Australia Pacific LNG Project

Volume 3: Gas Pipeline

Chapter 23: Matters of National Environmental Significance

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23. Matters of National Environmental Significance

23.1 Introduction

This chapter assesses the potential impacts of the Australia Pacific LNG Project (the Project) gas transmission pipeline on matters of national environmental significance (MNES). It has been prepared to facilitate the Australian Government's assessment of gas pipeline impacts on MNES under Chapter 4 of the *Environment Protection and Biodiversity Conservation Act 1999 (*EPBC Act).

Origin's commitment, progress and leadership in sustainability were recognised when it received the Ethical Investor Magazine's 'Sustainable Company of the Year' award for 2007. The success of Origin's commitment to the environment in coal seam gas (CSG) was demonstrated publicly through the Australian Petroleum Production and Exploration Association Environmental Award in 2007. The award was for the design and implementation of a reverse osmosis associated water treatment plant at their Spring Gully development. This project was also nominated as a finalist in the Queensland Environmental Protection Agency's Sustainability Awards in 2008. Origin reports annually against the environmental performance of all operations and activities through sustainability and annual reporting (www.originenergy.com.au).

Australia Pacific LNG (formerly Origin Energy CSG Limited) and its subsidiaries hold the tenures for the relevant gas fields. In the past five years, Australia Pacific LNG and its subsidiaries have not been fined or prosecuted for breaches of environmental legislative requirements.The EPBC Act provides for the identification and management of MNES, including threatened flora and fauna species, ecological communities, migratory species protected under international treaties, internationally recognised significant wetlands and critical habitat areas.

On 3 August 2009, the gas pipeline was determined to be a controlled action requiring assessment and approval by the Commonwealth Minister for the Environment, Heritage and the Arts. This decision was based on the referral (EPBC 2209/4976) received under the EPBC Act on 6 July 2009. The relevant controlling provisions under the EPBC Act were identified as:

- World Heritage (sections 12 and 15A)
- National Heritage Places (sections 15B and 15C)
- Listed threatened species and communities (sections 18 and 18A)
- Listed migratory species (sections 20 and 20A).

Australia Pacific LNG lodged two other EPBC Act referrals with the Australian Government Department of the Environment, Water Heritage, and the Arts (DEWHA) relating to the Project as follows:

- EPBC 2009/4974 – Walloons gas fields
- EPBC 2009/4977 – LNG facility and associated facilities.

These matters are addressed in this environment impact statement (EIS), Volumes 2 and 4.

Section 8 of the terms of reference (TOR), prepared by the Queensland Coordinator-General and Commonwealth Government for the Project's EIS, requires that this chapter *'should bring together assessments of impacts on MNES in other chapters, and produce a stand-alone assessment in a format suited for assessment under the EPBC Act*'. This chapter is structured according to Section 8.5 of the TOR, as follows:

- Section 23.1 describes the proposed action (the construction and operation of the gas pipeline), identifies the relevant technical and supporting studies, and outlines of the environmental record of the proponent (the person proposing to take the action)
- Section 23.8 describes the related assessment methodology applied to ensure impacts on MNES are addressed
- Section 23.9 gives an overview of the affected environment, key impact mechanisms and values relevant to the controlling provisions
- Section 23.10 details the assessment of impacts on listed threatened ecological communities and species
- Section 23.11 details the assessment of impacts on listed migratory species
- Section 23.12 discusses wetlands of international importance
- Section 23.13 details the assessment of impacts on World Heritage properties and National Heritage places
- Section 23.14 provides an outline of the environmental management plan (EM Plan), consisting of the key mitigation and management strategies detailed in threatened communities and species and listed migratory species, and those relating to other approvals and conditions
- Section 23.15 summarises the conclusions about impacts to MNES.

23.2 Project description

23.2.1 Project overview

Australia Pacific LNG proposes to develop a world scale 18 million tonnes per annum (mtpa), long-term coal seam gas (CSG) to liquefied natural gas (LNG) project in Queensland.

To supply the required quantity of CSG to support the Project at Gladstone, a series of CSG fields will need to be developed, along with the associated processing facilities. These gas fields and associated facilities will be linked to the proposed LNG facility at Gladstone via a gas pipeline. It will transport dehydrated and compressed CSG from the gas fields to the LNG facility.

The 30 year project being assessed by this EIS will involve:

- Developing the Walloons gas fields, including up to 10,000 CSG wells, in the Surat Basin in Queensland's Western Downs region
- Constructing and operating an LNG facility adjacent to Laird Point, Curtis Island near Gladstone for exporting up to 18 million tonnes of liquefied natural gas each year
- Constructing and operating a 450km underground main gas transmission pipeline (gas pipeline) to connect the Walloons gas fields with the LNG facility on Curtis Island.

This chapter assesses the potential effects of the construction and operation of the gas pipeline on MNES.

23.2.2 Pipeline route

The proposed gas pipeline route was chosen from a number of options, following analysis and investigation by a multi-disciplinary team of engineering, environmental and cultural heritage representatives. Using multi-criteria analysis and further desktop and field investigations, the central 'inland' route was chosen as the preferred option.

The location of the proposed gas pipeline route in relation to the Walloons gas fields and the LNG facility is shown on Figure 23.1, along with the pipeline study area which formed the basis for ecological assessments in the regional context.

The proposed pipeline route includes:

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

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

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

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

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

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

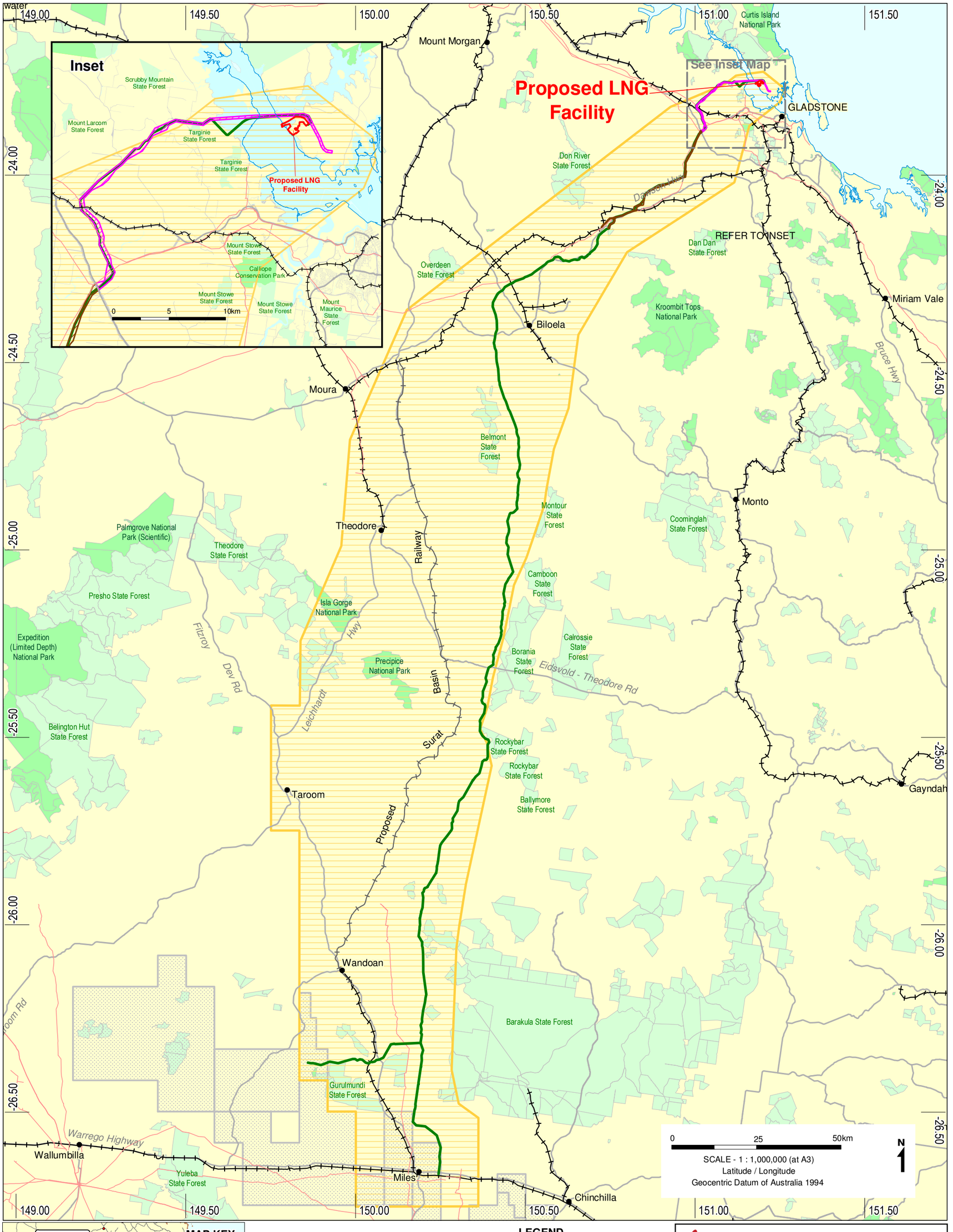
The route then passes to the west of several State forest borders, including Camboon State Forest. It crosses several creeks and gullies, including Silverleaf Gully, Quinns Gully, Big Gully, Braser Gully and Ross Creek.

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

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

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

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



SOURCE INFORMATION

Roads
Department of Main Roads 2009
Preferred Gas Pipeline Alignment
Provided by Origin Energy 03/11/2009
Protected Areas
Department of Environment and Resource Management 2009
Callide Common Infrastructure Corridor
supplied by the client 28/10/2009
Gladstone State Development Area Corridor (GSDAC)
Department of Infrastructure and Planning, Queensland 2009

LEGEND

- Road
- Existing pipeline
- Railway
- Gas pipeline route
- Walloons gas fields development area
- State forest
- APLNG main pipeline study area
- National park
- Callide Common Infrastructure Corridor
- Gladstone State Development Area Corridor

AUSTRALIA PACIFIC LNG PROJECT

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Figure 23.1 Location - gas pipeline route

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The route then crosses the Dawson Highway and the Burnett Highwayand then continues in a north easterly direction across generally flat agricultural land with a consistent elevation of about 250m, crossing Back Creek, Kroombit Creek's west channel, Callide Creek and the old Callide Creek channel.

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

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

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

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

23.2.3 Co-location opportunities

A number of other proponents are currently in the process of gaining environmental approvals for CSG projects, which also involve developing a gas pipeline from the Surat Basin to Curtis Island. During the route selection process, Australia Pacific LNG evaluated the potential to co-locate the pipeline with existing or planned infrastructure projects such as pipelines, roads or railways. The aim was to minimise environmental and landholder impact.

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

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

The following co-location options were also considered:

- The proposed Surat Basin Railway in the mountain range south of Cracow
- With other CSG proponents in the Callide Infrastructure Corridor, starting east of the Callide Mountain Range to the start of the Gladstone State Development Area at the Bruce Highway
- With other CSG proponents within the Gladstone State Development Area, from the Bruce Highway to Curtis Island, including the crossing of The Narrows.

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

Further co-location opportunities will be explored to minimise disruption to landholders and the environment. However, Australia Pacific LNG must also take into account separation distance to

minimise potential external interference threats, restrictions imposed by other existing infrastructure and steep terrain, and adequate space for future developments.

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

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

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

23.2.4 Design basis for the gas pipeline

The design basis for the gas pipeline is outlined in Table 23.1. The pipeline will be buried for the full route, with the pipeline diameter varying between 30 inches and 42 inches (762mm to 1,066.8mm respectively).

Table 23.1 Pipeline design basis

Parameter	Specification			
	Condabri lateral	Woleebee lateral	Main gas pipeline	The Narrows crossing
Length	44km	38km	362km	5km
Design temperature	Maximum: 60ºC Minimum: 10ºC			
Design life	50 years			
Nominal diameter	36inch/914.4mm	30inch/762mm	42inch/1,067mm	42inch/1067mm
Design factor	0.8 (meaning 80% of the specified minimum yield stress is applied to pressure containment)			
Pipeline coating	Three-layer polyethylene or Fusion bonded epoxy (FBE) (FBE may be either single layer or dual layer)			
Internal lining (proposed)	Factory applied epoxy internal lining			
Maximum allowable operating pressure	Up to15.3Mpag			
Cathodic protection	External coating and impressed current cathodic protection			
Indicative depth of cover	Generally – minimum 750mm Residential, cropping and potential cropping – minimum 900mm			

Parameter	Specification			
	Condabri lateral	Woleebee lateral	Main gas pipeline	The Narrows crossing
	Deep ploughing – to be determined in discussion with landowners Road crossings/road reserves – minimum 1200mm Watercourse crossings – minimum 1200mm Railway – minimum 2000mm			
Non destructive testing	Testing of welded joints and hydrostatic pressure testing of the pipeline in accordance with AS2885.			
Buried marker tape	Installed at open cut roads, throughout Heavy Industrial Secondary Land Classification and other risk areas, as defined in the Safety Management Study.			
Pipeline monitoring system	Supervisory Control and Data Acquisition (SCADA) system for remote monitoring and control of all facilities at each end of the pipeline, and also periodic patrolling along the pipeline.			

23.3 Pipeline construction

23.3.1 General construction methods

The construction of the gas pipeline will follow the typical sequence of construction preparation works, right of way establishment, clearing vegetation along an approved construction corridor, delivering pipe to lay-down areas, pipeline trenching, pipeline assembly (welding) and lowering into the trench, backfill and pipeline burial, reinstating the land to the original landform, and testing and commissioning the gas pipeline.

The methodology for determining the gas pipeline's alignment is outlined Volume 3 Chapter 3 – Project description. Chapter 3 also discusses design, construction, operation and rehabilitation of the gas pipeline in detail. The construction methodology will be in accordance with Australian Standard AS2885.

The proposed 40m right of way comprises a total land area of 1,759ha. Additional areas will be required for construction laydown areas and temporary accommodation facilities.

Prior to commencing construction, existing road and railway infrastructure may be upgraded to facilitate the transport of pipe to stockpile areas near the gas pipeline route. Temporary accommodation facilities will be established with communications augmented by existing telecommunication networks. The gas pipeline will require a marine crossing from the mainland to Curtis Island.

The crossing will need to be buried, so a range of construction/installation methods have been considered. It is proposed that establishment of the gas pipeline below The Narrows – the intertidal and marine area between the mainland and Curtis Island – will be by horizontal directional drilling. In the event that horizontal directional drilling is determined not to be feasible, based on final engineering investigations or construction constraints, Australia Pacific LNG would instead use dredging equipment to excavate a trench across the seabed of the Narrows into which the pipeline would be installed. This is discussed in Section 23.3.3.

All disturbed areas including pipe lay down areas, accommodation facility sites or other areas impacted by construction will be reinstated following pipeline installation. Measures will include ripping compacted soil areas, contouring, and re-spreading soil and cleared vegetation.

During operation, the pipeline will be monitored to ensure rehabilitation is maintained. In addition to electronic surveillance systems, helicopter and ground patrols will periodically check the physical integrity of the pipeline in accordance to the relevant codes and standards.

The construction period of the gas pipeline system is expected to take approximately 18 months and is planned to commence around the second quarter of 2012. The gas pipeline itself will be constructed with a total workforce of about 800 people. Additional personnel will be employed in supporting logistics functions, such as the transport and supply of materials and services to the gas pipeline construction effort. All work will be undertaken in compliance with the Australian Pipeline Industry Association's Code of Environmental Practice and Australian Standard AS2885.

Currently, the preferred direction of construction is from south to north. Other factors must also be considered in the final planning of the construction direction. These include weather patterns, logistics of materials transport, and the concurrent construction of other major pipelines in certain areas.

An easement will need to be established on the land during several key construction stages, including clear and grade, trenching and spoil placement (Figure 23.2), stringing, pipeline welding and laying.

A construction EM Plan will address detailed management for issues such as environment, weeds and pests, cultural heritage, health and safety (including onsite emergency aid and medical facilities), waste, water, logistics and traffic, and landholders and community.

Following pipeline establishment, each section of the pipeline will be hydrostatically pressure-tested ('hydro-testing') to establish the leak tightness of the section, and to confirm the pipeline's capability to operate at the maximum allowable operating pressure.



Figure 23.2 Example of pipeline trenching and spoil placement

23.3.2 Watercourse and infrastructure crossings on the mainland

Numerous watercourse crossings will be required for the 450km gas pipeline. Larger watercourse crossings include Calliope River and Cockatoo, Callide, Castle, Bungaban and Dogwood creeks.

Various methods may be used to construct the pipeline across watercourses, roads, railways and other infrastructure. These include open cut, open cut with flow diversion, boring, and horizontal directional drilling (HDD).

The selected watercourse crossing design and methods will address:

- Pipeline diameter
- Watercourse width, depth and flow
- Environmental sensitivity considerations
- Cultural heritage
- Geotechnical and stability considerations
- Substrate composition
- Hydrological data
- Engineering constraints
- Landowner issues
- Downstream users
- Regulatory requirements
- Available working space
- Economics.

The type of construction method for each crossing will be determined during further design and field inspections. Temporary vehicle crossings may also be constructed to allow construction vehicles to cross minor watercourses. Watercourse crossings will be completed within the shortest period practicable, to minimise the construction period and subsequent environmental disturbance. Small to moderate watercourse crossings would typically be completed within 24 hours.

23.3.3 The Narrows and associated intertidal wetlands crossing

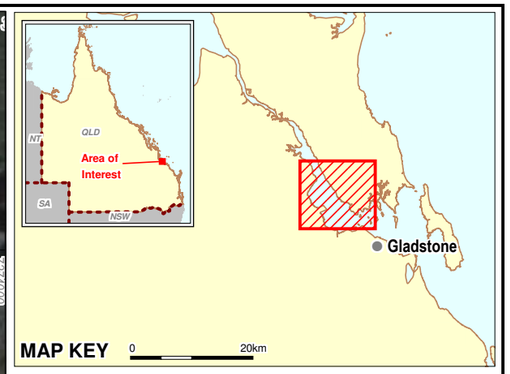
The strait between the mainland at Friend Point and Laird point on Curtis Island is called The Narrows. The Narrows crossing has two distinct sections. The first is the intertidal flats or 'marshland' on the mainland and a short section on Curtis Island.

The second is the open water section, which is The Narrows itself. Both sections will be crossed by different but interrelated methods, tailored for the respective environments. Figure 23.3 indicates the location of the proposed gas pipeline route in relation to The Narrows.

There are a number of scenarios proposed for crossing The Narrows. The Project's EIS is based on a standalone preferred option of crossing The Narrows using horizontal directional drilling (HDD). In the event that HDD is determined not to be feasible, based on final engineering investigations or construction constraints, Australia Pacific LNG would instead use dredging equipment to excavate a trench across the seabed of the Narrows into which the pipeline would be installed.

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LEGEND

- Gas pipeline route
- LNG facility
- LNG facility development footprint

Source Information

Satellite imagery
captured by GeoEye-1 on 24 March 2009

Transects
collected by Worley Parsons, November 2009

Development footprint
digitised from Conceptual Site Plan 25509-100-P1-000-10005.dgn
supplied by client 24/07/2009

Gas pipeline route
supplied by Origin Energy on 03/11/2009

AUSTRALIA PACIFIC LNG PROJECT

Volume 3 Chapter 23
Figure 23.3 Location of pipeline at the Narrows

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The Queensland Government and CSG to LNG proponents are in discussions regarding a 'bundled' approach for The Narrows. This would involve a joint installation of several pipelines constructed as a bundled single crossing. All pipelines would be installed at one time, in a common trench dredged across the Narrows and then backfilled.

A summary of these methodologies are described below and additional information relating to the crossings may be found in Volume 3 Chapter 12 – Coastal environment and Volume 3 Chapter 10 – Marine ecology.

Horizontal directional drilling method

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

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

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

Depending upon the length of the crossing and subsurface soil type, HDD can take anywhere between a few days to several weeks to complete. It usually requires continuous operation of the rig to prevent collapse of the drilled hole. Figure 23.4 is an example of HDD under a watercourse.

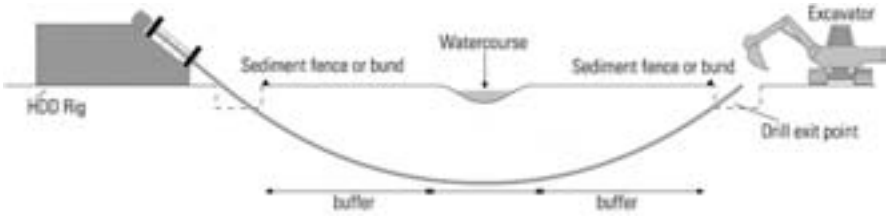


Figure 23.4 A horizontal directional drilling cross section illustration

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

Key equipment involved in an HDD would include:

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

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

A pipe is installed in this smaller hole to allow more efficient management of the mud, after the main hole exits at the other end.

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

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

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

HDD crossing of The Narrows

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

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

Either approach is considered feasible. The final site selection for the HDD rig will be made following additional site investigations and discussions with selected contractors. Figure 23.5 shows the proposed HDD crossing location, including entry and exit points.

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

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

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

- Coordination with other proponents
- Pipe transport and handling
- Location and development of temporary construction sites and associated temporary marine infrastructure

- Equipment and resources required
- Volume of materials
- Duration and staging
- Details of any proposed marine flora and fauna protection measures.

Drilling will be conducted by a specialist contractor and is expected to take several months of continuous operation. In the event of unexpected conditions being encountered during drilling, repeat attempts may be required to complete the drilling.

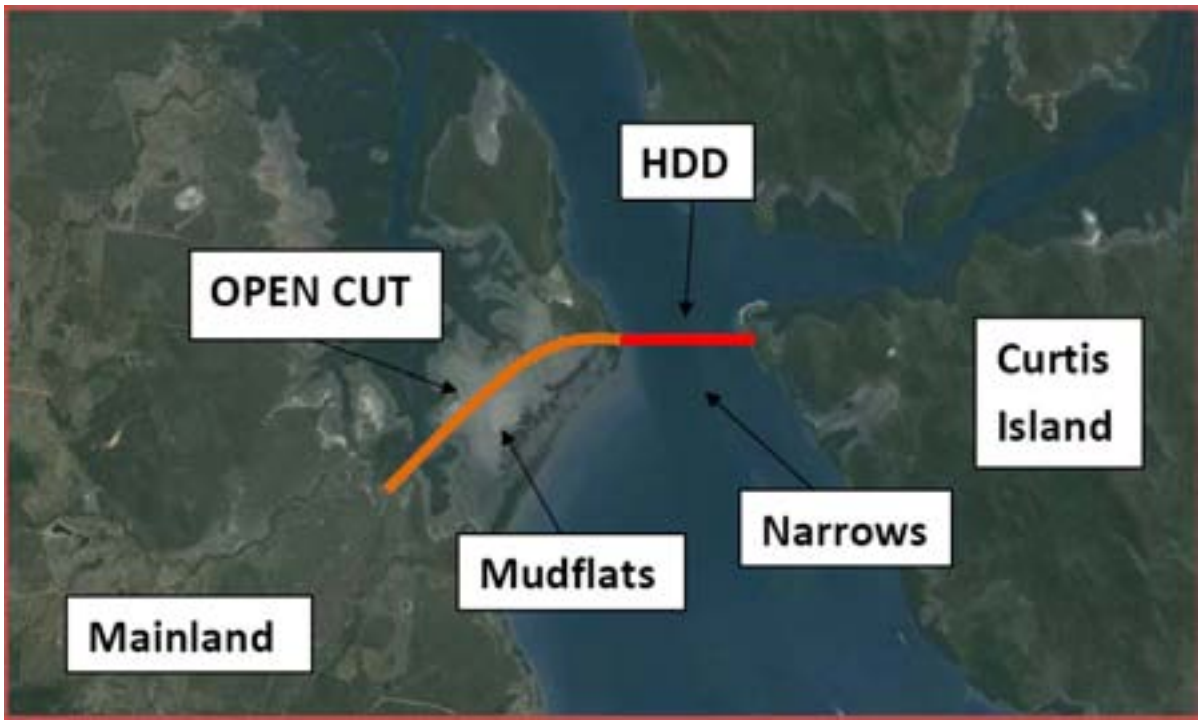


Figure 23.5 Indicative location of The Narrows crossing

Conventional dredged crossing of The Narrows

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

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

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

The trench for the crossing would be excavated by conventional dredging vessels to an appropriate size for the Australia Pacific LNG gas pipeline. Dredged spoil material would be deposited at Fisherman's Landing as part of the Gladstone Ports Corporation Port Expansion project. Approximate

volumes of material which would be dredged in this manner are detailed in Volume 3 Chapter 12 – Coastal environment. A discussion of the proposed areas for excavation by dredging and for placement of the spoil material is in Volume 3 Chapter 10 – Marine ecology.

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

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

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

Crossing of intertidal flats

It is proposed that the gas pipeline across the mud flats to the west of The Narrows be installed in an excavated trench. Excavation in muddy conditions requires a wide trench with sloped sides to prevent trench collapse.

Alternatively, the volume of material to be excavated may be minimised by installing parallel rows of sheet piles driven along the proposed trench line. The trench would be dug between the rows of sheet piling using low ground pressure excavators, working from a temporary construction access way built on top of the existing mudflats. In either case, spoil will be stockpiled on one side of the trench, while the other side will be used as the working side.

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

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

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

After treatment following procedures for managing acid sulfate soils, the spoil would be placed back over the pipeline to generally match the original landform. After pipeline installation, sheet piling and any other construction materials will be removed from the mudflats. It is anticipated that this installation will require between nine and 12 months to complete.

23.4 Rehabilitation of the construction corridor

The construction right of way will be re-contoured to match the surrounding land as soon as practicable after pipe laying and backfilling. Erosion controls will be constructed or installed, where necessary.

The right of way surface will usually be lightly scarified before spreading the topsoil, to promote vegetation regrowth and protect against the topsoil loss. Topsoil will be respread evenly across the disturbed area followed by mulched vegetation from separated stockpiles. This will assist in soil retention and provide seed stock. Rehabilitation will ensure that:

- Topsoil cover is re-established, and all land and waterways disturbed by project activities are returned to a stable condition as soon as possible after construction
- Land is returned to its previous productive use
- Stable landforms are re-established to original topographic contours
- Erosion control measures such as contour banks are installed in erosion prone areas.

Seed spreading may be carried out in areas at risk of erosion or in densely vegetated watercourses to enhance natural regeneration. Pipeline markers will be installed at intervals along the gas pipeline, in accordance with Australian Standard AS2885.

23.5 Operation and maintenance

Commissioning, operating and maintaining the gas pipeline will follow Australian Standard AS2885, Part 3. It will be operating continuously. The buried steel pipeline and associated stations will be monitored through a Supervisory Control and Data Acquisition (SCADA) system for operating parameters, equipment status and control. Selected equipment will be remotely controlled via the SCADA system.

A pipeline safety and operating plan and pipeline integrity management system will be developed during the project design stages to address ongoing environmental management commitments and requirements.

23.6 Decommissioning

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

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

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

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

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

23.7 Relevant technical and supporting studies

Information about potential MNES impacts associated with the gas pipeline was derived from the following technical and supporting studies commissioned for this EIS:

- **The Australia Pacific LNG Project – Gas transmission pipeline terrestrial ecology assessment**, undertaken by WorleyParsons for Australia Pacific LNG Project

  This study is available in Volume 5 Attachment 15, and includes a desktop review of existing data and field investigations of the proposed gas pipeline route. The desktop review identifies the key terrestrial flora and fauna values of the wider gas pipeline study area, a 10km wide corridor along the proposed route alignment. The report discusses the potential impacts and recommended mitigation measures for the threatened and endangered communities and species, including those listed under the EPBC Act

- **Aquatic Ecology, Water Quality and Geomorphology Impact Assessment – Gas Transmission Pipeline**, undertaken by Hydrobiology for Australia Pacific LNG Project (Upstream)

  This study is available in Volume 5 Attachment 15. It describess the existing environment and provided an assessment of potential impacts associated with the gas pipeline element of the Project on aquatic ecology, water quality and geomorphology. This includes consideration of potential MNES impacts

- **Australia Pacific LNG Main Transmission Pipeline- Marine Ecology**, undertaken by WorleyParsons for Australia Pacific LNG Project

  This study is available in Volume 5 Attachment 19. It describes the existing conditions and values of the marine environment in the vicinity of The Narrows, the potential effects of the proposed pipeline crossing of the marine environment and management measures necessary to mitigate potential adverse impacts on these values

- **Australia Pacific LNG Main Transmission Pipeline – Indigenous heritage**, undertaken by Heritage Consulting Australia Pty Ltd (HCA) for Australia Pacific LNG Project

  This study is available in Volume 5 Attachment 37. It considers the legislative requirements in relation to Indigenous cultural heritage and reviewed known Indigenous heritage and history along the gas pipeline route. The assessment is based on a list of registered sites provided within the 10km wide study area and an evaluation of potential risks posed by gas pipeline construction

- **Australia Pacific LNG Pipeline – Non-indigenous Heritage**, undertaken by Heritage Consulting Australia Pty Ltd (HCA) for Australia Pacific LNG Project

  This study is available in Volume 5 Attachment 40. It assesses the non-Indigenous heritage and post-contact landuse history of the proposed Australia Pacific LNG gas pipeline. The report documents the registered heritage places and potentially significant site locations in and around

the study area. It recommends measures to mitigate any impacts that might result from constructing the gas pipeline element of the Project.

23.8 Methodology for assessment of MNES

The assessment of potential MNES impacts relating to the gas pipeline involved the following studies:

Terrestrial ecology

This included desktop reviews of relevant literature and existing data, along with field reconnaissance surveys to identify locations within the gas pipeline study area likely to contain important ecological and cultural values of relevance to MNES. It also identified suitable sampling points for collection of additional data needed to assess potential impacts. Desktop research undertaken included searches utilising the EPBC Protected Matters Search Report, the QLD Herbarium HERBRECS Flora Collection Records, Department of Environment and Resource Management (DERM) Wildlife Online Database, Birds Australia database, Queensland Museum Fauna Collection Records, and Australian Heritage Places Inventory.

To identify vegetation patterns and key investigation areas and gain an appreciation of the proximity of the proposed project area to sensitive areas, the desktop assessments included reviews of satellite imagery, the DERM Regional Ecosystem (RE) (Version 5.0) and Regulated Regrowth Vegetation mapping (Version 1.0) and the RE description database (Version 6.0b November 2009). In addition, the DERM Essential Habitat, Queensland Wetland and Environmentally Sensitive Area mapping and Directory of Important Wetlands database were reviewed to identify important environmental values including any nationally important wetlands within the wider study area.

Terrestrial field surveys were conducted during two separate periods in 2009, from 26 September to 6 October, and 15 October to 30 October. This included an investigation of the presence/absence or likely presence/absence of EPBC-listed flora and fauna species and communities identified from the desktop assessment. Ground-truthing surveys were undertaken at 143 sites. Opportunistic significant species surveys were undertaken during ground-truthing exercises to identify populations and potential habitat areas within the study area

Aquatic ecology

This involved sampling waterbodies during field deployments from late June through to early October 2009. Additional sampling sites were selected based on habitat features, accessibility and availability of water. Representative examples of stream types, habitats and ecological features were selected to enable assessment of a range of potential aquatic impacts along the proposed gas pipeline route. Reference sites were also chosen, where possible.

Most waterways along the gas pipeline route were ephemeral and a number of sites were dry during sampling. Where water was present, sampling was generally confined to small (non-flowing) pools. A notable exception was a site on Cockatoo Creek, which is a spring fed stream. Sampling site locations are provided in Volume 5 Attachment 18. Each site (where site access was granted) was surveyed once for aquatic ecology, once for geomorphology and twice for water quality. Details of the sampling program and methods are provided in Volume 5 Attachment 18.

Marine ecology

This study assessed and analysed peer-reviewed literature, augmented with field observations. Field investigations of the habitats within the proposed development footprint were undertaken during June

2009. An Outland Technology Inc. video and video recording system was used at selected sites along the proposed gas pipeline route to provide visual information on typical seabed features along the crossing of The Narrows. Intertidal areas were visually inspected.

Cultural heritage

Field investigations were conducted in the vicinity of Miles, Cracow, Biloela, Callide Range, Mount Alma, Targinie, Friend Point and Curtis Island. In addition, consultation was undertaken with long-term residents involved in the collection of, and involvement with local history. Representatives of organisations charged with protecting heritage sites were also consulted including Regional Council officers and the National Trust of Queensland. This provided valuable insights into the listed sites along the route.

Interpretation and integration of existing scientific knowledge (e.g. contained in databases and published research), field survey outcomes and habitat preference analysis was then undertaken to identify and document likely impacts on MNES, such as EPBC Act-listed species and communities.

This involved documenting analysis in terms of the significant impact criteria (provided in DEWHA's Significant Impact Guidelines) relevant to potential MNES impacts of the Project. Species for which potential habitat was found to be present were analysed based upon the known ecology of each species.

23.9 Overview of affected environment, impacts and values

This section outlines the affected environment, impact mechanisms and values relevant to the controlling provisions. Terrestrial, freshwater aquatic and marine environments are discussed, along with cultural heritage.

23.9.1 Terrestrial environment

The gas pipeline will be almost entirely located within the Brigalow Belt South bioregion. The Brigalow Belt spans inland and eastern Queensland from Townsville in the north, to northern New South Wales. It covers an area of about six million hectares. Only about 2% of the Brigalow Belt is protected in conservation reserves. Most of this bioregion is used for agriculture, particularly cattle grazing in the rangelands.

The major threat to Brigalow Belt ecological communities is considered to be clearing or severe modification of vegetation, because much of the landscape is eminently suitable for agriculture. Most of the natural vegetation has been cleared since the 1960s. Many of the Brigalow remnants are in marginal habitats such as steep, rocky slopes, or are in poor condition and highly degraded.

In this context, the potential pre-mitigation impacts of the gas pipeline on MNES in the terrestrial environment include:

- **Direct effects** – direct loss of extent and distribution of ecological communities, habitats and items of cultural heritage.
- **Indirect effects** – including dust and litter, fragmentation of remnants, introduction or spreading of weeds, root compaction and increased damage along pipeline alignment edges.

Indirect effects on ecological communities, flora species and fauna habitat are likely to include increased localised areas of compaction through the use of heavy machinery, fragmentation of remnants, increased edge effects and damage along the existing edges caused by machinery, dust and litter and increased local disturbances through the creation of access tracks. If unmanaged, edge

effects and fragmentation can increase the prevalence of weed species in the vegetation adjacent to the right of way. This is due to canopy clearance, altered runoff patterns and increased exposure to foreign material carried into the study area on machinery and equipment. The levels of indirect impact will vary throughout the life of the proposed gas pipeline and are likely to be highest during the construction stage.

The construction of the proposed 40m alignment right of way will disturb a total area of 1,759ha. Of this, approximately 433ha or 24.6% is considered remnant vegetation as mapped by the Queensland Herbarium under the Regional Ecosystem mapping program. Therefore, 75.4% of the right of way does not contain any remnant vegetation, and clearing of remnant vegetation along the proposed alignment represents approximately 0.26 % of remnant vegetation estimated to occur within the wider study area (10km corridor). In addition, approximately 417ha of the 433ha of remnant vegetation is classed as a not-of-concern regional ecosystem (RE) which does not correspond with any threatened ecological communities (TECs). The remaining endangered and of concern REs total less than 16ha. Of this, only 1.86ha involve four endangered REs that correspond to two EPBC Act-listed TECs. Disturbance will also include clearing construction lay-down areas, temporary accommodation facilities and associated infrastructure. However, such facilities are expected to be located primarily within existing cleared areas.

The low levels of clearing required to establish the gas pipeline reflect the approach to route selection. This approach has ensured that the pipeline alignment minimises potential for impacts on large and connected areas of vegetation, and therefore on MNES-listed communities and habitats for MNES-listed flora and fauna species.

Where vegetation clearing is necessary to enable gas pipeline construction, the impacts may involve:

- Removing habitat such as mature vegetation, hollow-bearing trees and fallen logs, and therefore loss of shelter, breeding, nesting, perching and foraging resources for any present MNES-listed fauna species
- Disturbing rocky outcrops, and therefore shelter for reptiles and small mammals
- Disturbing fauna movement corridors and dry season fauna refuges (predominantly associated with creeks and seasonal wetland/waterway areas)
- Unearthing burrowing fauna species during construction
- Creating the potential for fauna to fall into, and become trapped in the open pipeline trench during construction (trenchfall).

No additional impacts are expected to occur during the operational phase of the gas pipeline largely because the pipeline is underground.

The assessment detailed in Section 23.10.2 indicates that 23 EPBC-listed flora species are present or are likely or possibly present (based on habitat preferences) in the right of way. The assessment detailed in Section 23.10.3 also indicates that 16 EPBC-listed-fauna species are present or are likely or possibly present.

In addition, the assessment in Section 23.11.2 indicates that 11 terrestrial migratory bird species are present or likely to be present in the right of way. This is in addition to the 30 migratory shorebird species present or predicted to be present as assessed in Section 23.11.1.

23.9.2 Freshwater aquatic environment

Waterways and aquatic ecological communities within the Dawson and Calliope catchments could be impacted during the construction of the gas pipeline, access roads and associated infrastructure. Sediment mobilisation is the main impact mechanism with the potential to affect the aquatic environment during this phase. This can occur through clearing vegetation adjacent to waterways, and bank or bed excavation. However, other impacts may also present a significant risk to aquatic biota, such as accidental chemical spillages, effluent generated from temporary accommodation facilities, and direct removal of aquatic flora and fauna through excavation.

The potential operational impacts on freshwater aquatic ecological communities include sediment mobilisation and erosion from exposed areas (road and pipeline crossings), accidental spillages, and altered low flow hydrology associated with road crossings. The assessment detailed in section 23.10.4 indicates that there are no EPBC Act-listed fish or macroinvertebrates species in waterways traversed by the gas pipeline.

The only freshwater wetlands of national importance known to occur in the vicinity of the gas pipeline corridor are the Great Artesian Basin (GAB) spring wetlands. These occur on the outer edge of the GAB in Queensland, NSW and South Australia. The communities of native species dependent on the natural discharge of groundwater from the GAB are listed as an endangered community under the EPBC Act 1999. Of these, two species of plant (artesian milfoil and salt pipewort) are known to occur within the Springsure Supergroup (DEWHA 2010b). Both of these species are known to occur in Cockatoo Creek, which will be traversed by the gas pipeline.

No other EPBC-Act significant macrophytes are likely to be present in the waterways traversed by the gas pipeline.

23.9.3 Marine environment

The gas pipeline will traverse a small part of the Great Barrier Reef World Heritage Area when it crosses the Narrows, the marine environment between the mainland and Curtis Island. The World Heritage values of the Great Barrier Reef are detailed in Volume 5 Attachment 19.

The gas pipeline will cross from the mainland near Friend Point to the west coast of Curtis Island near Laird Point. This is at the start of The Narrows, a 20,903ha passage separating Curtis Island from the mainland and one of only five tidal passages within Australia. The proposed location of the pipeline crossing is within Gladstone Port limits, but also within the Great Barrier Reef World Heritage Area.

The Port Curtis region contains extensive wetland habitats including saltmarsh, saltpan and mangroves, and extensive seagrass beds. These habitats support species of conservation significance such as dugong and marine turtles. Intertidal vegetation communities at The Narrows are shown on Figure 23.6. The Port Curtis region, including the proposed location of the pipeline crossing, is within a Dugong Protection Area. Various species of marine turtles also forage in these seagrass and bare sedimentary habitats. The endemic flatback turtle nests on the eastern beaches of Curtis Island near the township of South End.

The assessment detailed in Section 23.11.3 indicates that nine EPBC-listed vulnerable and/or migratory marine fauna species (excluding birds) are present, or are likely to be present based on habitat preferences, in the vicinity of the gas pipeline crossing of The Narrows. In addition, 30 migratory shorebird species are present or predicted to be present. The Narrows is zoned as a habitat protection zone, with the southern boundary of this zone forming a straight line across The Narrows at latitude 23°45.000'.

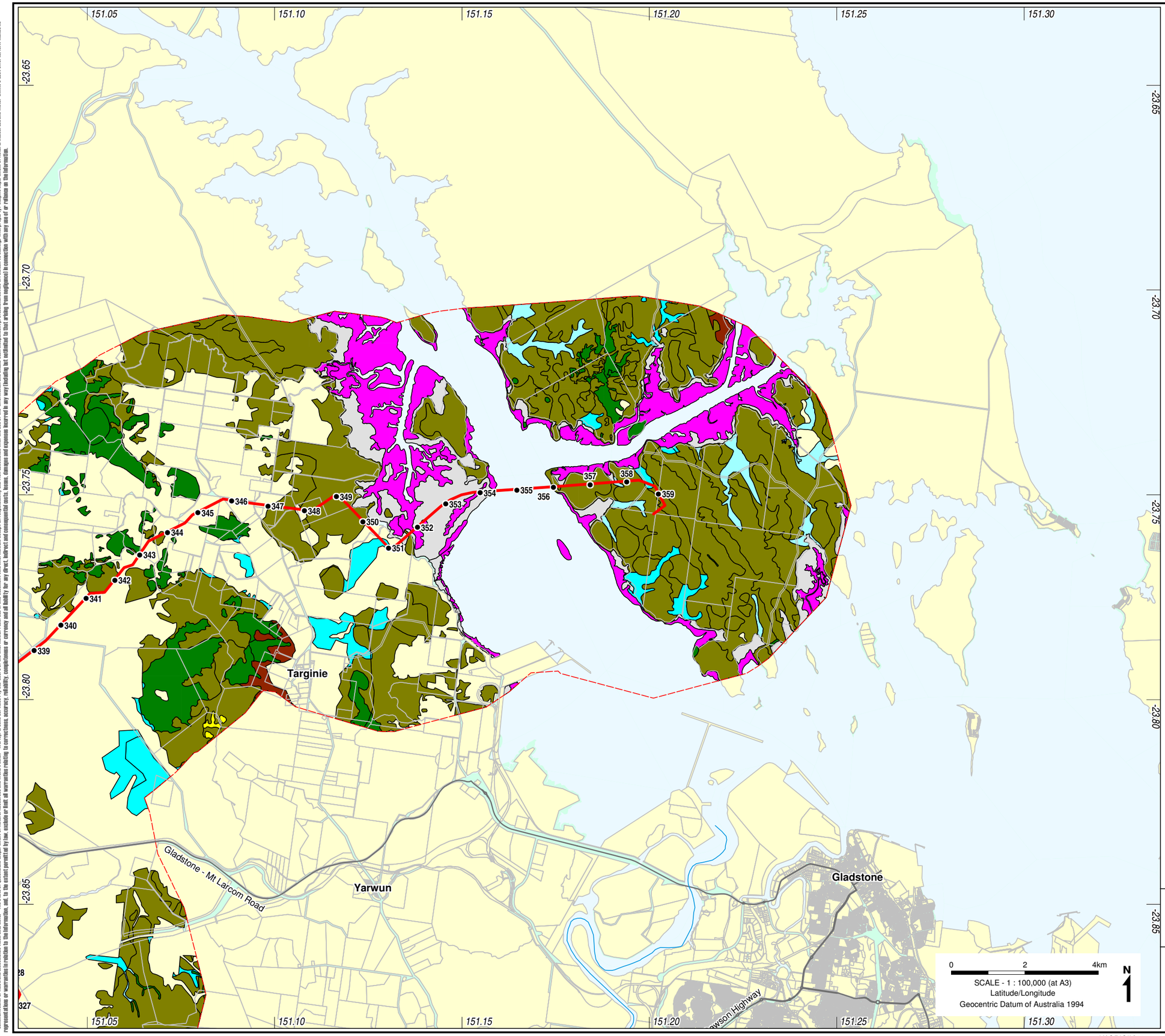
Ramsar wetlands are sites which have been determined to be significant under the Ramsar Convention on wetlands of International Importance, There are no Ramsar wetlands within or adjacent to the proposed gas pipeline route. The closest Ramsar wetlands are Corio Bay and Shoalwater Bay, which are approximately 150km north of the site. The wetlands at Laird Point (on Curtis Island) and Friend Point (on the mainland) are within the Port Curtis and The Narrows Nationally Important Wetlands (QLD019 and QLD021 respectively).

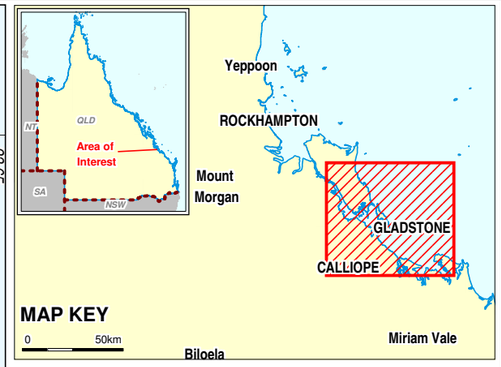
Depending on the construction techniques used (Section 23.3.3), the following impacting processes may affect the marine environment:

- Disturbance such as fragmentation of the mangrove and wetland areas during gas pipeline construction across the intertidal area
- Underwater noise generated by drilling or dredging activities to establish the horizontal directionally drilled pipeline
- Loss of drilling fluid directly or indirectly into the marine environment
- Disturbance of the subtidal seabed at any dredge locations

Creation of a turbid plume that will disperse into the broader Port Curtis marine environment.

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LEGEND

- Major drainage
- Road
- Railway
- Cadastral parcel

Proposed Infrastructure

- KP010 Kilometre point
- Gas pipleine route
- Gas pipeline corridor

Faunal Habitat

- Riparian woodland
- Saltpan
- Ironbark woodland
- Floodplain eucalypt woodland
- She-oak woodland
- Shrubland
- Mangroves
- Mixed Eucalypt woodland & open forest

Source Information

Cadastre and easements
Department of Natural Resources and Water, Queensland 2009

Faunal Habitat
Created by WorleyParsons November 2009 based on Survey and mapping of Pre-clearing Vegetation communities and Regional Ecosystems of Queensland, Version 5.0 and Survey and Mapping of 2003 Remnant Vegetation Communities and Regional Ecosystems of Queensland, Version 5 © The State of Queensland, Environmental Protection Agency 2009

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Figure 23.6 Intertidal vegetation at The Narrows

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23.9.4 Cultural heritage

A review of the Australian Heritage Places Inventory indicates that there are no items with strictly Indigenous heritage values recorded on the world, national or Commonwealth heritage lists or the Register of the National Estate within the gas pipeline study area.

While the Great Barrier Reef Marine Park was listed as a national and world heritage area primarily on the basis of its natural heritage values, Indigenous heritage values are recognised in its listing and management. As part of its management activities, the Great Barrier Reef Marine Park Authority consults with Traditional Owners, recognised Native Title claimants and Aboriginal representative bodies to ensure that Indigenous heritage values are retained within the Marine Park.

Any potential impacts to Indigenous and non-indigenous cultural heritage sites will be addressed in the cultural heritage management plans required under State legislation. These are currently being negotiated with Aboriginal parties who have an interest in land and sites along the gas pipeline route. Under the terms of these management plans, site protection and impact management will be undertaken prior to construction commencing.

23.10 Threatened communities and species

23.10.1 Threatened ecological communities

Three threatened ecological communities (TECs) listed under the EPBC Act were identified by the EPBC protected matters search. These are all endangered, and include:

- Brigalow (Acacia harpophylla dominant and co-dominant)
- Semi-evergreen vine thickets (SEVT) of the Brigalow Belt (North and South) and Nandewar bioregions
- Weeping myall woodlands.

Within the gas pipeline route, four regional ecosystems (REs 11.9.1, 11.9.5, 11.9.6 and 11.12.21) are analogous to brigalow (*Acacia harpophylla* dominant and co-dominant), one RE (11.11.18) is analogous to semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions, and one RE (11.3.2) where the tree canopy is at least half dominated by living, dead or defoliated weeping myall (*Acacia pendula*) trees.is considered analogous to weeping myall woodlands. These TECs are shown on Figure 23.7 a-c. Note that in the case of RE 11.3.2, no areas containing weeping myall woodlands were observed within the gas pipeline route.

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Roma Taroom Road

HORSE CREEK (EAST BRANCH)

WOLEEBEE CREEK

JUANDAH CREEK

Wandoan

Wandoan Road

Jackson

TCHANNING CREEK

Leichhardt Highway

DOGWOOD CREEK

Auburn Road

YULEBA CREEK

Warrego Highway

Miles

Chinchilla

DULACCA CREEK

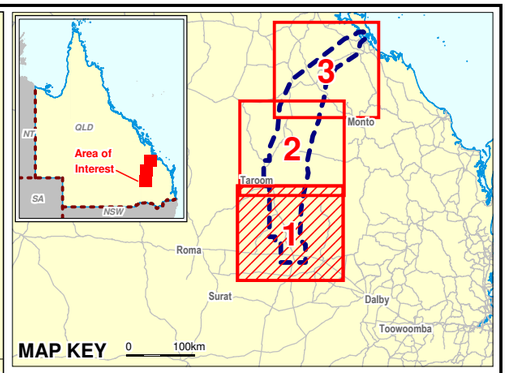
RLEYS CREEK

Warrego Highway

DOGWOOD CREEK

Roma - Condamine Road

Kogan Condamine Road



LEGEND

Major drainage
Road
Railway

Proposed Infrastructure

Gas pipeline route
Gas pipeline study area

EPBC - listed threatened ecological communities

Semi-evergreen Vine Thickets of the Brigalow Belt (North and South) and Nandewar Bioregions

Dominant
Sub-dominant

Brigalow (Acacia harpophylla dominant and co-dominant)

Dominant
Sub-dominant

Weeping Myall Woodlands

Dominant
Sub-dominant

Central Highlands Natural Grasslands

Dominant
Sub-dominant

Source Information

EPBC - listed threatened ecological communities
Created by WorleyParsons February 2010 based on
Regional ecosystems mapping (version 6) and RE descriptions (version 6.0b)
Department of Environment and Resource Management 2009

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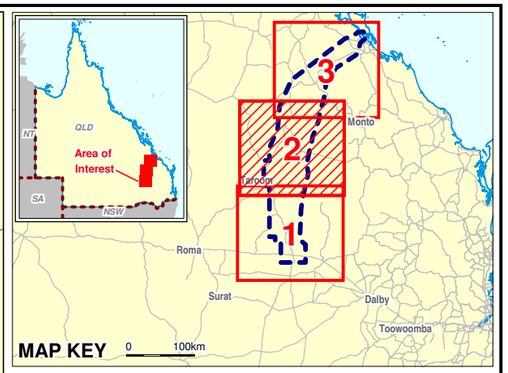
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Figure 23.7 (a) Threatened ecological communities within the gas pipeline study area (Map 1 of 3)

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Dawson Highway
Leichhardt Highway
Dev Road
Fitzroy
ROCKY GULLY
LONESOME CREEK
CASTLE CREEK
Theodore
PALM TREE CREEK
Leichhardt Highway
RIVER
Eidsvold - Theodore Road
DAWSON
AUBURN RIVER
ROBINSON CREEK
COCKATOO CREEK
Taroom
DAWSON RIVER
Roma Taroom Road



LEGEND

Major drainage
Road
Railway

Proposed Infrastructure

Gas pipeline route
Gas pipeline study area

EPBC - listed threatened ecological communities

Semi-evergreen Vine Thickets of the Brigalow Belt (North and South) and Nandewar Bioregions

Dominant
Sub-dominant

Brigalow (Acacia harpophylla dominant and co-dominant)

Dominant
Sub-dominant

Weeping Myall Woodlands

Dominant
Sub-dominant

Central Highlands Natural Grasslands

Dominant
Sub-dominant

Source Information

EPBC - listed threatened ecological communities
Created by WorleyParsons February 2010 based on
Regional ecosystems mapping (version 6) and RE descriptions (version 6.0b)
Department of Environment and Resource Management 2009

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SCALE - 1 : 500,000 (at A3)
Latitude/Longitude
Geocentric Datum of Australia 1994

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AUSTRALIA PACIFIC LNG PROJECT

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Figure 23.7 (b) Threatened ecological communities within the gas pipeline study area (Map 2 of 3)

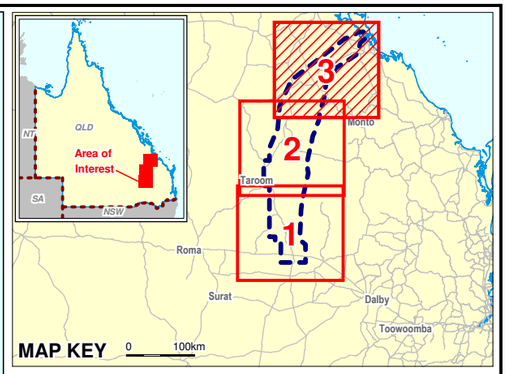
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150.00 150.50 151.00

-24.00 -24.50

Leichhardt Highway
Burnett Highway
Bruce Highway
DEE RIVER
CENTRE CREEK
RAGLAN CREEK
CALLIOPE RIVER
Gladstone
Dawson Highway
BELL CREEK
BOYNE RIVER
Gladstone - Monto Road
CALLIDE CREEK
Biloela
KROOMBIT CREEK
Burnett Highway
NORTH KARIBOE CREEK
GREVILLEA CREEK
BANANA CREEK
LONESOME CREEK



LEGEND

Major drainage
Road
Railway

Proposed Infrastructure

Gas pipeline route
Gas pipeline study area

EPBC - listed threatened ecological communities

Littoral Rainforest Coastal Vine Thickets
Dominant
Sub-dominant

Semi-evergreen Vine Thickets of the Brigalow Belt (North and South) and Nandewar Bioregions
Dominant
Sub-dominant

Brigalow (Acacia harpophylla dominant and co-dominant)
Dominant
Sub-dominant

Weeping Myall Woodlands
Dominant
Sub-dominant

Central Highlands Natural Grasslands
Dominant
Sub-dominant

Source Information

EPBC - listed threatened ecological communities
Created by WorleyParsons February 2010 based on
Regional ecosystems mapping (version 6) and RE descriptions (version 6.0b)
Department of Environment and Resource Management 2009

0 10 20km

SCALE - 1 : 500,000 (at A3)
Latitude/Longitude
Geocentric Datum of Australia 1994

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AUSTRALIA PACIFIC LNG PROJECT

Volume 3 Chapter 23
Figure 23.7 (c) Threatened ecological communities within the gas pipeline study area (Map 3 of 3)

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The type and quantity of the TECs (corresponding to six REs) within the gas pipeline right of way and a 5km buffer to the right of way are detailed in Table 23.2.

