The Coordinator-General

Shell Australia LNG project (also known as Arrow LNG Plant)

Coordinator-General's evaluation report on the environmental impact statement

September 2013

Contents

Figures

Tables

Synopsis

The proponent, Arrow CSG (Australia) Pty Ltd (Arrow), proposes to develop a liquefied natural gas (LNG) facility on Curtis Island adjacent to Gladstone. It will utilise gas resources supplied from coal seam gas (CSG) developments in the Surat and Bowen basins in South East and Central Queensland. A proposed gas pipeline to Curtis Island will supply gas to the LNG plant where it will be processed, cooled and stored in LNG tanks for subsequent loading onto LNG carriers via a jetty and exported to international markets.

The facility is proposed to be located within the Curtis Island Industry Precinct (CIIP) on the south-west corner of Curtis Island and is situated within the Gladstone Regional Council (GRC) local government area.

The key features of the project are:

- an LNG facility on Curtis Island—staged construction of up to four trains producing up to 18 million tonnes per annum (Mtpa) of LNG
- a nine-kilometre feed gas pipeline traversing Port Curtis in an underground tunnel
- marine logistics facilities on Curtis Island and the mainland
- dredging of the seabed in Port Curtis at the mouth of the Calliope River to provide access to marine facilities on Curtis Island and the mainland.

The project is expected to create approximately 3500 construction jobs during the peak construction phase and a further 2300 jobs during stage 2 of construction. The operational workforce will be approximately 450 for Stage 1, increasing to 600 at the completion of Stage 2. Operation of Stage 1 (the first two trains) is expected to commence in 2017 and 2018 respectively. The need for trains 3 and 4 will be determined by market demand.

In undertaking my evaluation of the environmental impact statement (EIS), I have considered the EIS, issues raised in submissions, the supplementary EIS (SEIS), additional information provided by the proponent and advice I have received from state agencies, GRC and the Australian Government Department of Sustainability, Environment, Water, Population and Communities (SEWPaC).

The following provides an overview of the key issues arising from the EIS assessment together with conditions and recommendations that I have made to manage impacts.

Community impacts

A social impact assessment (SIA) was completed for the project to identify its potential social impacts and the proponent's responses and mitigation measures in relation to housing and accommodation, workforce management, health and community wellbeing, community and stakeholder engagement and local business and industry content.

The SIA identified potential adverse impacts requiring enhancement, mitigation, management and monitoring relating to the:

- supply, cost and affordability of housing for purchase and rent

- increased demand on existing social infrastructure, facilities and services
- community concerns about the management of social issues, the effect on lifestyle, cost of living pressures and community cohesion
- labour market drain from other sectors into the LNG industry and the ability to replace these workers and their ability to afford to live in the region
- community safety in relation to crime, anti-social behaviour, drug and alcohol related activities.

Housing availability and affordability have been critical issues across the project area. With the commitment of three LNG projects in the last two years, a major influx of workers has eventuated, placing pressures on accommodation and housing. This has driven up demand, resulting in reduced supply and increased housing costs for low to medium income households not employed in the resources industry.

There were no critical residual impacts identified by the SIA. The proponent has committed to a range of actions to enhance, avoid, mitigate and manage social impacts, including:

- investment in affordable and worker housing, housing support programs, social and community infrastructure and emergency management
- stakeholder and community collaboration and negotiation as part of the development and implementation of programs, plans and procedures to address a range of specific issues or impacts identified by the SIA
- adoption of the Queensland Resources and Energy Sector Code of Practice for Local Content and implementation of strategies to promote, engage, encourage and build capacity for local service providers and business
- maximising local employment opportunities including under-represented and disadvantaged groups, providing training and development opportunities for people locally and regionally to improve skills and gain employment in the LNG sector and training opportunities to minimise impacts on local business due to loss of skilled workers.

The SIA found that the LNG industry will continue to present challenges for the local community, however the range of strategies to enhance, mitigate, manage and monitor impacts should ensure appropriate outcomes and opportunities can be generated to support the local community.

Accordingly, I have imposed a condition for the proponent to report annually for a period of five years on the effectiveness of all strategies and actions from the commencement of construction at Appendix 1, Condition 1.

