Australia Pacific LNG Project Supplemental information to the EIS

Project Description Improvements

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1. Introduction

Australia Pacific LNG, a 50:50 joint venture between Origin Energy Limited (Origin) and ConocoPhillips, proposes to develop a world-scale, long-term coal seam gas (CSG) to liquefied natural gas (LNG) project (the Project) in Queensland. The Project is anticipated to spend approximately A$35 billion through to 2020. The Project has a life of at least 30 years, and is made up of three primary elements:

- The further development of Australia Pacific LNG's gas fields in south central Queensland
- A high pressure gas pipeline from the gas fields to Gladstone in central Queensland
- An LNG facility on Curtis Island at Gladstone

On 9 April 2009, The Queensland Coordinator-General declared the Australia Pacific LNG Project to be a 'significant project for which an Environmental Impact Statement (EIS) is required' under the *State Development Public Works Organisation Act 1971* (SDPWO Act). The EIS process under this Act includes the relationship to the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and other relevant approvals processes.

On 29 March 2010, the Project's EIS was released for public comment for a period of five weeks. Since the publication of the EIS, further improvements and optimisation of the Project's infrastructure has occurred. A summary of the changes are discussed below.

The EIS is still publicly available and can be found at http://www.aplng.com.au/.

2. Purpose

The purpose of this document is to inform stakeholders of the project description improvements to the Australia Pacific LNG Project since the submission of the EIS. Project improvements which have reduced impacts described in the EIS have been developed through the consideration of potential environmental and social impacts and project economics, advancement of engineering solutions, and improved clarity around reserves in the gas field tenements.

3. Gas fields

3.1 Field development plan

The Walloons gas fields cover an area of approximately 570,000ha within petroleum tenures held by Australia Pacific LNG. To supply the required quantity of CSG to support the LNG facility at Gladstone, a series of gas fields will need to be progressively developed during a 30-year timeframe.

Infrastructure associated with the development of the gas fields includes gas compression and processing, power generation, water treatment facilities, feed and brine ponds, coal seam gas wells, low pressure gas and water pipelines as well as high pressure gas pipelines. Other infrastructure required will consist of road and access tracks, communications infrastructure, warehousing, temporary and permanent accommodation facilities, communications and logistics-related infrastructure.

The field development plan is regularly reviewed with the assessment of exploration results and gas reserves and refinements of engineering design. The indicative development program detailed in Volume 2 Chapter 3 Table 3.4 of the EIS has been refined for the first five years. The current development from 2011 to 2015 is scheduled to involve the construction and operation of the following infrastructure:

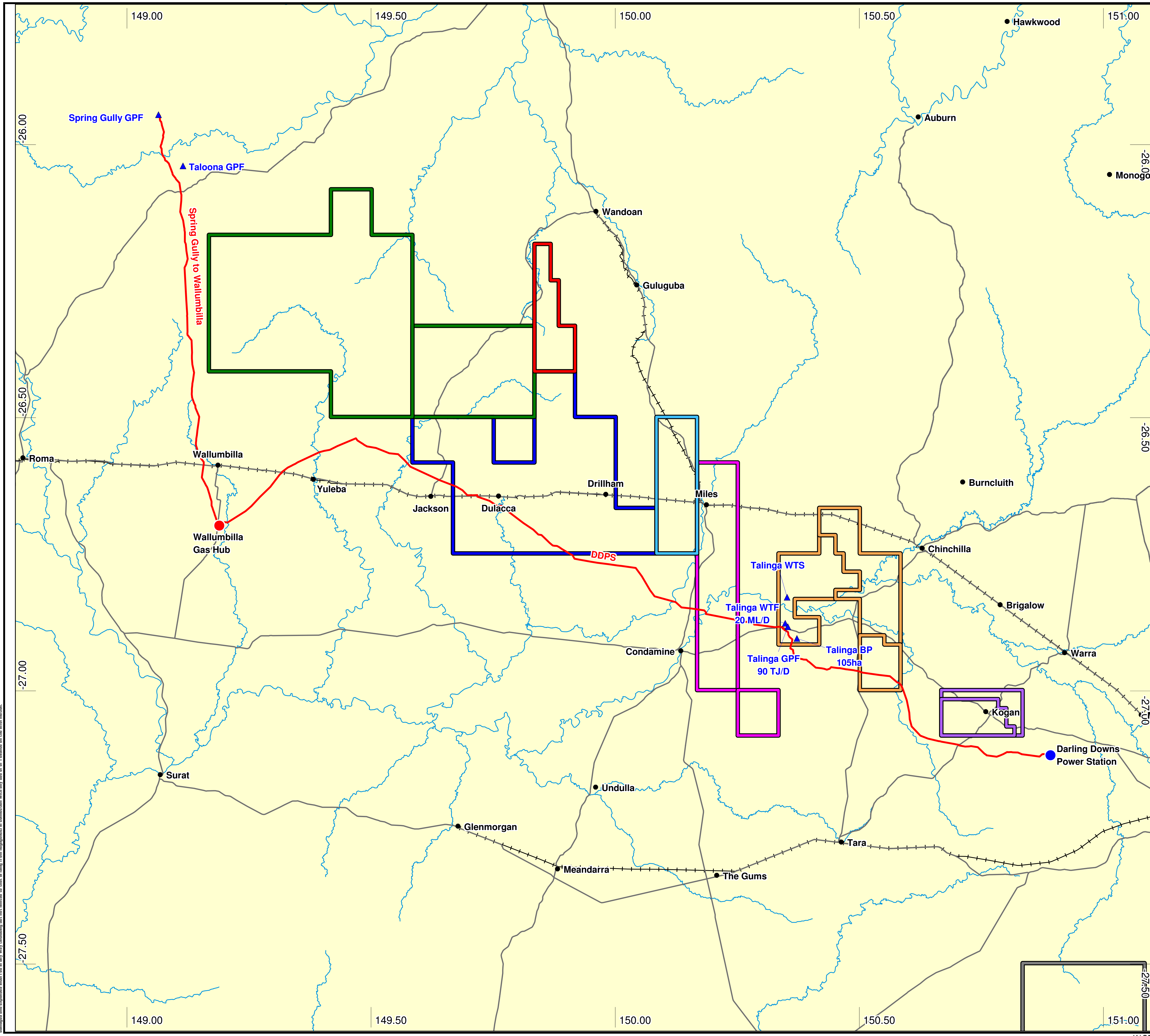
- Eight gas processing facilities (GPF)
- Two water treatment facilities (WTF)
- Two brine ponds (BP)
- Water transfer stations (WTS) and water gathering stations (WGS)
- High pressure gas pipelines
- Water pipelines
- 150 to 400 coal seam gas wells per year
- Wash down facilities
- Agricultural areas
- Laydown and storage areas
- Temporary and permanent accommodation facilities
- Administration offices

The development plan will be further detailed in a five-year operational plan, which will be updated when any significant changes to the development plan occur. Figure 3-1 to Figure 3-4 presents the major infrastructure (GPFs, WTF, BP, high pressure pipelines) to be constructed within the gas fields for the first five years. Major infrastructure will continue to be built in 2011, however it will not be brought online until 2012. Therefore no map for 2011 has been produced.

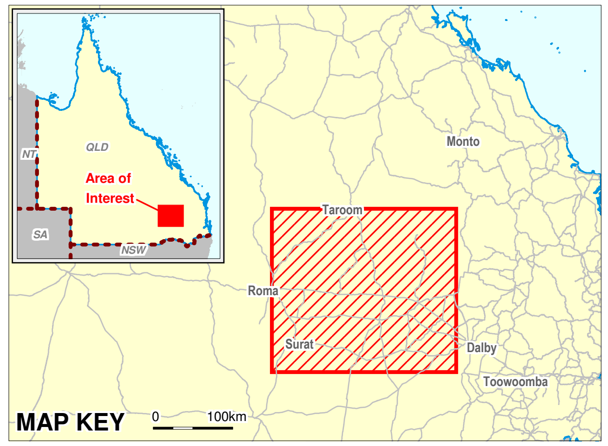
Refinements to the five-year field development plan were completed using the following planning processes:

1. Preliminary siting of key Project infrastructure, such as GPFs and WTFs, based on reserves developed during seismic and exploration work
2. Multi-criteria analysis (MCA) to objectively evaluate technical, environmental, social and cultural heritage constraints using existing information and information obtained through the EIS process (refer to Volume 2 Chapter 3 Section 3.4 of the EIS)
3. Refinement of all infrastructure locations and identification of appropriate technologies based on constraints mapping developed during the EIS process
4. Ecological scouting and landowner engagement to further refine the location of infrastructure. Figure 3-5 is an example of the landowner engagement process, with wells and gathering network sited giving consideration to impacts on agricultural land and sensitive ecological areas
5. Identification of mitigation measures and monitoring requirements, based on a risk assessment process that considers legislative requirements and impacts on the natural environment, the community and cultural heritage

Post 2015, further optimisation of Project infrastructure will continue to take place with extended exploration and pilot studies within these development areas. It is important to note that across the life of the Project Australia Pacific LNG is committed to using the process described above to ensure that the company follows due process that minimises the impacts to the region. Australia Pacific LNG requires approval for the life of the Project and Volume 2 Chapter 3 of the EIS details the maximum development scenario for the full 30 years of development.



MAP KEY



LEGEND

- Town
- Wallumbilla gas hub
- Road
- Railway
- Existing pipeline
- Existing infrastructure
- Darling Downs power station
- Major drainage

Walloons Gas Fields Development Areas

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

Source Information

Pipelines
Commonwealth of Australia (Geoscience Australia) 2009
Department of Mines and Energy, MERLIN Mining Tenures system and Database (MTDB) 2009
Gas pipelines
Supplied by Origin Energy 17/05/2010
Water treatment facility and brine pond location
Supplied by Origin Energy 25/05/2010
Gas processing facility location
Altered by WorleyParsons on 28/06/2010
Water transfer station location
Supplied by Origin Energy 10/06/2010

0 25km

N

SCALE - 1 : 750,000 (at A3)
Latitude/Longitude
Geocentric Datum of Australia 1994

AUSTRALIA PACIFIC LNG PROJECT

Figure 3-1
Existing Development 2010

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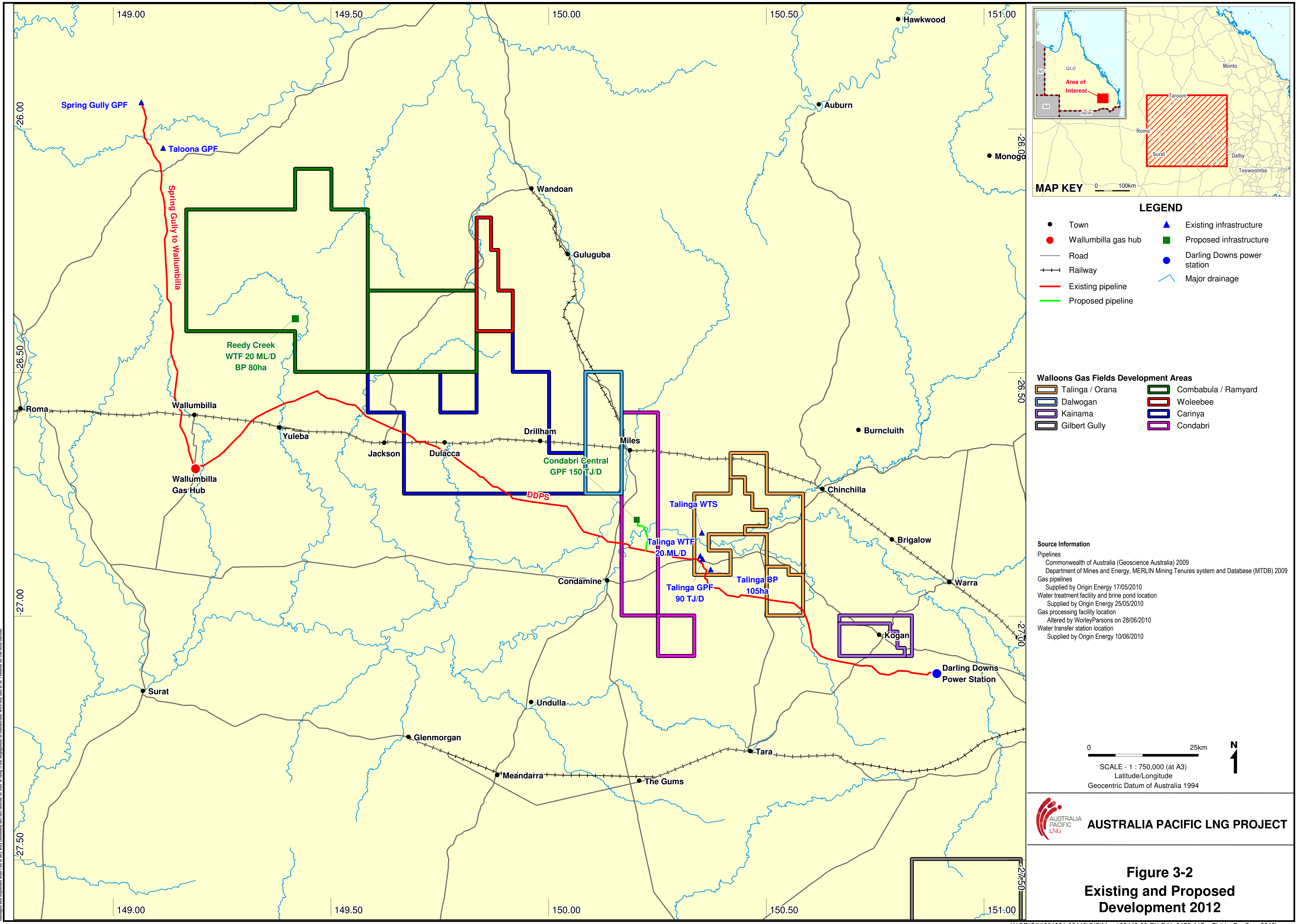