Potential impacts of the Project on EPBC Act Listed Threatened Communities are most likely to be associated with physical clearing of vegetation for infrastructure development. Other potential impacts are introducing and/or spreading invasive weeds and pests, and leaching pollutants or releasing sediment into retained areas of vegetation.

If unmanaged, edge effects and fragmentation can increase the prevalence of weed species in the vegetation adjacent to the right of way. This is due to canopy clearance, altered runoff patterns and increased exposure to foreign material carried into the study area on machinery and equipment.

Table 23.2 Threatened (endangered) ecological communities[1] along the gas pipeline

RE	Description (REDD V6.0b) – VMA	Description – EPBC Act	Area within 5km of right of way (ha)	Area within 40m wide right of way (ha)
11.9.5	*Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks.	Brigalow (*Acacia harpophylla* dominant and co-dominant)	1926.0	1.5
11.3.2	*Eucalyptus populnea* woodland on alluvial plains.	Weeping myall woodlands - where the tree canopy is dominated (at least 50%) by living, dead or defoliated weeping myall (*Acacia pendula*) trees.	884.5	0.4[2]
11.11.18	Semi-evergreen vine thicket on old sedimentary rocks with varying degrees of metamorphism and folding.	Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions.	596.3	0.2
11.12.21	*Acacia harpophylla* open forest on igneous rocks. Colluvial lower slopes.	Brigalow (Acacia harpophylla dominant and co-dominant)	541.0	0.1
11.9.6	*Acacia melvillei +/- A. harpophylla* open forest on fine-grained sedimentary rocks.	Brigalow (*Acacia harpophylla* dominant and co-dominant)	76.4	0.1
11.9.1	*Acacia harpophylla-Eucalyptus cambageana* open forest to woodland on fine-grained sedimentary rocks.	Brigalow (*Acacia harpophylla* dominant and co-dominant)	194.2	0.1

[1] EPBC listed threatened (endangered) ecological communities within or near the gas pipeline right of way.

[2] While 0.4 ha or RE 11.3.2 was observed within the gas pipeline right of way, there was no area that satisfied the requirements of the weeping myall woodlands Policy Statement V3.17.

Brigalow (Acacia harpophylla dominant and co-dominant) community

The brigalow (*Acacia harpophylla* dominant and co-dominant) community was listed as a threatened (endangered) ecological community under the EPBC Act on 4 April 2001.

This community has received protection under the Act as it has declined to 10% of its pre-clearing extent, with 90% of it removed.

Significant impact criteria – Brigalow community

An action is likely to have a significant impact on an endangered ecological community if there is a real chance or possibility that it will:

1. *Reduce the extent of an ecological community.*

   Within the alignment, four regional ecosystems (11.9.1, 11.9.5, 11.9.6 and 11.12.21) analogous to this community were observed. The alignment of the gas pipeline has been designed to conserve this community wherever possible. Where there has been no practicable alternative route, degraded areas will be impacted in preference to areas of high ecological value. It is proposed that approximately 1.8ha of this community will be disturbed for the Project.

   It is proposed that vegetation offsets be provided as part of the mitigation against the loss of this community. The offsets will be located outside the proposed right of way, and will compensate for the impacts of the Project. Areas used for offsetting will be selected following consultation with DEWHA and DERM. In addition, the relatively narrow configuration of proposed clearing for the Project is unlikely to significantly reduce the area of occupancy of this community in the long term, provided that appropriated offsets are provided.

   The natural regeneration of 85% of the 40m wide clearing strip will also return most disturbed vegetation communities in the long term.

2. *Fragment or increase fragmentation of an ecological community, such as by clearing vegetation for roads or transmission lines.*

   The relatively narrow configuration of proposed clearing, combined with the proposed offsets, makes it unlikely that clearing for the Project will fragment populations of this community into two or more populations in the long term. Where there has been no practicable alternative to transecting this community, the right of way will be narrowed to further minimise the direct impacts to this community. The offsets chosen for this development will be selected, with preference given to areas that connect two existing remnants. Natural regeneration of 85% of the 40m wide clearing strip will return most potential habitat for this species within the alignment, leaving a 6m wide gap.

3. *Adversely affect habitat critical to the survival of an ecological community.*

   There is no recovery plan established under the EPBC Act for the management of this community. In addition, habitat for this community is not listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act.

   A small area containing this community will be subject to disturbance, while natural regeneration of 85% of the 40m wide clearing strip will return the majority of disturbed vegetation communities in the long term. It is not considered that habitat critical to the survival of the community will be adversely impacted in the long term.

Modify, destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns.

Given the relatively small amount of proposed clearing within the gas pipeline corridor, and the natural regeneration of 85% of natural vegetation cleared, most potential habitat will be restored for this community. The proposed works will not substantially modify or destroy abiotic factors necessary to the survival of this community. Furthermore, appropriate vegetation offsets make it unlikely that this community will be significantly impacted in the long term.

4. *Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, such as through regular burning or flora or fauna harvesting.*

   Habitat management for works within and adjacent to this community will include actions to prevent impacts on this community including management of surface and ground waters, weed infestations, feral animal species, light, wind, temperature and fire.

   The relatively narrow configuration of proposed clearing combined with the proposed offsets makes it unlikely that the changes in species composition or important species will be lost. Therefore clearing of this community within the right of way will not cause a decline or loss of functionally important species. Brigalow communities in central Queensland are reasonably resilient to change and the decline of this community can generally be attributed to broadscale clearing for pasture lands.

5. *Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including but not limited to:*

   - *Assisting invasive species, that are harmful to the listed ecological community, to become established*
   - *Causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community.*

   Habitat management for works within and adjacent to this community will include actions to prevent impacts on this community including management of surface and ground waters, weeds infestations, feral animal species, light, wind, temperature and fire. In addition, the implementation of a biosecurity management plan is a requirement of the TOR. These measures are considered adequate to control and prevent the establishment of invasive species (and associated diseases) as a result of the Project.

6. *Interfere with the recovery of an ecological community.*

   While the Project may cause direct or habitat loss to this ecological community, this will be compensated for by the relatively narrow clearing (40m) and proposed offsets, along with natural regeneration restoring 85% of the native vegetation within the right of way. In addition, offsets are likely to include areas that are recovering brigalow communities, so the recovery effort will be assisted in some places.

Weeping myall woodlands

Weeping myall woodlands occur in open woodlands and woodlands, generally four to 12m high, in which weeping myall (*Acacia pendula*) trees are the sole or dominant overstorey species. Other

common names for weeping myall include myall, boree, balaar, nilyah, bastard gidgee, and silver leaf boree.

Weeping myall woodlands occur on arable land. Therefore much of the former range of the ecological community has been cleared for dryland /irrigated cropping or has been significantly modified by heavy grazing. Most sites still in good condition experience little grazing and are uncropped. This includes road reserves and travelling stock routes and reserves. These areas of structurally intact woodland tend to be relatively small and exist in a matrix of agricultural development with poor landscape connectivity.

Significant impact criteria – Weeping myall woodland

It should be noted that no weeping myall have been identified within or in proximity to the gas pipeline route.

An action is likely to have a significant impact on an endangered ecological community if there is a real chance or possibility that it will:

1. *Reduce the extent of an ecological community.*

   Although approximately 0.4ha of RE (11.3.2) was observed within the alignment, these areas contained no weeping myall and therefore these areas of this RE do not satisify the EPBC Act criteria for the weeping myall woodlands endangered ecological community.

   Although almost all potential areas of this community were observed during the field visit, if any areas of weeping myall woodland are located within the right of way during the preclearing surveys, it is proposed that vegetation offsets be provided as part of the mitigation against the loss of this community.

   The offsets will be located outside the proposed right of way and will compensate for the impacts of the development. Areas used for offsetting will be selected following consultation DEWHA and DERM.

2. *Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines.*

   No areas with weeping myall were observed during the survey, so no areas that satisify the EPBC Act criteria for the weeping myall woodlands endangered ecological community occur with the right of way.

3. *Adversely affect habitat critical to the survival of an ecological community.*

   No areas with weeping myall were observed during the survey, so no areas that satisify the EPBC Act criteria for the weeping myall woodlands endangered ecological community occur with the right of way.

4. *Modify, destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns.*

   No areas with weeping myall were observed during the survey. No disturbance to abiotic factors necessary for this ecological community's survival will be affected.

5. *Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting:*

No areas with weeping myall were observed during the survey, so no areas that satisify the EPBC Act criteria for the weeping myall woodlands endangered ecological community occur with the right of way. No change in the species composition or decline or loss of functionally important species is expeted in this community.

6. *Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including but not limited to:*

   - *Assisting invasive species, that are harmful to the listed ecological community, to become established*
   - *Causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community.*

   No areas with weeping myall were observed during the survey and therefore no areas that satisify the EPBC Act criteria for the weeping myall woodlands endangered ecological community occur with the right of way.

   In addition, the implementation of a biosecurity management plan is requirement of the TOR. These measures are considered adequate to control and prevent the establishment of invasive species (and associated diseases) as a result of the Project.

7. *Interfere with the recovery of an ecological community.*

   No areas with weeping myall were observed during the survey and no areas that appear to be recovering weeping myall woodlands occur within the right of way. Given the relatively narrow clearing (40m), it is unlikely the gas pipeline will interfere with the recovery of this community.

Semi-evergreen vine thickets – Brigalow Belt (North and South) and Nandewar bioregions

Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar bioregions are listed as endangered under the EPBC Act. This community has been substantially reduced in size with nine to 30% of the original area remaining. As a result of clearing, this community generally occurs as fragmented patch sizes of less that 100ha. Their small size makes these patches vulnerable to further degradation and decline from clearing, inappropriate fire regimes, grazing and weed invasion.

Significant impact criteria – Semi-evergreen vine thickets

An action is likely to have a significant impact on an endangered ecological community if there is a real chance or possibility that it will:

1. *Reduce the extent of an ecological community*

   Within the alignment one RE (11.11.19) analogous to semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions was observed. It is proposed that approximately 0.2ha of this community will be disturbed as part of the Project.

   It is proposed that vegetation offsets be provided as part of the mitigation against the loss of this community. The offsets will be located outside the proposed gas pipeline right of way and will compensate for the impacts of the development. Areas used for offsetting will be selected following consultation DEWHA and DERM. In addition, the relatively narrow configuration of proposed clearing for the Project is unlikely to significantly reduce the area of occupancy of this community in the long term provided that appropriated offsets are provided.

In addition the natural regeneration of 85% of the 40m wide clearing strip will return the majority of disturbed vegetation communities in the long term.

2. *Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines*

   The relatively narrow configuration of proposed clearing combined with the proposed offsets makes it unlikely that clearing for the Project will fragment populations of this community into two or more populations in the long term. Where there has been no practicable alternative to transecting this community, the gas pipeline right of way will be narrowed to further minimise the direct impacts to this community.

   The offsets chosen for this development will be selected with preference being given to areas that connect two existing remnants.

3. *Adversely affect habitat critical to the survival of an ecological community*

   There is no recovery plan established under the EPBC Act for the management of this community. In addition, habitat for this community is not listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act.

   Although a small area containing this community will be subject to disturbance, natural regeneration of 85% of the 40m wide clearing strip will return the majority of disturbed vegetation communities in the long term. It is not considered that habitat critical to the survival of the community will be adversely impacted in the long term.

4. *Modify, destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns.*

   Given the relatively small amount of proposed clearing required for the construction of the pipleline, the proposed works will not substantially modify or destroy abiotic factors necessary to the survival of this community.

   Furthermore, appropriate vegetation offsets make it unlikely that this community will be significantly impacted in the long term.In addition the natural regeneration of 85% of the 40m wide clearing strip will return the majority of disturbed vegetation communities in the long term.

5. *Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting*

   This community occurs in a sub-dominant mosaic with a Eucalypt dominated woodland community in a small area in the northern sections of the right of way. The relatively narrow configuration of proposed clearing combined with the proposed offsets makes it unlikely that there changes in species composition or loss of functionally important species will occur. Therefore clearing of this community within the right of way will not cause a decline or loss of functionally important species.

6. *Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:*

   – *Assisting invasive species, that are harmful to the listed ecological community, to become established; or*

- *Causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community.*

Habitat management for works within and adjacent to this community will include actions to prevent impacts upon this community including: management of surface and ground waters, weeds infestations, feral animal species, light, wind, temperature and fire.

In addition, the implementation of a biosecurity management plan is requirement of the TOR. These measures are considered adequate to control and prevent the establishment of invasive species (and associated diseases) as a result of the Project

7. *Interfere with the recovery of an ecological community*

The relatively narrow clearing (40m) and proposed offsets combined and the natural regeneration will restore 85% of the native vegetation within the right of way are considered sufficient to compensate for any proposed interference with the recovery of this community through direct loss or habitat loss proposed through the implementation of the Project.

In addition, offsets for are likely to include areas that are recovering semi-evergreen vine thicket communities and thus, facilitate the recovery effort in places.

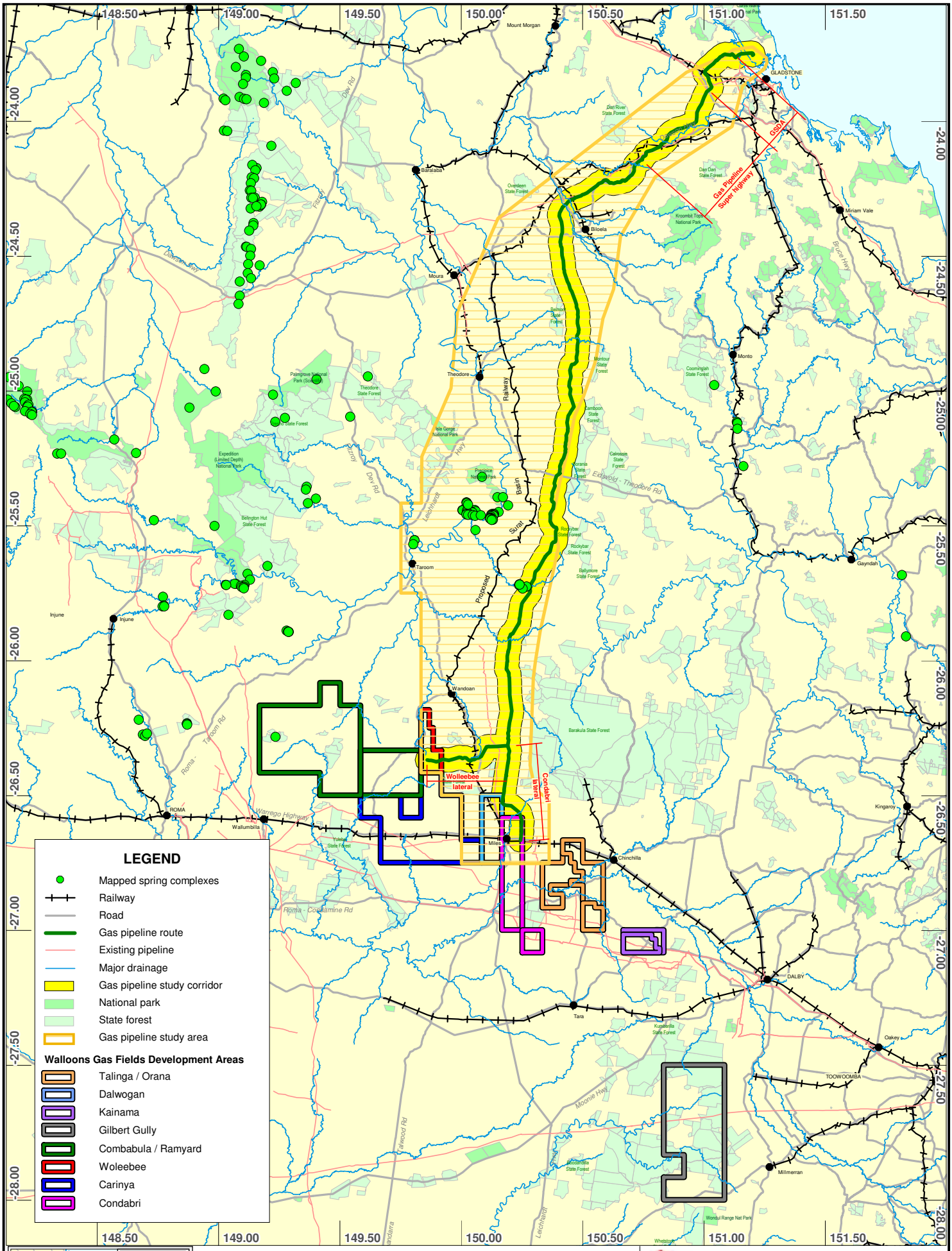
Communities associated with Great Artesian Basin spring wetlands

The only wetlands of national importance known to occur in the vicinity of the gas pipeline corridor are the communities of native species dependent on natural discharge of groundwater from the Great Artesian Basin (GAB). These occur on the outer edge of the GAB in Queensland, NSW and South Australia. The GAB springs are characterised into twelve 'supergroups'.

Each supergroup comprises smaller spring groups and spring complexes. The project area is located within the Springsure Supergroup, Brigalow Belt Complex (EPA 2005; Fairfax et al. 2007; Fensham et al. 2004). The community of native species dependent on the natural discharge of groundwater from the Great Artesian Basins is listed as an endangered community under the EPBC Act (1999).

Figure 23.8 indicates the location of spring complexes in proximity to the study area. GAB Spring communities known to occur close to the gas pipeline right of way are in the vicinity of Cockatoo Creek. These communities contain *Eriocaulon carsonii* (salt pipewort or button grass) and *Myriophyllum artesian* (artesian milfoil) stands.

The nearest mapped springs to the gas pipeline route are located 1.7km west of the Cockatoo Creek crossing (straight-line distance, equals 2.4km downstream along the creek channel). During surveys for the Surat-Gladstone Pipeline (AECOM 2009), the EPBC-listed plant salt pipewort was observed in springs near Cockatoo Creek 4.7km west of the Australia Pacific LNG gas pipeline crossing point.



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These springs are not located on Cockatoo Creek itself, but are adjacent to a small tributary about 1.5km upstream from Cockatoo Creek. Artesian milfoil was also observed in these springs, but this plant is not listed under the EPBC Act. AECOM (2009) stated that these springs are recharge springs and therefore are not the EPBC-listed threatened ecological community, which is defined to comprise discharge springs. As such, there are no known artesian spring MNES species or communities within or in close proximity to the right of way at Cockatoo Creek. However, in recognition of the ecological value of these springs and the presence of *Eriocaulon carsonii* (salt pipewort or button grass), each of the significant impact criteria relevant to the potential impact of the Project on this spring community are discussed below.

Significant impact criteria – GAB spring communities

An action is likely to have a significant impact on an endangered ecological community if there is a real chance or possibility that it will:

1. *Reduce the extent of an ecological community*

   The route of the gas pipeline will avoid any alignments which may result in disturbance to the communities. Although extremely unlikely, any unforeseen disturbance will be offset. It is proposed that vegetation offsets be provided following consultation with DEWHA and DERM as part of the mitigation against any loss of this community.

2. *Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines*

   The route of the gas pipeline will avoid any alignments which may result in disturbance to the communities. No additional infrastructure such as laydown areas or workers camps will be located in the vicinity of known spring locations such as downstream of the Cockatoo Creek crossing.

3. *Adversely affect habitat critical to the survival of an ecological community*

   This community is not listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act. The route of the gas pipeline will avoid any alignments which may result in disturbance to this community and the areas traversed by the right of way are not considered habitat critical to the survival of the community.

4. *Modify, destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns*

   The route of the gas pipeline will avoid any alignments which may result in disturbance to this community. It is not considered that the proposed works will substantially modify or destroy abiotic factors necessary to the survival of this community downstream from the right of way.

5. *Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting*

   The route of the gas pipeline will avoid any alignments which may result in disturbance to this community. No changes in species composition or loss of functionally important species will occur.

6. *Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:*

   - *Assisting invasive species, that are harmful to the listed ecological community, to become established; or*
   - *Causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community.*

   Habitat management for works within and adjacent to this community will include actions to prevent impacts upon this community including: management of surface and ground waters, weeds infestations, feral animal species, light, wind, temperature and fire.

   In addition, the implementation of a biosecurity management plan is required under State legislation to control and prevent the establishment of invasive species (and associated diseases) as a result of the Project.

7. *Interfere with the recovery of an ecological community*

The route of the gas pipeline will avoid any alignments which may result in disturbance to these communities. The crossing area proposed for Cockatoo Creek did not contain any recovering GAB spring communities.

23.10.2 Terrestrial flora

Desktop research included searches utilising the EPBC Protected Matters Search Report, the QLD Herbarium HERBRECS Flora Collection Records and the DERM Wildlife Online Database.

For the study area, these searches identified 33 threatened flora species. This included five species listed as endangered and 28 species listed as vulnerable under the EPBC Act. Field surveys were undertaken in 2009, including four days in April and 29 days in September and October.

Table 23.3 identifies these threatened species, their habitat preference and the likelihood of their occurrence within the project area. Field surveys have indicated that two threatened flora species listed under the EPBC Act were present within the gas pipeline corridor – Large-fruited zamia palm (*Cycas megacarpa*) and ooline (*Cadellia pentastylis)*. Based on habitat preference, the gas pipeline corridor may support suitable habitat for a further 21 listed threatened species.

In summary, a number of species have been identified that may be present along the gas pipeline corridor. These are described in the context of their significant impact guidelines later in this chapter. They include:

- Two threatened terrestrial flora species listed under the EPBC Act – large-fruited zamia palm and ooline
- Twenty-one species based on habitat preference – lobed blue-grass (*Bothriochloa biloba*), king blue-grass (*Dichanthium queenslandicum*), pink donkey-orchid (*Diurus tricolor*), Belson's panic grass (*Homopholis belsonii)*, Cobar greenhood orchid (*Pterostylis cobarensis*), Chinchilla wattle (*Acacia chinchillensis*), curly-barked wattle (*Acacia curranii*), Yarwun whitewood (*Atalaya collina*), heart-leaved bosistoa (*Bosistoa selwynii*), Gurulmundi fringe myrtle (*Calytrix gurulmundensis*), commersonia (*Commersonia argentea*), wedge-leaf tuckeroo (*Cupaniopsis shirleyana*), small-leaved denhamia (*Denhamia parviflora*), shiny-leaved ironbark (*Eucalyptus virens)*, decumbent homoranthus (*Homoranthus decumbens*), blunt-leaved phebalium (*Leionema obtusifolium*), northern bearded-heath (*Leucopogon cuspidatus*), quassia (*Quassia*

bidwillii), austral cornflower (*Rhaponticum australe*), slender tylophora (*Tylophora linearis),* and small-leaved westringia *(Westringia parviflora).*

Potential impacts of the gas pipeline on terrestrial flora are likely to be primarily associated with the physical clearing of vegetation for infrastructure development. Other potential impacts are:

- Introduction and/or spread of invasive weeds or pests
- Leaching of pollutants or release of sediment into retained areas of vegetation
- Dust emission impacts on adjoining areas during the construction phase.

As discussed earlier, unmanaged edge-effects and fragmentation can increase the prevalence of weed species in the vegetation adjacent to the Project.

Table 23.3 Likely occurrence of threatened flora species

These threatened species were identified in database searches.

Common name	Scientific name[1]	EPBC Act status[2]	Habitat preference	Likelihood of occurrence[3]	Source[3]
Large-fruited zamia palm	*Cycas megacarpa*	E	Spotted gum–ironbark woodlands and open woodlands on rocky substrates derived from acid volcanics, ironstone and mudstone and at 40–680m altitude in the Boulder combe-Woolooga of SE – C QLD (Botanic Gardens Trust 2008a).	Known - Observed in numerous locations west of the Callide Range in the northern sections of the Project area mostly associated with spotted gum and open woodlands on rocky substrates. Over 100 individuals observed during field visits.	1
Lobed blue-grass	*Bothriochloa biloba*	V	Cleared eucalypt forests and relict grasslands dominated by purple wiregrass (*Aristida ramosa*), red-leg grass (*Bothriochloa macra*), pitted bluegrass (*B. decipiens*) and windmill grass (*Chloris truncata*), in heavier-textured soils including brown or black clays, in SE Qld and N NSW (Department of Natural Resources (DNR) 1999).	Possible - Soil type and suitable habitat located in southern sections of the Project area	2
Miniature moss-orchid	*Bulbophyllum globuliforme*	V	Epiphyte on the scaly bark of the branches and upper trunk of mature hoop pine (*Araucaria cunninghamii*) trees of subtropical coastal ranges in SE QLD and NE NSW at 500-800m altitude (DNR 1999).	Unlikely. Hoop pines are not present within the Project area.	1
King blue-grass	*Dichanthium queenslandicum*	V	Native grasslands on open downs of Emerald and rarely Darling Downs regions of C and SE Qld in black clay soils. Found in association with coolibah	Possible - Soil type and suitable habitat located in southern sections of the alignment.	1, 2

Common name	Scientific name[1]	EPBC Act status[2]	Habitat preference	Likelihood of occurrence[3]	Source[3]
			grass (*Thellungia advena*), white speargrass (*Aristida leptopoda*), native millet (*Panicum decompositum*), Yabila grass (*P. queenslandicum*), sweet signal grass (*Brachiara eruciformis*), Queensland bluegrass (*Dichanthium sericeum*), golden silky browntop (*Eulalia fulva*) and spring grass (*Eriochloa pseudoacrotricha*) (Sharp and Simon 2002).		
Finger panic grass	*Digitaria porrecia*	E	Tropical and subtropical rainforests and sub-humid woodlands of subtropical coastal regions of Qld and NSW (Sharp and Simon 2002).	Unlikely - the gas pipeline only affects limited coastal regions and tropical and subtropical rainforest are unlikely to occur in the right of way.	1
Pink donkey orchid	*Diurus tricolor*	V	Sclerophyll forests and ironbark-acacia shrublands in association with white cypress pine (*Callitris glaucophylla*), poplar box (Eucalyptus populnea), gum coolibah (*E. intertexta*) and often with a grassy to herbaceous understorey, in sandy soils on flats and small rises and sometimes red earths on coastal ranges of E Aust, from SE Qld to the NSW-Vic border (Stanley and Ross 1989).	Likely - Large remnant communities of suitable habitat located throughout the alignment.	1, 2
Salt pipewort	*Eriocaulon carsonii*	E	Active or flowing artesian mound springs or the margins of the Great Artesian Basin of inland regions of Qld, NSW and SA on fen soils (Botanic Gardens Trust 2008).	Unlikely – This species has been observed in Cockatoo Creek 4.5km downstream from the right of way. However, Artesian springs are not present within the right of way.	1, 2

Common name	Scientific name[1]	EPBC Act status[2]	Habitat preference	Likelihood of occurrence[3]	Source[3]
				However, management measures to avoid impact on the spring community have been defined.	
Belson's panic grass	*Homopholis belsonii*	V	White box (*Eucalyptus albens*) communities and wilga (*Geijera parviflora*) woodlands on rocky hills; belah (*Casuarina cristata*) forests in alluvial soils on flat to undulating lands; poplar box woodlands; and dry woodlands on poor soils derived from basalt at 200-520m altitude from S Qld to N NSW. Also recorded in brigalow, myall (*Acacia melvillei*) and weeping myall communities; mountain coolibah (*E. orgadophila*) communities; and on roadsides (Sharp and Simon 2002).	Likely - Suitable habitat located in the southern sections of the alignment. Observed in numerous locations within the gas fields.	1, 2
Cobar greenhood orchid	*Pterostylis cobarensis*	V	Eucalypt woodlands, open mallee and cypress pine shrubland in skeletal sandy loam soils on low stony ridges and slopes and in association with Morris' grey mallee (*Eucalyptus morrisii*), green mallee (*E. viridis*), gum coolibah, Manara Hills red gum (*E. vicina*), white cypress pine, wilga, belah, spearwood (*Acacia doratoxylon*), cassias (*Senna* spp.) and emu bushes (*Eremophila* spp.) in central eastern Aust. (Threatened Species Scientific Committie (TSSC) 2008a).	Likely - Large remnant communities of suitable habitat located throughout the alignment.	1
Minute orchid	*Taeniophyllum muelleri*	V	Epiphyte on branches and branchlets of rainforest trees in coastal regions (Botanic Gardens Trust 2009b).	Unlikely - Coastal rainforest habitat unlikely to be present within the right of way.	1

Common name	Scientific name[1]	EPBC Act status[2]	Habitat preference	Likelihood of occurrence[3]	Source[3]
Chinchilla wattle	*Acacia chinchillensis*	V	Layered, open dry sclerophyll forest with mid to dense shrub layers in moderately deep to deep loamy sands to sandy loam soils with sandy clay subsoils in the Chinchilla region of SE Qld. Found on gently undulating flats in association with narrow-leaved red ironbark (*Eucalyptus crebra*), smooth-barked apple (*Angophora leiocarpa*), Pilliga grey box (*E. pilligaensis*), white cypress pine, black cypress pine (*C. endlicheri*), buloke (*Allocasuarina leuhmannii*) and white feather honey-myrtle (*Melaleuca decora*) (TSSC 2008b).	Possible - Some suitable habitat located in the alignment.	1
Curly-bark wattle	*Acacia curranii*	V	Dry sclerophyll forests and semi-arid woodlands on rocky outcrops of isolated hills and ranges in skeletal soils of the Gurulmundi area in south and central Qld. Also recorded in central NSW (New South Wales National Parks and Wildlife Service (NSW NPWS) 2008).	Likely - Suitable habitat located throughout the Gurulmundi area in the south of the alignment.	1, 2, 3
Sandalwood wattle	*Acacia eremophiloides*	V	Granite outcrops between 460-550m altitude, SSW of Gayndah, SE Qld (World Wide Wattle 2009).	Unlikely - Limited granite outcrops and limited areas higher than 460m located in the alignment.	3
Yarwun whitewood	*Atalaya collina*	E	Dry rainforest and SEVT communities in dark clay soils and on hillsides in the Yarwun–Miriam Value region of C and SE Qld (TSSC 2009a).	Possible - Some suitable habitat scattered in small patches throughout the alignment.	1, 2, 3
Heart-leaved bosistoa	*Bosistoa selwynii*	V	Wet sclerophyll forest, dry sclerophyll forest and rainforest up to 300m in altitude (TSSC 2010). See	Possible - Some suitable habitat located in the right of way.	1

Common name	Scientific name[1]	EPBC Act status[2]	Habitat preference	Likelihood of occurrence[3]	Source[3]
			below.		
Three-leaved bosistoa	*Bosistoa transversa* (syn. B. selywnii)	V	Wet sclerophyll forest, dry sclerophyll forest and lowland subtropical rainforests of subtropical coastal regions to 300 m altitude (TSSC 2010).	Possible - Some suitable habitat located in the right of way.	1, 2
Ooline	*Cadellia pentastylis*	V	Semi-evergreen vine thickets on sandstone and basalt slopes and currawong (*Acacia sparsiflora*), brigalow and belah communities of S-C Qld on undulating clay plains and low hills at altitudes 200–500m (DNR 1999).	Known - observed in one location along west sections of the Woleebee lateral. Located at the base of a sandstone jump-up.	1, 2
Gurulmundi fringe myrtle	*Calytrix gurulmundensis*	V	Hummock grasslands with scattered shrubs or in tall shrublands with eucalypt emergents on low lateritised sandstone ridges in well-drained, usually shallow and either gravelly sandy clay or sandy soils of the Gurulmundi and Barakula areas in SE Qld (TSSC 2008c).	Likely - Suitable habitat located in the southern sections of the Project area and numerous historic records of this species.	1, 2, 3
Commersonia	*Commersonia argentea*	V	Eucalypt forests on stony ridges in south and central Qld (TSSC 2008d).	Possible - Suitable habitat throughout the alignment.	1
Wedge-leaf tuckeroo	*Cupaniopsis shirleyana*	V	Rainforests in a variety of soil types on hillsides, mountain tops, lower slopes of valleys, rocky headlands, stream beds and along riverbanks in CE and SE QLD (TSSC 2009b).	Possible - Limited rainforest habitat located in the Project area. However, possible in the wetter creek lines in the coastal areas near Gladstone.	1, 2, 3
Small-leaved denhamia	*Denhamia parviflora*	V	Semi-evergreen vine thickets, vine scrubs and brigalow scrub communities in association with shrub persimmon (*Diospyros humilis*), crow's ash	Possible - Some suitable habitat scattered in small patches throughout the alignment.	3

Common name	Scientific name[1]	EPBC Act status[2]	Habitat preference	Likelihood of occurrence[3]	Source[3]
			(Flindersia australis), wilga, crow's apple (*Owenia venosa*) and python tree (*Austromyrtus bidwillii*) in fertile, red-brown, sandy, clay loams on hillslopes and crests of variable aspect in the greater Chinchilla area in SE Qld. Also recorded in narrow-leaved red ironbark forests (TSSC 2008e).		
Shiny-leaved ironbark	*Eucalyptus virens*	V	Restricted to four disjunct localities near Mt Moffatt in the Carnarvon area, Brovinia area south of Mundubbera, Tara area west of Dalby and Coolmunda Dam east of Inglewood in southern Queensland. Found in woodlands dominated by bendo (*Eucalyptus exserta*), *Angophora costata*, Tom Russell's mahogany (*Lysicarpus ternifolius*) and woolly she-oak (*Allocasuarina inophloia*) in coarse sandy, skeletal soils on outcropping sandstone escarpments; forests dominated by buloke and mugga ironbark (*E. sideroxylon*).	Likely - Anecdotal evidence indicates that this species may occur within the right of way in the central sections of the alignment. Suitable habitat present throughout the central sections.	4
Ball nut	*Floydia praealta*	V	Riverine and lowland subtropical rainforests of eastern Australia in association with lillypilly (*Acmena smithii*), rough-leaved elm (*Aphananthe phillipensis*), white booyong (*Argyrodendron trifoliatum*), mango-bark (*Canarium australasicum*), native tamarind (*Diploglottis cunninghamii*), scrub poison tree (*Excoecaria dallachyana*), crow's ash, white beech (*Gmelina leichhardtii*), white silky oak (*Greveillea hilliana*), tulipwood (*Harpulia pendula*), bastard crow's ash (*Pentaceras australe*), blush	Unlikely - Coastal or riverine rainforest habitat unlikely to be located in the right of way.	3

Common name	Scientific name[1]	EPBC Act status[2]	Habitat preference	Likelihood of occurrence[3]	Source[3]
			coondoo (*Planchonella laurifolia*), marara (*Pseudoweinmannia lachnocarpa*), giant water gum (*Syzygium francisii*), small-leaved lillypilly (*S. luehmannii*), durobby (*S. moorei*) and red cedar (*Toona ciliata*) (DNR 1999).		
Decumbent homoranthus	*Homoranthus decumbens*	V	Mixed eucalypt - callitris woodlands and dry sclerophyll forests of S Qld in loose sands, red gravelly soils, stony sodic soils, deep brownish sands, shallow sands overlaying grey brown, silty clays and stony lateritic clays on undulating hills and plains and rarely on low sandstone plateaux (DNR 1999)	Possible - Suitable habitat throughout the alignment.	1, 3
Blunt-leaved phebalium	*Leionema obtusifolium*	V	Open forests communities dominated by yellow stringybark (*Eucalyptus acmenoides*), brown bloodwood (*Corymbia trachyphloia*) and smudgy apple (*Angophora woodsiana*) in shallow, dark, well-drained and generally stony soils in hilly terrain on slopes with a serly aspect (DNR 1999).	Possible - Suitable habitat throughout the alignment.	3
Northern bearded heath	*Leucopogon cuspidatus*	V	Stunted open woodlands or shrublands usually dominated by yellow stringybark and brush box (Lophostemon confertus) and with a diverse understorey of shrubs and grasses including forest grasstree (Xanthorrhoea johnsonii), northern tea-tree (Leptospermum amboinense) and hill myrtle (Babingtonia collina) in poor skeletal soils, amongst	Possible - Suitable habitat throughout the alignment.	1

Common name	Scientific name[1]	EPBC Act status[2]	Habitat preference	Likelihood of occurrence[3]	Source[3]
			granite or serpeninite outcrops on mountain tops of the C Qld coastal region (Calvert et al. 2005).		
Queensland bush nut	*Macadamia integrifolia*	V	Rainforests on well drained soils on hill crests, hill slopes, scree slopes and foot slopes of coastal areas of S Qld and N NSW and in association with brown pearwood (Amorphosermum antilogum), rough-leaved elm (Aphananthe philippinensis), white booyong (Argyrodendron trifoliatum), rose tamarind (Arytera divaricata), native almond (Bosistoa pentacocca), union nut (Bouchardatia neurococca), hauer (Dissiliaria baloghioides), scrub poison tree, crow's ash, tulipwood (Harpullia pendula), pear-fruited tamarind (Msichocarpus pyriformis), native olive (Olea paniculata), blush coondoo (Planchonella laurifolia), narrow-leaved gardenia (Randia chartacea), red-fruited kurrajong (Sterculia quadrifida) and whalebone tree (Streblus brunonianus) (DNR 1999).	Unlikely - Rainforest habitat unlikely to be located within the right of way.	3
Mt Larcom monkey rope	*Parsonsia larcomensis*	V	Open heathlands and shrublands at or near the summits of mountain peaks on cliffs or among outcrops of acid volcanic rocks and serpentinite and in shallow, loamy soils in association with broad-leaved red ironbark (Eucalyptus fibrosa) at 350-750m altitude (DNR 1999).	Unlikely - Some suitable habitat scattered in small patches throughout the project area. However, this species is generally found at elevations greater than 350m.	1, 2, 3
Small-flowered Polianthion	*Polianthum minutiflorum*	V	Woodlands dominated by the ironbark, Eucalyptus suffulgens, Gympie messmate (E. cloeziana), brown	Known – Observed in a large remnant patch of sandstone in the	3

Common name	Scientific name[1]	EPBC Act status[2]	Habitat preference	Likelihood of occurrence[3]	Source[3]
			bloodwood and black cypress pine, and in association with Acacia pubicosta, Blake's wattle (Acacia blakei), forest boronia (Boronia rosmaniifolia), bipinnate boronia (B. bipinnata), the bitter-pea, Daviesia filipes, and triangle-leaved hopbush (Dodonaea triangularis) in sandy soils and light, gravelly loams derived from sedimentary rocks, in inland regions of S Qld, and up to 340m altitude (DNR 1999).	central sections of the alignment (Boobok 2009). Suitable habitat throughout the alignment.	
Quassia	*Quassia bidwillii*	V	Lowland rainforests or rainforest margins and occasionally open forests, woodlands and mangroves in lithosols, skeletal soils, loamy sands, sands, silts and sands with clay subsoils in coastal regions (DNR 1999).	Likely - Limited coastal or riverine rainforest habitat located in the right of way.	1, 2, 3
Austral cornflower	*Rhaponticum australe*	V	Eucalypt open forest with grassy understory on roadsides and on road reserves with Rhodes grass Chloris gayana, Cirsium vulgare, Queensland blue gum (Eucalyptus tereticornis) and Rough-barked Apple (*Angophora floribunda*) on black clay soil (TSSC 2008f).	Possible - Suitable habitat throughout the alignment.	3
Slender tylophora	*Tylophora linearis*	E	Grows in dry scrub and open forest. Recorded from low-altitude sedimentary flats in dry woodlands of broad-leaved red ironbark, mugga ironbark, white box, black cypress pine, white cypress pine and buloke (NSW DEC 2005a).	Possible - Suitable habitat throughout the alignment.	1
Small-leaved	*Westringia parviflora*	V	Restricted to a small area near Yelarbon and	Possible - suitable habitat	1

Common name	Scientific name[1]	EPBC Act status[2]	Habitat preference	Likelihood of occurrence[3]	Source[3]
westringia			Inglewood in south-eastern Queensland. Foundin mallee, woodlands and forests in association with Baker's Mallee (*Eucalyptus bakeri*),Green Mallee (*E. viridis*) and Spinifexes (*Triodia* spp.), in sandy and stony soils.	throughout southern sections of the alignment	

[1] Source: 1 = EPBC Act Protected Matters Search Report, 2 = QLD Herbarium HERBRECS Flora Collection Records, 3 = DERM Wildlife Online, 4 = Boobook 2009.

[2] EPBC Act Status: E = Endangered, V = Vulnerable.

[3] Likelihood of Occurrence: Known = Species recorded within the gas pipeline study area

Likely = Species identified by database searches as having geographical range overlapping the wider study area and suitable habitat is mapped within the project area; Possible = Species identified by database searches as having geographical range overlapping the wider study area and sub-optimal habitat or preferred habitat features are mapped within the Project area

Unlikely = Species identified by database searches as having geographical range overlapping the wider study area and suitable habitat is not mapped within the proposed project area.

Large-fruited zamia palm

The large-fruited zamia palm is listed as endangered under the EPBC Act and is endemic to south east Queensland. It is found from Woolooga in the south to Bouldercombe in the north. Spotted gum–ironbark woodlands on metamorphic hills are present throughout gas pipeline route and may provide some habitat for this species.

Large, healthy populations are considered important to the long-term viability of this species. Healthy populations are generally characterised by a broad range of life stages from seedlings, through to large mature trees between five and eight metres tall.

The national multi-species recovery plan for cycads (Queensland Herbarium 2007a) has identified seven important populations, including three in State forests at Biloela, Kroombit and Wonbah.

These populations are large with a broad range of size classes, so are considered particularly significant to the long-term conservation of this species. Other important populations occur in a recreational reserve at Bouldercombe and in 'not of concern' remnant vegetation (defined under the Queensland *Vegetation Management Act 1999*) on freehold land at Biloela, Mount Morgan and in the Dee Range.

The national recovery plan has identified threats to this species including:

- Destruction of habitat and individuals due to land clearing
- Legal harvesting and commercial salvage
- Illegal destruction and harvesting
- Loss of genetic variation and insect pollinators
- Land management practices.

Significant impact criteria – Large-fruited zamia palm

An action is likely to have a significant impact on an endangered species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of a population*

   This species was identified in numerous locations within the Callide Range in the northern sections of the proposed alignment and is known to occur with the 40m right of way at KPs (260, 262, 262.1, 266, 268, 269.35, 271.45, 272.1, 272.2 and 275.6). More than 100 individuals were observed within the vicinity of the proposed alignment between KPs 260 – 272.2, mostly associated with spotted gum and open woodlands on rocky substrates.

   The Calliope Range crossing was not surveyed during the field assessment due to access constraints, but surveys for the Surat-Gladstone Pipeline identified the presence of the species across the range very close to the Project's gas pipeline alignment (AECOM 2009). Database records indicate that there are 10 additional records for this species within a 5km buffer of the proposed alignment (Queensland Herbarium 2009).

   Detailed searches for this species are recommended in Volume 5 Attachment 15, Section 7.1, including un-surveyed sections of the gas pipeline in the Calliope Range. Where practicable, individual large-fruited zamia palms will be avoided, given an undisturbed buffer and monitored for long-term health.

When disturbance is unavoidable, a translocation plan will be specifically designed for this species. The translocation plan will be in accordance to Australian Network for Plant Conservation (2004) and it will include monitoring of survival numbers of translocated individuals. In addition to translocation and following consultation with DEWHA and DERM appropriate offsets strategy will be developed to ensure the species long term viability.

Narrowing the width of the right of way and minor alignment changes will minimise the direct impacts associated with this species. Implementation of translocation plans and appropriate offsets are considered sufficient to prevent a long-term decrease in the overall population of this species. Ongoing monitoring programs will be conducted to document the success of the translocation and offsets mitigation measures.

2. *Reduce the area of occupancy of the species*

Following the construction of the gas pipeline there will be minimal aboveground infrastructure located with in the Callide and Calliope Ranges. The relatively narrow configuration of proposed clearing for the Project is unlikely to significantly reduce the area of occupancy of this species.

This is particularly true when the translocation plans and appropriate offsets recommended above are implemented. On either side of the gas pipeline alignment, there will be a 3m zone which will be rehabilitated and will remain clear for maintenance of the right of way and pipeline

Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

3. *Fragment an existing population into two or more populations*

Following the construction of the gas pipeline there will be no aboveground infrastructure located with in the Callide and Calliope Ranges. The relatively narrow configuration of proposed clearing combined with the discrete compact areas occupied by known populations of this species makes it unlikely that clearing for the Project will fragment existing populations into two or more populations.

Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

4. *Adversely affect habitat critical to the survival of a species*

The national multi-species recovery plan for cycads (EPA 2006) has identified seven important populations including three in state forests at Biloela, Kroombit and Wonbah. These populations are large with a broad range of size classes and as such are considered particularly significant to the long-term conservation of this species.

Other important populations occur in a recreational reserve at Bouldercombe and in not of concern remnant vegetation (as defined under the VMA) on freehold land at Biloela, Mount Morgan and in the Dee Range.

There is no proposed clearing within any habitat identified as habitat critical to the survival of this species under the national multi-species recovery plan for cycads (EPA 2006).

5. *Disrupt the breeding cycle of a population*

Little is known about the pollination ecology of the large-fruited zamia palm, although beetles from the genera Hapalips and Ulomoides have been recorded from the male cones of the

species, suggesting a possible pollination process. Seed is produced from autumn but remain dormant for at least nine months before germination.

In addition, the relatively narrow vegetation clearing proposed during the Project is unlikely to significantly disrupt the breeding cycle of a population of this species.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   Following the construction of the gas pipeline there will be minimum aboveground infrastructure located with in the Callide and Calliope Ranges and regrowth of this species would be permitted within the right of way. Furthermore, appropriate offsets of habitat, following consultation with DEWHA and DERM, for actual habitat lost will make it unlikely that the proposed action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline in the long-term.

7. *Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat*

   The Project has the potential to introduce and spread invasive weed species, through vehicular movement and exposure of soil surface during clearing. An EM Plan for the clearing, construction, and operation of the Project is recommended in Volume 5 Attachment 15.

   The requirements for measures to be included within this EM Plan are considered sufficient to prevent negative impacts of invasive species as a result of the Project. Monitoring of populations of this species will be ongoing following translocation and offsets. Any infestations of weed species will be observed during these monitoring events.

8. *Introduce disease that may cause the species to decline*

   The Project has the potential to introduce and spread plant diseases which may detrimentally impact upon this species, but with the implementation of management measures this potential impact would be minimised. The implementation of a biosecurity management plan is a requirement of the TOR to control and prevent the establishment of invasive species (and associated diseases) as a result of the Project.

   Monitoring of populations of this species will be ongoing following translocation and offset areas. Any introduction of plant pests will be observed during these monitoring events.

9. *Interfere with the recovery of the species*

   The relatively narrow clearing (40m), proposed offsets and translocation plans are considered sufficient to compensate for any proposed interference with the recovery of this species through direct loss or habitat loss proposed through the implementation of this project.

Ooline

Ooline is listed as vulnerable under the EPBC Act and is restricted to central New South Wales and Central Queensland. It occurs between Narrabri in the south to Rannes in the North. Ooline is found in semi-evergreen vine thickets in association with:

- Native quinine (*Alstonia constricta*), hard alectryon (*Alectryon subdentatus*);leopard ash (*Flindersia collina*), wilga (*Geijera parviflora*) and narrow-leaved bottle tree (*Brachychiton rupestris*) on sandstone and basalt slopes

- Currawong (*Acacia sparsiflora*), brigalow and belah communities on undulating clay plains and low hills at altitudes of 200 to 500 metres.

There is currently no recovery plan established under the EPBC Act for the management of ooline. However, Fletcher (2002) and NSW DECC (2005c) identifies the main threats to ooline as:

- Localised extinction due to small and scattered populations
- Inbreeding which threatens genetic diversity in small populations
- Low seed viability which threatens breeding success
- Clearing for agriculture
- Grazing and soil compaction by domestic stock, feral goats (*Capra hircus*) and pigs (*Sus scrofa*)
- Invasion of habitat by weeds, such as tiger pear (*Opuntia aurantiaca*)
- Frequent fires
- Tunnel and sheet erosion
- Damage to roadside populations during roadworks
- Severe insect attack.

Significant impact criteria – Ooline

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of an important population of a species*

   A population of approximately 10 ooline was identified in a grazed paddock at the beginning of the Woleebee Lateral in the southern sections of the proposed gas pipeline route. All of the ooline observed were in a non-remnant paddock at the base of a sandstone jump-up. It appears these individuals have avoided historical mechanical clearing events due to the steep nature of the surrounding sandstone.

   It is expected that the surrounding cleared area currently grazed would have historically contained numerous ooline. Database records indicate that ooline is also present at two locations within a 5km distance from the proposed gas pipeline route (Gurulmundi – reserve 166) (QLD Herbarium 2009).

   Impacts from gas pipeline construction are likely to be limited to the direct loss of plants within the right of way and associated infrastructure (e.g. access tracks). The number of ooline that are likely to be removed by the proposed alignment is less than 10 individuals from a grazed paddock with scattered trees.

   Minor changes to the alignment, narrowing of the right of way and is likely to preserve the majority of individuals located within the right of way

   Potential impacts from gas pipeline construction are likely to be limited to the loss of habitat. Mitigation measures designed to reduce impacts associated with construction activities are discussed in Volume 5 Attachment 15 and include pre-clearing surveys to determine the location of threatened species prior to construction and threatened species management guidelines developed accordingly.

