12 PIPELINE CONSTRUCTION

This chapter, *Chapter 12*, describes the extent and nature of the construction of the Queensland Curtis LNG (QCLNG) Project's Pipeline Component, which comprises the Export Pipeline, Lateral and Collection Header. The description includes:

- the type and methods of construction
- construction equipment to be used
- items to be transported onto the construction site.

The staging of the Pipeline Component is also described in this chapter including a description of development sequencing and anticipated construction timeframes.

12.1 ROUTE SELECTION PROCESS

The development of routes for the Export Pipeline, Lateral Pipeline and the Upstream Infrastructure Corridor (UIC) in which the Collection Header will be located involved a five-stage methodology.

- Development of potential route options
- Desktop studies of collected site data
- Field reviews
- Selection of a preferred route for detailed study
- Detailed studies scheduled to refine the preferred route (ongoing).

12.1.1 Development of Potential Route Options

Section 3.2 of the *Australian Pipeline Industry Code of Environmental Practice* (APIA Code) identifies five key areas for consideration in the route selection process:

- safety - particularly risk
- commercial – taking into account markets and construction and operations costs
- engineering – taking into account terrain, climate and access requirements for the pipeline
- environment – the need to minimise impacts on the environment.

The APIA Code also cautions that legislation, and legislative changes, should also be taken into account in the route selection process.

The initial route screening process conducted in line with the APIA Code therefore considered:

- the complexity of the approvals processes
- nature of the land uses in the area
- the general environment (both built and natural)
- any constraints to construction of the pipeline.

A review of mapping and aerial photography was conducted for a wide area between Miles and Gladstone and across the area within which the QGC production lease areas lie. The most significant topographic constraints for the Project are the Callide and Calliope Ranges.

This preliminary review determined, based on physical, environmental and commercial viability constraints, that a 40 km corridor around a line between Miles and Gladstone (i.e. 20 km each side of a centre line) was the preferred location for more detailed studies for the Export Pipeline and Lateral Pipeline (refer to *Figure 2.12.1*).

Routes to the west of this preferred corridor did not provide any significant environmental or constructability advantages to offset the additional length and associated costs of routes in these locations. Similarly routes further to the east required greater length and would create greater impact on populated areas.

The Collection Header in the UIC underwent a similar process but was more constrained by the gas collection points. The Collection Header needs to connect gas production from five local areas around Miles and Chinchilla.

12.1.2 Desktop Studies

Desktop studies were then conducted during 2008 to broadly investigate the environmental constraints located in the Gas Field Component and between Miles and Gladstone. Key environmental constraints to the selection of an economically and technically viable pipeline route were also identified. This included topographic constraints that could affect the constructability of the pipeline.

The desktop studies included investigation of:

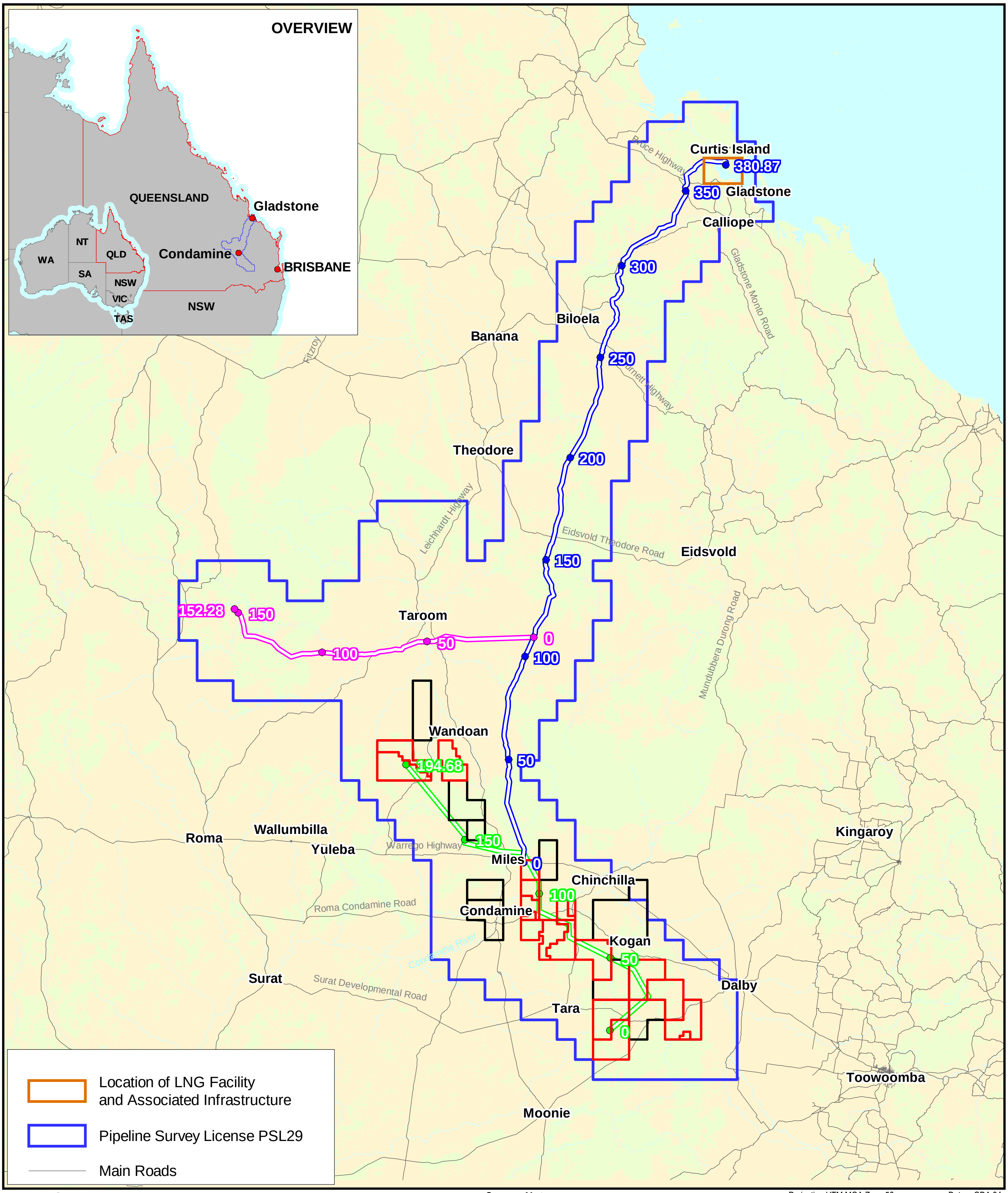
- government databases
- reviews of mapping and Landsat imagery
- high-level searches over the study corridor for areas of sensitivity (e.g. cultural heritage, threatened ecosystem and threatened flora and fauna.

Data collected was assembled into a series of maps which were then reviewed to identify the key constraints within the study corridor, such as:

- national parks
- known cultural heritage sites
- watercourses and wetlands
- topographic and ecosystem constraints.

Some of the key constraints that were identified included (refer to *Figure 2.12.1*):

- Queensland National Parks and conservation areas:
  - Precipice National Park
  - Kroombit Tops Forest Reserve
- protected regional ecosystems (REs)
- wetlands of significance
  - Lake Broadwater Conservation Park and reserve
  - The Gums Lagoon
  - Lake Nuga Nuga
  - Boggomoss Springs
- state forests
  - Barakula
  - Binkey
  - Quandery
  - Mundell
  - Rockybar
  - Borania
  - Montour
  - Belmont
  - Don River
  - Rundle
  - Curtis.



Legend:

- Export Pipeline & Kilometre Point
- Lateral Pipeline & Kilometre Point
- Upstream Infrastructure Corridor & Kilometre Point
- CSG Fields - ATP
- CSG Fields - PL & PLA

Source Note:
1:250,000 Topographic vector copyright Geoscience Australia

Projection UTM MGA Zone 56 — Datum GDA 94

0 50 75 100
Kilometres

N

QUEENSLAND CURTIS LNG — A BG Group business	Project: Queensland Curtis LNG Project	Title: QCLNG Project Study Area
	Client: QGC - A BG Group business	
ERM — Environmental Resources Management Australia Pty Ltd	Drawn: DB — Volume: 2 — Figure: 2.12.1	Disclaimer: Maps and Figures contained in this Report may be based on Third Party Data, may not be to scale and are intended as Guides only. ERM does not warrant the accuracy of any such Maps and Figures.
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	Date: 04.06.09 — Revision: A	

The data sources that were reviewed during the initial route selection studies included:

- Commonwealth Environment Protection and Biodiversity Conservation (EPBC) database (Protected Flora, Fauna, Ecological Communities, Heritage Places, sites of international significance such as World Heritage and Ramsar Wetlands)
- National Native Title Tribunal (native title)
- Queensland Herbarium (protected flora)
- Queensland Museum records (protected fauna)
- Queensland Department of Employment, Economic Development and Innovation (cadastral data and mineral tenements)
- Commonwealth Australian Heritage database
- Queensland Heritage Register (items listed under *Heritage Act 1992* (Queensland)).

12.1.3 Field Reviews

Field reviews of the study corridors were then conducted by vehicle to understand the general terrain in relation to constructability constraints. No detailed field studies or surveys were conducted at this initial stage. The routes traversed in the field review were restricted to public roads and tracks. No private properties were accessed at that stage.

12.1.4 Selection of Preferred Routes

Selection of preferred routes for detailed study was then made based on the assembled data and the selection criteria given in *Section 12.1.6*.

For the Export Pipeline a number of potential route options were selected within the 40 km corridor. Each route option was reviewed in detail and assessed against the route selection criteria, to determine the preferred route (see *Section 12.1.6)*.

For the Lateral Pipeline and Collection Header, routes are shorter and constrained due to the need to access coal seam gas (CSG) resources and avoid mining interests. A similar, but less detailed, approach was used to that of the Export Pipeline investigation.

12.1.5 Detailed Studies

Detailed studies, including in-field surveys, were then conducted to refine the routes. The results of these studies are described in *Volume 4* of this Environmental Impact Statement (EIS). The EIS studies, along with negotiations with landholders and regulatory authorities, were used to further refine the proposed pipeline routes to their current configuration.

Ongoing negotiations with landholders and Traditional Owners may further refine these routes.

Future refinements would be subject to ecological studies similar to those conducted for the EIS to ensure that the revised route(s) meet the key selection criteria.

12.1.6 Assessment of Pipeline Route Options

Each of the corridor options (refer to *Figure 2.12.2*) were considered against the following assessment criteria:

- corridor length
- environmental approvals and land access complexity
- land use and ownership (including title and native title)
- community impacts
- constructability (principally terrain)
- proximity to QGC tenements and prospective CSG regions
- long-term pipeline protection, maintainability and operability
- future expansion potential.

12.1.6.1 *Length*

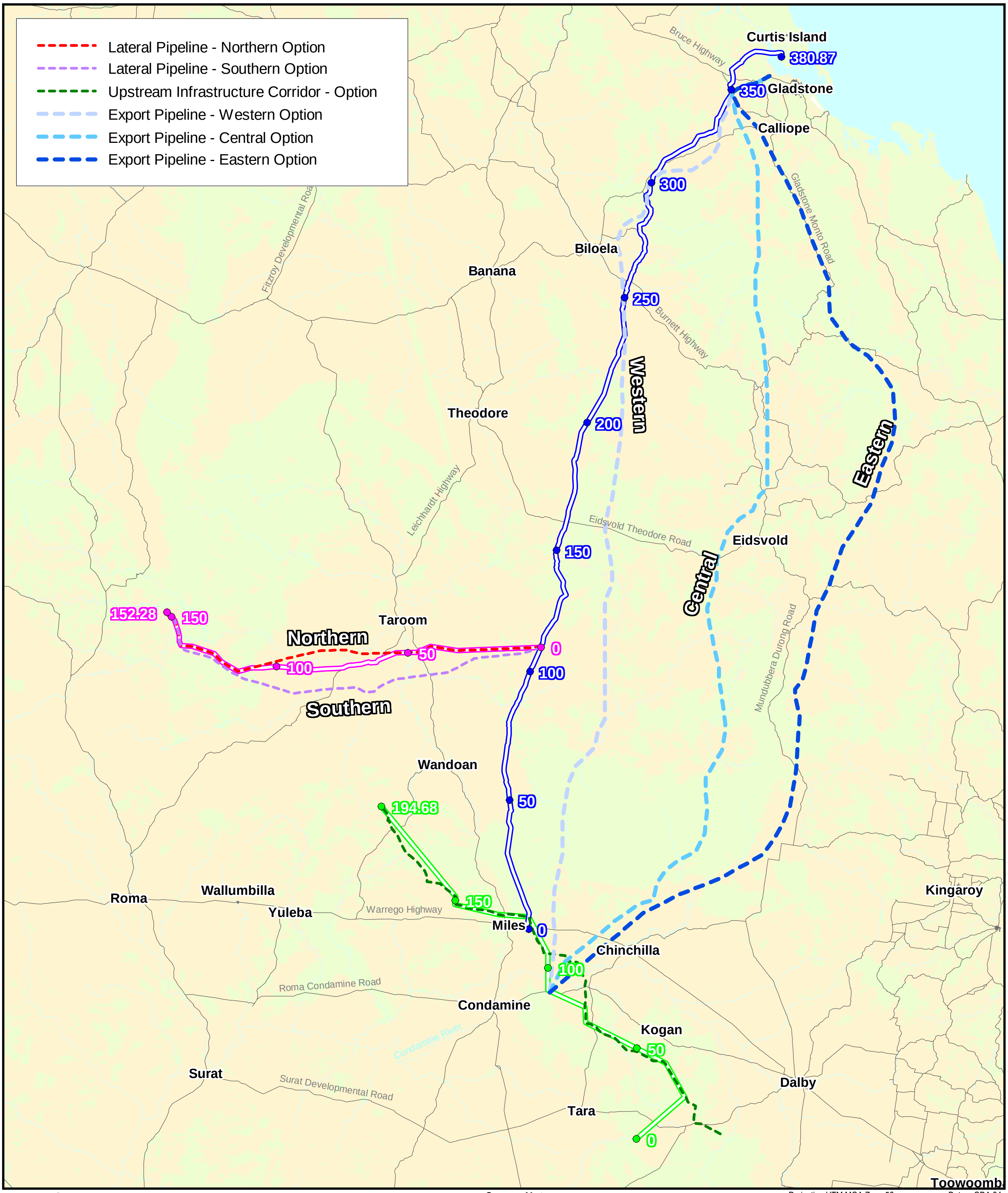
Geographic Information System (GIS) mapping allowed the measurement of each corridor to determine the likely length and cost of a final pipeline alignment.

