstone regional councils and the Banana Shire. A map showing these areas is available in Volume 3 Chapter 20, Figure 20.2.

The gas pipeline system will include:

- A 44km lateral pipeline connecting the Condabri development with the main pipeline
- A 38km lateral pipeline connecting the Woleebee development with the main pipeline
- A 362km main transmission pipeline from the junction with the laterals (above) east of Wandoan to Curtis Island in the north.

At the beginning and end of each of the above sections, and at the mid-point of the gas pipeline, equipment and components necessary to the operation, maintenance and inspection of the pipelines will be installed on the surface, enclosed within secure fencing. Such sites will include isolation valves, scraper launchers and receivers and instrumentation for control and monitoring.

The methodology for determining the location of the proposed onshore gas pipeline is outlined in Section 3.2. The details of the design, construction, operation and rehabilitation are included in Sections 3.3 to 3.13. The construction methodology will be in accordance with Australian Standard AS2885 series and with the Australian Pipeline Industry Association's Code of Environmental Practice.

The construction period of the gas pipeline system is approximately 18 months and is due to commence in 2012. Key milestones for gas pipeline construction are listed in Table 3.3.

The Project is underpinned by sustainability principles and a risk management approach that apply to all stages of the project life. Australia Pacific LNG will continue to openly engage with the community to ensure that their interests are identified and incorporated into the project planning, design, construction, operations, decommissioning and rehabilitation stages to the greatest degree possible.

3.1.1 Crossing of The Narrows

An integral component of the gas pipeline is a marine crossing of The Narrows from the mainland to Curtis Island. The alignment for the pipeline crossing will be determined having regard to the Department of Infrastructure and Planning's proposal for an extension to the Gladstone State Development Area to create a common gas pipeline corridor across to Curtis Island. Whilst the alignment of this common corridor for the pipeline crossing the wetlands on the mainland and The Narrows is not currently finalised, an indicative route has been provided by the Queensland Government. The total crossing distance is approximately 5.5km, of which 2.3km is The Narrows. For the purposes of this EIS, this indicative route has been assessed.

The route in part traverses the southern end of the Great Barrier Reef Coast Marine Park as described in Schedule 2 of the Marine Parks (Declaration) Regulation 2006. A route that traverses the Marine Park is not Australia Pacific LNG's preferred route. Australia Pacific LNG is working with other industry proponents (see discussion below) to define an alternate route which is immediately to the south and outside of the Marine Park.

Australia Pacific LNG proposes to utilise horizontal directional drilling (HDD) for this crossing. The assessments associated with this EIS have been completed on the basis that HDD is the preferred approach. In the event that HDD is determined not to be feasible, based on final engineering investigations or construction constraints, Australia Pacific LNG would instead use dredging equipment to excavate a trench across the seabed of The Narrows into which the pipeline would be installed. The impacts of dredging proposed by Australia Pacific LNG are addressed in Volume 3 Chapter 10 and Volume 3 Chapter 12.

There are presently four LNG plants proposed for Curtis Island, Gladstone, each requiring a gas transmission link from the mainland:

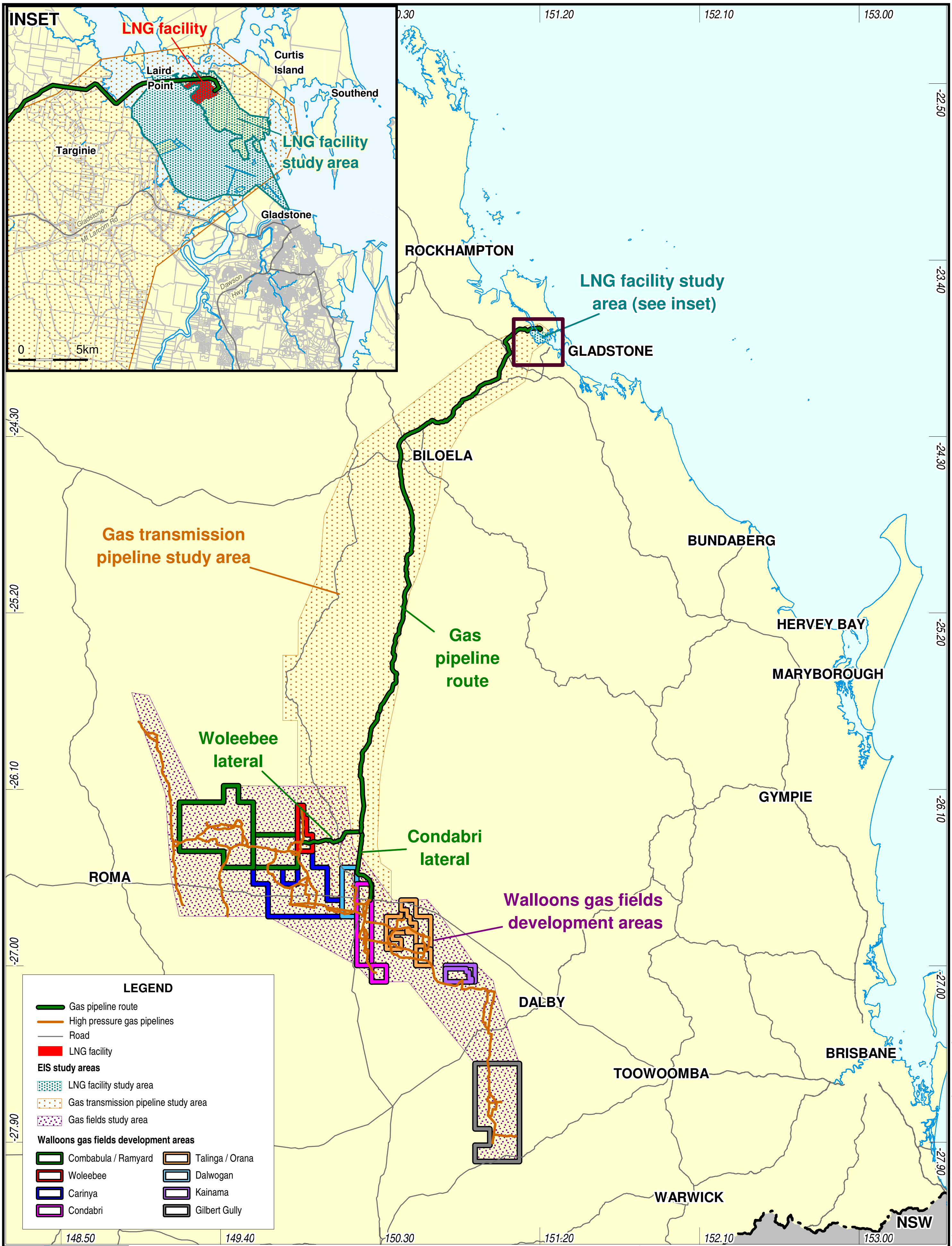
- Australia Pacific LNG - Origin/ConocoPhillips
- Gladstone LNG – Santos/PETRONAS
- Queensland Curtis LNG – BG Group
- Shell Australia LNG - Shell

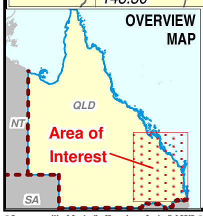
Discussions are currently underway with between these proponents regarding an alternative combined approach which would involve a joint installation of the pipelines constructed as a bundled single crossing. Details of the proposed crossing methodology are provided in Section 3.8.5.

At the time of writing, efforts were underway between the proponents and government agencies to clearly understand the exact relationship between the border of the Marine Park and the proposed gas pipeline corridor. Australia Pacific LNG understands that the Gladstone State Development Area (GSDA) corridor as initially proposed for crossing of The Narrows is at least partly within the Marine Park. Australia Pacific LNG, in collaboration with other proponents, is actively seeking clarification and definition of a revised corridor which is outside the Marine Park. The studies undertaken for this EIS assumed however that the gas pipeline would be within the Marine Park, in line with the initial GSDA corridor definition, and the gas pipeline EIS chapters and technical reports have been completed on that basis.

Although not required to support the Project, Australia Pacific LNG and other proponents have been asked to take into account a proposed bridge to link Curtis Island with the mainland. Land areas would be required at both ends and co-location must provide appropriate separation from the pipeline installation corridor. The separation distance is a function of construction activities proposed for both the pipelines and the bridge, and of an assessment of potential threats to the integrity of either the bridge or the pipelines imposed by co-location. The timing and exact location of the bridge construction are not yet finalised.

Discussions among the proponents and with the government on all these matters are ongoing.





SOURCE INFORMATION
Roads
Department of Main Roads 2009
Towns
Department of Main Roads 2009
Digital cadastral database
Department of Natural Resources and Water 2009
Gas pipeline route
Supplied by Origin Energy on 03/11/2009

0 50 100km

SCALE - 1 : 2,750,000 (at A4)
Latitude/Longitude
Geocentric Datum of Australia 1994

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AUSTRALIA PACIFIC LNG PROJECT

Volume 3 Chapter 3
Figure 3.1 Regional Context

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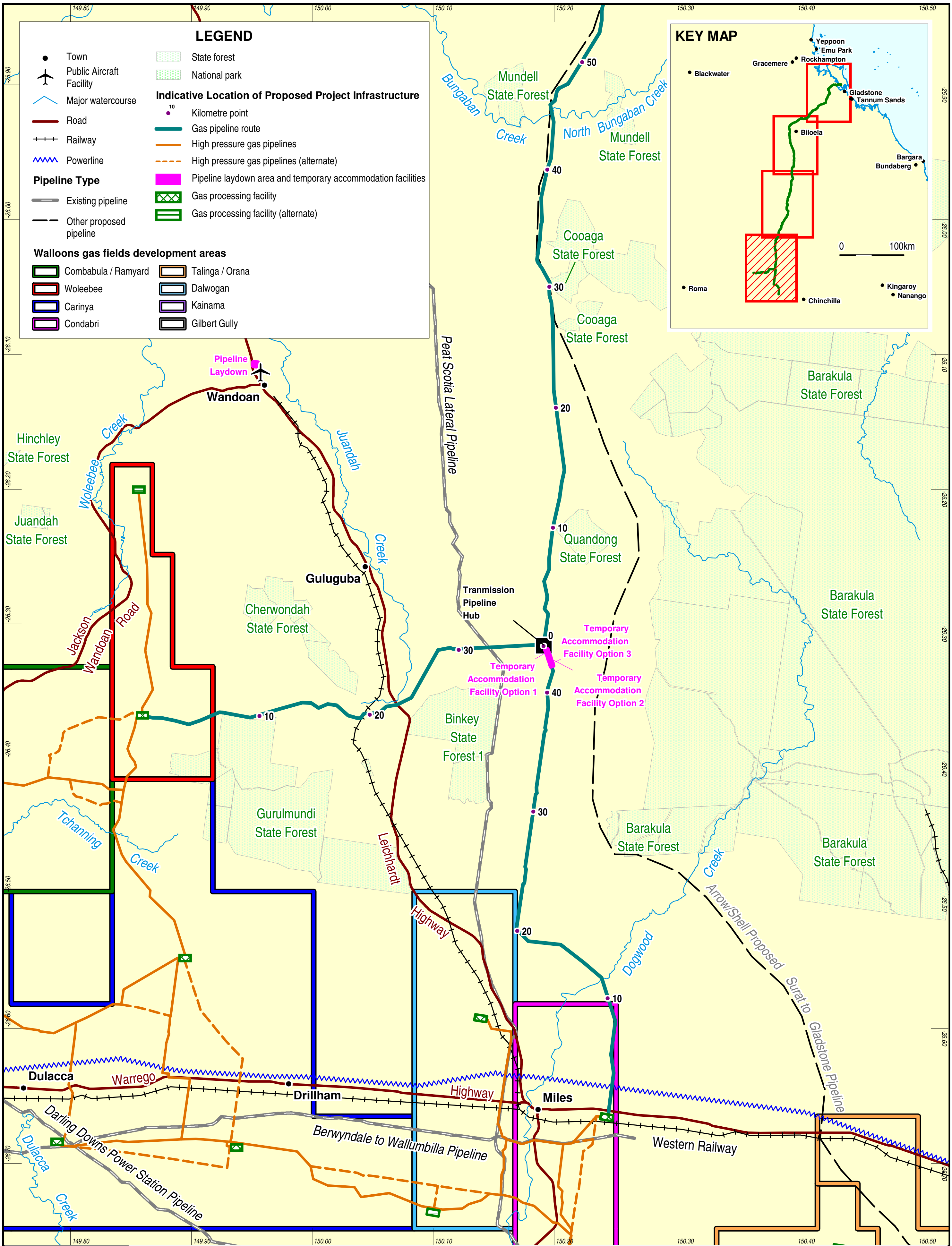

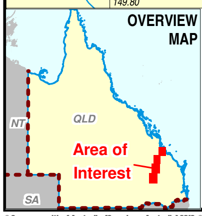

SOURCE INFORMATION

Protected Areas Of Queensland (estate)
Wetlands Directory of Important
Department of Environment and Resource Management (DERM) 2009
Aircraft Facility Point and Powerlines (based on 250k topography)
Commonwealth of Australia (Geoscience Australia) 2009

Watercourse (based on 250k topography)
Commonwealth of Australia (Geoscience Australia) 2009
Pipelines
Commonwealth of Australia (Geoscience Australia) 2009
Department of Mines and Energy, MERLIN
Mining Tenures system and Database (MTDB) 2009

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Latitude/Longitude
Geocentric Datum of Australia 1994

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AUSTRALIA PACIFIC LNG PROJECT