Figure 3-2
Existing and Proposed Development 2012

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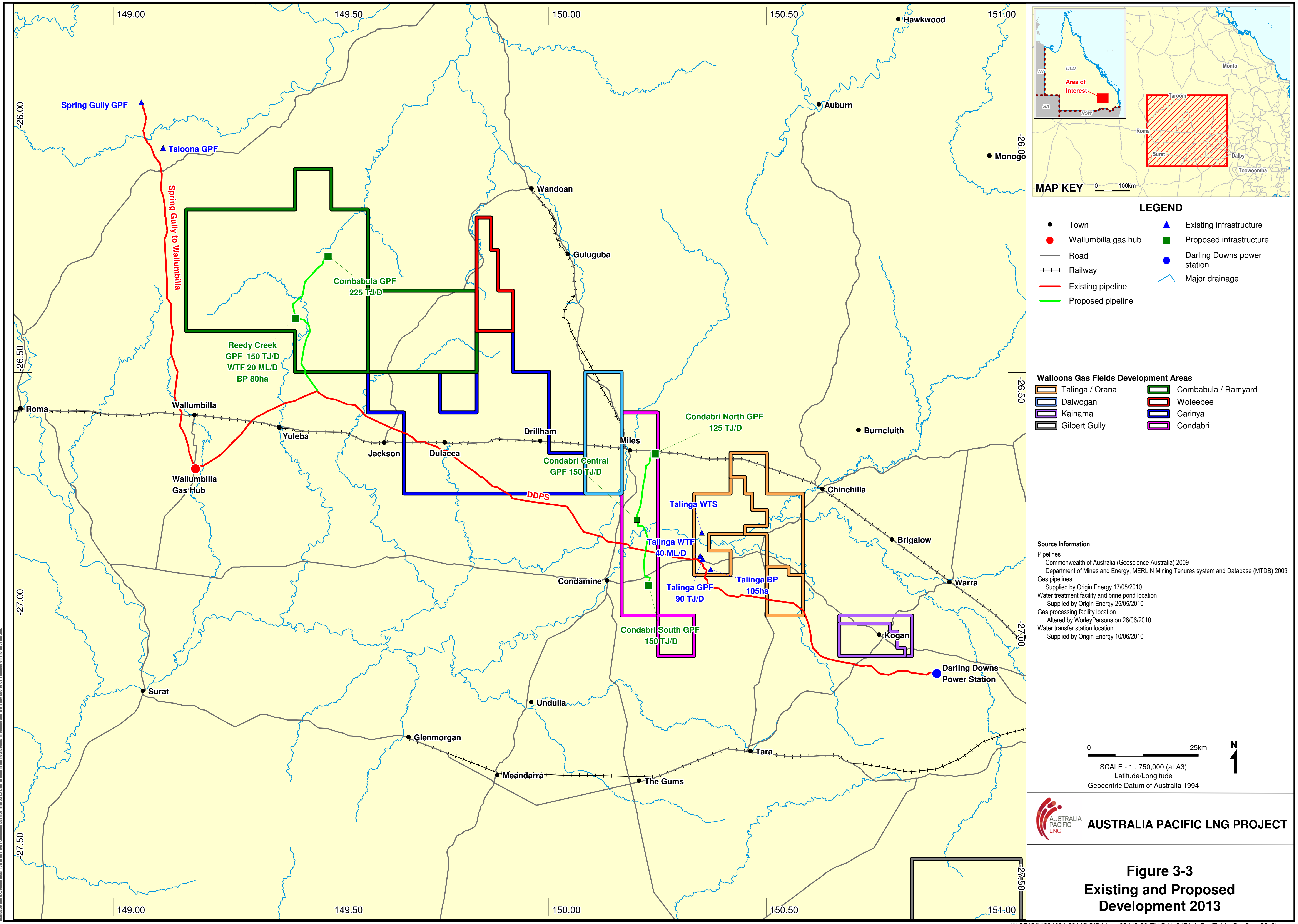

Figure 3-3
Existing and Proposed Development 2013

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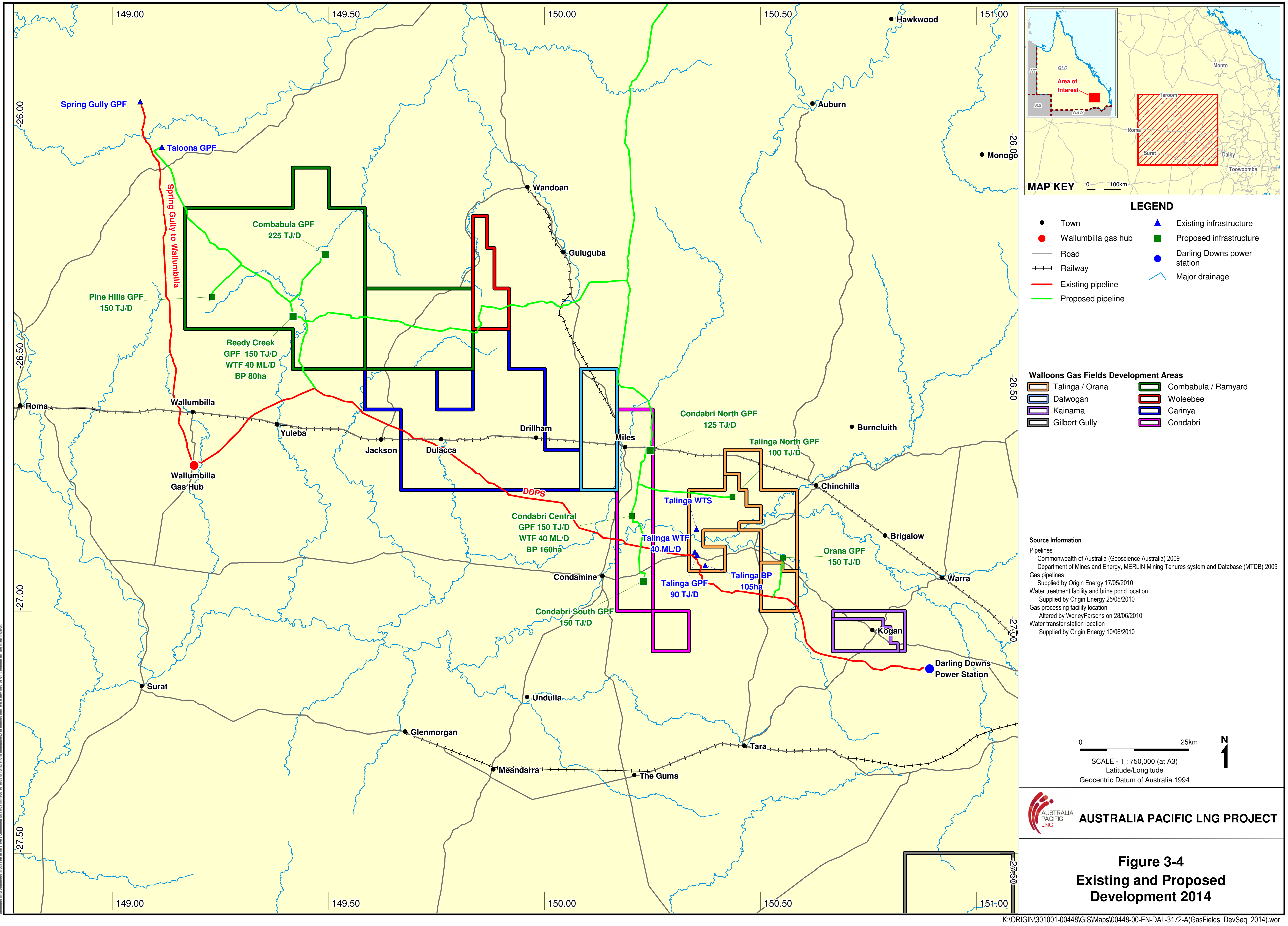


Figure 3-4
Existing and Proposed Development 2014

Figure 3-5 Siting of infrastructure and landowner engagement process

3.2 Electrification of the Gas Fields

GPFs compress and dehydrate the coal seam gas to remove any remaining water which may have been transferred with the gas through the gas gathering system. The compressed CSG is then sent to the high pressure gas pipeline system and the main gas transmission pipeline.

Volume 2 Chapter 3 Section 3.8 of the EIS presented the preferred energy source for compression in GPFs as being gas-fired engines with electric drive as an alternative. Further studies have identified grid electrical power as an attractive option due to the relative proximity of Powerlink's proposed 275kV powerlines, environmental benefits from reduced on site emissions (air and noise) and operational and maintenance efficiency advantages.

The development base case for the EIS assumed that the compression units would be a combination of rotary screw compressors for the initial pressure boost, followed by reciprocating units.

Electric driven GPFs in comparison will utilise two centrifugal compressors in a series to form a single compression train with intercooling utilised in between stages. The compressors will be operated by electric motors powered by grid electricity and utilising variable speed drives to control the speed (refer to Figure 3-6).

Table 3-1 provides the configurations of 100, 150 and 225TJ/d GPFs for both gas and electric drive.

Table 3-1 GPF configuration

GPF size	EIS base case	Electric drive
100TJ/d	Seven screw compressors driven by internal combustion engines, with compressed gas cooling carried out using air coolers with engine-driven fans. Four reciprocating compressors, with internal combustion engine drives with engine-driven cooling fans. One TEG dehydration unit, including gas fired boilers.	Two centrifugal compressors driven by electrical motors using grid power. Air coolers using electric fans will be used to cool gas following each compressor casing. A tri-ethylene glycol (TEG) dehydration unit using electric heaters.
150TJ/d	13 screw compressors driven by internal combustion engines, with compressed gas cooling carried out using air coolers with engine-driven fans. Seven reciprocating compressors, with internal combustion engine drives with engine-driven cooling fans. Two TEG dehydration units, including gas fired boilers.	Four centrifugal compressors (as described above).
225TJ/d	20 screw compressors driven by internal combustion engines, with compressed gas cooling carried out using air coolers with engine-driven fans. 10 reciprocating compressors, with internal combustion engine drives with engine-driven cooling fans. Three TEG dehydration units, including gas fired boilers.	Six centrifugal compressors (as described above).

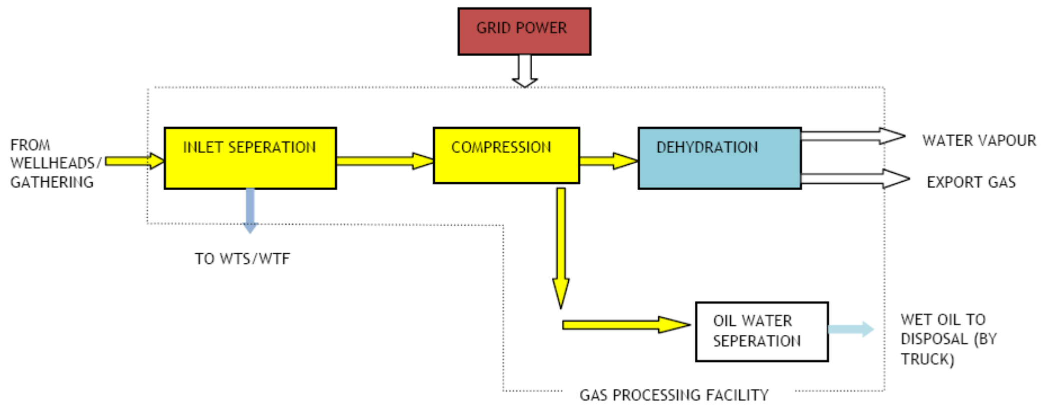


Figure 3-6 Typical input/output streams for a gas processing facility

A number of 132kV transmission lines will be required to provide the necessary power to the GPFs. The 132kV lines will be constructed and operated by a third party, including management of obtaining the relevant approvals. Within each of the gas field development areas, the proposed 132kV transmission lines would extend from the 132kV switchyards associated with Powerlink's 275kV network to the substations associated with the respective GPF.

Three indicative transmission line networks have been identified in the five-year development plan:

- Northern network – approximately 77km long and will connect Combabula, Reedy Creek and Pine Hills GPFs within the Combabula development area to the proposed Wandoan South Switchyard.
- Central network – approximately 92km long and is located in the Condabri and Talinga development areas. It will connect Condabri North, Central and South GPFs and Talinga North GPF with the proposed Columboola Switchyard.
- South eastern network – approximately 20km long and will connect the Orana GPF to the proposed Western Downs Switchyard.