12.1.6.2 *Environmental Approvals and Land Access Complexity*

Consideration of the overall complexity of the likely processes and issues to be managed in the approval of a pipeline alignment within the corridor included:

- extent of the pipeline alignment likely to be located within state forests, environmentally sensitive areas and areas with native and remnant vegetation
- number of landholders
- extent and nature of Government and reserve land
- primary production land use
- mining and other development interests.

The extent to which the pipeline routes impact upon sensitive areas and remnant vegetation is important in assessing the potential to impact upon protected flora and fauna species.



Legend:

Export Pipeline & Kilometre Point

Lateral Pipeline & Kilometre Point

Upstream Infrastructure Corridor & Kilometre Point

Source Note:
1:250,000 Topographic vector copyright Geoscience Australia

Projection UTM MGA Zone 56 Datum GDA 94

0 20 40 60 80

Kilometres

N

QUEENSLAND CURTIS LNG A BG Group business	Project **Queensland Curtis LNG Project**		Title **Pipeline Route Options**
	Client **QGC - A BG Group business**		
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	Date 08.07.09	Revision A	

State forest areas in Queensland have been set aside for various purposes and written consent from the Department of Environment and Resource Management (DERM) is required for construction works in these areas. In the initial screening process the extent of native vegetation and state forest likely to be affected by each route has been assessed through desktop studies and roadside visual inspection.

The number of landholders potentially affected was taken into consideration as an impact on the easement negotiation process and overall cost. This was assessed based on mapping and visual inspection of parcel/land use density.

In addition to ordinary landholders, the extent of government and reserve land was assessed based on mapping. Government and reserve land has the potential to increase the complexity of the easement acquisition process.

Primary production land use also has the potential to affect the complexity of the easement acquisition process and the overall cost. In addition, environmental approval will have to consider any impacts on Good Quality Agricultural Land (GQAL) as defined by DERM.

GQAL is a protected resource in Queensland and may require more stringent management and rehabilitation measures during construction. The level of primary production on the various routes was assessed by roadside visual inspection.

The other element that adds complexity to the easement acquisition process is the negotiation of mining leases and other developments in the area. This was considered through a review of various tenure mapping including mining tenure.

12.1.6.3 Land

Land was considered in relation to tenure and to the number and density of parcels likely to be affected.

The route selection process endeavoured to minimise impacts on leasehold and state-owned land due to the complexity of acquiring long-term secure easements over these lands.

12.1.6.4 Community Impacts

In assessing pipeline corridor options consideration was given to potential short-term and long-term impacts on communities, such as:

- proximity of the corridor to population centres and resultant construction disturbance
- public safety issues
- disruption to primary production
- impacts on visual amenity and encroachment/restrictions on public space.

12.1.6.5 *Constructability*

Each corridor option was considered via desktop mapping and through roadside inspection by experienced pipeline route selection personnel. The significant construction constraint for the Export Pipeline corridor options was the crossing of the Callide and Calliope Ranges.

Due to the proposed diameter of the Export Pipeline, extra consideration was given to the number of watercourses crossed by each option. Flat to undulating grazing land, substantially cleared of native vegetation, was considered optimum pipeline terrain for the assessment.

Corridors which provide the longest length of preferred terrain with the shortest crossing of the Ranges were ranked well from a constructability perspective.

In particular, avoiding side slopes was considered most important as the diameter of the pipe could result in considerable excavation works in these locations.

12.1.6.6 *Proximity to QGC Tenements and Prospective CSG Regions*

Assessment of the corridors also considered the extensive geographic spread of QGC tenements earmarked for liquefied natural gas (LNG) supply and the potential for the Export Pipeline to access extra CSG en-route to Curtis Island. A corridor which maximises the collection potential of CSG from QGC and others is considered highly desirable.

Each corridor was reviewed against mapping of QGC tenements and the Surat Basin ATP to assess its collection potential.

12.1.6.7 *Long-term Pipeline Protection and Operability*

As the pipelines will be designed, constructed and operated in accordance with AS 2885, early consideration of the risk and design profile of the likely pipeline alignments within each corridor was critical. On this criterion, a preferred alignment will generally be located in remote rural land operating at its foreseeable highest potential land use of grazing and unlikely to be subject to future intensive land use development or other high risk (to pipeline) activities.

As a general principle, preferred final alignment will avoid running parallel with electrical infrastructure (e.g. high-voltage power transmission lines and electrified rail) for extended distances due to safety issues during construction and to avoid induced current effects on steel pipelines during operation.

The process of assessment for this criterion was principally via the review of the information assembled for the environmental approvals, land access complexity and community impacts.

12.1.6.8 *Future Expansion Potential*

Future expansion was taken into consideration by assessing the likelihood of a final alignment which would provide for a pipeline easement capable of complete looping (duplication) at some time in the future.

The review process for this criterion was principally attempting to identify any sections of the likely final alignment within each corridor which may not be capable of future looping (e.g. width constrained by topography or land use).

12.1.6.9 *Assessment Results*

Export Pipeline

A detailed review of three route options was conducted for the Export Pipeline and the results of this review are summarised in *Table 2.12.1*. The routes that best met the nominated objectives and criteria were then selected as the preferred routes.

There are extensive areas of native vegetation and state forest between the gas receipt and delivery points. All of the routes identified intersected significant sections of native vegetation and the central options also intersected state forest.

The Eastern route was not preferred as in addition to native vegetation issues it passed in close proximity to the Mt Perry township, did not provide good access to other CSG resources, and was the longest route.

The Central route was considered more favourable as it avoided townships and was shorter. However, it intersected state forest as well as native vegetation and did not provide any better access to other CSG resources.

The Western route, while still impacting native vegetation, did avoid townships, was of a reasonable length, and provided slightly better access to other CSG resources. For these reasons the Western route was considered slightly superior to the other two alternatives. This route was adopted as Option One and has been further refined during the EIS process to arrive at the preferred route (Western Option Two) which is described in *Section 12.1.7.*

Table 2.12.1 Assessment of Export Pipeline Route Options

Corridor Options	Eastern	Central	Western (Option 1)
Length	420 km	390 km	380 km
Environmental approvals and land access complexity	**Medium to High** Kolan River area and other non-cleared areas contain significant sections of native vegetation. Land use generally appropriate for pipeline. Some mining resource issues, but not substantive.	**High** Significant length within state forests and long section of undisturbed native vegetation through crossing of Many Peaks Range.	**Low to Medium** Less sensitive crossing point of Range. Surat Coal Basin will require mining consultation. Low number of landholders and appropriate land use - some intensive farming at Thangool.
Land	>400 parcels due to length of route and increased density of population centres towards the east.	>250 parcels. This route is longer and through more densely populated areas.	<200 parcels. This route is shorter and west of most population density areas.
Community	Close proximity to Mt Perry township and areas of small rural living blocks.	Generally clear of communities and population densities.	Generally clear of communities and population densities. Crossing through Thangool agriculture area.
Constructability	Range areas are difficult and northern section has numerous watercourse challenges for large-diameter pipeline. Access is reasonable.	State forest sections likely to be harder country than the freehold grazing land. Many Peaks crossing is a substantial challenge for reasonable length. Access to most challenging areas is limited.	Substantial sections of route in undulating grazing country. Callide and Calliope Range crossings significant. Access is generally good for entire route, and particularly good in range crossing locations.
Proximity to CSG	Limited.	Limited.	Significant improvement with a Woleebee Creek lateral possible at approximately 40 km length and a Fairview lateral of approximately 200 km.
Pipeline protection and operability	Due to the low-density and generally rural land use, this corridor could provide a suitable pipeline alignment, design and operations profile.	Due to the low-density and generally rural land use, this corridor could provide a suitable pipeline alignment, design and operations profile.	Due to the low- density and generally rural land use, this corridor could provide a suitable pipeline alignment, design and operations profile.

Corridor Options	Eastern	Central	Western (Option 1)
Expansion	Range crossing would be very difficult to duplicate in same easement. New separate easement would be very challenging to locate and approve.	Range crossing would be very difficult to duplicate in same easement. New separate easement would be very challenging to locate and approve.	Callide and Calliope Range crossing may be difficult to replicate in easement. However more likely than for other options.
Relative Ranking	3	2	1

Key changes made to the Western route during the EIS resulted in:

- reduced length of native vegetation impacted by the route
- some impacts on state forest but predominantly within already cleared areas
- improved access to the Gas Field Component area, by allowing for a short connection to the Woleebee Creek tenements
- reduced length of connection lateral from other CSG areas
- avoiding areas of concern in regard to coal exploration.

In addition to the above assessment, a separate assessment was carried out for the crossing of The Narrows. Four general areas were reviewed:

- within the proposed common infrastructure corridor
- south of the common infrastructure corridor
- north of the common infrastructure corridor
- attached to a bridge/road across The Narrows.

Within these general areas a number of routes were reviewed (refer to *Figure 2.12.3*). Based on preliminary risk, environmental and engineering constraints it was determined that a route between Friend Pont and Laird Point outside of the Great Barrier Reef Coast Marine Park, was the preferred option.

Lateral Pipeline

The development of the Lateral Pipeline is heavily dependent upon developing commercial gas transportation agreements. At this stage of the Project, consideration was given to the potential to connect to other CSG resources to the north of the main QGC resources. Preliminary investigations were conducted on an east-west corridor between these resources and the proposed Export Pipeline.

The Lateral Pipeline route was constrained at the western end by escarpments and ranges and at the mid point by a range of prospective coal mining tenures. Three route options were investigated, all involving a direct east-west route with variations in the north-south. These investigations included desktop and field reviews (refer to *Section 12.1.3*). There have been no detailed field studies of this route.

Should a commercially viable requirement arise for a Lateral Pipeline, a petroleum pipeline licence (PPL) will be sought under a separate assessment process and detailed investigations will be undertaken as part of this application and subsequent approval process.

UIC

The Upstream Infrastructure Corridor (UIC) has been selected through an iterative process taking into account the steps and criteria set out in this section. The preferred route has been selected based on Gas Field Component development plans, avoiding significant environmental and social impacts and land tenure issues.

Legend

Proposed QCLNG Site Boundary

Wet Lease Area

Proposed LNG Facility Plant Layout

Great Barrier Reef Coast Marine Park

1 - 9 Indicative Potential Pipeline Crossing Options

Source Note:

Aerial Photo - SPOT 10m 2008 08 30
Curtis Island Road/Bridge Corridor - Connell Wagner
Indicative Pipeline Options - Xodus Group

Projection: UTM MGA Zone 56 Datum: GDA 94

0 0.5 1 2 km

N

QUEENSLAND CURTIS LNG A BG Group business	Project **Queensland Curtis LNG Project**		Title **The Narrows Crossing Route Options**
	Client **QGC - A BG Group business**		
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	Approved DS	File No: 0086165b_EIS_GIS029_F2.12.3	
	Date 14.07.09	Revision 1	

12.1.7 Preferred Route

12.1.7.1 Export Pipeline

The preferred route for the Export Pipeline runs predominantly in a straight line north-east from the area of the Gas Field Component to Gladstone (refer to Figure 2.12.4).

Commencing at kilometre point (KP) 0, the route travels north to north-west for about 45 km, mainly through lightly wooded country predominantly ironbark and wattle. The route crosses eight unsealed local government roads. There are 12 crossings of Bottle Creek or its tributaries in this section plus one crossing of Little Tree Creek. The terrain is flat to undulating and used for grazing.

At KP45 the route continues north for a further 5 km through predominantly cleared, flat country. At KP50 the route heads north-east through Quandong State Forest for approximately 3 km. The route has been selected to utilise already cleared land. The route intersects three local government roads and makes four crossings of branches of Downfall Creek.