Volume 3 Chapter 3
Figure 3.2 Location of Main Gas Transmission Pipeline

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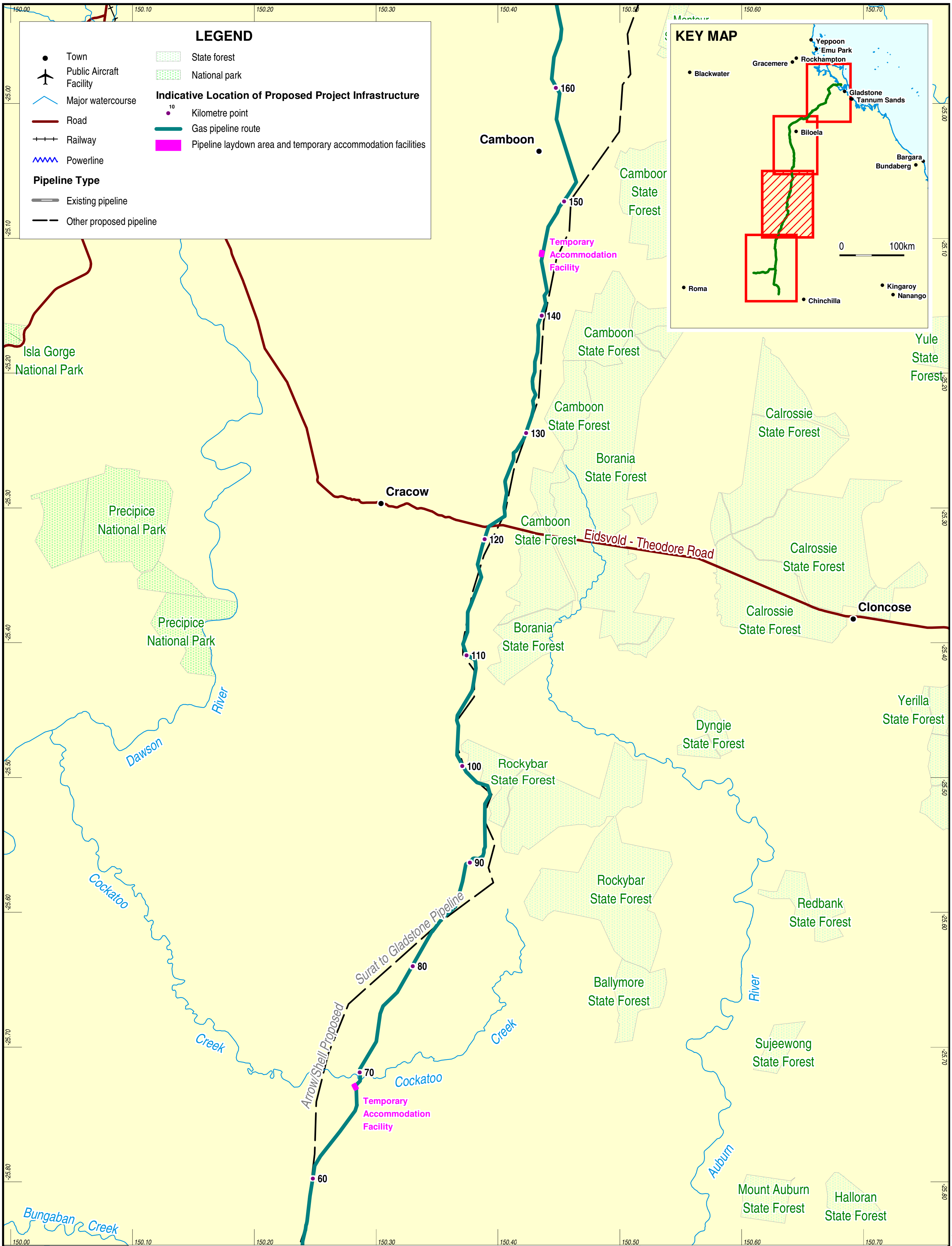

OVERVIEW MAP

NT QLD SA

Area of Interest

SOURCE INFORMATION

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Watercourse (based on 250k topography)
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Pipelines
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Department of Mines and Energy, MERLIN
Mining Tenures system and Database (MTDB) 2009

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SCALE - 1 : 400,000 (at A4)
Latitude/Longitude
Geocentric Datum of Australia 1994

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AUSTRALIA PACIFIC LNG PROJECT

Volume 3 Chapter 3
Figure 3.3 Location of Main Gas Transmission Pipeline

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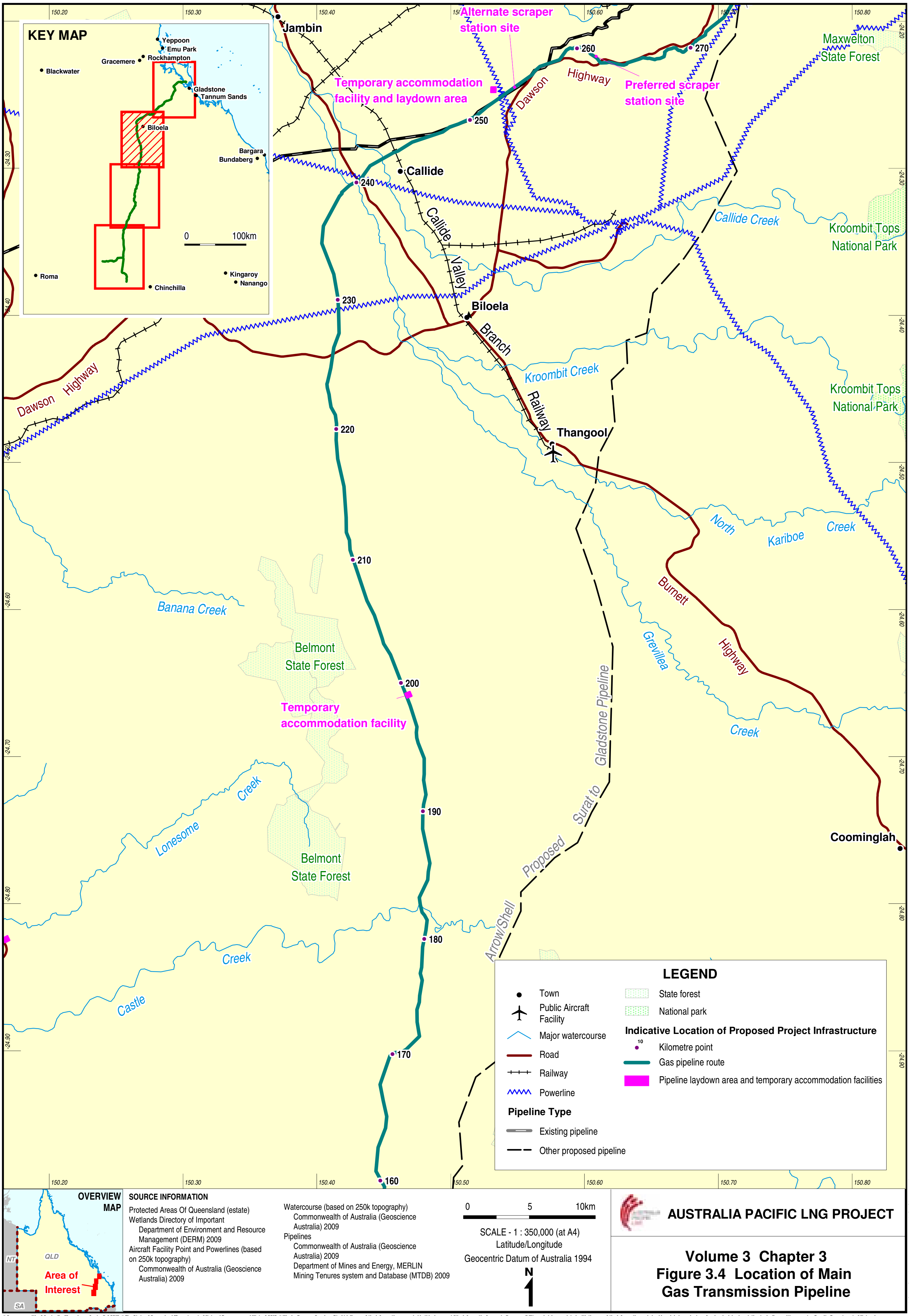

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Watercourse (based on 250k topography)
Commonwealth of Australia (Geoscience Australia) 2009
Pipelines
Commonwealth of Australia (Geoscience Australia) 2009
Department of Mines and Energy, MERLIN
Mining Tenures system and Database (MTDB) 2009

0 5 10km

SCALE - 1 : 350,000 (at A4)
Latitude/Longitude
Geocentric Datum of Australia 1994
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AUSTRALIA PACIFIC LNG PROJECT

Volume 3 Chapter 3
Figure 3.4 Location of Main Gas Transmission Pipeline

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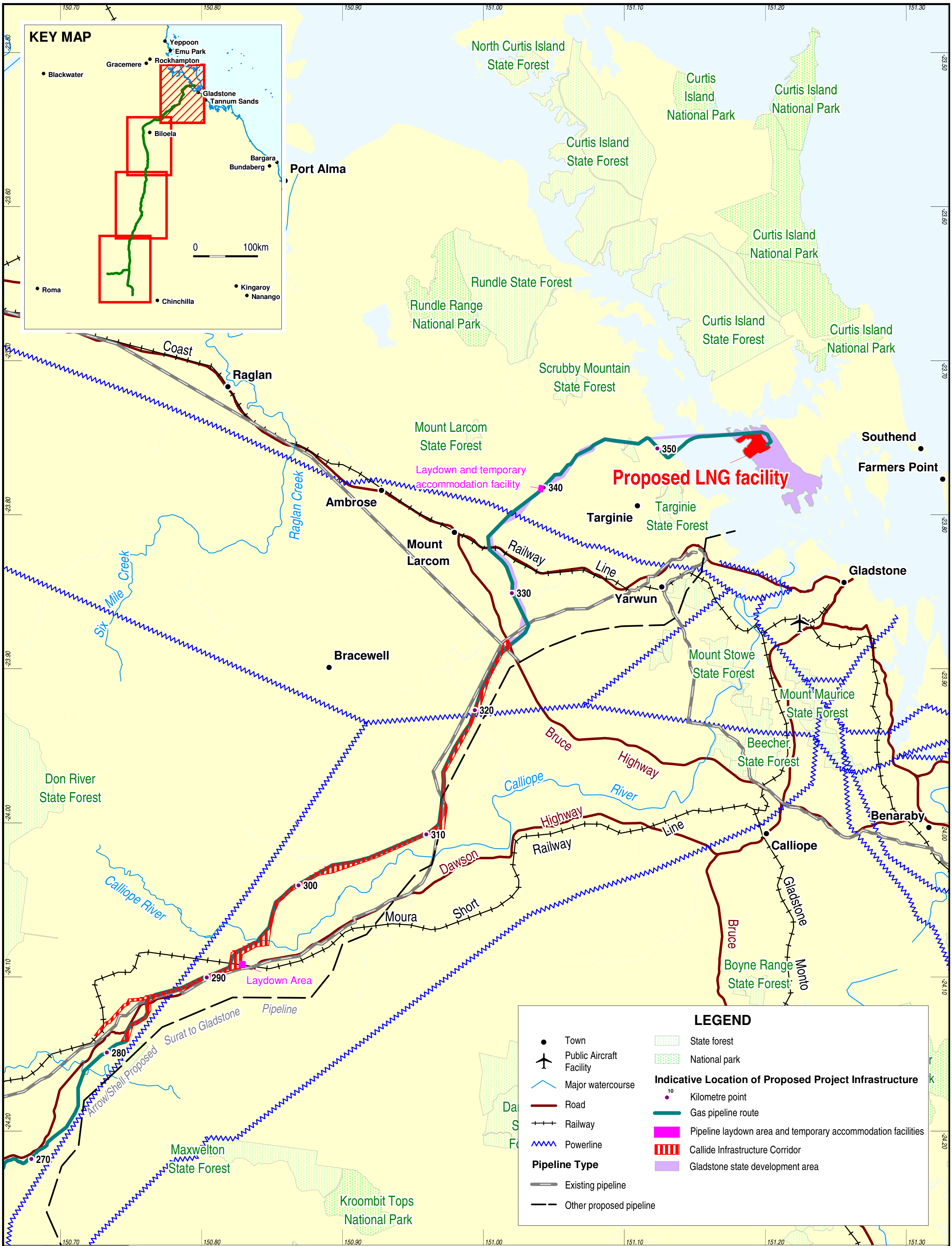

SOURCE INFORMATION

Protected Areas Of Queensland (estate)
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 Commonwealth of Australia (Geoscience Australia) 2009

Watercourse (based on 250k topography)
 Commonwealth of Australia (Geoscience Australia) 2009
Pipelines
 Commonwealth of Australia (Geoscience Australia) 2009
 Department of Mines and Energy, MERLIN
 Mining Tenures system and Database (MTDB) 2009

0 5 10km

SCALE - 1 : 350,000 (at A4)
Latitude/Longitude
Geocentric Datum of Australia 1994

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AUSTRALIA PACIFIC LNG PROJECT

Volume 3 Chapter 3
Figure 3.5 Location of Main Gas Transmission Pipeline

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3.2 Route selection

Australia Pacific LNG explored and assessed a number of possible gas pipeline alignments, from the Walloons development area near Miles to Curtis Island near Gladstone, as part of project development.

3.2.1 Route selection process

The process of determining a preferred gas pipeline route typically involves identifying one or more broad 'potential pipeline corridors'. These are investigated in detail and further refined to determine the optimal corridor. The viability of alternative gas pipeline corridors was assessed using:

- Detailed desktop studies using aerial photos, topographical maps and global information system (GIS) mapping
- Workshops with engineering, environmental, cultural heritage and community/stakeholder liaison representatives, to identify issues and assess risks
- Multi-criteria analysis using input from the above processes, to assess alternative corridors and select a preferred corridor for field evaluation in the EIS
- Weighting of assessment criteria to prioritise and refine alternative corridors and then routes. The highest weighting was initially given to 'constructability' (e.g. topography, soils, slope, geology), with a progressive application of land use considerations such as avoiding National Parks, forest reserves and culturally significant areas, together with environmentally sensitive/significant vegetation (e.g. Brigalow) or protected habitat areas
- Ground-truthing or field assessment to determine whether remote sensing data (e.g. maps, aerial photos) was accurate, and to confirm actual on-ground conditions.

Corridor and route options were analysed against the criteria and constraints detailed in Table 3.1. This included selection and design criteria from the Australian Pipeline Industry Association Code of Environmental Practice – Onshore pipelines (March 2009) and the Australian Standard AS2885.1 (May 2007).

Table 3.1 Route selection criteria and constraints

Criteria	Consideration
Land use, social aspects and topography	• Minimise the number of land owners affected and avoid smaller plots • Minimise impact on Good Quality Agricultural Land (GQAL) • Minimise alignment through populated areas • Consider terrain, seismic and geological constraints and hazards • Consider climatic implications such as flooding and cyclones • Avoid mountain ranges • Avoid side slopes • Consider proximity to current petroleum and mining leases

Criteria	Consideration
Environmental and Cultural Heritage	• Reduce the impact on local residents, traditional owners, existing land uses and infrastructure • Minimise impact of vegetation clearing and, where possible, make use of existing clearings • Avoid or effectively manage areas with historical and cultural heritage values • Avoid significant and endangered flora and fauna and communities • Reduce impact on watercourses by crossing at 90°, using existing clearing in bank vegetation, and avoiding riparian vegetation • Avoid wetlands and areas with possible inundation • Protect landscape values
Construction and operation requirements	• Consider access requirements for construction and operation • Consider the easement width needed to construct a large diameter pipeline • Consider accessibility to the gas pipeline corridor • Minimise rock excavation
Engineering	• Consider relevant engineering, construction and operational standards • Consider constructability, including bringing in construction materials and equipment • Incorporate pipeline bends at property boundaries and fence lines, where possible • Avoid proximity to high voltage powerlines and other sources of stray current • Consider future/planned developments, such as Nathan Dam, Surat Basin Railway, mining leases and so on
Safety	• Implement relevant safety requirements, particularly the AS2885 Safety Management Study • Assess project safety risks
Commercial	• Consider the length of the gas pipeline • Assess construction and operational costs • Consider current and future market development requirements
Co-location opportunities	• Consider adjoining Australia Pacific LNG easement to an existing easement. For example: Pipelines Road and unpowered railway easements

This rigorous analysis ensured the route selection process considered environmental, engineering, social and economic criteria. The alternative routes investigated are shown in Figure 3.6.

Australia Pacific LNG investigated a wide gas pipeline corridor between the Surat Basin and Gladstone. This study area was up to 60km wide to cover the diverse geology of the region. While many potential routes for the gas pipeline were investigated, the route selection process identified three options for consideration.