Typical infrastructure associated with the electrification of the gas fields will include:

- A 132kV sub-transmission network of either single or double circuit aerial lines (refer to Figure 3-7);
- Tubular galvanised steel or spun reinforced concrete poles, ranging from 27- 32m high, with a separation distance of over 300m
- Phase conductors in either a single or twin bundle configuration
- Insulators of either glazed porcelain or toughened glass
- Aerial earthwire with fibre optic cable

It is anticipated that construction of the transmission lines will require a Right-of-Way of no more than 50m. The entire Right-of-Way will not be disturbed, as the work areas will be concentrated around the construction of the poles which are constructed approximately every 280m. A 4m-wide track will be required during construction between each pole and for operational access and maintenance requirements.

The infrastructure to provide power to the Project will not be fully developed within the first five years of the Project. As a short-term solution, it is proposed that power will be provided by portable gas-fired power plant (engine or turbine driven ~35MW) which do not require connection to the 132kV lines. The power plants will be situated at the various GPF locations that are planned for the first five years.

These portable power plants will most likely be removed once the power from the main transmission system is available through the proposed Powerlink 275kV powerline. Alternatively the portable power plants could be used during peak power loads. The assessment and approval of the future Powerlink infrastructure will be undertaken by Powerlink within its standard development program.

There are a number of benefits to electrification which are outlined in Volume 2 Chapter 3 Table 3.8 of the EIS. Some of the benefits are outlined below.

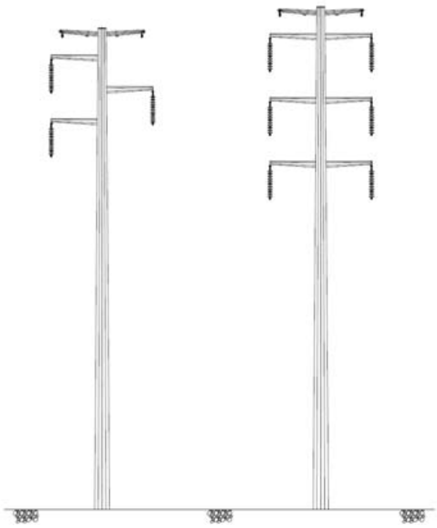


Figure 3-7 Single and double circuit powerlines

Noise

Electric driven GPFs produce less noise than gas-driven reciprocating GPFs as a result of the absence of combustion exhaust noise, smaller possible acoustic enclosure surface area, and reduced requirement for ventilation through the acoustic enclosure. Noise modelling undertaken for the EIS indicated that a 150TJ gas driven GPF using existing (Spring Gully) technology produces approximately 28dBA $L_{Aeq,adj}$ at 6km from GPF. Enclosure of the gas drivers and use of low noise fans reduces the noise footprint to approximately 28dBA at 2.1km. Recent modelling indicates that a 150TJ electric driven GPF with enclosed compressors and low-noise fans can reduce the noise footprint further to approximately 28dBA at 1km from the GPF. The reduction compared to an existing technology GPF is approximately 23dBA (from comparable predictions at 1km).

Figure 3-8 provides the noise contours for an electric driven GPF.

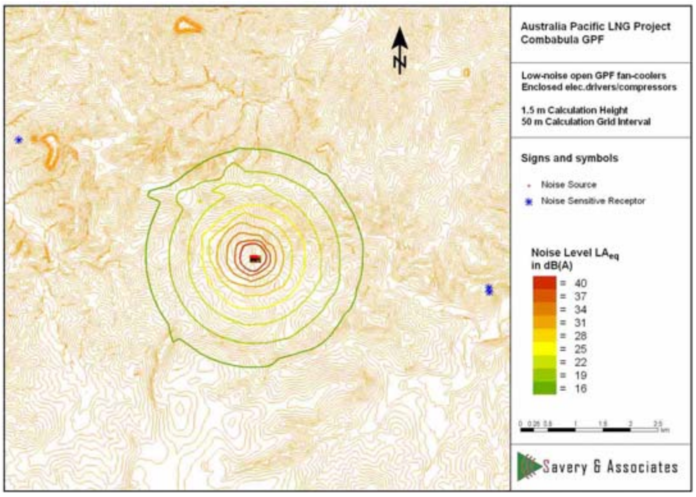


Figure 3-8 Electric driven GPF – Combabula (excluding temporary power plant)

Results from the updated noise modelling for electrification of the gas fields will be used for engineering design to meet the Department of Environment and Resource Management model conditions for level 1 environmental authorities for coal seam gas activities.

Air

The change from gas to electric driven compression will significantly reduce the rate and number of emission sources as electric drivers do not produce exhaust emissions.

Gas resource

Gas driven GPFs utilise gas at an approximate rate of 30PJ/yr at a compression flow of 1,380TJ/day. Using electric drive, it is estimated that there will be a gas fuel use saving of 6%, thereby making more gas available for LNG production.

Labour

Electric driven GPFs are less labour intensive which will reduce the size of temporary and permanent accommodation facilities.

Disturbance footprint

A smaller disturbance footprint is anticipated for electric driven GPFs as less compression units are required to generate the required compression power. Electric drivers produce more power which allow larger and therefore fewer compressors to be used in each GPF. A disturbance footprint for an electric driven GPF will only require half the disturbance footprint of a gas driven GPF.

3.3 High pressure gas pipelines

Following the publication of the EIS, the alignment of the high pressure gas network has been optimised for the first five years as shown in Figure 3-9.

Realignment of the high pressure gas network will enable optimising the capacity of the two major lateral pipelines (Woleebee and Condabri) and the addition of the Talinga North Lateral. This high pressure pipeline feeds directly into the Condabri Lateral, thereby eliminating the need to loop a section of the Darling Downs Power Station Pipeline. Re-alignment of the pipeline to Spring Gully has eliminated the need to loop a section of the Spring Gully to Wallumbilla Pipeline.

These changes in the alignments result in an overall reduction of total pipeline length, reduce the number of impacted landowners and decrease the environmental impacts associated with multiple high pressure pipelines by reducing the disturbance footprint. A portion of this re-alignment is consistent with the alignment that was described in the Australia Pacific LNG Infrastructure Facility of Significance (IFS) application which was published on 10 March 2010 (refer toFigure 3-9). The IFS document was available for public consultation and each landowner was directly contacted by Australia Pacific LNG to discuss the high pressure gas network.

3.4 Temporary and permanent accommodation facilities

Temporary and permanent accommodation facilities will be required to house the large workforce required to construct and operate the gas fields. As described in the EIS, the gas fields will require a peak construction workforce of up to 2,100 people and an operational workforce of more than 700.

The accommodation strategy presented in the EIS was to locate temporary accommodation facilities (TAF) near each GPF, which equates to a maximum 23 TAFs during the construction phase. During the operational phase, personnel would be encouraged to reside within communities in close proximity to where GPFs are located. GPFs located in more remote areas would be provided with permanent accommodation facilities (PAF).

Further assessment and optimisation of the accommodation strategy has occurred since the EIS was completed. Accommodation facilities are proposed to be located and designed taking into consideration:

- The impacts to local communities (locating facilities with consideration of reducing possible impact upon neighbouring properties, but where possible create opportunity for personnel to interact with the community and contribute/utilise local businesses)
- Health and safety with respect to travel times
- The standard of facilities in attracting and retaining personnel

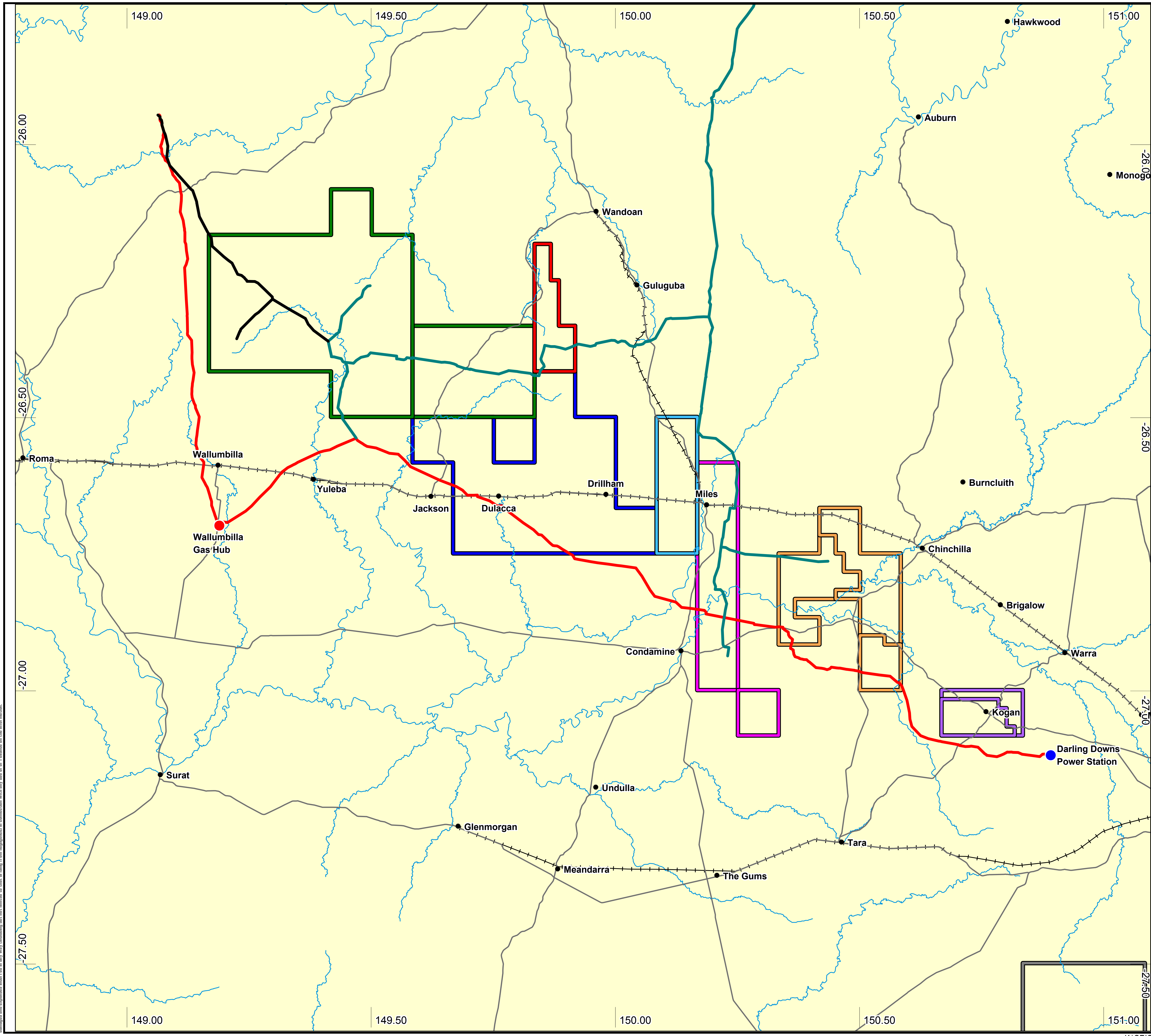
The following accommodation facilities will be required in the first five years:

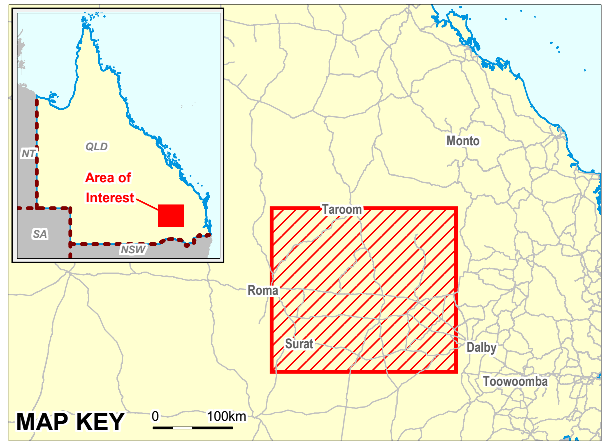
- Accommodation for GPF and WTF construction activities
  - 450 bed accommodation facility at Talinga (existing site) to service Talinga North and Orana GPF construction
  - 500 bed accommodation facility at Condabri North to service Condabri North, Condabri Central and Condabri South GPF and WTF construction
  - 500 bed accommodation facility at Reedy Creek to service Reedy Creek, Combabula and Pine Hills GPF and WTF construction
- Accommodation for gathering and infrastructure:
  - 300 bed accommodation facility in Condabri Central
  - 300 bed accommodation facility in Combabula
- Accommodation for drilling:
  - Centralised 60 bed accommodation facility in Combabula
  - Highly mobile 10-15 bed accommodation facility for each rig

All accommodation facilities will be located within Australia Pacific LNG petroleum leases and on land owned by Australia Pacific LNG.

Condabri Central and Reedy Creek will become the central bases for operational personnel with 130 and 230 person accommodation facilities respectively. These sites have been selected due to the centralised locations and the infrastructure and equipment, including GPFs, WTFs, ponds, workshop, stores, (I&E) testing facilities, administration complex and an Integrated Operations Centre (IOC) which will oversee the control of the smaller satellite GPFs. The Reedy Creek operational accommodation facility is larger as there are no communities in close proximity for employees to live.