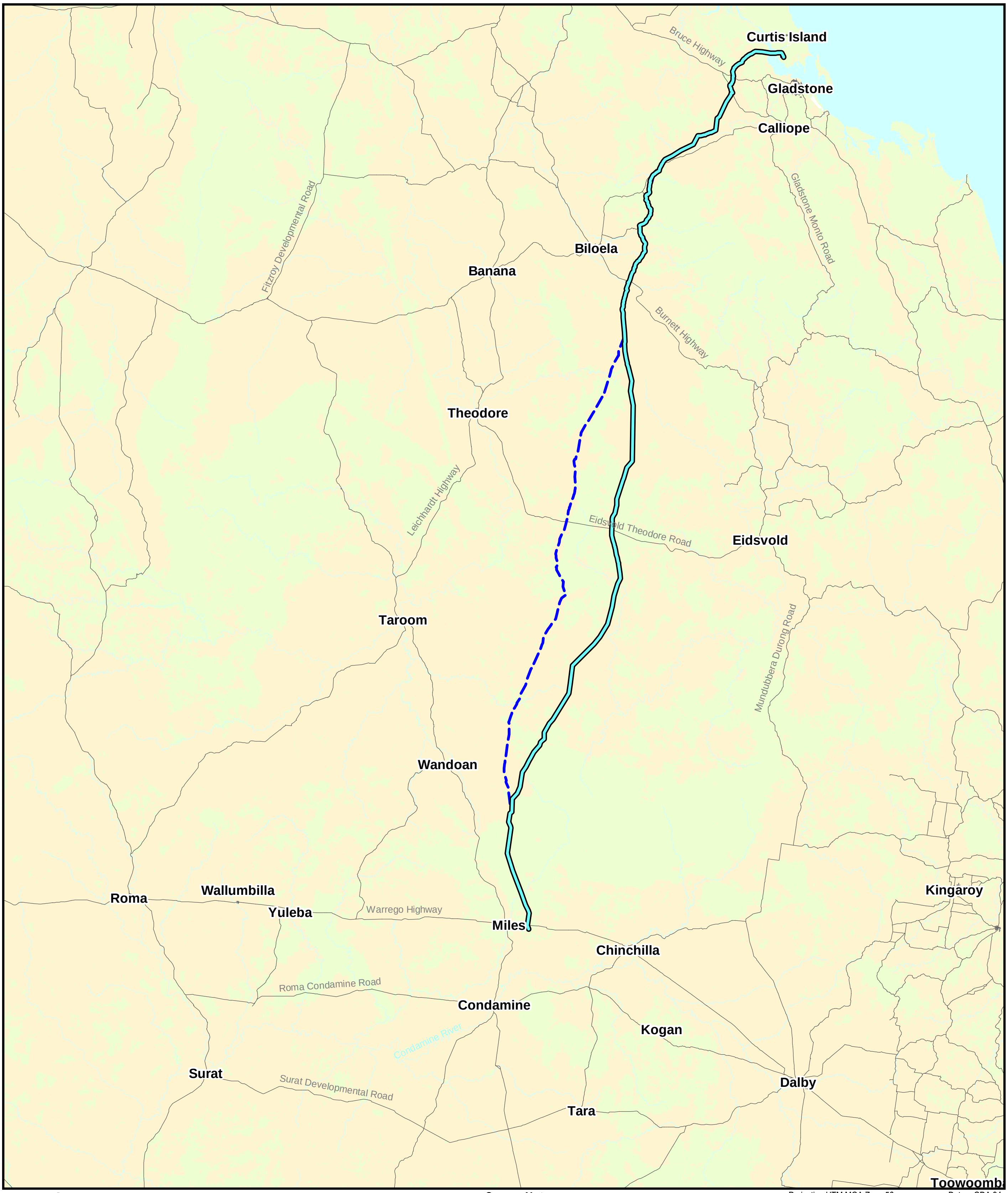
The next 10 km (KP53 to KP63) of the route continue north-east through flat, previously cleared land intersecting two local government roads. There are no creek crossings in this section.

The route continues north-east for a further 10 km (KP63 to KP73) through timbered country, crossing three local government roads and intersecting two branches of Roche Creek.

The route then enters Barakula State Forest for approximately 2 km, traverses approximately 5 km of wooded land and at around KP80 re-enters Barakula State Forest for 3 km. The route then travels north to north-east through predominantly cleared grazing land for about 65 km (KP145). The sections of the route through Barakula State Forest have been selected to utilise existing cleared areas and are under discussion with DERM. The route crosses a number of local government roads through this area and intersects Warrana, Roche, Spring, Ada, Lydia, Fishy, Pipe Clay, Paddy and Dogherty Creeks. The route also intersects Auburn River in a number of places. The creek and river crossings are all on tributaries to the main creek or river.

From KP145 to KP210 the route traverses mainly cleared land with patches of ironbark, gumtop box and wattle with some areas of improved brigalow country in the hollows. The terrain is fairly flat and then undulating at the approaches to the Callide Ranges. Numerous local roads are intersected and the route crosses the Eidsvold-Theodore Road. Creek crossings in this section are Chess, Glencoe, Trevethan, Pinnacle, Montour and Marvel Creeks.

At KP210 the route tends towards the north-west for about 20 km through hilly, lightly wooded terrain crossing One Mile, Ditz, Amy and Holsworthy



Legend:

Preferred Export Pipeline Route - Option2

Export Pipeline Route - Option1

Source Note:

1:250,000 Topographic vector copyright Geoscience Australia

Projection UTM MGA Zone 56 Datum GDA 94

0 20 40 60 80

Kilometres

N

QUEENSLAND CURTIS LNG A BG Group business	Project **Queensland Curtis LNG Project**		Title **Preferred Route - Export Pipeline**
	Client **QGC - A BG Group business**		
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	Date 08.07.09	Revision A	

Creeks. The route avoids the Montour State Forest to the west. Roads within this section include six local government roads and Rawbelle Road.

The route continues north from KP230 to KP255 through cleared brigalow or vine scrub and crosses ridges lightly timbered with ironbark. From KP255 to KP265 the route traverses the Callide Valley which is either cleared land or brigalow vine scrub with areas of blue gum along creeks. Creek crossings in this section of the route include Holsworthy, Scoria, Kariboe, Kroombit and Kariboe Creeks. The route lies approximately 7 km to the west of Thangool and crosses 11 local government roads and the Burnett Highway at around KP257. The region is still mainly grazing country although there is some intensive farm land cultivation near Thangool.

Skirting Biloela, 17 km to the west, and the Callide Mine, approximately 3 km to the west, the route heads north-north-west for approximately 10 km and then turns back to the north-east. At around KP277 the route crosses Kroombit Gully and heads across the Callide Range. There are a number of coal roads in this region servicing the Callide Mine.

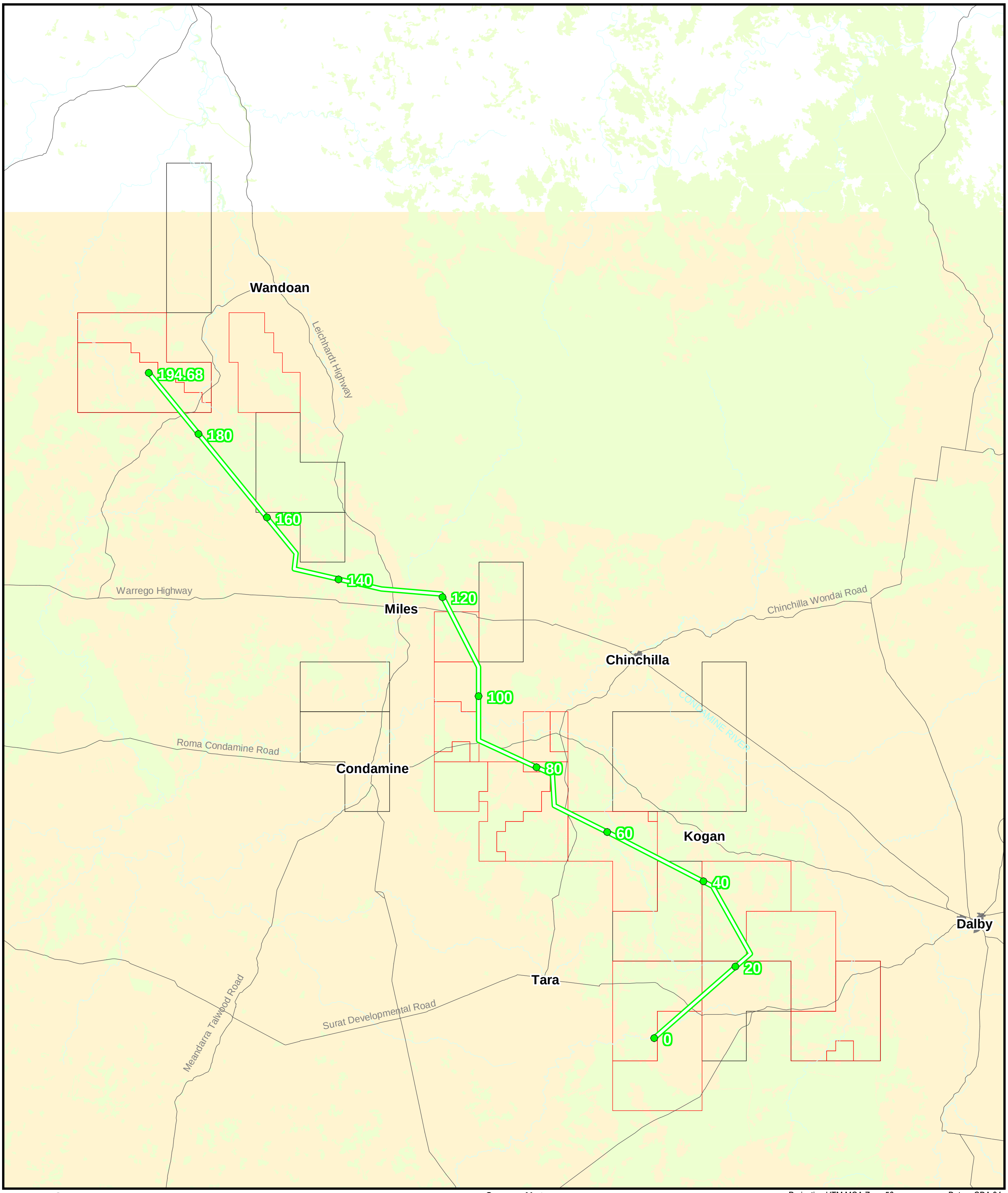
From Kroombit Gully to just north of the Callide Dam there is a mixture of cleared vine scrub, ironbark on the ridges and open black soil country. From just north of the Callide Dam the terrain is mainly creek flat blue gums rising onto ironbark ridges. There are a number of native tree forestry plantations on the slopes on the eastern side of the Callide Ranges (KP300). The route then crosses the Callide Range, mainly through previously cleared terrain and at approximately KP310 the route crosses the Dawson Highway and turns to the east crossing the Moura Short Line and intersecting Bells and Alma Creeks.

The route continues north north-east through cleared blue gum flats crossing the Bruce Highway at approximately KP350, skirting the township of Mount Larcom which lies about 4 km to the west of the route and entering the Gladstone State Development Area (GSDA). The route through this area has and continues to be developed in consultation with the Department of Infrastructure and Planning but generally lies around the northern boundary of the GSDA.

The route crosses the Gladstone to Mt Larcom Road and the North Coast Line at around KP355. It then intersects Targinnie Road at approximately KP368. Through this area the route intersects Alma, Maxwell, Harper, Sandy, Gravel and Larcom Creeks.

From Targinnie Road the route heads due east towards the coast to cross The Narrows just on the southern boundary of the Great Barrier Reef Coast Marine Park. The land is very flat with coastal mangroves adjacent to The Narrows.

Once on Curtis Island, the route heads eastward for approximately 1 km and then southward for 1 km to the proposed LNG Facility site. The route on Curtis Island is through eucalypt woodlands on a former grazing leasehold now within the LNG Precinct of the GSDA.



Legend:

- Upstream Infrastructure Corridor & Kilometre Point
- Gas Fields - PL & PLA
- Gas Fields - ATP

Source Note:
1:250,000 Topographic vector copyright Geoscience Australia

Projection UTM MGA Zone 56 | Datum GDA 94

0 10 20 30 40
Kilometres

N

QUEENSLAND CURTIS LNG
A BG Group business

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Project	Queensland Curtis LNG Project	Title	Preferred Route - Upstream Infrascture Corridor
Client	QGC - A BG Group business		
Drawn Mipela	Volume 2 Figure 2.12.5		
Approved CDiP	File No: EO5-P-MA-96173		
Date 08.07.09	Revision A		

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12.1.7.2 *UIC*

The UIC commences in the south-east corner of PLA 261 approximately 2 km south of the Vickery State Forest and 2 km north-east of the Kumbarilla State Forest. Except for 8 km of the route, between approximately KP139 and KP147, the UIC is wholly contained within QGC tenements (refer to *Figure 2.12.5*).

Commencing at KP0 the route travels north-east for 23.5 km skirting the southern edge of the Braemar State Forest and lying north of the Weranga State Forest.

From approximately KP1 to KP6 the route passes through a dominant eucalypt woodland community (Regional Ecosystem (RE) 11.3.2) which is generally associated with alluvial soils, and listed as Of Concern under the Queensland *Vegetation Management (VM) Act 1999* (Qld).