Traffic and transport impacts

The transport of people between the mainland and Port Curtis is proposed to be undertaken by fast passenger ferries with 150 or 250-person capacity initially operating from a pioneer launch site at Gladstone Marina or Auckland/Barney Point. The proponent's preferred permanent mainland launch facility is a location at the mouth of Calliope River rather than an alternative at the Western Basin Reclamation Area north

of Fishermans Landing. At peak, ferry movements from that location are expected to reach eight return trips per day.

The transport of heavy loads of construction equipment and consumables to the site will be undertaken by barges and heavy purpose cargo vessels. Sixty to seventy barge trips per year are anticipated along with 30–40 deliveries utilising heavy purpose cargo vehicles. Gladstone Marina, Auckland/Barney Point and Fishermans Landing adjacent to the Australia Pacific LNG project mainland launch site have been identified as potential launch sites for materials and equipment.

During major maintenance activities, personnel numbers could increase to 800 persons for trains 1 and 2, and up to 950 persons when all four trains are operational. Movement of between 800 and 950 persons will necessitate a ferry schedule similar to that proposed for construction.

It is estimated that vessels required during normal operations will include a fast passenger ferry with a capacity of 250 people per shift for a maximum of six return trips per day. In addition to passenger transport it is estimated that RoPax ferries (roll-on, roll-off ferry approximately 80 metres long with a capacity of 200 people and 80 cars) will make four return trips to Curtis Island to deliver materials and equipment, and to transport waste and equipment back to the mainland. A barge will be required for occasional deliveries of fuel, lubricants, equipment and plant direct to the materials offloading facility. Project-related shipping movements are expected to be able to operate without appreciable impact on bulk shipping operations or recreational users of the waterways.

A shipping transport management plan will be prepared, in conjunction with Maritime Safety Queensland (MSQ) and Gladstone Ports Corporation (GPC), to ensure marine safety can be effectively planned and managed, for both construction and operations.

Hazard and risk

LNG operations

A key potential hazard is a leak or uncontrolled release during handling of a flammable gas, LNG or refrigerant and the risk of injury or damage if there was an ignition. This hazard may occur during loading of LNG, unloading of LPG and shipping of LNG through the Port of Gladstone.

The alignment and separation of the LNG loading lines from the Gladstone LNG (GLNG) haul road minimises the risk associated with an uncontrolled release of flammable gas or LNG as a result of a vehicle accident (or loss of load) on the haul road.

The construction camp is located at a sufficient distance from the hazardous effects of possible fires, explosions or vapour explosions during purging and start-up activity, ensuring minimal risk from these events.

A propane import pipeline and associated unloading and transport during commissioning, and potentially during operation, creates hazards and risks. The propane pipeline is not included in the quantitative risk assessment and will be treated as a cryogenic pipeline as per the LNG product lines. On completion of a transfer of

propane, the pipeline will be cleared with nitrogen and purged with inert gas to ensure that the line is free of hydrocarbons.

The *Work Health and Safety Act 2011* and the Work Health and Safety Regulation 2011 will apply to the facility at all times during construction, commissioning and operation of the project. As a licensed major hazard facility, the operator must, at all times, have the capability to exert effective management control and where necessary, the power to direct that the whole facility be shutdown in response to safety issues.

Potential cumulative risks include the scenario that an incident at the LNG plant causes a flow-on effect at a neighbouring facility. The injury and propagation risk calculations in the EIS show that the risk of flow-on effects from the LNG plant and LNG carrier complied with the most stringent criteria for maximum acceptable risk at neighbouring facilities.

Hazard management requirements for the project will be consistent with those in place for the other LNG facilities on Curtis Island and will consider cumulative risks for the entire precinct.

Shipping

The key risk associated with LNG carrier transport is a breach of a cargo tank due to collision or grounding, which could lead to a loss of containment, injury or pollution of the receiving environment. The risk of a shipping accident involving an LNG carrier is considered low due to the operating parameters and safety controls that apply to LNG vessels. Key controls include the establishment of a 250-metre exclusion zone around LNG vessels within the channel and a 250-metre radius when berthed. Each carrier will be escorted by four tugs with a 30-minute departure distance between vessels.