Option 1 was an output of detailed desktop studies of aerial photos, topographical maps and GIS constraint mapping undertaken during the initial assessment, as part of studies presented in the initial advice statement (IAS) for the project. It was to commence in the northern part of the Woleebee field. The route went north towards Wandoan and, before reaching the Peat and Scotia gas fields, the route turned northwest and crossed the proposed Surat Basin Railway line. It then circumvented the proposed Nathan Dam impoundment area and crossed the Dawson River and the mountain ranges west of Precipice National Park adjacent to the Leichhardt Highway. South of Theodore the gas pipeline again crossed the Dawson River and ran north towards the Queensland Gas Pipeline (QGP) route. After joining this corridor it would be roughly co-located in corridors containing the QGP and/or other potential gas pipelines through to Curtis Island.

Option 2 was defined to avoid existing Xstrata mining tenements just north of the Woleebee field and due to adjustments in the Australia Pacific LNG gas field development sequence. In Option 2, the route commenced at a proposed gas processing facility site approximately 10km east of the township of Miles. This route traversed around the township of Miles and proceeded north, co-located with the Peat lateral pipeline corridor, and passed approximately 30km north of Wandoan and then connected to the route as defined in Option 1.

Initial environmental field investigations identified a number of significant environmental constraints with the Option 2 route including:

- Significant vegetation communities in proximity to the Precipice National Park, particularly in narrow valleys flowing to the north from the escarpment. Terrain constraints imposed severe limitations on gas pipeline route options in this area.
- Issues with traversing the Dawson River, including potential adverse effects on the Boggomoss snail *Adclarkia dawsonensis*, classified as 'critically endangered' under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and other vegetation communities and fauna species of significant conservation status.

These and other factors were considered to present a major impediment to the gas pipeline development; and therefore a third option was defined.

In **Option 3, the central 'inland' route**, the gas pipeline again bypasses the township of Miles and turns north. However, in this option it heads to Camboon and bypasses the Barakula, Rockybar and Borania State Forests. Co-location opportunities were investigated with Arrow's Surat Gladstone Pipeline (SGP). From Camboon, the proposed route would run north, parallel to the Crowsdale-Camboon Road, where it may be co-located with the Queensland Gas Pipeline (QGP) to Gladstone as per Option 1.

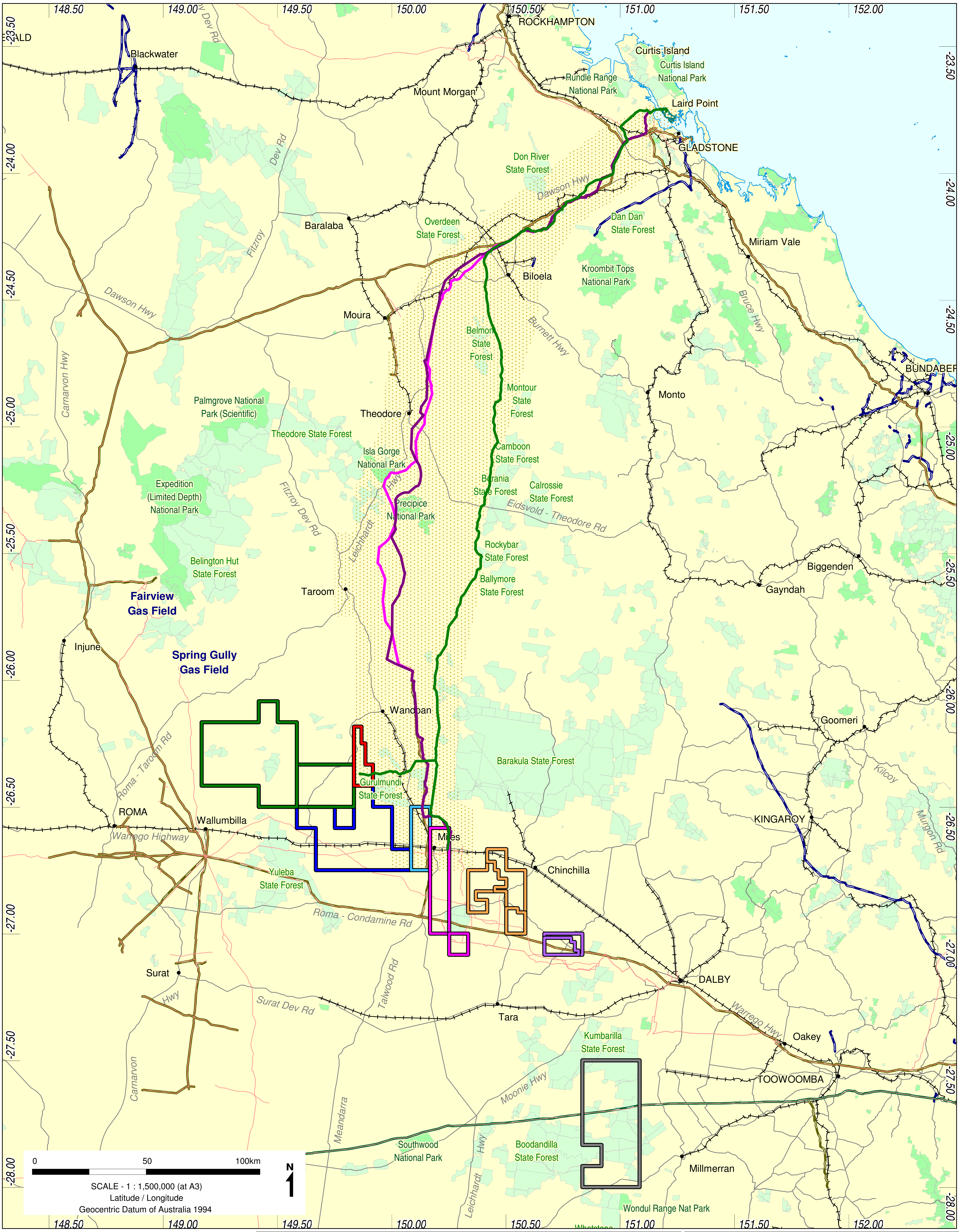
After the Callide Range crossing, the central 'inland' route follows the Callide Infrastructure Corridor State development Area and a proposed infrastructure corridor within the Gladstone State Development Area (GSDA). Both of these corridors are defined and managed by the Department of Infrastructure and Planning, with a proposed width of typically 200m. These areas are intended to accommodate all the proposed LNG projects' transmission pipelines.

The Callide Infrastructure Corridor runs from the east side of the Callide Range, northwest of the Calliope Range State Forest, to the intersection with the Bruce Highway. After the Bruce Highway, the route enters the GSDA, which includes the submerged crossing of The Narrows, and terminates at the LNG facility near Laird Point on Curtis Island.

Both the Callide Infrastructure Corridor and the proposed GSDA infrastructure corridor include areas of additional width to accommodate specific construction requirements, such as at watercourse crossings.

Within the third option, several alternatives were assessed and incorporated to reduce overall impact. Before selecting the preferred route, specialists conducted field surveys to assess engineering, construction, social and environmental risk and opportunities.

Option 3 has been selected following application of the criteria described above.



SOURCE INFORMATION

Protected Areas Of Queensland (estate)
Department of Environment and Resource Management 2009
Roads
Department of Main Roads 2009
Pipelines
Commonwealth of Australia (Geoscience Australia) 2009
Department of Mines and Energy, MERLIN
Mining Tenures system and Database (MTDB) 2009
Gas pipeline routes
Supplied by Origin Energy

LEGEND

Road
Railway
State forest
National park

Pipeline Type

Existing gas
Existing oil
Existing water
Petroleum Pipeline Licence (Centreline)
Main Gas Pipeline Option 1
Main Gas Pipeline Option 2
Main Gas Pipeline Option 3
Gas pipeline route study area

Walloons gas fields development areas

Combabula / Ramyard
Carinya
Talinga / Orana
Kainama
Woleebee
Condabri
Dalwogan
Gilbert Gully

AUSTRALIA PACIFIC LNG PROJECT

Volume 3 Chapter 3
Figure 3.6 Pipeline Route Options

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3.2.2 Pipeline co-location

During the route selection process, Australia Pacific LNG evaluated the potential to co-locate the gas pipeline with existing or planned infrastructure projects such as pipelines, roads or railways. The aim was to minimise environmental and landholder impact.

The potential to co-locate the gas pipeline with Arrow Energy's SGP over significant sections of the route was identified. Following discussion with Arrow Energy in late 2009, co-location of the two pipeline routes over approximately 120km has been agreed.

North of Biloela the Australia Pacific LNG gas pipeline route will be co-located with the existing QGP and the proposed Gladstone LNG pipelines as all three approach the Callide Range.

Further co-location opportunities will be explored to minimise disruption to landholders and the environment however, Australia Pacific LNG must also take into account separation distance to minimise potential external interference threats, restrictions imposed by other existing infrastructure and steep terrain, and adequate space for future developments.

When considering co-location opportunities, environmental and other constraints within the surveyed corridor were also considered. These included protected habitat, land use (mining), and proposed infrastructure such as the Nathan Dam and roads.

It is possible to co-locate the Australia Pacific LNG gas pipeline over longer sections, adjacent to powerlines and electrified railways, but at increased expense and risk. Induced voltages generated and potential fault currents could accelerate the rate of corrosion, so additional engineering and operational measures would need to be implemented. It is preferable for the gas pipeline corridor to be placed at an adequate separation distance from electrical infrastructure to ensure that the current has a negligible influence on pipe integrity.

Co-location will also require cooperation with other proponents. This would include allowing appropriate right of way width and alignment, as well as reaching planned agreement on construction techniques and public safety.

The following co-location options were considered:

- The proposed SGP route as discussed above
- The proposed Surat Basin Railway in the mountain range south of Cracow
- The QGP and the proposed Gladstone LNG pipeline, starting west of Callide to Curtis Island
- With other CSG proponents in the 'Callide Infrastructure Corridor', starting east of the Callide Mountain Range to the start of the GSDA at the Bruce Highway
- With other coal seam gas proponents within the GSDA infrastructure corridor, from the Bruce Highway to Curtis Island, including the crossing of The Narrows.

The corridor through the Callide Infrastructure Corridor and the GSDA has been established by the Department of Infrastructure and Planning, and includes the process of landowner negotiation.

Periodic coordination meetings with all other LNG proponents have been ongoing since April 2009. These meetings aim to coordinate the development of the corridors and reach agreement on construction arrangements in terms of timing, access to the area, and construction techniques applied to accommodate the mutual interests of all affected parties and mitigate risks arising from such co-location.

Australia Pacific LNG proposes to build the gas pipeline entirely within the defined corridors of the Callide Infrastructure Corridor and GSDA. It therefore does not anticipate any changes to right of way width or alignment in these areas. The only exception to this relates to the crossing of The Narrows as already addressed in the introduction above.

Potential hazards associated with co-location of gas pipelines, either within the infrastructure corridors or at other locations, have been considered and control measures including separation and design of pipelines will be implemented to minimise any threats to public safety (refer to Volume 3 Chapter 22).

If Australia Pacific LNG has to construct its pipeline in any common infrastructure corridors after one or more other proponents have installed and commissioned their pipelines, it will implement a number of processes to manage the risks associated with working adjacent to live gas pipelines. Measures include:

- Establishing contact with the pipeline owners and developing coordination arrangements
- Establishing clear buffer zones for construction interfaces
- Working under any necessary permit to work and supervision arrangements that the licence holders have in place
- Ensuring the live pipelines are physically located before any ground breaking activities are undertaken.

3.2.3 Proposed route

Following their analysis and investigation, a multi-disciplinary team of engineering, environmental and cultural heritage representatives applied multi-criteria analysis to select the central 'inland' route (Option 3) as the preferred option.

This route alignment:

- Is shorter
- Is more constructible
- Has fewer potential impacts, both to critical vegetation and in terms of fragmentation
- Provides co-location opportunities with other proposed pipelines
- Is largely located on private property.

Field investigation included helicopter flights along the routes to identify areas of potential concern followed by closer review on the ground at selected locations to resolve issues and to identify alternative alignments around obstacles and sensitive areas.

As mentioned, the preferred central 'inland' route is largely located on private property. Land uses such as agriculture, primarily grazing and cropping will continue after construction and during operation of the gas pipeline. The likelihood of future urban development in this area is low.

The route will continue to be refined based on the findings of ongoing detailed field assessments. These assessments include ecological and cultural heritage surveys, as well as stakeholder and landholder consultation. No significant deviations outside the initial investigation area are foreseen, nor is there any apparent need to relocate existing infrastructure.

Along the gas pipeline route (Option 3)

The proposed gas pipeline route has a number of key alignment and location features. It begins in the Condabri gas field, about half a kilometre south of the Warrego Highway. From here the route traverses in a northerly direction for approximately 43km, to intersect with the Woleebee lateral pipeline.

Immediately north of the Condabri gas field boundary, the route crosses Dogwood Creek. Here, the Great Dividing Range runs to the east and west of the gas pipeline corridor.

The Woleebee lateral pipeline begins in the Woleebee gas Field, near the base of Mount Horrible. It traverses in an easterly direction for about 37km, running to the north of the Garulmundi State Forest. It then runs parallel to Juandah Creek for about 12km, before crossing Leichhardt Creek.

From the intersection of the Condabri and Woleebee branches, the route progresses in a northerly direction to Old Chinchilla Road before it crosses Roche Creek and Glendoan Road. It then continues north before crossing Bungaban Creek and a series of its tributaries near Big Valley Road.

From here, the route runs north along drainage lines, through open grassland and remnant patches of vegetation. It crosses Cockatoo Creek and the smaller creeks that drain into it, such as Nine Mile Creek, Kennedy Creek and Rocky Creek. It continues on, crossing and running parallel with Pine Creek for about 6km, and then running adjacent to Ponty Pool Road for 2km before reaching Dearne Road.

The route then moves in a north westerly direction, passing to the west of several State forest borders, including Camboon State Forest. It crosses several creeks and gullies, including Silverleaf Gully, Quinns Gully, Big Gully, Braser Gully and Ross Creek.

Further south along the route, elevations above sea level are between 250 and 350m, but in this zone they reach up to 480m. The route continues, crossing Eidsvold Theodore Road about 10km from Cracow and continues on to JP Gully.

From JP Gully, the route runs northwest through open grassland and grazing land to Cracow Creek at elevations ranging from 370 to 410m. It crosses Delusion Creek, Horse Creek and Oxtrack Creek.

From here, it continues in a north westerly direction crossing several unsealed tracks as well as South and Keen creeks. As it traverses north from Keen Creek, the route runs parallel to the Banana Ranges to the west.

Approaching the Dawson Highway it crosses several creeks that drain from the Ranges including Pump, Twenty Mile, Twelve Mile, Dry, Prairie, Tiamby and Quartpot creeks.

Crossing the Dawson Highway and then the Burnett Highway the route continues north for about 10km. It then continues in a north easterly direction across generally flat agricultural land with a consistent elevation of about 250m. Here, it crosses Back Creek, Kroombit Creek's west channel, Callide Creek and the old Callide Creek channel.

The route then follows the Dawson Highway through the Callide Ranges crossing Collards Creek in several locations. This is a moderately undulating landscape, with elevations ranging from 350 to 400m.

For about 40km the route continues generally adjacent to the Dawson Highway. It crosses the highway near The Mole Hill and changes bearing at Sandy Creek. Here it continues northeast for approximately 16km, then heads in a more easterly direction at Larcom Creek for about 8km until reaching Gladstone-Mt Larcom Road.

The route crosses the road and follows a north easterly direction before crossing the Bruce Highway east of Larcom Creek. It then crosses several creeks including Bells, Collard, Calliope, Zig-Zag, Alarm, Duck, Sandy, Gravel, Larcom and Sneaker creeks.