The next 13 km of the route is predominantly cleared grazing land before it enters another patch of eucalypt woodland. The route crosses numerous branches of Moonie and Moramby Creeks in this section. Infrastructure crossings in this section include the Surat Development Road (KP9) and the Glenmorgan Branch Railway (KP11.5).

The route then turns approximately 90 degrees to travel north-west for approximately 15 km (KP38); 5 km of which is through the Braemar State Forest. This section of the route passes through an ironbark and spotted gum woodland community to KP34 where it then intersects a tract of previously cleared land. The route intersects upper tributaries of Kogan Creek and Moramby Creek. The section within the Braemar State Forest is provisional and dependent upon discussions with DERM.

The route then turns further west and travels in a straight line for 33 km (KP71) crossing further tributaries of Kogan Creek and Wambo Creek. This section of the route passes through predominantly cleared and non-remnant vegetation areas, with the exception of an open area of eucalypt woodland between KP62-66. At approximately KP45 the route crosses the Tara-Kogan Road and at KP69.5 crosses the Chinchilla-Tara Road.

The route then turns directly north for approximately 6 km (KP77) before again heading west-north-west for a further 15 km (KP92). This section of the route is through predominantly cleared country with the exception of several narrow fragments of a dominant brigalow community (RE 11.4.3) listed as Endangered under the *Vegetation Management Act 1999* (Qld) and the *Environmental Protection and Biodiversity Conservation Act 1999* (Cth). The route intersects tributaries of Nine Mile and Wieambilla Creeks and a number of local roads such as the Kogan-Condamine Road at approximate KP88.

From KP92 to KP106 the route travels due north crossing the upper reaches of the Condamine River and Bogrambilla Creek and intersecting two local roads. This area is predominantly cleared with the exception of two very narrow areas of endangered brigalow community (RE 11.4.3)

The route then heads north-west for 14 km crossing the Warrego Highway and Western Line railway at KP119. The route is predominantly through previously cleared land encountering some open eucalypt woodlands from approximately KP111 onwards. Between KP101 and KP104 the route intersects an area of cultivation. Creek crossings in this area include Columboola Creek and Cameby Creek. The Export Pipeline connects with the UIC in this area, avoiding dual crossings of the Warrego Highway and Western Line railway.

The route then turns due west for 28 km crossing numerous tributaries of Eleven Mile Creek and Camisla Creek before heading north for 3 km then north-west to the terminus at approximately KP200. The route passes 1 km to the west of the south-west corner of the Gurulmundi State Forest and crosses tributaries of Two Mile, Wallan, Tchanning, Ramyard, Myall, Ogle, and Wandoan Creeks. The route predominantly passes through ironbark-dominant eucalypt woodlands with cleared areas between KP152 and KP167. The route intersects a number of unsealed tracks and crosses the Jackson-Wandoan Road at KP164.

12.2 CO-LOCATION OPPORTUNITIES

Potential for co-location with other infrastructure was assessed in the development of the preferred pipeline routes. This included using existing or proposed linear routes (e.g. road, rail or powerline corridors) that may avoid or reduce impact to sensitive areas.

There are often constraints to using routes occupied by other infrastructure (e.g. electrical interference). These constraints may have implications for safety and corrosion. Also, the terrain itself may affect construction and operation of the pipeline. Terrain constraints are particularly relevant for co-location within powerline corridors as powerlines often traverse more hilly terrain than a gas transmission pipeline, particularly a large diameter pipeline.

The national standard (AS 2885) to which the pipelines are built requires certain proximity distances to be maintained for a wide range of specific operational conditions. Therefore, in addition to the issues mentioned above, the close location of other large-diameter steel pipelines brings further construction and operational constraints. This constraint was included in the route evaluation process.

Specific consideration was given to the following potential co-location opportunities:

Surat Wandoan Railway: QGC conducted a review of mapping to investigate whether some, or all, of the proposed railway corridor between Moura and Wandoan was likely to be suitable for a gas pipeline. The railway route is well west of the preferred route which would add considerable distance and cost to the Pipeline Component. Construction within the rail corridor would also present a number of design and pipeline safety issues. Thus, this option was not considered viable for the Export Pipeline.

Department of Infrastructure (DIP) and Planning Study: In November and December 2008 QGC was invited to participate in a study commissioned by DIP to investigate options and issues associated with infrastructure co-location, and in particular the multiple planned pipelines from the Surat Basin to Gladstone. QGC provided technical and route information to this study. The results of the study have not been made available at this time.

Gladstone State Development Area (GSDA): QGC has been working with DIP on coordinating and co-locating pipeline infrastructure through the GSDA and across to Curtis Island. A northerly route into the GSDA for LNG pipelines will, to the greatest extent possible, minimise impacts on land suitable for industrial development and will see all pipelines located in an orderly manner.

In addition to these co-location opportunities, QGC is, to the greatest extent possible and practical, endeavouring to co-locate its own infrastructure. This has included the development of the UIC to enable co-location of the planned Gas and Water Collection Headers. Route selection also endeavoured to locate the UIC operationally adjacent to existing QGC pipeline assets to minimise the segmentation of properties.

12.3 GAS TRANSMISSION PIPELINE SPECIFICATIONS

12.3.1 Design Parameters

The design parameters for the various pipeline elements are set out in *Table 2.12.2.*

Table 2.12.2 Gas Pipeline Design Parameters

Pipeline Component	Design Parameters		
	Export Pipeline	**Lateral**	**UIC (Collection Headers)**
Number of pipelines	1 x gas	1 x gas	1 x gas) 1 x water
Length (~km)	380	150	200
Diameter (mm)	1,050	1,050	Gas: 1,050 Water: 525
Wall thickness (mm)	15.66	15.66	Gas: 15.66 Water:12
Material	API5L – X70 or X80	API5L – X70 or X80	API5L – X70
Coating	Fusion bonded epoxy or other recognised system such as High	Fusion bonded epoxy or other recognised system such as High	Fusion bonded epoxy or other recognised system such as High

Pipeline Component		Design Parameters	
	Density Polyethylene	Density Polyethylene	Density Polyethylene
Free flow capacity	1,410 TJ/d	1,410 TJ/d	Gas: 1,410 TJ/d Water: 100 ML/d
Maximum allowable operating pressure (MAOP)	10.2 MPa	10.2 MPa	Gas: 10.2 MPa
Construction RoW (m) – average	40	40	80
Depth of cover (min.)	Generally: Deep cultivated areas: Road/Rail crossings: Watercourse crossings:	900 mm[1] 1,200 mm 1,200 mm 1,200-2,000 mm	
Corrosion protection	External coating and cathodic protection system		
Non-destructive testing	100% Non-destructive inspection of welded joints		
Monitoring system	Supervisory control and data acquisition (SCADA) connected to the QGC control centre		

1 Note that AS2885 requires a minimum of 750mm but the Project has adopted 900mm.

The Export Pipeline will initially be capable of transporting 1,410 terajoules (TJ) of gas per day to supply up to two LNG processing units, or “trains”.

Pipeline corrosion is prevented by a combination of a protective external coating and a cathodic protection (CP) system. The primary corrosion protection for the pipeline is provided by the coating.

12.3.2 Cathodic Protection

A CP system will be installed on the pipeline to provide a secondary form of corrosion protection. The secondary system will consist of small power rectifiers and anode beds that will maintain the pipe at a negative potential to prevent corrosion should the coating become damaged. Anode beds are likely to be located at each end of the pipeline and at the scraper station.

Test points (refer to *Plate 2.12.1*) will be located at approximately 3 km to 5 km intervals along the pipeline to allow monitoring of the system. The CP system will be checked regularly to ensure that the protection voltages are within limits and will be monitored to ensure that any areas of corrosion activity are identified.

Plate 2.12.1 Typical CP Test Point and Marker Post

The CP system and external coating system work independently to protect the pipeline from corrosion. If corrosion is detected, the relevant section of pipe may need to be excavated and remediation measures implemented.

In some cases where the pipeline crosses other infrastructure that is subject to CP, there may be a need to bond the two pipelines together and install a test post in the vicinity of the crossing.

12.3.3 Design Criteria for Temporary or Permanent Access Crossings

Temporary access crossings for machinery and transport across a waterway are dependent on the level of flow in the waterway. Dry waterway crossings are cleared in a similar manner to the remaining Right-of-Way (RoW). Although, all material removed is stockpiled back from the top of the bank and usually above the riparian zone. Vehicle access is then directly along the RoW.

If required, the area is compacted or felled timber may be laid across the traffic area to provide a more stable base. For waterways with a low volume of flow, a temporary culvert will be set up by installing pipes in line with the flow and providing compacted subsoil material over the pipe.

For waterways with heavy flows, an alternative crossing point will be located.

At locations where temporary crossings are created all excess materials will be removed at the completion of construction and the area reinstated.

Permanent crossing points would normally be existing access tracks and the Project would not expect to create any permanent access crossings.

12.3.4 Corridor Widths and Access

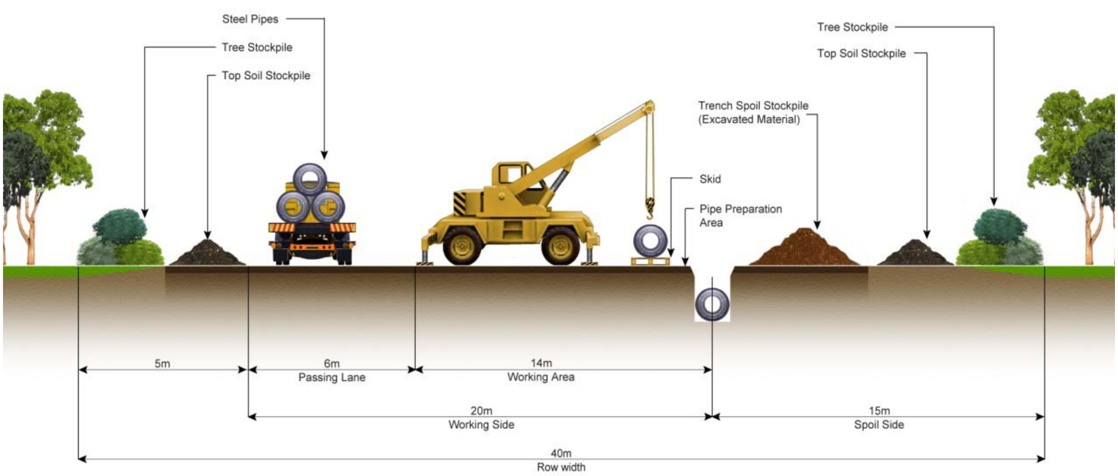
12.3.4.1 Corridor Widths

Generally the required easement width for the Export Pipeline and Lateral Pipeline will be 40 m (refer to *Figure 2.12.6*). However, this may be extended to accommodate additional areas for main line valves (MLVs), temporary work areas and truck turn-around areas for construction activities. The truck turn-around areas are typically up to 50 m in width and negotiated on an as-needs basis.

Such areas are temporary and restricted to the construction period alone.

The construction easement for the UIC, which requires multiple pipelines to be laid, will be 80 m.

Figure 2.12.6 Construction Corridor



The width of the RoW required for each pipeline is based on the need to safely maneuver all necessary plant and equipment while providing good environmental management. Good environmental outcomes require sufficient space for:

- the stacking of cleared vegetation so that it does not impact upon the retained/remaining vegetation
- stockpiling of topsoil with adequate separation from the stockpiled vegetation
- stockpiling of trench spoil with adequate separation from topsoil stockpiles
- laying out (stringing) of the pipeline
- construction equipment that is in use
- other traffic (e.g. pipe trucks, construction workers vehicles) to pass the working equipment without leaving the RoW.

Where the RoW is not sufficiently wide this can result in:

- degradation and/or loss of the topsoil through contamination with spoil or vehicle movements crushing the topsoil
- the spread of weed as the result of vehicles travelling off the cleared RoW through potentially weed-infested areas.

The APIA Code recommends a RoW width of between 25 m and 30 m for standard pipeline construction. This is based on a typical gas pipeline within Australia being ≤ 500 mm. Calculations have been carried out to determine the area of spoil stockpile that will be required for a 1,050 mm-diameter pipeline.

This has shown that the base of the stockpile will require at least 4.8 m. Taking into account the width of the other elements it has therefore been determined that a clearing width of 40 m will be required for the Export Pipeline and the Lateral Pipeline (refer to *Figure 2.12.6*). Since the UIC is required to contain multiple gas and water pipelines it has been determined that a clearing width of up to 80 m will be required.

In order for a pipeline to be constructed and operated, a petroleum pipeline licence (PPL) under the relevant jurisdiction is required (refer to *Volume 1 Chapter 6*). To obtain the licence, QGC is required to obtain an interest in all the land comprising the pipeline route. This interest is normally in the form of a negotiated easement over the affected land.

QGC is actively negotiating with landholders and native title claimants along the proposed route of the pipeline. Negotiations will continue with landholders on issues relating to compensation and terms and conditions of individual consent agreements (refer to *Volume 1, Chapter 5*).

12.3.4.2 Access

During construction, access tracks will be required to reach areas such as construction easements, work areas and campsites. Existing roads, tracks and disturbed areas will be utilised as far as practicable to minimise disturbance to the surrounding areas. Existing public roads and farm tracks have been mapped throughout the area and it is expected that few new access tracks will need to be created. Some minor upgrades will be required to existing tracks.