If disturbance to a known population of this species is unavoidable relevant permits and disturbance conditions from DERM will be obtained. Design and implement a translocation plan according to Australian Network for Plant Conservation (2004) (Tables N1 - N4 of Appendix N in Volume 5 Attachment 14). If offsets are necessary they will be made by agreement with DERM. DEWHA would be required to confirm the appropriateness of this approach.

The combination of avoidance where possible, translocation and or habitat offset is considered sufficient to mitigate any possible decline in this species.

2. *Reduce the area of occupancy of an important population*

   The relatively narrow configuration of proposed clearing for the gas pipeline is unlikely to significantly reduce the area of occupancy of this species. This is particularly true if translocation plans and appropriate offsets recommended above are implemented.

   Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

3. *Fragment an existing important population into two or more populations*

   The relatively narrow configuration of proposed clearing combined with the discrete compact areas occupied by known populations of this species makes it unlikely that clearing for the Project will fragment existing populations into two or more populations.

   Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

4. *Adversely affect habitat critical to the survival of a species*

   Habitat for this species is not listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act. Whilst habitat on site may be suitable for the species it is not considered to be habitat critical to the survival of the species, that is, the habitat is not considered to be critical habitat for activities such as breeding or dispersal, for the long-term maintenance of the species, to maintain genetic diversity and long term evolutionary development, or for the reintroduction of populations or recovery of the species.

5. *Disrupt the breeding cycle of an important population*

   Ten individuals of this species are known from the right of way. Minor changes to the alignment, narrowing of the right of way and is likely to preserve the majority of individuals located within the right of way and less than 10 of these individuals are expected to be lost as part of the proposed activities. The loss of these individuals is not expected to represent significant impact upon the breeding cycle of this species as a whole as translocation and/or reseeding will maintain the genetic stock of disturbed plants.

   In addition, the relatively narrow vegetation clearing proposed during the gas pipeline construction is unlikely to significantly disrupt the breeding cycle of a population of this species.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   The relatively narrow clearing (40m) and appropriate offsets of habitat made, following consultation with DEWHA and DERM, for actual habitat lost will make it unlikely that the proposed action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline in the long-term.

7. *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

   The proposed gas pipeline development has the potential to introduce and spread invasive weed species through vehicular movement and exposure of soil surface during clearing. An EM Plan for the clearing, construction, and operation of the Project is recommended in Volume 5 Attachment 15, the requirements for measures to be included within this EM Plan are considered sufficient to prevent negative impacts of invasive species as a result of the Project.

8. *Introduce disease that may cause the species to decline*

   The Project has the potential to introduce and spread plant diseases which may detrimentally impact upon this species, however with the implementation of management measures this potential impact would be minimised. The implementation of a biosecurity management plan is a requirement of the TOR to control and prevent the establishment of invasive species (and associated diseases) as a result of the Project.

9. *Interfere substantially with the recovery of the species*

   The impacts on the recovery of this species proposed by the development are considered to be minimal compared with the impacts associated with ongoing grazing within the paddock. The relatively narrow clearing (40m), proposed offsets and translocation plans are considered sufficient to compensate for any proposed interference with the recovery of this species through direct loss or habitat loss proposed through the implementation of the Project.

Lobed blue-grass

Lobed blue-grass is endemic to Queensland and northern New South Wales and is listed as vulnerable under the EPBC Act. The species is restricted to the Darling Downs region of southern Queensland, and the tablelands and western slopes of the Great Dividing Range in northern New South Wales. It is found in cleared eucalypt forests and relict grasslands dominated by purple wiregrass (*Aristida ramosa),* red-leg grass (*Bothriochloa macra*), pitted bluegrass (*B. decipiens*) and windmill grass (*Chloris truncata*) in heavier-textured soils including brown or black clays.

There is no recovery plan established under the EPBC Act for the management of lobed blue-grass. However, the main identified threats to this species include:

- The difficulty of maintaining Indigenous grasslands with pasture improvement measures (Fensham 1999)
- Competition from exotic species such as coolatai grass (*Hyparrhenia hirta*), nut grass (*Cyperus rotundus*) and lippia (*Phyla nodiflora*) (Fensham 1998; NSW Scientific Committee 2004).

Potential threats include:

- Competition from exotic grasses including African lovegrass (Eragrostis curvula), Paspalum dilatatum, Megathurius maximum, Pennisetum villosum and Sorghum halepense (Fensham 1998)
- The practice of spraying noxious weeds for roadside vegetation management, combined with mowing vegetation over 30cm high, which promotes the spread of aggressive weeds such as African lovegrass (Quinn et al. 1995)
- Overstocking may be detrimental to the species (NSW Scientific Committee 2004).

Significant impact criteria – Lobed blue-grass

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of an important population of a species*

   This species was not identified within the proposed alignment during field surveys. However, the species range is known to overlap with the project area. In addition, soil types suitable for this species and potential habitat are present within the southern sections of the proposed alignment.

   Potential impacts from gas pipeline construction are likely to be limited to the loss of habitat. Mitigation measures designed to reduce impacts associated with construction activities are detailed in Volume 5 Attachment 15 and include pre-clearing surveys to determine the location of threatened species prior to construction and threatened species management guidelines developed accordingly.

   If disturbance to a known population of this species is unavoidable relevant permits and disturbance conditions from DERM will be obtained. Design and implement a translocation plan according to Australian Network for Plant Conservation (2004) (Tables N1 - N4 of Appendix N in Volume 5 Attachment 14). If offsets are necessary they will be made by agreement with DERM. DEWHA would be required to confirm the appropriateness of this approach.

   The combination of avoidance where possible, translocation and or habitat offset is considered sufficient to mitigate any possible decline in this species.

2. *Reduce the area of occupancy of an important population*

   The relatively narrow configuration of proposed clearing for the Project is unlikely to significantly reduce the area of occupancy of this species. This is particularly true if translocation plans and appropriate offsets recommended above are implemented.

   Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

3. *Fragment an existing population into two or more populations*

   The relatively narrow configuration of proposed clearing combined with the discrete compact areas occupied by known populations of this species makes it unlikely that clearing for the Project will fragment existing populations into two or more populations.

   Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

4. *Adversely affect habitat critical to the survival of a species*

   Habitat for this species is not listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act.

   Whilst habitat on site may be suitable for the species it is not considered to be habitat critical to the survival of the species, that is, the habitat is not considered to be critical habitat for activities such as breeding or dispersal, for the long-term maintenance of the species, to maintain genetic diversity and long term evolutionary development, or for the reintroduction of populations or recovery of the species.

5. *Disrupt the breeding cycle of an important population.*

   As described above, if the species exists on the project site it is likely to be a small, isolated population. Therefore, whilst the Project may impact upon individuals it is unlikely to significant impact the breeding cycle of this species within the broader context.

   In addition, the relatively narrow vegetation clearing proposed during the Project is unlikely to significantly disrupt the breeding cycle of a population of this species.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   The relatively small amount of proposed clearing and appropriate offsets of habitat made, following consultation with DEWHA and DERM, for actual habitat lost will make it unlikely that the proposed action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline in the long-term.

7. *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

   The Project has the potential to introduce and spread invasive weed species through vehicular movement and exposure of soil surface during clearing. An EM Plan for the clearing, construction, and operation of the Project is recommended in Volume 5 Attachment 15, the requirements for measures to be included within this EM Plan are considered sufficient to prevent negative impacts of invasive species as a result of the Project.

8. *Introduce disease that may cause the species to decline*

   The Project has the potential to introduce and spread plant diseases which may detrimentally impact upon this species however within the implementation of management measures this potential impact would be minimised. The implementation of a biosecurity management plan is a requirement of the TOR to control and prevent the establishment of invasive species (and associated diseases) as a result of the Project.

9. *Interfere substantially with the recovery of the species*

   Preclearing surveys will aid in identifying any recovering populations of this species not identified during the initial field survey. However, the relatively narrow clearing (40m) is unlikely to interfere with the recovery of this species through direct loss or habitat loss proposed through the implementation of the Project.

King blue-grass

King blue-grass is endemic to Queensland and is listed as vulnerable under the EPBC Act. This species grows on black clay soils. It is restricted to Emerald and rarely in the Darling Downs in Queensland (DEWHA 2008). There is no recovery plan established under the EPBC Act for the management of king blue-grass. However, its main threats include broad-scale vegetation clearing, grazing and increased habitat fragmentation.

Significant impact criteria – King blue-grass

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of an important population of a species*

   This species was not identified within the proposed alignment during field surveys. However, the species range is known to overlap with the Project area. In addition, soil types suitable for this species and potential habitat are present within the southern sections of the proposed alignment.

   Potential impacts from gas pipeline construction are likely to be limited to the loss of habitat. Mitigation measures designed to reduce impacts associated with construction activities are detailed in Volume 5 Attachment 15 and include pre-clearing surveys to determine the location of threatened species prior to construction and threatened species management guidelines developed accordingly.

   If disturbance to a known population of this species is unavoidable relevant permits and disturbance conditions from DERM will be obtained. Design and implement a translocation plan according to Australian Network for Plant Conservation (2004) (Tables N1 - N4 of Appendix N in Volume 5 Attachment 14). If offsets are necessary they will be made by agreement with DERM. DEWHA would be required to confirm the appropriateness of this approach.

   The combination of avoidance where possible, translocation and or habitat offset is considered sufficient to mitigate any possible decline in this species.

2. *Reduce the area of occupancy of an important population*

   The relatively narrow configuration of proposed clearing for the Project is unlikely to significantly reduce the area of occupancy of this species. This is particularly true if translocation plans and appropriate offsets recommended above are implemented. Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

3. *Fragment an existing population into two or more populations*

   The relatively narrow configuration of proposed clearing combined with the discrete compact areas occupied by known populations of this species makes it unlikely that clearing for the Project will fragment existing populations into two or more populations. Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

4. *Adversely affect habitat critical to the survival of a species*

   Habitat for this species is not listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act. Whilst habitat on site may be suitable for the species it is not considered to be habitat critical to the survival of the species, that is, the habitat is not considered to be critical habitat for activities such as breeding or dispersal, for the long-term maintenance of the species, to maintain genetic diversity and long term evolutionary development, or for the reintroduction of populations or recovery of the species.

5. *Disrupt the breeding cycle of an important population.*

   As described above, if the species exists on the project site it is likely to be a small, isolated population. Therefore, whilst the Project may impact upon individuals it is unlikely to significant impact the breeding cycle of this species within the broader context. In addition, the relatively narrow vegetation clearing proposed during the Project is unlikely to significantly disrupt the breeding cycle of a population of this species.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   The relatively small amount of proposed clearing and appropriate offsets of habitat made, following consultation with DEWHA and DERM, for actual habitat lost will make it unlikely that the proposed action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline in the long-term.

7. *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

   The Project has the potential to introduce and spread invasive weed species through vehicular movement and exposure of soil surface during clearing.

   An EM Plan for the clearing, construction, and operation of the Project is recommended Volume 5 Attachment 15, the requirements for measures to be included within this EM Plan are considered sufficient to prevent negative impacts of invasive species as a result of the Project.

8. *Introduce disease that may cause the species to decline*

   The Project has the potential to introduce and spread plant diseases which may detrimentally impact upon this species however within the implementation of management measures this potential impact would be minimised.

   The implementation of a biosecurity management plan is a requirement of the TOR to control and prevent the establishment of invasive species (and associated diseases) as a result of the Project.

9. *Interfere substantially with the recovery of the species*

   Preclearing surveys will aid in identifying any recovering populations of this species not identified during the initial field survey.

   However, the relatively narrow clearing (40m) is unlikely to interfere with the recovery of this species through direct loss or habitat loss proposed through the implementation of the Project.

Tricolor diurus

The tricolour diuris is listed as vulnerable under the EPBC Act. It occurs from Toowoomba in Queensland through to Victoria, where a single plant was recorded in 2006 (Jones 2006). It is sporadically distributed along the western slopes in New South Wales, while in Queensland it occurs on the Darling Downs (Clements 2008).

Although population figures for the tricolour diuris are unavailable, the species is widespread and may be locally common (Jones 2006). The tricolour diuris grows in dry sclerophyll woodland and sclerophyll forest among grasses, often with *Callitris*. Soils are often sandy or lateritic, while landform ranges from flat to low laterite hills (Jones 2006).

There is no recovery plan established under the EPBC Act for the management of the tricolour diuris. However, its main threats are (NSW NPWS 2003; NSW Scientific Committee 2007):

- Clearing of vegetation (small-scale residential associated, through to broad-scale open-cut coal mining associated)
- Weed invasion, including by Rhodes grass, African love grass and coolatai grass
- Grazing by domestic stock
- Feral pigs disturbing or eating orchid tubers and
- Illegal collection.

Significant impact criteria – Tricolour diurus

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of an important population of a species*

   This species was not identified within the proposed alignment during field surveys. However, the species range is known to overlap with the Project area. In addition, soil types suitable for this species and potential habitat are present within the southern sections of the proposed alignment.

   Potential impacts from gas pipeline construction are likely to be limited to the loss of habitat. Mitigation measures designed to reduce impacts associated with construction activities are detailed in Volume 5 Attachment 15 and include pre-clearing surveys to determine the location of threatened species prior to construction and threatened species management guidelines developed accordingly.

   If disturbance to a known population of this species is unavoidable relevant permits and disturbance conditions from DERM will be obtained. Design and implement a translocation plan according to Australian Network for Plant Conservation (2004) (Tables N1 - N4 of Appendix N in Volume 5 Attachment 14). If offsets are necessary they will be made by agreement with DERM. DEWHA would be required to confirm the appropriateness of this approach. The combination of avoidance where possible, translocation and or habitat offset is considered sufficient to mitigate any possible decline in this species.

2. *Reduce the area of occupancy of an important population*

   The relatively narrow configuration of proposed clearing for the Project is unlikely to significantly reduce the area of occupancy of this species. This is particularly true if translocation plans and appropriate offsets recommended above are implemented. Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

3. *Fragment an existing population into two or more populations*

   The relatively narrow configuration of proposed clearing combined with the discrete compact areas occupied by known populations of this species makes it unlikely that clearing for the Project will fragment existing populations into two or more populations. Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

4. *Adversely affect habitat critical to the survival of a species*

   Habitat for this species is not listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act. Whilst habitat on site may be suitable for the species it is not considered to be habitat critical to the survival of the species, that is, the habitat is not considered to be critical habitat for activities such as breeding or dispersal, for the long-term maintenance of the species, to maintain genetic diversity and long term evolutionary development, or for the reintroduction of populations or recovery of the species.

5. *Disrupt the breeding cycle of an important population*

   If this species exists on the project site, it is likely to be a small, isolated population. Therefore, whilst the Project may impact upon individuals, it is unlikely to significant impact upon the breeding cycle of this species in the broader context in the long term.

   In addition, the relatively narrow vegetation clearing proposed during the Project is unlikely to significantly disrupt the breeding cycle of a population of this species.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   The relatively small amount of proposed clearing and appropriate offsets of habitat made, following consultation with DEWHA and DERM, for actual habitat lost will make it unlikely that the proposed action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline in the long-term.

7. *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

   The Project has the potential to introduce and spread invasive weed species through vehicular movement and exposure of soil surface during clearing. An EM Plan for the clearing, construction, and operation of the Project is recommended in Volume 5 Attachment 15 the requirements for measures to be included within this EM Plan are considered sufficient to prevent negative impacts of invasive species as a result of the Project.

8. *Introduce disease that may cause the species to decline*

   The Project has the potential to introduce and spread plant diseases which may detrimentally impact upon this species, but with the implementation of management measures this potential impact would be minimised. The implementation of a biosecurity management plan is a requirement of the TOR to control and prevent the establishment of invasive species (and associated diseases) as a result of the Project.

9. *Interfere substantially with the recovery of the species*

   The relatively narrow clearing (40m), proposed offsets and translocation plans are considered sufficient to compensate for any proposed interference with the recovery of this species through direct loss or habitat loss proposed through the implementation of the Project.

Belson's panic grass

Belson's panic grass (*Homopholis belsonii*) is listed as vulnerable under the EPBC Act. It occurs within the Brigalow Belt South in Queensland, and on the north-western slopes and plains of New South Wales (Trémont and Whalley 1993; Menkins 1998). In Queensland, it has been recorded in the Darling Downs area, near Oakey, Jondaryan, Bowenville, Dalby, Acland, Sabine, Quinalow,

Goombungee, Gurulmundi and Millmerran, and further west between Miles and Roma (Queensland Herbarium 2008).

Homopholis belsonii occurs at elevations ranging from 200m to 520m above sea level (Trémont and Whalley 1993; Menkins 1998). It is known to occur in dry woodland habitats on poor soils, such as those derived from basalt. It occurs on rocky hills supporting white box, as well as in wilga woodland, on flat to gently undulating alluvial areas supporting belah forest (Trémont and Whalley 1993; NSW DECC 2005a), and in soils and plant communities of poplar box woodlands (Leigh et al. 1984; Menkins 1998).

It may also be associated with shadier areas of brigalow, myall and weeping myall communities. It is generally found among fallen timber at the base of trees or shrubs, among branches and leaves of trees hanging to ground level, or along the bottom of netting fences (Trémont and Whalley 1993).

There is currently no recovery plan established under the EPBC Act for the management of *Homopholis belsonii*. However, its main threats are:

- Clearing of habitat for agriculture, development or pasture improvement, overgrazing by domestic stock, and invasion of habitat by introduced weeds (Leigh et al. 1984; Menkins 1998; NSW DECC 2005a)
- Clearing of habitat for mining (New Hope Coal Australia 2007).

Significant impact criteria – Belson's panic grass

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of an important population of a species*

   This species was not identified within the proposed alignment during field surveys. However, suitable habitate has been identified in the southern sections of the alignment. In addition, soil types suitable for this species and potential habitat are present within the southern sections of the proposed alignment.

   Potential impacts from gas pipeline construction are likely to be limited to the loss of habitat. Mitigation measures designed to reduce impacts associated with construction activities are detailed in Volume 5 Attachment 15 and include pre-clearing surveys to determine the location of threatened species prior to construction and threatened species management guidelines developed accordingly.

   If disturbance to a known population of this species is unavoidable relevant permits and disturbance conditions from DERM will be obtained. Design and implement a translocation plan according to Australian Network for Plant Conservation (2004) (Tables N1 - N4 of Appendix N in Volume 5 Attachment 14). If offsets are necessary they will be made by agreement with DERM. DEWHA would be required to confirm the appropriateness of this approach.

   The combination of avoidance where possible, translocation and or habitat offset is considered sufficient to mitigate any possible decline in this species.

2. *Reduce the area of occupancy of an important population*

   The relatively narrow configuration of proposed clearing for the Project is unlikely to significantly reduce the area of occupancy of this species. This is particularly true if translocation plans and appropriate offsets recommended above are implemented. Natural regeneration of 85% of the

40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

3. *Fragment an existing population into two or more populations*

   The relatively narrow configuration of proposed clearing combined with the discrete compact areas occupied by known populations of this species makes it unlikely that clearing for the Project will fragment existing populations into two or more populations.

   Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

4. *Adversely affect habitat critical to the survival of a species*

   Habitat for this species is not listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act. Whilst habitat on site may be suitable for the species it is not considered to be habitat critical to the survival of the species, that is, the habitat is not considered to be critical habitat for activities such as breeding or dispersal, for the long-term maintenance of the species, to maintain genetic diversity and long term evolutionary development, or for the reintroduction of populations or recovery of the species.

5. *Disrupt the breeding cycle of an important population*

   If this species exists on the Project site it is likely to be as small, isolated populations. Therefore, whilst the Project may impact upon individuals, it is unlikely to significant impact upon the breeding cycle of this species in the broader context in the long term.

   In addition, the relatively narrow vegetation clearing proposed during this project is unlikely to significantly disrupt the breeding cycle of a population of this species.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   The relatively small amount of proposed clearing and appropriate offsets of habitat made, following consultation with DEWHA and DERM, for actual habitat lost will make it unlikely that the proposed action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline in the long-term.

7. *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

   The Project has the potential to introduce and spread invasive weed species through vehicular movement and exposure of soil surface during clearing. An EM Plan for the clearing, construction, and operation of the Project is recommended in Volume 5 Attachment 15 the requirements for measures to be included within this EM Plan are considered sufficient to prevent negative impacts of invasive species as a result of the Project.

8. *Introduce disease that may cause the species to decline*

   The Project has the potential to introduce and spread plant diseases which may detrimentally impact upon this species however with the implementation of management measures this potential impact would be minimised. The implementation of a biosecurity management plan is a requirement of the TOR to control and prevent the establishment of invasive species (and associated diseases) as a result of the Project.

9. *Interfere substantially with the recovery of the species*

   The relatively narrow clearing (40m), proposed offsets and translocation plans are considered sufficient to compensate for any proposed interference with the recovery of this species through direct loss or habitat loss proposed through the implementation of the Project.

Cobar greenhood orchid

The Cobar greenhood orchid is listed as vulnerable under the EPBC Act. This species is known chiefly from the Nyngan–Cobar–Bourke district in the far western plains of New South Wales. However, the species is also known from the Central West, Namoi, Western (New South Wales) Border Rivers Maranoa–Balonne, Condamine (Queensland), and South Australia Arid Lands Natural Resource Management Regions.

The Cobar greenhood orchid inhabits eucalypt woodland, open mallee or *Callitris* shrubland on low stony ridges and slopes with skeletal sandy-loam soils. Associated species include Morris' grey mallee, green mallee, gum coolibah, Manara Hills red gum, white cypress pine, wilga, belah, spearwood and *Senna* and *Eremophila* species (DECC 2008a).

There is currently no recovery plan established under the EPBC Act for the management of the Cobar greenhood orchid. However, its main threats include damage caused by feral goats, broad-scale vegetation clearing, grazing pressure, altered hydrology, increasing salinity, fragmentation and loss of remnants (Australian Natural Resources Atlas (ANRA) 2007).

Significant impact criteria – Cobar greenhood orchid

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of an important population of a species*

   This species was not identified within the proposed alignment during field surveys. However, the species range is known to overlap with the Project area. In addition, soil types suitable for this species and potential habitat are present within the southern sections of the proposed alignment.

   Potential impacts from gas pipeline construction are likely to be limited to the loss of habitat. Mitigation measures designed to reduce impacts associated with construction activities are detailed in Volume 5 Attachment 15 and include pre-clearing surveys to determine the location of threatened species prior to construction and threatened species management guidelines developed accordingly. If disturbance to a known population of this species is unavoidable relevant permits and disturbance conditions from DERM will be obtained. Design and implement a translocation plan according to Australian Network for Plant Conservation (2004) (Tables N1 - N4 of Appendix N in Volume 5 Attachment 14). If offsets are necessary they will be made by agreement with DERM. DEWHA would be required to confirm the appropriateness of this approach.

   The combination of avoidance where possible, translocation and or habitat offset is considered sufficient to mitigate any possible decline in this species.

2. *Reduce the area of occupancy of an important population*

   The relatively narrow configuration of proposed clearing for the Project is unlikely to significantly reduce the area of occupancy of this species. This is particularly true if translocation plans and

appropriate offsets recommended above are implemented. Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

3. *Fragment an existing population into two or more populations*

   The relatively narrow configuration of proposed clearing combined with the discrete compact areas occupied by known populations of this species makes it unlikely that clearing for the Project will fragment existing populations into two or more populations.

   Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

4. *Adversely affect habitat critical to the survival of a species*

   Habitat for this species is not listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act. Whilst habitat on site may be suitable for the species it is not considered to be habitat critical to the survival of the species, that is, the habitat is not considered to be critical habitat for activities such as breeding or dispersal, for the long-term maintenance of the species, to maintain genetic diversity and long term evolutionary development, or for the reintroduction of populations or recovery of the species.

5. *Disrupt the breeding cycle of an important population.*

   If this species exists on the Project site, it is likely to be as a small, isolated population. Therefore, whilst the Project may impact upon individuals it is unlikely to significant impact upon the breeding cycle of this species in the broader context.

   In addition, the relatively narrow vegetation clearing proposed during the Project is unlikely to significantly disrupt the breeding cycle of a population of this species.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   The relatively small amount of proposed clearing and appropriate offsets of habitat made, following consultation with DEWHA and DERM, for actual habitat lost will make it unlikely that the proposed action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline in the long-term.

7. *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

   The Project has the potential to introduce and spread invasive weed species through vehicular movement and exposure of soil surface during clearing. An EM Plan for the clearing, construction, and operation of the Project is recommended in Volume 5 Attachment 15 the requirements for measures to be included within this EM Plan are considered sufficient to prevent negative impacts of invasive species as a result of the Project.

8. *Introduce disease that may cause the species to decline*

   The Project has the potential to introduce and spread plant diseases which may detrimentally impact upon this species, however with the implementation of management measures this potential impact would be minimised. The implementation of a biosecurity management plan is a requirement of the TOR to control and prevent the establishment of invasive species (and associated diseases) as a result of the Project.

9. *Interfere substantially with the recovery of the species*

   The relatively narrow clearing (40m), proposed offsets and translocation plans are considered sufficient to compensate for any proposed interference with the recovery of this species through direct loss or habitat loss proposed through the implementation of the Project.

Chinchilla wattle

The Chinchilla wattle is listed as vulnerable under the EPBC Act and is endemic to the Chinchilla region of Queensland. *Acacia chinchillensis* is recorded from more than 29 locations in Queensland, covering a range of 200km from just north of Chinchilla, as far east as Cecil Plains, and as far west as Tara. A further outlying population was recently discovered to the south, near Karara, west of Warwick (Queensland Herbarium 2007b).

The species occurs on gently undulating flat plains at 340 to 380m above sea level. It flourishes in deep loamy sands to sandy loam soils with sandy clay subsoils, often with poor drainage and low nutrient levels (Halford 1995). It occurs in a mid to dense shrub layer in open forest, with narrow-leaved red ironbark, smooth-barked apple and Pilliga grey box. It is often associated with buloke, black cypress pine, white cypress pine and white feather honey-myrtle.

The understorey often includes *Acacia crassa, A. conferta, A. muelleriana, honey gorse* (*Melichrus urceolatus*) and *Mirbelia pungens* along with grasses, most commonly *Aristida* species, *Calyptochloa gracillima* and barbwire grass (*Cymbopogon refractus*).

There is currently no recovery plan established under the EPBC Act for the management of the Chinchilla wattle. However, its main threats are destruction of habitat by clearing, and inappropriate fire regimes (Barker 1995).

Populations occurring in areas of remnant vegetation, as defined under the VMA, are currently protected from broad scale clearing, including all populations occurring in State forests. Populations occurring in the Tara and Millmerran shires are spread over crown land (road reserve) or freehold tenure.

Anecdotal evidence suggests loss of habitat at two of the sites due to road development and some clearing for cultivation (Halford 1995). However, Johnson (2003) observed for one population that clearing on its own, without land use change, did not adversely affect population numbers or available habitat for the species.

Significant impact criteria – Chinchilla wattle

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of an important population of a species*

   This species was not identified within the proposed alignment during field surveys. However, the species range is known to overlap with the Project area. In addition, soil types suitable for this species and potential habitat are present within the southern sections of the proposed alignment.

   Potential impacts from gas pipeline construction are likely to be limited to the loss of habitat. Mitigation measures designed to reduce impacts associated with construction activities are detailed in Volume 5 Attachment 15 and include pre-clearing surveys to determine the location of threatened species prior to construction and threatened species management guidelines developed accordingly.

If disturbance to a known population of this species is unavoidable relevant permits and disturbance conditions from DERM will be obtained. Design and implement a translocation plan according to Australian Network for Plant Conservation (2004) (Tables N1 - N4 of Appendix N in Volume 5 Attachment 14). If offsets are necessary they will be made by agreement with DERM. DEWHA would be required to confirm the appropriateness of this approach.

The combination of avoidance where possible, translocation and or habitat offset is considered sufficient to mitigate any possible decline in this species.

2. *Reduce the area of occupancy of an important population*

   The relatively narrow configuration of proposed clearing for the Project is unlikely to significantly reduce the area of occupancy of this species. This is particularly true if translocation plans and appropriate offsets recommended above are implemented. Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

3. *Fragment an existing population into two or more populations*

   The relatively narrow configuration of proposed clearing combined with the discrete compact areas occupied by known populations of this species makes it unlikely that clearing for the Project will fragment existing populations into two or more populations. Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

4. *Adversely affect habitat critical to the survival of a species*

   Habitat for this species is not listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act. Whilst habitat on site may be suitable for the species it is not considered to be habitat critical to the survival of the species, that is, the habitat is not considered to be critical habitat for activities such as breeding or dispersal, for the long-term maintenance of the species, to maintain genetic diversity and long term evolutionary development, or for the reintroduction of populations or recovery of the species.

5. *Disrupt the breeding cycle of an important population.*

   If this species exists on the Project site it is likely to be as isolated individuals. Therefore, whilst the Project may impact upon individuals, it is unlikely to significant impact upon the breeding cycle of this species in the broader context. In addition, the relatively narrow vegetation clearing proposed during the Project is unlikely to significantly disrupt the breeding cycle of a population of this species.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   The relatively small amount of proposed clearing and appropriate offsets of habitat made, following consultation with DEWHA and DERM, for actual habitat lost will make it unlikely that the proposed action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline in the long-term.

7. *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

   The Project has the potential to introduce and spread invasive weed species through vehicular movement and exposure of soil surface during clearing. An EM Plan for the clearing,

construction, and operation of the Project is recommended in Volume 5 Attachment 15 the requirements for measures to be included within this EM Plan are considered sufficient to prevent negative impacts of invasive species as a result of the Project.

8. *Introduce disease that may cause the species to decline*

   The Project has the potential to introduce and spread plant diseases which may detrimentally impact upon this species, however with the implementation of management measures this potential impact would be minimised. The implementation of a biosecurity management plan is a requirement under the TOR to control and prevent the establishment of invasive species (and associated diseases) as a result of the Project.

9. *Interfere substantially with the recovery of the species*

   Due to the lack of known populations on and adjacent to the Project site and the geographical isolation from large, well established populations on mainland Australia, the Project and associated activities are not considered that the development of the Project will interfere substantially with the recovery of the species.

Curly-bark wattle

The curly-bark wattle is endemic to New South Wales and Queensland and is listed as vulnerable under the EPBC Act. The curly-bark wattle is known from three separate areas – Lake Cargelligo and Gunderbooka Range near Bourke in New South Wales, and Gurulmundi in Queensland. The preferred habitat of this species consists of dry sclerophyll forests and semi-arid woodlands.

There is currently no recovery plan established under the EPBC Act for the management of this species. However, its main threats include (NSW DECC 2005b):

- Habitat erosion
- Grazing, browsing and horning of adult and seedling plants by feral goats, and grazing by stock, rabbits (Oryctolagus cuniculus) and macropods
- Clearing of vegetation for fire trail widening
- Quarrying activities at the Shephards Hill and Gurulmundi sites
- Predation of seeds by insects causing a large number of seeds to be non-viable
- Lack of suitable fire disturbance for seedling establishment.

Significant impact criteria – Curly-bark wattle

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of an important population of a species*

   This species was not identified within the proposed alignment during survey efforts although its range is known to overlap with the southern section of the Project area. In addition, database records indicate that this species is known to occur with 5km of the alignment (QLD Herbarium 2009).

   Potential impacts from gas pipeline construction are likely to be limited to the loss of habitat. Mitigation measures designed to reduce impacts associated with construction activities are detailed in Volume 5 Attachment 15 and include pre-clearing surveys to determine the location

of threatened species prior to construction and threatened species management guidelines developed accordingly.

If disturbance to a known population of this species is unavoidable relevant permits and disturbance conditions from DERM will be obtained. Design and implement a translocation plan according to Australian Network for Plant Conservation (2004) (Tables N1 - N4 of Appendix N in Volume 5 Attachment 14). If offsets are necessary they will be made by agreement with DERM. DEWHA would be required to confirm the appropriateness of this approach.

The combination of avoidance where possible, translocation and or habitat offset is considered sufficient to mitigate any possible decline in this species.

2. *Reduce the area of occupancy of an important population*

   The relatively narrow configuration of proposed clearing for the Project is unlikely to significantly reduce the area of occupancy of this species.

   This is particularly true if translocation plans and appropriate offsets recommended above are implemented. Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

3. *Fragment an existing population into two or more populations*

   The relatively narrow configuration of proposed clearing combined with the discrete compact areas occupied by known populations of this species makes it unlikely that clearing for the Project will fragment existing populations into two or more populations. Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

4. *Adversely affect habitat critical to the survival of a species*

   Habitat for this species is not listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act.

   Whilst habitat on site may be suitable for the species it is not considered to be habitat critical to the survival of the species, that is, the habitat is not considered to be critical habitat for activities such as breeding or dispersal, for the long-term maintenance of the species, to maintain genetic diversity and long term evolutionary development, or for the reintroduction of populations or recovery of the species.

5. *Disrupt the breeding cycle of an important population.*

   If this species exists on the Project site, it is likely to be as isolated individuals. Therefore, whilst the Project may impact upon these individuals, it is unlikely to significant impact upon the breeding cycle of this species in the broader context. In addition, the relatively narrow vegetation clearing proposed during the Project is unlikely to significantly disrupt the breeding cycle of a population of this species.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   The relatively small amount of proposed clearing and appropriate offsets of habitat made, following consultation with DEWHA and DERM, for actual habitat lost will make it unlikely that the proposed action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline in the long-term.

7. *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

   The Project has the potential to introduce and spread invasive weed species through vehicular movement and exposure of soil surface during clearing. An EM Plan for the clearing, construction, and operation of the Project is recommended in Volume 5 Attachment 15 the requirements for measures to be included within this EM Plan are considered sufficient to prevent negative impacts of invasive species as a result of the Project.

8. *Introduce disease that may cause the species to decline*

   The Project has the potential to introduce and spread plant diseases which may detrimentally impact upon this species however with the implementation of management measures this potential impact would be minimised. The implementation of a biosecurity management plan is a requirement of the TOR to control and prevent the establishment of invasive species (and associated diseases) as a result of the Project.

9. *Interfere substantially with the recovery of the species*

   The relatively narrow clearing (40m), proposed offsets and translocation plans are considered sufficient to compensate for any proposed interference with the recovery of this species through direct loss or habitat loss proposed through the implementation of the Project.

Yarwun whitewood

The Yarwun whitewood is endemic to Queensland and is listed as endangered under the EPBC Act. It is known from only two populations – west of Gladstone at Yarwun, where only 10 trees of an even age survive, and near Ubobo, west of Miriam Vale, Queensland. The species has an extent of occurrence of 750km² and occurs in semi-evergreen vine thicket on hill sides in dark clay soils (Queensland Herbarium 2008). Both sites occur in non-remnant vegetation as defined under the VMA, and therefore do not have protection from broad-scale clearing.

The distribution of this species overlaps with the semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions EPBC Act-listed threatened ecological community.

There is currently no recovery plan established under the EPBC Act for the management of the Yarwun whitewood. However, the main threats are its low numbers and lack of long term security.

At the Yarwun site, the 10 trees occur in a partially cleared and highly disturbed site where cattle graze (Barry and Thomas 1994). The southern population also occurs on partially cleared land.

Significant impact criteria – Yarwun whitewood

An action is likely to have a significant impact on an Endangered species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of a population*

   This species was not identified within the proposed alignment during survey efforts although its range is known to overlap with the southern section of the Project area and small areas of suitable habitat are scattered throughout the alignment.

   Potential impacts from gas pipeline construction are likely to be limited to the loss of habitat. Mitigation measures designed to reduce impacts associated with construction activities are detailed in Volume 5 Attachment 15 and include pre-clearing surveys to determine the location

of threatened species prior to construction and threatened species management guidelines developed accordingly.

If disturbance to a known population of this species is unavoidable relevant permits and disturbance conditions from DERM will be obtained. Design and implement a translocation plan according to Australian Network for Plant Conservation (2004) (Tables N1 - N4 of Appendix N in Volume 5 Attachment 14). If offsets are necessary they will be made by agreement with DERM. DEWHA would be required to confirm the appropriateness of this approach.

The combination of avoidance where possible, translocation and or habitat offset is considered sufficient to mitigate any possible decline in this species.

2. *Reduce the area of occupancy of the species*

   The relatively narrow configuration of proposed clearing for the Project is unlikely to significantly reduce the area of occupancy of this species. This is particularly true if translocation plans and appropriate offsets recommended above are implemented. Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

3. *Fragment an existing population into two or more populations*

   The relatively narrow configuration of proposed clearing combined with the discrete compact areas occupied by known populations of this species makes it unlikely that clearing for the Project will fragment existing populations into two or more populations. Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

4. *Adversely affect habitat critical to the survival of a species*

   Habitat for this species is not listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act. Whilst habitat on site may be suitable for the species it is not considered to be habitat critical to the survival of the species, that is, the habitat is not considered to be critical habitat for activities such as breeding or dispersal, for the long-term maintenance of the species, to maintain genetic diversity and long term evolutionary development, or for the reintroduction of populations or recovery of the species.

5. *Disrupt the breeding cycle of a population*

   If this species exists on the Project site it is likely to be as isolated individuals. Therefore, whilst the Project may impact upon these individuals, it is unlikely to significant impact upon the breeding cycle of this species in the broader context. In addition, the relatively narrow vegetation clearing proposed during the Project is unlikely to significantly disrupt the breeding cycle of a population of this species.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   The relatively small amount of proposed clearing and appropriate offsets of habitat following consultation with DEWHA for actual habitat lost will make it unlikely that the proposed action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline in the long-term.

7. *Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat*

   The Project has the potential to introduce and spread invasive weed species through vehicular movement and exposure of soil surface during clearing. An EM Plan for the clearing, construction, and operation of the Project is recommended in Volume 5 Attachment 15 the requirements for measures to be included within this EM Plan are considered sufficient to prevent negative impacts of invasive species as a result of the Project.

8. *Introduce disease that may cause the species to decline*

   The Project has the potential to introduce and spread plant diseases which may detrimentally impact upon this species, however with the implementation of management measures this potential impact would be minimised. The implementation of a biosecurity management plan is a requirement of the TOR to control and prevent the establishment of invasive species (and associated diseases) as a result of the Project.

9. *Interfere substantially with the recovery of the species*

   The relatively narrow clearing (40m), proposed offsets and translocation plans are considered sufficient to compensate for any proposed interference with the recovery of this species through direct loss or habitat loss proposed through the implementation of the Project.

Heart-leaved bosistoa

The heart-leaved bosistoa (*Bosistoa selwynii syn. B. selywnii*) is listed as vulnerable under the EPBC Act. The species is known from the Richmond River in New South Wales to Mt Larcom near Gladstone in Queensland. Population information is currently unavailable. The heart-leaved bosistoa grows in wet sclerophyll forest, dry sclerophyll forest and rainforest up to 300m in altitude. Associated vegetation includes booyong, red lilly pilly (*Syzygium hodgkinsoniae*), hairy walnut (*Endiandra pubens*), shiny-leaved stinging tree (*Dendrocnide photinophylla*), southern satinash (*Acmena ingens*), native tamarind (*Diploglottis australis*) and ebony (*Diospyros mabacea*) (BRI n.d.).

There is no recovery plan established under the EPBC Act for the management of the heart-leaved bosistoa. However, its main threats include habitat loss and degradation through clearing, fragmentation and disturbance, weed invasion, grazing by domestic stock, inappropriate fire, and timber harvesting (TSSC 2010).

Significant impact criteria – Heart-leaved bosistoa

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of an important population of a species*

   This species was not identified within the proposed alignment during survey efforts although its range is known to overlap with the Project area and small areas of suitable habitat are scattered throughout the alignment, particularly in the right of way. In addition, database records indicate that this species is known from eight locations with a distance of 5km from the alignment within the Mt Larcom area (Queensland Herbarium 2009).

   Potential impacts from gas pipeline construction are likely to be limited to the loss of habitat. Mitigation measures designed to reduce impacts associated with construction activities are

detailed in Volume 5 Attachment 15 and include pre-clearing surveys to determine the location of threatened species prior to construction.

If this species is identified a species translocation plan and offsets program will be developed in consultation with DEWHA and DERM. If the species is identified and disturbance is unavoidable, an application to DEWHA for disturbance is recommended. The design and implementation of a translocation plan will be in according with the Australian Network for Plant Conservation (2004).

Pre-clearing surveys will identify any populations of this species not observed during the initial field surveys. In addition, a threatened species management plan detailing species not known to occur within the right of way.will be submitted to all construction personnel. This is considered adequate to prevent a long-term decrease in the overall population of this species.

2. *Reduce the area of occupancy of an important population*

   The relatively narrow configuration of proposed clearing for the Project is unlikely to significantly reduce the area of occupancy of this species. This is particularly true if translocation plans and appropriate offsets recommended above are implemented. Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

3. *Fragment an existing population into two or more populations*

   The relatively narrow configuration of proposed clearing combined with the discrete compact areas occupied by known populations of this species makes it unlikely that clearing for the Project will fragment existing populations into two or more populations. Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

4. *Adversely affect habitat critical to the survival of a species*

   Habitat for this species is not listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act.

   Whilst habitat on site may be suitable for the species it is not considered to be habitat critical to the survival of the species, that is, the habitat is not considered to be critical habitat for activities such as breeding or dispersal, for the long-term maintenance of the species, to maintain genetic diversity and long term evolutionary development, or for the reintroduction of populations or recovery of the species.

5. *Disrupt the breeding cycle of an important population*

   If this species exists on the Project site it is likely to be as isolated individuals. Therefore, whilst the Project may impact upon these individuals, it is unlikely to significant impact upon the breeding cycle of this species in the broader context.

   In addition, the relatively narrow vegetation clearing proposed during the Project is unlikely to significantly disrupt the breeding cycle of a population of this species.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   The relatively small amount of proposed clearing, combined with appropriate offsets of habitat made following consultation with DEWHA and DERM for actual habitat lost will make it unlikely

that the proposed action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline in the long-term.

7. *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

   The Project has the potential to introduce and spread invasive weed species through vehicular movement and exposure of soil surface during clearing. An EM Plan for the clearing, construction, and operation of the Project is recommended in Volume 5 Attachment 15, the requirements for measures to be included within this EM Plan are considered sufficient to prevent negative impacts of invasive species as a result of the Project.

8. *Introduce disease that may cause the species to decline*

   The Project has the potential to introduce and spread plant diseases which may detrimentally impact upon this species, however with the implementation of management measures this potential impact would be minimised. The implementation of a biosecurity management plan is requirement under the TOR to control and prevent the establishment of invasive species (and associated diseases) as a result of the Project.

9. *Interfere substantially with the recovery of the species*

   The relatively narrow clearing (40m), proposed offsets and translocation plans are considered sufficient to compensate for any proposed interference with the recovery of this species through direct loss or habitat loss proposed through the implementation of the Project.

Gurulmundi fringe myrtle

The Gurulmundi fringe myrtle is endemic to Queensland and is listed as vulnerable under the EPBC Act. The species is known from the Gurulmundi, Guluguba and Barakula areas of Queensland. This species occurs on ridge tops in open scrubland with sparse stunted *Eucalyptus* spp, *Acacia* spp, and *Casuarina* in *Triodia*-hummock grassland with scattered shrubs. It also occurs on yellow lateritic sandy clay, shallow red gravelly soil and sandstone (Craven 1987).

There is currently no recovery plan established under the EPBC Act for the management of the Gurulmundi fringe myrtle. However, its main threats include vegetation clearing, increasing fragmentation and loss of remnants, changed fire regimes, quarrying and inappropriate timber harvesting (ANRA 2007).

Significant impact criteria – Gurulmundi fringe myrtle

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of an important population of a species*

   This species was not identified within the proposed alignment during survey efforts although its range is known to overlap with the Project area. In addition, the species is known from three locations near the Guluguba and Gurlumundi areas (QLD Herbarium) located within 5km of the proposed alignment. Suitable habitat for this species exists within the southern portion of the alignment.

   Potential impacts from gas pipeline construction are likely to be limited to the loss of habitat. Mitigation measures designed to reduce impacts associated with construction activities are detailed in Volume 5 Attachment 15 and include pre-clearing surveys to determine the location

of threatened species prior to construction and threatened species management guidelines developed accordingly.

If disturbance to a known population of this species is unavoidable relevant permits and disturbance conditions from DERM will be obtained. Design and implement a translocation plan according to Australian Network for Plant Conservation (2004) (Tables N1 - N4 of Appendix N in Volume 5 Attachment 14). If offsets are necessary they will be made by agreement with DERM. DEWHA would be required to confirm the appropriateness of this approach.

The combination of avoidance where possible, translocation and or habitat offset is considered sufficient to mitigate any possible decline in this species.

2. *Reduce the area of occupancy of an important population*

   The relatively narrow configuration of proposed clearing for the Project is unlikely to significantly reduce the area of occupancy of this species. This is particularly true if translocation plans and appropriate offsets recommended above are implemented. Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

3. *Fragment an existing population into two or more populations*

   The relatively narrow configuration of proposed clearing combined with the discrete compact areas occupied by known populations of this species makes it unlikely that clearing for the Project will fragment existing populations into two or more populations. Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

4. *Adversely affect habitat critical to the survival of a species*

   Habitat for this species is not listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act.

   Whilst habitat on site may be suitable for the species it is not considered to be habitat critical to the survival of the species, that is, the habitat is not considered to be critical habitat for activities such as breeding or dispersal, for the long-term maintenance of the species, to maintain genetic diversity and long term evolutionary development, or for the reintroduction of populations or recovery of the species.

5. *Disrupt the breeding cycle of an important population.*

   If this species exists on the Project site it is likely to be as an isolated individual or population. Therefore, whilst the Project may impact upon these individuals, it is unlikely to significant impact upon the breeding cycle of this species in the broader context.

   In addition, the relatively narrow vegetation clearing proposed during the Project is unlikely to significantly disrupt the breeding cycle of a population of this species.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   The relatively small amount of proposed clearing and appropriate offsets of habitat made, following consultation with DEWHA and DERM, for actual habitat lost will make it unlikely that the proposed action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline in the long-term.

7. *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

   The Project has the potential to introduce and spread invasive weed species through vehicular movement and exposure of soil surface during clearing. An EM Plan for the clearing, construction, and operation of the Project is recommended in Volume 5 Attachment 15, the requirements for measures to be included within this EM Plan are considered sufficient to prevent negative impacts of invasive species as a result of the Project.

8. *Introduce disease that may cause the species to decline*

   The Project has the potential to introduce and spread plant diseases which may detrimentally impact upon this species however with the implementation of management measures this potential impact would be minimised. The implementation of a biosecurity management plan is a requirement under the TOR to control and prevent the establishment of invasive species (and associated diseases) as a result of the Project.

9. *Interfere substantially with the recovery of the species*

   The relatively narrow clearing (40m), proposed offsets and translocation plans are considered sufficient to compensate for any proposed interference with the recovery of this species through direct loss or habitat loss proposed through the implementation of the Project.

Commersonia

Commersonia argentea is listed as vulnerable under the EPBC Act. Initially, only a small area was known to occur at Cadarga, near Chinchilla in southeast Queensland. It is now known to be more widespread, occurring from near Injune and west along the Great Dividing Range towards Tambo in central Queensland.

There is currently no recovery plan established under the EPBC Act for the management of this species, and threatening processes are currently unknown.

Significant impact criteria – Commersonia

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of an important population of a species*

   This species was not identified within the proposed alignment during survey efforts although its range is known to overlap with the Project area. Suitable habitat for this species exists within the southern portion of the alignment.

   Potential impacts from gas pipeline construction are likely to be limited to the loss of habitat. Mitigation measures designed to reduce impacts associated with construction activities are detailed in Volume 5 Attachment 15, and include pre-clearing surveys to determine the location of threatened species prior to construction and threatened species management guidelines developed accordingly.

   If disturbance to a known population of this species is unavoidable relevant permits and disturbance conditions from DERM will be obtained. Design and implement a translocation plan according to Australian Network for Plant Conservation (2004) (Tables N1 - N4 of Appendix N in Volume 5 Attachment 14). If offsets are necessary they will be made by agreement with DERM. DEWHA would be required to confirm the appropriateness of this approach.

The combination of avoidance where possible, translocation and or habitat offset is considered sufficient to mitigate any possible decline in this species.

2. *Reduce the area of occupancy of an important population*

   The relatively narrow configuration of proposed clearing for the Project is unlikely to significantly reduce the area of occupancy of this species. This is particularly true if translocation plans and appropriate offsets recommended above are implemented.

   Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

3. *Fragment an existing population into two or more populations*

   The relatively narrow configuration of proposed clearing combined with the discrete compact areas occupied by known populations of this species makes it unlikely that clearing for the Project will fragment existing populations into two or more populations. Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

4. *Adversely affect habitat critical to the survival of a species*

   Habitat for this species is not listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act. Whilst habitat on site may be suitable for the species it is not considered to be habitat critical to the survival of the species, that is, the habitat is not considered to be critical habitat for activities such as breeding or dispersal, for the long-term maintenance of the species, to maintain genetic diversity and long term evolutionary development, or for the reintroduction of populations or recovery of the species.

5. *Disrupt the breeding cycle of an important population*

   If this species exists on the Project site it is likely to be as isolated individuals. Therefore, whilst the Project may impact upon these individuals, it is unlikely to significant impact upon the breeding cycle of this species in the broader context.

   In addition, the relatively narrow vegetation clearing proposed during the Project is unlikely to significantly disrupt the breeding cycle of a population of this species.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   The relatively small amount of proposed clearing and appropriate offsets of habitat made following consultation with DEWHA for actual habitat lost will make it unlikely that the proposed action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline in the long-term.

7. *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

   The Project has the potential to introduce and spread invasive weed species through vehicular movement and exposure of soil surface during clearing. An EM Plan for the clearing, construction, and operation of the Project is recommended in Volume 5 Attachment 15 the requirements for measures to be included within this EM Plan are considered sufficient to prevent negative impacts of invasive species as a result of the Project.

8. *Introduce disease that may cause the species to decline*

   The Project has the potential to introduce and spread plant diseases which may detrimentally impact upon this species however with the implementation of management measures this potential impact would be minimised. The implementation of a biosecurity management plan is a requirement of the TOR to control and prevent the establishment of invasive species (and associated diseases) as a result of the Project.

9. *Interfere substantially with the recovery of the species*

   The relatively narrow clearing (40m), proposed offsets and translocation plans are considered sufficient to compensate for any proposed interference with the recovery of this species through direct loss or habitat loss proposed through the implementation of the Project.

Wedge-leaf tuckeroo

The wedge-leaf tuckeroo is listed as vulnerable under the EPBC Act. The species is known from south-eastern Queensland over a range of approximately 450km, between Brisbane and Curtis Island (SHG 2006). The species occurs in a number of small populations throughout its range, in dry rainforest and scrubby urbanised areas on moderate to very steep slopes, scree slope gullies and rocky stream channels at elevations of 60 to 550m above sea level (Thomas and McDonald 1989).

There is currently no recovery plan established under the EPBC Act for the management of the wedge-leaf tuckeroo. However, its main threats have been identified as clearing and disturbance from activities such as roadworks and other infrastructure works. This includes associated drainage works. These activities can impact directly on the species. It also promotes canopy gaps which are readily colonised by weed species, such as *Murraya ovatifoliolata* and lantana (*Lantana camara*) which form dense thickets.

Significant impact criteria – Wedge-leaf tuckeroo

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of an important population of a species*

   This species was not identified within the proposed alignment during survey efforts although its range is known to overlap with the Project area. In addition database records indicate that the species occurs within 5km of the alignment within the Mt Larcom area (QLD Herbarium 2009). Suitable habitat does occur for this species along the wetter creek lines in the coastal areas near Gladstone.

   Potential impacts from gas pipeline construction are likely to be limited to the loss of habitat. Mitigation measures designed to reduce impacts associated with construction activities are detailed in Volume 5 Attachment 15 and include pre-clearing surveys to determine the location of threatened species prior to construction and threatened species management guidelines developed accordingly.

   If disturbance to a known population of this species is unavoidable relevant permits and disturbance conditions from DERM will be obtained. Design and implement a translocation plan according to Australian Network for Plant Conservation (2004) (Tables N1 - N4 of Appendix N in Volume 5 Attachment 14). If offsets are necessary they will be made by agreement with DERM. DEWHA would be required to confirm the appropriateness of this approach.

