Australia Pacific LNG Project

Volume 3: Gas Pipeline

Chapter 25: Cumulative Impact Assessment

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25 Cumulative impacts

25.1 Introduction

This chapter summarises the potential cumulative impacts associated with the construction and operation of main gas transmission pipeline (gas pipeline) element of the Australia Pacific LNG Project (the Project), combined with relevant other projects in the region. Section 7 of the Project's environmental impact statement (EIS) terms of reference set out the requirements for cumulative impact assessment. The terms of reference requirements and the Australia Pacific LNG assessment methodology are described in Volume 1 Chapter 5.

25.1.1 Purpose

The objective of this cumulative impact assessment is to take account of the potential impacts of the Project's gas pipeline element, as well as its effects when combined with the impacts of other proposed projects that may have a significant effect on important physical/biological, social, cultural, economic and/or built environmental values in the vicinity of the gas pipeline.

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 decision about which projects to include in the cumulative impact assessment was based on criteria explained in Volume 1 Chapter 5. This chapter also includes summary details for each of the projects, as well as an explanation of how they, and the project selection criteria, relate to the Australia Pacific LNG Project. The projects that met the selection criteria are listed in Table 25.1. For more information on these projects, including location figures refer to Volume 1 Chapter 5.

Table 25.1 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
- 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

- Gladstone Steel Making Facility
- Gladstone to Fitzroy Pipeline
- Woori Coal Project
- Yarwun Alumina Refinery.

25.2 Assessment outcomes

25.2.1 Overview

Table 25.2 indicates the physical/biological, social, cultural, economic or built environmental values which could be significantly affected by the cumulative impacts arising from the identified existing or proposed projects. The table also summarises the overall risk of adverse cumulative impacts for the construction and operational phases of each project. They are grouped into three categories of project type:

- Mining, including CSG
- Manufacturing, including mineral processing
- Infrastructure, including gas pipelines.

Australia Pacific LNG has designed its mitigation strategies to address cumulative impacts as far as practicable, particularly those values that are expected to be at most risk of experiencing significant cumulative impacts.

The analysis underpinning the summary in Table 25.2 is provided in Sections 25.2.2 through to 25.2.16.

Table 25.2 Cumulative environmental value impact – project category relationship summary

Existing, approved or proposed projects		Land	Landscape and visual amenity	Terrestrial ecology	Aquatic ecology	Water resources	Marine environment	Air quality	Greenhouse gas emissions	Noise and vibration	Waste	Traffic and transport	Heritage	Social	Economic	Hazard and risk
Mining projects (e.g. various CSG to LNG projects, coal projects)	Construction	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Operations	✓	✓			✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
Manufacturing and mineral processing projects (e.g. Gladstone Pacific Nickel)	Construction	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
	Operations	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
Infrastructure and transport projects (e.g. Surat Basin Railway, Surat Gas Pipeline)	Construction	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Operations								✓					✓	✓	✓
Overall assessment of impact significance/level of risk L – low; M – moderate; H - high		L	L	M	L	L	L	L	H	L	M	M	L	H	H	L

25.2.2 Land

Infrastructure projects such as the proposed Surat Basin Railway and the various proposed gas pipelines linking gas fields to LNG facilities in Gladstone will have broadly similar impacts to those identified for the Australia Pacific LNG Project in Volume 3 Chapter 6. That is, the development of the Australia Pacific LNG gas pipeline and the other relevant projects may result in potential cumulative impacts related to land use changes, mainly in terms of agriculture and the use of resources (e.g. construction materials).

The loss of agricultural land within the region is a potential significant cumulative impact associated with the various relevant projects resulting from the construction and operation of project related work sites and structures. An impact will occur due to the disturbance of agricultural land. This impact will typically be higher during construction of buried linear infrastructure, such as the gas pipelines, but will be significantly reduced during operation through progressive rehabilitation and resumption of pre-construction agricultural or other land uses.

It is estimated that the construction of the Australian Pacific LNG gas pipeline will disturb approximately 1067ha of good quality agricultural land (GQAL), as described in detail in Volume 3 Chapter 6. The majority of the GQAL within the right of way is class B and C1. Following the completion of construction and associated rehabilitation activities, it is estimated that the development of the gas pipeline will remove around 31ha of GQAL from potential agricultural production for the operational life of the gas pipeline.

Table 25.3 summarises available data on potential impacts to the various land suitability classes from the other projects considered within the region of the gas pipeline. The table also shows the distribution of GQAL (land classes A and B) within the corridors for the seven linear infrastructure projects in the region.

Table 25.3 Cumulative land suitability impacts – gas pipeline region

Land suitability class	A (ha)	B (ha)	C (ha)	D (ha)	GQAL (ha)	GQAL (% of total land)
Australia Pacific LNG gas pipeline	131	720	1309	22	851	39
Central Queensland gas pipeline		130	737	0	121	15
Gladstone-Fitzroy water pipeline	0	21	329	0	21	6
Gladstone LNG gas pipeline	90	128	1000	64	218	17
Queensland Curtis LNG gas pipeline	N/A	N/A	N/A	N/A	1300	N/A
Surat-Gladstone pipeline	210	350	826	14	560	40
Surat Basin Railway	670	144	144	0	814	85

The area of GQAL within the corridors for these linear infrastructure projects is estimated to be approximately 3,885ha. Based on the Australia Pacific LNG gas pipeline assessment, it is expected that a similarly small percentage (1 to 2%) of this land related to gas pipeline projects will be removed from potential agricultural use for the life of the projects concerned. In contrast, the railway project may remove GQAL from production indefinitely.