From here, the route traverses in an easterly direction through the Mt Larcom Ranges between Scrubby Mountain and Mt Larcom. Finally, it crosses The Narrows passage before reaching Curtis Island.

Key issues to be addressed further in the EIS include the following:

- The potential impacts on Good Quality Agricultural Land (GQAL) in cropping and potential cropping areas
- Avoiding damage to existing infrastructure in the vicinity of the gas pipeline, including other pipelines and services, buildings and bridges
- Construction and rehabilitation techniques to be implemented in the steep and rocky areas of the Callide Range
- Potential impacts on the coastal marine environment of The Narrows crossing, as well as the technical challenges associated with construction of the crossing itself.

3.2.4 Detailed survey

To refine route selection, a further detailed survey of the gas pipeline right of way will be completed. This survey will consider engineering, hazard and risk, landowner requirements, environmental and cultural heritage issues.

A review by engineers, scientists and construction staff will then refine the route selection in order to minimise potential impacts. Australia Pacific LNG will identify any site specific construction requirements or mitigation measures. Following detailed route selection, the centreline will be surveyed with the aid of global positioning system (GPS) tools. Markers (pegs) may be placed along the entire route to identify the gas pipeline easement and right of way.

Surveyed construction gas pipeline alignment drawings will be prepared to identify:

- Any other constraints
- Right of way
- Areas of reduced width right of way
- Areas of environmental and cultural heritage
- Specific landowner requirements.

Any sensitive areas of cultural heritage will not be marked on the ground or on alignment sheets if so requested by traditional owners of those sites. As part of this process, vegetation boundaries will be defined and significant ecosystems flagged.

3.3 Design

All materials and workmanship will be in accordance with the applicable codes and standards referenced in Appendix A of AS2885.1. The design basis for the gas pipeline is outlined in Table 3.2.

Table 3.2 Gas pipeline design basis

Parameter	Specification			
	Condabri lateral	Woleebee lateral	Main pipeline	The Narrows crossing
Length	44km	38km	362km	5km
Design temperature	Maximum: 60ºC Minimum: 10ºC			
Design life	50 years			
Nominal diameter	36inch/914.4 mm	30inch/762.0mm	42inch/1066.8mm	42inch/1066.8mm
Design factor	0.8 (meaning 80% of the Specified Minimum Yield Stress is applied to pressure containment)			
Pipeline coating	Three-layer polyethylene or fusion bonded epoxy (FBE) (FBE may be either single layer or dual layer)			
Internal lining (proposed)	Factory applied epoxy internal lining			
Maximum allowable operating pressure	Up to15.3MPag			
Cathodic protection	External coating and impressed current cathodic protection			
Indicative Depth of cover	Generally – minimum 750mm Residential, cropping and potential cropping – minimum 900mm Deep ploughing – to be determined in discussion with landowners Road crossings/road reserves – minimum 1200mm Watercourse crossings – minimum 1200mm Railway – minimum 2000mm			
Non destructive testing	Testing of welded joints and hydrostatic pressure testing of the pipeline in accordance with AS2885			
Buried marker tape	Installed at open cut roads, throughout Heavy Industrial Secondary Land Classification and other risk areas, as defined in the Safety Management Study			
Pipeline monitoring system	Supervisory Control and Data Acquisition (SCADA) system for remote monitoring and control of all facilities at each end of the pipeline, and also periodic patrolling along the pipeline			

In addition, the design will comply with the specific requirements of the Queensland *Petroleum and Gas (Production and Safety) Act 2004*. The Department of Employment, Economic Development and Innovation will issue a petroleum pipeline licence.

The following risk studies will also be conducted as part of the design process:

- A pipeline safety management study in accordance with AS2885.1, with design inputs including penetration resistance and a fracture control plan. A preliminary study has already been carried out and is discussed in Volume 5 Attachment 48 and Volume 5 Attachment 49
- A surface facilities hazard and operability (HAZOP) study.

This diameter of high pressure gas pipe is not made in Australia, so it will be imported. Pipes will be supplied from overseas in lengths of up to 18m. On current planning, most will be unloaded in Gladstone with the balance unloaded in Brisbane. These will be transported, two or three lengths per trailer, as further described in Volume 3 Chapter 17. Rail transport is also being investigated as an alternative. Initial indications are that this alternative may be feasible.

3.3.1 Pipeline coating

All steel piping will be provided with an external coating to reduce the risk of corrosion once the pipe is buried. Australia Pacific LNG is evaluating three coating options – single layer fusion bonded epoxy, dual layer fusion bonded epoxy, and three layer polyethylene (i.e. fusion bonded epoxy covered with adhesive and then an outer layer of extruded polyethylene).

The gas pipeline may be internally lined with a thin layer of epoxy for flow enhancement.

Coating options include overseas application prior to importation or establishing a project-specific pipe coating plant in the project area, possibly at Biloela. The option for pipe coating in the project area will depend on the economics and lead time of establishing a plant, a suitable location relative to point of pipe import, and a reliable power supply.

Australia Pacific LNG will consider these factors in its final selection of coating plant location. All reasonable opportunities for local content enhancement using a project-established plant will be evaluated subject to the required approvals.

3.3.2 Emergency and safety

For multiple pipelines located in the same corridor, sufficient separation of buried pipelines will minimise the risk of a loss of containment event on one of the pipelines affecting another. At crossings of other pipelines, additional design measures will be implemented to mitigate escalation. This could include increased depth of cover or increased wall thickness.

In the event of a gas pipeline leak or rupture, a series of emergency actions will be initiated. The control system will alert the operations control centre and the section of gas pipeline will be isolated by closing the valves on either side of the damaged site.

Emergency services will be notified if there is a risk to public safety. Operations personnel will be dispatched immediately to investigate the leak or rupture, provide remedial action and minimise further damage. The emergency management centre and appropriate authorities will be notified.

Vents at the mainline valve sites at either end of each gas pipeline section may be opened to accelerate evacuation of gas from the damaged section, with due consideration to public safety. This will minimise the duration of the leak.

3.4 Construction

The construction period of the gas pipeline system is approximately 18 months and is due to commence in 2012. The gas pipeline itself will be constructed with a total workforce of about 800 people. This will include a specialist crew of about up to 150 starting work in difficult-to-construct areas along the route. The balance of the workforce will comprise an advance crew of 20 to 30 people, a main crew and a trailing crew.

Additional personnel will be employed in supporting logistics functions, such as the transport and supply of materials and services to the gas pipeline construction effort. Approximately 100 people will be employed in the project office in Brisbane. All construction work will be undertaken in compliance with the APIA Code of Environmental Practice and Australian Standard AS2885.

Current planning assumes that the direction of construction is from south to north. Factors which will be considered in the final selection of the construction direction include weather patterns, logistics of materials transport, management of noxious weeds, and the concurrent construction of other major pipelines in certain areas.

Alternative design and construction configurations were considered, such as utilising two 'spreads' instead of one to build simultaneously from north and south; or using 12m pipe lengths instead of 18m lengths. However, these alternatives were less attractive in cost and schedule terms, and were discarded. The process outlined above was considered to be the most appropriate for this gas pipeline in this region.

Project planning will include development of both a construction environmental management plan and a series of gas pipeline alignment drawings which describe constraints along the gas pipeline route. These plans will address detailed management for issues such as environment, weeds and pests, cultural heritage, health and safety (including onsite emergency aid and medical facilities), waste, water, logistics and traffic, and landholders and community.

The key milestones for the gas pipeline construction are included in Table 3.3. At any point along the gas pipeline (except for the crossing of The Narrows), the time from the start of construction activities through to final clean-up and rehabilitation is expected to be approximately three to five months. The Narrows crossing, including the mudflat section, is expected to take between nine and twelve months to complete.

Table 3.3 Gas pipeline construction milestones

Milestone	Date
Pipe manufacture	Q1 2011 to Q3 2012
Mobilisation to field	Q2 2012
Field construction	Q2 2012 to Q3 2013
Testing and commissioning	Q3 and Q4 2013
Pipeline Operational	Q1 2014
Demobilisation	Q1 2014

Construction of pipeline surface facilities and infrastructure is likely to take approximately three months per scraper facility and main line valve station, and six months for each inlet and receiver station. Following pipe installation, the pipeline trench will be backfilled and rehabilitated.

Figure 3.7 is a cross section of a typical pipeline construction right of way, and gas pipeline construction is described in more detail in the following sections.

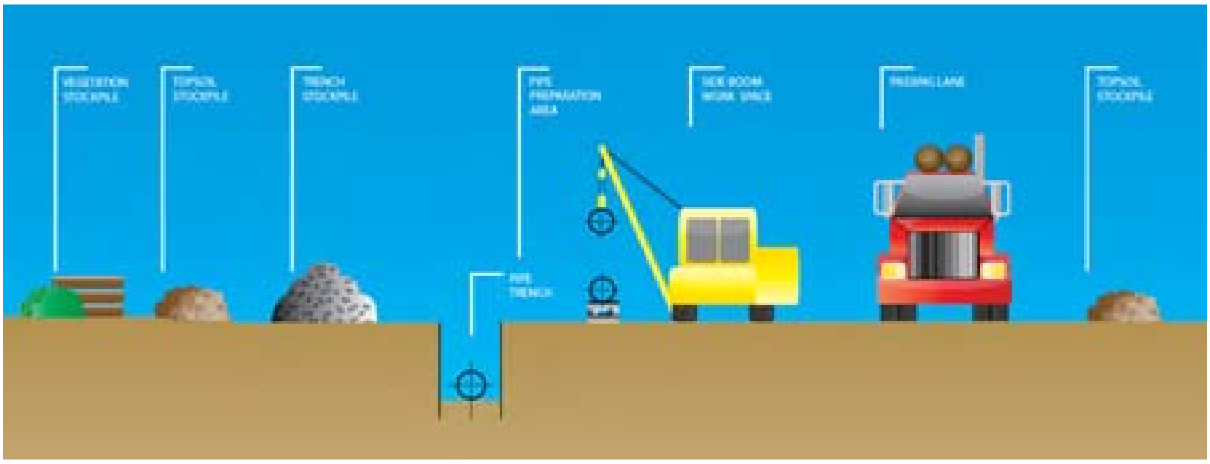

Figure 3.7 Gas pipeline right of way construction cross section

3.4.1 Access

Wherever practicable, the existing road network and private access tracks will be used to access the proposed easement and associated gas pipeline construction sites, and for moving equipment and personnel. Most of the roads along the gas pipeline route are unsealed public roads and/or private access roads.

The width of any new access track will be restricted to the minimum required to enable safe vehicle movement. Where possible, existing cleared lines through forested areas will be used and additional clearing will be minimised.

The following objectives will be implemented in finalising access arrangements:

- Access tracks and turn around points for vehicles will be identified on construction environmental management plans prior to construction, with track widths kept as narrow as possible with safety in mind (typically about 4m)
- The number of planned access tracks will be minimised as far as practicable
- All vehicle and equipment movements will be restricted to the construction easement or designated access tracks and roads, with speed restrictions in place and maintenance suitable for safe 4WD passage provided.

Weed management

The spread of weeds along the gas pipeline right of way during construction is a fundamental concern for both Australia Pacific LNG and many stakeholders. The principles specified in the Queensland Biosecurity Strategy 2009-14 (DPIF 2008) and the Regional Pest Management Strategy 2004-2009 (CPMG 2008) for managing weed species and plant diseases will be implemented. Regardless of the direction of construction, the following steps will be implemented to minimise the risk of spreading weeds:

- Weed introduction will be avoided through careful inspection of all vehicles and equipment by qualified personnel before construction. All vehicles and equipment that may carry declared weeds will be inspected and cleaned if necessary by qualified personnel

- Where environmental monitoring has revealed the presence of declared weeds, weed control will be instigated for those species where control is identified to be an effective management option, in consultation with government agencies and the landholder. Follow-up weed control for declared weeds will be completed after disturbances such as fire, as these can trigger major weed germination events
- During site health safety and environment induction, staff and contractors will be instructed on their responsibilities for declared weed management, cleaning procedures for vehicles and equipment, weed identification and weed reporting. They will also be informed of their environmental responsibilities for native flora and fauna protection.

3.4.2 Fencing

Temporary construction gates will be installed in existing fences. A fencing crew and associated vehicles will access the gas pipeline route via the surveyed right of way prior to clearing or, where practicable, existing access tracks.

3.4.3 Clear and grade

Clear and grade will be carried out to provide a safe construction right of way for vehicular movement including pipe trucks, trenching and other construction activities. This clear and grade will occur within an easement of 40m at most locations. Within the Callide Infrastructure Corridor and the GSDA an easement of 50m will be provided for each gas pipeline. An additional area may be required at larger crossings and turn around areas. Much of the proposed route has already been cleared for agricultural or other purposes. A total of approximately 433ha of the right of way has remnant vegetation which will need to be cleared to allow construction to proceed. More details are provided in Volume 3 Chapter 8.

The right of way may be reduced in width for limited distances through sensitive areas. Generally, a reduced right of way is only possible for more than a short distance if a road or track parallels the right of way and can be utilised as part of the construction work space.

The right of way will be cleared of vegetation with minimal clearance at creek crossings. However, root stock will be left in the ground where practicable to reduce erosion and to facilitate rapid rehabilitation.

In vegetated areas, vegetation will be stockpiled separately for respreading as part of the restoration process, subject to landholder approval. In densely vegetated areas, mulching of timber may be required, but some vegetation will be retained without mulching for respreading and habitat re-creation. Figure 3.8 shows a typical illustration of clear and grade activity underway to develop the right of way for construction.

Figure 3.8 Clear and grade

Breaks will be left in stockpiled vegetation to allow continued access for stock, fence lines, tracks, and drainage lines. Gates will be installed where fence lines need to be breached. Large mature trees will be preserved or trimmed in preference to removal where practicable.

The right of way will be levelled to the required gradient using graders, backhoes and bulldozers. Topsoil will be removed, typically to a depth of between 100 and 150mm or more. In non-cropping areas, topsoil removal may be reduced to a narrow strip (blade-width) over the trench at some locations. In cropping areas, the entire width of the construction right of way will be stripped of topsoil. Topsoil removal will also depend on factors such as soil type, terrain, construction requirements and weather conditions.

Topsoil and vegetation material will be stockpiled separately at the edges of the right of way. This will be used during rehabilitation. Once clear and grade activities commence, the average construction speed can vary from half a kilometre to 3km a day.