The combination of avoidance where possible, translocation and or habitat offset is considered sufficient to mitigate any possible decline in this species.

2. *Reduce the area of occupancy of an important population*

   The relatively narrow configuration of proposed clearing for the Project is unlikely to significantly reduce the area of occupancy of this species. This is particularly true if translocation plans and appropriate offsets recommended above are implemented.

   Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

3. *Fragment an existing population into two or more populations*

   The relatively narrow configuration of proposed clearing combined with the discrete compact areas occupied by known populations of this species makes it unlikely that clearing for the Project will fragment existing populations into two or more populations.

   Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

4. *Adversely affect habitat critical to the survival of a species*

   Habitat for this species is not listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act. Whilst habitat on site may be suitable for the species it is not considered to be habitat critical to the survival of the species, that is, the habitat is not considered to be critical habitat for activities such as breeding or dispersal, for the long-term maintenance of the species, to maintain genetic diversity and long term evolutionary development, or for the reintroduction of populations or recovery of the species.

5. *Disrupt the breeding cycle of an important population.*

   If this species exists on the Project site it is likely to be as isolated individuals or as a small population. Therefore, whilst the Project may impact upon these individuals, it is unlikely to significant impact upon the breeding cycle of this species in the broader context.

   In addition, the relatively narrow vegetation clearing proposed during the Project is unlikely to significantly disrupt the breeding cycle of a population of this species.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   The relatively small amount of proposed clearing, and appropriate offsets of habitat made, following consultation with DEWHA and DERM, for actual habitat lost will make it unlikely that the proposed action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline in the long-term.

7. *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

   The Project has the potential to introduce and spread invasive weed species through vehicular movement and exposure of soil surface during clearing. An EM Plan for the clearing, construction, and operation of the Project is recommended in Volume 5 Attachment 15, the requirements for measures to be included within this EM Plan are considered sufficient to prevent negative impacts of invasive species as a result of the Project.

8. *Introduce disease that may cause the species to decline*

   The Project has the potential to introduce and spread plant diseases which may detrimentally impact upon this species however with the implementation of management measures this potential impact would be minimised. The implementation of a biosecurity management plan is a requirement of the TOR to control and prevent the establishment of invasive species (and associated diseases) as a result of the Project.

9. *Interfere substantially with the recovery of the species*

   The relatively narrow clearing (40m), proposed offsets and translocation plans are considered sufficient to compensate for any proposed interference with the recovery of this species through direct loss or habitat loss proposed through the implementation of this project.

Small-leaved denhamia

The small-leaved denhamia is listed as vulnerable under the EPBC Act. The species is known from Eidsvold to Chinchilla and east of Kingaroy in Queensland. It occurs in roadside remnants of semi-evergreen microphyll vine thickets on red soil (Jessup 1984; BRI n.d.). There is no data available on area of occupancy of the species. Associated flora species include ooline, brigalow, *Backhousia angustifolia*, *Geijera salicifolia*, *Flindersia xanthoxyla*, crow's ash and *Cupaniopsis parvifolia* (BRI n.d.).

There is no recovery plan established under the EPBC Act for the management of this species. However, its main threats have been identified as historic broad scale vegetation clearing, changed fire regimes, invasion by exotic weeds and grazing pressure (ANRA 2007).

Significant impact criteria – Small-leaved denhamia

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of an important population of a species*

   This species was not identified within the proposed alignment during survey efforts although its range is known to overlap with the Project area. Suitable habitat does occur sporadically along the alignment route.

   Potential impacts from gas pipeline construction are likely to be limited to the loss of habitat. Mitigation measures designed to reduce impacts associated with construction activities are detailed in Volume 5 Attachment 15 and include pre-clearing surveys to determine the location of threatened species prior to construction and threatened species management guidelines developed accordingly.

   If disturbance to a known population of this species is unavoidable relevant permits and disturbance conditions from DERM will be obtained. Design and implement a translocation plan according to Australian Network for Plant Conservation (2004) (Tables N1 - N4 of Appendix N in Volume 5 Attachment 14). If offsets are necessary they will be made by agreement with DERM. DEWHA would be required to confirm the appropriateness of this approach.

   The combination of avoidance where possible, translocation and or habitat offset is considered sufficient to mitigate any possible decline in this species.

2. *Reduce the area of occupancy of an important population*

   The relatively narrow configuration of proposed clearing for the Project is unlikely to significantly reduce the area of occupancy of this species. This is particularly true if translocation plans and appropriate offsets recommended above are implemented. Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

3. *Fragment an existing population into two or more populations*

   The relatively narrow configuration of proposed clearing combined with the discrete compact areas occupied by known populations of this species makes it unlikely that clearing for the Project will fragment existing populations into two or more populations.

   Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

4. *Adversely affect habitat critical to the survival of a species*

   Habitat for this species is not listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act. Whilst habitat on site may be suitable for the species it is not considered to be habitat critical to the survival of the species, that is, the habitat is not considered to be critical habitat for activities such as breeding or dispersal, for the long-term maintenance of the species, to maintain genetic diversity and long term evolutionary development, or for the reintroduction of populations or recovery of the species.

5. *Disrupt the breeding cycle of an important population*

   If this species exists on the Project site it is likely to be as an isolated population. Therefore, whilst the Project may impact upon these individuals, it is unlikely to significant impact upon the breeding cycle of this species in the broader context.

   In addition, the relatively narrow vegetation clearing proposed during the Project is unlikely to significantly disrupt the breeding cycle of a population of this species.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   The relatively small amount of proposed clearing and appropriate offsets of habitat made, following consultation with DEWHA and DERM, for actual habitat lost will make it unlikely that the proposed action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline in the long-term.

7. *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

   The Project has the potential to introduce and spread invasive weed species through vehicular movement and exposure of soil surface during clearing. An EM Plan for the clearing, construction, and operation of the Project is recommended in Volume 5 Attachment 15, the requirements for measures to be included within this EM Plan are considered sufficient to prevent negative impacts of invasive species as a result of the Project.

8. *Introduce disease that may cause the species to decline*

   The Project has the potential to introduce and spread plant diseases which may detrimentally impact upon this species however with the implementation of management measures this

potential impact would be minimised. The implementation of a biosecurity management plan is a requirement under the TOR to control and prevent the establishment of invasive species (and associated diseases) as a result of the Project.

9. *Interfere substantially with the recovery of the species*

   The relatively narrow clearing (40m), proposed offsets and translocation plans are considered sufficient to compensate for any proposed interference with the recovery of this species through direct loss or habitat loss proposed through the implementation of this project.

Shiny-leaved ironbark

Eucalyptus virens is endemic to south-east Queensland and is listed as vulnerable under the EPBC Act. There are five recorded sites, as far south as Inglewood and as far west as Mt Moffatt (Queensland Herbarium 2008). The total population size is currently unknown. It inhabits plateaux, sandstone escarpments or sandy soils on low rises (Queensland Herbarium 2008). Most populations occur in areas of remnant vegetation as defined under the VMA, and are therefore protected from broad-scale clearing.

There is currently no recovery plan established under the EPBC Act for the management of this species. However, its main threats have been identified as timber harvesting of the species, disturbance of habitat during timber harvesting operations, and loss of habitat due to vegetation clearing (Halford 1998).

Significant impact criteria – Shiny-leaved ironbark

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of an important population of a species*

   This species was not identified within the proposed alignment during survey efforts although anecdotal evidence indicates that this species may occur within the right of way in the central sections of the alignment. Suitable habitat is present throughout the central sections of the alignment.

   Potential impacts from gas pipeline construction are likely to be limited to the loss of habitat. Mitigation measures designed to reduce impacts associated with construction activities are detailed in Volume 5 Attachment 15 and include pre-clearing surveys to determine the location of threatened species prior to construction and threatened species management guidelines developed accordingly.

   If disturbance to a known population of this species is unavoidable relevant permits and disturbance conditions from DERM will be obtained. Design and implement a translocation plan according to Australian Network for Plant Conservation (2004) (Tables N1 - N4 of Appendix N in Volume 5 Attachment 14). If offsets are necessary they will be made by agreement with DERM. DEWHA would be required to confirm the appropriateness of this approach.

   The combination of avoidance where possible, translocation and or habitat offset is considered sufficient to mitigate any possible decline in this species.

2. *Reduce the area of occupancy of an important population*

   The relatively narrow configuration of proposed clearing for the Project is unlikely to significantly reduce the area of occupancy of this species. This is particularly true if translocation plans and appropriate offsets recommended above are implemented.

   Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

3. *Fragment an existing population into two or more populations*

   The relatively narrow configuration of proposed clearing combined with the discrete compact areas occupied by known populations of this species makes it unlikely that clearing for the Project will fragment existing populations into two or more populations. Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

4. *Adversely affect habitat critical to the survival of a species*

   Habitat for this species is not listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act. Whilst habitat on site may be suitable for the species it is not considered to be habitat critical to the survival of the species, that is, the habitat is not considered to be critical habitat for activities such as breeding or dispersal, for the long-term maintenance of the species, to maintain genetic diversity and long term evolutionary development, or for the reintroduction of populations or recovery of the species.

5. *Disrupt the breeding cycle of an important population*

   If this species exists on the Project site it is likely to be as isolated individuals. Therefore, whilst the Project may impact upon these individuals, it is unlikely to significant impact upon the breeding cycle of this species in the broader context.

   In addition, the relatively narrow vegetation clearing proposed during the Project is unlikely to significantly disrupt the breeding cycle of a population of this species.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   The relatively small amount of proposed clearing and appropriate offsets of habitats made following consultation with DEWHA and DERM for actual habitat lost will make it unlikely that the proposed action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline in the long-term.

7. *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

   The Project has the potential to introduce and spread invasive weed species through vehicular movement and exposure of soil surface during clearing. An EM Plan for the clearing, construction, and operation of the Project is recommended in Volume 5 Attachment 15, the requirements for measures to be included within this EM Plan are considered sufficient to prevent negative impacts of invasive species as a result of the Project.

8. *Introduce disease that may cause the species to decline*

   The Project has the potential to introduce and spread plant diseases which may detrimentally impact upon this species however with the implementation of management measures this

potential impact would be minimised. The implementation of a biosecurity management plan is a requirement of the TOR to control and prevent the establishment of invasive species (and associated diseases) as a result of the Project.

9. *Interfere substantially with the recovery of the species*

   The relatively narrow clearing (40m), proposed offsets and translocation plans are considered sufficient to compensate for any proposed interference with the recovery of this species through direct loss or habitat loss proposed through the implementation of the Project.

Decumbent homoranthus

The decumbent homoranthus is endemic to Queensland and is listed as vulnerable under the EPBC Act. The species is known from the Barakula Forest area near Chinchilla and the Blackdown Tableland National Park in Queensland. This species grows in shrubland on shallow sandy soils containing lateritic pebbles, and on sandstone cliff edges (Byrnes 1984; Craven and Jones 1991).

There is currently no recovery plan established under the EPBC Act for the management of this species. However, its main threats have been identified as broad-scale vegetation clearing, increased fragmentation and loss of remnants, changed fire regimes and inappropriate plant collection (ANRA 2007).

Significant impact criteria – Decumbent homoranthus

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of an important population of a species*

   This species was not identified within the proposed alignment during survey efforts although its range is known to overlap the alignment route. In addition, suitable habitat is present along the alignment.

   Potential impacts from gas pipeline construction are likely to be limited to the loss of habitat. Mitigation measures designed to reduce impacts associated with construction activities are detailed in Volume 5 Attachment 15 and include pre-clearing surveys to determine the location of threatened species prior to construction and threatened species management guidelines developed accordingly.

   If disturbance to a known population of this species is unavoidable relevant permits and disturbance conditions from DERM will be obtained. Design and implement a translocation plan according to Australian Network for Plant Conservation (2004) (Tables N1 - N4 of Appendix N in Volume 5 Attachment 14). If offsets are necessary they will be made by agreement with DERM. DEWHA would be required to confirm the appropriateness of this approach.

   The combination of avoidance where possible, translocation and or habitat offset is considered sufficient to mitigate any possible decline in this species.

2. *Reduce the area of occupancy of an important population*

   The relatively narrow configuration of proposed clearing for the Project is unlikely to significantly reduce the area of occupancy of this species. This is particularly true if translocation plans and appropriate offsets recommended above are implemented.

   Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

3. *Fragment an existing population into two or more populations*

   The relatively narrow configuration of proposed clearing combined with the discrete compact areas occupied by known populations of this species makes it unlikely that clearing for the Project will fragment existing populations into two or more populations.

   Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

4. *Adversely affect habitat critical to the survival of a species*

   Habitat for this species is not listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act. Whilst habitat on site may be suitable for the species it is not considered to be habitat critical to the survival of the species, that is, the habitat is not considered to be critical habitat for activities such as breeding or dispersal, for the long-term maintenance of the species, to maintain genetic diversity and long term evolutionary development, or for the reintroduction of populations or recovery of the species.

5. *Disrupt the breeding cycle of an important population*

   If this species exists on the Project site it is likely to be as isolated individuals or as a small population. Therefore, whilst the Project may impact upon these individuals, it is unlikely to significant impact upon the breeding cycle of this species in the broader context.

   In addition, the relatively narrow vegetation clearing proposed during the Project is unlikely to significantly disrupt the breeding cycle of a population of this species.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   The relatively small amount of proposed clearingand appropriate offsets of habitat made following consultation with DEWHA and DERM for actual habitat lost will make it unlikely that the proposed action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline in the long-term.

7. *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

   The Project has the potential to introduce and spread invasive weed species through vehicular movement and exposure of soil surface during clearing. An EM Plan for the clearing, construction, and operation of the Project is recommended in Volume 5 Attachment 15, the requirements for measures to be included within this EM Plan are considered sufficient to prevent negative impacts of invasive species as a result of the Project.

8. *Introduce disease that may cause the species to decline*

   The Project has the potential to introduce and spread plant diseases which may detrimentally impact upon this species however with the implementation of management measures this potential impact would be minimised. The implementation of a biosecurity management plan is a requirement of the TOR to control and prevent the establishment of invasive species (and associated diseases) as a result of the Project.

9. *Interfere substantially with the recovery of the species*

   The relatively narrow clearing (40m), proposed offsets and translocation plans are considered sufficient to compensate for any proposed interference with the recovery of this species through direct loss or habitat loss proposed through the implementation of the Project.

Blunt-leaved phebalium

The blunt-leaved phebalium is listed as vulnerable under the EPBC Act. This species is known from a small area of southeast Queensland, in the Helidon and Ravensbourne areas (Stanley and Ross 1983).

Collections have been made at sites near Crows Nest; in the upper reaches of Alice Creek; Helidon Hills, in the 17 Mile Road area and White Mountain State Forest, north-east of Murphys Creek. Blunt-leaved phebalium occurs in eucalypt forest, often with white mahogany (*Eucalyptus acmenoides*) and brown bloodwood on sandstone substrates in the Helidon Hills and White Mountain State Forest areas, and on granite at Crows Nest NP (BRI n.d.).

There is currently no recovery plan established under the EPBC Act for the management of the blunt-leaved phebalium. However, its main threats have been identified as population loss or fragmentation through vegetation clearing, inappropriate fire regimes, and habitat degradation through inappropriate forest operations and grazing regimes (Boyes 2004).

Significant impact criteria – Blunt-leaved phebalium

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of an important population of a species*

   This species was not identified within the proposed alignment during survey efforts although its range is known to overlap the alignment route. In addition, suitable habitat is present along the alignment.

   Potential impacts from gas pipeline construction are likely to be limited to the loss of habitat. Mitigation measures designed to reduce impacts associated with construction activities are detailed in Volume 5 Attachment 15 and include pre-clearing surveys to determine the location of threatened species prior to construction and threatened species management guidelines developed accordingly.

   If disturbance to a known population of this species is unavoidable relevant permits and disturbance conditions from DERM will be obtained. Design and implement a translocation plan according to Australian Network for Plant Conservation (2004) (Tables N1 - N4 of Appendix N in Volume 5 Attachment 14). If offsets are necessary they will be made by agreement with DERM. DEWHA would be required to confirm the appropriateness of this approach.

   The combination of avoidance where possible, translocation and or habitat offset is considered sufficient to mitigate any possible decline in this species.

2. *Reduce the area of occupancy of an important population*

   The relatively narrow configuration of proposed clearing for the Project is unlikely to significantly reduce the area of occupancy of this species. This is particularly true if translocation plans and appropriate offsets recommended above are implemented.

Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

3. *Fragment an existing population into two or more populations*

   The relatively narrow configuration of proposed clearing combined with the discrete compact areas occupied by known populations of this species makes it unlikely that clearing for the Project will fragment existing populations into two or more populations.

   Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

4. *Adversely affect habitat critical to the survival of a species*

   Habitat for this species is not listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act. Whilst habitat on site may be suitable for the species it is not considered to be habitat critical to the survival of the species, that is, the habitat is not considered to be critical habitat for activities such as breeding or dispersal, for the long-term maintenance of the species, to maintain genetic diversity and long term evolutionary development, or for the reintroduction of populations or recovery of the species.

5. *Disrupt the breeding cycle of an important population.*

   If this species exists on the Project site it is likely to be as isolated individuals or as a small population. Therefore, whilst the Project may impact upon these individuals, it is unlikely to significant impact upon the breeding cycle of this species in the broader context.

   In addition, the relatively narrow vegetation clearing proposed during the Project is unlikely to significantly disrupt the breeding cycle of a population of this species.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   The relatively small amount of proposed clearing and appropriate offsets of habitat made, following consultation with DEWHA and DERM, for actual habitat lost will make it unlikely that the proposed action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline in the long-term.

7. *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

   The Project has the potential to introduce and spread invasive weed species through vehicular movement and exposure of soil surface during clearing. An EM Plan for the clearing, construction, and operation of the Project is recommended in Volume 5 Attachment 15, the requirements for measures to be included within this EM Plan are considered sufficient to prevent negative impacts of invasive species as a result of the Project.

8. *Introduce disease that may cause the species to decline*

   The Project has the potential to introduce and spread plant diseases which may detrimentally impact upon this species however with the implementation of management measures this potential impact would be minimised. The implementation of a biosecurity management plan is a requirement under the TOR to control and prevent the establishment of invasive species (and associated diseases) as a result of the Project.

9. *Interfere substantially with the recovery of the species*

   The relatively narrow clearing (40m), proposed offsets and translocation are considered sufficient to compensate for any proposed interference with the recovery of this species through direct loss or habitat loss proposed through the implementation of the Project.

Northern bearded heath

The northern bearded heath is listed as vulnerable under the EPBC Act. This species is endemic to Queensland and occurs from Blackdown Tableland in the south to the Mount Stewart area near Homestead Township in the north (BRI n.d.). Most populations occur in coastal districts and islands, but collections have been made as far west as Blackdown Tableland. Localities include Mackay, Bowen, Townsville, Gloucester, Magnetic Island, and serpentine outcrops in the Marlborough to Yaamba area. Northern bearded heath is now known to be more widespread than was initially thought based on early collections (BRI n.d.), and the species has been moved to 'least concern' under the *Nature Conservation Act 1992* (Queensland).

Northern bearded heath collections have been made from open forest, woodland and heath on rocky slopes with granitic or serpentinite substrates (BRI n.d.).

There is currently no recovery plan established under the EPBC Act for the management of this species. However, its main threats include inappropriate fire regimes, invasion by exotic weeds and habitat destruction from mining and cattle grazing.

Significant impact criteria – Northern bearded heath

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of an important population of a species*

   This species was not identified within the proposed alignment during survey efforts although its range is known to overlap the alignment route. In addition, suitable habitat is present along the alignment.

   Potential impacts from gas pipeline construction are likely to be limited to the loss of habitat. Mitigation measures designed to reduce impacts associated with construction activities are detailed in Volume 5 Attachment 15 and include pre-clearing surveys to determine the location of threatened species prior to construction and threatened species management guidelines developed accordingly.

   If disturbance to a known population of this species is unavoidable relevant permits and disturbance conditions from DERM will be obtained. Design and implement a translocation plan according to Australian Network for Plant Conservation (2004) (Tables N1 - N4 of Appendix N in Volume 5 Attachment 14). If offsets are necessary they will be made by agreement with DERM. DEWHA would be required to confirm the appropriateness of this approach.

   The combination of avoidance where possible, translocation and or habitat offset is considered sufficient to mitigate any possible decline in this species.

2. *Reduce the area of occupancy of an important population*

   The relatively narrow configuration of proposed clearing for the Project is unlikely to significantly reduce the area of occupancy of this species. This is particularly true if translocation plans and appropriate offsets recommended above are implemented.

Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

3. *Fragment an existing population into two or more populations*

   The relatively narrow configuration of proposed clearing combined with the discrete compact areas occupied by known populations of this species makes it unlikely that clearing for the Project will fragment existing populations into two or more populations.

   Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

4. *Adversely affect habitat critical to the survival of a species*

   Habitat for this species is not listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act. Whilst habitat on site may be suitable for the species it is not considered to be habitat critical to the survival of the species, that is, the habitat is not considered to be critical habitat for activities such as breeding or dispersal, for the long-term maintenance of the species, to maintain genetic diversity and long term evolutionary development, or for the reintroduction of populations or recovery of the species.

5. *Disrupt the breeding cycle of an important population*

   If this species exists on the Project site it is likely to be as isolated individuals or as a small population. Therefore, whilst the Project may impact upon these individuals, it is unlikely to significant impact upon the breeding cycle of this species in the broader context.

   In addition, the relatively narrow vegetation clearing proposed during the Project is unlikely to significantly disrupt the breeding cycle of a population of this species.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   The relatively small amount of proposed clearing, and appropriate offsets of habitat made following consultation with DEWHA and DERM, for actual habitat lost will make it unlikely that the proposed action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline in the long-term.

7. *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

   The Project has the potential to introduce and spread invasive weed species through vehicular movement and exposure of soil surface during clearing. An EM Plan for the clearing, construction, and operation of the Project is recommended in Volume 5 Attachment 15, the requirements for measures to be included within this EM Plan are considered sufficient to prevent negative impacts of invasive species as a result of the Project.

8. *Introduce disease that may cause the species to decline*

   The Project has the potential to introduce and spread plant diseases which may detrimentally impact upon this species however with the implementation of management measures this potential impact would be minimised. The implementation of a biosecurity management plan is requirement of the TOR to control and prevent the establishment of invasive species (and associated diseases) as a result of the Project.

9. *Interfere substantially with the recovery of the species*

   The relatively narrow clearing (40m), proposed offsets and translocation plans are considered sufficient to compensate for any proposed interference with the recovery of this species through direct loss or habitat loss proposed through the implementation of the Project.

Small-flowered polianthion

The small-flowered polianthion is a shrub growing to 1 m high. It is known from five areas in east Queensland, from Redcliffe Vale, about 110 km west of Mackay, south to Kingaroy, covering a distance of approximately 800 km (BRI collection records, n.d.). It grows in forest and woodland on sandstone slopes and gullies with skeletal soil, or deeper soils adjacent to deeply weathered laterite (Kellermann et al., 2006). Locations include Redcliffe Vale; near Blackwater; Callide Range, north-east of Biloela; East Boogalgopal, west of Monto; and in the Kingaroy area north of Nanango, north-east of Jandowae and near Goodger (BRI collection records, n.d.). The species has been recorded in State forest and timber reserves (BRI collection records, n.d.)

There is currently no recovery plan established under the EPBC Act for the management of this species, but the main identified threats to the small-flowered polianthion are vegetation clearing and altered fire regimes.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of an important population of a species*

   Small-flowered polianthion was observed 300m east of the proposed alignment at KP 103 in *Corymbia watsoniana* and *Eucalyptus* spp. woodland with an *Acacia* spp. and *Hakea plurinervia* shrublayer and a grassy understorey. Whilst this species was not observed within the right of way, suitable habitat is present along the alignment.

   Potential impacts from gas pipeline construction are likely to be limited to the loss of habitat. Mitigation measures designed to reduce impacts associated with construction activities are detailed in Volume 5 Attachment 15 and include pre-clearing surveys to determine the location of threatened species prior to construction and threatened species management guidelines developed accordingly.

   If disturbance to a known population of this species is unavoidable relevant permits and disturbance conditions from DERM will be obtained. Design and implement a translocation plan according to Australian Network for Plant Conservation (2004) (Tables N1 - N4 of Appendix N in Volume 5 Attachment 14). If offsets are necessary they will be made by agreement with DERM. DEWHA would be required to confirm the appropriateness of this approach.

   The combination of avoidance where possible, translocation and or habitat offset is considered sufficient to mitigate any possible decline in this species.

2. *Reduce the area of occupancy of an important population*

   The relatively narrow configuration of proposed clearing for the Project is unlikely to significantly reduce the area of occupancy of this species. This is particularly true if translocation plans and appropriate offsets recommended above are implemented. In addition the area in which this species was observed is a large track of rement vegetation.

Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

3. *Fragment an existing population into two or more populations*

   The relatively narrow configuration of proposed clearing combined with the discrete compact areas occupied by known populations of this species makes it unlikely that clearing for the Project will fragment existing populations into two or more populations.

   Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

4. *Adversely affect habitat critical to the survival of a species*

   Habitat for this species is not listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act. Whilst habitat on site may be suitable for the species it is not considered to be habitat critical to the survival of the species, that is, the habitat is not considered to be critical habitat for activities such as breeding or dispersal, for the long-term maintenance of the species, to maintain genetic diversity and long term evolutionary development, or for the reintroduction of populations or recovery of the species.

5. *Disrupt the breeding cycle of an important population*

   If this species exists on the Project site it is likely to be as isolated individuals or as a small population. Therefore, whilst the Project may impact upon these individuals, it is unlikely to significant impact upon the breeding cycle of this species in the broader context.

   In addition, the relatively narrow vegetation clearing proposed during the Project is unlikely to significantly disrupt the breeding cycle of a population of this species.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   The relatively small amount of proposed clearing, and appropriate offsets of habitat made following consultation with DEWHA and DERM, for actual habitat lost will make it unlikely that the proposed action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline in the long-term.

7. *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

   The Project has the potential to introduce and spread invasive weed species through vehicular movement and exposure of soil surface during clearing. An EM Plan for the clearing, construction, and operation of the Project is recommended in Volume 5 Attachment 15, the requirements for measures to be included within this EM Plan are considered sufficient to prevent negative impacts of invasive species as a result of the Project.

8. *Introduce disease that may cause the species to decline*

   The Project has the potential to introduce and spread plant diseases which may detrimentally impact upon this species however with the implementation of management measures this potential impact would be minimised. The implementation of a biosecurity management plan is requirement of the TOR to control and prevent the establishment of invasive species (and associated diseases) as a result of the Project.

9. *Interfere substantially with the recovery of the species*

The relatively narrow clearing (40m), proposed offsets and translocation plans are considered sufficient to compensate for any proposed interference with the recovery of this species through direct loss or habitat loss proposed

Quassia

The quassia is endemic to Queensland and is listed as vulnerable under the EPBC Act. It is known to occur in several localities from Mackay south to Goomboorian, north of Gympie, and has a geographical distribution range that overlaps the project area. Forest communities along the gas pipeline route may provide some habitat value to this species, but no individual was recorded within the Project area during the field survey.

There is no recovery plan established under the EPBC Act for the management of quassia. However, its main threats include soil erosion and habitat clearing as a result of agriculture, forestry, urban development and recreational activities. Inappropriate fire regimes are also considered a major threat, although the response of this species to fire is relatively unknown. Rather, it is the establishment and spread of weed species through fires, especially lantana and exotic grasses, which poses the most risk to the viability of this species.

Significant impact criteria – Quassia

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of an important population of a species*

   This species was not identified within the proposed alignment during survey efforts although its range is known to overlap the alignment route. In addition, suitable habitat is present in coastal or riverine rainforest habitat located in the right of way. Database records indicate that it is present at two locations within 5km of the proposed alignment (Mt Larcom and south of the Dawson Highway) (Queensland Herbarium 2009).

   Potential impacts from gas pipeline construction are likely to be limited to the loss of habitat. Mitigation measures designed to reduce impacts associated with construction activities are detailed in Volume 5 Attachment 15 and include pre-clearing surveys to determine the location of threatened species prior to construction and threatened species management guidelines developed accordingly.

   If disturbance to a known population of this species is unavoidable relevant permits and disturbance conditions from DERM will be obtained. Design and implement a translocation plan according to Australian Network for Plant Conservation (2004) (Tables N1 - N4 of Appendix N in Volume 5 Attachment 14). If offsets are necessary they will be made by agreement with DERM. DEWHA would be required to confirm the appropriateness of this approach.

   The combination of avoidance where possible, translocation and or habitat offset is considered sufficient to mitigate any possible decline in this species.

2. *Reduce the area of occupancy of an important population*

   The relatively narrow configuration of proposed clearing for the Project is unlikely to significantly reduce the area of occupancy of this species. This is particularly true if translocation plans and appropriate offsets recommended above are implemented. Natural regeneration of 80% of the

40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

3. *Fragment an existing population into two or more populations*

   The relatively narrow configuration of proposed clearing combined with the discrete compact areas occupied by known populations of this species makes it unlikely that clearing for the Project will fragment existing populations into two or more populations.

   Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

4. *Adversely affect habitat critical to the survival of a species*

   Habitat for this species is not listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act. Whilst habitat on site may be suitable for the species it is not considered to be habitat critical to the survival of the species, that is, the habitat is not considered to be critical habitat for activities such as breeding or dispersal, for the long-term maintenance of the species, to maintain genetic diversity and long term evolutionary development, or for the reintroduction of populations or recovery of the species.

5. *Disrupt the breeding cycle of an important population.*

   If this species exists on the Project site it is likely to be as small populations. Therefore, whilst the Project may impact upon these individuals, it is unlikely to significant impact upon the breeding cycle of this species in the broader context.

   In addition, the relatively narrow vegetation clearing proposed during this project is unlikely to significantly disrupt the breeding cycle of a population of this species.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   The relatively small amount of proposed clearing, and appropriate offsets of habitat made following consultation with DEWHA and DERM for actual habitat lost will make it unlikely that the proposed action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline in the long-term.

7. *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

   The Project has the potential to introduce and spread invasive weed species through vehicular movement and exposure of soil surface during clearing. An EM Plan for the clearing, construction, and operation of the Project is recommended in Volume 5 Attachment 15, the requirements for measures to be included within this EM Plan are considered sufficient to prevent negative impacts of invasive species as a result of the Project.

8. *Introduce disease that may cause the species to decline*

   The Project has the potential to introduce and spread plant diseases which may detrimentally impact upon this species however with the implementation of management measures this potential impact would be minimised. The implementation of a biosecurity management plan is a requirement of the TOR to control and prevent the establishment of invasive species (and associated diseases) as a result of the Project.

9. *Interfere substantially with the recovery of the species*

   The relatively narrow clearing (40m), proposed offsets and translocation plans are considered sufficient to compensate for any proposed interference with the recovery of this species through direct loss or habitat loss proposed through the implementation of the Project.

Native thistle

The native thistle is listed as vulnerable under the EPBC Act. Historically, this species extended through New South Wales and Victoria but is now presumed extinct in these two States (Murray 1992; Jeanes 1999). The total population size and extent of occurrence of this species are currently unknown. The native thistle grows in eucalypt open forest with grassy understory on roadsides and on road reserves with Rhodes grass, *Cirsium vulgare*, Queensland blue gum and rough-barked apple on black clay soil (BRI n.d.).

There is currently no recovery plan established under the EPBC Act for the management of this species, but its main threats include broad-scale vegetation clearing, invasion by exotic weeds, grazing pressure and roadworks (ANRA 2007).

Significant impact criteria – Native thistle

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of an important population of a species*

   This species was not identified within the proposed alignment during survey efforts although its range is known to overlap the alignment route and suitable habitat is contained along the alignment.

   Potential impacts from gas pipeline construction are likely to be limited to the loss of habitat. Mitigation measures designed to reduce impacts associated with construction activities are detailed in Volume 5 Attachment 15 and include pre-clearing surveys to determine the location of threatened species prior to construction and threatened species management guidelines developed accordingly.

   If disturbance to a known population of this species is unavoidable relevant permits and disturbance conditions from DERM will be obtained. Design and implement a translocation plan according to Australian Network for Plant Conservation (2004) (Tables N1 - N4 of Appendix N in Volume 5 Attachment 14). If offsets are necessary they will be made by agreement with DERM. DEWHA would be required to confirm the appropriateness of this approach.

   The combination of avoidance where possible, translocation and or habitat offset is considered sufficient to mitigate any possible decline in this species.

2. *Reduce the area of occupancy of an important population*

   The relatively narrow configuration of proposed clearing for the Project is unlikely to significantly reduce the area of occupancy of this species. This is particularly true if translocation plans and appropriate offsets recommended above are implemented.

   Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

3. *Fragment an existing population into two or more populations*

   The relatively narrow configuration of proposed clearing combined with the discrete compact areas occupied by known populations of this species makes it unlikely that clearing for the Project will fragment existing populations into two or more populations.

   Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

4. *Adversely affect habitat critical to the survival of a species*

   Habitat for this species is not listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act. Whilst habitat on site may be suitable for the species it is not considered to be habitat critical to the survival of the species, that is, the habitat is not considered to be critical habitat for activities such as breeding or dispersal, for the long-term maintenance of the species, to maintain genetic diversity and long term evolutionary development, or for the reintroduction of populations or recovery of the species.

5. *Disrupt the breeding cycle of an important population*

   If this species exists on the Project site it is likely to be as small isolated populations. Therefore, whilst the Project may impact upon these individuals, it is unlikely to significant impact upon the breeding cycle of this species in the broader context.

   In addition, the relatively narrow vegetation clearing proposed during the Project is unlikely to significantly disrupt the breeding cycle of a population of this species.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   The relatively small amount of proposed clearing, and appropriate offsets of habitat made, following consultation with DEWHA and DERM, for actual habitat lost will make it unlikely that the proposed action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline in the long-term.

7. *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

   The Project has the potential to introduce and spread invasive weed species through vehicular movement and exposure of soil surface during clearing. An EM Plan for the clearing, construction, and operation of the Project is recommended in Volume 5 Attachment 15, the requirements for measures to be included within this EM Plan are considered sufficient to prevent negative impacts of invasive species as a result of the Project.

8. *Introduce disease that may cause the species to decline*

   The Project has the potential to introduce and spread plant diseases which may detrimentally impact upon this species however with the implementation of management measures this potential impact would be minimised. The implementation of a biosecurity management plan is required under State legislation to control and prevent the establishment of invasive species (and associated diseases) as a result of the Project.

9. *Interfere substantially with the recovery of the species*

   The relatively narrow clearing (40m), proposed offsets and translocation plans are considered sufficient to compensate for any proposed interference with the recovery of this species through direct loss or habitat loss proposed through the implementation of the Project.

Slender tylophora

Slender tylophora is endemic to Queensland and New South Wales and is listed as endangered under the EPBC Act. This species is known from eight localities in the Dubbo area and Mt Crow near Barraba in NSW, and Myall Park near Glenmorgan in Queensland.

Slender tylophora grows in dry scrub, open forest and woodlands associated with *Melaleuca uncinata*, broad-leaved red ironbark (*E. sideroxylon*), white box, black cypress pine, white cypress pine, bull oke, hakea wattle (*Acacia hakeoides*), streaked wattle (*A. lineata*), and *Myoporum* and *Casuarina* species (Forster et al. 2004; NSW DEC 2005a).

There is currently no recovery plan established under the EPBC Act for the management of this species, but its main threats include forestry activities; disturbances such as grazing and fire, and invasion of habitat by introduced weeds such as lantana.

Significant impact criteria – Slender tylophora

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of an important population of a species*

   This species was not identified within the proposed alignment during survey efforts although its range is known to overlap the alignment route and suitable habitat for this species is contained throughout the alignment.

   Potential impacts from gas pipeline construction are likely to be limited to the loss of habitat. Mitigation measures designed to reduce impacts associated with construction activities are detailed in Volume 5 Attachment 15 and include pre-clearing surveys to determine the location of threatened species prior to construction and threatened species management guidelines developed accordingly.

   If disturbance to a known population of this species is unavoidable relevant permits and disturbance conditions from DERM will be obtained. Design and implement a translocation plan according to Australian Network for Plant Conservation (2004) (Tables N1 - N4 of Appendix N in Volume 5 Attachment 14). If offsets are necessary they will be made by agreement with DERM. DEWHA would be required to confirm the appropriateness of this approach.

   The combination of avoidance where possible, translocation and or habitat offset is considered sufficient to mitigate any possible decline in this species.

2. *Reduce the area of occupancy of an important population*

   The relatively narrow configuration of proposed clearing for the Project is unlikely to significantly reduce the area of occupancy of this species. This is particularly true if translocation plans and appropriate offsets recommended above are implemented.

   Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

3. *Fragment an existing population into two or more populations*

   The relatively narrow configuration of proposed clearing combined with the discrete compact areas occupied by known populations of this species makes it unlikely that clearing for the Project will fragment existing populations into two or more populations.

   Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

4. *Adversely affect habitat critical to the survival of a species*

   Habitat for this species is not listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act. Whilst habitat on site may be suitable for the species it is not considered to be habitat critical to the survival of the species, that is, the habitat is not considered to be critical habitat for activities such as breeding or dispersal, for the long-term maintenance of the species, to maintain genetic diversity and long term evolutionary development, or for the reintroduction of populations or recovery of the species.

5. *Disrupt the breeding cycle of an important population*

   If this species exists on the Project site it is likely to be as isolated individuals or as a small population. Therefore, whilst the Project may impact upon these individuals, it is unlikely to significant impact upon the breeding cycle of this species in the broader context.

   In addition, the relatively narrow vegetation clearing proposed during the Project is unlikely to significantly disrupt the breeding cycle of a population of this species.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   The relatively small amount of proposed clearing and appropriate offsets of habitat made, following consultation with DEWHA and DERM, for actual habitat lost will make it unlikely that the proposed action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline in the long-term.

7. *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.*

   The Project has the potential to introduce and spread invasive weed species through vehicular movement and exposure of soil surface during clearing. An EM Plan for the clearing, construction, and operation of the Project is recommended in Volume 5 Attachment 15, the requirements for measures to be included within this EM Plan are considered sufficient to prevent negative impacts of invasive species as a result of the Project.

8. *Introduce disease that may cause the species to decline*

   The Project has the potential to introduce and spread plant diseases which may detrimentally impact upon this species however with the implementation of management measures this potential impact would be minimised. The implementation of a biosecurity management plan is a requirement of the TOR to control and prevent the establishment of invasive species (and associated diseases) as a result of the Project.

9. *Interfere substantially with the recovery of the species*

   The relatively narrow clearing (40m) and proposed offsets and translocation plans are considered sufficient to compensate for any proposed interference with the recovery of this species through direct loss or habitat loss proposed through the implementation of the Project.

Small-leaved westringia

Small-leaved westringia is endemic to Queensland and is listed as vulnerable under the EPBC Act. This species is known from a small area near Yelarbon and Inglewood in southeast Queensland. The distribution range is approximately 80km. There is currently no available information regarding population size. This species grows with Baker's mallee (*Eucalyptus bakeri*) and green mallee, and between clumps of spinifex (*Triodia* sp.) on sandy and stony soils (BRI n.d.; White and Francis 1921).

There is currently no recovery plan established under the EPBC Act for the management of this species, but its main threats include broad-scale vegetation clearing, increasing fragmentation and loss of remnants, hydrological change and pollution (ANRA 2007).

Significant impact criteria – Small-leaved westringia

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of an important population of a species*

   This species was not identified within the proposed alignment during survey efforts although its range is known to overlap the alignment route. In addition, suitable habitat is present along the alignment, particularly the Mt Larcom area.

   Potential impacts from gas pipeline construction are likely to be limited to the loss of habitat. Mitigation measures designed to reduce impacts associated with construction activities are detailed in Volume 5 Attachment 15 and include pre-clearing surveys to determine the location of threatened species prior to construction and threatened species management guidelines developed accordingly. If disturbance to a known population of this species is unavoidable relevant permits and disturbance conditions from DERM will be obtained. Design and implement a translocation plan according to Australian Network for Plant Conservation (2004) (Tables N1 - N4 of Appendix N in Volume 5 Attachment 14). If offsets are necessary they will be made by agreement with DERM. DEWHA would be required to confirm the appropriateness of this approach.The combination of avoidance where possible, translocation and or habitat offset is considered sufficient to mitigate any possible decline in this species.

2. *Reduce the area of occupancy of an important population*

   The relatively narrow configuration of proposed clearing for the Project is unlikely to significantly reduce the area of occupancy of this species. This is particularly true if translocation plans and appropriate offsets recommended above are implemented.

   Natural regeneration of 85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

3. *Fragment an existing population into two or more populations*

   The relatively narrow configuration of proposed clearing combined with the discrete compact areas occupied by known populations of this species makes it unlikely that clearing for the Project will fragment existing populations into two or more populations. Natural regeneration of

85% of the 40m wide clearing strip will return the majority of potential habitat for this species within the alignment.

4. *Adversely affect habitat critical to the survival of a species*

   Habitat for this species is not listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act. Whilst habitat on site may be suitable for the species it is not considered to be habitat critical to the survival of the species. That is, the habitat is not considered to be critical habitat for activities such as breeding or dispersal, for the long-term maintenance of the species, to maintain genetic diversity and long term evolutionary development, or for the reintroduction of populations or recovery of the species.

5. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   The relatively small amount of proposed clearing and appropriate offsets of habitat made, following consultation with DEWHA and DERM, for actual habitat lost will make it unlikely that the proposed action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline in the long-term.

6. *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

   The Project has the potential to introduce and spread invasive weed species through vehicular movement and exposure of soil surface during clearing. An EM Plan for the clearing, construction, and operation of the Project is recommended in Volume 5 Attachment 15, the requirements for measures to be included within this EM Plan are considered sufficient to prevent negative impacts of invasive species as a result of the Project.

7. *Introduce disease that may cause the species to decline*

   The Project has the potential to introduce and spread plant diseases which may detrimentally impact upon this species however with the implementation of management measures this potential impact would be minimised. The implementation of a biosecurity management plan is a requirement of the TOR to control and prevent the establishment of invasive species (and associated diseases) as a result of the Project.

8. *Interfere substantially with the recovery of the species*

   The relatively narrow clearing (40m), proposed offsets and translocation plans are considered sufficient to compensate for any proposed interference with the recovery of this species through direct loss or habitat loss proposed through the implementation of the Project.

23.10.3 Terrestrial fauna

Desktop research included searches using the EPBC Protected Matters Search Tool, the Birds Australia database, the Queensland Museum Fauna Collection Records and DERM's Wildlife Online database. Database searches identified 18 threatened fauna species from the study area, including:

- One species listed as critically endangered under the EPBC Act
- Three species listed as endangered
- Fourteen species listed as vulnerable under the Act

An additional nine species were identified by the largely predictive Protected Matters Search Tool as possibly being present. Field surveys were undertaken in 2009, including four days in April and 29 days in September and October.

Table 23.4 outlines the species identified through a database search, including their habitat preference and likelihood of occurrence within the project area. One threatened fauna species listed under the EPBC Act was identified on site during the field surveys – the southern subspecies of squatter pigeon (*Geophaps scripta scripta*). Based on habitat preference, the project area may support suitable habitat for a further 15 of these species; including the Fitzroy River turtle (*Rheodytes leukops*), collared delma (*Delma torquata*), brigalow scaly-foot (*Paradelma orientalis),* yakka skink (*Egernia rugosa)*, ornamental snake (*Denisonia* maculata), Dunmall's snake (*Furina dunmalli*), squatter pigeon (southern subspecies) (*Geophaps scripta scripta)*, red goshawk (*Erythrotriorchis radiatus),* black-breasted button-quail (*Turnix melanogaster*), northern quoll (*Dasyurus hallucatus),* grey-headed flying-fox (*Pteropus poliocephalus),* Semon's leaf-nosed bat (*Hipposideros* semoni), greater long-eared bat (*Nyctophilus timoriensis*), large-eared pied bat (*Chalinolobus dwyeri)*, and false water-rat (*Xeromys myoides).*

Table 23.4 Likely occurrence of threatened terrestrial fauna species

Common name	Scientific name	EPBC status[1]	Preferred habitat	Likelihood of occurrence in project area[2]	Source[3]
Invertebrates					
Boggomoss snail	*Adclarkia dawsonensis*	CE	Alluvial flats, riparian environments and boggomosses (small peat bogs formed by water from aquifers being pushed to the surface through mound springs). Known only from two populations on the Dawson River between Theodore and Taroom, at least 25km west of the alignment (Stanisic 2008).	Unlikely	1, 4
Frogs					
Kroombit tinkerfrog	*Taudactylus pleione*	V	Rocks and leaf litter beside small flowing streams or seepages in rainforest patches and rainforest edges above 500m. Confined to Kroombit Tops, east of Biloela in Queensland (Cogger 2000; DEWHA 2009i).	Not expected to occur	3, 4
Reptiles					
Fitzroy River turtle	*Rheodytes leukops*	V	Riverine species dependent on shallow fast-flowing water (riffle zones). Occurs within permanent freshwater riverine reaches and large, isolated permanent waterholes. Confined to Fitzroy and Dawson Rivers and tributaries (Tucker et al. 2001).	Possible	1, 4
Collared delma	*Delma torquata*	V	A small, secretive species that shelters in soil cracks, leaf litter and under rocks in open eucalypt forest with a shrub and tussock grass understorey. Soil type is usually shallow and deep-cracking or stony (Ehmann 1992; Wilson and Swan 2008).	Likely	1, 4
Brigalow scaly-foot	*Paradelma orientalis*	V	Once thought to be confined to remnant brigalow or sparse tussock grass vegetation on grey cracking soils (Shea 1987), but also occurs in other acacia species woodland, poplar box woodland, sandstone rises in dry sclerophyll forests, ironbark dominated forest and mixed open woodland with spinifex (Schulz and Eyre 1997;	Likely	1, 3, 4

Common name	Scientific name	EPBC status[1]	Preferred habitat	Likelihood of occurrence in project area[2]	Source[3]
			Kutt et al. 2003).		
Five-clawed worm-skink	*Anomalopus mackayi*	V	Open grasslands on heavy cracking clay in the Darling Downs. Usually in soil under dead grass. Often on relict roadside verges (Richardson 2006).	Unlikely	1
Yakka skink	*Egernia rugosa*	V	Ground-dwelling, reliant on logs, ground debris and/or burrows for shelter. Widespread but rare. Dry open forests or woodland with dense ground vegetation, rocky areas, fallen timber and other debris (Richardson 2006).	Likely	1, 3
Ornamental snake	*Denisonia maculata*	V	Occurs in low-lying areas with deep-cracking clay soils that are subject to seasonal flooding, and adjacent areas of clay and sandy loams. The species is found in woodlands and shrublands and in riverine habitats, living in soil cracks and under fallen timber. It is secretive and nocturnal and feeds almost entirely on frogs (Ehmann 1992; Wilson and Swan 2008). When the soil or topography change, the species can change from being abundant to absent over a few hundred metres (Swan and Wilson 2008).	Likely	1, 3
Dunmall's snake	*Furina dunmalli*	V	The biology of this species is virtually unknown. Most records are from open forests and woodlands, particularly brigalow and woodlands growing on cracking black clay and clay loams (Cogger et al. 1993).	Likely	1, 3, 4
Birds					
Squatter pigeon (southern subspecies)	*Geophaps scripta scripta*	V	Open grasslands often in eucalypt woodland. Preference for areas on sandy soil with low gravel ridges and nearby water. Nests on the ground among tall trees along watercourses (Crome and Shields 1992; Higgins and Davies 1996).	Known	1, 4, 5
Shy albatross	*Thalassarche cauta*	V	Pelagic species, feeds in southern Australian continental waters from Fremantle to southern Queensland. Nests on rocky islands in southern Tasmania and Bass Strait (Marchant and Higgins 1990).	Not expected to occur	3, 4

Common name	Scientific name	EPBC status[1]	Preferred habitat	Likelihood of occurrence in project area[2]	Source[3]
Southern giant-petrel	*Macronectes giganteus*	E	A marine bird that occurs in Antarctic to subtropical waters. It is wide spread throughout the Southern Ocean, most abundant around ice packs where penguins are breeding or over the continental shelf. Nests on off shore islands, shorelines south of Rockhampton, often near a steep drop or on slope (Marchant and Higgins 1990).	Not expected to occur	1
Kermadec petrel (western)	*Pterodroma neglecta neglecta*	V	Pelagic species that forages at sea in tropical and subtropical waters of the South Pacific; nests on high islands among rocks and vegetation. Extremely rare visitor to the east coast of Queensland and New South Wales (Marchant and Higgins 1990).	Not expected to occur	1
Red goshawk	*Erythrotriorchis radiatus*	V	Occurs in woodlands and forests, ideally with a mosaic of vegetation types and permanent water, particularly riverine forests. The species avoids both very dense and very open habitats (Marchant and Higgins 1993).	Possible	1, 4
Plains wanderer	*Pedionomus torquatus*	V	Occurs in natural open grasslands, treeless with patches of open ground; may be lightly grazed. Avoids country where the grass is too tall or dense, or too sparse, low or heavily grazed. Rare, patchy distribution in southern inland Australia (Marchant and Higgins 1993; Geering et al. 2007).	Unlikely	4
Australian painted snipe	*Rostratula australis*	V	Occurs in terrestrial shallow wetlands, both ephemeral and permanent, usually freshwater but occasionally brackish. They also use inundated grasslands, saltmarsh, dams, rice crops, sewage farms and bore drains (Marchant and Higgins 1993).	Possible	1, 2, 4
Black-breasted button-quail	*Turnix melanogaster*	V	Mostly recorded from closed dry rainforest and vine thickets with abundant leaf-litter, although they can also be occasionally recorded from scrubs including brigalow, belah, bottletree thickets and in dry eucalypt forests where there is a dense understorey such as lantana and grass groundcover (Marchant and Higgins 1993).	Likely	1, 2, 4

Common name	Scientific name	EPBC status[1]	Preferred habitat	Likelihood of occurrence in project area[2]	Source[3]
Swift parrot	*Lathamus discolor*	E	Occurs in woodlands, riparian vegetation and remnant patches of mature eucalypts in agricultural areas, though they prefer dry sclerophyll forest (Higgins 1999; NPWS 2003). It is infrequently, though possibly annually, recorded in south-eastern Queensland in winter.	Unlikely	1
Star finch (eastern subspecies)	*Neochmia ruficauda ruficauda*	E	Occurs mainly in dense, damp grasslands bordering wetlands and watercourses, but also in open grassy woodlands that are near permanent water or are subject to regular inundation. Very few records in central Qld since 1990, centred on Rockhampton area. Probably extinct in the gas pipeline corridor area (Higgins et al. 2006).	Not expected to occur	1
Mammals					
Northern quoll	*Dasyurus hallucatus*	E	Most common in rocky eucalypt woodland and open forest within 200km of the coast (Menkhorst and Knight 2004). It is now largely confined to six areas within its former range often dominated by rocky escarpment country (Oakwood 2000, 2008).	Possible	1, 3, 4
Spotted-tailed quoll (south-east mainland)	*Dasyurus maculatus maculatus*	E	Occurs in a wide variety of habitats including rainforests, wet and dry sclerophyll forests, coastal heath, scrub and sometimes Red Gum forests along inland rivers. They are found from sea-level to sub-alpine regions (Menkhorst and Knight 2004). The south-east mainland sub-species was formerly distributed from Bundaberg in the north and Chinchilla in the west in Queensland and extended south to southern Australia (Maxwell et al. 1996). However, the species has undergone a range contraction in Queensland and is now rare in most areas throughout its range.	Not expected to occur	3, 4
Grey-headed flying-fox	*Pteropus poliocephalus*	V	Forages in rainforests, open eucalypt forests, woodlands, melaleuca swamps and banksia woodlands. Roosts are commonly within dense vegetation close to water, primarily rainforest patches, stands of melaleuca, mangroves or riparian vegetation (Nelson 1965), but colonies may use exotic vegetation in urban areas (Birt et al.	Possible	1, 3, 4

Common name	Scientific name	EPBC status[1]	Preferred habitat	Likelihood of occurrence in project area[2]	Source[3]
			1998).		
Semon's leaf-nosed bat	*Hipposideros semoni*	E	Rainforests, around dense vegetation and drier open woodlands from Cape York south to Cooktown, with an isolated roost at Kroombit Tops. Roosts in caves, old mines, cracks in rocks and under rock overhangs (Churchill 2008).	Possible	1, 4
Greater long-eared bat	*Nyctophilus timoriensis*[4]	V	Occurs in variety of dry forest habitats including river red gum, open woodland, mallee, brigalow and other arid and semi-arid habitats. It appears to be more common in box, ironbark and cypress-pine forests on sandy soils on the western slopes of New South Wales and southern Queensland (Churchill 2008; Turbill et al. 2008).	Possible	1
Large-eared pied bat	*Chalinolobus dwyeri*	V	Know to roost in disused mine tunnels, rock overhangs, caves and fairy martin *Petrochelidon ariel* nests (Eyre et al. 1997; Thompson 2002). In south-eastern Queensland, the species seems to be more associated with higher altitude moist forests and adjacent rainforest (Eyre et al. 1997).	Possible	1
False water-rat	*Xeromys myoides*	V	Occurs in mangroves, saltmarsh, sedged lakes near foredunes and coastal freshwater swamps. Require relatively large areas of intertidal flats for foraging and suitable adjacent areas for nest sites. Home ranges of around 0.7ha have been recorded and known to cover up to 2.9km (Van Dyck 1996; Gynther and Janetzki 2008).	Possible	1

[1] Status: EPBC: CE = Critically Endangered, E = Endangered, V = Vulnerable.