In addition to the short term disruption of land uses outlined above, GQAL may be subject to a reduction in agricultural production due to:

- Interference with overland flow through the modification of runoff controls
- An increase in soil compaction as a result of heavy traffic, reducing water infiltration pending correction during rehabilitation
- Decreased fertility
- Increased erosion.

While accurate estimates are not generally available for the other relevant projects in the area, it is anticipated that the loss of GQAL associated with the Australia Pacific LNG Project represents an average loss in respect of the linear infrastructure projects proposed for the area. Collectively these projects are not likely to materially alter the land use balance in the south central and central Queensland regions.

Demand on existing or new local extractive material sources (e.g. quarries), which may be required for construction purposes will increase. Material requirements could not be quantified for any of the relevant projects but will be progressively determined during detailed design phases. However, large increases in demand for construction materials are expected to be manageable based on the ability of neighbouring regions to address the challenges of developing sets of concurrent large-scale projects such as has been experienced in south east Queensland in recent years, particularly in terms of water and transport projects.

Impacts to land from potential contamination caused by spills and leaks could occur during both construction and operational phases of projects. Due to the nature and relatively short duration of the linear infrastructure projects it is expected that any such impacts would result in localised areas of contamination only. Off-site migration of contamination via soil or groundwater is not likely from the design and construction of appropriate standard containment structures and management controls that have proven to be effective in the past. Similarly, the risk of land contamination associated with the operational phases of all the gas pipeline projects is considered to be very low as each gas pipeline is required to meet Australian standards of design and operation to prevent leaks and ruptures.

There is potential for significant cumulative impacts related to disturbance of acid sulfate soils in the low-lying land (below 5m of the Australian Height Datum) in the Gladstone district. Soil acidification and decline in downstream water quality, particularly in Port Curtis, could occur during the construction phase of all projects or project elements in this coastal area. This cumulative impact is expected to be low, once standard and detailed acid sulphate soil and geotechnical investigations are undertaken and the regulated mitigation and management measures are implemented for all projects.

25.2.3 Landscape character and visual amenity

The analysis of landscape character and visual amenity in the region of the gas pipeline presented in Volume 3 Chapter 7 indicates that, depending on where they are located, the small number of aboveground gas pipeline facilities have a limited potential to create a visual contrast to existing rural landscapes. In general, the visual impacts of the work sites and structures associated with these projects are constrained by the scarcity of sensitive receptors due to the relatively sparsely populated nature of the various project areas.

Some cumulative impacts may result from co-location of pipelines within the Callide Infrastructure Corridor and the Gladstone State Development Area. The major change to visual amenity during the

construction phase will occur through forested areas where each gas pipeline will require separate vegetation clearing to create a corridor potentially 200m wide. This, potentially significant effect will generally be limited to small sections of steep forested country. However, some of these sections are close to sensitive view locations on the Dawson and Bruce highways.

Gas pipeline signage may be seen from some sensitive view locations on highways and from some landholder residences. However, such signage is required for safety and to meet government regulations.

These potential impacts can be reduced if all project proponents adopt similar management and mitigation strategies to those proposed by Australia Pacific LNG including:

- Re-aligning the infrastructure to avoid forested areas, where possible
- Screening sensitive receptor locations, especially potentially affected residences and the highways.

25.2.4 Terrestrial ecology

An assessment of terrestrial ecological cumulative impacts must take into account not only the potential impacts of the Project, but its effects in combination with the impacts of other proposed projects. There is the potential to affect regional terrestrial biodiversity values in the absence of effective coordination and cooperation among project proponents and regulatory authorities.

The 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 development projects. Existing reporting for these projects provides limited data on how much habitat will be lost, which habitat types will be affected, the resulting severity of impact, and mitigation and offset measures.

Most of the ecological communities in the area in which the Australia Pacific LNG gas pipeline 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 25.1 shows the remnant vegetation by regional ecosystem type over the gas pipeline's study area, including indicative locations for those other proposed projects where suitable information is available. Similarly, Figure 25.2 shows the bioregional corridors of state or regional significance within the gas pipeline's study area,

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
GLADSTONE
Baralaba
Biloela
Moura
Monto
Theodore
Taroom
Wandoan
ROMA
Miles
Chinchilla

350 300 250 200 150 100 50 0

Gas pipeline route
Woleebee Lateral
Condabri Lateral

Dawson Hwy
Dawson Valley Rd
Fitzroy Dev Rd
Taroom Rd
Roma
Warrego Highway
Leichhardt Hwy
Eidsvold - Theodore Rd

LEGEND

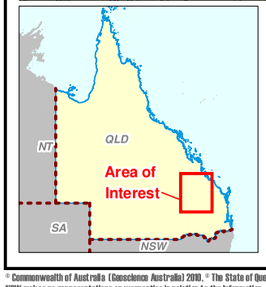
- Towns
- Pipeline kilometre point
- Nathan dam (Proposed)
- Railway
- Major road
- Pipeline licence (Application)
- Pipeline licence (Granted)

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

Remnant vegetation containing of concern regional ecosystems
- Dominant
- Sub-dominant
- Non - remnant
- Remnant vegetation that is a least concern regional ecosystem