The selection of access track routes will be based on:

- ease of access (most direct) to the RoW
- avoidance of environmentally sensitive areas
- minimising impacts to landholders.

The creation of access tracks will be subject to the conditions of the Environmental Management Plan (EMP) (refer to *Volume 10*) and the Cultural Heritage Management Plan (CHMP) and completed in consultation with all relevant landholders and regulatory authorities. Access tracks shall be rehabilitated in accordance with landholder requirements.

12.3.5 Engineering Design

The proposed pipelines will be designed and constructed in accordance with the current versions of *AS 2885 Pipelines – Gas and Liquid Petroleum.* This standard covers the design, construction and operation of pipelines in Australia. AS 2885 stipulates in excess of 80 Australian, American and European standards in accordance with which the pipeline and facilities must be designed.

The design can be broken down to two main activities:

- risk assessment – route selection, third-party activities, future development, erosion, flooding, land movement etc
- detailed design – steel and coating selection, depth of burial, corrosion protection, alternating current (AC) interference, remote monitoring, operations and maintenance.

12.3.5.1 Risk Assessment

At the commencement of design, a risk assessment database is developed to document all identified potential risks to the pipelines. The detailed design then has to ensure that all the risks are mitigated to an acceptable level; normally as low as reasonably practicable (ALARP).

Examples of identified risks that influence detailed design are: land use such as deep ripping or blade ploughing, irrigation, future mining, road or urban development, land slip areas that may destabilise the pipeline, flooding or erosion, utility activities such as power, water and communications and road and rail maintenance.

AS2885 requires, as part of the risk assessment process, that the area the pipelines will traverse be classified into one of four primary location classes: R1 (rural non-residential), R2 (rural residential), T1 (urban residential) and T2 (high-density residential). These classifications influence the detailed design of the pipeline.

A preliminary risk assessment has been carried out and is detailed in *Volume 4, Chapter 16*. This will be updated during the detailed design phase of this Project.

12.3.5.2 Detailed Design

The first step involves determining the diameter and operating pressure of the pipelines. This is based on the required throughput of gas to meet the identified market demand. Once the operating pressure is determined the steel strength and thickness is selected (refer to *Table 2.12.2*). Suitable corrosion protection coating and supplementary corrosion protection system are then selected.

The detailed design takes into account the findings of the risk assessment to determine requirements for additional protection measures such as: heavier wall pipe in more vulnerable locations, increased depth of cover (e.g. under roads, in some agricultural areas), installation of concrete slabs (to protect against third-party damage), buried marker tape and additional signage.

The depth to which the pipeline is buried will be determined by the requirements of *AS 2885 Part 1 Design and Construction of Pipelines – Gas and Liquid Petroleum*. The minimum requirement under AS 2885 for normal excavation is 750 mm cover. However, QGC has adopted a minimum cover of 900 mm.

At watercourse crossings, depth depends on the nature of the watercourse and the geology at the site. At large rivers with permanent water, trenchless techniques may be used. Design of the river crossings for large rivers will take into consideration the Q100 (or once in a century event) flood impacts when determining the depth of cover.

Crossing of swamp areas can be achieved through a number of techniques including open cut, trenchless or float and sink (refer to *Section 12.5*). Piled techniques would not be considered for a gas transmission pipeline as these techniques would leave the pipeline exposed with the potential for third-party damage.

12.3.6 Testing Activities

The pipelines will be subjected to non-destructive inspection (NDI) of each welded joint and hydrostatic testing (hydrotesting) of the entire pipeline. Hydrotesting is the only test method with the potential for transfer of water along the pipeline.

Each weld is subjected to a NDI, in accordance with AS 2885, to check for compliance to specification, thus ensuring the integrity of each weld. This is typically carried out immediately after welding so that any defects in the weld can be repaired whilst the welding crews are still in the general vicinity.

Hydrotesting of the pipeline will be undertaken in sections after backfill but before restoration of the RoW. This will involve capping the pipe section with a test manifold, filling the pipe with water to a specified test pressure and holding the water under pressure for a period of time as prescribed in AS 2885.

Hydrostatic testing requires large, single volumes of water to be pumped into the pipe in sections. The water must be filled in a single, continuous fill to ensure that there are no air pockets within the test section. The methodology for hydrotesting depends upon the quality and quantity of water available, but may include transferring hydrotest water from one section of the pipeline to another to minimise the overall volume of water required.

Corrosion-inhibiting chemicals may be added to the hydrotest water depending upon the quality of the available water and the length of time the water is required to be held in the pipe. These chemicals will be selected to minimise their potential to cause harm to the environment while adequately protecting against corrosion in the pipeline.

The source of water for hydrotesting of the pipelines has not as yet been determined and a number of options are being considered that include the use of Associated Water from the Gas Field Component and surface or groundwater resources. A full study will be undertaken of hydrotest water options during the detailed design phase of the Project. Depending upon the source of the water, treatment may be required before injection into the pipeline and contaminants (e.g. salts in Associated Water) collected and disposed of off site to a licensed disposal location. It is anticipated that the water will be transferred from one section of pipe to another. The number of sections that can be tested before the test water is completely changed out is a factor of the testing process and the quality, quantity and availability of water. Disposal of the test water will be to land at a suitable location. Depending upon the quality of the water and additives used in the process some treatment of the water may be required before it is released to land. Again this will be determined during detailed design. Any release of hydrotest water will be carried out to ensure no environmental harm occurs as a result of the action.

If water is required to be sourced from surface water resources (e.g. for top-up purposes during hydrotest) filter systems will be included in the extraction or disposal equipment to ensure that no pest species are picked up and transported along the pipeline. If water is drawn from state resources water permits will be obtained under the *Water Act 2000* (Qld).

Water volumes are discussed in *Section 12.17* and disposal in *Section 12.19*.

12.3.7 Temporary and Permanent Aboveground Facilities

A range of temporary facilities will be required during pipeline construction. These include work areas for equipment, pipe delivery and storage. In addition, campsites for temporary accommodation of the construction workforce will be required. Occasionally borrow pits to source additional fill material may be required.

The location of the temporary facilities will be based on logistical requirements, the objectives for the pipeline route selection and the APIA Code. This will include:

- ensuring campsites are located at a suitable distance from watercourses
- are not endangered by threat of flood
- do not require clearing of remnant vegetation
- are managed in such a way as to ensure no long-term land contamination issues.

Permanent aboveground facilities for the pipeline will include:

- mainline valves
- scraper stations
- meter stations
- in-line compressor
- communication towers
- cathodic protection facilities (refer to *Section 12.3.2*)
- marker signs.

12.3.7.1 Mainline Valves

The principal purpose of mainline valves (MLVs) is to enable sections of the pipeline to be isolated in the event of damage or scheduled maintenance. MLVs typically occupy a fenced and gravelled area of 300 m^2 and will be located on the pipeline easement. They will be located at appropriate intervals based on risk assessment (refer to *Volume 4, Chapter 16*) and the requirements of the appropriate codes, in order to minimise the potential volume released from accidental pipeline discharge.

A typical MLV is shown in *Plate 2.12.2*. Emergency shutdown valves will also be located at the inlet to the pipeline and at the delivery point in Gladstone.

The actual number and locations of MLVs will be determined in accordance with risk analysis undertaken during detailed design. At this stage, it is anticipated that there will be five MLVs along the Export Pipeline, three on the Lateral Pipeline and three on the Collection Header.

12.3.7.2 Scraper Stations

Scraper stations allow the insertion and/or retrieval of devices (known as “pigs”) to clean the internal sections of the pipe or to detect damage or metal loss within the pipe.

It is anticipated that there will be three scraper stations located along the Export Pipeline route (i.e. one at each end and one intermediate) two on the Lateral Pipeline and two on the UIC. A typical scraper station, shown in *Plate 2.12.3* and MLV combined will occupy a space of approximately 2,000m^2. At the start and end of the Export Pipeline the scraper station will be incorporated within the off-take and sales stations respectively.

Plate 2.12.2 Typical MLV Station

Plate 2.12.3 Typical Scraper Station

Note this is for a smaller pipeline (300mm) but the set up would be similar

12.3.7.3 Meter Stations

Meter stations will be constructed at the start and finish of the Export Pipeline and the Lateral Pipeline. Meter stations include filtration equipment and generally occupy an area of approximately 2,500 m^2. There will be no meter station on the Collection Header.

12.3.7.4 In-line Compressors

In-line compressors are discussed in *Section 12.6*.

12.3.7.5 Communication Towers

Communications will predominantly be via the existing telephone network and/or mobile and satellite telephones as required. All construction camps will utilise existing services, where available, and satellite facilities at other times.

Some communications towers, for radio communication, will be required during construction and may be retained at the completion of this phase for use during operations. Existing facilities will be used as far as practicable.

12.3.7.6 Marker Signs

Pipeline marker signs in accordance with AS 2885 (refer to *Plate 2.12.1*) will be installed to indicate the presence of the pipeline to reduce the risk of inadvertent damage by third parties. Marker signs will be installed at:

- both sides of road and rail crossings
- both sides of significant watercourse crossings
- all fence lines
- all utility crossings
- all bends
- all aboveground facilities
- as otherwise required to be visible (by line of sight from one sign to the next).

12.3.8 Existing Infrastructure

Existing infrastructure potentially impacted by the pipelines will be identified through consultation with infrastructure providers (e.g. Queensland Rail, Powerlink, Telstra) and landholders and through “Dial Before You Dig”. All existing infrastructure will be clearly identified on construction drawings and located and clearly marked in the field during construction. Infrastructure identified to date (refer to *Volume 4, Chapter 5*) includes:

- roads
- rail lines
- powerlines.

12.4 CONSTRUCTION TIMEFRAME AND STAGING

Construction of the pipelines is anticipated to take approximately 18 months from establishment of the first camp to final clean-up, reinstatement and commissioning.

Crossing of The Narrows to Curtis Island will be considered as a special section of the works and will be undertaken concurrently with the Export Pipeline construction.

Construction activities will commence in the field once all permits, authorities and permissions have been granted and when mobilisation activities have been completed.

12.5 COASTAL MARINE WORKS

12.5.1 Construction Methods

Construction methods under consideration for the coastal and marine elements of the Export Pipeline are:

- conventional offshore pipe lay
- open cut
- trenchless
- post-trench
- bridge attachment.

12.5.1.1 Conventional Offshore Pipe Lay

In conventional offshore pipe lay technique, line pipe is welded together on a lay vessel and lowered to the seabed. With this technique the installed pipeline may either be left on the sea bottom or post-trenched. The process requires a shallow water lay barge to lay the pipe string which is welded and fabricated on board the barge. Support vessels are required to bring the pipe lengths to the barge during the installation process. Risk assessments will assist with determining whether trenching is required. The pipeline may also be installed into a pre-cut trench, although this is technically more challenging than post-lay trenching.

This method would be utilised in conjunction with an onshore or offshore pull, hence trench construction would be required at the beach crossing points.

12.5.1.2 Open Cut

This technique is described in *Sections 12.8.2* and *12.8.8.1*. It would be used for the onshore sections of the pipeline.

At the landfall locations on each side of The Narrows, this technique would be augmented with a coffer dam construction to protect construction activities and the marine environment. This would involve installing sheet metal piling around the site and driving it down into the ground. This method reduces the risk of the trench collapsing and minimises the width of excavation. The sheet piling is removed once the pipeline is fully installed.

In the swamp areas adjacent to the landfall on the mainland, standard open-cut techniques can be used. This can be achieved by constructing a working platform either by the use of a raised bund or installation of geotextile. The platform supports the plant and equipment during construction and is removed once the pipe is installed.

Alternatively, swamp excavators or barge-mounted excavators can be used to excavate a trench. The pipe is then welded together on stable ground onshore and then floated out over the trench and sunk into the water-filled trench. Concrete weights are attached to the pipe to retain it in the trench and the trench is back filled.

12.5.1.3 Trenchless

Trenchless techniques are described in *Sections 12.8.8.2 to 12.8.8.4*. These techniques are highly dependent upon the geology of the area and the size of the pipe to be installed. Trenchless techniques are under consideration for The Narrows crossing between Friend Point and Laird Point.

12.5.1.4 Post Trench

Post trench construction is one in which the pipe is lowered to the seabed and the trench is created under the pipe. This can be done by jetting, fluidising or ploughing the seabed. In jetting, high-pressure water jets are used to create a trench below the pipe. Fluidising uses water jets to liquefy the seabed enabling the pipe to sink to the required depth. Ploughing is generally reserved for deeper waters than would be encountered in The Narrows and would, therefore, not be appropriate for this Project. Once the pipe is in place the high tidal currents present within The Narrows area would restore the surface of the seabed.

12.5.1.5 Bridge Attachment

Bridge attachment has been considered and may be an option should a bridge be constructed between the mainland and Curtis Island. However, it is not consistent with the Queensland Government's commissioned study by Connell Wagner and would be rejected from a safety perspective.

12.5.1.6 Preferred Construction Method

As the Project is still in the feasibility phase, engineering design has not progressed sufficiently to determine which construction method would be used. However, open cut onshore and trenchless across The Narrows are the favoured options at this stage. The final choice will depend on a number of factors including environmental, engineering, geology and commercial viability.