[2] Likelihood of Occurrence: Known: species has been recently recorded within gas pipeline study area

Likely: species is known from the wider study area and preferred habitat is present on site

Possible: species is known from the wider study area and suboptimal habitat is present in the gas pipeline study area; Unlikely; species is known from the wider study area but suitable habitat is not present in the gas pipeline study area.

[3] Source: 1 = EPBC Act Protected Matters Search Tool, 2 = Birds Australia, 3 = QLD Museum Fauna Collection Records, 4 = DERM Wildlife Online, 5 = Worley Parsons survey.

[4] *Nyctophilus timoriensis* is no longer considered to occur in Australia. The species found in the study area has recently been described as *N. corbeni* (Parnaby 2009).

In summary, only one terrestrial fauna species listed as vulnerable (EPBC Act) has been identified through field surveys along the gas pipeline study area. This is the squatter pigeon. However, based on habitat preference, it is considered that the study area may support suitable habitat for a total of 16 species listed under the EPBC Act, including two endangered species and fourteen vulnerable species.

The relevant endangered species are:

- Northern quoll
- Semon's leaf-nosed bat

The relevant vulnerable species are:

- Fitzroy River turtle
- Collared delma
- Brigalow scaly-foot
- Yakka skink
- Ornamental snake
- Dunmall's snake
- Squatter pigeon - southern subspecies
- Australian painted snipe
- Black-breasted button-quail
- Rey-headed flying-fox
- Greater long-eared bat
- Large-eared pied bat
- False water-rat
- Red goshawk

Each species is discussed in detail below in relation to relevant significant impact criteria.

The Project's potential impacts on terrestrial fauna are likely to be primarily associated with habitat loss, degradation, fragmentation and loss of connectivity due the physical clearing of vegetation for infrastructure development. This may include:

- Removal of habitat such as mature vegetation, hollow-bearing trees and fallen logs, and therefore loss of shelter, breeding, nesting, perching and foraging resources
- Disturbance to rocky outcrops and therefore shelter for reptiles and small mammals
- Disturbance to fauna movement corridors and dry season fauna refuges (predominantly associated with creeks and seasonal wetland / waterway areas)
- Unearthing of burrowing fauna species during construction
- The potential for fauna to fall into and become trapped in the open pipeline trench during construction (trenchfall).

Other potential impacts are associated with reduction in the quality of habitat including:

- Introducing and/or spreading invasive weeds or pests which may increase prevalence of predators
- Reducing foraging range due to noise and light pollution
- Increasing vehicle collision induced fatalities.

Northern quoll

The northern quoll is the smallest of the quoll species and the most arboreal (tree-living). Although found in a variety of habitat, it is most common in rocky eucalypt woodland and open forest within

200km of the coast (Menkhorst and Knight 2004). The species is generally nocturnal, but may also be active during the day in overcast weather or during the breeding season. They are opportunistic omnivores, feeding on invertebrates, small birds and mammals, frogs, reptiles, fruits and nectar. Northern quolls den in tree hollows, termite mounds, fallen logs and rock crevices and will use a number of dens across their territory (Oakwood 2002, 2008).

This species was formerly distributed across northern Australia, from the Pilbara in Western Australia to south-eastern Queensland. It is now largely confined to six areas within its former range, often dominated by rocky escarpment country. Births occur between June and September. Young leave the den in January coinciding with the wet season and abundant food resources (Oakwood 2000, 2008).

The most significant threatening process for this species is the introduction of cane toads *Rhinella marina* into areas which the northern quoll utilises. Data suggests that local populations of northern quoll in the Northern Territory are usually extinct within a year of the arrival of cane toads. Field surveys confirmed the presence of cane toads within the study area. However, there are populations of northern quolls persisting in Queensland in areas where cane toads are present. As such, it is assumed that a population(s) of northern quoll may persist along the gas pipeline route, particularly within the Callide/Calliope Range, the Rockybar/Fairyland sandstone area, and possibly the Gurulmundi State Forest area.

Significant impact criteria – Northern quoll

An action is likely to have a significant impact on an endangered species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of a population*

   It is understood that the most significant threatening process that may lead to potential long term decline in the northern quoll population is the presence and expansion in range of the cane toad (Woinarski et al. 2008). Cane toads were observed during the field assessments and are likely to be found throughout the study area. If a northern quoll population persists along the gas pipeline right of way the facilitation of the establishment of cane toads on site (e.g. through the introduction of further readily available sources of water) may be considered a potential threat to this population. The gas pipeline may also assist in the introduction of feral predators (that is, cats and dogs) to large bushland areas which may impact on any potential northern quoll populations.

   However given that cane toads and feral predators are already established within the wider study area, it is considered unlikely that development of the proposed facility would have a significant impact on the northern quoll or lead to a long-term decrease in the size of a population.

2. *Reduce the area of occupancy of the species*

   Database searches revealed records of this species within the study area and they are known from Carnarvon Gorge, to the west of the study area. If a population of northern quolls persists along the gas pipeline right of way then the linear nature of the proposed works will result in the removal of some habitat suitable for this species. Given this, there is potential for a small reduction in the area of occupancy for this species, however spread of logs and other favourable habitat across the right of way following construction is likely to maintain area of occupancy of the species.

3. *Fragment an existing population into two or more populations*

   Northern quolls are usually solitary, occupying large home ranges of over 100ha for males and approximately 35ha for females (Woinarski et al. 2008). They utilise a variety of dens over their range including rock crevices, tree hollows, logs, termite mounds, and goanna burrows. As previously mentioned, the rocky woodland areas within the study area may provide suitable habitat for the northern quoll. Considering the linear nature of the gas pipeline right of way it is considered unlikely that the proposed works would result in fragmentation of a potential population of northern quolls in the study area.

4. *Adversely affect habitat critical to the survival of a species*

   There is currently no recovery plan that outlines critical habitat for the northern quoll. Persisting populations of northern quolls are more likely to be found at rocky sites, particularly with large boulders, on steeper slopes and shallow soils and with low disturbance by fire (Woinarski et al. 2008). There are three areas within the gas pipeline right of way that provide potentially suitable habitat for the northern quoll and which are consistent with habitat where persisting populations have previously been found. Considering the linear nature of the proposed works and the extent of potential habitat adjacent to the gas pipeline right of way it is considered unlikely that the habitat directly impacted by the proposed works is critical for the survival of this species.

5. *Disrupt the breeding cycle of a population.*

   Northern quolls breed once per year. Breeding takes place in late June and the young are born in July. The males of this species usually die after one year and after mating. If a population of northern quolls do occur within the gas pipeline right of way there is potential for the breeding cycle of local individuals to be disrupted. However, given the linear nature of the proposed works and provided pre-clearing surveys are carried out by a qualified fauna specialist the considered impacts are likely to be negligible and restricted to individual animals.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   The most significant threat to the northern Quoll population is the arrival of cane toads. Persisting populations of northern quolls in Queensland have been associated with areas of steep terrain, shallow soils and rugged rocky areas, particularly area with large boulders (Woinarski et al. 2008). If a population of northern quolls persists along the gas pipeline right of way in the presence of cane toads as well as other feral predators, it is expected the more rugged areas would be the most likely areas where a population would persist. As previously mentioned, the study area contains several areas where populations may persist. Given the linear nature of the proposed works it is considered unlikely that removal of habitat within the study area is likely to be the cause of decline in a potential population at these locations.

7. *Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat*

   The most significant threat to northern quoll populations is the spread of cane toads. In Queensland there are persisting populations of northern quolls in areas where cane toads have been present for over 30 years. Rugged rocky areas are identified as being more likely to contain persisting populations (Woinarski et al. 2008). Given that cane toads already exist within the study area, it is considered that the development of the proposed facility will not significantly

alter their current influence on any potential population of northern quolls within or adjacent to the study area.

The proposed works also have the potential to increase access to the wider area for feral predators due to fragmentation of the landscape. As such there is potential for feral species to impact on the population(s). The implementation of a biosecurity management plan and an EM Plan is required under State legislation to control and prevent the establishment of invasive species as a result of the Project. Provided that active feral animal control is undertaken and quarantine rules and regulations are adhered to, it is considered unlikely that the proposed facility will result in an invasive species harmful to the northern quoll becoming established in the area beyond the existing extent.

8. *Introduce disease that may cause the species to decline*

Disease has been considered to be a cause of northern quoll population declines in the past, however recent consideration of the role of disease in the decline of northern quoll populations in Kakadu concluded that disease was not a major contributor at the time. The major contributor to the decline of quoll populations in more recent times has been the spread of the cane toad (Woinarski et al. 2008).

The implementation of a biosecurity management plan is required under State legislation to control and prevent the establishment of invasive species (and associated diseases) as a result of the Project. It is considered unlikely the proposed works would cause the introduction of a disease that would impact on any existing populations of northern quolls within the study area.

9. *Interfere with the recovery of the species*

   – *There is currently no recovery plan in place for the northern quoll.*

It is considered unlikely that the proposed project will facilitate or enhance the most significant threatening process for the northern quoll.

Semon's leaf-nosed bat

Semon's leaf-nosed bat has been recorded roosting in caves and tree hollows, as well as a variety of unusual sites such as an oven, a closet and the door handle of a car (Churchill 2008; Hall 2008). It occurs in rainforest, wet sclerophyll forest and open savanna woodland in the north of its range. The species largely occurs in north Queensland, but an isolated population is known from Kroombit Tops, approximately 28km south of where the gas pipeline right of way crosses the Callide Range. There are several unconfirmed echolocation call records suggesting the species may occur as far south as State forest near Maryborough (Churchill 2008). The distribution and ecology of this species is not well understood. The species roosts in small numbers (up to 10 animals) within suitable habitat. There is no information on the requirements of maternity roosts.

Geological features such as cliffs, caves and rock overhangs are usually avoided during pipeline alignment selection due to construction issues associated with trench digging. It is considered unlikely that any areas of extensive caves would be located within the gas pipeline right of way. The most likely area the species may occur within the gas pipeline right of way may be the Callide/Calliope Range. While the Calliope Range was not able to be assessed during the field surveys, the Callide Range was assessed and this included two nights of ultrasonic bat detection surveys. This species is associated with moist, dense forests which do not occur within the gas pipeline right of way. If this species is present within the wider area, it may be impacted by loss of habitat within its foraging range.

Significant impact criteria – Semon's leaf-nosed bat

An action is likely to have a significant impact on an endangered species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of a population of a species*

   There is no known population within the gas pipeline right of way.

   The proposed development is unlikely to disturb a major roost site for this species, as there is little suitable habitat on the gas pipeline right of way. Any roost site identified within the gas pipeline right of way would be avoided and buffered from gas pipeline activities. The loss of tree hollows and of potential foraging habitat is not considered likely to lead to a decrease in the size of a population of this species.

2. *Reduce the area of occupancy of a population*

   If there is a population within the gas pipeline right of way there is potential for foraging habitat to be lost due to the development of the Project. It is considered unlikely that the development will reduce the area of occupancy of a population.

3. *Fragment an existing population into two or more populations*

   If there is a local population within the Gladstone region there is potential for foraging habitat to be lost due to the development of the Project. It is considered unlikely that the development will fragment any possible existing population.

4. *Adversely affect habitat critical to the survival of a species*

   It is considered unlikely that roosting habitat such as caves or mines occur within the gas pipeline right of way and there is little suitable foraging habitat for the species in this area. As such, it is considered unlikely that the proposed development will affect any habitat considered critical to the survival of the species.

5. *Disrupt the breeding cycle of a population*

   The breeding biology of this species is little known. There is no information available on the requirements of maternity roost sites, although the species is not known to form large aggregations. Given the lack of suitable foraging habitat within the gas pipeline right of way it is considered unlikely the Project would disturb the breeding cycle of a population of this species.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   There is a lack of suitable foraging habitat for the species within the gas pipeline right of way and there is no known roost site. Any roost site identified within the gas pipeline right of way would be avoided and buffered from gas pipeline activities. It is considered unlikely that the proposed development will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

7. *Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat*

   Feral pigs have been identified as a threatening process for this species. The implementation of the biosecurity management plan is a requirement of the TOR to control and prevent the establishment of invasive species as a result of the Project.

8. *Introduce disease that may cause the species to decline*

   Given the current lack of knowledge regarding the ecology of this species the impact of disease on the Semon's leaf-nosed bat is unknown. The implementation of a biosecurity management plan is required under State legislation to control and prevent the establishment of invasive species (and associated diseases) as a result of the Project.

9. *Interfere with the recovery of the species*

   The study area is not considered to contain habitat important enough for the species such that its modification, destruction, removal or isolation, or a decrease in its availability or quality would interfere with the recovery of the species.

Fitzroy River turtle

The Fitzroy River turtle is only known from the waterways of the Fitzroy River catchment. It is the sole member of its genus. It can breathe through specialised cloacal pouches that can absorb oxygen from water, allowing it to spend long periods submerged. The species relies on faster flowing riffle habitats and generally does not move far from them within its home range (Tucker et al. 2001). The species breeds in spring and summer, nesting in sandy substrates up to four metres above the waterline (Cann 1998).

The gas pipeline right of way transects several smaller tributaries of the Fitzroy catchment, all of which were either dry or had intermittent shallow pools during the field surveys. The lack of permanent deep water at these areas suggests they are poor quality habitat for this species.

Significant impact criteria – Fitzroy River turtle

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of an important population of a species*

   The lack of suitable habitat within the gas pipeline right of way means it is considered unlikely that the Project will lead to a long term decrease in the size of any local population, whether or not such a population would be considered important.

2. *Reduce the area of occupancy of an important population*

   If a population is present within the wider area of the gas pipeline right of way then development of the proposed gas pipeline may impact the extent of suitable habitat available for that population. Given the linear nature of the proposed works and post-construction rehabilitation of the right of way, it is considered that any impact that may occur on an important population (if such exists within the gas pipeline right of way) is likely to be negligible.

3. *Fragment an existing important population into two or more populations*

   Considering the linear nature of the proposed works, post-construction rehabilitation of the right of way and the extent of suitable habitat outside of the development footprint, it is considered unlikely that the proposed works will result in the fragmentation of an existing important population.

4. *Adversely affect habitat critical to the survival of a species*

   There is no identified critical habitat for the Fitzroy River turtle. Habitat features identified as being utilised by this species include rivers or creeks with faster-flowing riffles adjacent to large,

deep pools. Several creeklines are crossed by the gas pipeline right of way, however virtually all were dry or reduced to small, muddy waterholes, indicating low quality habitat for this species. Considering the extent of higher quality habitat within the wider area the habitat within the gas pipeline right of way is not considered to be critical to the survival of this species.

5. *Disrupt the breeding cycle of an important population*

   The species is known to breed in spring and summer. Nests are located in sandy areas up to 4m above the waterline. Considering the extent of more viable habitat within the wider area, if a population of Fitzroy River turtle was present on the gas pipeline right of way it is considered unlikely that the breeding cycle of this population would be disrupted by the proposed development.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   Considering the extent of better quality habitat within the wider area, if a population of Fitzroy River turtle is present within the gas pipeline right of way it is considered unlikely that the loss of this habitat will result in the decline of this species.

7. *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

   The implementation of a biosecurity management plan is required under State legislation to control and prevent the establishment of invasive species as a result of the Project.

8. *Introduce disease that may cause the species to decline*

   Disease has not been identified as a threatening process for this species. The implementation of a biosecurity management plan is required under State legislation to control and prevent the establishment of invasive species (and associated diseases) as a result of the Project.

9. *Interfere substantially with the recovery of the species*

   The study area is not considered to contain habitat important enough for the species such that its modification, destruction, removal or isolation, or a decrease in its availability or quality would interfere with the recovery of the species.

Collared delma

The collared delma is a small, secretive species that shelters in soil cracks, leaf litter and under rocks in open eucalypt forest with a shrub and tussock grass understorey. Soil type is usually shallow and deep-cracking or stony (Ehmann 1992; Wilson and Swan 2008). The species generally occurs on rocky hillsides and is patchily distributed from the western edges of Brisbane north to Blackdown Tableland and inland to the Bunya Mountains and Expedition Range (Wilson 2005; Wilson and Swan 2008).

The gas pipeline right of way contains habitat that may be considered suitable for this species. Given the current and historical distributions, the species may occur in the study area, particularly in the Callide and Calliope Ranges.

Significant impact criteria – Collared delma

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of an important population of a species*

   Currently, the species is reliably known only from the Mt Crosby area (west of Brisbane) and the Bunya Mountains. There are historical records from Ulam Range west of Gladstone (DEWHA 2009b). The gas pipeline right of way transects a range of woodland types, many of which are considered suitable habitat for a population or populations of collared delma. Considering the extent of similar suitable habitat within the wider area and provided that effective pre-clearing surveys are conducted, it is considered unlikely that the Project will lead to a long term decrease in the size of an important population.

2. *Reduce the area of occupancy of an important population*

   There is no known population within the vicinity of the gas pipeline study area. If a population is present within the wider area of the gas pipeline right of way then development of the proposed gas pipeline may impact the extent of suitable habitat available for that population. Given the linear nature of the proposed works, post-construction rehabilitation of the right of way, and provided that effective pre-clearing surveys are conducted it is considered that any impact that may occur on an important population (if such exists within the gas pipeline right of way) is likely to be negligible.

3. *Fragment an existing important population into two or more populations*

   The little information available regarding the home range requirements or movement patterns of the collared delma suggests the species has a small home range.

   Considering the current known distribution of the species, linear nature of the proposed works, post-construction rehabilitation of the right of way and the extent of suitable habitat outside of the development footprint it is considered unlikely that the proposed works will result in the fragmentation of an existing important population.

4. *Adversely affect habitat critical to the survival of a species*

   There is no identified critical habitat for the collared delma. Habitat features identified as being utilised by this species include rock outcrops, leaf litter, rocks and fallen timber, generally in areas with low vegetation cover (Porter 1998).

   Many of the woodland types transected by the gas pipeline right of way are considered suitable habitat for the collared delma. Considering the current known distribution of the species and the extent of similar suitable habitat within the wider area, the habitat within the gas pipeline right of way area is not considered critical to the survival of this species.

5. *Disrupt the breeding cycle of an important population.*

   There is little understanding of the breeding cycle of this species. Considering the current known distribution of the species and the extent of suitable habitat within the wider area, if a population of collared delma is present on the gas pipeline right of way it is considered unlikely that the breeding cycle of this population would be disrupted by the proposed development.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   Considering the current known distribution of the species and the extent of similar suitable habitats within the wider area, if a population of collared delma is present within the gas pipeline right of way it is considered unlikely that the loss of this habitat will result in the decline of this species.

7. *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

   There is no invasive species listed as a threat to the collared delma. The implementation of a biosecurity management plan is required under State legislation to control and prevent the establishment of invasive species as a result of the Project.

8. *Introduce disease that may cause the species to decline*

   Disease has not been identified as a threatening process for this species. The implementation of a biosecurity management plan is required under State legislation to control and prevent the establishment of invasive species (and associated diseases) as a result of the Project.

9. *Interfere substantially with the recovery of the species*

   There is no current recovery plan listed for this species. The study area is not considered to contain habitat important enough for the species such that its modification, destruction, removal or isolation, or a decrease in its availability or quality would interfere with the recovery of the species.

Brigalow scaly-foot

The brigalow scaly-foot is distributed throughout the Brigalow Belt. The species was once thought to be confined to remnant brigalow or sparse tussock grass vegetation on grey cracking soils (Shea 1987). However, recent records have found the species in additional habitats including *Acacia falciformis* woodland, gidgee (*A. cambagei*) woodland, poplar box open woodland, sandstone rises in dry sclerophyll forests, lemon-scented spotted gum (*Corymbia citriodora*) and narrow-leaved red ironbark dominated forest and mixed open woodland with spinifex (*Triodia mitchelli*) (Schulz and Eyre 1997; Kutt et al. 2003).

Most records are from relatively undisturbed habitats but the species does also occur in two to three years old regrowth, heavily grazed areas (Kutt et al. 2003) and cultivated areas. This indicates it is resilient to disturbance (DEWHA 2009e). Fragments of invertebrates such as spiders and crickets have been recorded from scats. However, sap constitutes a significant proportion of this species diet, particularly sap from *Acacia* species (Tremul 2000).

Given the range of habitats for this species, it is considered likely to occur in areas throughout the pipeline right of way.

Significant impact criteria – Brigalow scaly-foot

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of an important population of a species*

   The gas pipeline right of way transects a range of woodland types, many of which are considered suitable habitats for a population or populations of brigalow scaly-foot. Considering the extent of similar suitable habitat within the wider area, the proposed natural regeneration of 85% of the 40m wide clearing strip and provided that effective pre-clearing surveys are conducted it is considered unlikely that the Project will lead to a long term decrease in the size of an important population.

2. *Reduce the area of occupancy of an important population*

   If a population or populations is present within the wider area of the gas pipeline right of way then clearing for the proposed gas pipeline may reduce the area of occupancy for the species. However, given the linear nature of the proposed works and post-construction rehabilitation of the right of way it is considered that any impact that may occur on an important population (if such exists within the gas pipeline right of way) is likely to be short term and negligible.

3. *Fragment an existing important population into two or more populations*

   There is little information regrading the home range requirements or movement patterns of the brigalow scaly-foot. Considering the linear nature of the proposed works, post-construction rehabilitation of the right of way and the extent of suitable habitat outside of the development footprint it is considered unlikely that the proposed works will result in the fragmentation of an existing important population.

4. *Adversely affect habitat critical to the survival of a species*

   There is no identified critical habitat for the brigalow scaly-foot. Habitat features identified as being utilised by this species include low lying shrubs and tussocks, rock outcrops and ground cover such as leaf litter, rocks, fallen timber and fallen bark (Richardson 2006). Many of the woodland types transected by the gas pipeline right of way are considered suitable habitat for the brigalow scaly-foot. Considering the extent of similar suitable habitat within the wider area, the habitat within the gas pipeline right of way area is not considered critical to the survival of this species.

5. *Disrupt the breeding cycle of an important population.*

   There is little understanding of the breeding cycle of this species. Considering the extent of suitable habitat within the wider area, if a population of brigalow scaly-foot was present on the gas pipeline right of way it is considered unlikely that the breeding cycle of this population would be disrupted by the proposed development.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   Considering the extent of similar suitable habitat within the wider area, if a population of brigalow scaly-foot is present within the gas pipeline right of way it is considered unlikely that the loss of this habitat will result in the decline of this species.

7. *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

   The implementation of a biosecurity management plan is required under State legislation to control and prevent the establishment of invasive species as a result of the Project.

8. *Introduce disease that may cause the species to decline*

   Disease has not been identified as a threatening process for this species. The implementation of a biosecurity management plan is required under State legislation to control and prevent the establishment of invasive species (and associated diseases) as a result of the Project.

9. *Interfere substantially with the recovery of the species*

   The study area is not considered to contain habitat important enough for the species such that its modification, destruction, removal or isolation, or a decrease in its availability or quality would interfere with the recovery of the species. The conducting of pre-clearing surveys and undertaking of management practices such as the retention of fallen timber in vegetated buffers will also assist the recovery plan objectives.

Yakka skink

The yakka skink is distributed throughout the Brigalow Belt and north to Cape York. It is usually found in open dry sclerophyll forest or woodland and lives in colonies, occupying communal burrows, often under dead timber or in deep rock crevices. It is usually found in areas of coarse gritty soils that are well drained (Ehmann 1992; Cogger 2000; Drury 2001; Wilson 2005). Colonies have been observed among piles of logs or rocks that have been left remaining in cleared paddocks, demonstrating resilience to disturbance (DEWHA 2009c). The species is threatened by loss of habitat, loss of shelter sites through agricultural practices, too-frequent fire, trampling of burrows by livestock and predation by foxes and cats (Drury 2001).

Given the range of habitats in which the species is known to occur, it is considered likely to occur in areas throughout the gas pipeline right of way.

Significant impact criteria – Yakka skink

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of an important population of a species*

   There has been no population of yakka skink identified as an important population of this species. The region, in which this species mostly occurs (the Brigalow Belt) has been subject to extensive clearing for agriculture, which has resulted in increasing pressure on the whole population of yakka skink (Richardson 2006).

   Considering the habitat suitability within the study area and the secretive nature of this species, it is considered possible for a population or populations of yakka skink to occur within the gas pipeline right of way. The eucalypt woodland is the most suitable habitat within the study area for this species.

   However, given the linear nature of the gas pipeline footprint and the extent of similar suitable habitat within the wider study area and provided that pre-clearing surveys by qualified fauna personnel are conducted, it is considered unlikely that development along the gas pipeline right

of way would lead to a decrease in the size of potential local populations, whether or not any such population would be considered an important population.

2. *Reduce the area of occupancy of an important population*

   Yakka skinks dig a burrow system under logs or rocks from which they venture out during the cooler parts of the day. They are described as gregarious, with populations occurring primarily as colonies. Colonies have been observed among piles of logs or rocks that have been left remaining in cleared paddocks, thus demonstrating resilience to disturbance (DEWHA 2009c).

   The eucalypt woodland within the study area is the most suitable habitat for the yakka skink. If a population was present close to the development footprint then it would be subject to potential loss of habitat. Given the gregarious nature of this species and provided that effective pre-clearing surveys are undertaken it is considered unlikely that the proposed development would result in the reduction of the area of occupancy of an important population.

3. *Fragment an existing important population into two or more populations*

   Yakka skinks are gregarious, living in colonies within a network of burrows. They are mostly diurnal, coming out of the burrow during the cooler times of the day and sometimes at night (DEWHA 2009c). For fragmentation of the population to occur there would need to be a disruption to the colony. Providing pre-clearing surveys are conducted it is considered unlikely that the proposed development would result in the fragmentation of a local population, whether or not such a population would be considered an important population.

4. *Adversely affect habitat critical to the survival of a species*

   There is no specific habitat that has been identified as critical habitat for the yakka skink. Land clearing and land management activities where populations occur have been identified as threatening processes for the survival of the species. Micro-habitat features utilised by the yakka skink include rock outcrops and ground cover such as leaf litter, fallen timber and fallen bark (Richardson 2006). The eucalypt woodland within the study area provides the most potentially suitable habitat for the yakka skink, containing surface rock and ample fallen timber. Considering the linear nature of the proposed works and the extent of similar suitable habitat within the wider area, the habitat within the study area is not considered to be critical habitat for this species.

5. *Disrupt the breeding cycle of an important population.*

   The yakka skink is gregarious and lives in small colonies throughout its range. These colonies contain skinks of various ages. Around six young are born per litter (Richardson 2006). Considering the gregarious nature of this species, and provided that effective pre-clearing surveys are undertaken by qualified fauna specialists, it is considered unlikely that the proposed project will disrupt the breeding cycle of a population of this species.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   The eucalypt woodland within the study area provides potentially the most suitable habitat for the yakka skink. Considering the extent of similar suitable habitat within the wider area, the loss of habitat within the development footprint is considered unlikely to cause the decline of this species.

7. *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

   Identified threats for this species include predation by cats and foxes, both of which are known to occur throughout the gas pipeline right of way. The proposed works have the potential to increase access to the area for feral predators due to fragmentation of the landscape. As such, if yakka skink is present in the wider area there is potential for feral species to impact on the population. However provided that active feral animal control is undertaken, it is considered unlikely that the proposed gas pipeline will result in an invasive species harmful to the yakka skink becoming established in this area beyond any existing extent.

   The implementation of a biosecurity management plan is required under State legislation to control and prevent the establishment of invasive species as a result of the Project.

8. *Introduce disease that may cause the species to decline*

   Disease has not been identified as a threatening process for this species. The implementation of a biosecurity management plan is required under State legislation to control and prevent the establishment of invasive species (and associated diseases) as a result of the Project.

9. *Interfere substantially with the recovery of the species*

   The study area is not considered to contain habitat important enough for the species such that its modification, destruction, removal or isolation, or a decrease in its availability or quality would interfere with the recovery of the species. The conducting of pre-clearing surveys and undertaking of management practices such as the retention of fallen timber in vegetated buffers will also assist the recovery plan objectives.

Ornamental snake

The ornamental snake occurs in low-lying areas with deep-cracking clay soils that are subject to seasonal flooding, and adjacent areas of clay and sandy loams. The species is found in woodlands and shrublands, such as brigalow, and in riverine habitats, and lives in soil cracks and under fallen timber. It is a secretive and nocturnal species and feeds almost entirely on frogs, though lizards may very occasionally be eaten (Ehmann 1992; Wilson and Swan 2008). When the soil or topography changes, the species can change from being abundant to absent over a few hundred metres (Wilson and Swan 2008). The ornamental snake is found in the Dawson and Fitzroy River Drainages of central coastal Queensland (Ehmann 1992).

Given the distribution of the species, it is considered likely to occur in suitable habitat in the northern extent of the gas pipeline right of way.

Significant impact criteria – Ornamental snake

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of an important population of a species*

   There is no listed important population for this species. The gas pipeline right of way transects a range of woodland types, some of which are considered suitable habitats for a population or populations of ornamental snake. Considering the extent of similar suitable habitat within the wider area and provided that effective pre-clearing surveys are conducted, it is considered unlikely that the Project will lead to a long term decrease in the size of an important population.

2. *Reduce the area of occupancy of an important population*

   Narrow bands of riparian and/or floodplain eucalypt woodland habitat are crossed by the alignment at the Calliope River and 11 creek systems. The alignment would also cause the loss of 1.2ha of mapped freshwater habitat and 2ha of brigalow/belah woodland, some of which is on cracking clay soils. Such areas may provide suitable resources important habitat for this species.

   If a population or populations of ornamental snake is present within the wider area of the gas pipeline right of way then development of the proposed gas pipeline may impact the extent of suitable habitat available for that population or populations.

   However, given the linear nature of the proposed works, post-construction rehabilitation of the right of way and provided pre-clearing surveys are conducted by qualified fauna specialists it is considered that any impact that may occur on an important population (if such exists within the gas pipeline right of way) is likely to be negligible.

3. *Fragment an existing important population into two or more populations*

   There is little information regrading the home range requirements or movement patterns of the ornamental snake.

   Considering the linear nature of the proposed works, post-construction rehabilitation of the right of way and the extent of suitable habitat outside of the development footprint it is considered unlikely that the proposed works will result in the fragmentation of an existing important population.

4. *Adversely affect habitat critical to the survival of a species*

   There is no identified critical habitat for the ornamental snake; however the species requires permanent or ephemeral waterbodies (e.g. gilgais) for foraging. Habitat features identified as being utilised by this species include soil cracks, fallen timber and fallen bark close to permanent or ephemeral waterbodies (Ehmann 1992).

   Several of the woodland types transected by the gas pipeline right of way are considered suitable habitat for ornamental snake. Considering the extent of similar suitable habitat within the wider area, the habitat within the gas pipeline right of way area is not considered critical to the survival of this species.

5. *Disrupt the breeding cycle of an important population.*

   There is limited understanding of the breeding cycle of this species.

   Considering the extent of suitable habitat within the wider area, if ornamental snake is present on the gas pipeline right of way it is considered possible that the breeding cycle of this population may be disrupted by the proposed development. However, given the linear nature of the proposed works and post-construction rehabilitation of the right of way, it is considered that any impact that may occur on the breeding cycle of an important population (if such exists within the gas pipeline right of way) is likely to be negligible and short term.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   Considering the extent of similar suitable habitat within the wider area, if ornamental snake is present within the gas pipeline right of way it is considered unlikely that the loss of this habitat will result in the decline of the species.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

The implementation of a biosecurity management plan is required under State legislation to control and prevent the establishment of invasive species as a result of the Project.

As ornamental snake is a frog predator cane toads may be considered a risk to the species. Cane toads are known from throughout the study area. Given that cane toads already exist within the study area it is considered that the development of the proposed gas pipeline will not significantly alter their current influence on any potential population(s) of ornamental snake from the gas pipeline right of way.

7. *Introduce disease that may cause the species to decline*

   Disease has not been identified as a threatening process for this species. The implementation of a biosecurity management plan is required under State legislation to control and prevent the establishment of invasive species (and associated diseases) as a result of the Project.

8. *Interfere substantially with the recovery of the species*

   There is no current national or state recovery plan for this species.

   The study area is not considered to contain habitat important enough for the species such that its modification, destruction, removal or isolation, or a decrease in its availability or quality would interfere with the recovery of the species.

   Given the linear nature of the proposed works, post-construction rehabilitation of the right of way and provided pre-clearing surveys are carried out by a qualified fauna specialist it is considered that any impacts are unlikely to interfere substantially with the recovery of this species.

Dunmall's snake

This species is highly cryptic, extremely secretive and possibly scarce. Only a handful of records occur within any given decade, so the biology of the snake is virtually unknown. Most records appear in open forests and woodlands, particularly brigalow and woodlands growing on cracking black clay and clay loams (Cogger et al. 1993).

However, the species has also been recorded from dry eucalypt forests and anecdotal evidence suggests it may even occur in vine thickets. Cogger et al. (1993) describes it as occurring from Yeppoon in the north to Oakey and Glenmorgan in the south. However, the species has also been recorded from around Emerald in central Queensland and in northern New South Wales (Wilson 2005).

Given the distribution of the species it is considered likely to occur in suitable habitat within the gas pipeline right of way.

Significant impact criteria – Dunmall's snake

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of an important population of a species*

   There are no listed important populations for this species, however the species is poorly known. The gas pipeline right of way transects a range of woodland types, some of which are

considered suitable habitats for a population or populations of Dunmall's snake. Considering the extent of similar suitable habitat within the wider area and provided that effective pre-clearing surveys are conducted, it is considered unlikely that the Project will lead to a long term decrease in the size of an important population.

2. *Reduce the area of occupancy of an important population*

   Narrow bands of floodplain eucalypt and brigalow/belah woodland habitat are crossed by the alignment at the Calliope River and 11 creek systems. Such areas may provide important habitat for this species. If Dunmall's snake is present within the wider area of the gas pipeline right of way then development of the proposed gas pipeline may impact the extent of suitable habitat available for that population or populations.

   However, given the linear nature of the proposed works, post-construction rehabilitation of the right of way and provided pre-clearing surveys are conducted by qualified fauna specialists it is considered that any reduction in the area of occupancy of an important population (if such exists within the gas pipeline right of way) is likely to be negligible and short term.

3. *Fragment an existing important population into two or more populations*

   There is little information regrading the home range requirements or movement patterns of Dunmall's snake. Considering the linear nature of the proposed works, post-construction rehabilitation of the right of way and the extent of suitable habitat outside of the development footprint, it is considered unlikely that the proposed works will result in the fragmentation of an existing important population.

4. *Adversely affect habitat critical to the survival of a species*

   There is no identified critical habitat for the Dunmall's snake, but the species is known to occur in brigalow woodlands on clay soils. Habitat features identified as being utilised by this species include soil cracks and fallen timber (Ehmann 1992). Several of the woodland types transected by the gas pipeline right of way are considered suitable habitat for ornamental snake. Considering the extent of similar suitable habitat within the wider area, the habitat within the gas pipeline right of way area is not considered critical to the survival of this species.

5. *Disrupt the breeding cycle of an important population*

   There is little understanding of the breeding cycle of this species. Considering the extent of suitable habitat within the wider area, if Dunmall's snake is present on the gas pipeline right of way it is considered possible that the breeding cycle may be disrupted by the proposed development. However, given the linear nature of the proposed works and post-construction rehabilitation of the right of way it is considered that any impact that may occur on the breeding cycle of an important population (if such exists within the gas pipeline right of way) is likely to be negligible and short term.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   Considering the extent of similar suitable habitat within the wider area, if Dunmall's snake is present within the gas pipeline right of way it is considered unlikely that the loss of this habitat will result in the decline of the species.

7. *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

   Invasive species are not noted as a threat to this species. The implementation of a biosecurity management plan is required under State legislation to control and prevent the establishment of invasive species as a result of the Project.

8. *Introduce disease that may cause the species to decline*

   Disease has not been identified as a threatening process for this species. The implementation of a biosecurity management plan is required under State legislation to control and prevent the establishment of invasive species (and associated diseases) as a result of the Project.

9. *Interfere substantially with the recovery of the species*

   There is no current national or state recovery plan for this species. The study area is not considered to contain habitat important enough for the species such that its modification, destruction, removal or isolation, or a decrease in its availability or quality would interfere with the recovery of the species. Given the linear nature of the proposed works, post-construction rehabilitation of the right of way and provided pre-clearing surveys are carried out by a qualified fauna specialist it is considered that any impacts are unlikely to interfere substantially with the recovery of this species.

Squatter pigeon – southern subspecies

Squatter pigeons are terrestrial and foraging, and breed on the ground. The species occurs in open dry sclerophyll woodland with grassy understorey, nearly always near permanent water. Birds may occasionally feed in sown grasslands and pastures. Squatter pigeons eat mainly seeds, including those of exotic pasture plants, and some insects (Crome and Shields 1992; Higgins and Davies 1996).

This species was historically found from Cape York Peninsula in Queensland south to the Dubbo region in New South Wales. There have been no official records in New South Wales since the 1970s and the species has declined greatly in southern Queensland (Higgins and Davies 1996; NSW NPWS 2003). Breeding is poorly known but does appear to be greatly influenced by rainfall. The nest is a shallow depression in the ground (Frith 1982; Higgins and Davies 1996).

The grassy woodlands contained within the gas pipeline right of way provide suitable habitat for the squatter pigeon. Permanent water in the form of farm dams can be found throughout the area. There are several database records for the wider area and the species was recorded on five occasions during the field surveys, indicating a population or populations reside in the study area.

Significant impact criteria – Squatter pigeon

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of an important population of a species*

   There is currently no specific recovery plan for this species. No specific population has been identified as important to the long term survival of the species (DEWHA 2009d). The squatter pigeon mainly occurs in grassy woodland and open forest dominated by eucalypts. They have been observed in grazed country and disturbed habitats, such as foraging along roads. They are commonly observed in habitats close to water bodies (DEWHA 2009c).

The gas pipeline right of way contains open eucalypt woodland habitat, which is suitable habitat for this species. Within the wider area there is a large extent of similar habitat available. Squatter pigeons are considered locally nomadic and are classified as high mobility taxa (EPA 2006). Considering the habitat affected within the study area and the extent of similar habitat in the wider area, it is considered unlikely that the proposed works would lead to the decrease of a local population, whether or not the population is considered an important population.

2. *Reduce the area of occupancy of an important population*

   As discussed, there has been no specific population identified as an important population for this species.

   The proposed development will result in the loss of suitable habitat for this species. This will however, be restricted to the gas pipeline footprint. Considering the linear nature of the proposed development, post-construction rehabilitation of the right of way, the amount of similar habitat within the wider area and the mobility of the squatter pigeon, the loss of habitat within the development footprint is considered unlikely to reduce the area of occupancy of an important population.

3. *Fragment an existing important population into two or more populations*

   The squatter pigeon is a high mobility taxa (EPA 2006) and considered to be locally nomadic (DEWHA 2009d). Given the linear nature of the proposed works and the mobility of this species, it is considered unlikely that the gas pipeline right of way would fragment an existing population of squatter pigeon.

4. *Adversely affect habitat critical to the survival of a species*

   There is currently no habitat that has been defined as critical to the survival of the squatter pigeon. In the context of this development, the most suitable habitat within the study area is eucalypt woodland. The proposed development will result in the loss of suitable habitat for this species. However, considering the extent of similar suitable habitat within the wider area the gas pipeline right of way is not considered to contain habitat critical to the survival of this species.

5. *Disrupt the breeding cycle of an important population.*

   Squatter pigeons (southern subspecies) breed from late winter into summer with pairs potentially capable of raising two broods per season. Nests are scraped into the ground beneath a tussock of grass and sparsely lined with grass. Once hatched, the young are dependant on the adults for around six to seven weeks.

   Considering the construction and operation of the proposed gas pipeline and the breeding requirements of the squatter pigeon there is potential during construction to disrupt individual squatter pigeon's breeding activity. However, provided that effective pre-clearing surveys are undertaken it is considered unlikely that the proposed works would disrupt the breeding cycle of a local or important population.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   As previously discussed, the habitat within the study area is potentially suitable for the squatter pigeon. Given the extent of similar suitable habitat within the wider area and the mobility of this species; it is considered unlikely that the loss of potential habitat resulting from the proposed development will cause the species to decline.

7. *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

   An identified threatening process for this species is excessive predation, particularly from cats and foxes (DEWHA 2009d). Tramp ants are another invasive species which need to be considered. Tramp ants are a group of ants having similar behavioural and ecological attributes which assists their spread and increases their invasive potential.

   They are found in a range of cargo entering Australia, with some species being known to have established in Australia. Squatter pigeons have been identified as potentially impacted by the introduction of tramp ants. The threat abatement plan for reduction in impacts of tramp ants on biodiversity in Australia and its territories (Commonwealth of Australia 2006) outlines the management procedures for threat of tramp ants.

   The proposed works have the potential to increase access to the area for feral predators due to fragmentation of the landscape. As such there is potential for feral species to impact on any population(s). Construction activities involving the importation of material and the movement of soils have the highest potential for the introduction of tramp ants. However provided that active feral animal control is undertaken and quarantine rules and regulations are adhered to, it is considered unlikely that the proposed gas pipeline will result in an invasive species harmful to the squatter pigeon becoming established in the area beyond any existing extent.

   The implementation of a biosecurity management plan is required under State legislation to control and prevent the establishment of invasive species as a result of the Project.

8. *Introduce disease that may cause the species to decline*

   Disease may be a threatening process to the squatter pigeon. Avian influenza is one form of noted disease that occurs in Australia. Newcastle disease is consider a potential threat to Australian avian fauna and is found in most countries around the world. Although there have possibly been some outbreaks of this disease, Newcastle disease has not yet become established in Australia. The import of birds into Australia through illegal smuggling operations has been identified as the most significant threat for the introduction of new avian disease into Australia.

   Considering the operation of the gas pipeline and provided that quarantine rules and regulations are adhered to, it is considered unlikely that a disease will be introduced as a result of the Project that would cause this species to decline.

   The implementation of a biosecurity management plan is required under State legislation to control and prevent the establishment of invasive species (and associated diseases) as a result of the Project.

9. *Interfere substantially with the recovery of the species*

   Currently there is no recovery action identified for this species. The Project is not expected to interfere substantially with the recovery of the species.

Red goshawk

The red goshawk is sparsely distributed across northern Australia and down the east coast of Queensland (NSW NPWS 2002). The red goshawk occurs in woodlands and forests, ideally with a mosaic of vegetation types and permanent water, particularly riverine forests. The species avoids both very dense and very open habitats and occurs in areas of high biodiversity, typically with large bird

populations. The species is sparsely distributed, with home ranges of 120km^2 and 200km^2 for females and males, respectively (Marchant and Higgins 1993). Nests are restricted to trees taller than 20m and within 1km of a watercourse or wetland (Garnett and Crowley 2000).

The study area has the potential to fall within the foraging range of the red goshawk. The mixed woodland is suitable as foraging habitat for this species. The gas pipeline right of way does not contain a permanent watercourse so these creeklines are unlikely to be utilised as breeding habitat.

Desktop studies revealed records of red goshawk within the wider area of the gas pipeline right of way. However, the study area is generally not considered suitable as a breeding site for this species. A conservative approach has been adopted and the study area has been considered as part of the foraging range of the red goshawk.

Significant impact criteria – Red goshawk

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of an important population of a species*

   The red goshawk occurs in a very sparse distribution across eastern and northern Australia. They are generally solitary birds occupying large home ranges. In southeast Queensland, the estimated home range for breeding pairs is between 50 to 220 km2. The current recovery plan for this species has not identified important populations of this species.

   The recovery objectives and discussion highlight the need to identify and protect nesting sites for this species. Red goshawk nests are located up to 1km away from permanent fresh water (NSW NPWS 2002). Habitat within the study area was identified as being suitable for foraging for the red goshawk. It is considered unlikely that the study area would be utilised as a breeding site as there was no permanent freshwater available along creeklines crossed by the gas pipeline right of way.

   Given the extent of similar suitable foraging habitat within the wider area it is considered unlikely that the development of the Project will lead to a long term decrease in the size of a population.

2. *Reduce the area of occupancy of an important population*

   As discussed previously, an important population of this species has not been defined; rather breeding sites are identified as important for this species. If a breeding pair was utilising habitat within the gas pipeline right of way then it may be considered that the proposed development would remove potential foraging habitat. There has been no breeding site identified within the study area and it is considered unlikely that suitable sites (creeklines) within the gas pipeline right of way would be utilised as a breeding site. The Project is not considered likely to reduce the area of occupancy of any possible population of the species.

3. *Fragment an existing important population into two or more populations*

   The red goshawk has a naturally sparse distribution across its range. They are considered high mobility taxa (EPA 2006) that occupy large home ranges. The proposed works will result in the removal of potential foraging habitat.

   However, this will be restricted to the development footprint. Considering the mobility of this species and the linear nature of the gas pipeline footprint; it is considered unlikely that the proposed development will cause fragmentation of an important population of this species.

4. *Adversely affect habitat critical to the survival of a species*

   The action plan for the red goshawk (Garnett and Crowley 2000) has not identified habitat critical to the survival of this species. Identification and protection of nesting sites and associated habitat have been identified as recovery objectives for this species. The study area has not been identified as containing potential nesting locations for this species. The study area is considered a possible foraging area for this species. As such the Project is unlikely to affect habitat critical to the survival of this species.

5. *Disrupt the breeding cycle of an important population.*

   Red goshawks are thought to be monogamous. Breeding generally occurs in spring in the south-east of the species' range, with one or two eggs laid between August and October. Large nests are constructed usually near the top of the tallest tree and within 1km of permanent fresh water.

   Potential threats to breeding for this species include illegal egg collecting, disruption of breeding cycles and nest trees by fire (Garnett and Crowley 2000) and use of pesticides such as DDT which cause eggshell thinning (NSW NPWS 2002). Considering these threats to breeding, it is unlikely the red goshawk would nest within the gas pipeline right of way. It is considered unlikely the proposed works will disrupt the breeding cycle of a breeding pair of red goshawks.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   The most significant cause of decline of the Red Goshawk in eastern Queensland is widespread deforestation for agriculture, particularly of lowland riverine forests (Garnett and Crowley 2000). Construction of the proposed gas pipeline will result in the removal of potential foraging habitat for this species. The impacted habitat within the study area is largely cleared/modified lands with some eucalypt woodland. The study area does not contain riverine forest suitable for breeding. Considering the habitat available within the gas pipeline right of way and the extent of potential foraging habitat within the wider area, the habitat impacted by the proposed works is considered unlikely to cause the decline of the species.

7. *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

   Feral species have not been identified as a threatening process for the red goshawk. The prey species for red goshawk is primarily small birds, which are impacted by feral predators such as cats and foxes. Both of these feral species are likely to occur throughout the study area and as such it is considered that the proposed works are unlikely to alter this balance, to the extent that it will affect this species. The implementation of a biosecurity management plan is required under State legislation to control and prevent the establishment of invasive species as a result of the Project.

8. *Introduce disease that may cause the species to decline*

   Disease has not been identified as a threatening process to the red goshawk. The import of birds into Australia through illegal smuggling operations has been identified as the most significant threat for the introduction of new avian disease into Australia.

   The implementation of a biosecurity management plan is required under State legislation to control and prevent the establishment of invasive species (and associated diseases) as a result of the Project.

9. *Interfere substantially with the recovery of the species*

Currently there is not a national recovery plan for the red goshawk. The objectives of the NSW recovery plan can be taken in context and utilised to provide a guide to recovery effort. The specific objectives of the NSW NPWS red goshawk Recovery Plan 2002 are to:

- Improve the co-operation and co-ordination of recovery efforts between New South Wales and Queensland
- Review the legal status of the species at the national level
- Standardise survey method
- Increase awareness of the conservation status and threats affecting the red goshawk
- Identify and protect any known habitat or nest sites that occur in New South Wales.

The proposed gas pipeline will result in the loss of potential foraging habitat for this species. Considering the extent of similar foraging habitat within the wider area, the Project is unlikely to interfere substantially with the recovery of this species.

Australian painted snipe

The Australian painted snipe is a secretive, cryptic, crepuscular species that occurs in terrestrial shallow wetlands, both ephemeral and permanent, usually freshwater but occasionally brackish. They also use inundated grasslands, saltmarsh, dams, rice crops, sewage farms and bore drains. They feed on vegetation, seeds and invertebrates, including crustaceans and molluscs (Marchant and Higgins 1993).

Painted snipes in Australia have previously been considered a subspecies of *Rostratula benghalensis*, a species found in sub-Saharan Africa and Asia (Marchant and Higgins 1993). Australian birds are now considered to be an endemic species, *R. australis*, in which case *R. benghalensis* does not occur in Australia (Garnett and Crowley 2000; Geering et al. 2007). They are patchily distributed throughout Australia, with most records being in the southeast. Records are erratic, with the species being absent from areas in some years and common in others.

Breeding occurs mainly in the Murray-Darling region, but is also recorded in other parts of Queensland, New South Wales and South Australia. Nests are shallow scrapes on the ground and are often found on islands in freshwater swamps/wetlands. Breeding habitat requirements appear to be specific. They include shallow wetlands with patches of bare mud, dense low cover and sometimes tall dense cover (Rogers et al. 2005). Breeding has been recorded all year round and may be a response to wetland conditions rather than season. Most records from southern Australia occur from August to February. In north Queensland breeding has been recorded between May and October (Marchant and Higgins 1993).

Freshwater habitats, which correspond to RE11.3.27, make up less than 0.003% of the habitats within the 10km buffer of the gas pipeline alignment. The alignment would cause the loss of 1.2ha of mapped freshwater habitat, but these areas are ephemeral or at best semi-permanent and are degraded by livestock. Although this habitat may be suitable at times for this species, it is not considered to be important habitat. Additional habitat may be created due to heavy rain events flooding paddocks, but would be highly ephemeral. Foraging opportunities for the species would be very sporadic under such circumstances.

Significant impact criteria – Australian painted snipe

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of an important population of a species*

   The current population is considered to occur across much of eastern and northern Australia as a single, contiguous breeding population (Garnett and Crowley 2000).