Risks associated with LNG carrier loading and unloading will be controlled through a range of measures including compliance with the MSQ Port Procedures Manual, relevant legislative requirements and industry standards as agreed by MSQ. An emergency shutdown system will also be put in place during loading and unloading and will activate automatically in the event of a loss of containment.

I am satisfied that harbour management by GPC and the LNG shipping provisions of MSQ, through the Regional Harbour Master, will be sufficient to manage the transit of LNG ships through Gladstone harbour in a safe manner.

I have stated a condition outlining acceptable solutions for any off-site impact from a foreseeable hazard scenario. I have also stated conditions in this report to ensure the appropriate management of emergency environmental incidents including financial assurance.

Marine and coastal environment

Management of acid sulfate soils

The EIS reported that most soils in and adjacent to Boatshed Point and adjacent to the LNG jetty site are potential acid sulfate soils (PASS) with moderate to extremely high acid-generating capacity. The net acid-generating capacity is more than 100 times the Queensland Acid Sulfate Soils Investigation Team (QASSIT) indicator levels in some

soils and is 40 times this limit based on average values. Results of testing on samples taken from the Calliope River suggest that PASS is restricted to two localised areas.

Given the high potential for disturbed soils within the project area to generate acid once disturbed, the proponent has committed to developing an acid sulfate soils (ASS) management plan (Appendix 4, C12.17) in accordance with State Planning Policy (SPP) 2/02: Planning and Managing the Development of Acid Sulfate Soils 2002, and SPP 2/02 Guideline: Acid Sulfate Soils.

The ASS management plan will detail strategies for the management and disposal of ASS/PASS including options for offshore management, as is currently being undertaken for materials dredged as part of the other LNG projects. Offshore disposal should minimise PASS oxidation and potential acid generation. Sediment quality analysis conducted for the EIS indicates that the proposed dredge material is considered to be largely uncontaminated and the works would not be expected to result in the introduction of contaminants into marine waters.

While further assessment is required prior to construction commencing to fully define the extent of PASS that may be present, I have stated conditions in this report requiring the proponent to manage ASS and PASS in accordance with Queensland Government guidelines, and ensure that rehabilitation is undertaken to prevent or minimise environmental harm.

Dredging

Construction of multiple LNG facilities on Curtis Island and the ongoing development of the Port of Gladstone require improved shipping access within Port Curtis. GPC is undertaking the deepening, widening and extension of existing shipping channels, swing basins and berth pockets within Port Curtis through the Western Basin Dredging and Disposal (WBDD) project. At the time of writing, Stage 1 of the WBDD project was more than 90 per cent complete.

The proponent has proposed two optional locations on the mainland to develop a passenger, equipment and materials launch facility. This infrastructure requires additional dredging either at the mouth of the Calliope River or at the northern end of the Western Basin reclamation area. Dredging is also needed for access to maritime infrastructure on Curtis Island. Depending on the mainland launch site option chosen as part of the final design, the total volume of dredging ranges from 446 500 cubic metres to 1.34 million cubic metres. The maximum value corresponds to the preferred Calliope River launch site option.

The following three potential dredge spoil sites have been identified:

- East Banks Sea disposal site
- Western Basin Reclamation Area
- Wiggins Island Coal Export Terminal Area B or C.

These dredging activities require a separate approval to the WBDD project. Dredging for construction of the project will be governed and strictly controlled by a dredge management plan that will detail measures at each site to limit potential impacts, such

as increased turbidity and effects on marine fauna. I have stated conditions in this report to ensure the appropriate management of dredging impacts.

Marine megafauna

Marine megafauna known to frequent Port Curtis include the:

- dugong (*Dugong dugon*) (migratory, under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act))
- Australian snubfin dolphin (*Orcaella heinsohni*) (migratory, EPBC Act)
- Indo-Pacific humpback dolphin (*Sousa chinensis*) (migratory, EPBC Act)
- flatback turtle (*Natator depressus*) (vulnerable, EPBC Act)
- green turtle (*Chelonia mydas*) (vulnerable, EPBC Act)
- loggerhead turtle (*Caretta caretta*) (endangered, EPBC Act).