12.5.2 *Temporary Marine Infrastructure*

Other than the launching area discussed in *Section 12.5.4* and possible coffer dams for the landfall areas no other marine infrastructure is considered necessary at this stage of design.

12.5.3 *Equipment*

For onshore works, which will be undertaken by standard trenching techniques, the required equipment will be the same as that set out in *Section 12.10*.

For offshore works the equipment required will depend upon the construction method adopted but could include:

- water lay barge
- linear winches
- sheet piling
- support vessels
- microtunnelling boring machine
- sled with high-pressure water jets.

12.5.4 *Launching Area*

A temporary launching area may be required at the landfall either on the mainland or Curtis Island. This would be a concrete ramp used to launch the pipe sections.

All other pipe and equipment transport would either be by road for the mainland side of the works or by systems set up for delivery of materials to Curtis Island (refer to *Volume 2, Chapter 13*).

12.5.5 *Materials*

At this stage the volume of materials required for the coastal and marine works has not been defined. Line pipe is included in the overall transport analysis for movements on the mainland. Materials to be shipped from Gladstone are addressed under the requirements for the LNG Component in *Volume 2, Chapter 13*.

12.6 *PIPELINE COMPRESSION FACILITIES*

It is anticipated that in-line compression will not be required for the Export Pipeline during the first few years of operation and will not be required for the

Lateral Pipeline or the Gas Collection Header during the life of the Project.

When in-line compression is required it is anticipated that it will have a footprint of approximately 4 ha with additional area required for laydown and assembly.

In addition to the gas compression facilities, the water pipelines within the UIC will require pumping stations and break/storage tanks to be located along the route. These will typically occupy an area of 10,000 m^2. The pump stations and tanks will be used to receive water from the gathering system and pressure it into the Water Collection Header for transport to the holding ponds.

12.7 PRE-CONSTRUCTION ACTIVITIES

A number of pre-construction studies have been undertaken for the EIS, including geotechnical studies and centreline surveys.

The EIS studies have been conducted in accordance with the requirements of the Environmental Authority (PEN200190208) issued for petroleum survey licence (PSL) 29. These studies were non-invasive and simply required technical specialists to gain access to the field to verify the desktop data.

Further studies may be needed to verify specific issues (e.g. presence of protected flora) in support of any route refinements but these would be non-invasive.

A small number of over flights by helicopter may be necessary to confirm route constructability during the detailed engineering phase of the Project.

Pre-construction activities that will be carried out post the EIS will include geotechnical studies, pegging of the pipe centreline, installation of temporary gates and set up of camp sites and pipe storage areas.

Further geotechnical studies will be required to determine the nature of soils to be trenched, the geology of any trenchless crossing sites and to identify acid sulfate soils (ASS) within the preferred alignment. This enables rock suitability to be identified, assists in determining which trenchless techniques can be used and provides data for the finalisation of an ASS management plan.

Just prior to construction, commencing surveyors will be mobilised to drive the length of the pipeline routes in 4WD vehicles and peg out the route to be followed by construction. Fencing crews will be mobilised to set up temporary gates and fences along the route to allow for construction crew movement and protection of livestock. Gates will be installed where fence lines need to be crossed.

It may be necessary to prepare lay-down areas for pipe storage at strategic locations along the pipeline route, and to make provision camp sites. These activities will require the clearing of vegetation and topsoil from the area in accordance with the requirements of the EMP (refer to *Volume 10*).

Cleared vegetation and topsoil will be stockpiled for use during rehabilitation of the site.

12.8 CONSTRUCTION ACTIVITIES

Pipeline construction requires a number of procedures to be undertaken consecutively such as: clearing and grading of the RoW, trenching, pipe stringing and bending, pipe welding, testing and inspection, joint coating, pipe placement in the trench (lowering in and laying), backfilling and compaction, hydro-testing and rehabilitation. Each of these activities will be carried out by a dedicated crew and all of the crews together are referred to as a spread.

The key characteristics of the construction program are set out in *Table 2.12.3*.

Table 2.12.3 Construction Program Characteristics

Construction Element	Details
Width of vegetation clearing	40 m for Export and Lateral Pipelines 80 m for UIC
Depth of trench to provide the minimum depth of cover set out in *Table 2.12.2*	Generally 1,950 mm Deep Cultivated Areas 2,250 mm Road Crossings 2,250 mm Creeks/Rivers 3,000 mm
Construction workforce	Approx 400 – 500 personnel for Export Pipeline and Lateral Pipeline 100 – 200 personnel for Collection Header
Construction spreads	Two for each pipeline except the Lateral which may only require a single spread
Standard construction hours	06:00 – 18:00 hours seven days/week[1]
Construction duration (approximate)	12 – 18 months
Refuelling	Mobile fuel truck and construction depot
Normal time between clear and grade and restoration	Up to four months

1 This would apply to most activities but may be exceeded where a weld required completion, hydrotest filling was occurring or for trenchless crossings. These later two activities require continuous work until completed.

12.8.1 Clear and Grade

Clear and grade is carried out to provide a safe construction RoW for vehicular movement, trenching and other construction activities. As discussed in *Section 12.3.4* an impact width of approximately 40 m to 80 m will generally be required to enable construction operations for a pipeline of this diameter to be safely and efficiently carried out. This width will be increased adjacent to watercourses to provide additional room for stockpiling felled vegetation, trench spoil and soil outside of the watercourse (refer to *Figure 2.12.7*).

The RoW is cleared of heavy vegetation. However, root stock is left in the ground where practicable to stabilise the area and reduce erosion. In scrubby areas the vegetation is stockpiled for re-spreading as part of the restoration process. Breaks are left in stockpiled vegetation to allow continued access to stock, fence lines, tracks, and drainage lines. Large mature trees are preserved where practicable.

The RoW is levelled to the required gradient using graders, backhoes and bulldozers. Topsoil is removed and stockpiled separately for reuse during rehabilitation. At creek crossings, sediment fences (e.g. geofabric attached to wooden stakes or star pickets) are installed around the toe of the topsoil stockpiles to prevent soil loss. Refer to *Plate 2.12.4*.

Figure 2.12.7 ROW for Watercourse Crossing

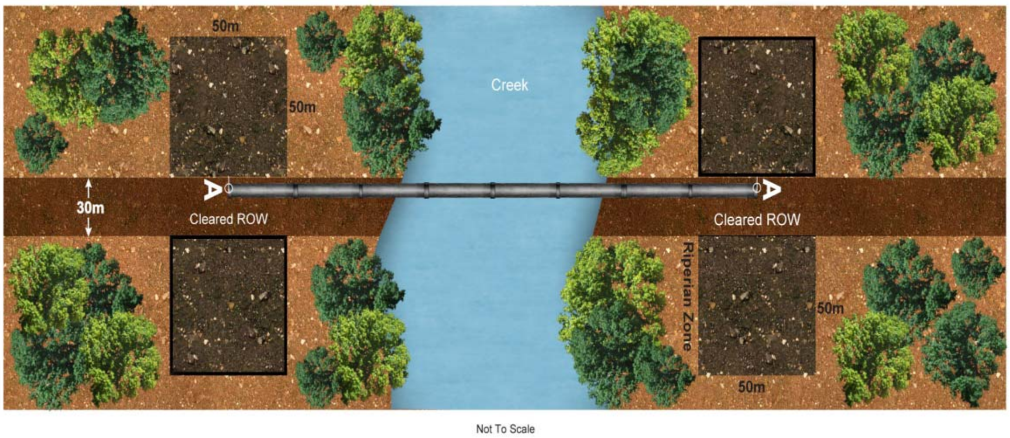


Plate 2.12.4 Watercourse Crossing

12.8.2 Trenching

A wheel trencher, rocksaw or excavator is used to dig the trench in which the pipe will lie (refer to *Plate 2.12.5*). Controlled blasting will be used in hard rock terrain where the use of this equipment is not feasible. At this stage, blasting is not anticipated. However, this will be confirmed during the detailed design phase. If blasting is required a Blasting Operation Procedure will be prepared detailing the proposed method of blasting, including safety, drill pattern, charges, explosives, detonation methods and debris control, prior to commencement.

Blasting activities are strictly controlled by state legislation and standards and are only undertaken by suitably qualified personnel. Prior notice will be given to all affected landholders, construction crews and other potentially affected parties.

For a 1,050 mm-diameter pipe, the trench will need to be excavated to a minimum depth of approximately 2 m and a width of 1.5 m.

The minimal practicable distance of trench is left open, depending on the land use, but is typically up to 70 km in total on a given pipeline. This distance allows for the safe movement of all crews and timely management of the various construction activities. Fauna and livestock management measures which will be implemented to manage this length of open trench include:

- breaks in the trench to facilitate stock and wildlife crossing and agricultural vehicle movements

- installation of fauna escape measures such as trench breakers, ramped ends of trench and fauna ladders at intervals of no more than 500 m to minimise fauna entrapment.

Further detail on fauna management measures is provided in *Volume 4, Chapter 7* of this EIS.

Plate 2.12.5 Trenching

12.8.3 Stringing and Bending

Stringing is the term used to describe the laying out of pipe in preparation for welding. Pipe is generally transported to site on trucks in lengths of up to 18 m. The pipe is laid out adjacent to the trench and held off the ground on skids that protect the pipe coating from damage (refer to *Plate 2.12.6*).

Contours and changes in direction will be accommodated by bending pipe lengths in the field using specialist pipe-bending machines. Tie-ins are likely to be designated at special crossings (e.g. roads, watercourses, sharp changes in direction etc.) and these will be undertaken by specialist crews working in the wake of the front-end crews.

For sharp bends, special factory-made bends are employed and transported separately to site.

Plate 2.12.6 Pipe Stringing

12.8.4 Welding, Inspection and Joint Coating

Once the pipe is strung, a line-up crew positions the pipe using side boom tractors and internal line-up clamps. Specialised construction crews undertake the welding phase of the Project (refer to *Plate 2.12.7*). Pipes are typically welded into strings of up to 500 m in length prior to lowering into the trench.

As discussed in *Section 12.3.6* each weld is then subjected to a NDI. Following this, the joints are cleaned by grit blasting and an external coating, compatible with the factory-applied coating, is applied (refer to *Plate 2.12.8*). Blasting operations are carefully controlled to avoid grit contaminating the environment.

Plate 2.12.7 Welding the Pipe

Plate 2.12.8 Field Coating Join

12.8.5 Lowering In and Backfilling

The trench is prepared as necessary to protect the pipe. This may include placing padding in the bottom of the trench, particularly in very rocky ground.

The pipe coating is inspected and tested for defects and then the pipe is lifted off the skids and lowered into the trench using side-boom tractors (refer to *Plate 2.12.9*).

Impermeable trench blocks (known as trench breakers refer to *Plate 2.12.10*) may be installed prior to backfilling of the trench to control water movement along the backfilled trench in areas with slope. 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 is then backfilled with screened trench spoil, which will sift around the pipe providing a stone-free covering.

The remaining subsoil is then placed in the trench in layers (typically two layers) with compaction between each layer.

Plate 2.12.9 Pipe Being Lifted into Place

Plate 2.12.10 Typical Trench Breaker[1]

12.8.6 Clean Up and Restoration

A clean up and restoration crew will be responsible for reinstatement of the RoW once the testing activities have been completed (refer to *Section 12.3.6*).

Clean up and reinstatement measures are applied to the RoW, access tracks and any campsites in consultation with the relevant landholder. Generally, clean up and reinstatement involves removal of foreign material (e.g. construction material and waste), surface contouring, compaction relief, re-spreading topsoil, re-spreading felled vegetation and reseeding (typically with native grass or other approved species).

Typically no plant matter is removed from the RoW but rather it is re-spread over the RoW (refer to *Plate 2.12.11*). The re-spreading of plant matter, either whole or mulched, assists in both stabilising the ground and re-establishing vegetation re-growth.

Occasionally it is necessary to dispose of plant matter (e.g. heavy weed infestation) and this is done through burning off under controlled conditions under direction from a regulatory authority. However, this is normally a last resort and will only be undertaken with the appropriate approvals from the

1 The trench breaker shown has been created with sand filled bags. Trench breakers may also be created with proprietary foam.

local fire authority and during the appropriate season.

The landscape is reinstated to pre-existing contours and natural drainage lines restored and protected (if required). In certain cases reinstatement is tailored to site-specific conditions in consultation with the landholder.

To promote vegetation re-growth and protect against the loss of topsoil, the RoW surface is normally lightly scarified prior to re-spreading of topsoil.

Reinstatement is undertaken in accordance with the APIA Code to 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 as close as possible to its previous productivity
- stable landforms are re-established to original topographic contours
- natural drainage patterns are reinstated
- erosion control measures (e.g. contour banks, filter strips) are installed in erosion prone areas
- the environment is reinstated to the condition of the surrounding area and disturbed habitats recreated.

The aim is to leave the land such that 50 per cent vegetation cover can be achieved after 24 months.

Plate 2.12.11 Pipeline Reinstatement Work

12.8.7 Commissioning

Commissioning of the pipelines will involve testing activities previously described in *Section 12.3.6*, checking and putting into operation the telemetry system, validating all records and then introducing gas into the pipeline up to the required pressure.

12.8.8 Watercourse Crossings

Pipeline construction methods for the crossing of watercourses fall into two main categories:

- open cut
- trenchless.