The following general procedures will be followed for clear and grade activities:

- The right of way, areas of reduced right of way, and areas of environmental, cultural heritage or landowner significance will be clearly identified in accordance with the surveyed construction pipeline alignment drawings. This includes marking of vegetation to be retained
- Microhabitat features such as rocks and fallen logs will be stockpiled at the edge of the right of way for use in rehabilitation. Timber mulching may be utilised where vegetation is dense, but a selection of micro-habitat features will be retained. Mulched timber will also be available for use in rehabilitation
- Trees with hollows or potential nesting sites will be checked for the presence of arboreal fauna prior to felling

- Where possible, large trees on the edge of the right of way will be trimmed rather than removed. Vegetation will be removed in approved areas, but stands of ecologically significant vegetation will be avoided where practicable
- Injured fauna discovered during construction will be taken to an appropriate animal care organisation
- On either side of the trench area vegetation will be stripped at surface level with limited disturbance to subsoils to preserve roots and seed stock
- Topsoil and seed stock will be graded off the easement and stockpiled along the edges, separate from the previously cleared vegetation stockpile. Vegetation, topsoil and subsoil will not be stockpiled against fence lines or vegetation to be retained
- Disturbance to natural drainage patterns will be minimised and blockages of channels with graded material will be avoided where practicable
- During construction, temporary erosion control banks and drains will be installed across the right of way as necessary to limit erosion of the disturbed surface
- Erosion controls will divert run-off to stable areas off the right of way, such as vegetated areas, without affecting existing overland flow paths
- Erosion controls will be inspected during and after rainfall events to check for any maintenance requirements or the need to install additional control measures
- Grading of slopes will be kept to a minimum, but the impacts related to slope grading will be mitigated when considered necessary by:
  - Limiting the grading of narrow ridges and sharp changes of slope to the extent required to allow the pipe to be constructed within the limits of pipe bending, and to permit the safe passage of heavy equipment
  - Stripping top soil and stockpiling it on each side to facilitate future replacement
  - Not side-casting excavated material down ridge slopes, as this can impede drainage, damage or cover vegetation, create serious visual impacts, and cause slope instability.

3.4.4 Stringing

Stringing is the term used to describe laying out the pipe lengths in preparation for welding. Pipe will be transported to site on trucks in lengths of up to 18m. The pipe will be delivered from the Port of Gladstone and the Port of Brisbane initially to stockpiles. Vacuum lift equipment will be used for pipe handling for increased safety, as shown in Figure 3.9. The pipe will then be delivered to the right of way and laid out along it as shown in Figure 3.10.

Figure 3.9 Pipe being loaded at stockpile using vacuum lift

Figure 3.10 Pipe strung on the right of way

3.4.5 Bending

The pipe will be laid out along the right of way and held off the ground on wooden skids, sandbags or soil to protect the pipe coating from damage, as shown in Figure 3.10. Where required, pipe lengths are bent to match changes either in elevation or trench direction, using a hydraulic bending machine as shown in Figure 3.11.

Figure 3.11 Pipe bending

3.4.6 Welding

Once the pipe is strung, a line-up crew will position the pipe using side boom tractors and internal line-up clamps. Specialised construction crews undertake the welding phase of the Project. Pipes are welded, in accordance with Australian Standard AS2885.2, into strings typically up to 1km in length. After lower-in, the strings are welded together (a 'tie-in') in the trench, as shown in Figure 3.12. Tie-ins may also be completed above-ground in some circumstances, before lowering in the next string.

Figure 3.12 Completing a tie-in weld

3.4.7 Non destructive testing

Every weld is subjected to non destructive testing inspection using xray or ultrasonic methods, as shown in Figure 3.13. This checks compliance with the specification and ensures the integrity of each weld.

Figure 3.13 Non destructive testing of welded joints

3.4.8 Field joint coating

Following welding and non destructive testing, welded joints will be cleaned by grit blasting with garnet and an external coating layer compatible with the factory applied coating will be applied, using either automatic or manual methods depending on the type selected.

Figure 3.14 shows manual field coating of a pipeline and Figure 3.15 shows automatic joint coating of a pipeline.

Figure 3.14 Manual field joint coating

Figure 3.15 Automatic application of field joint coating

3.4.9 Trenching

A wheel trencher, rocksaw or excavator will be used to dig the trench to provide depths of cover defined in accordance with the AS2885.1 Safety Management Study process and recorded on construction alignment sheets.

The distance covered each day will vary due to a number of factors including terrain type, equipment and weather conditions. However, on projects of this nature a production rate of around 2km a day is expected. With a large diameter 42 inch pipeline, the trench will be between two and three metres deep to allow the minimum cover. This will require careful consideration of workforce and third party safety issues.

Breaks in the open trench, referred to as trench breaks or trench plugs, will be included to facilitate stock and wildlife crossings and agricultural vehicle movements. Breaks will also be included at fences and drainage lines. No disruption to groundwater is anticipated other than at some watercourse crossings and across the wetlands approaching The Narrows.

Methods such as trench breaks or ramped ends of trenches will also be adopted to minimise fauna entrapment. This will ensure fauna entry and exit points in trenches will be no more than 500m apart.

Trench spoil will be stockpiled on the non-working side of the right of way, separate from topsoil. During construction the length of open trench will be kept to a minimum and will vary depending on the number of construction teams and progress.

The following procedures will be followed for trenching activities:

- Care will be taken to avoid mixing trench spoil with topsoil. Topsoil and trench spoil stockpiles will be separated
- Trench spoil will be stockpiled on the trench side of the easement. It will not be contaminated with general rubbish or any foreign material which might damage the pipe during backfill
- Topsoil will not be used for padding or backfill
- To facilitate fauna movement and vehicle access, gaps and spaces will be provided in the trench spoil stockpiles, consistent with topsoil and vegetation gaps left by grading
- Trench plugs will be used at appropriate intervals to allow access across the construction corridor, and to make it easy for fauna to exit the trench
- Ramps will be installed approximately every 500m in the trench to allow fauna to exit the trench
- At crossings of pipelines, utilities, and other foreign services, additional location and excavation procedures will be applied to prevent damage by trench excavation equipment
- The time between trenching and backfilling will be minimised
- At watercourse crossings, trenching will not take place until the welded pipe is ready to install. Trench material from the bed will not be mixed with material from the bank
- Trench dewatering will be required if rainfall occurs between trenching and backfilling. Dewatering allows the pipeline to be installed in a dry trench. Dewatering pumps will have a leak collection bund with an adequately sized impermeable liner to contain contents of the pump fuel tank. Dewatering will be directed onto areas where erosion risk is low, and away from waterways

- Fauna refuges, such as sawdust-filled dampened hessian bags, will be provided approximately every 200m within the pipeline trench. This provides a humid refuge for fauna and concentrates fauna into regularly situated and easily monitored checkpoints. Qualified personnel will check the fauna refuges daily and keep appropriate records in accordance with regulatory requirements.

Figure 3.16 shows the trench being constructed, with spoil material stockpiled on the left. The topsoil material is stockpiled on the left-hand side of the right of way. A coated steel high pressure gas line is strung out along the trench.

Figure 3.16 Pipeline trenching

3.4.10 Rock blasting

Controlled blasting will be undertaken in rocky terrain, where conventional excavation, rock hammering or trenching equipment is ineffective. An operational procedure will be prepared detailing the proposed method when blasting is required. It will include safety, drill pattern, charges, explosives, detonation and debris control. This procedure will be developed to ensure effective rock removal, without risk to public safety or damage to the surrounding environment or nearby infrastructure

Blasting activities will comply with relevant legislation and standards, and be carried out by suitably qualified personnel, as per AS 2187. Relevant legislation includes the *Explosives Act 1999*, Explosives Regulation 2003, Section 440ZB of the *Environmental Protection Act 1994*, Dangerous Goods Safety Management Regulation 2001, Petroleum Regulation 2004, and Environmental Protection (Waste Management) Regulation 2000.

3.4.11 Bedding and padding

In some rocky areas, it may be necessary to place a layer of rock-free material in the trench before the pipe is lowered in to protect the pipe coating from abrasion damage. This material is generally known as 'bedding', and is also referred to as 'padding' when added after the pipe has been lowered into the trench.

Padding machines (shown in Figure 3.17) are used to generate bedding and padding by sieving the excavated trench subsoil to remove rocks and coarse materials which may damage the external coating. The fine material the padding machine generates is used to prepare the trench bottom before pipe placement and to pad around the pipe before trench backfilling. In suitable ground conditions, this process may be facilitated by the installation of foam pillows to support the pipe.

There are a number of sections along the proposed gas pipeline route where imported sand may be required, as a padding machine may be unable to provide adequate padding. It is anticipated any new borrow pits for mining of the sand, if required, will be located close to the gas pipeline. New borrow pits would be subject to landowner approval and appropriate permits.

It is currently estimated that up to 100km of the route may require an external source for as much as 15,000m^3 of padding material. However, the actual amount of padding material required will not be confirmed until work onsite has commenced.

Figure 3.17 Padding machine in operation

3.4.12 Lowering in and backfilling

As the pipes are lifted off the skids and lowered into the trench using side-boom tractors (see Figure 3.18), the pipe coating will be inspected and tested for defects. Sections of pipe will then be welded (or tied in) to form a continuous pipeline segment, ready for pressure testing (refer to Section 3.5), as shown in Figure 3.19. If rain water or groundwater has accumulated in the trench, it may be necessary to dewater the trench before laying the pipe.

Impermeable trench blocks, known as trench or sack breakers (shown in Figure 3.20), may be installed before backfilling the trench to control underground water movement along the backfilled trench. Trench breakers are commonly installed in a number of environmental conditions, such as adjacent to watercourses, on steep slopes or where drainage patterns change. The trench will then be backfilled with trench spoil and compacted by wheel-rolling in most areas. Compaction equipment will be used at selected areas such as road crossings.

Care will be taken to avoid mixing topsoil and trench spoil during backfilling, to prevent loss of seed stock and nutrients through soil inversion. Any surplus excavated material will be used elsewhere, or reinstated under environmental specialist supervision with careful consideration of the surrounding topography, vegetation and soils.

Figure 3.18 Lowering pipe into the trench

Figure 3.19 Welded pipe prior to lower-in

Figure 3.20 Trench breakers on installed pipe

3.5 Hydrostatic testing

Each section of the gas pipeline will be hydrostatically pressure-tested (hydrotesting) to establish the leak tightness of the section, and to confirm the gas pipeline's capability to operate at the maximum allowable operating pressure.

Hydrotesting will be conducted in accordance with Australian Standard AS2885.5 Pipeline – Gas and liquid petroleum Part 5 – Field pressure testing.

Temporary test manifolds will be welded on both ends of the newly constructed underground pipeline section. The pipe will be cleaned internally, the inside diameter gauged to inspect for imperfections, and the entire section filled with water.

To assess its strength, the test section will be pressurised up to 1.25 times the maximum allowable operating pressure, for a minimum of four hours. The pressure will then be reduced to leak test pressure and held for a minimum of 24 or 48 hours, depending on the length and volume of the section. Pressure and temperature readings will be taken along the section during this time period, to validate any fluctuations in the test pressure trend.

In addition to the hydrostatic testing described, several pre-tests will be performed on pipe strings used during construction of road borings, horizontal directional drilled and other specialised sections before they are tied into the main pipeline. The volumes of these sections are limited and test water will be sourced locally.

Equipment and piping for pumping, testing and water transfer will be temporarily located at either end of each test section.

3.5.1 Water sources

While the total volume of the entire pipeline is over 340 megalitres (ML), it is expected that a maximum of 100ML of non-potable water will be required for testing. Care will be taken to ensure the test water does not introduce contamination, bacteria, or dangerous chemicals to the pipe material.

Given the length of the pipeline and the locations of water sources, a range of water sources will be investigated. Options will be addressed as part of the associated water management strategy.

Sources of water, in order of preference, are:

- Treated water from the Project's existing gas field reverse osmosis plants
- Reused water from other test sections, continuously pumped down the pipeline for the next section to be tested
- Commercial suppliers
- Water from local watercourses/rivers
- Untreated coal seam gas associated water.

Where required, permits will be obtained from the relevant regulatory authority.

A few temporary ponds of approximately 20ML capacity are likely to be required along the gas pipeline route to hold test water. The volume of the holding ponds will provide sufficient freeboard (space above normal level) to allow for additional rainwater. If the hydrotest water is drawn from a regulated source, relevant approvals would be obtained prior to construction.

The pond areas will be rehabilitated as soon as practicable following the hydrotesting activities. In some cases, landowners may request that ponds remain in place for their ongoing use.

Potable water for temporary accommodation facilities will be sourced from the nearest available source and trucked or piped by temporary pipelines to the facilities. Sources to be further investigated during construction planning include bores of appropriate quality and productivity and local township water supplies.

3.5.2 Test water management

Additives such as biocides, oxygen scavengers and corrosion inhibitors may be added to hydrotest water, if required, to remove biological organisms and reduce corrosion potential during testing. The use of additives will depend on the source and quality of hydrotest water.

Use of additives in hydrotest water will be minimised and, where possible, test water will be re-used to reduce the amount of water to be managed. If re-use is not possible, the water will be tested and managed in the process outlined below.

Detailed procedures for hydrotest water management will be developed during the design and construction phases of the project. These procedures will aim to maximise the efficiency of testing, taking into consideration the timing of construction and commissioning, and will follow good environmental practice.

The possible options for managing hydrotest water are:

- Disposing of it to land or a suitable drainage channel or watercourse, if assessment shows water meets relevant criteria and approvals are obtained
- Returning it to temporary holding pond(s). Engineering options are being evaluated to determine whether one or more ponds may be required. This option would require transport of the hydrotest water back through the tested pipe
- Using existing facilities and/or ponds (either belonging to Australia Pacific LNG, or where agreement can be obtained, those of other coal seam gas proponents).

The location of disposal areas will be determined once front end engineering and design (FEED) is completed. Prior to hydrotesting, a detailed assessment of potential impacts and recommended mitigation measures will be undertaken. Where hydrotest water must be disposed of outside of the easement, landholder approval will be sought.

Discharge of hydrotest or trench water will be in compliance with all regulatory and landholder requirements and will be treated in a manner aimed at minimising any environmental impacts.

3.6 Post construction clean up and rehabilitation

Pipeline construction creates little waste (refer to Volume 3 Chapter 16). Wastes are expected to include pipe off cuts, welding rods, pipe caps, rope spacers and timber skids. These are all usually recycled. All waste materials will be removed from the work area, and recycled, or disposed of, appropriately.

The easement will be re-contoured to match the surrounding land as soon as practicable after pipe laying and backfilling. Erosion controls will be constructed or installed, where necessary. The right of way surface will usually be lightly scarified before spreading the topsoil, to promote vegetation regrowth and protect against the topsoil loss. Topsoil will be respread evenly across the disturbed area followed by mulched vegetation from separated stockpiles. This will assist in soil retention and provide seed stock.

Rehabilitation will be undertaken in accordance with industry practice and in consultation with landholders, and will ensure that:

- Topsoil cover is re-established, and all land and waterways disturbed by project activities are returned to a stable condition as soon as possible after construction
- Land is returned to its previous productive use

- Stable landforms are re-established to original topographic contours
- Erosion control measures such as contour banks are installed in erosion prone areas.

Seed spreading may be carried out in areas at risk of erosion or in densely vegetated watercourses to enhance natural regeneration.

The effectiveness of the rehabilitation measures will be assessed by follow-up monitoring programs during the initial operations phase of the project. Routine pipeline patrols will identify any areas of deterioration of the rehabilitation measures allowing corrective action to be taken. This may involve re-contouring of erosion control measures, re-seeding and fertilisation if required in some locations, or reinforcement of scour protection on stream banks if damaged during flood activity.

Pipeline markers will be located at intervals along the gas pipeline, in accordance with Australian Standard AS2885. The marker signs will be placed on both sides of road, track, railway and watercourse crossings, and at property fence lines and utility crossings. Marker signs will also be placed at each change of direction.

An operational pipeline access within the easement will be maintained. These tracks will normally be about 6m wide, but will be limited at sensitive watercourse crossings and ecosystems to the minimum required for vehicle and emergency response equipment access.