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



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

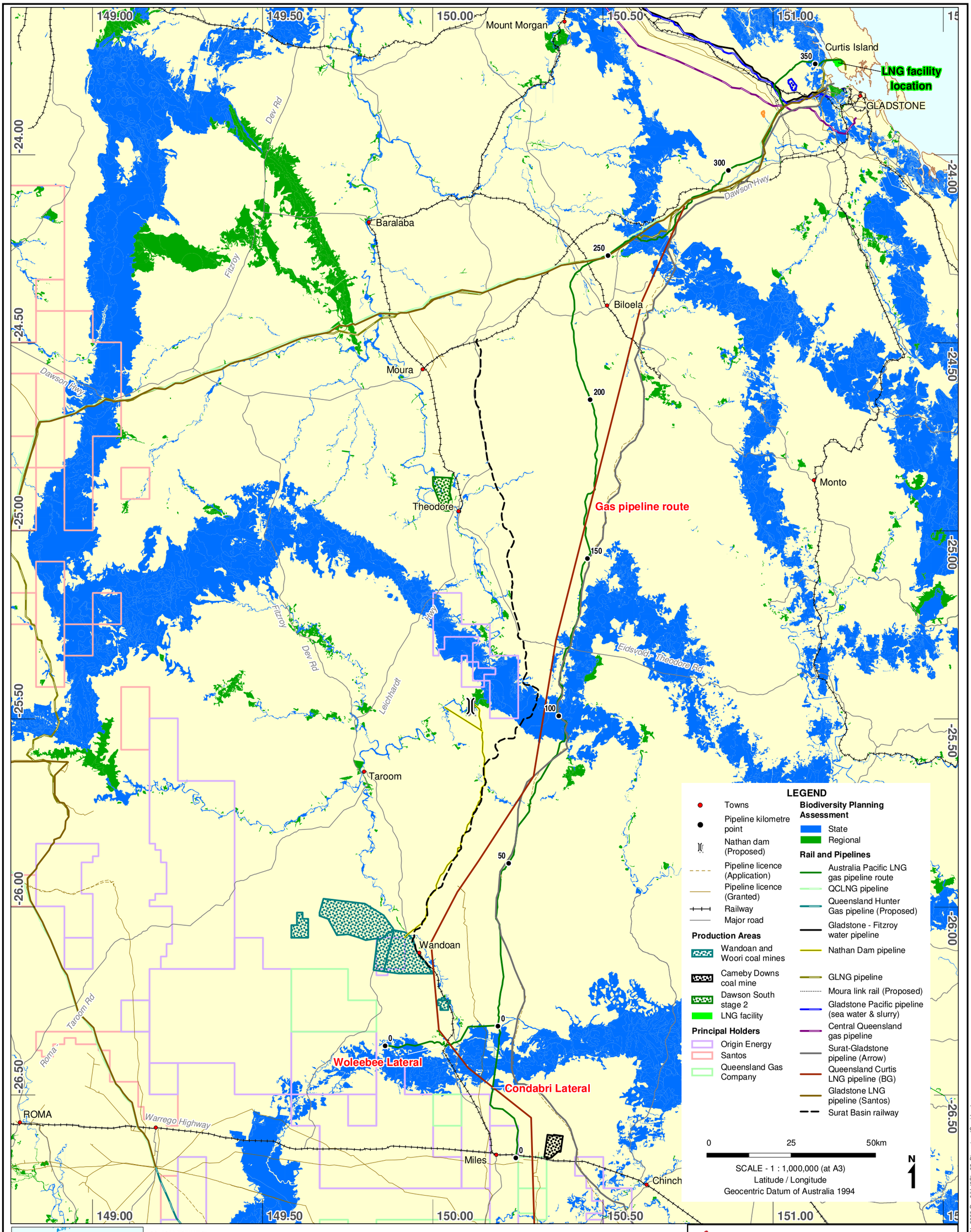
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AUSTRALIA PACIFIC LNG PROJECT

Volume 3 Chapter 25
Figure 25.1 Regional Ecosystems

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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

AUSTRALIA PACIFIC LNG PROJECT

Volume 3 Chapter 25
Figure 25.2 - Bioregional corridors

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Together these projects would result in an increase in vegetation disturbance associated with construction activities, which could lead to cumulative impacts from severance of biodiversity corridors, edge effects and changes to the floristic structure and composition of remnant regional ecosystems. Significant increased traffic movements, particularly during the construction phase may also promote the introduction and/or spread of weed species.

Fragmentation also has the capacity to degrade the quality of significant areas of adjacent habitat over time. Weed and pest animal species control for the duration of these projects is vital for the protection of the significant number of 'endangered, vulnerable or rare' or near threatened species present within both remnant and non-remnant vegetation in the region.

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 the 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 gas pipeline route crosses the Calliope Range.

Given the 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 offsets will be provided for this species. Where individual trees cannot be avoided, they will be translocated to suitable areas. With the implementation of the mitigation measures these impacts will be significantly lower.

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 fragmentation 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 have long term impacts on habitats for a number of conservation significant flora and fauna species. Where gas pipeline co-location occurs, this will require a cooperative approach to management of terrestrial ecological impacts by all proponents in conjunction with government. Species most at risk are those which are endemic to the region and rely specifically on connected, large tracts of intact, remnant vegetation.

25.2.5 Water resources

The analysis within Volume 3 Chapter 11 identifies that construction of the gas pipeline and its associated activities could have an affect on shallow groundwater systems, if not properly managed. Some of these impacts could include disturbing surface water connectivity mechanisms, disruption to groundwater dependent ecosystems and contamination from gas pipeline leakage. Further, people who use these shallow groundwater resources for domestic purposes or stock watering and agriculture, may be affected as a result of such impacts.