The reduced number of accommodation facilities decreases the environmental footprint and associated impacts and allows for greater efficiencies and economy of scale including catering, cleaning and optimum use of utility services (electricity, sewage treatment, water supply and use, etc).





LEGEND

- Town
- Darling Downs power station
- Wallumbilla gas hub
- Road
- Major drainage
- Railway
- Existing pipeline
- IFS Process - Main APLNG Pipeline System
- Optimised HP Gas Network

Walloons Gas Fields Development Areas

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

Source Information

Pipelines
Commonwealth of Australia (Geoscience Australia) 2009
Department of Mines and Energy, MERLIN Mining Tenures system and Database (MTDB) 2009
Gas pipelines
Supplied by Origin Energy 17/05/2010
Existing, main and optimised pipelines amended by WorleyParsons 13/08/2010

0 25km
SCALE - 1 : 750,000 (at A3)
Latitude/Longitude
Geocentric Datum of Australia 1994

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AUSTRALIA PACIFIC LNG

AUSTRALIA PACIFIC LNG PROJECT

Figure 3-9
Optimised high pressure gas pipelines

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4. Main Gas Pipeline

4.1 Pipe transportation

The main gas pipeline shown in Figure 4-1 will transport dehydrated and compressed CSG from the Walloons gas fields to the LNG facility on Curtis Island. Further investigations regarding the transportation of pipe have been completed following the results of the EIS modelling.

Volume 3 Chapter 17 of the EIS presented road transport as the base case for the movement of pipe with the option to use rail being under investigation. Further discussion with Queensland Rail, along with investigations into engineering and feasibility, indicates that rail is feasible and is Australia Pacific LNG's preferred option as it will reduce the potential for traffic impacts in Gladstone.

The gas pipeline will be delivered to Gladstone Port from late 2011 at a rate of one shipment per month. It is estimated that the pipeline will comprise of:

- 380km at 42 inch diameter
- 81km at 36 inch diameter
- 96km at 30 inch diameter

Approximately 50km of 42 inch pipe will be transported by road to a laydown area near Mount Larcom while the remainder will be loaded onto trains and delivered to the proposed Biloela support base via a railhead at Biloela. It is anticipated that one train per day for 12 months will be required. The pipe will then be transported from the Biloela support base to pipe stockpiles at approximately 100km intervals along the pipeline using extendable semi trailers. The pipe will then be transported to the Right of Way.

Australia Pacific LNG has completed an updated traffic and transport assessment incorporating the rail option to assess the sensitivity from the model output. Australia Pacific LNG is committed to working with DIP and DTMR on the cumulative model which has been commissioned.

4.2 Biloela support base

A project support base is planned at Biloela which will provide a range of services including project management, administration, training and logistics support (receiving and dispatching materials and equipment). It is anticipated that the support base will be required for approximately three years from 2011 to support the construction and commissioning of the pipeline.

A peak workforce of 70 personnel will be required at the Biloela support base and will be accommodated in motels, commercial camps or rented houses.

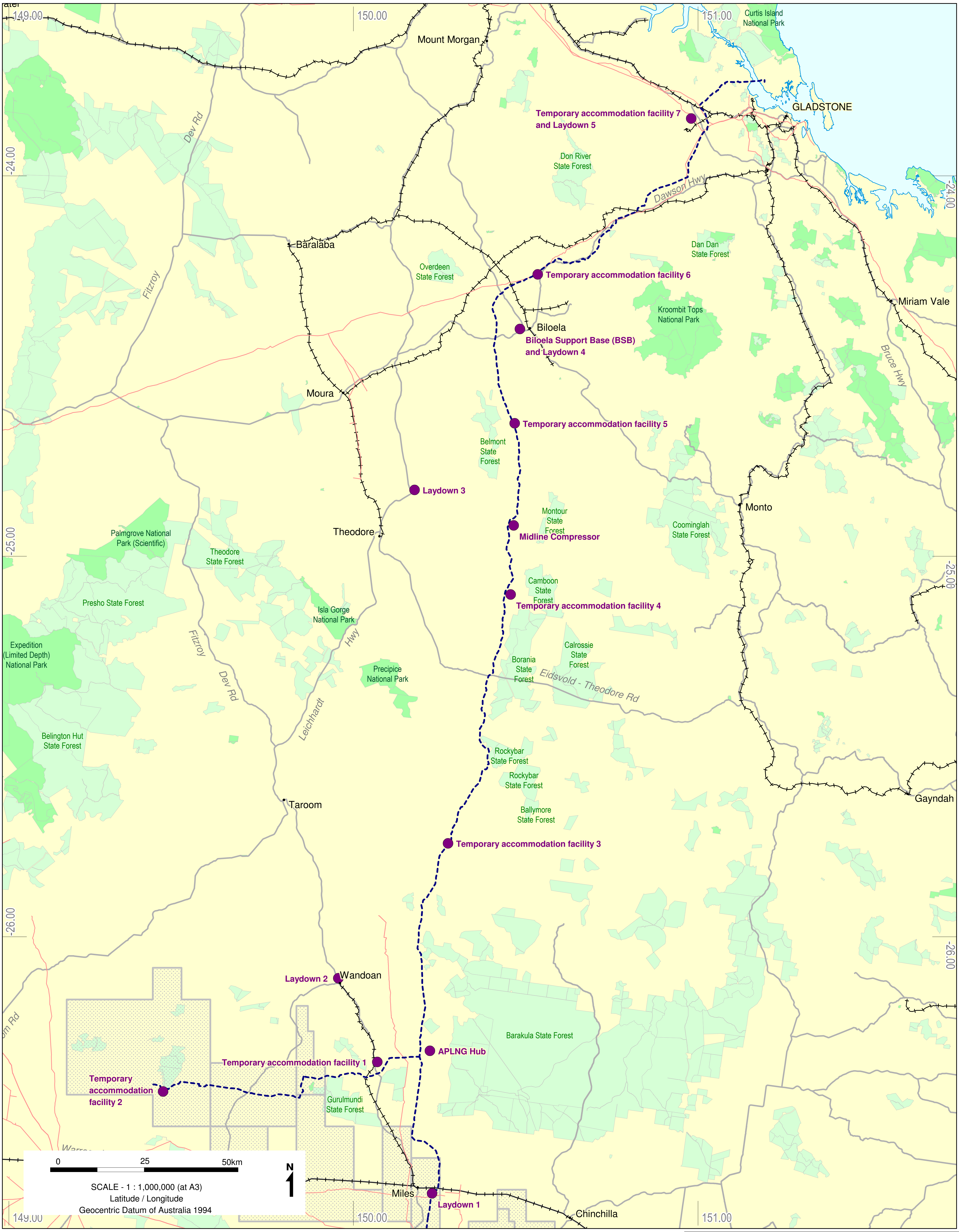
4.3 Accommodation facilities and laydown areas

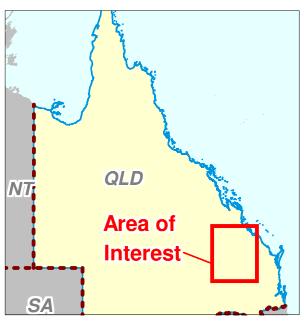
Volume 3 Chapter 3 Section 3.10.2 of the EIS describes the accommodation facilities required during the construction of the pipeline. Further assessment has refined the locations to ensure travel times to and from the Right of Way is a maximum of one hour each way. The proposed locations are provided in Figure 4-1. It is anticipated that each accommodation facility will be required for approximately four months, which is an additional two months from what was presented in the EIS.

A total of seven TAFs will be required from early 2012 to late 2013. A lead (fly) TAF will be established followed by the main and then the trail TAF. These will use common core facilities, with accommodation units transferring forward as required by the construction progress.

The TAFs will accommodate approximately 600 personnel and will include one unit per person (with ensuite), catering and recreational facilities (refer to Figure 4-2). The recreational facilities will typically include a gymnasium, television and DVD room, reading room and open sports areas for activities.

The locations of laydown areas have also been refined since the publication of the EIS to ensure distances to and from the Right of Way are manageable. The proposed locations are provided in Figure 4-1. The laydown areas will store line pipe, bends and other material, as required (refer to for a typical layout).





SOURCE INFORMATION

Main APLNG gas pipeline alignment
Provided by Origin Energy 17/05/2010

Gas pipeline laydown areas and temporary accommodation facility locations
Provided by Origin 12/06/2010

Main Roads
Department of Main Roads, Queensland 2009

Protected Areas
Department of Environment and Resource Management (DERM) 2009

Existing Pipelines
Department of Mines and Energy, MERLIN Mining Tenures system and Database (MTDB) 2009
Commonwealth of Australia (Geoscience Australia) 2009

LEGEND

- Town
- Road
- Railway
- Existing pipline
- National Park
- State Forest
- Walloons gas fields development areas

Proposed Infrastructure

- Gas pipeline route
- Gas pipeline laydown area and temporary accommodation facility location

AUSTRALIA PACIFIC LNG PROJECT

Figure 4-1
Main gas pipeline laydown areas and temporary accommodation facilities

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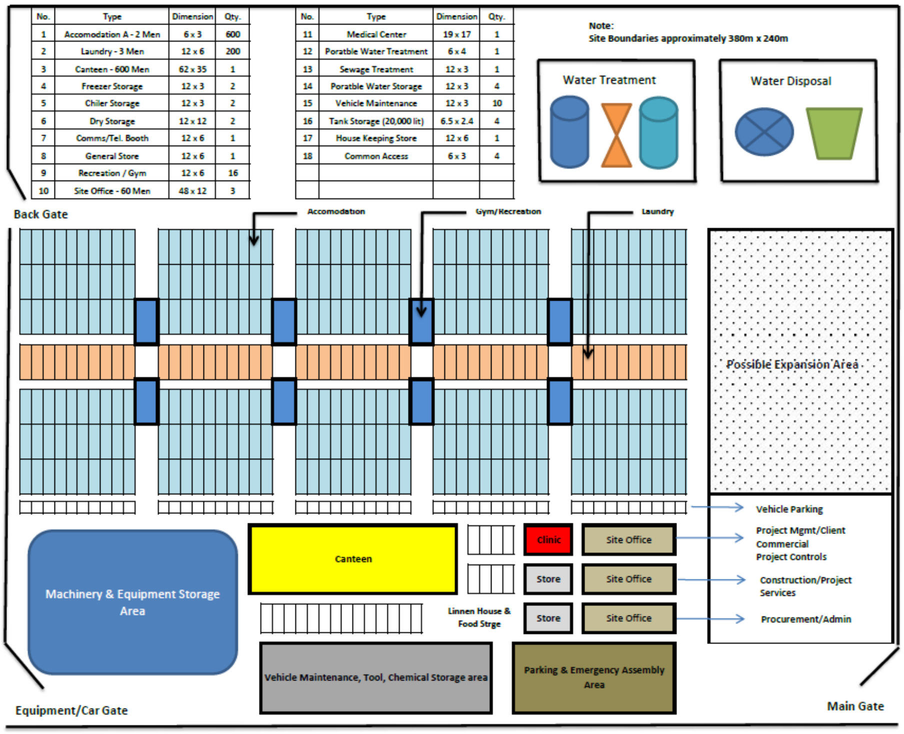


No.	Type	Dimension	Qty.	No.	Type	Dimension	Qty.
1	Accomodation A - 2 Men	6 x 3	600	11	Medical Center	19 x 17	1
2	Laundry - 3 Men	12 x 6	200	12	Poratble Water Treatment	6 x 4	1
3	Canteen - 600 Men	62 x 35	1	13	Sewage Treatment	12 x 3	1
4	Freezer Storage	12 x 3	2	14	Poratble Water Storage	12 x 3	4
5	Chiler Storage	12 x 3	2	15	Vehicle Maintenance	12 x 3	10
6	Dry Storage	12 x 12	2	16	Tank Storage (20,000 lit)	6.5 x 2.4	4
7	Comms/Tel. Booth	12 x 6	1	17	House Keeping Store	12 x 6	1
8	General Store	12 x 6	1	18	Common Access	6 x 3	4
9	Recreation / Gym	12 x 6	16				
10	Site Office - 60 Men	48 x 12	3				

Figure 4-2 Typical temporary accommodation facility layout

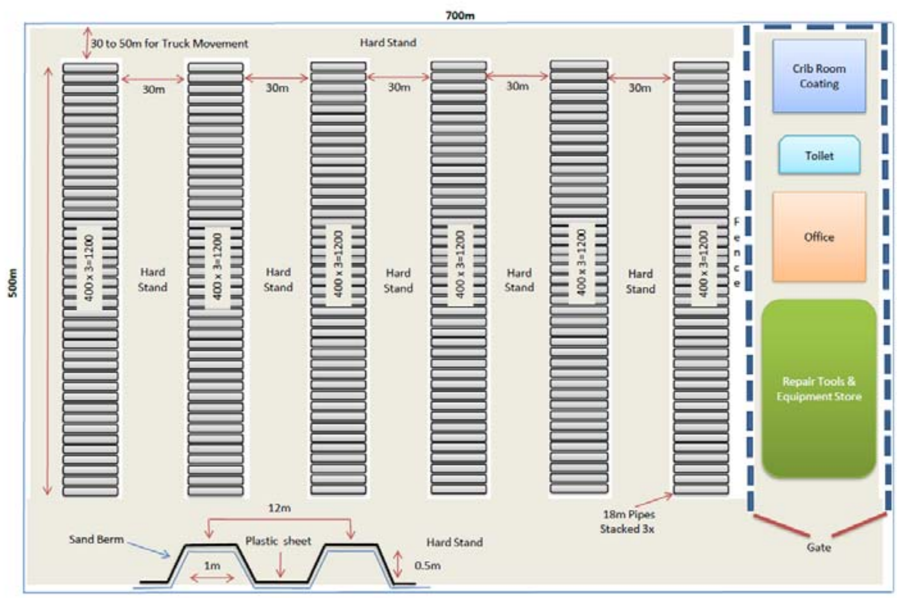


Figure 4-3 Typical layout of laydown areas

4.4 The Narrows crossing

An integral component of the gas pipeline is the marine crossing of The Narrows from the mainland near Friend Point to Curtis Island. The Narrows crossing has two distinct sections; the mud flats on the mainland foreshore and an open water section, which is The Narrows itself.