Figure 3.21 shows rehabilitation of a pipeline right of way in vegetated areas, where vegetation is mulched and spread over the right of way. Figure 3.22 shows a work crew revegetating a bank following disturbance of the bank during pipeline construction.

Figure 3.21 Rehabilitation of a right of way along an existing track

Figure 3.22 Rehabilitation of a disturbed bank

3.7 Watercourse and infrastructure crossings

Various methods may be used to construct the gas pipeline across watercourses, roads, railways and other infrastructure. These include:

- Open cut
- Open cut with flow diversion
- Boring
- Horizontal directional drilling (HDD).

The selected crossing design and methods will take into consideration:

- Pipeline diameter
- Watercourse width, depth and flow
- Environmental sensitivity considerations
- Cultural heritage
- Geotechnical and stability considerations
- Substrate composition
- Hydrological data
- Engineering constraints
- Landowner issues
- Downstream users

- Regulatory requirements
- Available working space
- Economics.

Construction planning for watercourse crossings will also take into consideration the short-term forecast for rain and any potential for flooding during the construction of each crossing.

The type of construction method for each crossing will be determined during further design and field inspections. All necessary regulatory approvals will be obtained prior to construction.

A number of watercourse crossings will be required for construction of the 450km gas pipeline. Watercourse crossings are identified on Figure 3.2 to Figure 3.5 and include the Calliope River and Cockatoo, Callide, Castle, Bungaban and Dogwood creeks.

Temporary vehicle crossings may also be constructed to allow construction vehicles to cross minor watercourses. Watercourse crossings will be completed within the shortest period practicable, to minimise the construction period and subsequent environmental disturbance. The trenching and backfill activities on small to moderate watercourse crossings would typically be completed within 24 hours.

Locations and specific details of disruptions to groundwater flow and ground/surface water interaction will also be determined. Where disruptions do occur, the water will be drained from the trench to a suitable stable area to enable construction to proceed. Possible locations for groundwater discharge would include existing drainage channels and suitable watercourses. Measures will be taken to prevent erosion or scour from occurring.

3.7.1 Open cut method

The majority of watercourse crossings and most unsealed roads are expected to be constructed using standard open cut (trenching) construction. For watercourses this technique is most suited to dry or low flow conditions which are expected during most of the construction period. An example of preparation for the open cut method used to cross an ephemeral creek is shown on Figure 3.23.

Generally, watercourses will be surveyed, a profile established, and a pipe section designed and fabricated. Where the watercourse is deemed minor, the crossing may be installed according to a typical approved design.

The standard open cut crossing method involves establishing a profile through the banks of the watercourse, to provide access and a stable working area. The trench would only be completed through the banks immediately before pipe installation. Tie-in points to connect the pipe section used for the watercourse crossing to the adjacent sections of gas pipeline would be located away from the banks.

Watercourse bed and bank material and trench spoil will be stockpiled separately, clear of the watercourse channels where practicable. The requirement for concrete coating in watercourses and other potentially inundated areas will be determined during detailed design. Concrete coating protects the external coating and creates negative buoyancy, preventing the pipe from floating when installed. Pipe welding and concrete coating will be carried out prior to placement of the pipe in the trench.

Welded pipe would be laid, then spoil material returned to the trench. In addition, rock protection over the trench line may be installed in the stream bed to prevent potential scouring during flood conditions.

Banks are reinstated as near as practicable to their original profile. Geotextile fabric such as jute matting will be used, where required, to hold soil in place. This is permeable to water and plant growth.

Figure 3.23 Open cut crossing of a creek prior to trenching

Direct seeding may also be carried out where required, to facilitate revegetation and stabilisation of watercourse banks.

Following construction, reinstatement is monitored and access may be restricted to facilitate rehabilitation. An example of a completed open cut method across a creek is shown on Figure 3.24.

Figure 3.24 Rehabilitated open cut creek crossing

3.7.2 Flow diversion

Watercourse crossings with significant flow will require flow diversion, which is a modification to the standard open cut method. It is used to maintain ecological water flow or for social and engineering reasons.

The technique involves constructing temporary dams, upstream and downstream of the crossing, and diverting water around the crossing point. This creates a dry construction area between the dams.

The two possible flow diversion techniques are:

- Fluming, where flow is diverted through flume pipes to prevent siltation, which would arise during trenching, lowering in and backfilling. This technique is less suitable for watercourses with broad channels, low gradients or permeable substrates
- Dam and pump, where barrier dykes, aqua dams or head walls are constructed above and below the trenched area and the work area is pumped dry. This is appropriate for low gradient streams with discharges of less than 1,000 litres per second during construction.

Either technique would be done during periods of very low water flow if practicable, with consideration of short-term weather forecasting to avoid any potential for flooding during the crossing.

3.7.3 Boring

The boring technique is commonly used to install pipelines beneath infrastructure such as sealed bitumen roads, railways and buried utilities.

Boring is a low impact technique that involves drilling short distances below ground from within an enlarged trench area, or bore pit, located inside the construction easement. Bore pits are required on either side of the road or railway. The pit holding the thrust bore rig is typically 25m long and 4 to 5m wide to accommodate the rig.

The receiving pit is typically 10m long and 4m wide. A bore can take anywhere between two to five days to complete, depending on the length of the crossing, the amount of weld to be completed, and site geology.

The feasibility of boring is limited by site conditions such as geology, as uniform ground conditions are preferable. Other limitations include landform and soil type, and the depth and width of the road crossing.

Shallow groundwater may be intersected during boring. If so, water would be drained to a suitable stable area to allow construction to continue. It would then be discharged to a suitable drainage channel or watercourse, under a relevant approval.

3.8 The Narrows and associated wetlands crossing

The Narrows crossing has two distinct sections. The first is the mud flats on the mainland foreshore. The second is the open water section, which is The Narrows itself. These sections will be crossed by different but interrelated methods tailored for the respective environments.

As described in the Introduction, the basis of this project is the HDD method currently proposed by Australia Pacific LNG for the open water section, while the mud flats will be crossed using an open cut excavation methodology.

3.8.1 Crossing The Narrows

The horizontal directional drilling method

HDD is generally used to install pipeline crossings at major obstacles such as large or high-flow watercourses, highways, or railways where standard open cut methods are not feasible. The feasibility of using HDD is limited by site conditions such as soil type, stability, slope, access, available workspace and the nature of subsurface rock.

Installing the pipeline by HDD involves drilling a pilot hole at a shallow angle beneath the surface, under the watercourse to an exit point on the other side. Next the diameter of the hole is enlarged by reaming, and then the welded pipe string is pulled back through the drill hole. Drilling is conducted by a purposely designed drill rig, operated by a specialist contractor.

A variety of associated equipment and infrastructure is required. Excavations are usually required for a cuttings settlement pit and drilling mud containment pits at the drill entry and exit points.

Depending upon the length of the crossing and subsurface soil type, HDD can take anywhere between a few days to several weeks to complete. It usually requires continuous operation of the rig to prevent collapse of the drilled hole. Figure 3.25 is an example of HDD under a watercourse.

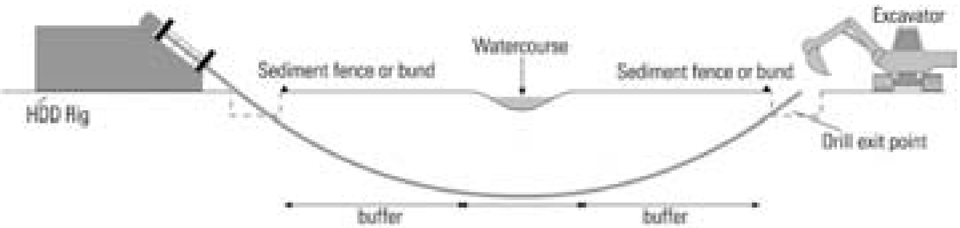

Figure 3.25 An HDD cross-section illustration

The size of the HDD rig and its associated footprint depends on the size of the pipe, subsurface geology and drill length. A typical layout area for a medium to large HDD rig is approximately 2,000m^2.

Key equipment involved in a HDD would include:

- A specialised drilling rig capable of drilling the hole and pulling back pipe string
- Excavation and earth moving equipment to develop sites at either end of the HDD
- Pumps, tanks, and pipework for managing the recycled drilling mud system
- Pipeline welding, construction, and testing equipment for preparing the HDD pipe string.

Drilling mud is usually bentonite, a naturally occurring clay mixed with water. This is used to drive the drilling head hydraulically, wash the drill cuttings to the surface and seal and line the drilled hole to facilitate pipe insertion. The returning bentonite carrying the drill hole cuttings is screened at the entry side and recycled back into the system. A second small diameter hole may be drilled at the same location for installation of a pipe allowing more efficient management of the mud after the main hole exits at the other end.

On completion of the drill hole, the pipe string is pulled into the hole and the space between the inside diameter of the drill hole and the outside of the pipe is filled using drilling mud. Once the pipe string is installed and tied into the main sections of the pipeline, the entry and exit points are remediated and excess material disposed of at an approved waste disposal area as discussed in Volume 3 Chapter 16.

HDD generally minimises above ground impacts, but the technique introduces additional environmental considerations such as drill site sediment control, waste management and noise. It can also be more technically challenging and costly than other methods that achieve the same result.

However, due to the temporary nature of the HDD activities, these issues are manageable and the impacts are present only for a short period of time. To address these issues, site specific management procedures will be prepared prior to drilling commencing.

Application of HDD for The Narrows crossing

Initial construction planning assumed that the HDD rig would be placed on the western shore of The Narrows, drilling toward Curtis Island. Environmental assessments have been completed on this basis. After further consideration of space requirements for fabrication of the welded pipeline string, and discussion with experienced contractors, it is now proposed that the HDD rig would instead be located on Curtis Island, and drill toward the mudflats area, where the pipe string would be welded in preparation for pullback.

Environmental impacts associated with construction of a temporary work platform for the HDD rig would be similar on either shore. Environmental impacts associated with creating a workspace within which to fabricate the pipe string are reduced with the current planning, as the string will be fabricated on the same temporary access way constructed for excavation and installation of the mudflats section of the pipeline, avoiding the need for preparation of an additional workspace on Curtis Island.

Either approach is considered feasible. The final site selection for the HDD rig will be made following additional site investigations and discussions with selected contractors. Figure 3.26 shows the proposed HDD crossing location, including entry and exit points.

A temporary right of way will be built onto the mudflats to access the exit point on the western shore, and then removed after construction. This right of way will also be used to support the open cut construction method over the mud flats. The drilled hole will intersect with the open cut trench on the mudflats near the western shore of The Narrows.

The pipe string will be assembled on the mud flats and tested. It will be buoyancy-controlled using a smaller diameter high density polyethylene pipe inside the string and filled with water as weight before installation. The string will be pulled into the directional drill hole and the buoyancy control pipe removed. Figure 3.27 shows the HDD rig.

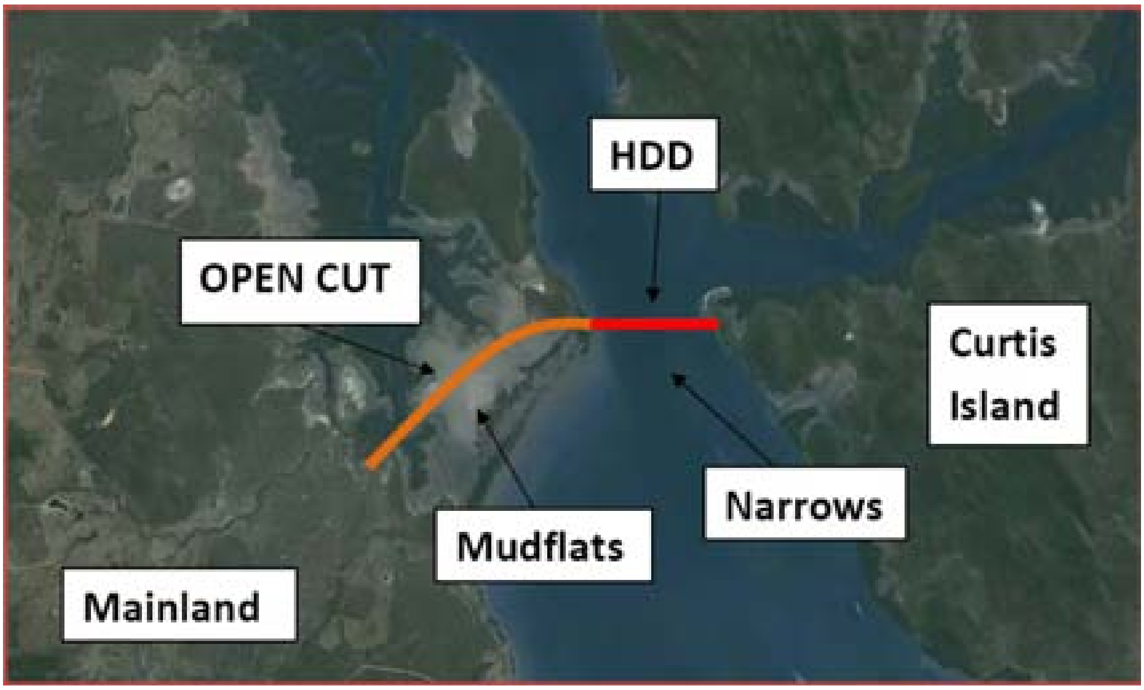

Figure 3.26 Indicative location of the HDD crossing

Figure 3.27 HDD rig

A HDD management plan will be developed during the detailed design phase to address:

- Coordination with other proponents
- Pipe transport and handling
- Location and development of temporary construction sites and associated temporary marine infrastructure
- Equipment and resources required
- Volume of materials
- Duration and staging
- Details of any proposed marine flora and fauna protection measures.

Drilling will be conducted by a specialist contractor and is expected to take several months of continuous operation.

In the event of unexpected conditions being encountered during drilling, repeat attempts may be required to complete the drilling.

3.8.2 Conventional dredged crossing

HDD is Australia Pacific LNG's preferred crossing method, if the crossing is completed on a stand-alone project basis. In the event that HDD is determined not to be feasible based on final engineering investigations or construction constraints, Australia Pacific LNG would instead use dredging equipment to excavate a trench across the seabed of The Narrows into which the pipeline would be installed.

The pipeline must be buried in a trench beneath the seabed to protect it from the activities of marine vessels and to stabilise it, preventing movement caused by the effects of waves and currents.

The depth of burial would depend on studies to assess the risk of damage from dropped or dragged anchors in the vicinity of the pipeline crossing and the amount of mobility of the seabed material. For this initial study a burial depth to top of pipe of at least 2m is assumed, with a backfill/capping of rock segments for supplementary external protection.

The trench for the crossing would be excavated by conventional dredging vessels to an appropriate size for the Australia Pacific LNG gas pipeline. Dredged spoil material would be deposited at Fisherman's Landing as part of the Gladstone Ports Corporation Port Expansion project. Approximate volumes of material which would be dredged in this manner are detailed in Volume 3 Chapter 12.

A discussion of the proposed areas for excavation by dredging and for placement of the spoil material is in Volume 3 Chapter 10.