   The gas pipeline right of way contains very little habitat considered suitable for this species. Within the wider area there is a large, (although patchy) extent of similar habitat available. Movement patterns are not well known, however the species is often recorded intermittently in suitable habitat, suggesting some nomadic dispersal patterns. Considering the habitat affected within the study area and the extent of similar habitat in the wider area, it is considered unlikely that the proposed works would lead to the decline of a local population.

2. *Reduce the area of occupancy of an important population*

   As discussed, the gas pipeline right of way contains little habitat suitable for this species.

   The proposed development will result in the estimated loss of a linear strip of 1.2ha of suitable wetland habitat for this species. Any reduction in the area of occupancy of this species is considered to be minor and short term, regardless of whether or not any possible population within the gas pipeline right of way would be regarded as an important population.

3. *Fragment an existing important population into two or more populations*

   Given the intermittent nature of the species records, the linear nature of the proposed works and the minimal amount of suitable habitat to be cleared it is considered unlikely that the gas pipeline right of way would fragment an existing population of Australian painted snipe.

4. *Adversely affect habitat critical to the survival of a species*

   Given the degraded nature of the wetland habitat within the gas pipeline right of way and the minimal amount of suitable wetland habitat to be cleared it is considered unlikely the proposed works will affect habitat critical to the survival of this species.

5. *Disrupt the breeding cycle of an important population*

   Breeding is thought to be a response to wet weather events rather than seasonal.

   Depending on local weather conditions there is potential during construction to disrupt the breeding cycle of individual Australian painted snipe. However, given the minimal amount of habitat suitable for this species to be cleared and provided that effective pre-clearing surveys are undertaken it is considered unlikely that the proposed works would disrupt the breeding cycle of an important population.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   As previously discussed, there is minimal habitat within the gas pipeline right of way that is considered potentially suitable for Australian painted snipe.

   Given the extent of similar suitable habitat within the wider area it is considered unlikely that the loss of potential habitat resulting from the proposed development will cause the species to decline.

7. *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

   An identified threatening process for this species is excessive predation, particularly from cats and foxes (DEWHA 2009g) which are already known to occur in the wider area. The proposed works have the potential to increase access to the wider area for feral predators due to fragmentation of the landscape. As such there is potential for feral species to impact on any possible population. However, provided that active feral animal control is undertaken and quarantine rules and regulations are adhered to, it is considered unlikely that the proposed facility will result in an invasive species harmful to the Australian painted snipe becoming established in the area beyond the existing extent.

   The implementation of a biosecurity management plan is required under State legislation to control and prevent the establishment of invasive species as a result of the Project.

8. *Introduce disease that may cause the species to decline*

   There are no known introduced pathogens listed for this species. However, avian influenza is one form of noted disease that occurs in Australia. Newcastle disease is also considered a potential threat to Australian avian fauna and is found in most countries around the world. Although there have possibly been some outbreaks of this disease, Newcastle disease has not yet become established in Australia. The import of birds into Australia through illegal smuggling operations has been identified as the most significant threat for the introduction of new avian disease into Australia.

   The implementation of a biosecurity management plan is required under State legislation to control and prevent the establishment of invasive species as a result of the Project.

9. *Interfere substantially with the recovery of the species*

   There are several recovery actions identified for this species. Some recommendations outlined for the species include:

   - The establishment of control measures for feral predators
   - Protection of habitat from degrading processes such as livestock
   - Rehabilitation of selected wetlands previously used for breeding
   - Protect and manage habitat at principal breeding and wintering sites (Garnett and Crowley 2000).

   The Project is considered unlikely to interfere with the recovery of the species.

Black-breasted button-quail

The species is predominantly recorded from closed dry rainforest and vine thickets with abundant leaf-litter, although they can also be occasionally recorded from scrubs including brigalow, belah, bottletree thickets and in dry eucalypt forests where there is a dense understorey such as lantana and grass groundcover (Marchant and Higgins 1993). Black-breasted button-quails have specific habitat requirements based on soil fertility, leaf litter and structural attributes which determine food availability and protection from predation (Mathieson and Smith 2009).

The species is known from Byfield in central Queensland, south to northeast New South Wales. The habitat and the sub-populations are highly fragmented. The two main population centres in south-eastern Queensland are in semi-evergreen vine thickets (SEVT) in the Yarraman-Jimna and region

and in coastal dune scrubs in the Great Sandy region (Mathieson and Smith 2009). Their movements are not fully understood. They are often recorded intermittently or occasionally, before disappearing for extended periods (Marchant and Higgins 1993).

Most records of nesting birds occur between around November and March, but the species may nest all year round if conditions are suitable (Marchant and Higgins 1993). Radio-tracking studies by Smith et al. (1998) suggest that the birds do not occupy exclusive territories. Home ranges appear to range in size from 2.2 to 6.1ha.

The SEVT contained within the gas pipeline right of way will provide the most suitable habitat for this species. There are known important remnant populations within Barakula State Forest, which is directly to the east of the southern extent of the pipeline and there are several database records for the wider area.

Significant impact criteria – Black-breasted button quail

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of an important population of a species*

   There is a current national recovery plan for this species. Three populations have been identified as important to the long term survival of the species, with smaller populations at Barakula State Forest and Palmgrove National Park also considered as important remnant populations. Black-breasted button-quail mainly occurs in SEVT and other dense scrubs with little ground cover (Mathieson and Smith 2009).

   The gas pipeline right of way contains very little habitat considered suitable for this species. Within the wider area there is a large (although patchy) extent of similar habitat available. Movement patterns are not well known, however the species is often recorded intermittently in suitable habitat, suggesting some nomadic dispersal patterns. Considering the habitat affected within the study area and the extent of similar habitat in the wider area, it is considered unlikely that the proposed works would lead to the decrease of any possible local population.

2. *Reduce the area of occupancy of an important population*

   As discussed, there are several populations identified as important for this species, including areas in the vicinity of the study area (that is, Barakula National Park).

   The proposed development will result in minimal loss of suitable habitat for this species and will be restricted to the gas pipeline footprint. Considering the minimal loss of suitable habitat, the amount of similar habitat within the wider area and provided that pre-clearing surveys by qualified fauna personnel are conducted it is considered unlikely to reduce the area of occupancy of any population within the study area.

3. *Fragment an existing important population into two or more populations*

   Given the linear nature of the proposed works and the lack of suitable habitat to be cleared it is considered unlikely that the gas pipeline right of way would fragment an existing population of black-breasted button-quail.

4. *Adversely affect habitat critical to the survival of a species*

   Habitat that has been defined as critical to the survival of the black-breasted button-quail includes SEVT and other dry rainforest types, and woodlands/shrublands with a dense understorey (Mathieson and Smith 2009).

   In the context of this development, the most suitable habitat within the study area is SEVT. The proposed development will result in the minimal loss of suitable habitat for this species. Considering the extent of similar suitable habitat within the wider area, the gas pipeline right of way is not considered to contain habitat critical to the survival of this species.

5. *Disrupt the breeding cycle of an important population.*

   Black-breasted button-quail are thought to breed from September through to late May, however some populations may be capable of breeding year round (DEWHA 2009k). Nests are scraped into the ground and lined with grass, moss or leaves. Nests are hidden at the base of tree buttresses, grass tussocks or low bushes.

   Considering the linear nature of the proposed gas pipeline and the breeding requirements of the species, there is some potential during construction to disrupt individual black-breasted button-quail. However, provided that effective pre-clearing surveys are undertaken it is considered unlikely that the proposed works would disrupt the breeding cycle of a local or important population.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   As previously discussed, there is minimal habitat within the gas pipeline right of way that is considered potentially suitable for the black-breasted button-quail. Given the extent of similar suitable habitat within the wider area it is considered unlikely that the loss of potential habitat resulting from the proposed development will cause the species to decline.

7. *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

   An identified threatening process for this species is excessive predation, particularly from cats and foxes (DEWHA 2009k) which are known to occur in the wider area. The proposed works have the potential to increase access to the wider area for feral predators due to fragmentation of the landscape. As such there is potential for feral species to impact on any possible population. However, provided that active feral animal control is undertaken and quarantine rules and regulations are adhered to, it is considered unlikely that the proposed facility will result in an invasive species harmful to the black-breasted button-quail becoming established in the area beyond the existing extent.

   The implementation of a biosecurity management plan is required under State legislation to control and prevent the establishment of invasive species as a result of the Project.

8. *Introduce disease that may cause the species to decline*

   There are no known introduced pathogens listed for this species. However, avian influenza is one form of noted disease that occurs in Australia. Newcastle disease is also considered a potential threat to Australian avian fauna and is found in most countries around the world. Although there have possibly been some outbreaks of this disease, Newcastle disease has not yet become established in Australia. The import of birds into Australia through illegal smuggling

operations has been identified as the most significant threat for the introduction of new avian disease into Australia.

The implementation of a biosecurity management plan is required under State legislation to control and prevent the establishment of invasive species as a result of the Project.

9. Interfere substantially with the recovery of the species

There are several recovery actions identified for this species. Some recommendations outlined for the species include:

- The establishment of control measures for feral predators, particularly foxes and cats
- Rehabilitation of suitable habitat and protection of habitat from degrading processes such as livestock
- The establishment of conservation measures to protect suitable habitat on private and public lands (Mathieson and Smith 2009).

The proposed project is considered unlikely to interfere with the recovery of this species.

Grey-headed flying-fox

Two habitat characteristics are important for grey-headed flying-foxes – foraging resources and roosting sites. As the species is a canopy-feeding frugivore and nectarivore, they use vegetation including rainforests, open eucalypt forests, woodlands, melaleuca swamps and banksia woodlands. Roosts are commonly within dense vegetation close to water, primarily rainforest patches, stands of melaleuca, mangroves or riparian vegetation (Nelson 1965), but colonies may use exotic vegetation in urban areas (Birt et al. 1998).

The species congregates in large camps of up to 200,000 individuals from early until late summer, with the number of bats within a camp being influenced by the availability of blossom in the surrounding area. Adults normally disperse during the winter and can migrate up to 750km as individuals or small groups, with the young forming winter camps (Churchill 2008).

The species is generally recorded between the coast and the western slopes of the Great Dividing Range. Regular or frequently used camps have been located between Mackay in Queensland south to around Mallacoota in East Gippsland, Victoria. Less consistent records extend the south range of the species to Warrnambool, Victoria (Duncan et al. 1999) and recent surveys have located camps of this species as far north as the Mackay region (Roberts et al. 2008).

Night foraging is usually conducted within 15km of a daytime roost and can extend up to 50km. As such, the project area potentially falls into the foraging range of this species. Nectar and pollen from flowering eucalypts, melaleucas and banksias are the primary diet of this species (DEWHA 2009f).

No roosting sites are known or were recorded within the gas pipeline corridor area. It is considered unlikely that the proposed development in this area will affect roosting sites for this species.

Significant impact criteria – Grey-headed flying fox

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of an important population of a species*

The grey-headed flying-fox is highly mobile moving up and down the east coast of Australia in response to the availability of food. This mobility indicates that this is a single interbreeding

population (DEWHA 2009f). There are no identified important populations of this species. In considering the potential impacts on local populations a roosting site for the grey-headed flying-fox has been identified to the south of Gladstone. Foraging is usually conducted within 50km of a daytime roost. As such, the study area potentially falls into the foraging range of this species. Nectar and pollen from flowering eucalypts, melaleucas and banksias are the primary diet of this species (DEWHA 2009f).

The eucalypt woodlands within the gas pipeline right of way are suitable for the foraging and feeding requirements of the grey-headed flying-fox. Considering the proximity of the nearest known grey-headed flying-fox camp, the linear nature of the area impacted and the extent of similar habitat within the wider area, it is considered unlikely that proposed works will lead to the long term decrease of a grey-headed flying fox population in this area.

2. *Reduce the area of occupancy of an important population*

The draft recovery plan of the grey-headed flying-fox does not specify important populations for this species. The nearest known grey-headed flying-fox roost is located to the south of Gladstone. This species is known to share roosts with the black flying-fox (Pteropus alecto) (DEWHA 2009f). There are no roosts located with the gas pipeline right of way. There is potential for habitat within the study area to fall within the foraging range of the grey-headed flying-fox. As such, the proposed project may result in reduced foraging habitat for this species but is not expected to reduce the area of occupancy of an important population.

3. *Fragment an existing important population into two or more populations*

Individuals of this species move up and down the east coast in response to available food resources. They are considered a highly mobile taxa, defined as having large home ranges of over 100ha per breeding pair (EPA 2006).

Considering the linear nature of the proposed works and the mobility of the grey-headed flying-fox, it is considered unlikely that the gas pipeline will result in fragmentation of an important grey-headed flying-fox population.

4. *Adversely affect habitat critical to the survival of a species*

Critical habitat mapping for this species has not yet been completed. The eucalypt woodland species within the gas pipeline right of way would flower primarily during spring and summer, although the flowering of eucalypts does not occur every year. As such, the habitat within the study area potentially constitutes part of the foraging habitat for the grey-headed flying-fox. If the grey-headed flying-fox is utilising this habitat within its foraging range, then there is potential for the proposed development to impact on foraging habitat of this species. However this habitat is not considered critical to the survival of the species.

5. *Disrupt the breeding cycle of an important population*

Female grey-headed flying-foxes reach sexual maturity after three years and bear a single young each year. Mating occurs in early autumn with the young being born around October. The female carries the young for the first four to five weeks and thereafter the young remain in maternal camps until around 12 weeks of age.

Females are known to abort their pregnancy during times of food shortage or stress and young are sometimes abandoned during times of food shortage (DEWHA 2009f).

Identified threatening processes to the grey-headed flying-fox include the disruption or destruction of camps and the hybridisation of the species with the black flying fox. The removal

of potential foraging habitat may reduce the available resources of a population roosting within this region.

However, considering the linear nature of the gas pipeline corridor and the amount of similar habitat within the wider area, it is considered unlikely that the facility will contribute to these threatening processes and the Project is not expected to disrupt the breeding cycle of an important populations.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

Habitat within the study area has the potential to be classified as being within the essential foraging habitat of the grey-headed flying-fox. The proposed works are unlikely to impact on a roosting site. The predominant habitat within the gas pipeline right of way is largely cleared/modified lands with some eucalypt woodland which potentially provides foraging resources.

Loss of habitat within the study area is likely to be limited to the development footprint. Considering the linear nature of the proposed works, and the extent of similar suitable foraging habitat within the wider area, it is considered unlikely that the Project will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

7. *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

Invasive species have not been identified as a threatening process for the grey-headed flying fox. The implementation of a biosecurity management plan is required under State legislation to control and prevent the establishment of invasive species as a result of the Project.

8. *Introduce disease that may cause the species to decline*

Disease is identified as a low priority threat for the grey-headed flying-fox. There are three viruses that are known to be carried by the grey-headed flying-fox population, Australian bat lyssavirus, hendra virus and menangle virus. The impact of the Australian bat lyssavirus is not thought be significant unless the population is under stress, during which the impact on the population increases.

The impact of the hendra and menangle viruses is unknown (NSW DECC 2009). Transmission of the disease is via a scratch or some form of wound from an infected animal. The natural history of strains of these types of viruses indicates that they are host specific with the Australian bat lyssavirus being endemic to the Australian bat population.

Considering the mode of transmission of these diseases and the proposed footprint, it is unlikely that construction and operation of the gas pipeline will introduce a disease for this species. The implementation of a biosecurity management plan is required under State legislation to control and prevent the establishment of invasive species as a result of the Project.

9. *Interfere substantially with the recovery of the species*

Published recovery objectives for the grey-headed flying-fox include:

- Stabilise the population at its current level
- Define patterns of landscape use and identify and protect essential habitat

- Develop non-destructive methods for crop protection
- Develop non-destructive methods for management of camps in problem areas
- Ensure consistent management of the species across all range states (Queensland, New South Wales and Victoria).

For the development of the gas pipeline right of way there is potential for loss of habitat within the foraging area of grey-headed flying-fox.

The area affected however, will be limited to the development footprint. Considering the suitable foraging habitat within the wider area, it is unlikely the proposed development will substantially interfere with the recovery of this species.

Greater long-eared bat

Nyctophilus timoriensis is no longer considered to occur in Australia. For some time the *Nyctophilus* species relevant to the study area was undescribed and referred to as *Nyctophilus* species 2 (Churchill 2008). The genus in Australia was revised very recently and the species found in southeast Queensland is now known as *Nyctophilus corbeni* (Parnaby 2009).

The biology of the greater long-eared bat is not well known. They are known to roost in tree crevices and under bark (Churchill 2008). Larger tree hollows are used as maternity colonies in spring and summer (Turbill et al. 2008).

The species occurs in a variety of forest/woodland types including SEVT, but prefers areas where the vegetation has a distinct canopy with a dense understorey. It is largely confined to the Murray-Darling basin, being most abundant in woodlands on sandy soils along the western slopes and plains of southern Queensland and New South Wales. Surveys suggest that larger remnants are needed to support high population densities (Turbill et al. 2008).

No major roosting site has been identified in the wider area. Given the species known distribution and roosting habitat, the gas pipeline right of way potentially provides roosting and foraging habitat for a population(s), particularly west of the Callide/Calliope Ranges. If this species is present within the wider area, it may be impacted by loss of habitat within its range.

Significant impact criteria – Greater long-eared bat

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of an important population of a species*

   There is no known important population of greater long-eared bat identified for the gas pipeline right of way. However, the species is rarely caught and their distribution and ecology is not well understood.

   The species is most abundant in large remnants and does not appear to tolerate habitat fragmentation (Turbill et al. 2008).

   As the greater long-eared bat is a tree roosting species it is considered possible the proposed works may disturb a roost site for this species, particularly in larger areas of extant vegetation such as the Fairydale/Rockybar area and Gurulmundi/Barakula area. However, considering the linear nature of the proposed works, the extent of similar habitat available within the wider area, and, most importantly, provided that effective pre-clearing surveys are undertaken by qualified

fauna specialists it is unlikely the proposed development at this location will lead to a decrease in size of an important population.

2. *Reduce the area of occupancy of an important population*

   There is no recorded important population of greater long-eared bats in this area.

   The eucalypt woodlands within the gas pipeline right of way contain tree hollows, which may be utilised as roosting sites by the greater long-eared bat. Given the current information available on the study area and this species, it is considered possible the proposed works may reduce the area of occupancy of an important population. However any reduction would be minor and short-term.

3. *Fragment an existing important population into two or more populations*

   Greater long-eared bats are thought to roost solitarily, except when small maternity colonies are established in tree hollows in spring and summer (Turbill et al. 2008).

   Given the current understanding of this species, the potential for fragmentation of a population is likely to be through the disturbance of the maternity sites. Provided pre-clearing surveys are carried out by a fauna specialist it is considered unlikely the proposed development would fragment an existing population.

4. *Adversely affect habitat critical to the survival of a species*

   There is currently no identified critical habitat for this species.

   Given the species utilises tree hollows/crevices for roosting and maternity sites it is considered likely the study area may contain these features. Provided that management and mitigation measures are undertaken (e.g. use of a trained fauna specialist to undertake inspections of tree crevices and hollows prior to clearing) it is considered unlikely that the proposed development will adversely affect habitat critical for a local population of greater long-eared bat.

5. *Disrupt the breeding cycle of an important population.*

   The current understanding of the breeding cycle of greater long-eared bats is unknown, but it is considered likely to be similar to that of other Nyctophilus species with mating occurring during winter and young estimated to be born from late October to November. The females congregate in small numbers using tree hollows as a maternity roost.

   As previously discussed, areas of the gas pipeline right of way are likely to contain trees suitable as roosting sites or maternity roosts. As such, it is considered possible the proposed works at these areas may disrupt the breeding cycle of a population of this species. However, provided that management and mitigation measures are undertaken (e.g. use of a trained fauna specialist to undertake inspections of tree crevices and hollows prior to clearing) it is considered unlikely that the proposed development will disrupt the breeding cycle of an important population.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   Given the species distribution and known population concentrations, the proposed development is not likely to result in the decline of the species. If greater long-eared bats roost within the study area there is potential for the Project to remove some roosting and foraging habitat. Given the linear nature of the proposed works, the extent of similar habitat within the wider area and provided management and mitigation measures are undertaken, it is considered unlikely

that the Project will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

7. *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

   Invasive species have not been identified as a threatening process for the greater long-eared bat. Potential competition for tree hollows as roosting sites may occur. Tree hollows are a finite resource within the landscape and are utilised by a range of native species and some feral species. In this locality feral bees are a potential competitor for tree hollows. However the Project will not facilitate the establishment of feral bees within the wider area.

   The common myna (Sturnus tristris) and the common starling (S. vulgaris) also utilise tree hollows for nesting. Although these species have been recorded within the wider area the proposed works are considered unlikely to alter this balance to the extent that it will affect the species.

   Considering the known roosting requirements of the greater long-eared bat, it is considered unlikely that the Project will result in an invasive species becoming established that would subsequently impact significantly on this species.

   The implementation of a biosecurity management plan is required under State legislation to control and prevent the establishment of invasive species as a result of the Project.

8. *Introduce disease that may cause the species to decline*

   Given the current lack of knowledge regarding the ecology of this species, the impacts of disease on the greater long-eared bat are unknown. Australian bat lyssavirus is endemic in the Australian bat population. The potential effects of this disease on this species are unknown. The Australian bat lyssavirus has been identified as having two strains, one strain affecting fruit bats and the second strain affecting insectivorous bats. The virus has been detected in four species of fruit bat and one insectivorous bat, the yellow-bellied sheath- tail bat (Saccolaimus flaviventris) (Agriculture and Resource Management Council of Australia and New Zealand 1999).

   The spread of this disease or other disease in the bat population is considered unlikely to be facilitated by the proposed works. The implementation of a biosecurity management plan is required under State legislation to control and prevent the establishment of invasive species as a result of the Project.

9. *Interfere substantially with the recovery of the species*

   There is no current recovery plan for this species.

   The gas pipeline right of way includes areas that contain roosting habitat (including maternity roosts) and foraging habitat for this species. Provided that a qualified fauna specialist undertakes pre-clearing inspections of these areas prior to construction activities, it is considered unlikely that the proposed works will interfere with the recovery of this species.

Large-eared pied bat

The large-eared pied bat has been recorded roosting in disused mine tunnels, rock overhangs, caves and fairy martin *Petrochelidon ariel* nests (Dwyer 1966; Eyre et al. 1997; Schulz 1998; Thompson 2002). It is possible the species roosts in the hollows of trees (DEWHA 2009a). It is found in areas with extensive cliffs and caves, and in well timbered areas with gullies close to roosting areas. In

southeast Queensland, the species seems to be more associated with higher altitude moist forests and adjacent rainforest (Eyre et al. 1997), while most records from New South Wales are from dry and wet sclerophyll forest including *Callitris* forests, tall open eucalypt forests with a dry understorey, sub-alpine woodland, and sandstone outcrop country (Duncan et al. 1999).

While there is potential for areas of cliffs and/or caves to occur near the gas pipeline right of way associated with sandstone areas within and adjacent to Gurulmundi State Forest, no cliffs or caves, and therefore no roosting habitat of this type, are likely to occur within the gas pipeline right of way. No major roosting site has been identified in the wider area. However, if tree hollows are utilised as roosts, then the gas pipeline right of way study area potentially provides roosting sites for a population. If this species is present within the wider area it may be impacted by loss of habitat within its foraging range.

Significant impact criteria – Large-eared pied bat

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of an important population of a species*

   There is no important population of large-eared pied bat identified for the gas pipeline right of way. The closest identified important populations are at Shoalwater Bay and Blackdown Tablelands (DEWHA 2009a). The distribution and ecology of this species is not well understood. The Shoalwater Bay area is currently accepted as being the northern range of this species. Large-eared pied bats appear to exist in small populations throughout the range with the larger maternity colonies consisting of up to 50 individuals (DEWHA 2009a).

   It is considered unlikely that the proposed works may disturb a major roost site for this species, as there are no known areas with potential roosting habitat (caves or cliffs) in the vicinity of the alignment and no cliffs or caves were observed within the right of way. There is potential loss of tree hollows, which may also be utilised by this species. However, considering the linear nature of the proposed works, the extent of similar habitat available within the wider area, and provided that effective pre-clearing surveys are undertaken by qualified fauna specialists, it is considered unlikely the Project will lead to a decrease in size of an important population.

2. *Reduce the area of occupancy of an important population*

   There is no recorded important population of large-eared pied bats in this area. Individuals disperse from the maternity roost around April and theses roosts are not utilised again until September. The distance these individuals travel from the maternity roost is not known but it is thought to be less than 100km (DEWHA 2009a).

   The majority of the habitat within the gas pipeline right of way consists of cleared/modified lands and eucalypt woodland. However the study area contains habitat suitable for foraging by this species. The eucalypt woodland contains tree hollows, which may be utilised as roosting sites by the large-eared pied bat. Given the current information available on the study area and this species, it is considered possible the proposed works may reduce the area of occupancy of a population. However, provided roost sites are identified by a suitably qualified fauna specialist and then avoided, any reduction in the area of occupancy of the species will be minor and short term.

3. *Fragment an existing important population into two or more populations*

   Large-eared pied bats are thought to be distributed in small populations throughout their range. Females have been observed congregating in maternity roost in caves and disused mines. These roosts are not used throughout the year, as individuals disperse from these roosts around April (DEWHA 2009a).

   Given the current understanding of this species, the potential for fragmentation of a population is likely to be through the disturbance of the maternity sites such as tree hollows. However, provided roost/maternity sites are identified by a suitably qualified fauna specialist and then avoided, the Project is not expected to fragment an important population.

4. *Adversely affect habitat critical to the survival of a species*

   There is currently no identified critical habitat for this species. Important populations have been identified for this species, of which the Shoalwater Bay and Blackdown Tableland populations are the closest to the study area. It is considered unlikely the proposed works would adversely affect the survival of either population. When considering the available habitat for a local population of large-eared pied bat, recovery objectives for this species discuss the identification and protection of major roost and maternity sites as one of the conservation objectives.

   Given the current description of major roosts and maternity sites, there is a low likelihood that study area may contain these features. Provided that management and mitigation measures are undertaken (e.g. use of a trained fauna specialist to undertake inspections of tree hollows prior to clearing) it is considered unlikely that the proposed development will adversely affect habitat critical for a local population of large-eared pied bat.

5. *Disrupt the breeding cycle of an important population.*

   The current understanding of the breeding cycle of large-eared pied bats is that mating occurs during winter with the young estimated to be born around late November. Current observations indicate that most females will have two young per season. The females congregate in a maternity roost during this time, dispersing from the maternity roost around April (DEWHA 2009a). The identification and protection of maternity roosts has been identified as one of the recovery objectives for this species.

   It is considered possible, albeit with a very low likehood, that the proposed works may disrupt the breeding cycle of a population/s of this species. However, provided maternity sites are identified by a suitably qualified fauna specialist and then avoided, the Project is not expected to disrupt the breeding cycle of an important population.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   The current extent of occurrence for this species is approximately 9120km² with much of the known distribution occurring in New South Wales (DEWHA 2009a).

   Given the species distribution and the known population concentrations, the proposed development is not expected to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

7. *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

   Invasive species have not been identified as a threatening process for the large-eared pied bat. Potential competition for tree hollows as roosting sites may occur, should the species use them. Considering the known preferred roosting requirements of the species, it is considered unlikely that the Project will result in an invasive species becoming established that would subsequently impact significantly on this species.

   The implementation of a biosecurity management plan is required under State legislation to control and prevent the establishment of invasive species as a result of the Project.

8. *Introduce disease that may cause the species to decline*

   Given the current lack of knowledge regarding the ecology of this species, the impact of disease is unknown. Australian bat lyssavirus is endemic in the Australian bat population. The potential effects of this disease on this species are unknown. The Australian bat lyssavirus has been identified as having two strains, one strain affecting fruit bats and the second strain affecting insectivorous bats. The virus has been detected in four species of fruit bat and one insectivorous bat, the yellow-bellied sheath- tail bat (Saccolaimus flaviventris) (ARMCANZ 1999).

   The spread of this disease or other disease in the bat population is considered unlikely to be facilitated by the proposed works. The implementation of a biosecurity management plan is required under State legislation to control and prevent the establishment of invasive species as a result of the Project.

9. *Interfere substantially with the recovery of the species*

   The identification and protection of roost and maternity sites for this species is identified in the recovery recommendations. The gas pipeline right of way includes areas that potentially contain roost or maternity roost (in tree hollows) for this species. Provided that a qualified fauna specialist undertakes inspection of tree hollows prior to construction activities; it is considered unlikely that the proposed works will interfere with the recovery of this species.

False water-rat

The false water-rat is found in disjunct populations along the Northern Territory and Queensland coasts. This specialised rodent inhabits intertidal wetlands and adjacent habitats. It is an active predator of invertebrates, particularly grapsid crabs (Ball 2004). There are no identified population near the proposed works, with the closest known population located approximately 45km south of Gladstone (DERM 2009a).

However standard survey techniques do not generally record this species. The false water-rat constructs nesting mounds in which it shelters during the day and in between tidal cycles. Little is currently known about the reproductive biology of the false water-rat. One study has observed that up to eight animals may share a mound. The study observed that the species were of mixed age, but there was only one sexually-active male in each mound. Studies indicate that the false water-rat requires a large area in which to forage.

Habitat suitable for this species contained within the gas pipeline right of way is restricted to the mangroves and associated mudflats either side of the Narrows (north of Gladstone) on the mainland and Laird Point on Curtis Island.

Significant impact criteria – False water rat

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of an important population of a species*

   A number of important populations of false water-rat have been identified in protected areas along the central and south eastern Queensland coast. There is no known population in the area. The closest known population is located approximately 45km south of Gladstone.

   The mangrove habitat and marine couch plains provide potential habitat for this species within the gas pipeline right of way and 15.2ha of saltpan and mangroves are expected to be cleared for the Project. However, these ecosystems are naturally transient and disturbance from events like cyclones are common, therefore the impacts on the False water rat are expected to be minimal. The Project is not expected to result in a long-term decrease in any possible population, whether or not such a population would be considered an important population.

2. *Reduce the area of occupancy of an important population*

   If a local population of false water-rat occurs within the gas pipeline right of way area, the proposed project is likely to reduce the area of occupancy for this population, whether or not any such population would be considered an important population. Such a reduction, however, would be minor and short-term.

3. *Fragment an existing important population into two or more populations*

   The construction of the gas pipeline may fragment existing mangrove habitat, particularly on the mainland side of the Narrows. If a population of false water-rat is present within the gas pipeline right of way area there is potential for the proposed works to cause fragmentation of suitable habitat. The habitat utilised by the fase water rat is naturally transient and disturbance from events like cyclones are common, therefore the impacts of the gas pipeline construction on this species are expected to be minimal and will not result in fragmenting an existing important population into two or more populations.

4. *Adversely affect habitat critical to the survival of a species*

   Ecological information and expert knowledge was used to demarcate 'essential habitat' for the species as part of the Queensland DERM Biodiversity Planning Assessments (DERM 2009a). A review of the Biodiversity Planning Assessment indicated that no essential habitat for this species has been identified in the gas pipeline right of way area or the wider area. Given the extent of similar suitable habitat within the wider area the habitat within the gas pipeline right of way is not considered critical to the survival of this species.

5. *Disrupt the breeding cycle of an important population*

   The false water-rat constructs nesting mounds in which it shelters during the day and in between tidal cycles. Little is currently known about the reproductive biology of the false water-rat. One study has observed that up to eight animals of mixed age may share a mound.

   The gas pipeline right of way will not impact on any known populations of false water-rat. However if a local population of false water-rat exists within the Project area, there is potential for this development to impact on the breeding of this population either directly of through edge effects associated with the development. However, habitat utilised by the fase water rat is naturally transient and disturbance is common. Given the small area affected by the right of

way it is considered unlikely that the breeding cycle of an important population of this species will be disrupted.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   The gas pipeline right of way is not considered to contain habitat important enough for the species such that its modification, destruction, removal or isolation, or a decrease in its availability or quality would result in overall species decline.

7. *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

   Identified threats to false water-rat populations include direct predation from feral predators such as dogs, cats and foxes, competition for resources from native and introduced fauna and habitat destruction or degradation by hard hoofed feral animals such as pigs and cattle (DERM 2009a). Implementation of a biosecurity management plan is required under State legislation to control and prevent the establishment of invasive species as a result of the Project.

8. *Introduce disease that may cause the species to decline*

   The implementation of a biosecurity management plan is required under State legislation to control and prevent the establishment of invasive species (and associated diseases) as a result of the Project.

9. *Interfere substantially with the recovery of the species*

   The Project area is not considered to contain habitat important enough for the species such that its modification, destruction, removal or isolation, or a decrease in its availability or quality would interfere with the recovery of the species.

23.10.4 Aquatic fauna

One freshwater aquatic fauna species (excluding turtles addressed above in the terrestrial section) listed under the EPBC Act was identified in database and literature reviews as being present or likely to be present in waterways crossed by the gas pipeline right of way.

No other listed fish or macroinvertebrates are present, and this is supported by the fact that no listed species was caught (or recorded) from the sites sampled.

In describing the existing environmental values and assessing the potential impacts of the Project, aquatic ecology, water quality and geomorphology assessments of the proposed gas pipeline alignment study area were undertaken. The description of the assessments and findings were reported in Volume 5 Attachment 18.

Murray Cod

The Murray Cod is the largest freshwater fish found in Australia. It is a long lived predator species that is highly territorial and aggressive. It occurs naturally in the waterways of the Murray–Darling Basin in a wide range of warm water habitats, ranging from clear, rocky streams to slow flowing turbid rivers and billabongs. The Murray Cod migrates upstream prior to spawning in late spring or early summer, when the water attains a temperature of between 16 and 21°C. The adhesive eggs are laid on solid substrates, then the larvae drifts down river before the fry settles in suitable protected habitat.

Murray Cod are artificially maintained through stocking in the Condamine-Balonne River and may potentially occur in Dogwood Creek during significant flow events. The main impact during the construction phase is likely to be increased sediment delivery due to erosion in the development areas. Murray Cod are unlikely to be affected by short-term increases in sediment delivery as they are adapted to high levels of turbidity (DEWHA 2010a).

Significant impact criteria – Murray cod

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of an important population of a species*

   No potential habitat for this species will be lost as a result of the proposed action. A draft National Murray Cod Recovery Plan for the cod has been developed. The project will not affect the implementation or effectiveness of this plan.

2. *Reduce the area of occupancy of an important population*

   No potential habitat for this species will be lost as a result of the proposed action. Controls on stream crossings and sediment and erosion levels will ensure that the area of occupancy will not be affected and prevent any long-term decrease in the size of the population.

3. *Fragment an existing population into two or more populations*

   Should a population be fragmented as a result of the proposed action such fragmentation would be minor and temporary. Controls on watercourse crossings as described above will mitigate any potential effects.

4. *Adversely affect habitat critical to the survival of a species*

   No critical habitat is likely to be affected by the Project. Mitigation measures will focus on effective erosion and sediment control measures in accordance with the Queensland Guidelines for Erosion and Sediment control and measures described in Volume 5 Attachment 6.

   These will mitigate the potential for elevated turbidity in areas downstream of the gas pipeline corridor.

5. *Disrupt the breeding cycle of an important population*

   No potential breeding habitat for this species will be lost as a result of the proposed action. Impacts on flow conditions associated with breeding will be negligible to positive depending on the extent, if any, of permeate discharge released to the Condamine River. A draft National Murray Cod Recovery Plan for the cod has been developed.

   The project will not affect the implementation or effectiveness of this plan.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   No potential habitat for this species will be lost as a result of the proposed action. There is likely to be no species decline given effective control of sediment discharge from the gas pipeline development areas. Control measures are described in Volume 5 Attachment 6.

7. *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

   No invasive species are likely to become established in watercourses as a result of the project. The application of biosecurity management plan is a requirement of the TOR. Measures identified in the biosecurity management plan are considered sufficient to prevent negative impacts of invasive species as a result of the Project.

8. *Introduce disease that may cause the species to decline*

   The likelihood of Introduction of diseases that may affect the fish is very low. The implementation of the biosecurity management plan within the relevant EM Plan for each phase of the Project will assist in the prevention of the introduction of animal diseases as a result from the Project.

9. *Interfere with the recovery of the species*

   No potential habitat for this species will be lost as a result of the proposed action. A draft National Murray Cod Recovery Plan for the cod has been developed. The project will not affect the implementation or effectiveness of this plan.

23.10.5 Marine fauna

Desktop research included searches using the EPBC Protected Matters Search Report. This search identified 33 threatened and/or migratory marine species from the study area.

As these species are also migratory species they are discussed in the following section. Table 23.6 identifies these threatened marine species, their habitat preference and likelihood of occurrence within the vicinity of the gas pipeline right of way.

There are only two threatened marine species that are not also migratory species. These are Green sawfish and whale shark. These species are included in Table 23.6 and are not considered likely to be present in the area.

23.11 Listed migratory species

23.11.1 Migratory shorebirds and waterbirds

Australia is party to international conventions and agreements to protect many migratory species. These include the Japan-Australia Migratory Bird Agreement (JAMBA), China-Australia Migratory Bird Agreement (CAMBA), Republic of Korea - Australia Migratory Bird Agreement (ROKAMBA) and the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention). Australia delivers its international obligations to protect migratory species through the EPBC Act.

Desktop research was undertaken including searches utilising the EPBC Protected Matters Search Tool, the Birds Australia databases, the QLD Museum Fauna Collection Records and the EPA Wildlife Online database. Field surveys were undertaken during 2009, including four days in April and 29 days in September and October.

Database searches and a review of recent surveys undertaken within the study area identified 46 EPBC-listed migratory bird species. Table 23.5 identifies these 46 species, along with their habitat preference and likely occurrence in the vicinity of the pipeline crossing of The Narrows, and the adjacent areas on Curtis Island and the mainland.

In summary, 41 migratory bird species listed under the EPBC Act are predicted to occur in the study area, with eight species identified during the field survey of the study area and a further 33 migratory bird species considered to be likely or possibly present based on habitat preference.

The eight that were identified as present during the survey were eastern reef egret, white-bellied sea-eagle, Pacific golden plover, whimbrel, eastern curlew, rainbow bee-eater, rufous fantail and satin flycatcher.

Based on habitat preference, the project area may support suitable habitat for the 33 other migratory bird species. These include white-throated needletail, fork-tailed swift, brown booby, eastern great egret, cattle egret, glossy ibis, eastern osprey, grey plover, lesser sand plover, Latham's snipe, bar-tailed godwit, little curlew, terek sandpiper, common sandpiper, grey-tailed tattler, common greenshank, marsh sandpiper, wood sandpiper, great knot, red knot, red-necked stint, sharp-tailed sandpiper, curlew sandpiper, broad-billed sandpiper, little tern, Caspian tern, lesser crested tern, crested tern, Oriental cuckoo, black-faced monarch, spectacled monarch, clamorous reed-warbler and barn swallow.

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Table 23.5 Likely occurrence of migratory bird species

Common name	Scientific name	Preferred habitat[1]	Likelihood of occurrence in Project area[2]	Source[3]
White-throated needletail	*Hirundapus caudacutus*	Variety of habitats. Aerial forager, including over infrastructure. Breeds in northern hemisphere.	Likely	1, 2, 4
Fork-tailed swift	*Apus pacificus*	Varied; airspace over habitat ranging from rainforest to semi-desert. Breeds in the northern hemisphere.	Likely	1, 2, 4
Shy albatross	*Thalassarche cauta*	Pelagic species, feeds in southern Australian continental waters from Fremantle to southern Queensland. Nests on rocky islands in southern Tasmania and Bass Strait.	Not expected to occur	3, 4
Southern giant-petrel	*Macronectes giganteus*	A marine bird that occurs in Antarctic to subtropical waters. It is wide spread throughout the Southern Ocean. Nests on offshore islands.	Not expected to occur	1
Brown booby	*Sula leucogaster*	Mainly tropical marine habitats including deep waters and inshore shallows.	Possible	2, 4
Eastern great egret	*Ardea modesta (alba)*	Floodwater, rivers, shallows of wetlands, intertidal mudflats.	Likely	1, 2, 4
Cattle egret	*Ardea ibis*	Found in pasture and the shallows of freshwater wetlands.	Likely	1, 2, 4
Eastern reef egret	*Egretta sacra*	Found on beaches, rocky shores, tidal rivers and inlets, mangroves, and exposed coral reefs.	Known	2, 4, 5
Glossy ibis	*Plegadis falcinellus*	Shallows of swamps, floodwaters, irrigated pastures.	Likely	2, 4
Eastern osprey	*Pandion cristatus*	Coastal seas, estuaries, inlets and large water bodies, both coastal and inland.	Likely	4
White-bellied sea-eagle	*Haliaeetus leucogaster*	Coastal seas, islands, estuaries and inlets. Follows major rivers and	Known	1, 2, 4, 5

Common name	Scientific name	Preferred habitat[1]	Likelihood of occurrence in Project area[2]	Source[3]
		wetlands far inland.		
Pacific golden plover	*Pluvialis fulva*	Widespread along the coastline. Found on muddy, rocky and sandy wetlands, shores, paddocks, salt marsh, estuaries and lagoons.	Known	2, 4, 5
Grey plover	*Pluvialis squatarola*	Generally found on intertidal flats, particularly in estuaries and bays.	Likely	2
Lesser sand plover	*Charadrius mongolus*	Found in sheltered bays, harbours and estuaries with large intertidal sand flats or mudflats. EPBC report indicates roosting known to occur in the wider study area.	Likely	2, 4
Painted snipe[4]	*Rostratula benghalensis s. lat.*	Cryptic nomadic bird of shallow wetlands, nests on ground in reeds close to water. Found in areas with shallow muddy freshwater swamps and marshes. Also flooded paddocks and bore drains.	Possible	1, 2, 3, 4
Latham's snipe	*Gallinago hardwickii*	Low rank vegetation around shallows of wetlands, reeds, sedges, salt marsh.	Possible	1, 2, 4
Bar-tailed godwit	*Limosa lapponica*	Coastal tidal mudflats and sandbars of estuaries, lagoons, ephemeral inland lakes.	Likely	2, 4
Little curlew	*Numenius minutus*	Widespread in the north of Australia and scattered elsewhere. Found on coastal and inland grasslands, often artificially grassed areas or on the grassed edges of freshwater wetlands.	Possible	1
Whimbrel	*Numenius phaeopus*	Common across northern Australia and uncommon to rare further south. Found mainly on the coast, on tidal and estuarine mudflats and lagoons, especially near mangroves.	Known	2, 4, 5
Eastern curlew	*Numenius madagascariensis*	Associated with sheltered coast, bays and estuaries.	Known.	2, 4, 5

Common name	Scientific name	Preferred habitat[1]	Likelihood of occurrence in Project area[2]	Source[3]
Terek sandpiper	*Xenus cinereus*	Sheltered coastal mudflats, estuaries and lagoons as well as reefs, coastal swamps and salt fields. Common summer migrant to the north coast of Australia but scarce to rare in the south.	Likely	2, 4
Common sandpiper	*Actitis hypoleucos*	Coastal and interior wetland habitats including the narrow muddy edges of billabongs, river pools, mangroves, reefs and beaches. Widespread but generally uncommon.	Likely	2, 4
Grey-tailed tattler	*Tringa brevipes*	Associated with sheltered coast, bays and estuaries.	Likely	4
Common greenshank	*Tringa nebularia*	Occurs on intertidal mudflats and a variety of coastal and inland wetlands.	Likely	2, 4
Marsh sandpiper	*Tringa stagnatilis*	Widespread distribution across Australia on a variety of fresh and salt water wetland. Prefers freshwater and generally avoids intertidal mudflats unless well sheltered.	Likely	2, 4
Wood sandpiper	*Tringa glareola*	More common in the northern half of Australia. Preference for shallow freshwater wetlands and pools with emergent reeds and grass.	Possible	2
Great knot	*Calidris tenuirostris*	Found in sheltered areas such as mudflats of estuaries, inlets, harbours, lagoons and mangrove swamps.	Likely	4
Red knot	*Calidris canutus*	Distributed around the coastline on sheltered areas such as mud flats, sandbars in estuaries and lagoons.	Likely	2,4
Sanderling	*Calidris alba*	Found around the coastline on open sandy beaches.	Not expected to occur	2
Red-necked stint	*Calidris ruficollis*	Wide distribution, in sheltered inlets, bays, lagoons, estuaries, intertidal and inland mudflats and protected sandy or coralline shores.	Likely	2, 4

Common name	Scientific name	Preferred habitat[1]	Likelihood of occurrence in Project area[2]	Source[3]
Sharp-tailed sandpiper	*Calidris acuminata*	Widespread distribution, found in flooded fields, mudflats, mangroves, rocky shores and beaches. Occurs on both coastal and inland wetlands but prefers non-tidal fresh or brackish wetlands.	Likely	2, 4
Curlew sandpiper	*Calidris ferruginea*	Found on intertidal mudflats of estuaries, lagoons, mangroves, as well as beaches, rocky shores, floodwaters and flooded saltbush surrounds of inland lakes.	Likely	2, 4
Broad-billed sandpiper	*Limicola falcinellus*	Generally uncommon, found in sheltered coastal estuaries and lagoons with intertidal mudflats, and on muddy coastal creeks and swamps.	Possible	2, 4
Little tern	*Sternula (Sterna) albifrons*	Coastal waters, nesting on exposed sandbanks or beaches.	Possible	1
Caspian tern	*Hydroprogne (Sterna) caspia*	Found in a variety of coastal waters and can range a long way inland.	Likely	2, 4
Lesser crested tern	*Thalasseus (Sterna) bengalensis*	Prefers offshore waters including islands, coral cays and reefs.	Possible	2, 4
Crested tern	*Thalasseus (Sterna) bergii*	Variety of coastal waters including beaches, tidal rivers, larger rivers, salt swamps and offshore waters.	Likely	2, 4
Oriental cuckoo	*Cuculus optatus*	Prefers areas of dense vegetation including rainforest, mangroves, monsoon forest and riparian vegetation.	Possible	4
Rainbow bee-eater	*Merops ornatus*	Open country, most vegetation types, sand dunes, banks.	Known	1, 4, 5
Rufous fantail	*Rhipidura rufifrons*	Rainforest, dense wet eucalypt forest, paperbark and mangrove swamps, riparian vegetation.	Known	1, 4, 5
Satin flycatcher	*Myiagra cyanoleuca*	Distributed along the east coast of Australia from far northern	Known	1, 4, 5

Common name	Scientific name	Preferred habitat[1]	Likelihood of occurrence in Project area[2]	Source[3]
		Queensland to Tasmania. Found in forests, woodlands, mangroves and coastal heath but avoids rainforest.		
Black-faced monarch	*Monarcha melanopsis*	Distributed along the east coast, found in rainforests, mangroves, eucalypt woodlands, coastal scrub and damp gullies.	Likely	1, 4
Spectacled monarch	*Symposiarchus (Monarcha) trivirgatus*	Mainly found in coastal rainforest but also found in mangroves and gullies of dense wet Eucalypt forest.	Likely	1, 3, 4
Clamorous reed-warbler[5]	*Acrocephalus stentoreus*	Dense vegetation alongside water, especially thick reed beds, as well as tall crops, bamboo thickets and lantana. Occurs throughout Australia where there is suitable habitat.	Possible	4
Barn swallow	*Hirundo rustica*	Found in a wide variety of habitats with the exception of the more heavily forested regions and drier inland areas. Often near water.	Possible	1

[1] Habitat preferences are sourced from Pringle (1987), Marchant and Higgins (1993), Higgins and Davies (1996) and Geering et al. (2007).

[2] Likelihood of occurrence: Known: species has been recently recorded within gas pipeline study area
Likely: species is known from the wider study area and preferred habitat is present on site
Possible: species is known from the wider study area and suboptimal habitat is present in the gas pipeline study area
Unlikely; species is known from the wider study area however, suitable habitat is not present in the gas pipeline study area
Not expected to occur – based on known distribution and habitat preferences.

[3] Source: 1 = EPBC Protected Matters Search Tool, 2 = Birds Australia, 3 = QLD Museum Fauna Collection Records, 4 = DERM Wildlife Online 5 = WorleyParsons this study

[4] Painted snipe *Rostratula benghalensis* is no longer considered to occur in Australia. Australian birds are Australian painted snipe *R. australis*.

[5] Clamorous reed-warbler *Acrocephalus stentoreus* is no longer considered to occur in Australia. Australian birds are Australian reed-warbler *A. australis*.

The majority of these 41 species known or predicted to occur are associated with waterbodies, either coastal and/or freshwater wetlands. The gas pipeline alignment has been selected to avoid major watercourses and wetlands. No Ramsar wetland occurs along or adjacent to the proposed alignment. However, two wetland areas listed in the Directory of Important Wetlands in Australia (Environment Australia 2001) – Port Curtis and The Narrows – are transected by the proposed gas pipeline. The areas within the gas pipeline right of way in the Gladstone/Port Curtis area are mapped as part of State and local government wetland areas.

The proposed alignment would require the clearing of 15.2ha of coastal wetland vegetation in the Port Curtis wetland area. Construction and operational activities associated with the Project have the potential to further impact on retained and adjacent coastal wetland vegetation through modification of tidal flows, increased boat traffic and boat wash, debris and dust emissions and erosion.

Generally the larger freshwater ephemeral systems transected by the right of way predominantly exist as dry stream beds with occasional and mainly seasonal flooding overtopping the channel into adjacent floodplains. According to the Queensland Wetland Mapping (DERM 2009b), the proposed alignment intersects estuarine systems, river and creek channel riverine systems at Roche Creek, lacustrine (lake) systems at Dogwood Creek, palustrine (swamp and marsh) systems and many drainage line riverine systems. The more defined creek channel at Roche Creek was observed during field surveys. However, ground-truthing in the vicinity of Dogwood Creek found no lacustrine system.

The Draft EPBC Act policy statement 3.21 *Significant impact guidelines for 36 migratory shorebird species: Migratory species (2009)* has been used for the impact assessment for bird species covered by the policy that have been identified as potentially occurring at the site.

Under these guidelines, a site is considered an important site for migratory shorebirds if it:

- Is identified as internationally important
- Supports at least 0.1 per cent of the flyway population of a single species
- Supports at least 2000 migratory shorebirds, or
- Supports at least 15 shorebird species.

A 'site' for migratory shore birds is defined as 'the entire (discrete) area of contiguous habitat used by the group of migratory shorebirds, which may include multiple roosts and feeding areas'. For permanent wetlands, 'support' is defined as 'migratory shorebirds are recorded during surveys and/or are known to have occurred at the site within the previous five years' DEWHA (2009h). Considering the data reviewed and these draft guidelines, there is potential for the wetlands within the study area to be classified as important habitat for migratory shorebirds.

Relevant species known or expected to occur within the gas pipeline right of way are Pacific golden plover, grey plover, lesser sand plover, painted snipe, Latham's snipe, bar-tailed godwit, little curlew, whimbrel, eastern curlew, terek sandpiper, common sandpiper, grey-tailed tattler, common greenshank, marsh sandpiper, wood sandpiper, great knot, red knot, red-necked stint, sharp-tailed sandpiper, curlew sandpiper and broad-billed sandpiper.

These migratory shorebird species are all Charadriiformes and belong to the families Charadriidae (plovers and dotterels) and Scolopacidae (sandpipers). Most live on or near the coast, beaches, reefs and tidal mudflats, though some also frequent or are largely confined to freshwater habitats (Pringle 1987).

Flat tidal shores with extensive muddy intertidal areas support the most species and individuals, though some species, such as whimbrel, common and terek sandpipers and grey-tailed tattler, feed in mangroves forests at low tide (Lane 1987). The coastal species have a life cycle driven largely by the tidal cycle, roosting in flocks above the high water mark at high tide and moving to feeding areas as the tide recedes. Most of these species are gregarious, wary and fly strongly and swiftly. None breed in Australia (Pringle 1987; Geering et al. 2007).

Significant impact criteria – Migratory shorebirds and waterbirds

The guidelines are relevant to 21 of the 41 present or predicted to be present species. These 21 species are discussed as a group in relation to relevant significant impact criteria from the guidelines.