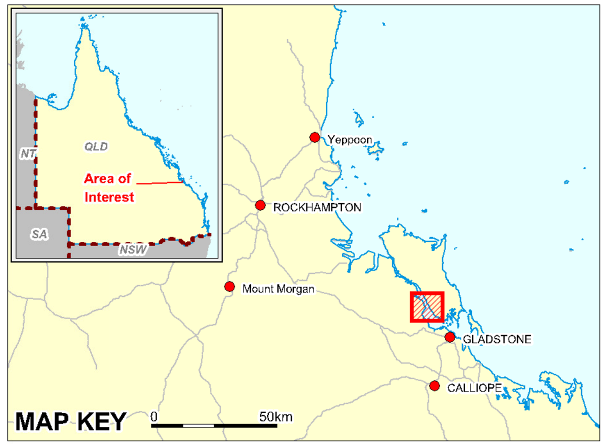
For a single pipeline, the EIS presented two construction methodologies to cross The Narrows; open cut excavation across the mud flats and horizontal directional drilling (HDD) for The Narrows, with open cut trench as an alternative. As indicated in the EIS Volume 3 Chapter 3 Section 3.8.5, Australia Pacific LNG is continuing to engage in technical and commercial negotiations with other proponents to enable a joint pipeline crossing of The Narrows.

Further investigations have determined that for the single crossing methodology, HDD across The Narrows is not feasible due to engineering constraints. Open cut trench using a cutter suction dredge, which was presented as an alternative method in the EIS, has been identified as a technically sound option. The pipe string would be pre-fabricated and tested on the mudflats at Friend Point in preparation for a 'bottom tow' pull towards Laird Point at Curtis Island. Once the pipeline is in place, rock armour would be used to protect the pipeline and the sediment would be allowed to refill the trench over the pipe and rock armour.

The mud flats will be trenched with sections sheetpiled or drilled as presented in Volume 3 Chapter 3 Section 3.8.3 of the EIS.

The alignment of the pipeline across The Narrows has been refined since the release of the EIS to align with the preferred corridor advised by Department of Infrastructure and Planning (DIP) and following submissions to avoid impacts on the Queensland Energy Resources Ltd (QERL) shale oil resources. The revised alignment is shown in Figure 4-4

Australia Pacific LNG has undertaken further environmental assessments of the alignment within the Callide Infrastructure Corridor (CIC) and Gladstone State Development Area (GSDA) which were not investigated prior to completion of the EIS due to access issues. These updated assessments are based on Australia Pacific LNG's construction methodology for a single stand alone crossing of the mudflats and the Narrows and have been completed to feed into the detailed design of Australia Pacific LNG's single crossing and for subsequent approvals.



LEGEND

- Gas pipeline route
- EIS gas pipeline route
- GSDA - Proposed Narrows pipeline corridor

Source Information

Satellite imagery
captured by GeoEye-1 on 24 March 2009

Gas pipeline route
supplied by Origin Energy on 17/05/2010

GSDA - Proposed Narrows Pipeline Corridor
Supplied by Origin Energy on 10/06/2010

AUSTRALIA PACIFIC LNG PROJECT

Figure 4-4
Gas Pipeline Route
Crossing of the Narrows

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5. LNG Facility

5.1 LNG Facility Layout/Design

Since the submission of the EIS, the LNG facility's design has been further optimised to improve operability and reduce environmental impacts. Such changes were discussed as alternatives in Section 3.3.1, Volume 4 of the EIS. The optimisation has resulted in the following key layout and/or design modifications:

- Material Offloading Facility (MOF) - the revised MOF location and footprint will enhance marine accessibility as it is orientated in a manner that is more in line with the direction of the marine currents. This has also resulted in improvements to safety and navigation for marine access. The alternate configuration of the MOF is also reduced in size, resulting in less reclaimed seabed and associated environmental impacts. An operational ferry terminal has been included in the design of the MOF
- Ground Flares - the design of the flare system has been modified from two wet/dry ground flares with a stack marine flare, to a five ground flare system that includes wet/dry and marine flaring. Three of the five ground flares will be constructed during the development of trains 1 and 2, with one of three being a spare. At ultimate development two additional flares will be incorporated in the flare system. The spare unit allows maintenance to occur on the flares without impacting the operation of the plant, thereby increasing plant availability. The revised configuration has the same duty as described in the Australia Pacific LNG Project's EIS, but allows splitting of the flare to multiple smaller units to increase efficiency. The optimised configuration (five ground flare system and the inclusion of the marine flare) has reduced visual impacts to sensitive receptors. It has also reduced heat turbulence at altitude, which reduces potential impacts to aviation safety
- LNG Storage Tanks – the revised location of the LNG storage tanks to the south west area within the LNG facility site will result in less generation of boil-off gas during the loading operations and reduced construction effort. This is due to improved foundation suitability and the shorter loading line to the loading berths from the storage tanks
- Stormwater and Discharges – stormwater management improvements and revised discharge point locations have been incorporated into the updated LNG facility layout. Improvements to stormwater management include:
  - Increased diversion drains around entire land-based site boundary to reduce ingress of stormwater onto the development area
  - Increased number of sedimentation ponds for retention of stormwater and management of water quality across various levels of the site
  - Clean stormwater within the site will be directed by surface drains to sedimentation ponds for reuse or release via outfalls
  - Potentially contaminated stormwater collected in the north area will be sent to the CPI separator and in the south area will be sent to an oil skimmer and the oil to the CPI separator

Further information on stormwater drainage and brine and wastewater discharges is provided in Section 5.5 and Section 5.6 respectively

- Acid Gas Incinerators – acid gas incinerators have been included on the acid gas removal units to allow for any changes in sulphur content of CSG across the life of the Project. Australia Pacific LNG has undertaken air dispersion modelling associated with emissions from the acid gas incinerators. Modelling has indicated that air quality objectives for sulphur dioxide are met for normal and non-normal operation of the LNG facility (inclusive of background levels) at sensitive receptors
- Utility Infrastructure – Utility infrastructure has been revised in response to progression of LNG facility design, including:
  - Feasibility study underway on a potential water supply line from the mainland to Curtis Island. This is being undertaken by the Gladstone Area Water Board
  - The estimated demand for water during the construction phase of trains 1 and 2 includes 850,000 m^3 potable water, 574,000 m^3 for site preparation and dust control, 140,000 m^3 for hydrotesting and 31,000 m^3 for concrete work. Impounding ponds will be established as soon as practicable to capture surface water runoff water as part of the temporary site drainage system. This water will be used for dust control, firewater and for hydrotest purposes. The estimated demand for freshwater during operations is 1,550 m^3/day (four trains)
  - Removal of the reuse of condensed water from the inlet air propane chilling process from the LNG facility design due to additional study work indicating that this is economically unsound
  - Refinement of the fire protection system to include a single firewater tank for the purposes of fighting a four hour duration fire in accordance with NFPA 59A
  - An additional back-up gas turbine power generator to support the 13 Solar Titan gas turbine generator sets for the four LNG trains
  - External telecommunications connectivity (primary and backup) to the LNG facility through a local communications carrier in Gladstone. Primary connectivity shall be through a terrestrial fibre optic cable entering the facility with the gas pipeline. Backup connectivity will be through a high speed, private point-to-point microwave link

The LNG facility site is shown in Figure 5-1. The indicative LNG facility development area and layout are depicted on Figure 5-2 and Figure 5-3 respectfully. Updated artist's impressions of the LNG facility are shown in Figure 5-4, Figure 5-5, Figure 5-6, and Figure 5-7.