There are three subsea pipeline trenching activities which may be required:

- Dredging (generally pre installation)
- Jetting (post installation)
- Ploughing (post installation)

Various methods of dredging are being assessed and the method most appropriate for this crossing could be either 'cutter suction dredging' or 'trailing suction hopper dredging'. Various proven methods of backfilling the trench like jetting and/or ploughing which move material from the trench walls over the pipeline. The pipe string would be pre-fabricated and tested on the mudflats at Friend Point in preparation for a 'bottom tow' pull towards Laird Point at Curtis Island (refer to Figure 3.28). For this pulling operation, winches would be installed at Curtis Island. For site stability and for erosion control, cofferdams constructed of sheet piling would be constructed along the shore crossings on both sides of the crossing.

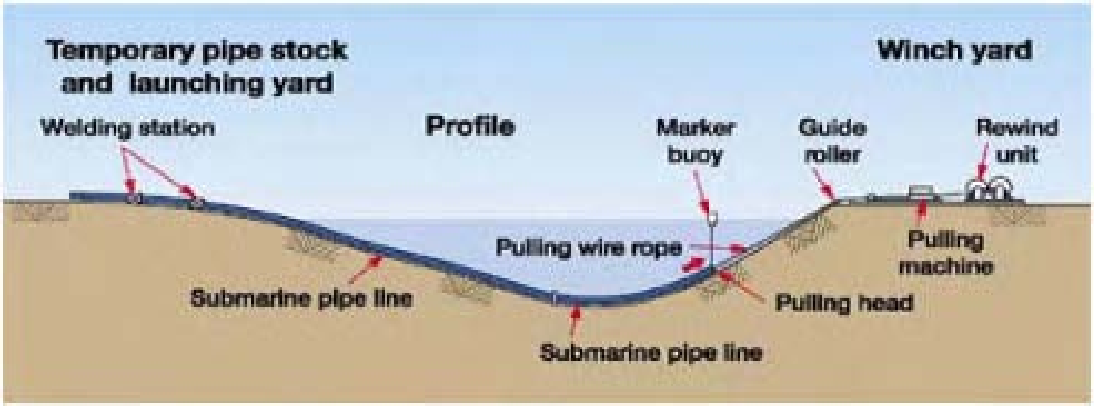

Figure 3.28 Bottom pull installation of crossing pipeline

After the pipe is pulled into position, the pipeline will be connected to the land pipeline sections. The installed pipe would then be armoured by rock dumping and sediment would be allowed to refill the ditch over the pipe and rock armour. The sheet piling of the cofferdams would be removed.

The duration of the dredging operation could be from several weeks up to six months, depending on factors such as available vessel type, weather and current conditions. If possible, co-ordination will be arranged with the dredging of the Port of Gladstone.

3.8.3 Wetlands crossing

It is proposed that the pipeline across the mud flats to the west of The Narrows be installed in an excavated trench. Excavation in muddy conditions requires a wide trench with sloped sides to prevent trench collapse. Alternatively the volume of material to be excavated may be minimised by installing parallel rows of sheet piles driven along the proposed trench line. The trench would be dug between the rows of sheet piling using low ground pressure excavators, working from a temporary construction access way built on top of the existing mudflats. In either case, spoil will be stockpiled on one side of the trench while the other side will be used as working side.

The excavated spoil will probably contain acid sulphate soils, and so will be treated using lime or similar material before it is returned into the trench. Details of the proposed methodology for treatment of acid sulfate soils are provided in Volume 3 Chapter 5.

Two techniques are available for installation of the welded pipeline, depending on further examination of water levels and tidal influences in the area. One involves floating the pipe into a flooded trench. The pipe string will be welded and pressure tested on the temporary right of way to the west of the water crossing. Flotation devices would then be attached to the pipeline, and the pipe string pulled into place using a cable attached to a winch on the HDD rig on the opposite shore. The flotation devices would then be removed, allowing the pipe to settle to the bottom of the ditch.

If further construction investigation planning indicates that the trench can be maintained in a relatively dry state, then the pipe may be fabricated on the temporary access way beside the trench line, tested, and then lowered into the trench in a manner similar to conventional onshore pipeline construction.

After treatment in accordance with procedures for management of acid sulfate soils, the spoil would then be placed back over the pipeline to generally match the original landform.

After installation of the pipeline, sheet piling and any other construction materials will be removed from the mudflats.

It is anticipated that this installation will require between nine and 12 months to complete.

3.8.4 Information relevant to all crossing methods

Control measures applicable to the crossings of both The Narrows and the wetlands will include minimising acid sulfate soil leaching to The Narrows waterway, monitoring for drilling fluid loss of circulation, use of geotextile under any temporary right of way, as well as the standard controls for pipeline construction in these conditions.

None of the methods proposed would require landing of pipe in the immediate area of the crossing. Pipe would be delivered to an existing wharf within the port and trucked to the site for fabrication on the construction area developed across the mud-flats. Marine equipment such as the dredges and any support barges would be launched from existing wharves and moored in position with anchors if necessary.

The volume of materials to be transported to the site is a function of the methods to be implemented and therefore cannot be accurately reflected until more detailed planning is completed. The materials would generally include the following:

- Construction equipment and consumables such as welding materials, grit blasting sand and so forth
- Geotextile materials and additional fill to form the temporary access ways across the mudflats and temporary construction areas upon which to site the HDD rig and associated equipment
- Pipe and coating materials for actual fabrication and installation of the pipeline
- Lime for treatment of acid sulfate soils excavated on the mudflats
- Sheet piling both for stabilisation of the soils in the area of the mudflats pipeline trench excavation, and for development of temporary construction areas subject to tidal and wave influence.

Installation of both the mudflats crossing and the HDD crossing of The Narrows would take place between Q2 2012 and Q3 2013.

3.8.5 The Narrows crossing – four pipe crossing

As discussed in Section 3.1.1, four proponents for LNG plants on Curtis Island each require a gas transmission pipeline link from the mainland. A proposal has been put forward for a combined approach to the complete crossing which would involve a joint installation of the pipelines in the same continuous construction window. The installation of the pipelines in the marine crossing would be in two stages: installation across The Narrows then installation across the mudflats.

The proposal involves the laying of four pipelines each with an outside diameter of 1067mm. A number of options are under consideration for the installation process. The current concept involves installing the four pipes in two pairs. Across The Narrows the two pairs of pipes would be installed in one combined trench whilst across the mudflats the pairs of pipes would be installed in two, parallel, adjoining trenches. A laydown area would be required on the mainland, adjacent to the mudflats, for set up of the works, site amenities and pipe stockpiles.

The Narrows crossing

Each pipeline for The Narrows crossing will be welded into a single string of approximately 2.3km in length. The pipelines will be coated with a concrete layer to avoid buoyancy. Once assembled each pipeline will be individually hydrotested. Once the pipelines have passed the hydrotest they will be pulled, by winches located on Curtis Island, across The Narrows in pairs using a bottom pull method. The winch set up on Curtis Island would require an area of approximately 2500m^2; part of this area will fall outside of the proposed GSDA corridor.

To prepare the pipe-string for The Narrows crossing, a set of three, parallel rails at 8m centres will be constructed across the mudflats. The rails will be supported on piles, driven to a sufficient depth below ground level, and will support platforms for sheet pile driving or rail bogies (i.e. set of wheels used under train carriages) for the transport of the pipe. To allow for personnel or vehicle access along the rail frame, tracks of around 5-7 m width will be required along both sides of the rail area creating an overall footprint of approximately 30m across the mudflats.

After constructing the rail system, all four pipe strings for The Narrows crossing will be assembled on bogies along the rails. This will involve moving the pipe along the rails as each section is welded in place so that the total length of pipe is in place on the rails for hydrotesting.

A single trench of between 3m and 7m depth and varying in width, based on geotechnical information, from 15m at the base to around 55m at the top would be dredged across The Narrows. Once the two pairs of pipe are installed in the single trench, the trench would be backfilled and covered with rock armouring to a depth of approximately 2 m. The rock armouring would provide protection to the pipelines from marine activities such as anchoring of vessels. Based on the available geotechnical information, the total volume of material to be excavated for The Narrows crossing trench has been estimated at 130,000m^3

The wetlands crossing

Installation of the pipelines across the mudflats would be carried out from The Narrows back to the mainland with one pair of pipelines being installed at a time. A trench would be excavated across the mudflats, between the rails, for each pair of pipes. Excavation would be carried out by excavators supported on the rails. It is anticipated that each trench would be up to 6m in width and 2.6m in depth and would be excavated in sections of up to 200m in length. Sheet piling is proposed to contain each trench to minimise the impacts of acid sulphate soil disturbance. After finalizing the first trench, the second would be constructed.

3.9 Construction materials and plant equipment

During the construction of the gas pipeline, a range of materials and equipment will be used, and may be stored on the right of way. Materials include:

- Slag or garnet for sand blasting pipes
- Markers, posts and signs
- Fencing
- Wooden skids
- Styrofoam blocks/foam pillows
- Sawdust filled hessian bags
- Sand bags for trench breakers and pipe stringing
- Explosives for blasting, if required

- Steel line pipe, up to18m in length
- Valves, fittings and flanges for intermediate facilities
- Consumables such as welding rods, grinding discs and tape
- Field joint coating materials (sleeves or epoxy)
- Marker tapes
- Diesel and unleaded fuels
- Lubricants
- Emergency response equipment and spill kits.

Major items of equipment required will include:

- Graders
- Bulldozers
- Side-boom equipment
- Excavators
- Trenchers
- Padding machines
- Fuel trucks
- Water trucks
- Welding machines
- Mulchers
- Semi trailers
- Cherry pickers
- X-ray equipment (to test pipeline welds)
- Light vehicles
- Rocksaws and rock breakers
- Front end loaders
- Forklifts
- HDD equipment
- Barges
- Crawler cranes
- Boring machines.

3.10 Construction workforce and associated infrastructure

3.10.1 Construction workforce

Main gas pipeline construction will progress from south to north at up to 2km per day. Several temporary accommodation facilities will operate at the same time. Overall the total construction workforce, including support personnel, will fluctuate and will average approximately 800 people.

There is likely to be four crews working generally 12-hour days, rostering 28 days on and nine days off. Standard construction hours will be from 6:00am to 6:00pm, seven days a week.

The exact manner in which the roster will be applied is still under consideration. It is likely that the rosters would be staggered, with gas pipeline construction crews being rostered on and off over a period of days in accordance with their role in the sequence of construction. This would significantly reduce the demands placed on flights to and from the project area. In this manner the period in which there was little construction activity onsite would be less than nine days.

Another alternative under consideration is to apply a rotating shift roster in which a portion of the construction personnel are rostered on and off each week, which requires additional personnel to be employed but means that construction activity levels do not drop and average progress is continuously maintained. A particular benefit of this approach is that more gas pipeline construction can be accomplished within dry season weather windows.

The construction workforce will be flown in using charter flights, with bus transport from the airport to the temporary accommodation facilities.

3.10.2 Temporary accommodation facilities and offices

Several temporary accommodation facilities will be required sequentially to house the workforce throughout construction. Offices will be co-located with these facilities. Indicative locations for these facilities are shown on figures Figure 3.2, Figure 3.3and Figure 3.4. Rostered workers would fly to the nearest commercial airport or other suitable aerodrome and be collected by bus to travel to the accommodation facility.

The main temporary accommodation facility will house about 600 workers and will be relocated approximately every two months. Additional smaller temporary accommodation facilities (known as 'fly camps') will be developed to house the specialist crews.

The temporary accommodation facilities are planned to ensure the temporary workforce does not negatively impact existing accommodation resources in the region.

Water required at the temporary accommodation facilities will be transported by truck or temporary pipeline from an approved source (see Section 3.5.1) and stored in portable tanks at the accommodation facility site.

Power requirements for each facility will be provided by diesel generators. Connections to the local power grid are not anticipated given the temporary nature of the installations.

Package sewerage treatment plants will be used at each temporary accommodation facility. The plants are sized to allow sufficient capacity for all workforce needs. Treated waste water may be either irrigated to land or trucked as regulated waste, depending on the licence requirements, size of the plant, soil type and location.

A typical sewerage treatment plant will include:

- A balance tank for flow equalisation
- A primary tank for settlement, digestion and storage of solid matter
- An aeration compartment for biological degradation of organic matter
- A clarifier for further removal of residual suspended solids
- A final effluent tank for disinfection and storage of treated water.

Plants will be designed to treat water to either Class C or Class D effluent quality, depending on licence requirements. Sub-surface irrigation is the preferred method of irrigation, but the plant location will be based on soil type, size of plant and time constraints.

A site level assessment will be conducted at each location to determine the appropriate method of wastewater disposal at the time of installation.

Refer to Volume 3 Chapter 6 for additional details on the proposed temporary accommodation facilities locations, land use in each location, the relevant planning frameworks and planning policy compliance.

3.10.3 Temporary workshops and laydown areas

Workshops and laydown areas required by construction will usually be co-located with temporary accommodation facilities and offices. In addition, two additional sites have been selected along the Leichardt Highway, in the vicinity of Wandoan and Theodore.

3.10.4 Transportation requirements

Construction of the gas pipeline will require significant movements of equipment, pipe materials, personnel, and resources (refer to Volume 3 Chapter 17).

In summary, pipe materials and some pipeline construction equipment will be imported through either the Port of Gladstone or the Port of Brisbane, for further transport by truck (or possibly rail) to the construction sites.

Increased road traffic associated with the Project and other proposed regionally significant projects will require the following works:

- Upgrades to numerous federal, state and local government road links within the project area
- Upgrades to numerous state-controlled intersections within the project area
- Pavement rehabilitation works brought forward on federal, state and local government road segments due to heavy vehicle traffic generated by the Project.

The transportation of people, principally construction staff during shift rotations, will require additional movements of passengers and aircraft through the regional and local airports. A large number of the additional flights required will be dedicated charter flights.

With the upgrades underway, the Gladstone Regional Airport will be able to handle the highest number of additional passengers. This is estimated at 100 each day, on average, during construction periods. Cumulative impacts also need to be considered as they are likely to be at least double the demands assessed for the Project.

There would also be a need to upgrade to the Miles airport, which does not currently operate regular commercial services. Australia Pacific LNG will work with the Western Downs Regional Council, relevant government agencies and service providers to determine the most appropriate options for the use of Miles aerodrome.

3.10.5 Coating plant

Before delivery to site for construction, the pipe will require the application of an external coating which will prevent corrosion after burial. Australia Pacific LNG is considering a number of options for both the type of coating and the location at which it is to be applied.

The coating will be either fusion bonded epoxy (FBE) or three layer polyethylene. The FBE may be applied either as a single layer or in two layers (dual layer FBE). The internal surface may be lined with an epoxy paint. As the pipe will be manufactured overseas, the pipe could be coated either overseas before shipment, or in Australia after receipt and before construction. Coating within Australia is preferred as this avoids the risk of coating damage during marine transportation. However, some increase in project execution risk associated with any failure of this local coating plant is acknowledged.

For the volume of pipe coating work proposed by Australia Pacific LNG (and possibly other proponents) it may be feasible to establish a coating plant at a suitable location near the project area.

The location will require a large open area for stockpiling of the bare and coated pipes, and will need to be easily accessed by truck transportation, and possibly by rail transport as well.

An area of approximately 15ha is required, of which the actual plant would require only about one hectare. The building will be of steel-frame industrial style construction, and the site will require power, water, sewage, and communications utility services. Machinery to clean and heat the pipe prior to application, and the actual coating application machinery will be installed in the building.