Project activity may impact on these species during pile driving and shipping activities. Pile driving and shipping would create underwater noise, possibly at levels that may negatively impact on the ability of these animals to communicate and locate prey or foraging resources. The proponent has committed to a number of mitigation and management measures to reduce impacts from underwater noise and has proposed to contribute to research of underwater noise impacts on marine megafauna within the Port of Gladstone.

Possible collision from shipping activity may also result in injury to these species. The proponent has committed to reduce impacts from shipping through installing propeller guards and contributing to the Port of Gladstone's shipping activity strategy and management plan.

Lighting on turtle habitats

Green turtles (*Chelonia mydas*) and flatback turtles (*Natator depressus*), both listed as 'vulnerable' under the EPBC Act, nest at beaches on the seaward-side of Curtis Island and other beaches near Port Curtis. Nesting and hatchling turtles may be impacted by artificial light from the project, including the LNG flare.

The LNG flare and its glow may be visible from Southend, especially during clear weather conditions. During cloudy conditions, the LNG flare will produce a visible glow that will be noticeable from all beaches. Light glow from the project will add to the existing light glow from the other industrial developments in Port Curtis.

The proponent has committed to several mitigation and management measures to reduce lighting impacts on marine turtles using the beaches around Port Curtis. A lighting management plan will be implemented and routine planned maintenance flaring will be avoided at night-time during sensitive turtle-reproductive periods.

The proponent has also committed to participating in a long-term marine turtle management plan that aims to monitor the impact of current and future industrial lighting in the Gladstone region on hatchlings emerging on the beaches of Curtis and Facing Islands.

Water mouse

The water mouse (*Xeromys myoides*) is listed as 'vulnerable' under the EPBC Act and has been identified at Curtis Island during field surveys for the Australia Pacific LNG project EIS.

Field surveys undertaken for the Arrow LNG Plant EIS did not find any individual water mice at any sites and no evidence of recent activity on the mainland. Evidence of recent water mouse activity was identified to the east of Boatshed Point by an active nesting hollow and evidence of feeding. An abandoned nesting hollow and footprints were also identified to the west of Boatshed Point.

Construction of the LNG plant requires clearing of up to 2.5 hectares of mangrove habitat. A small area of mangroves (0.8 hectares) will be cleared to the west of Boatshed Point and 1.7 hectares of mangroves will be cleared at North China Bay.

Indirect impacts on the water mouse from project activities include habitat degradation and fragmentation. Approximately 16.6 hectares of mangrove habitat between Hamilton Point and Boatshed Point will be fragmented by project infrastructure. Habitat degradation would occur from project lighting and changes to natural hydrology. Artificial lighting from the project could alter foraging and dispersal patterns, could lead to abandonment of nesting hollows and could increase the risk of predation. Changes to hydrology through runoff and sedimentation could reduce the viability of crabs living in the intertidal zone, which are water mouse prey. Prey reduction would negatively impact on the water mouse.

The proponent has committed to several mitigation and management measures to reduce impacts to the water mouse including lighting, pest and erosion management plans. Subject to my eventual decision on offsets, the proponent has proposed offsets for impacts to the water mouse that are included in the marine and intertidal habitat offsets required under Queensland legislation.

Matters of national environmental significance

Great Barrier Reef World Heritage Area

The proposed LNG plant lies within the Great Barrier Reef World Heritage Area (GBRWHA) on Curtis Island, and therefore would affect the aesthetic values and ecosystem processes that underpin the outstanding universal values (OUV) of the world heritage property.

The EIS included a detailed assessment of the project's potential effect on the OUV of the GBRWHA and concluded that impacts would not be unacceptable.

The landscape of the Port of Gladstone is characterised by industrial development, which has recently expanded to include the CIIP where three other LNG plants are currently under construction and where the Arrow LNG plant is proposed to be located. The addition of the Arrow LNG plant would have an incremental impact by extending the footprint of the industrial landscape on Curtis Island and within the Port of Gladstone.

The proposed vegetation clearing on the LNG plant site is considered to be a relatively minor impact on the overall OUV of the GBRWHA, given the extensive areas of

remnant woodland that remain on Curtis Island and noting its continuing conservation status under Queensland's regulatory system. Earthworks for the project will also change the topography of the site from undulating hills to levelled platforms, similar to the construction works for the other three LNG facilities in the CIIP.