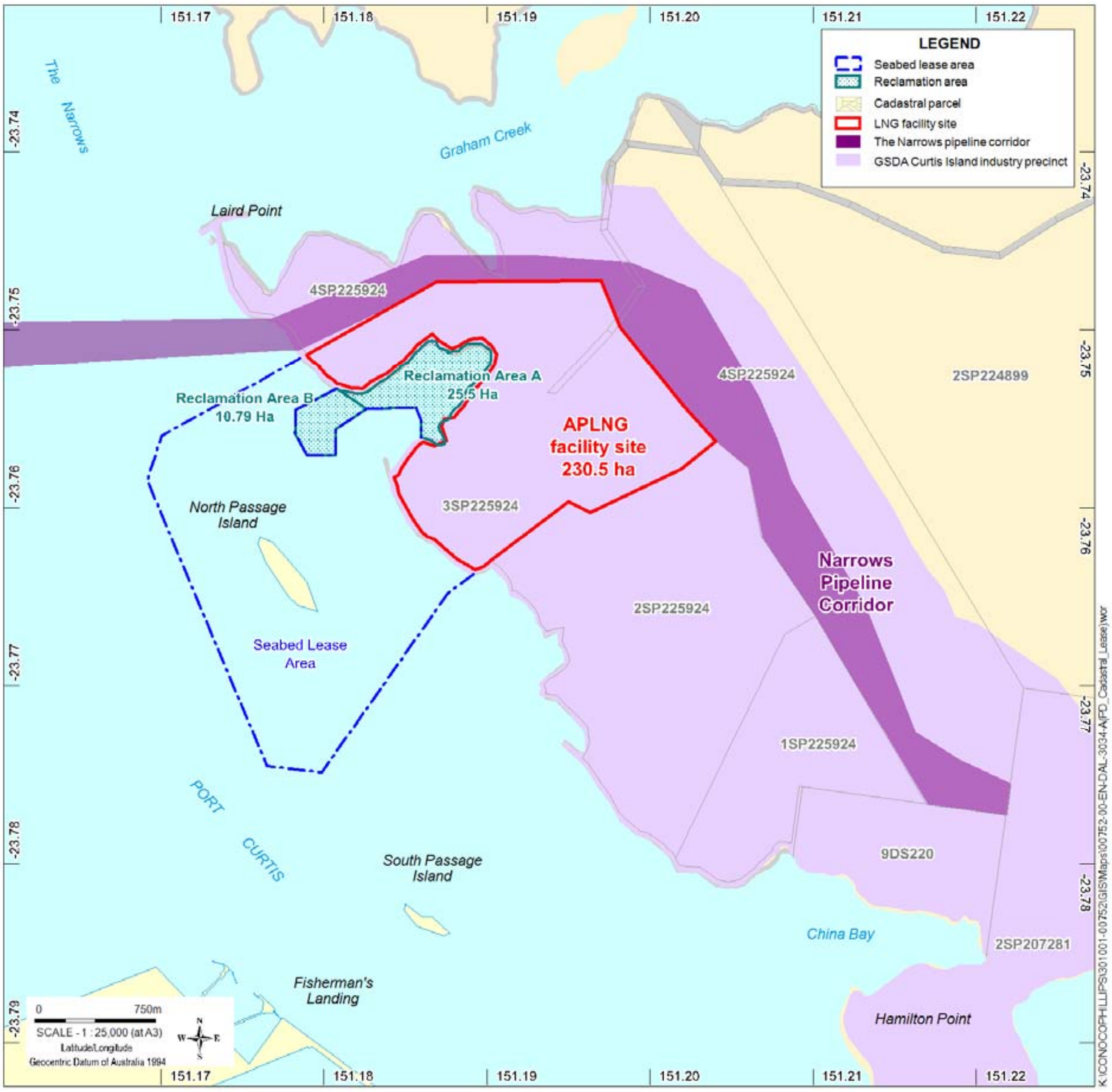

Figure 5-1 Cadastral boundaries and proposed lease areas

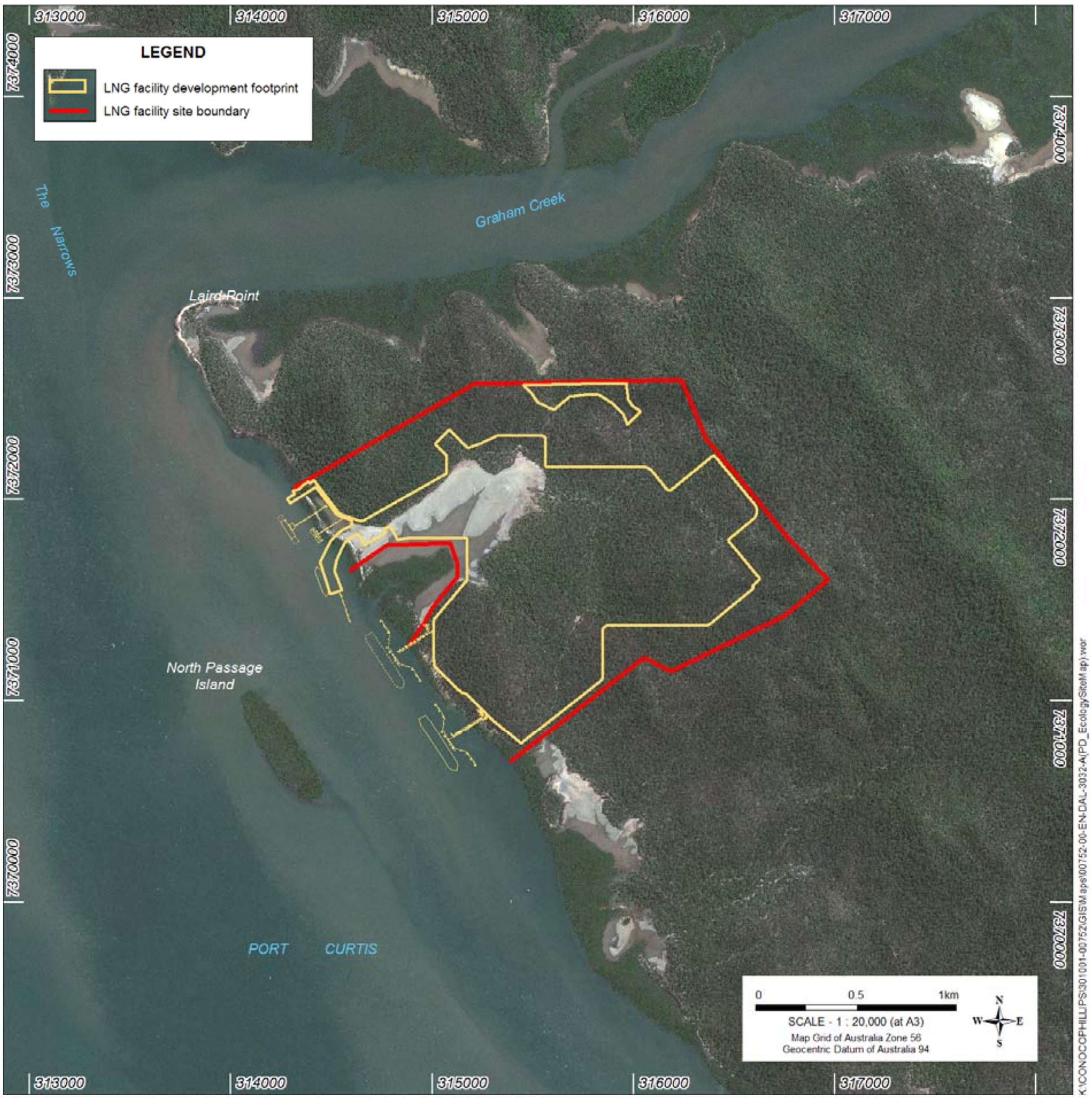

Figure 5-2 LNG facility development area

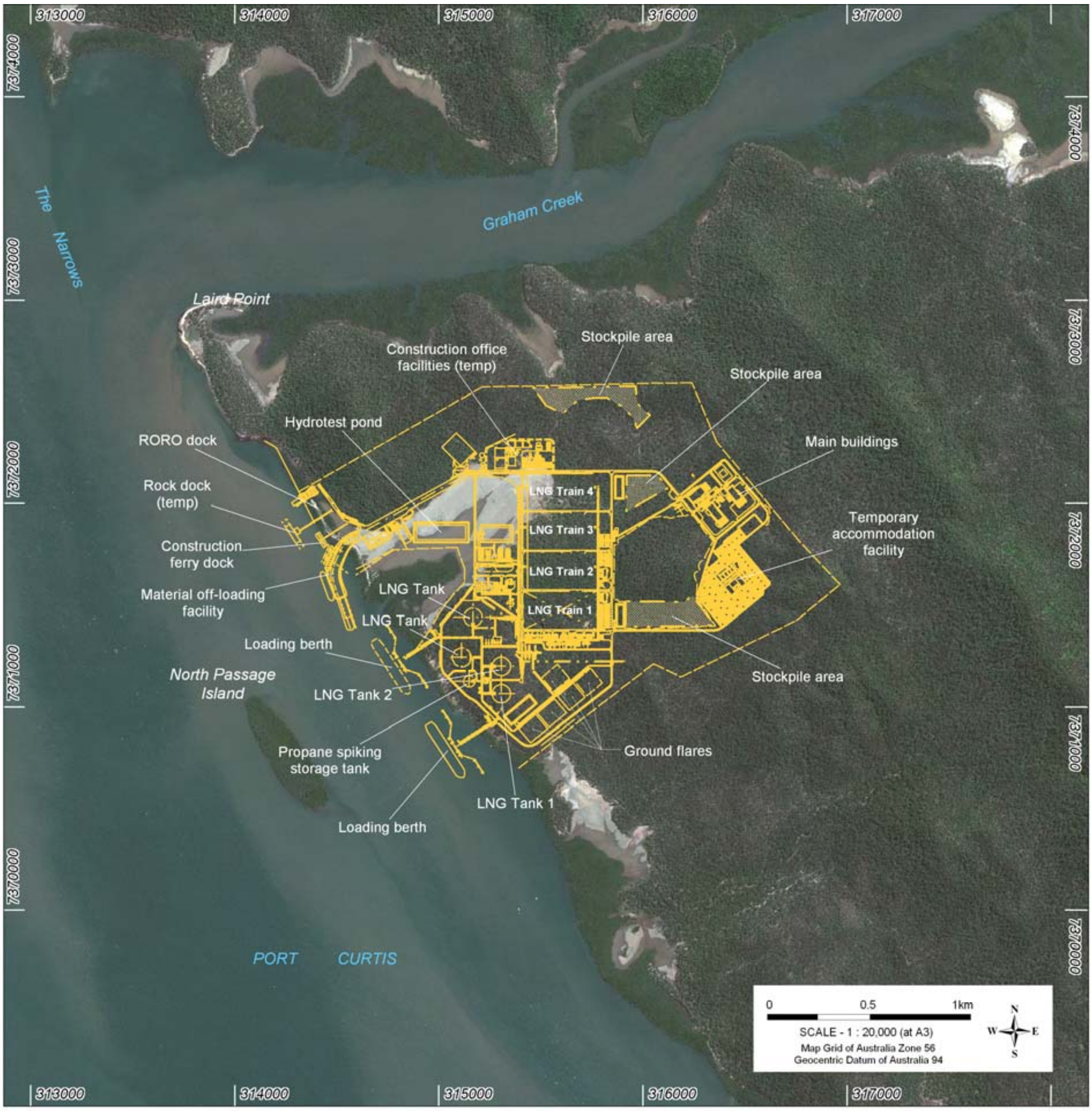

Figure 5-3 LNG facility indicative layout

Figure 5-4 Artist's impression of LNG facility – indicative view from north

Figure 5-5 Artist's impression of LNG facility – indicative view from west (aerial)

Figure 5-6 Artist's impression of LNG facility – indicative view from west

Figure 5-7 Artist's impression of LNG facility – indicative view from east

The hazard and risk assessment for the LNG facility has been updated using the revised layout and design. Modelling results showed that $30kW/m^2$, $9kW/m^2$, and $5kW/m^2$ radiation exclusion distances from tank impoundment fires are completely contained within the site boundary. Thus, NFPA 59A siting requirements are met by the LNG facility site layout. Additionally, the site layout appears to meet all of NFPA 59A's spacing requirements, including the tank requirements that relate to tank-to-tank radiation during a tank-top fire.

Modelling also showed that with the exception of buildings within or near the liquefaction trains, the facility layout also provides adequate spacing for the permanent plant buildings. The locations designated for all buildings outside the liquefaction areas are outside of the 4.1kPa vulnerability zone.

Fatality risk contours for the updated layout were reviewed and are illustrated in Figure 5-1. These contours are based on a wide range of accident scenarios and combine the potential consequences with failure frequency and weather probability data to map the risk around the facility following potential release scenarios. The site with four LNG trains will most likely not pose a risk greater than 50×10^{-6} on offsite areas. Some adjacent offsite areas could be exposed to risk levels greater than 1.0×10^{-6}; however, based on regulatory requirements, it is acceptable for the particular land use. Risk levels due to the facility are expected to be less than 1.0×10^{-8} at most boundaries.

Shipping was reviewed with regard to the revised LNG facility layout and the following were concluded:

- The layout has a substantial separation distance between ship berths and the LNG storage tanks and LNG trains. This ensures that LNG ships at berth are outside of the overpressure and fire radiation vulnerability zones created by the process and storage of LNG
- LNG/LPG ships at berth are protected from the existing shipping lanes in the Port of Gladstone by North Passage Island. Protection provided by the island and the physical separation from the shipping lanes greatly reduces the potential risk of a LNG/LPG ship at berth being struck by a wayward vessel

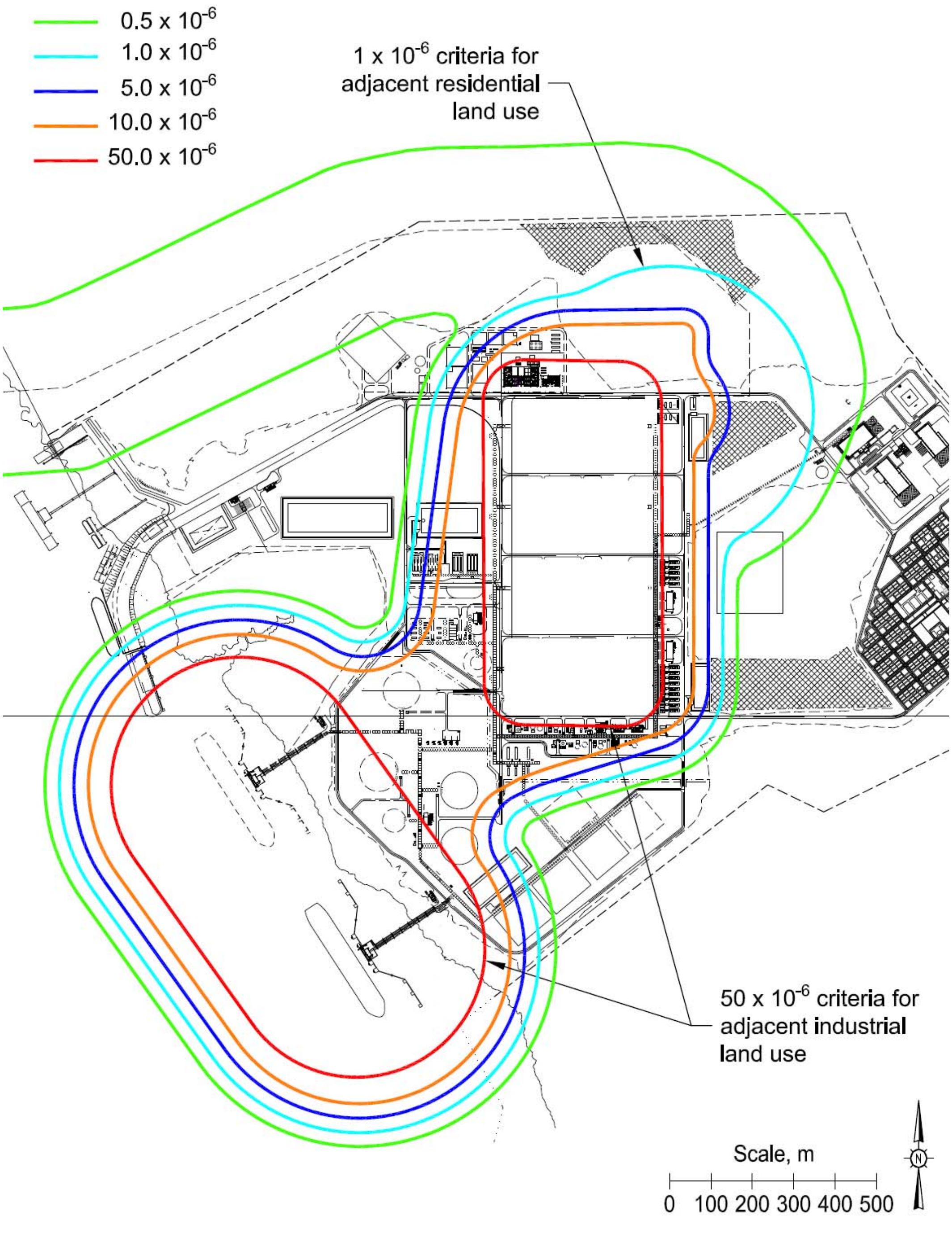

Figure 5-8 Fatality risk contours

5.2 Construction Marine Infrastructure

Aside from the changes to the MOF discussed in Section 4.1, marine infrastructure design that was described in Chapter 3, Volume 4 of the EIS, has been advanced since the EIS was submitted.