There are few licensed groundwater users in the vicinity of the gas pipeline corridor, but there are a large number of users of groundwater for stock and domestic purposes. Springs and areas of seepage are abundant in the outer regions of the Great Artesian Basin, but the only spring complexes in the vicinity of the gas pipeline route are near the Cockatoo Creek crossing.

The risk of impacts to groundwater systems from construction and operation of the gas pipeline is considered to be quite low, due the route selection to avoid known groundwater dependent ecosystems and the design and construction methods.

The surface water risks to third parties, property and the environment for the proposed gas pipeline relate primarily to potential changes in waterway geomorphology and water quality related to changes in stream-flow and riparian vegetation.

The Australia Pacific LNG gas pipeline has a low potential to cause minor flow diversions or ponding associated with watercourse crossing activities during the construction period. The buried gas pipeline is not expected to cause any significant impact on post-construction flood behaviour.

The design of the watercourse crossings will incorporate measures to minimise erosion of the creek banks and scour and sedimentation of the channels. These potential impacts are expected to be minor in magnitude, localised in extent and short in duration and are considered to have negligible potential to contribute significantly to cumulative impacts with other infrastructure works in the region.

Should proponents of other linear infrastructure projects adopt similar and well established mitigation measures to those that Australia Pacific LNG will apply, it is considered that there is a low risk of cumulative impacts to water resources environmental values from proposed projects in the vicinity of the gas pipeline route.

25.2.6 Aquatic ecology

The aquatic ecology values, potential impact mechanisms and related impact mitigation strategies relating to the gas pipeline corridor are detailed in Volume 3 Chapter 9. These are generally applicable to all potential projects identified for the area.

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.

The assessment in Volume 3 Chapter 9 demonstrates that following implementation of the proposed mitigation strategies, the residual risk levels for aquatic ecology values is assessed as low. The cumulative impacts are expected to be low if other projects adopt similar mitigation measures to those Australia Pacific LNG is committed to.

25.2.7 Marine environment

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
- Discharges to the marine environment.

It is not possible to undertake a quantitative analysis of cumulative impacts. However, it is possible to describe in general terms differences in scale as a result of considering impacts in a cumulative manner.

For the projects to be considered in the cumulative impact assessment, the volume of dredging is in the vicinity of 60 million cubic metres (Gladstone Ports Corporation 2009a). Relative to the consideration of dredging for the Australia Pacific LNG Project in isolation, the cumulative impact of this dredging which will primarily be undertaken under the Gladstone Ports Corporation's Western Basin Dredging and Disposal project results in:

- A longer period (four to six years) over which turbidity will be generated and suspended sediment transported
- A considerable increase in the spatial scale of the marine habitat disturbed as a result of dredging activities
- Significant increase in the area of intertidal and shallow sub-tidal habitat reclaimed - it is estimated that the combined project reclamation area is approximately 700ha, which includes areas of high value habitat including seagrass, mangrove and saltmarsh/saltpan
- Increased duration of decant water release from the reclamation areas.

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.

When considered together, it is plausible that these discharges may result in long term impacts that are greater than those estimated for individual projects. A diversity of constituents is contained in these discharges and it is currently uncertain how they would accumulate and interact in Port Curtis over time.

Australia Pacific LNG's preferred method for crossing The Narrows, as a stand alone project, is by horizontal directional drilling. This is described in Volume 3 Chapter 3. With this preferred method, construction of the gas pipeline is not expected to make any significant contribution to the abovementioned potential cumulative impacts. This is because the potential impacts of the gas 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, referred to 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 the 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 from the dredge spoil facility are understood. As stated, the relative magnitude of the cumulative dredging activities for the pipeline elements of the projects is much smaller than the total Western Basin Dredging and Disposal project.

If not managed properly, the cumulative impact of all proposed dredging activities within Port Curtis could be high.

25.2.8 Air quality

As detailed in Volume 3 Chapter 13, the primary source of air emissions within the gas pipeline area will be construction and transport activities (e.g. dust generated from earthmoving activities and vehicle movements on unpaved roads and construction sites, and emissions from internal combustion engines). The more significant impact to air quality in the region is related to dust.

Australia Pacific LNG proposes a range of dust mitigation and management measures including minimising the area and duration of land disturbance, dust suppression, traffic controls and speedy rehabilitation of disturbed areas.

As a consequence, these potential impacts are expected to be minor in magnitude, localised in extent and short in duration. They are considered to have a very low potential to contribute significantly to cumulative impacts with other infrastructure works in the region.

25.2.9 Greenhouse gas emissions

Assessment of the cumulative impact of the 30 projects in the region on state and national greenhouse gas (GHG) emissions inventories was undertaken in comparison to emissions in 2007. The impact on Australia's projected GHG emissions for 2030 was also considered. Due to the non-site specific nature of GHG emissions, the analysis considered the emissions from all projects, irrespective whether they are located within the vicinity of the gas fields, gas pipeline, or LNG facility.

Table 25.4 shows the scope 1 (and where relevant, scope 2)[1] GHG emissions of the Australia Pacific LNG Project and other major projects in the region, specifically those projects currently undergoing expansion and new projects (including CSG developments) not yet operating.