Open cut crossings are used for dry or shallow water crossings. The technique may involve cutting the stream banks back to create a gentler slope for the construction equipment to traverse. The trench is then constructed in the same manner as the rest of the pipeline.

Trenchless techniques may involve drilling, tunnelling or boring under the watercourse.

These techniques are discussed in more detail further in *Sections 12.8.8.2*, *12.8.8.3* and *12.8.8.4*.

In addition to pipe laying, temporary vehicle crossings may also be constructed to facilitate the movement of construction vehicles over watercourses (refer to *Section 12.3.3*).

In selecting an appropriate pipeline watercourse crossing method, many factors must be taken into consideration. These include (but are not limited to):

- pipeline diameter
- watercourse width, depth and flow
- environmental sensitivity
- geotechnical concerns
- substrate composition
- cost
- navigation
- need for access across watercourse during construction
- regulatory constraints
- equipment availability
- downstream water users

- landholder and community issues and expectations
- engineering constraints
- timing (i.e. season)
- amount of working space.

Preferred methods for major watercourse crossings will be finalised during the engineering design phase of the Project. At this stage it is anticipated that all of the watercourse crossing will be open cut (i.e. trenched).

A brief description of the available watercourse construction techniques follows.

12.8.8.1 Standard Open Cut

This technique is most suited to dry or low-flow conditions.

The standard open-cut method involves establishing a stable working platform either side of the watercourse and creating a trench using excavators; the trenching equipment will work through the creek bed. Tie-in points will be located on high ground well away from any water flow.

Watercourse bed and bank material and trench spoil will be stockpiled separately. Where watercourses are dry, there is no potential for rainfall upstream of the crossing site and works can be reinstated within 24 hours, material may be stockpiled within the watercourse otherwise all excavated material will be stockpiled above the high water mark.

Pipe string welding and concrete coating generally occur prior to placement of the pipe in the trench. The pipe may be concrete wrapped at watercourse crossings to protect the external coating and to prevent the pipe from floating once in place.

It is possible that a crossing may require water flow controls to aid construction or minimise sediment. If this is considered necessary, a special construction procedure will be designed and approval sought.

12.8.8.2 Horizontal Directional Drill

The feasibility of using horizontal directional drill (HDD) is strongly limited by site conditions such as soil stability, slope, access, available workspace and nature of subsurface rock. The length of the drill and the pipe diameter also influence the ability to use HDD.

The installation of the pipeline by HDD involves drilling a hole at a shallow angle beneath the surface through which the pipe is threaded. Drilling is conducted by a specially designed drill rig, operated by a specialist contractor. A variety of associated equipment and infrastructure is required. Note that the work area (equipment layout) usually exceeds the RoW width, being typically about 50 m wide.

Although HDD reduces impacts to the bed and banks of watercourses, the technique introduces additional environmental considerations. These include clearing of an area for the set up of the equipment and pipe string, drill site sediment control, drill mud (water-based bentonite) management, potential for drill mud seepage through alluvial materials and waste management. Access for vehicles and equipment around the watercourse is also required resulting in the additional use, or creation of, access tracks.

HDD also has the potential for the drill bit to intersect a fracture within the riverbed. When this occurs, bentonite mud may be released into the watercourse. This event is referred to as a “frac out”. Bentonite is a natural clay-like substance formed from the deposition of volcanic ash. When it is released into a watercourse through a frac out it will cause increased turbidity until the material is fully dispersed.

As expansive clay, bentonite works to reseal the fracture and released material normally settles quite rapidly. To aid the sealing of the fracture, wood or bark chips are often pumped into the drill hole combined with the bentonite. Where the watercourse is dry it is often preferable to leave the spilt bentonite in situ where it will dry out and break down into the surrounding area. Where a large spill occurs the material can be removed and buried.

To address these issues, QGC will prepare site-specific management procedures prior to drilling as an outcome of the detailed design phase of this Project.

12.8.8.3 Boring

Boring is a low-impact technique involving drilling short distances from below ground within an enlarged trench area (bore pit) either side of the crossing location within the RoW. This method may be used for road and rail crossings as well as for watercourses.

The feasibility of using a bore is limited by site conditions including depth required, width of crossing, geology, landform, soil type and service/infrastructure.

12.8.8.4 Tunnelling

Tunnelling is similar to boring but requires much larger bore pits and micro-tunnelling equipment is used instead of a drill. The technique reduces the depth and distance that would be required to achieve a HDD crossing with large-diameter pipe. The tunnel is lined with concrete sections through which the pipe is threaded. This method is not suitable for certain types of soil, e.g. gravels.

12.8.9 Duration and Interruption to Land Use

Generally each crew works at the rate of about 1 km to 2 km per day depending on the terrain (i.e. if there are more trees or the ground is very rocky progress may be slower). To enable the crews to work safely and efficiently there is often a delay between the arrival dates of each crew. Typically it will take about four months for all the crews (i.e. the spread) to pass through an area and complete their tasks.

During this time there will be interruptions to some land uses (e.g. no crop growing or grazing over the RoW) and this will be negotiated with landholders. If dual pipe is constructed then two spreads would be required to pass through a given area thus doubling the time for which the land would be affected.

The crossing of any roads or rail lines will be carried out by a specialist crew enabling the activity to be completed within one to two days in most cases. At no time will a road be rendered permanently impassable. Traffic management measures will be implemented.

All rail crossings will be bored and there will be no interruption to rail traffic although some reduction in speed may be required. This will be negotiated with the relevant rail authority prior to commencement of a specific crossing.

12.8.10 Weed Management

QGC considers weed management for the life of the Project of critical importance. Control techniques will be implemented at all phases of the Project and will apply to any personnel traveling in the region. Control techniques include the identification and avoidance of infested areas where practicable; mapping of infested areas and wash-down points and regular wash-down of vehicles.

Prior to construction, access routes will be identified and, if necessary, a program of pre-spraying will be initiated. All vehicles and equipment will be required to be weed free at the commencement of construction and to adhere to the approved access routes and the RoW.

Weed management is detailed in *Volume 4, Section 7* and a draft of the weed management measures for construction activities is included in the Draft EMP in *Volume 10*. This plan will be finalised prior to the commencement of construction.

All personnel entering the Project area will be required to conform to the weed management measures.

12.8.11 Multiple Pipelines

If the decision is made to install two smaller pipelines rather than one single large pipeline this would be done in one of two ways:

- laying two pipes within a single trench
- digging two separate trenches.

Due to the pipe sizes under consideration, it is most likely that the latter process would be adopted in the event of QGC opting for dual pipes. It is likely that separate spreads would be used to construct each pipeline.

The spreads would either work from different ends concurrently or work from the same end with a delay between the spreads. The aim would be to use the same camp locations for each spread to minimise the clearing requirements. The spreads would all use the same access routes and all works would be carried out within the RoW and work area widths previously described.

12.9 ROAD INFRASTRUCTURE WORKS

As discussed in *Section 12.3.4* it may be necessary to construct temporary access roads for the purpose of delivering materials to site locations and for RoW and camp-site access. These locations were not known at the time of preparing the EIS. The majority of temporary access roads will be reinstated on completion of the construction works.

In addition, permanent roads and accesses are proposed for new above- and below-ground installations along the route of the pipeline such as MLV and scraper station installations.

In a number of locations the pipelines will need to cross existing roads. A list of the roads in which pipeline construction will need to be undertaken is provided in *Volume, 4 Chapter 5.*

The depth of pipe under road crossings will be a minimum of 1.2 m below the bottom of the table drains in accordance with Department of Transport and Main Roads requirements as set out in the *Main Roads – Road Planning & Design Manual*.

Drawings of road crossing construction will be provided to the relevant authorities prior to construction commencing in a given area.

The relevant road authorities will be consulted in relation to all road crossings or for the use of road reserve for construction. Works on state-controlled roads will be carried out in accordance with *Main Roads – Road Planning & Design Manual.*

Once the access route locations are known the road intersections will be reviewed with the relevant road authority to determine that the location and capacity of the intersection meets the required safety standards.

Traffic control for all road works will be in accordance with AS1742.3 – *Manual of uniform traffic control devices Part 3: Traffic control devices for works on roads.*

A review of transport of materials and equipment for the pipelines has identified a potential requirement to strengthen bridges to cope with the additional vehicle loads and movements. A full discussion of transport and road impact issues is provided in *Volume 4, Chapter 13.*

12.10 MATERIAL AND EQUIPMENT REQUIREMENTS

Typical equipment that will be used in the construction of the pipeline includes:

- Bull dozers
- Graders
- Trucks
- Excavators
- Pipe-bending machines
- Loaders
- Sideboom tractors
- Padding machines
- Wheel-ditching machines
- Water trucks

Specialist plant and equipment (e.g. pipe bending machines, side booms and padding machines) may be sourced from interstate, depending upon location and availability at the time of construction. The bulk of the earthmoving equipment (e.g. excavators, graders, water trucks) will be generally sourced locally.

Typical materials to be supplied to, and stored on, the RoW during pipeline construction will include:

- steel pipe
- diesel fuel
- consumables (e.g. welding rods, grinding discs)
- two part epoxy for coating of pipeline joins (5,000 L) or tape wrap
- garnet for grit-blasting welded joints.

The pipe may be imported already coated. However, an option would be to locate a temporary coating plant near the port of entry. The decision on whether the pipe will be imported bare or coated will be made once the pipe bids are received and this is not known at the time of compiling this EIS.

Pipe will be supplied to the RoW pre-coated and a pipe coating plant will not be required at site. Large-diameter pipe (1,050 mm) is not currently manufactured in Australia and will therefore be sourced from overseas.

Diesel fuel will be stored at the camp-sites either in a self-bunded tank or in a tank within a HPDE-lined earthen bund.

Consumables will be stored at the camp-site compound within a storage unit; typically a shipping container.

Epoxy materials will be supplied in drums (240 L) and stored within a bunded area.

Garnet will be supplied in bags (600 kg), stored on pallets and covered to protect it from the weather.

Trenchless crossings for the various pipelines will require:

- concrete: 20 m^3
- sheet piling: 8 m high, 40 m long, 20 mm thick
- grout.

12.11 STORAGE REQUIREMENTS

The main storage requirements during construction of the pipeline will be for line pipe. A stockpile of approximately 10 km of pipe may be maintained at Wandoan and Gladstone. The actual stockpile/transfer location would be determined based on transportation agreements. Land availability is not yet known in the Gas Field Component area although these locations would be on QGC-owned land. In Gladstone the proposed pipeline storage/laydown area would be at Auckland Point (Refer *Figure 2.4.8*).

The selection of stockpile sites would be in accordance with the same requirements as for access tracks and camp sites:

- use of existing cleared areas where practicable
- minimise clearing of vegetation
- avoidance of protected vegetation
- not adjacent to a watercourse.

12.12 SITE SECURITY

There are no special security measures required for the RoW. Landholders will be consulted in relation to land use management during construction to minimise the impacts to agricultural or grazing activities.

Construction supervisors associated with each spread will conduct daily inspections of the activity areas and implement additional measures, such as traffic controls, RoW controls (using ultra high frequency (UHF) radio communications) as required.

Occasionally security measures such as fencing may be implemented at a camp site but this is not common.

12.13 ACCOMMODATION

It is anticipated that the bulk of the construction workforce for pipeline construction will be accommodated in dedicated temporary construction camps to be established along the pipeline routes, and in QGC Gas Field Component camp accommodation. This is due to the predominantly rural and semi-remote nature of the proposed pipeline network, size of the construction workforce and limited accommodation availability along the route of the gas transmission pipelines.

It is estimated that two or three camp sites may be required during the construction period. It is expected that no more than two camp sites will be in operation at any one time per pipeline and per spread.

Camps are normally located to keep travel distances to the work area to a maximum of 70 km. While actual sites have not been identified, it is anticipated that these may be located in the vicinity of KP60, KP180 and KP300.

It is anticipated that up to 500 direct jobs will be created during construction of the Pipelines Component of the Project. Local contractors and service companies will be involved with the construction phase of the proposed pipeline and associated facilities where possible.

However, many aspects of the construction process (e.g. welding, specialist crossing techniques and testing) require specialist pipeline/technical expertise which may not be available in some local areas (refer to *Volume 2, Chapter 6*).

The temporary camp facilities will be air-conditioned, demountable-style units including:

- accommodation blocks containing up to six rooms with shared ensuites (i.e. three bathrooms per block). The ensuite will contain a toilet and shower with hand basins provided in each room. Rooms are typically equipped with a bed, wardrobe, table and small fridge
- central ablution unit containing toilets and laundry facilities for use by camp occupants
- messing units which include cooking and eating facilities and a wet mess with recreation lounge
- offices
- training/meeting room
- equipped recreational room
- first aid room
- workshop for maintenance of vehicles and equipment.

Camp facilities are designed to comply with all the appropriated health and hygiene requirements. While activities undertaken under the *Petroleum and Gas (Production and Safety) Act 2004* (Qld) (P&G Act), including campsites, do not trigger approvals under the *Integrated Planning Act 1997* (Qld) (IPA), QGC will liaise with all affected Regional Councils to ensure that:

- camp locations are appropriate
- buildings are to a suitable standard (e.g. tie-down, fire protection, sewage treatment)

- food preparation is in accordance with legislative requirements.