To facilitate the early transfer of materials, equipment and personnel to/from the site for construction and operational purposes, a temporary rock dock, a roll-on roll-off dock and a construction ferry dock are required (refer Figure 5-9). These marine facilities will be located to the north of the MOF with access from Fisherman's Landing to the Laird Pt site from around the north of North Passage Island. As a result, additional dredging to that described and assessed in the Gladstone Ports Corporation's (GPC) Western Basin Dredging and Disposal Project's EIS will be required (refer Section 5.3 of this document).

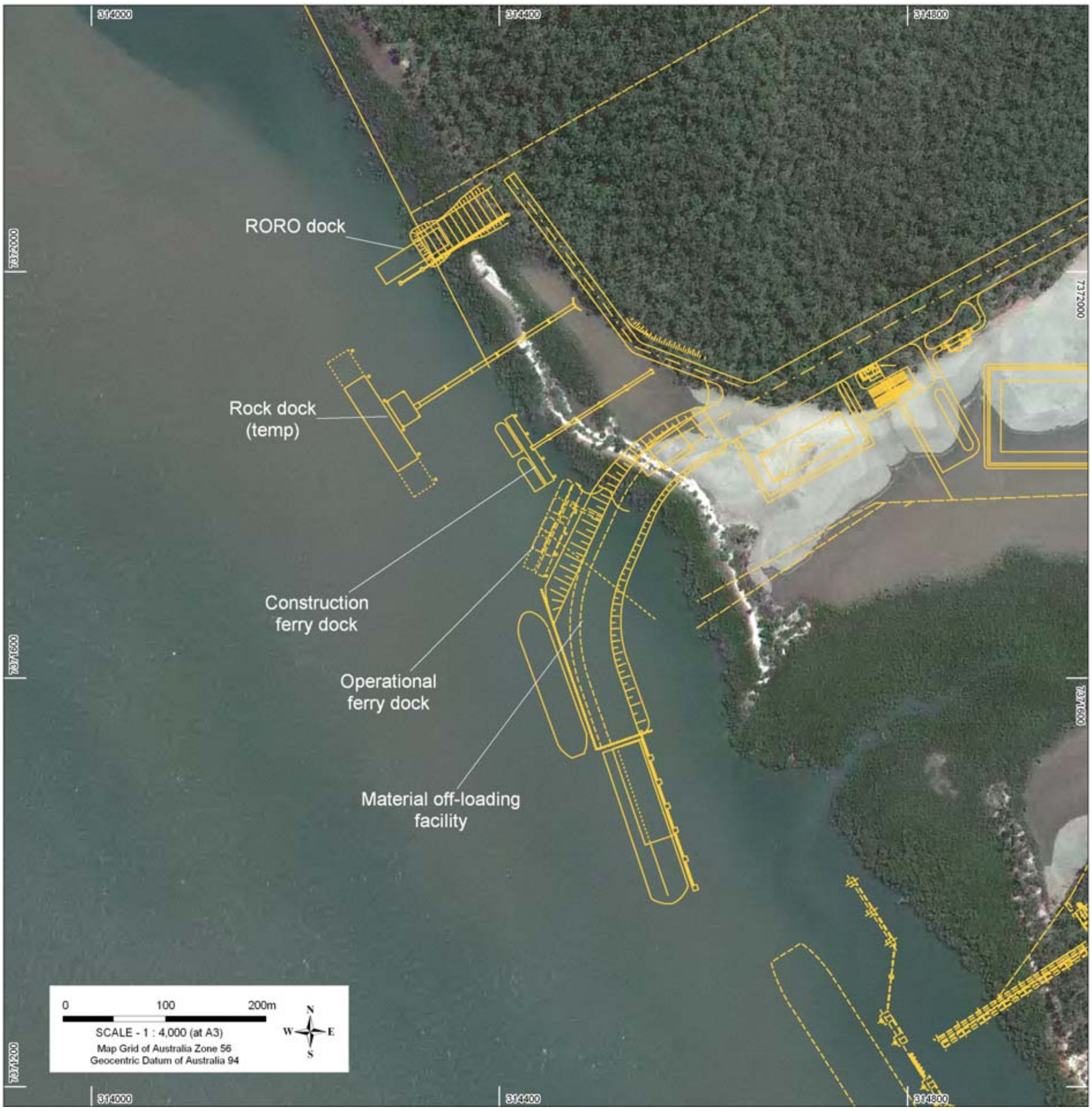

Figure 5-9 Construction marine infrastructure

5.3 Dredging

Dredging will be required for the construction of the revised marine infrastructure, including the rock dock, roll-on roll-off dock, construction ferry dock, MOF, jetty and wharfs, and access to the rock dock, roll-on roll-off dock and construction ferry dock. This dredging has been assessed by Australia Pacific LNG. Most of this dredging work is located to the north of the dredge option 2a footprint and has an estimated approximate volume of 900,000m^3. Australia Pacific LNG is assessing options for minimising the dredging footprint and quantity of dredge material for disposal associated with these marine facilities. Dredging for vessel access to the marine terminal at Fisherman's Landing Northern Expansion will also be required. While these requirements have the effect of increasing dredging associated with the Australia Pacific LNG Project, it is noted that design optimisation activities associated with the main shipping channel and swing basins for the Poject and access to the MOF (assessed in the Western Basin Dredging and Disposal Project's EIS) has reduced quantities of dredge material for the option 2a footprint subsequent to the release of the EIS for the Western Basin Dredging and Disposal Project.

Figure 5-10 illustrates the optimised dredging requirements required for the Australia Pacific LNG Project as well as dredging outlined in the Western Basin Dredging and Disposal Project EIS and includes expected timing.

As discussed in Section 3.1, Volume 4 of the Australia Pacific LNG Project's EIS, dredge material associated with the Australia Pacific LNG Project will be disposed of in a location approved under approval processes by Gladstone Port Corporation, such as that for the Western Basin Dredging and Disposal Project.

Australia Pacific LNG has undertaken sediment characterisation studies of the additional dredge sediment to identify any contamination potential. Sediment contaminant concentrations were assessed against the *National Assessment Guidelines for Dredging* (NAGD) (Commonwealth of Australia 2009) screening levels and Environmental Investigation Levels (EIL) and Health Investigation Levels for residential land use (HIL-A) as detailed in the *Draft Guidelines for the Assessment and Management of Contaminated Land in Queensland* (DEH 1998). Chemical analyses of sediments within the rock dock, roll-on roll-off dock, construction ferry dock, MOF, jetty and jetty berth dredge areas identified that contaminant substances, if present, are generally below NAGD Screening Levels.

In general, the results of this study are consistent with those of previous studies within the area. Based on the analyses undertaken, it is considered that the material to be dredged within these areas is suitable for unconfined placement at sea, according to the NAGD contaminant assessment framework. The material is also suitable for placement on land, according to the DEH (1998) guidelines.

It is anticipated that GPC will undertake this dredging on behalf of Australia Pacific LNG. The disposal of all dredge material within the scope of the Australia Pacific LNG's EIS will be at location(s) approved within GPC's approved projects such as the Western Basin Dredging and Disposal Project.

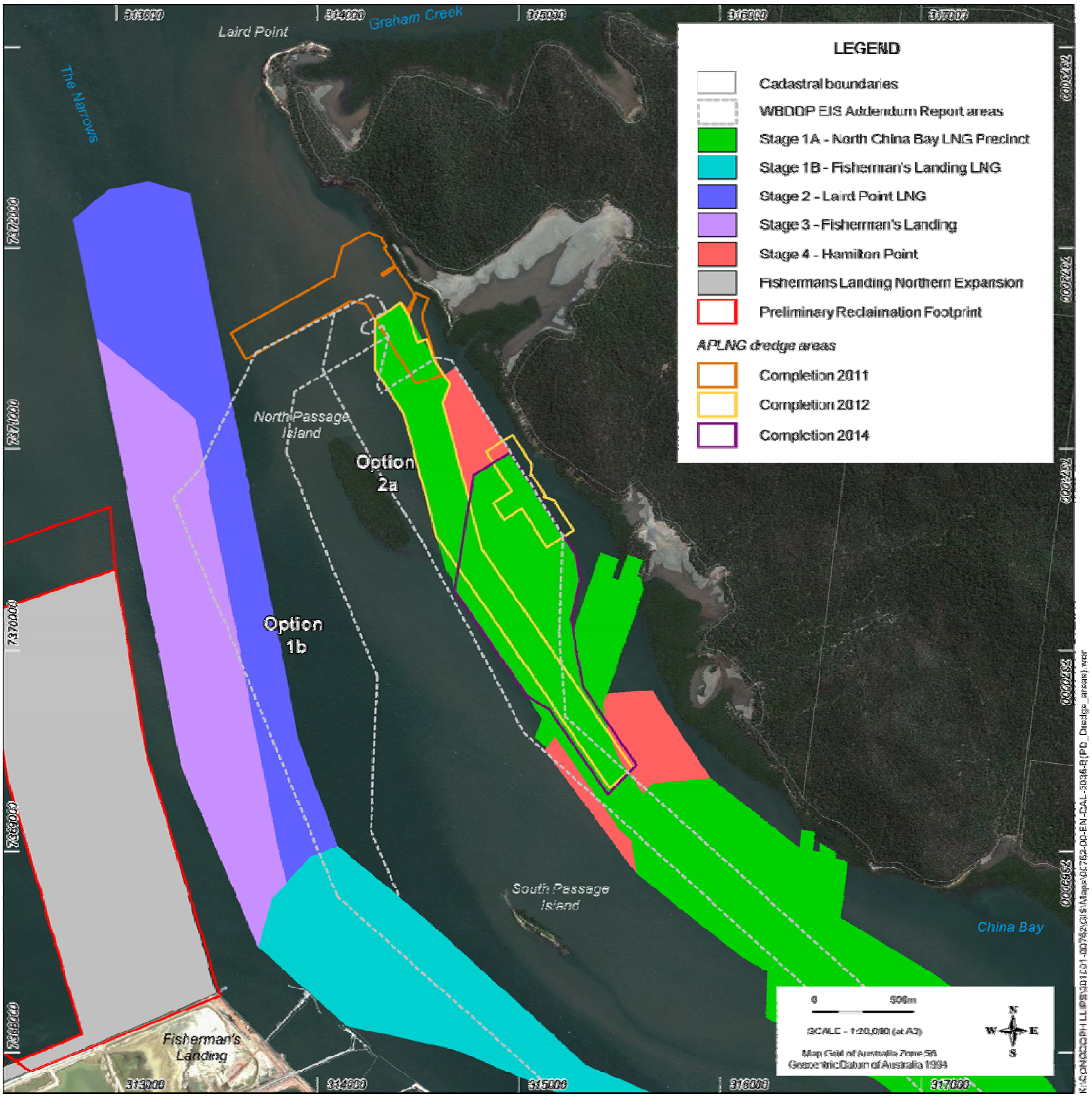

Figure 5-10 Indicative dredge options

Australia Pacific LNG has undertaken coastal modelling to identify the potential impacts from dredging plumes. Results indicate that Total Suspended Solids (TSS) concentrations associated with the dredging for the rock dock, roll-on roll-off dock, construction ferry dock and MOF are not significant. For this dredging, TSS concentrations are characterised by elevated levels on the eastern side of The Narrows' main channel for short durations at low tide. Statistical analysis of the modelled results was undertaken for selected locations at dredging locations and within sensitive seagrass areas. This analysis indicated that the 90th percentile TSS concentrations associated with this dredging would not exceed levels of normal background concentrations. Australia Pacific LNG and will develop mitigation measures in consultation with GPC to minimise potential impacts during dredging operations.

5.4 Mainland Facilities

Volume 4, Chapter 3 Section 3.3.4 of the EIS describes the mainland facilities required to support the construction and operation of the LNG facility and includes a discussion about alternatives. Since submission of the EIS, Australia Pacific LNG has progressed assessment of the mainland site required for temporary construction car parking and offices and selected an alternative to the site described in the EIS. It is proposed that a site on Bensted Road in Gladstone will be developed for car parking facilities, a bus terminal to transport personnel to the mainland marine facilities at Fisherman's Landing, operations' offices and training and hiring facilities.

The design of the marine facilities proposed for Fisherman's Landing (aggregate handling) and Fisherman's Landing Northern Expansion (roll-on roll-off dock, passenger ferry dock) has progressed since the EIS was completed. GPC is progressing the approvals for the construction of the aggregate load out facilities on Fisherman's Landing South (Cell 3).

5.5 Stormwater drainage

For construction of the LNG facility, a temporary stormwater drainage system will direct site runoff to sedimentation ponds. Outfall structures will enable high flows encountered during major storm events to be managed by discharging to Port Curtis after an initial 10 minute diversion.