GHG data were sourced from environmental impact statements for the other major projects, where they were publicly available. For example, data for the Gladstone Steel Plant, the East End Mine Expansion, the Wiggins Island Coal Terminal and the Yarwun Alumina Refinery were either not available or not reliable for use in this analysis.

Data on the estimated GHG emissions for the proposed Shell LNG project were not publically available at this time. Scope 1 GHG emissions data for the Shell LNG project were therefore estimated based on the average GHG emissions intensity for the Australia Pacific LNG, Gladstone LNG (GLNG), Queensland Curtis LNG (QCLNG) and Gladstone LNG – Fisherman's Landing projects. The estimated average is 0.3 million tonnes of carbon dioxide equivalent per year (Mt CO_2-e/yr). The estimated LNG production capacity of the Shell LNG plant is 16Mtpa LNG; so the estimated GHG emissions are 4.8Mt CO_2-e/yr. The gas fields' GHG emissions were estimated for the Shell LNG and Gladstone LNG – Fisherman's Landing projects on the basis that the ratio of gas fields to LNG plant GHG emissions, which is about 1:1 on average.

Some GHG emissions estimates are for peak annual GHG emissions (e.g. Australia Pacific LNG, Gladstone LNG and QCLNG), while GLNG GHG emissions data is an annual average and the Shell LNG data is coarse estimates. Complexities due to differing CSG production ramp-up periods for each project were not considered in this analysis.

It should be emphasised that the data presented in Table 25.4 for Shell LNG and Gladstone LNG – Fisherman's Landing projects are estimates. A comparison of the GHG intensity data for the proposed

[1] Scope 1 GHG emissions are produced directly from combustion and fugitive sources that are within the project's boundary. Scope 2 GHG emissions arise from the generation of purchased electricity, heat and steam. This energy is generated outside of the project boundary and is transmitted to the project site.

Australia Pacific LNG, Gladstone LNG – Fisherman's Landing, GLNG and QCLNG LNG facilities is presented in more detail in Volume 4 Chapter 14 and Volume 5 Attachment 31.

The total GHG emissions for these major projects in the Gladstone region are approximately 39Mt CO_2-e/yr. These projects would represent 6.5% of Australian GHG emissions in 2007 (597Mt CO_2-e). In terms of Queensland GHG emissions in 2007 (182Mt CO_2-e), these projects represent 21.4% of state GHG emissions.

A second scenario considers if all projects were operational in 2030. From the Garnaut Report (Garnaut 2008), Australia's GHG emissions under a business as usual scenario without a carbon pollution reduction scheme could reach approximately 800Mt CO_2-e. If it is assumed that all facilities would continue their GHG emissions at their current or presently projected levels, then total GHG emissions from the major projects in the Gladstone region represent 4.9% of Australia's net GHG emissions. Of this 4.9%, 3.2% is related to LNG projects. Based on the analysis conducted in Volume 5 Attachment 31, the combined LNG projects could avoid global emissions of 190Mt CO_2-e/yr based on 42Mtpa of export LNG substituting for coal-fired electricity generation. This equates to a reduction of 24% of Australia's emissions in 2030.

Table 25.4 Summary of GHG emissions for major projects in the south central Queensland region

Project	Emissions data Mt CO_2-e/yr	Comments
Australia Pacific LNG	3.3	Estimated annual scope 1 GHG emissions for the Project gas fields and the gas pipeline during peak LNG production.
	2.4	Estimated annual scope 1 GHG emissions from other gas fields during peak LNG production.
	5.5	Estimated annual scope 1 GHG emissions for the Australia Pacific LNG facility with four-LNG production train (train) operations producing 18Mtpa of LNG.
Boyne Smelters Reduction Line Expansion	3.1	Total scope 1 and 2 GHG emissions for the expansion of the plant's three reduction lines (refer Boyne Smelters 2002).
GLNG Facility	3.7	Average annual scope 1 GHG emissions for the 10Mtpa case using the upper limit GHG emissions, covering operations and land-clearing (refer Santos Ltd. and PETRONAS 2009).
	3.5	Average annual scope 1 emissions (10Mtpa) assuming ConocoPhillips' Optimized Cascade® Process technology is adopted.
Gladstone LNG – Fisherman's Landing	0.6	Estimated scope 1 GHG emissions for gas field and gas pipeline operations carried out by Arrow Energy/AGL (refer Gladstone LNG 2008).
	0.6	Estimated maximum annual scope 1 and 2 GHG emissions for two-train operations (3Mtpa).
Gladstone Pacific Nickel	0.2	Stage 1 emissions: scope 1 and 2 GHG emissions per annum (refer URS Australia 2009, Appendix M)
	0.6	Stage 2 emissions: scope 1 and 2 GHG emissions per annum.
Moura Link Railway	0.5	Scope 1 and 2 GHG emissions per annum (refer Queensland Rail 2008, Section 10).
QCLNG	2.5	Maximum annual scope 1 GHG emissions for gas field and gas pipeline emissions scaled by 1.5 for three-train operations (refer QGC Limited 2009).
	3.0	Maximum annual scope 1 GHG emissions for 11Mtpa operations (includes commissioning phase).