The proponent has designed the LNG plant site layout to minimise impacts to landscape and visual amenity from the mainland. I have stated conditions that require the proponent to minimise the visual impact of the construction and operation of the LNG facility by ensuring the colour scheme of the LNG facility and related infrastructure blends with the scenery and disturbance is minimised.

Threatened species, ecological communities and migratory fauna

Investigations for the EIS indicated that a limited number of listed fauna species would be affected by the project, including the water mouse (*Xeromys myoides*) and marine megafauna. Impacts to these species are described above.

Patches of the 'critically endangered' threatened ecological community (TEC), Littoral Rainforest and Coastal Vine Thickets of Eastern Australia, were found within the project boundaries. The project footprint has been designed to avoid these habitat patches so there is no direct impact on the TEC. The proponent has committed to retain a wildlife corridor to connect the habitat patches to the approximately 4500-hectare environmental management precinct adjacent to the project site.

No critical habitat for any listed species was identified in the project area. However, approximately 127 hectares of foraging habitat for the vulnerable grey-headed flying fox (*Pteropus poliocephalus*) is proposed to be cleared at Curtis Island on the LNG plant site. A further 24 hectares (approximately) of grey-headed flying fox habitat may also be cleared on the mainland if TWAF 8 is chosen and up to 8 hectares of habitat may be cleared for the construction right-of-way leading to the mainland tunnel launch site.

Approximately 15 hectares of shorebird habitat is proposed to be cleared for the LNG plant site at Curtis Island and approximately 40 hectares is proposed to be cleared on the mainland. The habitat to be cleared is not identified as critical habitat for shorebirds. However, an important roosting habitat on the mainland at the Clinton ash ponds is located adjacent to the project launch site 1. Indirect impacts to this roosting habitat from the project could include degradation from lighting, although the area is already subject to industrial disturbance. Impacts of lighting from the project on shorebirds at this habitat are not considered to be unacceptable.

Offsets

The proponent submitted an offset proposal as part of the EIS that outlines:

- the proposed total disturbance of remnant vegetation and marine and intertidal habitat within the GBRHWA on Curtis Island
- offset requirements for endangered and 'of concern' regional ecosystems on Curtis Island and on the mainland
- offset requirements for marine fish habitat outside the GBRWHA on the mainland

- an approach to offset delivery.

Arrow must now conclude offset arrangements with the Commonwealth on matters of national environmental significance. Once this work is completed, I will make my decision on the additional offset compensatory measures for the project.

I have imposed a condition requiring the proponent to finalise and implement an offset plan to address significant residual impacts identified in the EIS that are not covered by Commonwealth offset obligations.

Coordinator-General's conclusion

I consider that the environmental impact assessment requirements of the SDPWO Act for the Arrow LNG Plant project have been met and that sufficient information has been provided to enable a thorough evaluation of the potential impacts of the project.

I conclude that there are significant local, state and national benefits to be derived from the development, and that any adverse environmental impacts can be acceptably avoided, minimised, mitigated or offset through the implementation of the proponent's mitigation measures and commitments outlined in the EIS documentation. My conditions and recommendations in this report have been formulated in order to further manage all impacts associated with the project.

Accordingly, I approve the project to proceed subject to the conditions and recommendations set out in the appendices of this report. In addition, it is expected that the proponent's commitments will be fully implemented.

This report will be provided to the Commonwealth Environment Minister, pursuant to section 36(2) of the SDPWO Regulation and the bilateral agreement between the State of Queensland and the Australian Government to support a decision on the controlled actions for this project pursuant to section 133 of the EPBC Act.

A copy of this report will also be provided to the proponent, GRC and relevant state government agencies, and will also be made publicly available at: **www.dsdip.qld.gov.au/arrowlng**

Barry Broe

.....

Barry Broe
Coordinator-General

10 September 2013

1. Introduction

This report has been prepared pursuant to section 35 of the *State Development and Public Works Organisation Act 1971* (Qld) (SDPWO Act) and provides an evaluation of the environmental impact statement (EIS) for the Arrow LNG Plant Project (the project).