The increased number of sedimentation ponds will impound most stormwater and be used to manage water quality. The main sedimentation pond will be used to store stormwater to enable its use for dust control, firewater and/or hydrotesting.

The proposed drainage plan for the fully developed LNG facility is provided in Figure 5-11.

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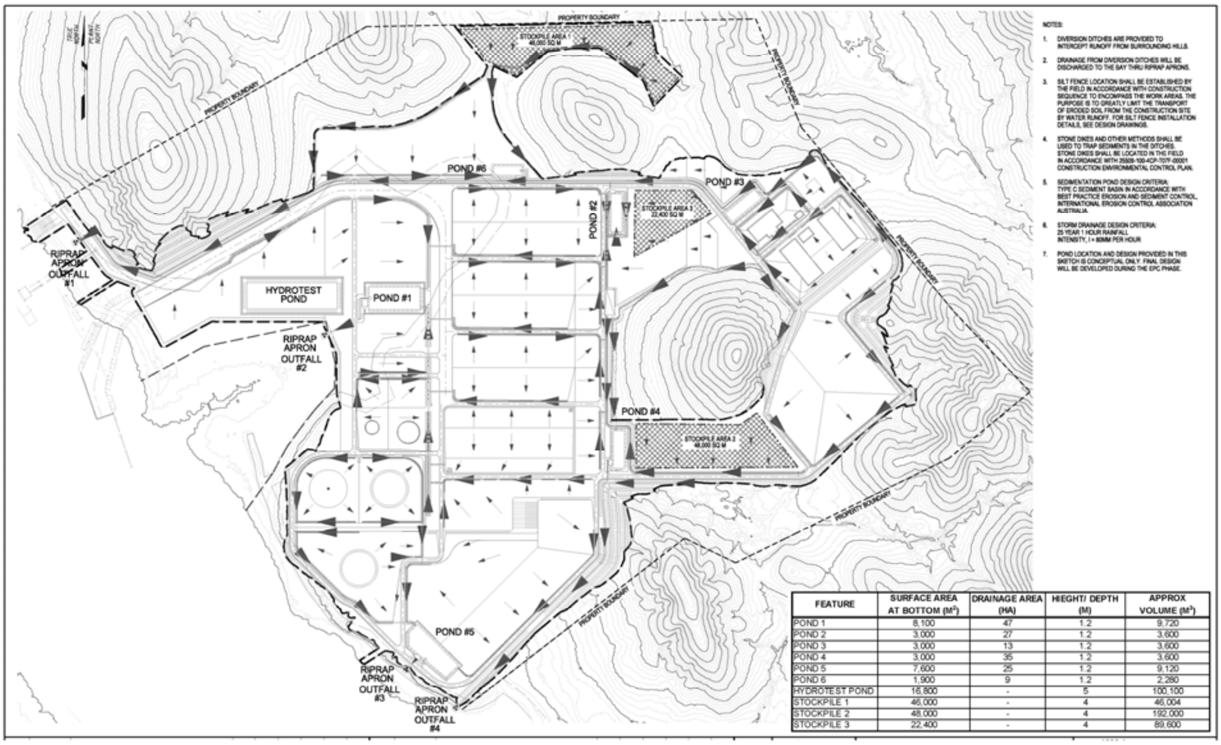

FEATURE	SURFACE AREA AT BOTTOM (M^2)	DRAINAGE AREA (HA)	HIEGHT/ DEPTH (M)	APPROX VOLUME (M^3)
POND 1	8,100	47	1.2	9,720
POND 2	3,000	27	1.2	3,600
POND 3	3,000	13	1.2	3,600
POND 4	3,000	35	1.2	3,600
POND 5	7,600	25	1.2	9,120
POND 6	1,900	9	1.2	2,280
HYDROTEST POND	16,800	-	5	100,100
STOCKPILE 1	46,000	-	4	46,004
STOCKPILE 2	48,000	-	4	192,000
STOCKPILE 3	22,400	-	4	89,600

Figure 5-11 Indicative drainage plan

Stormwater from the undeveloped areas of the site will be diverted around the LNG facility's development area to reduce the quantity of stormwater entering the site. Diversion ditches will intercept stormwater near the LNG facility's site boundaries and carry it directly to the outfalls to Port Curtis.

All storm water entering or falling within the developed area of the site will be classified based on potential for contamination and directed to treatment accordingly.

5.6 Brine and Treated Wastewater Discharges

The revised locations for the discharge of desalination plant brine and treated wastewater are:

- Rock dock during the construction phase
- Product Loading Jetty during the operational phase

Near-field and far-field modelling of the combined discharge of desalination plant brine and treated wastewater has been undertaken for various discharge mixing and flow scenarios to achieve dilutions of discharge concentrations consistent with Water Quality Objectives for Port Curtis. The proportion of brine to wastewater in the discharge was important in determining the density of the discharge, which affects mixing with the receiving waters. A range of discharge scenarios, such as brine only, average brine with average wastewater flow, maximum brine and maximum wastewater flow, were considered so that a worst-case could be established.

Modelling for the construction phase using an appropriate diffuser (indicative design is 20m long with four port openings [diameter of 0.05 m] with the ports discharging in the offshore direction, horizontal

to the bed and perpendicular to the current direction) indicated that a dilution of 1 in 50 within 12.8m of the diffuser could be achieved.

For the operation phase, modelling with an appropriate diffuser (indicative design is 20m long with six port openings (diameter of 0.10m) with the ports discharging in the offshore direction, horizontal to the bed and perpendicular to the current direction) indicated a dilution of 1 in 50 within 7.20m of the diffuser could be achieved in all cases.

Modelling also indicated that dilution of brine in the near-field zone is aided by the addition of treated wastewater.

5.7 Construction Workforce and Accommodation

Through further project development, workforce requirements have been re-evaluated. It is anticipated that construction of the LNG facility will require a peak workforce of approximately 3,300. Australia Pacific LNG continues to work on optimising and refining the size of the workforce. The increased construction workforce will increase the economic and employment benefits of the Project.

In order to mitigate the potential impacts and enhance opportunities associated with this workforce increase, Australia Pacific LNG proposes a number of strategies. To reduce the impact to the housing market, and in acknowledgment of the limited availability of local labour, Australia Pacific LNG proposes to accommodate up to 2,600 workers in the temporary accommodation facility (TAF) on Curtis Island. Figure 5-12 illustrates the proposed layout of the TAF.

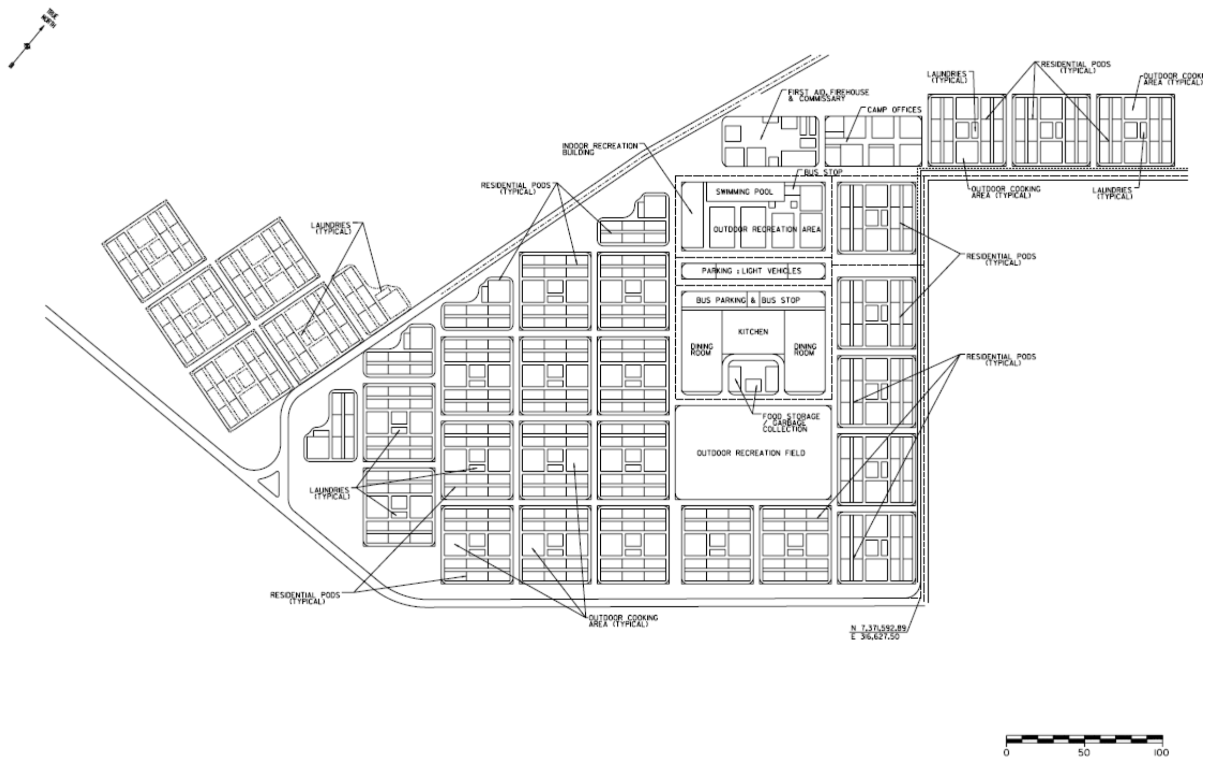

Figure 5-12 Indicative temporary accommodation facility conceptual layout

Australia Pacific LNG has commenced the development of a Housing and Accommodation Strategy to establish the most appropriate methods to accommodate this non-local workforce. The Strategy is designed to mitigate potential impacts on the local housing and rental market, focusing on four key areas: temporary accommodation, permanent accommodation, short-term accommodation and affordable housing.

Since the release of the EIS, Australia Pacific LNG has further developed its strategy for accommodating the non-local workforce prior to construction of the TAF on Curtis Island.

Australia Pacific LNG proposes to accommodate 325 workers in a temporary accommodation facility located on the mainland (for example the facility located in Calliope which has gained preliminary development approval). This will limit the impact to the short-term and permanent accommodation market in Gladstone and will ensure that there is a long-term solution for temporary accommodation for utilisation by other industries.

A permanent accommodation facility for approximately 110 people will also be incorporated into the design of the LNG facility on Curtis Island for emergency situations and will only be used as required.

5.8 Interim Construction Access

Interim access for equipment, material and personnel to the Curtis Island LNG facility site will be required while marine facilities (mainland and on Curtis Island) are being constructed. A multi-user facility in the Gladstone marina (assessment and approval by other parties) will be used as an interim mainland terminal for personnel and equipment transfer. Initial access to the LNG facility site from adjacent properties e.g. Laird Point, will be required because the construction of marine facilities on the Australia Pacific LNG site is contingent on timing of dredging. Interim access plans and construction management plans are being developed based on the following refined construction schedule:

- Dredging to support construction access to the LNG facility site at Laird Point will commence in early 2011
- Construction of LNG train 1 will commence in 2011. Construction of train 2 will commence approximately six months after the commencement of train 1 to take advantage of the workforce and construction equipment already mobilised. The baseline construction schedule for the construction of the first two trains is four years and nine months and it is expected that the trains will be operational after this time
- Dredging required for MOF construction will commence in 2011 with major capital dredging works (included in Western Basin Dredging and Disposal Project) closely following. MOF construction will commence soon after completion of the dredging and will be completed in approximately fifteen months
- Dredging required for construction of the LNG ship jetties will be completed in 2012. Construction of the ship berths will take approximately 28 months
- Construction of train 3 would commence in 2015 and train 4 would commence approximately six months after the commencement of train 3 (as for trains 1 and 2)

5.9 Traffic and Transport

Due to the increased construction workforce and location changes to the mainland facilities, traffic movements (road and marine) and routes may increase and change. Refinements to traffic movements assessed in the Australia Pacific LNG Project EIS include:

- Estimated number of truck movements to the Fisherman's Landing area over the duration of the construction of Train 1 and 2 includes 13,000 for aggregate, 19,000 for road base, 18,000 for structural fill, 7,000 for sand, 3,000 for cement, 1,700 for diesel, 3,700 for construction equipment., 13,000 for plant and 2,300 for waste
- Estimated number of barge movements from the Fisherman's Landing area to Cutis Island over the duration of the construction of Train 1 and 2 includes 83 for aggregate, 125 for road base, 130 for structural fill and 42 for sand
- Estimated number of roll-on roll-off passenger vessel movements from the Fisherman's Landing area to Cutis Island over the duration of the construction of Train 1 and 2 includes 501 for cement, 267 for diesel, 454 for construction equipment, 1236 for plant and 384 for waste
- 27 module barges and 12 ships carrying cargo for construction directly arriving at the LNG facility site on Curtis Island

In accordance to the Coordinator-General's report on the GLNG and QCLNG Projects in relation to traffic and transport cumulative impact study, Australia Pacific LNG will contribute to a Road Transport Infrastructure Cumulative Impacts Study – Proposed LNG Industry Impacts. The most current traffic and transport data will be provided to this cumulative impact study. Australia Pacific LNG will use the most current traffic data in its transport impact assessments necessary to inform road use management plans and infrastructure agreements.