Project	Emissions data Mt CO_2-e/yr	Comments
Shell LNG (with Arrow Energy)	4.8 4.8	Estimated scope 1 GHG emissions. Only initial advice statements available at this time (Shell CSG (Australia) Pty Ltd 2009). Estimated scope 1 GHG emissions for a 16Mtpa LNG facility with four-train operations.
GPC Western Basin Dredging	0.3	Data provided in EIS, assumed to be scope 1 emissions (refer Gladstone Ports Corporation 2009a, Appendix T).
GPC Fisherman's Landing Northern Expansion	0.03	Data provided in EIS, assumed to be scope 1 emissions (refer Gladstone Ports Corporation 2009b, Appendix F).
Yarwun Alumina Refinery	0.002	Stage 2 of the expansion will increase output to 3.4Mtpa. Reported GHG emissions data may not be reliable and are therefore not used in this analysis.

25.2.10 Noise and vibration

The principle sources of noise for most of the linear infrastructure projects in the gas pipeline project area are expected to relate to construction activities, apart from the operation of the Surat Basin Railway. This is due to the fact that gas pipelines are buried with very limited surface infrastructure. Most of this infrastructure will not be a source of noise emissions, except during periodic maintenance or emergencies. Mid-line booster compression facilities, which are a potential source of noise emissions during operations, have not been proposed for most gas pipeline projects.

The qualitative assessment of noise and vibration emissions associated with construction of the Australia Pacific LNG gas pipeline are detailed in Volume 3 Chapter 15, which demonstrate that noise and vibration impacts from these activities are localised and do not generally extend for significant distances. The primary source of noise and vibration is related to rock breaking, including potential localised blasting for limited sections of the pipeline trench. Such activities are generally expected over rocky terrain, which is typically much more sparsely populated. In addition, traffic noise associated with transport of equipment or personnel, particularly on quieter rural roads out of hours, could cause local noise disturbance.

Given the transient nature and relatively short duration of such construction activities at any particular location, it is highly unlikely that any location could experience significant cumulative noise impacts. The exception to this is for those gas pipelines that are co-located, particularly within the Queensland Government's infrastructure corridors. Cumulative noise impacts could occur if construction activities were undertaken simultaneously, as is proposed for the 'bundled' crossing of The Narrows (see Section 25.2.7).

The analysis of marine noise associated with a dredged crossing of The Narrows is presented in Volume 3 Chapter 15. The analysis found that significant adverse physiological or behavioural responses of marine animals to dredging noise or vessel noise are not expected. Neither mitigation nor management are therefore necessary.

Based on past experience with similar projects, any short-term noise impacts affecting particular landholders can be suitably addressed via consultation, where necessary.

25.2.11 Waste

Australia Pacific LNG will:

- Implement the waste hierarchy – avoid, reduce, re-use, recycle, dispose
- Dispose of any generated waste in a safe and efficient manner, limiting risk to employees and the public and in compliance with the relevant legislation.

While limited data is currently available, the extent of cumulative waste may have the potential to place pressure on the capacity of landfills in the area.

This issue will require effective consultation by the various project proponents with local councils to determine current landfill capacities and accepted waste types. Should insufficient capacity be identified, the proponents will need to individually or collectively provide information to councils to enable planning for the expansion and upgrade of their landfills.

25.2.12 Traffic and transport

The traffic and transport analysis outlined in Volume 3 Chapter 17 highlights that the key cumulative traffic and transport impacts associated with the Australia Pacific LNG gas pipeline and other proposed regionally significant projects will be related to substantial increases in road traffic for the duration of the construction phase. It is likely that other proposed projects would use the same general road network for transport of equipment, materials and personnel as that proposed by Australia Pacific LNG.

When determining the impact of the projects, four components of the road infrastructure network were analysed as part of this technical study, as follows:

- Road link capacity
- Intersection capacity
- Pavement capacity
- Bridge capacity.

The first three components listed above were assessed using a spreadsheet based sketch traffic model which combined background traffic and growth rates with project generated traffic. The impact of the projects on bridges was assessed qualitatively as only limited bridge condition data was made available for this assessment.

These projected traffic increases will require the following works to upgrade the road network in the relevant parts of the region:

- Upgrades to federal, state and local government road links within the region
- Upgrades to numerous intersections within the Gladstone district to accommodate project traffic particularly those associated with the construction phase of the projects
- Pavement rehabilitation works brought forward on federal, state and local government road segments due to heavy vehicle traffic generated by the proposed projects.

The technical analysis summarised in Volume 3 Chapter 17 indicates that with the proposed mitigation measures the cumulative impacts on traffic and road networks of all LNG projects and other regionally significant projects will be significantly lower. However, the risk of serious traffic accidents remains high due to the relatively ‘uncontrolled’ nature of this risk. To reduce the risk of accidents to employees and other transport network users from project operations, Australia Pacific LNG will develop and implement detailed traffic management plans and transport and logistics management plans for constructing and operating the Project. These plans will incorporate safety measures to be implemented across all relevant modes of transport. Australia Pacific LNG will also work with the relevant regulatory authorities and, where appropriate, other project proponents to address road safety issues.

25.2.13 Heritage

Potential impacts to Indigenous and non-indigenous (shared) cultural heritage in the vicinity of the gas pipeline typically relate to construction activities.

Australia Pacific LNG is developing cultural heritage management plans with the relevant Indigenous parties along the gas pipeline route to minimise potential impacts to cultural heritage values.

Should the other projects develop cultural heritage management plans to meet regulatory requirements and manage Indigenous heritage, the likelihood of cumulative impacts to registered Indigenous heritage sites is considered to be low.