Ecological element affected: Important habitat

1. *Loss of important habitat*

   The alignment crosses a large expanse of intertidal saltpan habitat to the west of Friend Point, with several small bands of mangroves. These intertidal flats provide feeding habitat for a range of migratory waders and other shorebirds.

   Intertidal habitat on the southern side of the Friend Point area has been identified as a major shorebird feed site, while a major shorebird roost site has been identified just adjacent to the alignment on the tip of Friend Point (EPA 2003). The Curtis Island crossing point does not have the extensive saltpan habitat that occurs adjacent to Friend Point, but some migratory shorebirds have been recently recorded in this area.

   There will be a loss of 11.9ha of saltpan and saltmarsh and 3.3ha of mangroves. It is considered likely that this area may support 15 or more migratory shorebird species, which would make it important habitat.

   During construction of the proposed pipeline at the crossing of The Narrows a buffer zone of 200m would be maintained around identified major feeding and roosting sites for migratory shorebirds, to minimise potential disturbance if identified within the work area of the proposed crossing.

   Indirectly, disturbance from the construction of this gas pipeline may reduce the usability of the adjacent undisturbed habitat. This will be discussed below.

   Narrow bands of riparian and/or floodplain eucalypt woodland habitat are crossed by the alignment at the Calliope River and 11 creek systems. Such areas are not considered important habitat for these species. Freshwater habitats, which correspond to RE11.3.27, make up less than 0.003% of the habitats within the 10km buffer of the alignment. The alignment would require the loss of 1.2ha of mapped freshwater habitats however these areas are ephemeral or at best semi-permanent and are degraded by livestock. Although this may be suitable at times for some of these species it is not considered to be important habitat for these species.

2. *Degradation of important habitat leading to a substantial reduction in migratory shorebirds using the site*

   There will be a loss of 11.9ha of saltpan and saltmarsh and 3.3ha of mangroves. Provided management guidelines are implemented there should be no degradation of any adjacent habitat, whether or not this habitat is considered important habitat.

3. *Increased disturbance leading to a substantial reduction in migratory shorebirds using the site*

   Disturbance may result in a reduction of available foraging time and may cause shorebirds to expend energy which is required for migration. The habitat areas of most importance when considering potential disturbance levels are roosting sites and feeding grounds. Disturbance of roosting sites may result in unnecessary expenditure of energy to relocate to a safer location. Shorebirds have a limited opportunity to forage during the low tide times.

   Disturbance can prevent birds from foraging effectively (Bamford et al. 2008). Of the various forms, small aircraft and helicopter disturbance is seen as the most severe and long lasting. Close approaches from the water generally disturb more birds than approaches from the land. This is due to the majority of the shore birds being close to the water's edge when foraging or roosting. Disturbance from the land is generally a result of movement along the tidal flat which includes people and animals, particularly dogs (Davidson and Rothwell 1993). Studies undertaken on shorebirds in the Dutch Wadden Sea suggest that shorebirds are impacted by high sound levels with the threshold for noise impact considered to be 120 dB(A). Birds impacted by noise move away from the area (Smit and Visser 1993).

   Disturbance may occur during construction for the Project.

   The construction period potentially involves a high level of disturbance with increased activity on land and water. It is assumed that increased activity and potentially loud intermittent noise during construction may result disturbance. The impact may be minimised through timing of construction activities. Although there are shorebirds present year round, including some first year birds, for the migratory birds the area would be most significantly utilised from November through to March each year. Construction activity outside of this period would significantly lessen disturbance.

   Once operational, the gas pipeline should cause minimal direct disturbance, if any, to migratory shorebirds. A potential indirect impact of the gas pipeline is increased access to the area by feral predators. Feral dogs, cats and foxes have previously been recorded within the right of way and it is therefore considered likely that some level of disturbance of shorebirds due to pest species exists currently. The implementation of a biosecurity management plan is required under State legislation to control and prevent the establishment of invasive species as a result of the Project.

4. *Direct mortality of birds leading to a substantial reduction in migratory shorebirds using important habitat*

   Given the mobility of shorebirds, it is considered unlikely that the construction and operation of this gas pipeline will result in direct mortality of migratory shorebirds in the study area. Shorebirds are likely to move away from disturbance during the construction period.

   A potential indirect impact of this gas pipeline is the increased access to the area by feral predators. Feral dogs, cats and foxes have previously been recorded within the right of way and it is therefore considered likely that some level of disturbance of shorebirds due to pest species exists currently. The implementation of a biosecurity management plan is required under State legislation to control and prevent the establishment of invasive species as a result of the Project.

Latham's snipe

Latham's snipe is an additional species from the identified 36 species (above), so is considered using different criteria. This is because important wetlands for the Latham's snipe are identified as sites that:

- support at least 18 individuals of the species
- are naturally occurring open freshwater wetlands with vegetation cover nearby

Ecological element affected:

1. *Loss of important habitat*

   Narrow bands of riparian and/or floodplain eucalypt woodland habitat are crossed by the gas pipeline corridor at the Calliope River and 11 creek systems. Such areas may provide suitable if variable resources but are not considered important habitat for this species. Freshwater habitats, which correspond to RE11.3.27, make up less than 0.003% of the habitats within the 10km buffer of the alignment. The right of way would cause the loss of 1.2ha of mapped freshwater habitat however field survey found these areas to be ephemeral or at best semi-permanent and degraded by livestock. Although freshwater habitats within the right of way may be suitable at times for this species it is not considered to be important habitat.

   Additional habitat may be created due to heavy rain events flooding paddocks but would be highly ephemeral. Foraging opportunities for the species would be very sporadic under such circumstances.

2. *Degradation of important habitat leading to a substantial reduction in migratory shorebirds using the site*

   The suitable habitat for this species within the right of way is not considered important habitat.

3. *Increased disturbance leading to a substantial reduction in Latham's snipe using the site*

   Use of the study area by Latham's snipe is unlikely to be reduced by gas pipeline disturbance.

4. *Direct mortality of birds leading to a substantial reduction in Latham's snipe using important habitat*

   Given the mobility of the species, it is considered unlikely that the construction and operation of the gas pipeline will result in direct mortality of Latham's snipe in the study area. If present, the species is likely to move away from disturbance during the construction period.

   A potential indirect impact is the increased access to the area by feral predators. The implementation of a biosecurity management plan is required under State legislation to control and prevent the establishment of invasive species as a result of the Project.

The remaining 11 relevant migratory shorebird species listed as Migratory under the EPBC Act (in addition to those discussed above) that are present or predicted to be present are brown booby, eastern great egret, cattle egret, eastern reef egret, glossy ibis, little tern, Caspian tern, lesser crested tern, crested tern and clamorous reed-warbler.

In addition, painted snipe is now considered a species endemic to Australia – Australian painted snipe *Rostratula australis*. As such, it is a vulnerable species under the EPBC Act and has been addressed in Section 23.3.

What was considered a subspecies of clamorous reed-warbler in Australia is now considered an endemic or near endemic species, Australian reed-warbler *Acrocephalus australis*. Other than little

tern and painted snipe, the species listed above are considered to have stable populations in the region. There are no areas of critical habitat or threatening processes identified for these individual species.

Brown booby, eastern reef egret, little tern, lesser crested tern and crested tern will all be restricted to intertidal habitat surrounding the crossing from the mainland to Curtis Island. Eastern great egret and cattle egret may be found in a wide variety of habitats. Cattle egret is largely associated with livestock when foraging, and typically breeds in dense vegetation near or within waterbodies.

Glossy ibis will be restricted to open freshwater habitats such as swamps and lakes. Painted snipe will also be largely restricted to freshwater habitats, typically with fringing vegetation and including flooded paddocks and drainage lines. The species will be assessed in conjunction with glossy ibis. Clamorous reed-warbler occurs in dense, low aquatic or riparian vegetation in or around nearly any type of fresh, brackish or saline wetland (Higgins et al. 2006).

Significant impact criteria – Migratory wetland birds

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

1. *Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species*

   – Brown booby

   This marine species is likely to be found within the gas pipeline corridor only as an occasional visitor to intertidal areas. No important habitat for the species will be modified, destroyed or isolated by the Project.

   – Great egret, cattle egret and eastern reef egret

   Great egret is common and widespread in a variety of habitats. Cattle egret is associated with paddocks and livestock, but requires wetlands for breeding. Eastern reef egret prefers rocky shores and reefs but also uses mudflats. No important habitat for these species will be modified, destroyed or isolated by the Project.

   – Glossy Ibis and painted snipe

   Freshwater habitats, which correspond to RE11.3.27, make up less than 0.003% of the habitats within the 10km buffer of the alignment. The alignment would require the loss of 1.2ha of mapped freshwater habitat however field survey found these areas to be ephemeral or at best semi-permanent and degraded by livestock. Although freshwater habitats within the right of way may be suitable at times for these species it is not considered to be important habitat.

   – Little tern, Caspian tern, lesser crested tern and crested tern

   Little, lesser crested and crested terns occur in sheltered coastal areas and on ocean beaches. Caspian tern occurs in maritime areas and on larger inland waterbodies.

   A lack of large freshwater waterbodies within the right of way means that the study area contains suitable foraging and roosting habitat for the four species only within the intertidal areas of Port Curtis. Considering the suitable habitat potentially impacted by the Project and the extent of similar suitable habitat within the wider Port Curtis area, it is unlikely that the area potentially impacted by the Project would be considered important habitat for these species.

- Clamorous reed-warbler

Generally the larger freshwater ephemeral systems transected by the right of way predominantly exist as dry stream beds with occasional and mainly seasonal flooding overtopping the channel into adjacent floodplains. According to the Queensland Wetland Mapping (DERM 2009b), the proposed alignment intersects a lacustrine (lake) system at Dogwood Creek but field survey in the vicinity of Dogwood Creek found no lacustrine system. The alignment would require the loss of 1.2ha of mapped freshwater habitat however field survey found these areas to be ephemeral or at best semi-permanent and degraded by livestock. Although freshwater habitats within the right of way may be suitable at times for this species they are not considered to be important habitats. Suitable waterbodies are not known in brackish or saline parts of the alignment.

2. *Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for a migratory species*

   Implementation of a biosecurity management plan is required under State legislation to control and prevent the establishment of invasive species as a result of the Project. Management of feral species should ensure that there is no increase in feral species activity in the gas pipeline alignment.

3. *Seriously disrupt the lifecycle of an ecologically significant proportion of the population of a migratory species*

   The gas pipeline alignment is not considered to include important habitat for these species. The Project is not expected to disrupt the lifecycle of any ecologically significant proportion of any population of these species.

23.11.2 Migratory terrestrial birds

In addition to the shorebirds and waterbirds discussed above, database searches and field surveys identified 11 species of terrestrial birds listed as migratory under the EPBC Act as occurring, or having the potential to occur, in the study area. These are the white-throated needletail, fork-tailed swift, eastern osprey, white-bellied sea-eagle, Oriental cuckoo, rainbow bee-eater, rufous fantail, satin flycatcher, black-faced monarch, spectacled monarch and barn swallow.

White-throated needletail, fork-tailed swift and barn swallow are non-breeding aerial foragers. These species may potentially forage in air space over the study area. The needletail and swift may forage over all habitats including cleared land, open ocean and infrastructure. Barn swallow is most likely to occur over cleared land, including cultivation. It is considered unlikely that these species will be impacted by the proposed development.

Eastern osprey and white-bellied sea-eagle are large raptors associated with coastal environments and large inland waterbodies such as lakes, dams and large rivers.

Oriental cuckoo is a regular non-breeding summer migrant to coastal eastern and northern Australia. It occurs in a variety of habitats including rainforest, vine thicket, casuarina forest and eucalypt woodland.

Rainbow bee-eater is a widespread species that may be readily observed over a variety of habitats, including highly modified lands such as golf courses. They nest by digging burrows in the loose soil of exposed banks.

Black-faced monarch, spectacled monarch, satin flycatcher and rufous fantail are all species that tend to prefer habitats with a dense understorey and canopy. Black-faced and spectacled monarchs are summer breeding migrants to south-east Australia occurring in coastal rainforests and other dense habitats, but black-faced monarch will occur in more open woodlands. Satin flycatcher occurs in coastal woodlands, mangroves and gardens during its summer migration to south-east Australia. Rufous fantail undergo both latitudinal (summer migrant to southern Australia) and altitudinal migrations (winter migrant from mountain rainforests) and may occur a considerable distance inland in suitable habitat.

Significant impact criteria – Migratory terrestrial species

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

1. *Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species*

   – White-throated needletail, fork-tailed swift and barn swallow

   As these species are aerial foragers and may occur over heavily modified habitats it is considered that no important habitat for these species will be modified, destroyed or isolated by the Project.

   – Eastern osprey and white-bellied sea-eagle

   These species are largely coastal although both may occur further inland on larger rivers and waterbodies, particularly the white-bellied sea-eagle. The gas pipeline right of way will not impact any large inland waterbodies and coastal disturbance is minimal. Considering the suitable habitat potentially impacted by the Project and the extent of similar suitable habitat within the wider Port Curtis area, it is unlikely that the area potentially impacted by the Project would be considered important habitat for these species.

   – Oriental cuckoo

   Oriental cuckoo does not occur very far inland and is an uncommon visitor to subtropical Australia. Considering the suitable habitat potentially impacted by the Project and the extent of similar suitable habitat within the wider study area, it is unlikely that the area potentially impacted by the Project would be considered important habitat for this species.

   – Rainbow bee-eater

   Rainbow bee-eater is a widespread and common species that can occur in a variety of habitats. Considering the suitable habitat potentially impacted by the Project and the extent of similar suitable habitat within the wider study area, it is unlikely that the area potentially impacted by the Project would be considered important habitat for this species.

   – Black-faced monarch, spectacled monarch, satin flycatcher and rufous fantail

   These species tend to prefer more heavily vegetated habitats and do not regularly venture far inland (except for the rufous fantail). Considering the suitable habitat potentially impacted by the Project and the extent of similar suitable habitat within the wider study area, it is unlikely that the area potentially impacted by the Project would be considered important habitat for these species.

2. *Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for a migratory species*

   Implementation of a biosecurity management plan is required under State legislation to control and prevent the establishment of invasive species as a result of the Project.

   Of these species only rainbow bee-eater is likely to be significantly affected by invasive species, should breeding occur on site. Rainbow bee-eaters nest in burrows in soil and sand banks. Feral predators and cane toads, which are known to prey on eggs and nestlings (Boland 2004b), are already established in the study area. The control of foxes, cats and dogs has been identified as a management objective. Management of feral species should ensure that there is no increase in feral species activity in the Project site.

3. *Seriously disrupt the lifecycle of an ecologically significant proportion of the population of a migratory species*

   There is no evidence to suggest that the study area supports an 'ecologically significant proportion of a population' of any of the migratory birds known or considered likely to occur.

23.11.3 Other migratory marine fauna

The EPBC Protected Matters Database search indicated that up to 20 migratory and vulnerable marine species (excluding birds) potentially occur in the gas pipeline study area around Port Curtis. These threatened and migratory marine species, their habitat preference and likelihood of occurrence within the Project area are identified in Table 23.6. These were identified in database searches.

In summary, it is known or considered likely that nine threatened and migratory marine species (excluding birds) may utilise the offshore area of the Project site, or areas immediately adjacent to the offshore area, namely loggerhead turtle greeen turtle, hawksbill turtle, olive ridley turtle, flatback turtle, dugong, Indo-Pacific humpback dolphin, bottlenose dolphin, and the Australian snubfin dolphin.

The relevant critically endangered species are dugong, Indo-Pacific humpback dolphin, bottlenose dolphin, and Australian snubfin dolphin. The relevant endangered species are loggerhead turtle, leatherback turtle, and Olive Ridley turtle. The relevant vulnerable species is the hawksbill turtle.

There are two possible methods still being considered for constructing the gas pipeline, horizontal directional drilling (HDD) and dredging, with HDD being the preferred approach. The potential impacts of both are considered here and the impacting processes are as follows:

- Disturbance and fragmentation of mangrove and saltmarsh/saltpan habitat (dredging and HDD)
- Underwater noise (dredging)
- Disturbance of sub-tidal habitat and subsequent turbidity plumes if dredging is undertaken.

The potential impact of the Project on each of the threatened marine fauna species is described in relation to the significant impact criteria, in the following tables:

- Green turtle
- Olive Ridley turtle
- Flatback turtle
- Loggerhead turtle
- Hawksbill turtle
- Dugongs
- Dolphins are grouped together in one assessment.

The Dugong and various Dolphin species and their preferred habitats may be impacted by one or several of the gas pipeline construction and operation activities described above.

Table 23.6 Likely occurrence of threatened and migratory marine fauna species

This excludes birds.

Common name	Scientific name	EPBC status[1]	Preferred habitat	Likelihood of occurrence in Project area[2]	Source[3]
Flatback turtle	*Natator depressus*	V, Mi	South End on Curtis Island is a medium density nesting beach for flatback turtles. Foraging habitats for the species are shallow coastal environments including rocky reef and sedimentary habitats	Known to occur	1,2,3
Green turtle	*Chelonia mydas*	V, Mi	Occasional nesting on Curtis and Facing Islands. Forage in shallow coastal areas, in particular seagrass beds.	Known to occur	3,4
Loggerhead turtle	*Caretta caretta*	E, Mi	Occasional nesting on Curtis and Facing Islands, but the principal nesting area on the east coast is the Bundaberg region. Foraging occurs over a wide range of intertidal and sub-tidal habitats including coral and rocky reefs, seagrass meadows, and unvegetated sand or mud areas.	Known to occur	5
Leatherback turtle	*Dermochelys coriacea*	E, Mi	Oceanic environments from the sea surface to the seabed. Nests on beaches but major nesting areas are overseas. No recorded nesting of the species in Queensland since 1996.	Unlikely	6
Olive Ridley turtle	*Lepidochelys olivacea*	E, Mi	Nests on beaches, but no concentrated nesting occurs in Australia and none recorded in recent times from the east coast. Principally forages in shallow unvegetated coastal environments	Possible	7
Hawksbill turtle	*Eretmochelys imbricata*	V, Mi	Principally forages in rocky reef and coral reef habitats. Nesting in Queensland occurs on beaches on Cape York and the Torres Strait.	Possible	8
Humpback whale	*Megaptera novaeangliae*	V, Mi, Ce	Principally occurs in oceanic waters. Port Curtis is not a known feeding, resting or calving area for the species.	Unlikely	9
Bryde's whale	*Balaenoptera edeni*	Mi, Ce	Occurs in oceanic waters and do not generally frequent estuarine	Unlikely	9

Common name	Scientific name	EPBC status[1]	Preferred habitat	Likelihood of occurrence in Project area[2]	Source[3]
			areas.		
Killer whale	*Orcinus orca*	Mi, Ce	Occurs in oceanic waters and do not generally frequent estuarine areas.	Unlikely	9
Minke whale	*Balaenoptera acutorostrata*	Mi, Ce	Occurs in oceanic waters and do not generally frequent estuarine areas.	Unlikely	9
Risso's dolphin	*Grampus griseus*	Mi, Ce	Occurs in oceanic waters and do not generally frequent estuarine areas.	Unlikely	9
Spotted dolphin	*Stenella attenuata*	Mi, Ce	Occurs in oceanic waters and do not generally frequent estuarine areas.	Unlikely	9
Common dolphin	*Delphinus delphis*	Mi, Ce	Occurs in oceanic waters and do not generally frequent estuarine areas.	Unlikely	9
Green sawfish	*Pristis zijsron*	V	Occur in shallow coastal and estuarine environments. Detailed records of the occurrence of the species from 1912 to 2004 identify that no individuals of the species have been recorded in the Port Curtis region during that period.	Unlikely	10
Whale shark	*Rhincodon typus*	V	Occurs in oceanic waters and do not generally frequent estuarine areas.	Unlikely	11
Dugong	*Dugong dugon*	Mi, Ce	Occurs in coastal tropical and subtropical waters in association with seagrass beds. Known to occur in Port Curtis.	Known to Occur	12
Indo-Pacific humpback dolphin	*Sousa chinensis*	Mi, Ce	Occurs in coastal and estuarine waters. Known to occur in Port Curtis.	Known to Occur	13
Bottlenose	*Tursiops truncatus*	Mi, Ce	Occurs in coastal and estuarine waters. Known to occur in Port Curtis	Known to Occur	13,14

Common name	Scientific name	EPBC status[1]	Preferred habitat	Likelihood of occurrence in Project area[2]	Source[3]
dolphin					
Australian snubfin dolphin[4]	*Orcaella heinsohni*	Mi, Ce	Occurs in coastal and estuarine waters. Known to occur in Port Curtis although more common on the east coast of Australia north of Townsville	Known to Occur	14
Estuarine crocodile	*Crocodylus porosus*	Mi	The southern most range of the Estuarine Crocodile is generally recognised as the Fitzroy River although individuals straggle as far south as Colosseum Inlet and Seven Mile Creek systems. While it is plausible that estuarine crocodile may be sited near the gas pipeline corridor, the area does not represent key habitat for the species. The key areas for estuarine crocodile populations in Queensland is the north western Cape York Peninsula, particularly parts of the Wenlock River and the Lakefield National Park	Possible	15

[1] EPBC status: V = vulnerable; Mi = migratory; Ce = cetacean

[2] Likelihood of occurrence:

[3] Source: 1 Limpus et al. (2006); 2 Hodge et al. (2006); 3 Limpus et al. (2002); 4 Brand-Gardner et al (1999); 5 Limpus (2008a); 6 Limpus (2009b); 7 Limpus (2008b); 8 Limpus (2009b); 9 Bannister et al. (1996); 10 Stevens et al. (2005); 11 Meekan et al. (2008); 12 Lawler and Marsh (2001); 13 Corkeron et al. (1997); 14 Parra (2006); 15 Read et al. (2004)

[4] The Australian snubfin dolphin (*Orcaella heinsohni*) was previously identified as the widely distributed Irrawaddy dolphin (*Orcaella brevirostris*). It is now known that the Irrawaddy dolphin does not occur in Australia.

Significant impact criteria – Green turtle

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of an important population of a species*

   The impacting processes are not of a sufficient scale or magnitude to lead to a long-term decrease in the size of a population.

2. *Reduce the area of occupancy of an important population*

   The green turtle is widely distributed throughout tropical and sub-tropical waters. The proposed project will not reduce the area of occupancy in any ecologically meaningful way.

3. *Fragment an existing important population into two or more populations*

   The proposed project will not create any barriers to movement for green turtles.

4. *Adversely affect habitat critical to the survival of a species*

   Nesting beach habitat will not be physically impacted by the proposed project. Seagrass beds are the critical foraging habitat for the species, and the gas pipeline will not disturb any major seagrass beds.

5. *Disrupt the breeding cycle of an important population.*

   Lighting near turtle rookeries has the potential to disrupt the nesting of adult turtles and the survival of hatchlings. The light regime in the Port Curtis region is already heavily modified by existing industrial and residential development. While occasional nesting of green turtles is recorded from Facing and Curtis Islands, the major breeding location for the east coast population of green turtles is the Capricorn-Bunker group of islands. Pipeline construction activities will not result in a change to the lighting regime that will disrupt the breeding cycle.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   The area to be disturbed does not constitute high value green turtle habitat.

7. *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

   It is not likely that an invasive species that is harmful to green turtles will be introduced.

8. *Introduce disease that may cause the species to decline*

   It is not likely that a green turtle disease will be introduced.

9. *Interfere substantially with the recovery of the species*

   There is a recovery plan in place for all marine turtle species found in Australia. The proposed project activities will not interfere with the recovery of marine turtle species.

Significant impact criteria – Olive ridley turtle

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of an important population of a species*

   The impacting processes are not of a sufficient scale or magnitude to lead to a long-term decrease in the size of a population.

2. *Reduce the area of occupancy of an important population*

   The Olive Ridley turtle is widely distributed throughout tropical and sub-tropical waters. The proposed project will not reduce the area of occupancy in any ecologically meaningful way.

3. *Fragment an existing important population into two or more populations*

   The proposed project will not create any barriers to movement for Olive Ridley turtles.

4. *Adversely affect habitat critical to the survival of a species*

   The Olive Ridley turtle does not commonly feed in central Queensland, but suitable feeding habitats are found throughout Port Curtis and elsewhere in the central Queensland region.

5. *Disrupt the breeding cycle of an important population.*

   No concentrated nesting of Olive Ridley turtles occurs in Australia and none recorded in recent times from the east coast.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   The area to be disturbed does not constitute high value Olive Ridley turtle habitat.

7. *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

   It is not likely that an invasive species that is harmful to Olive Ridley turtles will be introduced.

8. *Introduce disease that may cause the species to decline*

   It is not likely that an Olive Ridley turtle disease will be introduced.

9. *Interfere substantially with the recovery of the species*

   There is a recovery plan in place for all marine turtle species found in Australia. The proposed project activities will not interfere with the recovery of marine turtle species.

Significant impact criteria – Flatback turtle

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of an important population of a species*

   Impacting processes are not of a sufficient scale or magnitude to lead to a long-term decrease in population size.

2. *Reduce the area of occupancy of an important population*

   The flatback turtle is widely distributed throughout tropical Australia and also occurs in Papua New Guinea. The proposed project will not reduce the area of occupancy in any ecologically meaningful way.

3. *Fragment an existing important population into two or more populations*

   The proposed project will not create any barriers to movement for flatback turtles.

4. *Adversely affect habitat critical to the survival of a species*

   Nesting beach habitat will not be physically impacted by the proposed project.

5. *Disrupt the breeding cycle of an important population.*

   Lighting near turtle rookeries has the potential to disrupt the nesting of adult turtles and the survival of hatchlings. The light regime in the Port Curtis region is already heavily modified by existing industrial and residential development. Pipeline construction activities will not result in a change to the lighting regime that will disrupt the breeding cycle.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   While unvegetated sub-tidal habitat is being disturbed as a result of the construction activities if dredging is undertaken, it is not of a sufficient scale to affect the survival of any marine turtle species.

7. *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

   It is not likely that an invasive species that is harmful to flatback turtles will be introduced.

8. *Introduce disease that may cause the species to decline*

   It is not likely that a flatback turtle disease will be introduced.

9. *Interfere substantially with the recovery of the species*

   There is a recovery plan in place for all marine turtle species found in Australia. The proposed project activities will not interfere with the recovery of marine turtle species.

Significant impact criteria – Loggerhead turtle

An action is likely to have a significant impact on an endangered species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of a population*

   The impacting processes are not of a sufficient scale or magnitude to lead to a long-term decrease in the size of a population.

2. *Reduce the area of occupancy of the species*

   Globally, the loggerhead turtle is a circum-tropical species. The proposed project will not reduce the area of occupancy in any ecologically meaningful way.

3. *Fragment an existing population into two or more populations*

   The proposed project will not create any barriers to movement for loggerhead turtles.

4. *Adversely affect habitat critical to the survival of a species*

   Nesting beach habitat will not be physically impacted by the proposed project. The gas pipeline will not disturb any major foraging habitat

5. *Disrupt the breeding cycle of a population.*

   Lighting near turtle rookeries has the potential to disrupt the nesting of adult turtles and the survival of hatchlings. The light regime in the Port Curtis region is already heavily modified by existing industrial and residential development. While occasional nesting of loggerhead turtles is recorded from Facing and Curtis Islands, the major breeding location for the east coast population of loggerhead turtles is the Bundaberg coast. Pipeline construction activities will not result in a change to the lighting regime that will disrupt the breeding cycle.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   While unvegetated sub-tidal habitat is being disturbed as a result of the construction activities if dredging is undertaken, it is not of a sufficient scale to affect the survival of any marine turtle species.

7. *Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat*

   It is not likely that an invasive species that is harmful to loggerhead turtles will be introduced.

8. *Introduce disease that may cause the species to decline*

   It is not likely that a loggerhead turtle disease will be introduced.

9. *Interfere with the recovery of the species*

   There is a recovery plan in place for all marine turtle species found in Australia. The proposed project activities will not interfere with the recovery of marine turtle species.

Significant impact criteria – Hawksbill turtle

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

1. *Lead to a long-term decrease in the size of an important population of a species*

   The impacting processes are not of a sufficient scale or magnitude to lead to a long-term decrease in the size of a population.

2. *Reduce the area of occupancy of an important population*

   Globally, the hawksbill turtle is a widely distributed species. The proposed project will not reduce the area of occupancy in any ecologically meaningful way.

3. *Fragment an existing population into two or more populations*

   The proposed project will not create any barriers to movement for hawksbill turtles.

4. *Adversely affect habitat critical to the survival of a species*

   The proposed project will not adversely impact the preferred foraging habitat for the species which is rocky and coral reefs.

5. *Disrupt the breeding cycle of a population.*

   Hawksbill turtle nesting on the east coast occurs on eastern Cape York beaches and some islands offshore of the eastern Cape. No nesting occurs in central Queensland so the breeding cycle will not be interrupted by the proposed project.

6. *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

   The proposed project will not adversely impact the availability or quality of habitat for the species which is rocky and coral reefs.

7. *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

   It is not likely that an invasive species that is harmful to hawksbill turtles will be introduced.

8. *Introduce disease that may cause the species to decline*

   It is not likely that a hawksbill turtle disease will be introduced.

9. *Interfere with the recovery of the species*

   There is a recovery plan in place for all marine turtle species found in Australia. The proposed project activities will not interfere with the recovery of marine turtle species.

Significant impact criteria – Dugong

An action is likely to have a significant impact on a vulnerable (migratory) species if there is a real chance or possibility that it will:

1. *Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species*

   No important dugong habitat is being destroyed or isolated as a result of the proposed development.

2. *Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species*

   It is not likely that an invasive species that is harmful to dugong will be introduced.

3. *Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.*

   While underwater noise associated with construction activities may disrupt dugong, it will be a temporary impact only that will not persist.

Dolphins

It was identified that three species of dolphins are known to occur or are likely to occur in the project area. These are the Indo-Pacific humpback dolphin, Bottlenose dolphin and Australian snubfin dolphin. The assessment considers the three species together, as the impacting processes are the same and the likely responses are similar.

Significant impact criteria – Dolphins

An action is likely to have a significant impact on a vulnerable (migratory) species if there is a real chance or possibility that it will:

1. Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species

   No important dolphin habitat is being destroyed or isolated as a result of the proposed development.

2. Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species

   It is not likely that an invasive species that is harmful to dolphins will be introduced.

3. Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species

   While underwater noise associated with construction activities may disrupt dolphins, it is a temporary impact only that will not persist.

Estuarine crocodile

It is generally recognised that the Fitzroy River is the southern most extent of the estuarine crocodiles core habitat. However, individuals straggle as far south as Colosseum Inlet and Seven Mile Creek systems and have previously been seen in Gladstone (DERM 2006).

Significant impact criteria – Estuarine crocodile

An action is likely to have a significant impact on a vulnerable (migratory) species if there is a real chance or possibility that it will:

1. *Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species*

   Vagrant individuals do straggle as far south as Colosseum Inlet and Seven Mile Creek systems and have previously been seen in Gladstone. However, it is generally recognised that the Fitzroy River is the southern most extent of the estuarine crocodile's core habitat.

   Given that this area of The Narrows is located 40km south of the Fitzroy River, the southern extent of estuarine crocodile's core habitat. No important estuarine crocodile habitat is being destroyed or isolated as a result of the proposed development.

2. *Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species*

   It is not likely that an invasive species that is harmful to estuarine crocodile will be introduced as a result of the gas pipeline development.

3. *Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species*

   Given that this area of The Narrows is located 40km south of the Fitzroy River, the southern extent of estuarine crocodile's core habitat. No important estuarine crocodile habitat is being destroyed or isolated as a result of the proposed development.

   While underwater noise associated with construction activities may disrupt vagrant indivduials travelling through the area, it is a temporary impact only that will not persist and will not disrupt the lifecycle of this species.

23.12 Wetlands of international importance

Wetlands at Laird Point, including the proposed location for the LNG facility, are within the The Narrows and Port Curtis Nationally Important Wetlands (QLD021 and QLD019 respectively) but are not wetlands of international importance. Figure 23.7 indicates the extent of intertidal vegetation at The Narrows.

No Ramsar wetlands are located within or adjacent to the proposed development site. However, the southern section of the alignment was identified as occurring within thesame catchment as the Narran Lake Nature Reserve Ramsar site. The northern prts of the alignment were identified as being within same catchment as the Shoalwater and Corio Bays Ramsar site. Narran Lake Nature Reserve is located 440km south west of the most southern point of the Condabri lateral. Shoalwater and Corio Bays are located 140km north of the alignment near Gladstone. Any impacts associated with the construction and operation of the gas pipeline is not expected to affect either of these Ramsar sites.

23.13 World Heritage and National Heritage places

23.13.1 The Great Barrier Reef World Heritage values

The Great Barrier Reef was inscribed on the World Heritage List in 1981. The World Heritage criteria against which the Great Barrier Reef was listed remain the formal criteria for this property. The World Heritage criteria are periodically revised and the criteria against which the property was listed in 1981 are not necessarily identical with the current criteria.The current criteria are as follows

Outstanding example representing a major stage of the earth's evolutionary history.

The Great Barrier Reef is by far the largest single collection of coral reefs in the world. The World Heritage values of the property include:

- 2904 coral reefs covering approximately 20,055km^2
- 300 coral cays and 600 continental islands
- Reef morphologies reflecting historical and on-going geomorphic and oceanographic processes
- Processes of geological evolution linking islands, cays, reefs and changing sea levels, together with sand barriers, deltaic and associated sand dunes
- Record of sea level changes and the complete history of the reef's evolution are recorded in the reef structure

- Record of climate history, environmental conditions and processes extending back over several hundred years within old massive corals
- Formations such as serpentine rocks of South Percy island, intact and active dune systems, undisturbed tidal sediments and "blue holes"
- Record of sea level changes reflected in distribution of continental island flora and fauna.

Outstanding example representing significant ongoing geological processes, biological evolution and man's interaction with his natural environment.

Biologically the Great Barrier Reef supports the most diverse ecosystem known to man and its enormous diversity is thought to reflect the maturity of an ecosystem, which has evolved over millions of years on the northeast Continental Shelf of Australia. The World Heritage values include:

- The heterogeneity and interconnectivity of the reef assemblage
- Size and morphological diversity (elevation ranging from the sea bed to 1142m at Mt. Bowen and a large cross-shelf extent encompass the fullest possible representation of marine environmental processes)
- On going processes of accretion and erosion of coral reefs, sand banks and coral cays, erosion and deposition processes along the coastline, river deltas and estuaries and continental islands
- Extensive *Halimeda* beds representing active calcification and sediment accretion for over 10,000 years
- Evidence of the dispersion and evolution of hard corals and associated flora and fauna from the "Indo-West Pacific centre of diversity" along the north-south extent of the reef
- Inter-connections with the Wet Tropics via the coastal interface and Lord Howe Island via the East Australia current
- Indigenous temperate species derived from tropical species
- Living coral colonies (including some of the world's oldest)
- Inshore coral communities of southern reefs
- Five floristic regions identified for continental islands and two for coral cays
- The diversity of flora and fauna, including:
  - Macroalgae (estimated 400-500 species)
  - Porifera (estimated 1500 species, some endemic, mostly undescribed)
  - Cnidaria: Corals - part of the global centre of coral diversity and including:
    - hexacorals (70 genera and 350 species, including 10 endemic species)
    - octocorals (80 genera, number of species not yet estimated)
  - Tunicata: Ascidians (at least 330 species)
  - Bryozoa (an estimated 300-500 species, many undescribed)
  - Crustacea (at least 1330 species from 3 subclasses)
  - Worms:

    - Polychaetes (estimated 500 species)
    - Platyhelminthes: include free-living Tubelleria (number of species not yet estimated), polyclad Tubelleria (up to 300 species) and parasitic helminthes (estimated 1000's of species, most undescribed)
  - Phytoplankton (a diverse group existing in two broad communities)
  - Mollusca (between 5000-8000 species)
  - Echinodermata (estimated 800 extant species, including many rare taxa and type specimens)
  - Fishes (between 1200 and 2000 species from 130 families, with high species diversity and heterogeneity; includes the Whale Shark *Rhynchodon typus*)
  - Seabirds (between 1.4 and 1.7 million seabirds breeding on islands)
  - Marine reptiles (including 6 sea turtle species, 17 sea snake species, and 1 species of crocodile)
  - Marine mammals (including 1 species of dugong (*Dugong dugon*), and 26 species of whales and dolphins)
  - Terrestrial flora: see "Habitats: Islands"
  - Terrestrial fauna, including:
    - Invertebrates (pseudoscorpions, mites, ticks, spiders, centipedes, isopods, phalangids, millipedes, collembolans and 109 families of insects from 20 orders, and large over-wintering aggregations of butterflies)
    - Vertebrates (including seabirds (see above), reptiles: crocodiles and turtles, 9 snakes and 31 lizards, mammals)
- The integrity of the inter-connections between reef and island networks in terms of dispersion, recruitment, and the subsequent gene flow of many taxa
- Processes of dispersal, colonisation and establishment of plant communities within the context of island biogeography (e.g. dispersal of seeds by air, sea and vectors such as birds are examples of dispersion, colonisation and succession)
- The isolation of certain island populations (e.g. recent speciation evident in two subspecies of the butterfly *Tirumala hamata* and the evolution of distinct races of the bird *Zosterops spp)*
- Remnant vegetation types (hoop pines) and relic species (sponges) on islands
- Evidence of morphological and genetic changes in mangrove and seagrass flora across regional scales
- Feeding and/or breeding grounds for international migratory seabirds, cetaceans and sea turtles.

Contain unique, rare and superlative natural phenomena, formations and features and areas of exceptional natural beauty.

The Great Barrier Reef provides some of the most spectacular scenery on earth and is of exceptional natural beauty. The World Heritage values include:

- The vast extent of the reef and island systems which produces an unparalleled aerial vista
- Islands ranging from towering forested continental islands complete with freshwater streams, to small coral cays with rainforest and unvegetated sand cays
- Coastal and adjacent islands with mangrove systems of exceptional beauty
- The rich variety of landscapes and seascapes including rugged mountains with dense and diverse vegetation and adjacent fringing reefs
- The abundance and diversity of shape, size and colour of marine fauna and flora in the coral reefs
- Spectacular breeding colonies of seabirds and great aggregations of over-wintering butterflies
- Migrating whales, dolphins, dugong, whale sharks, sea turtles, seabirds and concentrations of large fish.

Provide habitats where populations of rare and endangered species of plants and animals still survive.

The Great Barrier Reef contains many outstanding examples of important and significant natural habitats for *in situ* conservation of species of conservation significance, particularly resulting from the latitudinal and cross-shelf completeness of the region. The World Heritage values include:

- Habitats for species of conservation significance within the 77 broad-scale bioregional associations that have been identified for the property and which include:
  - Over 2900 coral reefs (covering 20 055km2) which are structurally and ecologically complex
  - Large numbers of islands, including:
    - 600 continental islands supporting 2195 plant species in 5 distinct floristic regions
    - 300 coral cays and sand cays
    - Seabird and sea turtle rookeries, including breeding populations of green sea turtles and Hawksbill turtles
    - Coral cays with 300-350 plant species in 2 distinct floristic regions
  - Seagrass beds (over 5000km squared) comprising 15 species, 2 endemic
  - Mangroves (over 2070km squared) including 37 species
  - *Halimeda* banks in the northern region and the unique deep water bed in the central region
- Large areas of ecologically complex inter-reefal and lagoonal benthos
- Species of plants and animals of conservation significance.

The significant impact guidelines (policy statement 1.1) indicate an action is likely to have a significant impact on the World Heritage values of a declared World Heritage property or on the National Heritage values of a National Heritage place if there is a real chance or possibility that it will cause:

- One or more of the World Heritage or National Heritage values (respectively) to be lost
- One or more of the World Heritage values or National Heritage values (respectively) to be degraded or damaged
- One or more of the World Heritage values or National Heritage values (respectively) to be notably altered, modified, obscured or diminished.

The significant impact guidelines provide further guidance through examples of actions likely to have a significant impact on natural heritage values. These examples are virtually identical for world and national heritage values and places. Those examples relevant to the ascribed values of the Great Barrier Reef are briefly described in Table 23.7.

Table 23.7 Examples of significant impact on World Heritage or National Heritage Places

Values associated with geology or landscapes
• Damage, modify, alter or obscure important geological formations in a World Heritage property or National Heritage place
• Damage, modify, alter or obscure landforms or landscape features, for example, by excavation or infilling of the land surface in a World Heritage property or National Heritage place
• Modify, alter or inhibit landscape processes, for example, by accelerating or increasing susceptibility to erosion, or stabilising mobile landforms, such as sand dunes, in a World Heritage property or National Heritage place
• Divert, impound or channelise a river, wetland or other water body in a World Heritage property or National Heritage place
• Substantially increase concentrations of suspended sediment, nutrients, heavy metals, hydrocarbons, or other pollutants or substances in a river, wetland or water body in a World Heritage property or National Heritage place.
Biological and ecological values
• Modify or inhibit ecological processes in a World Heritage property or National Heritage place
• Reduce the diversity or modify the composition of plant and animal species in all or part of a World Heritage property or National Heritage place
• Fragment, isolate or substantially damage habitat important for the conservation of biological diversity in a World Heritage property or National Heritage place
• Cause a long-term reduction in rare, endemic or unique plant or animal populations or species in a World Heritage property or National Heritage place
• Fragment, isolate or substantially damage habitat for rare, endemic or unique animal populations or species in a World Heritage property or National Heritage place.
Wilderness, natural beauty or rare or unique environment values
• Involve construction of buildings, roads, or other structures, vegetation clearance, or other actions with substantial, long-term or permanent impacts on relevant values

- Introduce noise, odours, pollutants or other intrusive elements with substantial, long-term or permanent impacts on relevant values.

Given the Great Barrier Reef was placed on the National Heritage List due to its World Heritage listing and associated values, it is considered relevant to assess the potential for impact on world heritage and national heritage values together.

For each of the world heritage values Table 23.8 indicates the aspects of the construction and operation of the gas pipeline that have potential to particularly impact that value. This section deals specifically with potential impacts of the gas pipeline relevant to the world heritage values described at Section 23.13.1. Further detailed assessment for each of those impacts is provided in the chapters and technical reports described in Table 23.7. The EIS in its entirety provides further context to the potential impact of the gas pipeline.

Table 23.8 Potential sources of impact to World Heritage value

World Heritage value	Potential source of impact
Outstanding example representing a major stage of the earth's evolutionary history	Construction of the gas pipeline by Australia Pacific LNG
Outstanding example representing significant ongoing geological processes, biological evolution and man's interaction with his natural environment	Construction of the gas pipeline by Australia Pacific LNG
Contain unique, rare and superlative natural phenomena, formations and features and areas of exceptional natural beauty	Construction of the gas pipeline by Australia Pacific LNG
Provide habitats where populations of rare and endangered species of plants and animals still survive	Construction of the gas pipeline by Australia Pacific LNG

Pipeline crossing

The strait between the mainland at Friend Point and Laird Point on Curtis Island is called The Narrows. The Narrows crossing has two distinct sections. The first is the intertidal flats or 'marshland' on the mainland and a short section on Curtis Island. The second is the open water section, which is The Narrows itself. Both sections will be crossed by different but interrelated methods, tailored for the respective environments.

It is proposed that the gas pipeline across the mud flats to the west of The Narrows be installed in an excavated trench. Excavation in muddy conditions requires a wide trench with sloped sides to prevent trench collapse.

Alternatively, the volume of material to be excavated may be minimised by installing parallel rows of sheet piles driven along the proposed trench line. The trench would be dug between the rows of sheet piling using low ground pressure excavators, working from a temporary construction access way built on top of the existing mudflats. In either case, spoil will be stockpiled on one side of the trench, while the other side will be used as the working side.

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

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

Either approach is considered feasible. The final site selection for the HDD rig will be made following additional site investigations and discussions with selected contractors

Further details regarding the crossing and the preferred way to grossing this are are discussed in 23.3.3 of this report.

Soils, topography, geomorphology and geology

The 450km of gas pipeline traverses a wide variety of landform features including, but not limited to sandstone scarps, freshwater wetlands and alluvial floodpains. Given that the propsed clearing width in any given place is a maximum of 40m and 85% of this area will be allowed to regenerate following the completion of construction impacts to areas away from the coast are expected to be minimal. In terms of impacts on the World heritage and National heritage values of the Great Barrier Reef the potential impacts of this pipeline are considered to be limited to the crossing of the strait between the mainland at Friend Point and Laird point on Curtis Island.

The predoimate geology affected will be the marine sediments directly below the low watermark and the marine clay plains that host the samphire forblands and mangrove forests on the mainland side of the narrows.

Regardless the option sort for the construction of the gas pipeline the entire gas pipeline will be located permanently underground. The short term temporary disturbance involved by both the trenching and HDD options are unlikely to cause an impact that would result in the changes to the solis, topography, geomorphology and geology.

The potential impacts of the alteration to landform, such as impacts on stormwater quantity and quality, are able to be mitigated through measures described for water resources. Further detail regarding potential impact to topography, geology and soils is provided at Volume 3 Chapter 5.

Landscape character and visual amenity

One of the criteria of the listing of the GBRWHA on the World Heritage list is the exceptional natural beauty of the Great Barrier Reef. However it is recognised that Gladstone Harbour's industrial influenced landscape has a lower sensitivity than untouched areas of the world heritage area.

Key characteristics of the local and regional landscape character surrounding the LNG facility site are:

- Landscape of contrast and variety- which includes heavy industry and port related activities
- Large scale water views with extensive vistas to level horizons and huge sky expanses
- Enclosed forested hills and valleys

- Forested mountains
- Mangrove vegetation and associated mudflats.

The impacts to the landscape character and visual amaenity associated with the pipeline are like to be highest during construction when drilling/trenching machinery and boats will be used to facilitate the underground pipeline. Once construction is complete the entire of the gas pipeline will be located permanently underground and thus, there are no long term visual amenity impacts resulting from the gas pipeline.

Terrestrial ecology

The proposed Project would require the clearing of 15.3ha of remnant vegetation on Curtis Island and 11.7ha of regional ecosystem on marine clay plains on the mainland. However none of this vegetation includes any threatened ecological community listed under the EPBC Act, endangered Regional Ecosystem (RE) under the VMA or vegetation with high biodiversity values under the biodiversity planning assessment.

Field surveys on Curtis Island identified 121 species of flora across 51 families and 100 genera recorded including 25 non-native species (refer to Volume 4 Chapter 8 for a list of species identified). Three significant weed species were identified on site being the common prickly pear (*Opuntia stricta*) and rubber vine (*Cryptostegia grandiflora*) and lantana (*Lantana camara*). Rubber vine and common lantana are also listed as weeds of national significance under the Australian Weeds Strategy (NRMMC 2006) and all were recorded on site in small, isolated infestations.

Thirteen endangered, vulnerable or rare (EVR) bird species, four EVR reptile species and eight EVR mammal species were identified as potentially occurring within the Project area (refer to Volume 4 Chapter 8 for a list of species identified) along with 39 migratory bird species that may utilise habitat within the Project area from time to time.

The construction of the gas pipeline has the potential to impact upon terrestrial flora and fauna values on site through direct loss or harm to individual species, populations and vegetation communities and degradation/modification of habitat areas. However, with the implementation of mitigation measures recommended in this assessment, these impacts can be managed to reduce their severity and longevity, thereby minimising the overall impact of gas pipeline on these values. Vegetation clearing will be limited to a 40m corridor. Following construction 85% of the corridor will be allowed to regenerate leaving only a 6m wide cleared area.

With the implementation of mitigation measures as described, the potential impacts associated with the gas pipeline can be managed to reduce their severity and longevity, thereby minimising the overall impact on these values. Further detail regarding potential impacts of the LNG facility to terrestrial ecology and proposed mitigation measures is provided at Volume 3 Chapter 8.

Marine ecology

The proposed pipeline traverses the Great Barrier Reef World Heritage Area, and in part a habitat protection zone of the *Great Barrier Reef Coast Marine Park*. The objectives of the habitat protection zone are to provide for the conservation of the areas of the marine park within the zone through the protection and management of sensitive habitats that are generally free from potentially damaging activities, and to provide opportunities for reasonable use of the areas.

Broadly, the key ecological features of the marine environment in Port Curtis are:

- Extensive saltpan/saltmarsh, seagrass and mangrove habitats that provide important nursery habitat for juvenile fish and prawns, and support fisheries production. The seagrass is also a food source for dugong.
- Nesting and feeding habitats for marine turtles.
- Habitat for inshore dolphin species including the endemic Australian snubfin dolphin, the Indo-Pacific humpback dolphin and the inshore form of the bottlenose dolphin.
- Although the seabed is dominated by unvegetated sedimentary environments, natural rocky reef habitat occurs, and there is artificial hard substrata including jetty piles and rock walls.
- An assemblage of macrobenthic infauna that is dominated by filter feeding organisms, with species richness and abundance that is lowest on fine muddy substrates in intertidal areas, and greatest in the coarse sandy sediments that predominate in the deeper channels of the estuary.

The proposed pipeline crossing traverses saltpan/saltmarsh habitat that drains into Targinie Creek before entering The Narrows in the vicinity of Friend Point. The foreshore in this area is mangrove fringed with extensive intertidal flats. The sub-tidal area of the proposed pipeline route is unvegetated.

All proposed for traversing the narrows involve disturbing and fragmenting saltpan/saltmarsh and mangrove habitat including the potential for changing local patterns of hydrology which may impact saltmarsh plants and mangroves. To mitigate impact, construction activities should be undertaken to minimise the area of disturbance and hydrodynamic changes across the saltpan/saltmarsh habitat.

Dredging will result in a turbidity plume. Turbidity plumes can decrease the ambient light levels that extend through to the seabed which can affect photosynthesis through the water column and impact vegetated habitats on the seabed such as seagrass and algae. When a turbidity plume settles out it can also smother benthic assemblages. While increases in turbidity are a natural event, the duration of elevated turbidity plumes from the proposed dredging program are much longer than those that occur naturally. Elevated turbidity from the dredge plume in The Narrows and Graham Creek will persist for between ten days and one month after dredging activities have ceased. The dredge plume is likely to overlap spatially with the seagrass beds in the vicinity of North Passage Island.

To minimise the turbidity plume of dredging and the potential transport of a turbidity plume from within the materials offloading facility (MOF) area during material placement, the following measures are recommended:

- Where practical, Australia Pacific LNG will deploy silt curtains to prevent migration of turbidity plumes
- Dredging will only operate within safe weather conditions (as defined by the Harbour Master) to minimise spillage of dredged material and hence minimise the magnitude of the turbidity plume generated.

The mitigation measures serve to potentially limit both the spatial scale and the magnitude of the impact from dredging activities.

Dredging and HDD will both generate underwater noise that has the potential to impact the local distribution and behaviour of dolphins and dugong. This impact will not persist beyond the construction phase. It is recommended that monitoring the usage of the area at and adjacent to the pipeline area by cetaceans and dugong will be undertaken prior, during and after construction.

Bentonite is proposed to be used as the principal drilling fluid and it is possible that some of this material will directly or indirectly enter the marine environment. While bentonite is a natural clay compound, its physical properties can potentially result in significant environmental impacts.

To mitigate potential impacts from the use of bentonite, it is recommended that no deliberate discharge of drilling fluid to the marine environment be undertaken and all drilling fluid should be disposed of off-site. It is also recommended that in the event of a potential or actual spill of drilling fluid, the pumping of drilling fluid and the drilling activity should cease immediately until remedial action is taken.

Once the construction of the gas pipeline has been completed it is not anticipated that additional impacts will arise from the maintenance of the pipeline.

Water resources

Development of the gas pipeline will include bulk earthworks within the intertidal wetland to the west of The Narrows waterway. The technique for most of this earthwork will be by trench and cover. The crossing of The Narrows or the construction of the gas pipeline of on Curtis Island is not likely to have a significant impact on the surface water drainage on the site and adjoining land. However, there will be high erosion potential during the construction period during rain events due to the removal of vegetation and associated earthworks. There is also the potential release of contaminants that may be attached to the soils that enter drainage lines and subsequently flow into Port Curtis.