The report provides an assessment of the key matters associated with the project's potential impacts on the physical, social and economic environment. It does not record all matters identified and subsequently settled during the EIS process. Rather, it concentrates on the substantive environmental effects[1] and related matters identified during the EIS process.

The project has been assessed under a bilateral agreement existing between the Australian and Queensland governments that allows the Coordinator-General to conduct one EIS assessment process to meet the needs of both jurisdictions.

EIS information and assessment has been sufficient to enable the necessary evaluation of potential environmental impacts, development of mitigation strategies and conditions of approval. The report includes conditions that must be incorporated into subsequent development approvals and licences required to be issues by various State and Local governments. It also includes recommendations where appropriate to assist and guide relevant decision makers on future assessments and approvals required at the more detailed design phases of the project.

Additional information and investigations will continue to be provided during the detailed design phases of the project and through the further assessments undertaken as part of subsequent Australia, State and Local Government approval processes.

This report represents the conclusion of the Coordinator-General's impact assessment process under the SDPWO Act and the bilateral agreement. For information on the EIS process, including details of the organisations and individuals who commented on the proponent's EIS, refer to Section 3 of this report (page 8).

[1] For a definition of 'environmental effects', refer to the Glossary on page 294 of this report

2. About the project

2.1. The proponent

The proponent for the project is Arrow CSG (Australia) Pty Ltd (Arrow). Arrow is a Queensland-based company owned by Arrow Energy Holdings Pty Ltd (Arrow Energy Holdings), a joint venture between subsidiaries of Royal Dutch Shell plc (Shell) and PetroChina Company Limited (PetroChina). The joint venture took ownership of Arrow on 23 August 2010.

Shell has had a presence in Australia since 1901. Current operations include refining, sale of petroleum products and retail businesses. Shell maintains equity in the exploration and development of large gas resources off the coasts of Western Australia and the Northern Territory. Shell has liquefied natural gas (LNG) facilities in Qatar, Nigeria, Russia and South East Asia and operates a LNG carrier fleet.

PetroChina is a subsidiary of China's largest state-owned oil and gas producer and distributer, China National Petroleum Corporation with experience in exploration, refining and marketing of oil and natural gas in China and other countries.

Arrow Energy Holdings is an integrated energy company with interests in coal seam gas developments, pipeline infrastructure, electricity generation and the proposed Arrow LNG Plant. Arrow Energy Holdings has interests in more than 65 000 square kilometres of petroleum tenures, mostly within Queensland's Surat and Bowen basins. The company also has interests in the Clarence-Moreton, Coastal Tertiary, Ipswich, Styx and Nagoorin Garben basins.

Arrow Energy Holdings' Queensland petroleum tenures are located close to the state's three key energy markets: Townsville, Gladstone and Brisbane. The Moranbah Gas Project in the Bowen Basin and the Tipton West, Daandine, Kogan North and Stratheden projects in the Surat Basin near Dalby comprise Arrow Energy Holdings' existing coal seam gas production operations. These existing operations currently account for approximately 20 per cent of Queensland's overall gas production.

Arrow Energy Holdings supplies gas to the Daandine, Braemar 1 and 2, Townsville and Swanbank E power stations, which participate in the National Electricity Market. With Arrow Energy Holdings' ownership of Braemar 2, and the commercial arrangements in place for Daandine and Townsville power stations, the company has access to up to 600 megawatts of power generation capacity.

2.2. Project description

2.2.1. Location

An LNG plant is proposed to be located on Curtis Island, approximately six kilometres east of the city of Gladstone and within the Gladstone Regional Council (GRC) area. The island is around 57 000 hectares in size with approximately 2.5 per cent of the island allocated to LNG development as part of the Gladstone State Development Area

(GSDA) and eight per cent allocated to conservation by declaration of the Environmental Management Zone of the GSDA. Pipelines and ancillary infrastructure are proposed to be located at several mainland locations in the GRC area including the intertidal mudflats south of Boat Creek, the mouth of the Calliope River, Targinie, Clinton Ash Ponds, Gladstone Marina and Auckland Point.