Cultural heritage management approaches usually involve:

- Identifying listed Indigenous cultural heritage locations early in project planning
- Carrying out a site selection process to avoid identified locations
- Agreeing on mitigation and management measures with the Indigenous parties where impacts cannot be avoided.

There is potential for increased risks to non-indigenous (shared) heritage sites from the cumulative effects of multiple projects in the region, particularly during construction phases of the various proposed projects.

Australia Pacific LNG proposes to manage shared heritage through avoiding identified non-indigenous heritage sites, managing development impacts in the vicinity of these sites, formulating procedures to deal with sites detected during construction, carrying out detailed recording (archives) of threatened sites, and recovering information on early non-indigenous land use.

If other project proponents manage shared heritage in a similar manner to Australia Pacific LNG, the cumulative risks are considered to be low.

25.2.14 Social impacts

The development of multiple projects within the gas pipeline's study area will impact on the local social environment and values. These impacts are broadly consistent with those associated with the Australia Pacific LNG Project in isolation. However, the probability and consequences of cumulative impacts are greater if they are not appropriately mitigated. More detailed discussions and proposed mitigation measures on particular aspects of cumulative social impacts are provided in Volume 3 Chapter 20.

In the context of cumulative social impacts, quantitative and qualitative tools (e.g. modelling and stakeholder consultation) were used to evaluate the collective information from the projects to assess the cumulative impacts to the gas pipeline's study area. Cumulative social impacts have been classified according to a number of categories identified through existing knowledge of the study area and contemporary social impact assessment practices, and then refined during the Australia Pacific LNG impact assessment workshops.

Population increases resulting directly and indirectly from the construction of the various projects in the gas pipeline's study area have the potential to significantly impact the social values and environment of the local communities. If all projects proposed in the gas pipeline's study area were to proceed, it is anticipated that they could directly employ up to 5,585 construction workers by 2012. Conversely, it is anticipated that there will be considerably fewer impacts to the population of the study area associated with the cumulative workforce impacts during the operational phase, with only 68 workers estimated to be required across all projects.

A range of secondary impacts on local communities may be associated with a significant increase in population (both permanent and temporary), including increased demand for housing, services, and other infrastructure, as well as increased transport movements and changes in demographic composition. Additional population-related impacts will occur as a result of secondary demand generated by workforces for increased goods and services. There is also a likelihood of population

increases associated with partners and families of workers relocating to the region, and of 'spill-over' population impacts from the gas fields' construction and operations, particularly in the southern pipeline communities of Taroom, Wandoan and Miles.

Increasing population (both permanent and temporary), transport movements and businesses have the potential to increase demand for services and infrastructure; including roads, housing, and education and health facilities. The construction workforce for the various projects is expected to be accommodated in temporary accommodation facilities onsite, which will reduce the potential impact on demand for facilities and services in the region. However, overall it is expected the region will experience an increase in demand when flow-on effects are considered.

Although the majority of proponents would be using temporary style accommodation for their construction workforces, there would be some reliance on short-term commercial accommodation from contractors, consultants and support services. Furthermore, an increase in economic activity in the area has the potential to attract people from outside the region and place further pressure on the housing market. Cumulative impacts to housing and accommodation may be significant, particularly if the workforces for all projects were to reside in a single gas pipeline community. If the operational workforces are located in various communities throughout the gas pipeline's study area, is anticipated that current housing stocks will be able to absorb this additional demand.

The cumulative effects of income related impacts may increase the potential Australia Pacific LNG Project impacts. Potential impacts include an estimated cumulative increase in real post-tax wages of 0.6% Australia-wide, accompanied by a regional increase in goods and services in the short to medium term, as the supply side in local areas adjust to the increase in demand. Local business may be impacted positively through increased revenue and opportunities to expand and/or diversify.

The large cumulative construction workforce requirement is also expected to place pressure on labour force availability, if the projects seek to source their employees locally. Competition for labour may be sufficiently significant to create pressure in terms of the availability of staff for local businesses. Although the cumulative operational workforce requirements are not large, any need for additional labour in an already stretched labour market (due to low regional unemployment) has the potential to contribute to the regional skills shortage. This is especially to the case with electrical and instrumentation technicians and electrical engineers.

An increase in the population due to cumulative construction workforce requirements, particularly an influx of young, male-dominated workers may lead to an increase in community concerns regarding safety and health. Cumulative impacts due to construction of the gas pipeline's infrastructure will cause a significant increase to road, air and shipping movements as a direct result of the transport of personnel, materials and equipment and potentially impact on community health and safety.

In order to address the cumulative impacts associated with the anticipated population increase and related social impacts, Australia Pacific LNG will work with other industries, government and service providers to plan and share information relating to potential impacts and mitigation measures. This will facilitate longer term planning and seek to mitigate the potential impacts detailed above.

25.2.15 Economic impacts

Australia Pacific LNG engaged KPMG Econtech to undertake economic modelling to identify the economic impact of its project as well as the other projects listed in Table 25.1. The cumulative impact modelling captures the impact on the national, state and regional economies if the identified 30 major projects (including the Australia Pacific LNG Project) proceed to full operation.

Detailed information about the modelling is provided in Volume 5 Attachment 44.

The model was used to assess the economy-wide cumulative impact of the 30 identified projects. Due to the specific geographical nature of the projects, these impacts were also examined at a state and regional level. In order to evaluate the maximum impact associated with the projects, it has been assumed that all projects will proceed.