The camp facilities are completely self-contained, portable facilities with their own power supplies, refrigeration and effluent disposal. They can be transported by road, established on a graded site and removed in a short time, leaving the site restored to its original condition. Local water supply will be required to provide camps with potable water.

Pets are banned from all pipeline construction activities to ensure that no pest species are introduced.

Food wastes will be kept covered to prevent the introduction/attraction of vermin and flies. Wastes will be removed from site on a regular basis (refer to *Section 12.19* and *Volume 4, Chapter 14*).

Potential breeding sites for mosquitoes may include equipment and materials on the site able to retain water. A mosquito control plan has been included in the Draft EMP (refer to *Volume 10*) and strategies include:

- disposal of any items of equipment or debris, which may hold water, and are no longer required as soon as possible
- weekly inspection of campsites for potential breeding sites and evidence of breeding
- elimination or treatment of breeding sites if breeding is detected.

Camp sites are typically located at a distance from the RoW to minimise any noise and dust impacts on workers' accommodation. All units, including all sleeping areas, will be air-conditioned for the comfort of workers.

Where required, typical dust suppression (e.g. water truck) will also be employed around the campsite to reduce dust impacts. Pipeline construction is typically carried out on a single, 12-hour shift with only limited personnel working at night (e.g. camp staff, vehicle and equipment fuelling and maintenance crews).

Camp sites are typically located at a sufficient distance from the RoW to ensure that these personnel are not disturbed while sleeping during the day.

Except as set out in *Volume 4, Chapter 12,* it is not anticipated that night work will be required.

12.14 TELECOMMUNICATIONS

All construction offices will utilise existing services where available and satellite facilities at other times. It may be necessary to install temporary communications towers during construction. Some of the towers may in due course form part of the permanent radio network.

12.15 TRANSPORT REQUIREMENTS AND INFRASTRUCTURE

Construction of a pipeline generates traffic through the transport of plant and equipment, materials (predominantly pipe), camp facilities and the workforce. Transport will be undertaken by a haulage contractor and may involve a combination of transport methods (i.e. road, rail, ship) depending upon the availability of plant, equipment and materials. It may be necessary to set up a distribution point from which materials would then be transported by road to the RoW.

A haulage contractor would be utilised and all transport vehicles would be refuelled and maintained at commercial service stations or the contractor's depot.

This section provides information on the potential traffic generation and is provided based on a typical construction spread. Assessment of the potential impacts from this traffic is provided in *Volume 4, Chapter 13*.

12.15.1 Plant and Equipment

Transportation of plant and equipment to the RoW will largely be by low loader and heavy-duty trucks. Typically this will involve moving earth movers and excavators, welding stations, sidebooms, cranes, profiling and preheat equipment, inspection apparatus, wrapping machines, trenchers, screening equipment and compactors.

A traffic management plan will be drawn up to manage and control the movements of this plant and equipment and will include the use of approved routes and restricted and out of bounds accesses.

12.15.2 Pipe

The pipe will be transported by extendible semi-trailers (and/or by rail) in 12 m or 18 m lengths. The number of pipes that can be carried per trailer is a function of pipe mass or diameter. Pipe trucks can carry up to 23 tonnes of pipe. However, for pipe a truck can only carry two to three pipes with a diameter of 1,050 mm. Thus for 1,050 mm pipe a truck can carry 36 m to 54 m while for 525 mm pipe (water pipe) 108 m can be transported per truck. Pipe will be delivered to site on a daily basis throughout the construction phase.

The number of trucks and trips generated for pipe transport are addressed in *Volume 4, Chapter 13*.

12.15.3 Camps

Transport for each accommodation camp (assume one per spread) would involve approximately 90 semi-trailer loads for transport to the site. The core elements of a camp (i.e. messing units, office units and equipment) and the workshop represent approximately 40 loads (24 being approximately 15 tonnes per load and the remainder six tonnes per load) while the accommodation units represent the remaining 50 loads (six tonnes per load).

If more than one camp location is required, the camps are set up by installing the core elements and workshop and then relocating the accommodation as required. Therefore Camp One would require the full 90 loads to be delivered to site while Camp Two will have the 40 core and workshop loads delivered with 50 accommodation loads progressively relocated from Camp One.

Typically, pipeline construction crews work 28 days on and nine days off although this may vary depending upon the specific project. As many of the work crews are specialists who travel from around Australia or overseas they will work on a fly-in fly-out basis. Buses will be used to transport workers to and from the nearest airport at the start and end of each work cycle.

When necessary, charter flights will be used for the transport of personnel. Camps are normally relocated during the scheduled breaks to minimise any local traffic inconvenience or disruption to work flow.

12.15.4 Construction Trips

Construction trips for each spread will include workers moving between their accommodation and the construction RoW, water cartage, waste disposal, fuel deliveries and floating of tracked plant and equipment around obstacles. Most of these trips will be short as water will be sourced as close to the construction corridor as possible and float of tracked plant will be limited as far as practicable.

The vehicle fleet per spread will include approximately 100 light vehicles (mainly Toyota Landcruisers or similar), which will be used to transport up to 200 personnel daily, and 40 heavy vehicles (e.g. service trucks, Hiab crane trucks).

Haulage of fuel for use at site will be by conventional road tanker through a licensed provider. Refuelling of Project vehicles will occur at the site workshop or be carried out by dedicated tankers along the construction RoW.

12.16 ELECTRICITY/ENERGY

Construction of the pipeline will not draw on Queensland state infrastructure for power resources. Power required for the construction of the Pipeline Component will be provided through onsite diesel generators.

12.17 WATER SUPPLY AND MANAGEMENT

12.17.1 Water Demand

Raw water will be required for dust suppression (quantity dependent on conditions) and hydrotesting of the pipeline during construction.

Potable water for domestic use will be required at the construction camps during the construction phase.

Hydrotesting typically requires a length of pipe to be filled with water. This equates to around 865 kL/km for the 1,050 mm pipeline and 196 kL/km for the 500 mm pipeline. The total water demand depends upon how often the test water is reused. The maximum volume of water used in a single test section is typically 25 ML which would equate to a maximum test length of approximately 30 km.

An indicative guide is set out in *Table 2.12.4* which indicates that the maximum demand for hydrotest would be 620 ML and the minimum demand would be 102 ML. These would be one-off requirements and the actual demand would lie between these values.

Table 2.12.4 Hydrotest Water Demand

Parameter	Export Pipeline	Lateral	Collection Header
Diameter (mm)	1,050	1,050	1,050
Length (km)	380	150	200
Unit volume (ML/km)	0.87	0.87	0.87
Maximum test section (km)	30	30	30
Volume per section (ML)	25	25	25
Top up per section (5%) ML	1.25	1.25	1.25
Total water per section (ML)	26.25	26.25	26.25
Max total water (no reuse) (ML)	345	135	180
Min total water (assume reuse all sections) (ML)	40	30	32
No. of test sections	13	5	7

12.17.2 Water Supply and Storage

Raw water for construction will be sourced from local water supplies (e.g. dams, rivers, bores or local supply pipelines) or from the Gas Field Component Associated Water.

The relevant permits will be gained, as and where required. It may be necessary to construct farm dam-style water retention facilities at locations along the pipeline for the storage of hydrotest water, pre-testing.

In the case of potable water for the pipeline construction, this will be trucked in by a contractor during construction, or raw water will be treated on site at the campsite.

12.18 STORMWATER

Stormwater management for the pipeline will include:

- daily monitoring of weather forecasts during construction to enable adequate planning measures to be in place each day
- installation of sediment fences to prevent soil transport into watercourse

- installation of berms to direct flow away from the construction RoW and on to stable ground
- provision of breaks in vegetation and soil stockpiles to minimise impacts on overland flows.

12.19 SOLID AND LIQUID WASTE MANAGEMENT

Waste management in Queensland is controlled under the *Environmental Protection (Waste Management) Policy 2000* and the *Environmental Protection (Waste Management) Regulation 2000* which are both sub-ordinate legislation under the *EP Act* (Qld). There are environmentally relevant activities for waste, as set out in the *Environmental Protection Regulations 2008* associated with the pipeline construction element of the Project, such as sewage treatment effluent.

12.19.1 Waste Generation

Relatively small amounts of domestic and industrial waste will be generated during construction of the pipeline. The actual hazardous materials inventory for the Project has not been finalised. However, based on other projects it is expected that these will comprise materials for plant and vehicle maintenance (e.g. gasket adhesives, fuels and oils), cutting lubricants, cleaning agents, water treatment chemicals and non-destructive testing. Material Safety Data Sheets (MSDS) for relevant materials will be available on site during all phases of the Project.

All waste material will be removed from the RoW daily or stored on site in skips which will be removed on a regular basis. Wastes will be disposed of to a facility agreed to by the Local Government Authority (LGA) and in accordance with regulatory waste management guidelines.

The principal waste types anticipated for the Project are provided in *Table 2.12.5* and typical volumes in *Table 2.12.6*.

Potential impacts and waste management measures are discussed in *Volume 4, Chapter 15.*

Table 2.12.5 Waste Types and Classification

Type	Activity	Classification
Tyres	• Operation of temporary maintenance workshop	Recyclable
Hydrostatic test waters	• Hydro-testing	Liquid
Drilling muds, such as bentonite muds, consisting of approved water-based products or synthetic lubricants	• Infrastructure crossings (trenchless techniques)	Liquid
Liquid waste from human waste storage facilities or waste treatment, including pump-out waste and sewage	• Operation of temporary construction camps	Regulated

Type	Activity	Classification
Fuels, engine coolant	• Operation of temporary maintenance workshop	Regulated
Batteries, gasket adhesives, cutting lubricants, cleaning agents, water treatment chemicals, and non-destructive testing (spent pipeline x-ray film), acid to etch the pipe surface prior to coating, fusion bonded epoxy (FBE) powder or other plastic material	• Operation of temporary maintenance workshop • Pipe welding and inspection	Regulated
Wastes from food preparation at camp sites	• Operation of temporary construction camps	General solid waste (putrescible)
Recyclables including glass, aluminium cans, plastic bottles, welding rods, circumferential fibre/nylon rope spacers used in pipe transport, scrap metal and off-cuts, paper and cardboard	• Operation and demobilisation of temporary construction camps • Pipe delivery, stringing and bending and welding • Construction of MLVs, scraper stations	General solid waste (non-putrescible)
Soils (top soil, fill materials), rock escarpment (sheet rubble)	• Clear and grade of the RoW • Trenching • Blasting • Backfilling and compaction • Reinstatement	General solid waste (non-putrescible)
Garnet for grit-blasting welded joints	• Pipe cleaning and inspection	General solid waste (non-putrescible)
Drained and crushed oil filters, oil soaked rags, oil absorbent materials	• Operation of temporary facilities	General solid waste (non-putrescible)
General store yard rubbish (example drums, synthetic material fibres)	• Operation of temporary construction camps and maintenance workshop • Construction of ancillary pipeline facilities	General solid waste (non-putrescible)

Table 2.12.6 Pipeline Waste Volumes

Waste Type and Generation Point	Volume	Disposal
Solid inert	2 m^3 per week	Landfill
Recyclable	0.5 m^3 per week	Recycle if practicable
Campsite wastes: putrescibles, paper, timber and plastic piping	5 m^3 per week	Reuse or landfill as applicable
Effluent (including sewage) at camp sites	For up to 400 personnel	As approved by LGA
Drilling muds/cuttings	5 m per 250 m drilled	Licensed landfill

Removal of waste spoil from the site is not anticipated as the use of padding machines, which sift the soil, enables spoil material to be used instead of imported soils for bedding of the pipe. Any residual spoil material would be spread across the RoW, creating a berm effect that would flatten over time or would be stockpiled in strategic locations, in consultation with the landholder, for future maintenance work.

Similarly felled vegetation (including grasses, established trees and shrubs) from ground-clearing will not be transported off site but will be stockpiled and re-spread during reinstatement works.

12.20 NOISE EMISSIONS

The major noise emission associated with construction of a pipeline is earthmoving equipment used for land clearing, trenching, backfill and truck, plant and equipment movements. These noise sources are temporary and/or of short duration.

As far as practicable, the pipeline route has been selected to reduce proximity to residential areas and major highways. This should reduce adverse impacts from plant and equipment noise. Other management techniques employed are reduction of speed limits, particularly in proximity to residences.

Impact and mitigation measures for pipeline construction noise are described and assessed in *Volume 4, Chapter 12*.

12.21 AIR EMISSIONS

Air emissions predicted to be generated during pipeline construction are described in detail and assessed in *Volume 4, Chapter 11*.

The major air emission associated with the construction of a pipeline is dust from land clearing, trenching, backfill and truck, plant and equipment movements. Some dust will always be generated during construction particularly in dry climates such as those that predominate in Australia.

Trenching, which disturbs earth to depths of up to 2 m, tends to generate a short-term dust cloud depending upon the type of soil encountered. The spread of this dust is dependent upon the prevailing wind conditions.

As far as practicable the pipeline route has been selected to reduce proximity to residential areas and major highways. This should reduce adverse impacts from trenching generated dust.

Other management techniques employed include water trucks to damp down travel areas on the RoW and any key, unsealed access roads and reduction of speed limits, particularly in dusty areas in windy conditions.