2.2.2. Components

Key elements of the project as described in the EIS and supplementary EIS (SEIS) include the LNG plant, a feed gas pipeline, dredging and disposal works and ancillary facilities (refer Figure 2.1 below).

LNG plant

The LNG plant will have a base case capacity of 16 million tonnes per annum (Mtpa), with a total plant capacity of up to 18 Mtpa. The plant will consist of four LNG trains, each with a nominal capacity of 4 to 4.5 Mtpa. Major infrastructure and components required to develop the project will include LNG trains, LNG storage tanks, LNG loading lines, a seawater inlet for desalination and stormwater outlet pipelines, water and wastewater treatment facilities, a 115-metre-high flare stack, power generators, administrative buildings and workshops.

Ancillary facilities

Marine facilities will include a LNG jetty, materials offloading facility (MOF), personnel jetty and mainland launch site. Power for the LNG plant and associated site utilities will be supplied from the electricity grid (mains power), gas turbine generators, or a combination of both. The preferred option is a mechanical/electrical option with an all-mechanical option the alternative.

Temporary workers accommodation facilities (TWAFs) for up to 3500 people will be constructed. An accommodation facility catering for up to 2500 people and located at Boatshed Point on Curtis Island is the preferred option for the workforce accommodation during construction. Two additional TWAF locations are being considered on the mainland including a pastoral property near the township of Targinie (TWAF 8) and a site on Red Rover Road, south of the Gladstone Power Station.

Feed gas pipeline

A feed gas pipeline (refer to Figure 2.1 below) approximately nine kilometres long will supply gas to the LNG plant from its connection to the Arrow Surat Pipeline on the mainland. The feed gas pipeline will be constructed in three sections.

(a) connection of the Arrow Surat Pipeline to the tunnel launch shaft on intertidal mudflats south of Boat Creek on the mainland

(b) pipeline to traverse Port Curtis harbour in a tunnel to be bored under the harbour from the launch shaft to a reception shaft on Hamilton Point

(c) underground from Hamilton Point to the LNG plant.