All runoff from the construction works area will be directed to the sediment ponds for treatment prior to discharge to Port Curtis. The sediment ponds will capture the first 25mm of runoff. Riprap aprons will be constructed at all discharge outlets to prevent scour and erosion.

Coastal environment

Potential impacts associated with the gas pipeline crossing of The Narrows largely depend on the construction methodology to be adopted by Australia Pacific LNG. The preferred construction technique for the intertidal wetland to the west of The Narrows waterway is by trench and cover.

Assessment of the coastal environment considered the potential impacts to coastal processes resulting from the development of the gas pipeline which links Curtis Island and the mainland. The impact assessment associated with the pipeline is discussed further in the (Volume 3 Chapter 12); however, given the scale of development assocated with Port infrastructure in the greater Port Curtis area the impact on the coastal environment by the pipeline development are consider to be relatively minimal.

Summary of potential impact (significant impact criteria)

The significant impact critera for the Great Barrier Reef Wotld heritage and national heritage places are as follows

1. *One or more of the World Heritage or National Heritage values (respectively) to be lost*
2. *One or more of the World Heritage values or National Heritage values (respectively) to be degraded or damaged*
3. *One or more of the World Heritage values or National Heritage values (respectively) to be notably altered, modified, obscured or diminished*

The pipeline crossing is proposed for a secion of water locally known as The Narrows. This area represents a narrower section of the waterway that exists between Curtis Island and the mainland thus

reducing the impact associated with underwater construction. Given the inderwater activities associated with the areas surrounding Gladstone Port the activititeis associated with the construction of the pipeline are relatively minimal. The relatively minimal disturbance and the mitigation measures outlined in the EM Plans for the construction of the pipeline the impacts on the Great Barrier Reef are not expected to be significant.

Following the construction and operation of the pipeline it is expected that none of the Great Barrier Reef World Heritage values or National Heritage values (respectively) will be lost, degraded or damaged or notably altered, modified, obscured or diminished.

No other World Heritage or National Heritage Places will be impacted by the gas pipeline.

23.13.2 Great Barrier Reef Marine Park

Since 25 November 2009, the Great Barrier Reef Marine Park has been recognised as a stand alone matter of national environmental significance with its own significant impact critera.

The Great Barrier Reef Marine Park does not occupy the same spatial extent as the Great Barrier Reef World Heritage Area. A review of the spatial data supplied by the Great Barrier Reef Marine Park Authority (GBRMPA) indicates that the marine park begins on the eastern beach of Curtis Island and therefore does not include The Narrows or any land on Curtis Island.

No action proposed by the development of the gas pipeline is likely to have a significant impact on the environment of the Great Barrier Reef Marine Park.

23.13.3 Indigenous and non-indigenous heritage

Heritage sites of international or national significance are recorded on Commonwealth heritage lists and registers. These are primarily the National Heritage List, the Commonwealth Heritage List, the Register of the National Estate and the World Heritage List. These lists are the responsibility of DEWHA, and the site information can be requested through the Department. Site information on locations of National or International significance is available through online searches, which reveal sites registered for their natural or palaeontological values.

Detailed heritage assessment technical reports are located in Volume 5 Attachments 40 and Volume 5 Attachment 37. These assessments were completed for both Indigenous and non-Indigenous heritage matters, and included assessments in relation to MNES matters.

These assessments considered the legislative requirements in relation to Indigenous and non-Indigenous cultural heritage. The initial phase of the assessment involved the collation of site information from sources such as the online resources for heritage site database, Commonwealth Heritage Lists for sites of international and national significance, and reviewed known Indigenous heritage and history along the proposed gas pipeline route..

An evaluation of potential risks posed by gas pipeline construction was then undertaken for registered sites within 10km of the study corridor. This second stage included using the mapped site locations to identify patterns in the data. From these, zones of high site occurrence and high site potential were identified. These zones guided the route selection process, and led to the rejection of alignments that could potentially have adversely impacted significant cultural landscapes and heritage sites. The third stage of the assessment process would further refine the route through targeted field investigations, check the validity of the sensitivity zones, and identify further heritage features that would preclude the gas pipeline construction.

In addition, a contextual history of the study area and previous studies were reviewed. Site information from the various site databases and data sources were collated and mapped. To provide a context in which to assess the heritage values of the sites in the project area, heritage locations in the surrounding area were considered. While this may have resulted in the inclusion of sites well distant from the proposed gas pipeline alignment, it ensured that significant heritage places that may be directly impacted by the Project were also identified. It also puts the sites in the study area into context.

The assessment found that no items with strictly Indigenous heritage values are recorded on the world, national or Commonwealth heritage lists for the gas pipeline study area. However, Indigenous heritage values are recognised in the listing and management of the Great Barrier Reef as a national and world heritage area, and must therefore be considered in the context of the EPBC Act. These matters were discussed in Section 23.13.

Other than the Great Barrier Reef World Heritage area, there are no heritage sites of national or state heritage significance along the gas pipeline route that would be affected. Two registered heritage places on the National Heritage List – Sea Hill Point Lighthouse and the Cape Capricorn Lightstation – are both identified as having state heritage significance and are listed on the Register of the National Estate. These are situated at the northern end of Curtis Island, and are at least 28km from the proposed development. Neither would be affected directly or indirectly by the Project's gas pipeline construction.

Potential impacts to previously undetected Indigenous heritage sites will be managed through measures specified in the cultural heritage management plan required by State legislation. In general, the principle governing the gas pipeline route selection has, and will continue to be, that identified heritage sites will be avoided wherever possible.

Impact mitigation measures will include avoidance of any identified highly sensitive areas and further field investigation including sub-surface testing, recovery of datable material, collection and relocation of cultural heritage items. Such measures relating to Indigenous heritage items will be finalised in the cultural heritage management plan being negotiated between Australia Pacific LNG and each Aboriginal Party.

Similarly, potential impacts to previously undetected Indigenous heritage sites will be managed through a heritage management plan. This is to be prepared in consultation with the local community stakeholders and reviewed by DERM. Measures will include ongoing field inspections and procedures to ensure the timely reporting of heritage items uncovered during construction. In addition, induction training will be provided to all workers involved with construction activities on the gas pipeline. This will include information about the importance of heritage sites and the procedures to be followed if sites or items are discovered.

23.14 Environmental management plan outline

A stand alone EM Plan for the gas pipeline has been developed in accordance with the TOR issued for the Project, and is included at Volume 3 Chapter 24. The Plan provides measures for the management of impact to MNES for the construction, operation and decommissioning of the gas pipeline. It has been designed to:

- Be a comprehensive document which identifies all of the environmental values, potential impacts and management strategies for the gas fields
- Ensure the environmental impacts are minimised through proposed performance criteria and implementation strategies for each element

- Provide government agencies and stakeholders with evidence that the environmental management of the project is acceptable.

The EM Plan will be used as the overarching management plan for the Project. It consists of the construction, operation, decommissioning and rehabilitation of the gas pipeline. It provides a summary of the environmental values and potential impacts for the following elements:

- Land
- Terrestrial ecology
- Aquatic ecology
- Marine ecology
- Traffic and transport
- Indigenous cultural heritage
- Shared cultural heritage
- Water resources
- Coastal environment
- Air quality
- Greenhouse gases
- Noise and vibration
- Waste management
- Social
- Hazard and risk.

Each relevant part of the EM Plan involves performance criteria, implementation strategies, monitoring, auditing, reporting, and corrective actions, and these are outlined in Table 23.9.

Table 23.9 Environmental plan structure

Element/issue	Aspect of construction or operation to be managed (as it affects environmental values)
Operational policy	The operational policy or management objective that applies to the element
Performance criteria	Measurable performance criteria (outcomes) for each element of the operation
Implementation strategy	The strategies, tasks or action program (to nominated operational design standards) that would be implemented to achieve the performance criteria
Monitoring	The monitoring requirements to measure actual performance (i.e. specified limits to pre-selected indicators of change)
Auditing	The auditing requirements to demonstrate implementation of agreed construction and operation environmental management strategies and compliance with agreed performance criteria
Reporting	Format, timing and responsibility for reporting and auditing of monitoring results
Corrective action	The action (options) to be implemented in case a performance requirement is not reached and the person(s) responsible for action (including staff authority and responsibility management structure)

The EM Plan in Volume 3 Chapter 24 provides a summary of the environmental values and potential impacts for the MNES-related issues summarised in Section 23.9. The Plan specifies relevant performance criteria and mitigation strategies for MNES. The mitigation measures are also discussed in the assessment sections of this chapter. Mitigation and management measures have been developed with the aim of avoiding impacts where practicable through alignment changes undertaken prior to and during the field surveys. Areas identified as containing TECs or habitat for EPBC-listed flora and fauna species and riparian vegetation have been avoided as far as possible. It is recognised

that further refinement of the alignment may be required at a local scale for constructability and to further mitigate impacts.

23.15 Cumulative impacts

23.15.1 The Australia Pacific LNG Project

Each of the three main components of the Project – the gas fields, the gas pipeline to the LNG facility on Curtis Island, and the LNG facility itself, have been subject to separate assessments for MNES. The assessments have been conducted separately due to the very different nature of the types of disturbance that are proposed for each Project component, and due to the bioregional variation between the locations of each of the Project components.

There are currently a number of existing, approved or proposed projects within the vicinity of the gas pipeline that could contribute to cumulative impacts. The projects assessed as part of the environmental impact statement for cumulative impact are listed in Table 23.10.

Table 23.10 List of projects considered for cumulative impact assessment

- Australia Pacific LNG Project
- Arrow Energy Gas Field Development
- Australian Inland Rail Expressway - Toowoomba to Gladstone Railway (see Surat Basin Railway)
- Boyne Smelters Expansion Project
- Cameby Downs (Coal) Expansion Project
- Central Queensland Gas Pipeline
- Darling Downs Power Station
- Dawson Coal Mine Expansion Project
- East End No.5 Limestone Mine
- Fisherman's Landing Port Expansion
- Gladstone LNG Project
- Gladstone LNG Project – Fisherman's Landing
- Gladstone Pacific Nickel Refinery
- Gladstone Steel Making Facility
- Gladstone-Fitzroy Pipeline
- Linc Energy Underground Coal Gasification
- Moura Link (government project)
- Nathan Dam and Associated Pipelines (government project)
- Queensland Curtis LNG Project
- Queensland Gas Pipeline Expansion
- Shell Australia LNG Project
- Surat Basin Railway
- Surat to Gladstone Pipeline
- Walloon Coal Seam Gas Field
- Wallumbilla-Darling Downs Power Station Gas Pipeline
- Wandoan Coal Project
- Western Basin Dredging and Disposal Project
- Wiggins Island Coal Terminal
- Woori Coal Project
- Yarwun Alumina Refinery.

23.15.2 Linear infrastructure

A quantification of proposed impacts of projects other than the Australia Pacific LNG Project has been constrained by the lack of information available in relation to other linear infrastructure development projects. Existing reporting for these projects provides limited quantification of how much habitat will be lost, which habitat types will be affected, the severity of impacts, and mitigation and offset measures.

To compensate for a lack of information on which to base cumulative impact assessment, the other linear infrastructure known to be subject to development applications have been mapped in conjunction with the Australia Pacific LNG gas pipeline. Sites of other projects in the approval or early development stage have also been mapped. Figure 23.9 and Figure 23.10 indicate the location of other projects in proximity to the Australia Pacific LNG gas pipeline route including in the Gladstone area.

Most of the ecological communities in the area in which the gas pipeline element of the Project occurs are already highly disturbed and fragmented due to past land use activities. However, biodiversity corridors of state and regional significance and associated flora and fauna connectivity values exist in this area and will be potentially impacted by the Australia Pacific LNG Project and other proposed linear infrastructure projects in the region.

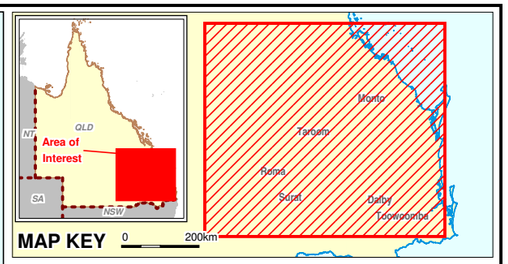
Figure 23.11 shows the bioregional corridors of state or regional significance by sub-region over the gas pipeline study area. Similarly, Figure 23.12 show the remnant vegetation by regional ecosystem type within the gas pipeline study area,

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ROCKHAMPTON
EMERALD
BLACKWATER
Mount Morgan
GLADSTONE
CALLIOPE
Springsure
Fitzroy Dev Road
Miriam Vale
Biloela
Moura
Bargara
BUNDABERG
Monto
Theodore
Howard
HERVEY BAY
Bidsvold - Theodore Road
Biggenden
MARYBOROUGH
Mundubbera
Gayndah
Taroom
Injune
Roma - Taroom Road
Wandoan
Goomeri
GYMPIE
Murgon
Wondai
Warrego Highway
Mitchell
ROMA
Miles
Chinchilla
Jandowae
KINGAROY
Cooroy
Tewantin
NAMBOUR
Nanango
Yarraman
Blackbutt
Kilcoy
Surat
DALBY
Tara
Crows Nest
Esk
Cabooltur
Oakey
TOOWOOMBA
Gatton
Laidley
IPSWICH
Rosewood
Millmerran
ST GEORGE
WARWICK



MAP KEY 0 200km

LEGEND

- Nathan dam (Proposed)
- Pipeline licence (Granted)
- Major road
- Pipeline licence (Application)
- Railway
- Major watercourse

Rail and Pipelines

- QCLNG pipeline
- Queensland Hunter Gas pipeline (Proposed)
- Surat - Gladstone pipeline
- Gladstone - Fitzroy water pipeline
- Nathan Dam pipeline
- Gas pipeline route
- Surat Basin railway (Proposed)
- GLNG pipeline
- Moura link rail (Proposed)
- Gladstone Pacific pipeline (sea water & slurry)
- Central Queensland gas pipeline

Production Areas

- Wandoan coal mine
- Linc Energy UCG
- Dawson South stage 2
- East End mine expansion
- Woori coal mine
- Cameby Downs coal mine
- Boulder Steel

Principal Holders

- Origin Energy
- Santos
- Queensland Gas Company

Production Plants

- Darling Downs power station (Proposed)
- GLNG production plant
- Shell LNG processing plant
- Boyne Island aluminium production plant
- QCLNG production plant
- Yarwun alumina refinery

Source Information

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Cameby Downs Expansion Project
http://www.derm.qld.gov.au/register/p03029aa.pdf
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http://qclng.com.au/uploads/docs/eis/vol02/Vol-2-Ch-04-Location-of-Project-Components-01.pdf
Santos pipeline
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http://www.suratbasinrail.com.au/files/EIS/Map%20Folio/Maps/Map_1_Overall_Location.pdf
Proposed Woori Coal Mine – Surat Coal Pty Ltd
http://www.derm.qld.gov.au/register/p02908aa.pdf
Darling Downs Power - Origin
http://www.dip.qld.gov.au/docs/library/pdf/mp_darling_downs_IAS_jun07.pdf
Chinchilla UCG Project Site
http://www.dip.qld.gov.au/resources/project/linc/linc_energy_ias_figure1.pdf
Nathan Dam
http://www.dip.qld.gov.au/resources/project/nathan-dam/nathan_dam_initial_advice_statement_figure1.pdf
Nathan to Dalby Pipeline
http://www.dip.qld.gov.au/resources/project/nathan-dam/nathan_dam_initial_advice_statement_figure5.pdf
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Central Queensland Gas Pipeline
http://www.dip.qld.gov.au/docs/library/pdf/Central_Qld_Gas_pipeline_map.pdf
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Steel Making Facility – Boulder Steel Ltd
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Location of the LNG Facility and Associated Infrastructure
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Wharf Facilities – Wiggins Island
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Shell LNG processing plant
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http://www.gladstoneindustry.org.au/documents/1199772015_gsda_a3l_dip_infrastructure_dec_2007.pdf

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SCALE - 1 : 2,000,000 (at A3)
Latitude/Longitude
Geocentric Datum of Australia 1994

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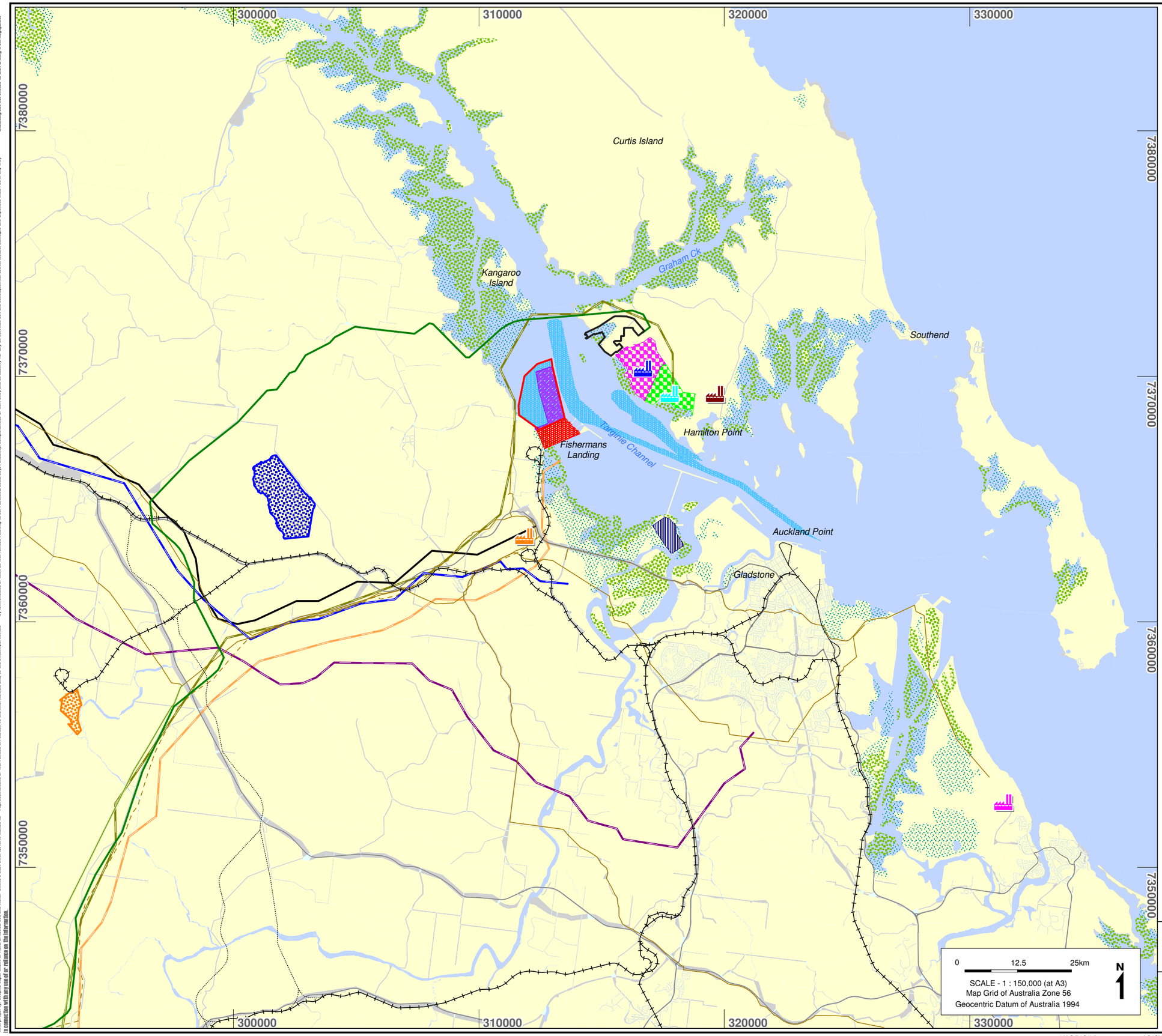
AUSTRALIA PACIFIC LNG PROJECT

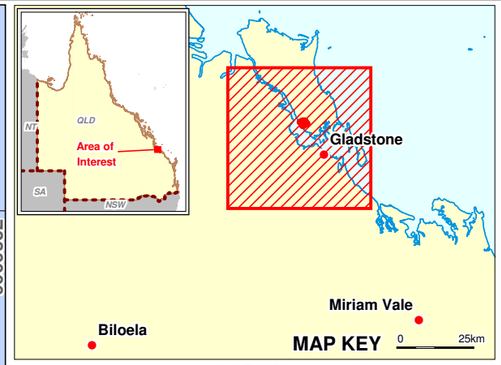
Volume 3 Chapter 23
Figure 23.9 Cumulative impacts - gas pipeline route

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LEGEND

- Pipeline licence (Application)
- Pipeline licence (Granted)
- Railway
- Major Road
- Mangroves
- Saline coastal flats

Rail and Pipelines

- QCLNG pipeline
- Surat Basin railway (Proposed)
- Queensland Hunter Gas pipeline (Proposed)
- GLNG pipeline
- Surat - Gladstone pipeline
- Moura link rail (Proposed)
- Gladstone - Fitzroy water pipeline
- Gladstone Pacific pipeline (sea water & slurry)
- Central Queensland gas pipeline
- Gas pipeline route

Production Areas

- Boulder Steel
- East End mine expansion
- Fisherman's Landing Port expansion
- Western Basin dredging
- Wiggins Island coal terminal
- GLNG facility
- QCLNG facility
- GPC dredging
- Fisherman's Landing
- Australia Pacific LNG facility

Production Plants

- Boyne Island aluminium production plant
- GLNG production plant
- QCLNG production plant
- Shell LNG processing plant
- Yarwun alumina refinery

Source Information

Gas pipeline route
Supplied by Origin Energy on 03/11/2009
Boulder steel making facility
http://www.dip.qld.gov.au/resources/project/gladstone-steel-making/gladstone-steel-making-ias.pdf
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http://www.cqpa.com.au/Pages/Publications/Wiggins%20Island/EIS%20Volume%201/Section%2003.pdf
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Gladstone Pacific Nickel Limited nickel and cobalt laterite mine
http://gladstonepacific.com.au/index.php?submenu=environment&src=gendocs&link=environment&category=environment

AUSTRALIA PACIFIC LNG PROJECT

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Figure 23.10 Cumulative Impacts Gladstone Area

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149.00 149.50 150.00 150.50 151.00

-24.00 -24.50 -25.00 -25.50 -26.00 -26.50

Mount Morgan
Curtis Island
LNG facility location
GLADSTONE
Baralaba
Biloela
Moura
Theodore
Monto
Gas pipeline route
Taroom
Wandoan
Woleebee Lateral
Condabri Lateral
ROMA
Miles
Chinch

350 300 250 200 150 100 50 0

Dawson Hwy
Fitzroy
Dev Rd
Taroom Rd
Roma
Warrego Highway
Leichhardt Hwy
Eidsvold - Theodore Rd

LEGEND

- Towns
- Pipeline kilometre point
- Nathan dam (Proposed)
- Pipeline licence (Application)
- Pipeline licence (Granted)
- Railway
- Major road

Production Areas

- Wandoan and Woori coal mines
- Cameby Downs coal mine
- Dawson South stage 2
- LNG facility

Principal Holders

- Origin Energy
- Santos
- Queensland Gas Company

Biodiversity Planning Assessment

- State
- Regional

Rail and Pipelines

- Australia Pacific LNG gas pipeline route
- QCLNG pipeline
- Queensland Hunter Gas pipeline (Proposed)
- Gladstone - Fitzroy water pipeline
- Nathan Dam pipeline
- GLNG pipeline
- Moura link rail (Proposed)
- Gladstone Pacific pipeline (sea water & slurry)
- Central Queensland gas pipeline
- Surat-Gladstone pipeline (Arrow)
- Queensland Curtis LNG pipeline (BG)
- Gladstone LNG pipeline (Santos)
- Surat Basin railway

0 25 50km

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

N

NT QLD SA NSW
Area of Interest

SOURCE INFORMATION

Gas pipeline route
Provided by Origin Energy 03/11/2009

Roads
Department of Main Roads, Queensland 2009

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

Other Sources
Refer to Figure 23.9

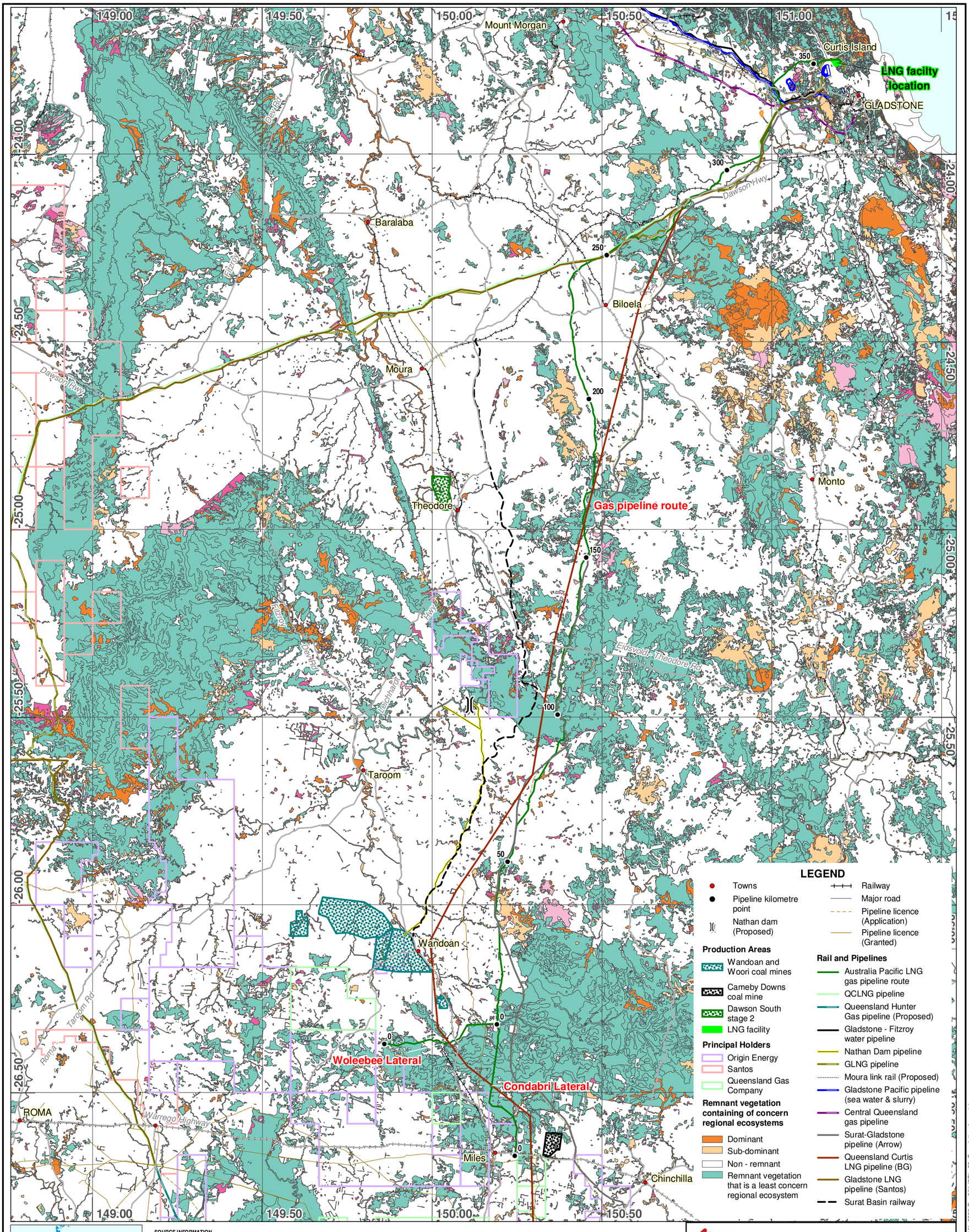
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Figure 23.11 Bioregional Corridors - Cumulative Impacts

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SOURCE INFORMATION

Gas pipeline route
Provided by Origin Energy 03/11/2009

Roads
Department of Main Roads, Queensland 2009

Regional ecosystems mapping (version 6) and RE descriptions (version 6.0b)
Department of Environment and Resource Management) 2010

Other Sources
Refer to figure 23.9

0 25 50km

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

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AUSTRALIA PACIFIC LNG PROJECT

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Figure 23.12 Regional Ecosystems - Cumulative Imapcts

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Terrestrial ecology

It is likely multiple linear projects would result in an increase in vegetation disturbance associated with construction activities, and lead to habitat impact, edge effects and fragmentation of regional ecosystems.

Significant increased traffic movements, particularly during the construction phase may also promote the introduction and/or spread of weed species.

The clearing proposed by all proponents for linear development will result in a narrow linear disturbance. The rehabilitation of these linear disturbances will assist in reducing habitat impact, fragmentation and edge effects.

A particular terrestrial ecology cumulative impact of national significance relates to a large population of the endangered cycad Large-fruited zamia palm (*Cycas megacarpa*), which occurs along Callide Range section of the proposed gas pipeline route between KPs 260–272. This species has also been recorded close to the location where the alignment crosses the Calliope Range.

Given conservation status of this species and the possible number of plants to be removed by the proposed infrastructure projects in these areas, there is potential for a significant cumulative impact on this species. Australia Pacific LNG and some other project proponents propose that translocations and offsets will be provided for this species and where individual trees cannot be avoided (Section 23.9.1).

Apart from the Gladstone section of the Australia Pacific LNG gas pipeline, which is within the industrial and semi-urban areas of the Gladstone State Development Area, most of the relevant projects assessed for cumulative impacts within the vicinity of the gas pipeline are associated with other linear infrastructure.

Due to the linear nature of most of these proposed projects, there is scope to minimise the effects of biodiversity corridor severance and edge effects by locating the projects in existing clearings, particularly where they transect such corridors of state or regional significance.

In addition, a broad-scale and integrated planning approach to rehabilitation and offset locations is essential to ensure the combination of proposed projects do not to result in long term degradation of habitats for a number of conservation significant flora and fauna species. This will require a cooperative approach to management of terrestrial ecological impacts by all proponents, in conjunction with active involvement of regional communities. Species most at risk are those which are endemic to the region and rely specifically on connected, large tracts of intact, remnant vegetation.

Coordination of habitat rehabilitation efforts for all of the relevant projects is outside of the authority of any of the individual proponents and will require government input to ensure that all of the projects adequately compensate for the potentially significant cumulative impacts by cooperating to minimise cumulative impacts and potentially achieve long term landscape-scale ecological benefits.

Aquatic ecology

Most of the rivers along the gas pipeline corridor contain poor or very poor quality aquatic habitat due to past habitat disturbance. However, there are some localised sites in these river systems which contain important habitat values as a result of good channel and habitat diversity, minimal surrounding land use impact and good riparian connectivity and shading.

Should other projects adopt similar mitigation measures (Section 23.9.2) to those that Australia Pacific LNG is committed to, this low risk conclusion is unlikely to be affected by the development of all proposed projects in the vicinity of the gas pipeline route.

Marine ecology

Cumulative impacts in the marine environment could range from simple additions to prior impacts of similar types, to complex interactions of environmental stresses due to multiple (and differing) impacts. The gas pipeline element of the Project will impact the marine environment with the crossing of The Narrows. The two potential cumulative impacts on marine assemblages in Port Curtis from proposed projects that need to be considered are:

- Water quality and hydrodynamic impacts from dredging and reclamation
- Potential discharges to the marine environment.

A number of point source discharges are proposed for the projects under consideration in Port Curtis. There remain significant uncertainties regarding the exact nature and location of these discharges, and these factors are outside the control of Australia Pacific LNG.

Australia Pacific LNG's preferred method for crossing The Narrows as a stand alone project is by horizontal directional drilling (Section 23.3). As such, construction of the pipeline is not expected to make any significant contribution to the abovementioned potential cumulative impacts as the potential impacts of the pipeline are expected to be minor in magnitude, localised in extent and short in duration.

Currently, other proponents for LNG projects on Curtis Island propose to construct their gas pipelines across The Narrows by conventional dredging methods. The cumulative impacts on the marine environment of these multiple construction phases could be significantly reduced by conducting a single dredged crossing and pipeline laying project, known as a 'bundled' approach. Australia Pacific LNG would participate in such a bundled crossing, subject to satisfactory commercial and other technical arrangements.

If horizontal directional drilling is determined not to be feasible, based on final engineering investigations or construction constraints or a bundled approach to crossing The Narrows is not agreed amongst LNG proponents, Australia Pacific LNG would use conventional dredging techniques for the marine crossing.

The scale of the cumulative impacts on the marine environment from dredged crossings of The Narrows has not been quantified, although the nature of the impacts associated with direct disturbance of marine habitats and indirect impacts from sediment turbidity plumes and sediment decant water run-off of the dredge spoil facility are understood. As stated above, the relative magnitude of the cumulative dredging activities for the pipeline components of the projects is much smaller than the total Western Basin Dredging and Marine Disposal project.

If not managed properly, the cumulative impact of dredging within Port Curtis could be high.

23.16 Environmental Offsets

Environmental offsets may be considered for compensation of impacts which can not be adequately reduced through avoidance and mitigation. The regulatory and policy framework for environmental offsets that may be relevant to this Project includes Commonwealth and Queensland government policy and requirements.

Use of environmental offsets under the EPBC Act

The Austaralian Government has developed a policy relevant to the use of environmental offsets; *'Draft Policy Statement: Use of environmental offsets under the Environment Protection and Biodiversity Conservation Act 1999'*. The policy indicates that:

Environmental offsets can be used under the EPBC Act to maintain or enhance the health, diversity and productivity of the environment as it relates to matters protected by the EPBC Act (i.e. MNES). Environmental offsets can be applied as an approval condition under the EPBC Act for developments that have undergone assessment. They may be used when a development will result in impacts on a matter protected by the EPBC Act.

The draft policy indicates that eight principles for the use of environmental offsets under the EPBC Act have been identified. These eight principles are to be used to assess any proposed environmental offsets to ensure consistency, transparency and equity under the EPBC Act. The Australian Government's position as per the draft policy is that:

- Environmental offsets should be targeted to the matter protected by the EPBC Act that is being impacted
- A flexible approach should be taken to the design and use of environmental offsets to achieve long-term and certain conservation outcomes which are cost effective for proponents
- Environmental offsets should deliver a real conservation outcome
- Environmental offsets should be developed as a package of actions - which may include both direct and indirect offsets
- Environmental offsets should, as a minimum, be commensurate with the magnitude of the impacts of the development and ideally deliver outcomes that are 'like for like'
- Environmental offsets should be located within the same general area as the development activity
- Environmental offsets should be delivered in a timely manner and be long lasting
- Environmental offsets should be enforceable, monitored and audited.

Use of offsets under the Queensland Government framework

The Queensland Government Environmental Offsets Policy establishes a framework for using environmental offsets in Queensland. The policy is based on the premise that offsets should only be considered after all environmental impacts have been avoided and minimised.

The policy is based on seven policy principles that direct the way offsets must be used to contribute to Ecologically Sustainable Development:

- Environmental offsets will not replace or undermine existing environmental standards or regulatory requirements, or be used to allow development in areas otherwise prohibited through legislation or policy
- Environmental impacts must first be avoided, then minimised, before considering the use of offsets for any remaining impact
- Environmental offsets must achieve an equivalent or better environmental outcome
- Environmental offsets must provide environmental values as similar as possible to those being lost

- Environmental offset provision should minimise the time-lag between the impact and delivery of the offset
- Environmental offsets must provide additional protection to environmental values at risk, or additional management actions to improve environmental values
- Environmental offsets must be legally secured for the duration of the offset requirement.

The Queensland Government has several specific-issue offsets policies that indicate where environmental offsets are needed, and what form they should take. The specific-issue offsets policies, and their regulating agencies are for:

- Vegetation Management (Policy for Vegetation Management Offsets, September 2007, Department of Natural Resources and Water)
- Marine Fish Habitat (Mitigation and Compensation for Works or Activities Causing Marine Fish Habitat Loss, 2002, Department of Primary Industries and Fisheries)
- Koala Habitat (Offsets for Net Benefit to Koalas and Koala Habitat, 2006, Environmental Protection Agency)

Specific-issue policies are currently in development to address impacts on waste water quality and biodiversity.

Use of offsets

Biodiversity offsets

The objectives of the Queensland Government draft Policy for Biodiversity Offsets (EPA 2008) are to improve the long-term protection and viability of the State's biodiversity, to increase the area of habitat restored and enhanced and to ensure development in Queensland is ecologically sustainable. It provides criteria for identifying and utilising biodiversity offsets to counterbalance an impact that causes a loss of biodiversity values.

Under the draft policy, biodiversity offsets must achieve an equivalent or better environmental outcome for the biodiversity values impacted and may include direct offsets (such as acquiring lands to be included in a protected estate or rehabilitation and protection of regrowth vegetation), or indirect offsets including removing threats to biodiversity values, providing fauna assisted crossings and implementing actions of a recovery plan, biodiversity action plan or management plan.

The draft Policy for Biodiversity Offsets may provide a useful guide to calculate potential offsets based on the conservation status of the values impacted. However, the policy in its present form is a consultation draft and is subject to considerable change. Therefore, it is not considered further here.

Marine habitat offsets

For the marine fish habitat that is to be disturbed, consideration of mitigation and offsets are guided by the State government Fish Habitat Management Operational Policy FHMOP (2002) *Mitigation and Compensation for Works or Activities Causing Marine Fish Habitat Loss*.

The objectives of this Policy are:

- To maintain fisheries values, including fish habitat values

- To seek to ensure the costs associated with fish habitat losses attributed to public or private works are matched with, or are less than, a level of mitigation and/ or compensation appropriate to the disturbance of fish habitat
- To promote maintenance of marine fish habitats through implementation of mitigation or compensation to meet the objective of No Net Loss of Marine Fish Habitat Policy
- To recognise the natural capital of fish habitats
- To create public awareness of the value of fish habitats.

Compensatory activities may be carried out off-site but in the region where the disturbance is occurring, or may be part of a 'Statewide Compensation Program.' Australia Pacific LNG have investigated a number of compensatory options for marine fish habitat loss. Australia Pacific LNG have consulted widely with local fishing stakeholders on offset options and have identified a preference for offsets at the local/regional level as it is the local/regional stakeholders that will potentially be impacted by the proposal. The specific options that have been considered to date include the following:

- Restoration and/or rehabilitation of 'like for like' habitats in the Gladstone region
- Creation of purpose built inshore artificial reefs which also serve to mitigate loss of fishing access
- Fish stocking of Awoonga Dam to further enhance the recreational fishery
- Financial and in-kind support for fish and habitat monitoring through recreational fishing groups specifically CapReef
- Financial and in-kind support for fish habitat or other relevant local marine research projects.

In terms of habitat restoration, Australia Pacific LNG has considered options in the Port Curtis region but has not identified any areas where restoration is necessary or likely to be effective. Australia Pacific LNG has considered options proposed in the Port Alma region to improve connectivity of saltmarsh/saltpan habitat to assist barramundi recruitment, but considered it too far removed from the project location, in addition to there being significant uncertainties regarding feasibility.

Australia Pacific LNG has considered the creation of inshore artificial reefs using purpose built materials to in part offset habitat loss, but principally to offset loss of recreational fishing access. No specific location for an artificial reef in the Port Curtis region has been identified, however Australia Pacific LNG commits to further investigation of inshore artificial reefs if the community desire for these is strong.

CapReef is a community program monitoring the status of fish resources and the use of fish habitat in Central Queensland. CapReef is a partnership between government agencies, researchers and fishing groups with a strong community focus. Australia Pacific LNG commits to providing resources for programs such as CapReef to undertake relevant components of monitoring associated with fisheries and fisheries habitats.

At the current time however, Australia Pacific LNG has not finalised all options for offsetting the loss of marine fisheries habitat, but APLNG continues to work through the options with stakeholders and relevant agencies to implement activities that effectively compensate for loss of marine habitat.

Australia Pacific LNG has shown through the stakeholder engagement process to date that it is committed to working with fishing stakeholders to minimise loss of fishing access. A number of options to offset loss of fishing access have been investigated, and these options have been considered in

combination with those for addressing habitat loss. Australia Pacific LNG has consulted widely with fishing stakeholders to attempt to offset loss of fishing access. As well as further investigation of inshore artificial reef opportunities, Australia Pacific LNG will continue to consult with recreational fishing groups in the Gladstone region, relevant agencies and the Gladstone Port Corporation to further investigate opportunities for recreational fishing offsets. This may include providing support for the ongoing fish stocking activities at Awoonga Dam.

23.17 Conclusions

23.17.1 Threatened ecological communities

Three threatened ecological communities listed under the EPBC Act were identified by the EPBC protected matters search. All are endangered and include:

- Brigalow (*Acacia harpophylla* dominant and co-dominant)
- Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar bioregions
- Weeping myall woodlands.

It is proposed that approximately 1.8ha, 0.2ha and 0.4ha of these communities (respectively) will be disturbed as part of the Project. However, in the case of the weeping myall woodlands no weeping myall will be disturbed by the gas pipeline project.

It is proposed that an offset strategy be developed as part of the mitigation against the loss of these brigalow and SEVT communities. The offsets sought for the compensation will be finalised following consultation with DEWHA and DERM. In addition, the relatively narrow configuration of proposed clearing for the Project is unlikely to significantly reduce the area of occupancy of this community in the long term, provided that appropriate offsets are provided.

In addition, the natural regeneration of 85% of the 40m wide clearing strip will return the majority of disturbed vegetation communities in the long term.

The community of native species dependent on the natural discharge of groundwater from the Great Artesian Basins is also listed as an endangered community under the EPBC Act (1999). Spring communities are known to occur 4.5km downstream of the gas pipeline right of way in Cockatoo Creek. These communities are not listed under the EPBC Act as they are recharge springs. However, these communities contain the EPBC listed *Eriocaulon carsonii* (salt pipewort or button grass). Given the management strategies presented in Section 23.10.1, the route of the gas pipeline will avoid any disturbance to these communities.

23.17.2 Threatened terrestrial flora

Two threatened terrestrial flora species listed under the EPBC Act have been identified through field surveys on the project site – large-fruited zamia palm and ooline. In addition, it is considered that based on habitat preference, the Project site may support suitable habitat for an additional 21 species – lobed blue-grass (king blue-grass, tricolour diurus, Belson's panic grass, Cobar greenhood orchid, Chinchilla wattle, curly-bark wattle, Yarwun whitewood, heart-leaved bosistoa, Gurulmundi fringe myrtle, commersonia, wedge-leaf tuckeroo, small-leaved denhamia, shinny-leaved ironbark, decumbent homoranthus, blunt-leaved phebalium, northern bearded heath, quassia, native thistle, slender tylophora and small-leaved westringia.

A pre-construction survey will be undertaken to determine whether any of the above species are within the proposed right of way. Where practicable individual plants will be avoided, buffered and monitored for long-term health. If disturbance is unavoidable, the design and implementation of a translocation plan according to the Australian Network for Plant Conservation (2004) will occur in consultation with DEWHA and DERM. If offsets are necessary, they will be made following consultation with DEWHA and DERM. Narrowing the width of the gas pipeline right of way and minor alignment changes will minimise the direct impacts associated with these species. Ongoing monitoring programs will be conducted to document the success of the translocation and offsets mitigation measures.

23.17.3 Threatened terrestrial fauna

Only one terrestrial fauna species listed as vulnerable (EPBC Act) has been identified through field surveys along the gas pipeline right of way – the squatter pigeon. However, based on habitat preference, the gas pipeline study site may support suitable habitat for a total of 16 species listed under the EPBC Act. This includes two endangered species and 14 vulnerable species. The relevant endangered species are the northern quoll (*Dasyurus hallucatus*) and Semon's leaf-nosed bat (*Hipposideros semoni*).

The relevant vulnerable species are:

- Fitzroy River turtle
- Collared delma
- Brigalow scaly-foot
- Yakka skink
- Ornamental snake
- Dunmall's snake
- Squatter pigeon (southern subspecies)
- Australian painted snipe
- Black-breasted button-quail
- Grey-headed flying-fox
- Greater long-eared bat
- Large-eared pied bat
- False water-rat
- Red goshawk

In most cases, it is considered unlikely that the proposed development will affect any important habitat of these species, particularly considering the linear nature of the proposed works and the limited extent of potential habitat adjacent to the gas pipeline right of way. Pre-clearing surveys will be carried out by qualified fauna specialists to ensure that any impacts are negligible and restricted to individual animals.

Where necessary, habitat suitability for species such as endangered northern quolls at sites of persistence will be enhanced. This will be achieved by undertaking activities such as weed and pest control. The implementation of a biosecurity management plan is a requirement of the TOR, and this will control and prevent the establishment of invasive species.

23.17.4 Threatened aquatic and marine fauna

The Murray Cod is the only listed freshwater fish in the area. This species is artificially maintained in the Condamine-Balonne River through stocking. The Murray Cod migrates upstream prior to spawning in late spring or early summer, and during high rainfall events this species could occur within the right of way at Dogwood Creek.

Suitable habitat for this species within the gas pipeline right of way is not considered important habitat. No important habitat for this species will be modified, destroyed or isolated by the Project. For the

purposes of this assessment, freshwater turtles and migratory species are addressed in the terrestrial, marine and migratory categories as relevant.

23.17.5 Threatened marine fauna

There are only two threatened marine species that are not also migratory species. These two species are Green sawfish and whale shark. These species are not considered likely to be present in the area.

23.17.6 Listed migratory birds

It is assessed that 41 migratory bird species listed under the EPBC Act are predicted to occur in the study area, with eight species identified during the field survey of the study area and a further 33 migratory bird species considered to be likely or possibly present based on habitat preference.

During construction of the gas pipeline it is proposed that a survey will be completed in a 200m zone of the proposed activity to identify if wetland communities supporting migratory birds are present. If disturbance within the buffer zone, threatened species management guidelines will be implemented.

Disturbance from the construction of this gas pipeline may indirectly reduce the usability of the adjacent undisturbed habitat for the following species:

- Pacific golden plover
- Grey plover
- Lesser sand plover
- Painted snipe
- Bar-tailed godwit
- Little curlew
- Whimbrel
- Eastern curlew
- Terek sandpiper
- Common sandpiper
- Grey-tailed tattler
- Common greenshank
- Marsh sandpiper,
- Wood sandpiper
- Great knot
- Red knot
- Red-necked stint
- Sharp-tailed sandpiper
- Curlew sandpiper
- Broad-billed sandpiper.

The construction period potentially involves a high level of temporary disturbance with increased activity on land and water. It is assumed that increased activity and potentially loud intermittent noise during construction may result in disturbance. The impact may be minimised through timing high impact construction activities during April to October, where practicable. Once operational, the gas pipeline should cause minimal direct disturbance, if any, to migratory shorebirds.

It is considered that no important habitat for the following species will be modified, destroyed or isolated by the Project:

- Latham's Snipe Little tern
- Caspian tern
- Lesser crested tern
- Crested tern
- Glossy Ibis
- Spectacled monarch
- Satin flycatcher
- Rufous fantail
- White-throated needletail
- Fork-tailed swift

- Painted snipe
- Great egret
- Cattle egret
- Eastern reef egret,
- Brown booby
- Clamorous reed-warbler
- White-throated needletail
- Fork-tailed swift
- Barn swallow
- Eastern osprey
- White-bellied sea-eagle
- Oriental cuckoo
- Barn swallow
- Eastern osprey
- White-bellied sea-eagle
- Oriental cuckoo
- Rainbow bee-eater
- Black-faced monarch
- spectacled monarch
- Satin flycatcher
- Rufous fantail
- Rainbow bee-eater
- Black-faced monarch

23.17.7 Other migratory marine fauna

It is known or considered likely that nine threatened and migratory marine species (excluding birds) may utilise the offshore area of the Project site, or areas immediately adjacent to the offshore area. These are loggerhead turtle *(Caretta caretta),* green turtle *(Chelonia mydas*), hawksbill turtle *(Eretmochelys imbricate),* Olive Ridley turtle (*Lepidochelys olivacea),* flatback turtle *(Natator depressus*), Dugong *(Dugong dugon*), Indo-Pacific humpback dolphin *(Sousa chinensis),* Bottlenose dolphin (*Tursiops truncates)* estuarine crocodile *(Crocodylus porosus)*, and the Australian snubfin dolphin (*Orcaella heinsohni*).

The Project will not reduce the area of occupancy of these species in any ecologically meaningful way. Similarly, no existing important population will be fragmented into two or more populations for any of these species. While underwater noise associated with construction activities may disrupt some of these species, it will only be a temporary impact that will not persist.

23.17.8 World Heritage and National Heritage places

No items with strictly Indigenous heritage values are recorded on the world, national or Commonwealth heritage lists for the gas pipeline study area.

Other than the Great Barrier Reef World Heritage area, there are no heritage sites of national or state heritage significance along the gas pipeline route that would be affected.

On the basis of proposed mitigation measures, the gas pipeline will have negligible impacts on World Heritage values.

Potential impacts to previously undetected Indigenous heritage sites will be managed through measures specified in the cultural heritage management plans required by Queensland legislation. In general, the principle governing the gas pipeline route selection has, and will continue to be, that identified heritage sites will be avoided wherever possible.

Similarly, potential impacts to previously undetected Indigenous heritage sites will be managed through a heritage management plan. This will be prepared in consultation with the local community

stakeholders and reviewed by DERM. Measures will include ongoing field inspections and procedures to ensure the timely reporting of heritage items uncovered during construction.

23.18 Project commitments – MNES issues

To manage potential impacts on MNES from activities within the gas fields, Australia Pacific LNG has committed to a range of strategies. The key commitments and their relevant chapter headings are detailed in the following sections. Further details and mitigation measures are also incorporated in the relevant chapters in Volume 3.

23.18.1 Terrestrial ecology

To manage potential impacts on terrestrial ecology associated with the construction, operation and decommissioning of the gas pipeline, Australia Pacific LNG will:

- Conduct surveys for large-fruited zamia palm and Pedley's wattle along the Callide Range (KP 255-271) and Calliope Range KP 281.5-282.1), and for shiny-leaf ironbark and other EVR plants (i.e. listed as endangered, vulnerable or rare under State legislation) in the central section of the route (KP 90-105) and develop strategies to reduce impacts
- Limit vegetation clearing to the minimum practicable extent along the right of way
- Undertake pre-clearing surveys to identify the presence of EVR and other significant flora and fauna species where they are likely to occur. Where populations are identified, the gas pipeline route will be realigned or the right of way narrowed for short distances, where safe, so as to reduce damage or loss of these populations
- Develop and implement biosecurity management measures for weeds and pest animals
- Work with regional councils in weed control and contribute to the construction of a permanent weed washdown facility in the Banana Shire
- Develop a vegetation offsets program in consultation with the Queensland DERM and the Commonwealth Department of Environment, Water, Heritage and the Arts.

23.18.2 Aquatic ecology

To manage the potential impacts on water quality, aquatic ecology and habitat and fluvial geomorphology associated with the construction, operation and decommissioning of the proposed gas pipeline infrastructure, Australia Pacific LNG will:

- Design and implement erosion and sediment control devices according to regulatory requirements (Queensland 'Guidelines for Erosion and Sediment Control)
- Design watercourse crossings to not impede flow and therefore the passage of organisms.

23.18.3 Marine ecology

Australia Pacific LNG is committed to managing the potential impacts that constructing the gas pipeline may have on the marine environment, particularly when constructing the pipeline crossing of The Narrows.

Australia Pacific LNG will:

- Develop a construction methodology that will minimise disturbance
- Work with the Queensland Government, Gladstone Ports Corporation and other proponents proposing similar crossings to achieve an outcome that minimises cumulative impacts
- Establish a process for visual observations and recording of dugongs and cetaceans.

If horizontal directional drilling is determined not to be feasible, based on final engineering investigations or construction constraints, Australia Pacific LNG will select an appropriate dredging method to construct a pipeline trench across The Narrows. All dredging activities will be in accordance with dredge management procedures, to reduce potential impact to the water course and marine flora and fauna.

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