For practicable purposes, the economic impacts have been modelled for the whole Project from the gas pipeline through to the LNG facility. This has been largely been done so the impacts can be examined and mitigated in a holistic manner. The cumulative impact scenario has assumed that each project impacts the economy independently, with no sharing of resources. The following results represent the deviation from the baseline scenario, where no projects proceed. This captures the effects on the economy of all 30 proposed projects as detailed in Volume 3 Chapter 21.

Once all of the proposed projects are fully operational, the national economy will benefit from:

- Higher real Gross Domestic Product on average by A$6.1 billion annually
- Increased real national income, driving both higher consumption and investment
- Higher consumer welfare of around A$1.1 billion annually, on average.

Because of the anticipated increase to Australian real national income, the price of non-tradeables relative to tradeables, the real exchange rate is expected to be higher. Modelling illustrates that in the cumulative impact scenario, the Australian dollar would appreciate by 2.1%.

The change in the real value of the Australian dollar would impact on both export and import levels in Australia. Specifically, with an appreciation of the exchange rate, Australia's international competitiveness on global markets would be marginally lower, leading to lower demand for Australian exports. However, this will not be the case for LNG exports, which will continue to increase. Trade exposed industries, such as manufacturing and agriculture, are expected to experience lower production levels following appreciation of the Australian dollar. Although an appreciating Australian dollar poses a number of challenges to export dominated industries, there are also a number of positive benefits including a reduction in the cost of imported goods and services thus reducing living costs for households.

At the state level, once projects are fully operational:

- The projects are estimated to lead to higher employment in Queensland by an average of 55,000 jobs (both direct and indirect)
- Queensland's Gross State Product is expected to be A$6.9 billion higher on average each year (or 3.6 %).

As with the impact of the Australia Pacific LNG Project in isolation, the contribution to the Queensland economy is greater than for the Australian economy because of the location of the 30 projects in Queensland. This will mean that a higher proportion of inputs (labour, goods and services) would be sourced from within Queensland than elsewhere in Australia.

At the regional level, the projects at full operation are estimated to have the following impacts on the regional economies in which the gas pipeline is situated:

- In the Mackay-Fitzroy-Central West region, the projects are estimated to lead to higher employment by an average of 15,400 jobs
- In the Darling Downs-South West region, the projects are estimated to lead to higher employment by an average of 39,300 jobs

- Mackay-Fitzroy-Central West's Gross Regional Product is expected to be A$2.6 billion higher on average each year (or 10.0%)
- Darling Downs-South West's Gross Regional Product is expected to be A$5.2 billion higher on average each year (or 41.4%) with the projects at full operation.

The primary cumulative economic impacts of the projects will be positive, leading to increased incomes, expenditure and employment. The Gladstone area, at the northern end of the gas pipeline's study area will be a key beneficiary of the impacts on the Mackay-Fitzroy-Central West region, while the gas pipeline and gas fields' study areas will realise much of the economic gains associated with the Darling Downs-South West Queensland region. These impacts will create substantial employment opportunities in communities such as Miles, Wandoan and Biloela, specifically in the mining, electricity, gas, water and construction industries.

As well as directly stimulating output, if all 30 proposed projects included in the cumulative impact scenario proceed, there will be a range of indirect flow-on benefits. This will occur through an increase in demand from the projects' supply chains, and increased demand by the project workers. This, in turn, would boost revenue in the Mackay-Fitzroy-Central West and Darling Downs-South West economies. This higher revenue will then flow through to extra spending in the regions' consumer-oriented industries, such as retail trade, health and community services and cultural and recreational services will be key beneficiaries of the impacts.

25.2.16 Hazard and risk

The design and implementation of comprehensive and effective risk management practices which use the concepts based on Australian standards (AS/NZS ISO 31000:2009) represent standard operating procedure in relation to the development and operation of major mining and infrastructure projects.

Similarly, the Australia Pacific LNG gas pipeline will be designed, constructed and operated in accordance with AS 2885: Pipelines – Gas and liquid petroleum. The cumulative hazards and risks associated with co-located high pressure gas pipelines have been assessed in Volume 3 Chapter 22. The assessment determined that the risk of gas pipeline rupture effecting an adjacent pipeline would be insignificant if the pipelines have been designed in accordance with AS 2885 and there is a minimum separation distance of about 10m. Pipelines with the common infrastructure corridors will be approximately 50m apart.

Australia Pacific LNG adheres to the systematic and ongoing standard process of hazard identification, assessment, treatment and monitoring. Should all other proponents do likewise, the cumulative risks associated with known potential hazards, as detailed in Volume 3 Chapter 22, are assessed to be relatively low.

25.3 Conclusions

Cumulative impacts on physical/biological, social, cultural, economic and built values have been assessed for the collective 30 projects currently proposed for the broader central Queensland and Western Downs regions. Fifteen categories of environmental values were assessed.

In 12 categories, it is considered that there is a low to moderate level of risk associated with potential cumulative impacts.

In contrast, there are a limited number of cases (i.e. social, economic and greenhouse gas) for which one or more of the following factors led to a high rating in terms of impact significance and/or risk:

- There is a relatively high degree of complexity in relation to the characteristics of the values in question
- There is a relatively high degree of complexity in relation to the project-related cumulative impact mechanisms
- The available mitigation approaches are not standardised and require the ongoing cooperation of multiple parties.

In these cases, it is considered that the risks can be suitably managed if the various proponents and relevant regulatory authorities cooperate effectively to implement impact mitigation strategies such as those committed to by Australia Pacific LNG.

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