There will be a significant level of truck activity in the area. Loading and unloading of trucks will be done by mobile cranes or excavators fitted with vacuum lifters to pick up and place the pipes. The travel lanes of the stockpile area will be formed as temporary roads and surfaced to minimise the generation of dust. Fork lift trucks or loaders may be used for pipe handling between the coating plant and stockpiles and may also be used for loading and unloading trucks, as required.

The plant will normally operate on the basis of two 8-hour shifts per day, but may be required to run on a 24-hour basis to meet throughput requirements. Loading and unloading will normally only take place during daylight hours. However if night activity is required, floodlighting would be installed in the stockpile area as required for the safety of loading and unloading operations.

Noise generated is anticipated to be typical of an industrial site, arising primarily from the operating machinery, mobile equipment and pipe movement within the stockpiles and plant.

Airborne emissions from the coating plant will be limited to some evaporation of the volatile components of the liquid coating materials, which are similar to ordinary epoxy paint. No objectionable or noxious odours are expected. Some steam may be emitted during the cooling process, but this would be predominantly from water cooling bare steel pipes during the setting up process. Pipes are cleaned in a large circumferential grit blasting machine called a wheelabrator, and dust collectors are fitted to the exhaust vents. Dust collectors are also fitted to the FBE powder process equipment to collect waste product.

Another stage of pipe cleaning involves an acid wash. Spent acids are diluted to the required levels and neutralised prior to disposal in the sewage system.

FBE coating is applied as a sprayed powder, creating an overspray stream, within an application booth, with most product recycled. However, a small amount of waste will be sealed in drums and taken to a licensed disposal facility. Other solid wastes typical of industrial activity would be either recycled or disposed of locally.

All hazardous materials used at the site will be stored separately in a secure area in accordance with applicable legislation. The processes utilised in the application of pipe coating do not present significant risk of accident or threat to the surrounding area.

Initial planning has identified a number of potentially suitable sites in the project area, and a location in the vicinity of Biloela is currently under consideration. This site is owned by the Banana Shire Council and is already zoned for industrial use. Development approvals applicable to the establishment of the coating plant would be sought and obtained by the coating contractor.

The number of people to be employed by the coating contractor at the site could range from 50 to 100, depending on the coating selected and the shift roster worked. Key management and supervision personnel from the coating contractor's staff would re-locate to the area for the duration of the coating plant operation, and there would be good opportunities for local employment of unskilled or semi-skilled labourers, tradespersons, and mobile equipment operators.

Establishment of the coating plant would commence following award of contracts by Australia Pacific LNG (currently planned for mid-2010) and require from nine to 12 months to be ready for pipe coating. The plant would coat pipe for Australia Pacific LNG until approximately Q1 2013. The coating plant could also be used by other proponents to coat pipe for their CSG to LNG projects.

Following the completion of major pipeline projects currently proposed, the ongoing need for continued operation of the coating plant at that location would be re-assessed. If the plant was shut down, the equipment would be dismantled and removed. Depending on the potential for the building and site to be re-used by others, the building could either be left in place or removed, and the site rehabilitated to its current condition.

3.11 Key pipeline infrastructure

Operational and maintenance pipeline infrastructure will include cathodic protection, inlet and receiver stations, main line and isolation valves, metering and provision for future booster stations. This infrastructure is described in more detail in this section.

Key surface pipeline infrastructure will be built above the 100-year flood level and will have secure fencing. The surfaces of the sites will be finished with crushed rock or other material suitable to the ongoing use of the facility, and sites will be sloped so as to drain stormwater away from the facilities. Other than at scraper launchers and receivers, there will be no areas subject to spillage during operations.

During operational activities at scraper launchers and receivers, temporary control measures to contain any liquids spillage will be implemented. The requirement for any oily water separation facilities at pipeline infrastructure sites will be further assessed during detailed design of those facilities.

In Table 3.4, the location of key infrastructure along the gas pipeline route is summarised. Other associated infrastructure will include data collection and transmission equipment, water sources such as bores, and electricity supplies from the local grid or generator sets. The final number and locations of above ground facilities will be determined during detail design.

Table 3.4 Key infrastructure along the gas pipeline route

Approximate kilometre point	Pipeline infrastructure	Diameter (inches)	Comment
Condabri lateral			
0	Inlet Station (Launcher, isolation valve)	36	Start lateral
44	Receiver, isolation valve	36	KP0 of main gas pipeline
Woleebee lateral			
0	Inlet Station (Launcher, isolation valve)	30	Start lateral
37.5	Receiver, isolation valve	30	KP0 of main gas pipeline

Approximate kilometre point	Pipeline infrastructure	Diameter (inches)	Comment
Main pipeline			
0	Mainline Hub (Receivers for Laterals, Mainline Launcher, isolation valves, metering if required, and connections for future compression)	42	Proposed future compression facility
29	Main Line Valve No 1	42	
58	Main Line Valve No 2	42	
87	Main Line Valve No 3	42	
116	Main Line Valve No 4	42	
146	Main Line Valve No 5	42	
174	Main Line Valve No 6	42	
203	Scraper Station (Launcher-receiver, isolation valve, connection for future compression)	42	Proposed future compression facility
231	Main Line Valve No 7	42	
260	Main Line Valve No 8	42	
290	Main Line Valve No 9	42	
320	Main Line Valve No 10	42	
335	Main Line Valve No 11	42	
350	Main Line Valve No 12, side valve	42	Tie-in point for future looping upstream of The Narrows crossing
362	Delivery and Metering Station (receiver, isolation valve, filtering, metering)	42	End pipeline at LNG facility

3.11.1 Inlet stations

An inlet station or 'scraper launcher' will be installed at the start of the gas pipeline near Woleebee and also near Miles. This will enable cleaning and inspection tools to be inserted into the pipeline under pressure.

The inlet stations may be incorporated into the associated gas processing facilities, and will include a launcher trap, emergency isolation, pigging equipment (which is used to monitor and record the internal condition of the pipeline), materials storage, a water tank, and other required equipment. The new inlet station will be connected to the high pressure gas pipelines, to transport coal seam gas from gas processing facilities to the gas pipeline. Provision will be made for installing meter runs as required.

3.11.2 Mainline hub

At the intersection of the lateral pipelines and the start of the mainline, pipeline equipment as described in the table above will be installed. This may also be the location of a future compressor station, and suitable space and connection provisions will be made in the initial design for this purpose.

3.11.3 Delivery and meter stations

An outlet delivery and meter station will be installed at Curtis Island. This will control the temperature and pressure of the gas, and monitor quality before the gas is delivered to the LNG facility.

The station will consist of emergency shutdown valves and normal block valves, a pig receiver, possibly heaters, a dry gas filter, a meter run (custody transfer standard) and a pressure regulating run; as well as related controls and instruments. It will also include materials storage and other utilities as required.

Any gas to be vented from the pipeline facilities at this location will be piped into the LNG facility for management as part of the plant vent and flare systems.

The exact delineation between the gas pipeline and the LNG facility is currently not finalised. For purposes of this EIS it is assumed that the facilities described in this section are all part of the pipeline, and that the LNG facility starts at another emergency shut down valve immediately downstream of the meters and pressure regulation.

Metering may also be installed at the pipeline inlet. Metering data will be transmitted back to the control room and be accessible through the Supervisory Control and Data Acquisition (SCADA) system (refer Section 3.12.1). Critical instrumentation will be maintained through quality checks at regular intervals.

3.11.4 Main line valves

Main line valves are in-line block valves fitted with actuators, to be used in the unlikely event that the segment may need to be isolated and depressurised to gain access for repair. Main line valves will be located at intervals set in the relevant Australian Standard for maintenance and emergency isolation purposes.

Main line valves will include vents for depressurising the gas pipeline when required. An intermediate mainline valve site is shown in Figure 3.29.

Figure 3.29 Completed intermediate mainline valve site

3.11.5 Scraper stations

A mid-line scraper station is required about half way along the gas pipeline to launch and receive pigs under pipeline pressure. The launchers and receivers are attached to, and isolatable from, the pipeline itself and act like a 'lock'.

The pig is loaded into the unpressurised launcher and the vessel is closed and pressurised to equal the pipeline pressure. The pig is then sent down the pipeline using the flowing gas as the driving force. The pig is collected at the receiver at the other end of the pipe and the receiver is isolated, depressurised and opened to retrieve the pig.

A scraper launcher is shown in Figure 3.30.

Figure 3.30 Scraper launcher

3.11.6 Compressor stations (future)

Mid-line compressor stations may be required in future to increase the pipeline capacity. Design of the pipeline system will therefore provide for future connection of these stations. Two possible locations have been identified:

- At the mainline hub, where the lateral pipelines meet the main gas pipeline
- At the midline scraper station along the gas pipeline alignment, east of the Belmont State Forest (kilometre point 203).

3.11.7 Cathodic protection

In addition to the external coating, a cathodic protection system will be installed on the pipeline to further protect it from corrosion. Anodes are typically buried in the vicinity of the main line valve or scraper station, and then connected to the pipeline via underground cabling.

In addition, cathodic protection test points are connected to the pipeline and located approximately every two to five kilometres. These test points are required to allow measurement of the effectiveness of the corrosion protection system.

These points are normally sited adjacent to marker posts, and ideally along roads and tracks, for accessibility and to minimise the impact on land use. Impressed current cathodic protection ground beds will use either power from the local grid delivered via short power lines, or solar power with battery back-up.

3.11.8 Control systems

The surface facilities described above will be connected to a central control room via buried fibre optic cable which carries both data and voice communication signals between the sites. Current planning assumes that two redundant fibre optic cables will be installed along the gas pipeline to allow effective data transmission and communication between all three project elements; the gas fields, the gas pipeline facilities, and the LNG facility.

Equipment installed at each pipeline surface facility will collect data from local instruments and connect to the fibre optic cables. The combined data collection and transmission system is generally referred to as the SCADA system.

Abnormal operating conditions will be detected by instruments and communicated to the control room for operator attention. Local control systems will be designed so that the facilities would shut down automatically if required, even if communication with the central control room is lost.

3.12 Commissioning, operation and maintenance

Commissioning will be undertaken according to Australian Standard AS2885. The gas pipeline will be provided with appropriate safety signage at all intersections with roads and access tracks, as well as aerial markers at intervals to assist identification during aerial patrols.

Operation and maintenance of the gas pipeline will be in accordance with Australian Standard AS2885, Part 3. The pipeline licensing requirements set by the Department of Employment, Economic Development and Innovation will also be applied.

The gas pipeline will operate continuously, and unscheduled outages are not expected. However, emergency line pipe, repair equipment and sufficient spares will be available in the event that urgent repairs are required. The repairs will be supported by a suite of assessment and repair procedures.

Plans will be developed during the project design stages to address ongoing environmental management commitments and requirements. A safety and operating plan and an emergency response plan will be developed and managed in accordance with Australian Standard AS2885.3.

Maintenance of the gas pipeline will include inspection surveys by vehicle along the gas pipeline, routine visual inspections from the air, and pigging at regular intervals. If pigging detects any areas of concern, 'dig ups' of those pipeline sections may be required to enable visual inspections.

Skilled staff and/or contractors will be deployed to deliver scheduled or unscheduled maintenance. Approximately 20 people will be required for operation and maintenance of the gas pipeline. Additional specialist contract personnel will be engaged on a short-term basis for activities such as intelligent pigging or minor earthworks to repair any erosion.

If compressor stations are required, they will be operated and maintained by either staff and/or external contractors. Scheduled maintenance shut-downs of the compression station(s) are expected every five to six years. The impact of potential unscheduled outages will be minimised through adequate redundancy and maintenance planning.

A pressure control facility will also be located at the pipeline outlet just before the LNG facility. Operators in the control room will monitor this and other sites remotely.

3.12.1 SCADA

At the main pipeline control room, pipeline operators will use the SCADA system to monitor all main line valve and scraper facilities along the main pipeline for operating parameters, equipment status and control. Functionality for local monitoring and control will also be provided at key facilities.

Both a main pipeline control facility and a back-up control facility will be installed. The locations of these will be confirmed during the front end engineering and design (FEED).

3.12.2 Pipeline surveillance

Patrols are to be conducted as outlined in Australian Standard AS2885.3. Depending on the location, these will be conducted either by flying, driving or walking along the gas pipeline corridor.

Patrol frequency will be set to ensure early detection of events which might cause gas pipeline failure or create hazardous conditions. Initial surveillance will be by air, and visual surveillance will be completed at frequencies appropriate to the variety of locations along the route. Ground visual surveillance will be completed at least monthly, subject to weather and access restrictions (such as crop status).

Surveillance objectives are to monitor or check for:

- Signs of gas or liquid leaks
- Condition of cathodic protection test points
- Third party activities on or near the gas pipeline easement
- Damage to Australia Pacific LNG property
- Pipeline marker posts and signage (condition and visibility)
- Effects of natural events or hazards such as storm damage, wind erosion, watercourse scouring, landslides, flooding and washouts
- Security of fenced facilities
- Gas pipeline right of way accessibility
- Extent of vegetation overgrowth on the easement which may prohibit access, or locations where rootstock may interfere with the buried pipeline
- Condition of aboveground pipe work
- Fire hazards and fire protection equipment status
- Environmental issues such as introduced weeds and erosion.

3.12.3 Intelligent pigging

The pipelines will be inspected periodically by running an 'intelligent pig' inside the gas pipeline to detect possible corrosion. This device monitors and records the internal condition of the gas pipeline. To ensure the gas pipeline's continued integrity, each section will be inspected approximately every three to five years, or as directed by Pipeline License conditions. Durations may be extended if deemed appropriate by the integrity monitoring program results and as agreed with the technical regulator.

3.12.4 Operations and maintenance access

If the easement cannot be viewed from an existing track or road, vehicle access along the right of way will be required. Australia Pacific LNG operators will use the track for periodic patrolling of the gas pipeline and to access measuring points of the cathodic protection.

Ground access to the easement will be through vehicle gates along roads, tracks and boundary fences. Both Australia Pacific LNG operators and land users/owners will have shared access by the lock-in-lock system. Access to some sites may also be via helicopter.

3.13 Decommissioning and rehabilitation

In the event that the gas pipeline is no longer required, it will either be decommissioned or abandoned:

- Decommissioning – depressurising the pipeline, then capping and filling it with an inert gas such as nitrogen or water with corrosion inhibiting chemicals. The cathodic protection would be maintained to prevent the pipe corroding.
- Abandonment – purging the pipe of natural gas, disconnecting it from the manifolds and removing all above ground facilities. The pipe would be cut at intervals to prevent inadvertent transfer of groundwater from one area to another. The pipe would then be left in place to corrode.

Both decommissioning and abandonment have the potential for small scale temporary environmental impacts that will need to be carefully managed. Recovering the pipe from the ground is unlikely to be a commercially viable option and would result in significant and unnecessary environmental impacts.

Pipeline surface facilities would be similarly decommissioned as the gas fields aboveground components removed from site, allowing the surface to be rehabilitated to the existing surrounding land conditions.

A detailed rehabilitation and monitoring program would be developed and implemented in consultation with landholders and the Regulator at the time of abandonment. The abandoned gas pipeline easement would either be returned to its pre-pipeline vegetation or as negotiated with the landholder.

Regular updates about construction of the gas pipeline will be provided on the Australia Pacific LNG website (www.aplng.com.au) as they become available.