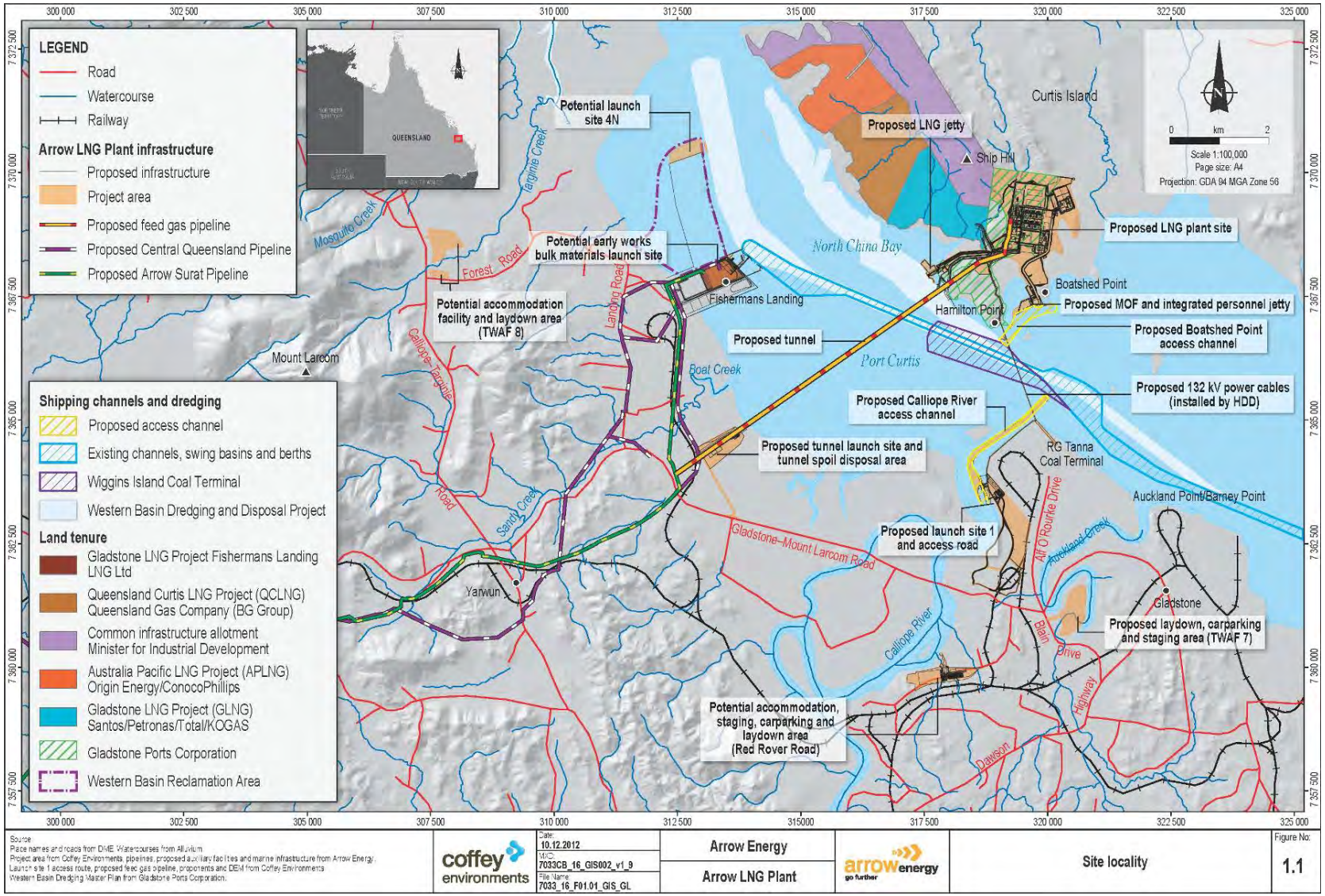

Figure 2.1 Site locality

Marine infrastructure

A mainland launch site is required for storage, loading and unloading of aggregate and materials and for the transfer of materials, aggregate, vehicles, plant and equipment, and personnel to and from Curtis Island. The proponent has proposed two options for the mainland launch site. The preferred option is launch site 1 at the mouth of the Calliope River, and the alternative is launch site 4N, adjacent to the Western Basin Reclamation Area at Fishermans Landing.

Up to a maximum of 900 000 cubic metres of dredging will be required to facilitate construction and operations at launch site 1. Launch site 4N will require dredging of up to 2500 cubic metres.

Dredging (up to 279 000 cubic metres) is also required at Boatshed Point for the MOF and passenger jetty and at Hamilton Point for the LNG jetty. Dredging required for LNG shipping access to Port Curtis has been assessed under the approved Gladstone Ports Corporation (GPC) Western Basin Dredging and Disposal (WBDD) Project EIS.

Preferred disposal sites for project dredged material include the Western Basin Reclamation Area, East Banks Sea Disposal Site and Wiggins Island Coal Export Terminal disposal areas. Final disposal locations will be determined under commercial agreements between the proponent and GPC.

2.2.3. Development stages

The plant will be constructed in two stages. Stage 1 will involve the construction of LNG trains 1 and 2, two LNG storage tanks (each with a capacity of between 120 000 and 180 000 cubic metres), the Curtis Island construction camp and/or a mainland workforce accommodation camp. Associated marine infrastructure, such as a passenger jetty, will also be required as part of stage 1.

Stage 2 will involve the construction of LNG trains 3 and 4 and potentially a third LNG storage tank. Construction of stage 1 is scheduled to commence in 2014 with train 1 producing the first LNG cargo in 2017. The proponent has advised that construction of stage 2 is anticipated to commence approximately five years after the completion of stage 1 but will be guided by market conditions and a final investment decision at that time.

2.2.4. Dependencies and relationships with other projects

Shell CSG (Australia) Pty Ltd (Shell Australia) was the original proponent of the Arrow LNG Plant project, first known as the Shell Australia LNG project. Following the successful acquisition of Arrow Energy Holdings by a joint venture between subsidiaries of Royal Dutch Shell and PetroChina on 23 August 2010, the former Shell Australia LNG Project is now known as the Arrow LNG Plant project and is a part of the Arrow LNG project.

Prior to acquisition, Arrow was undertaking separate approvals processes to develop its Surat Basin gas resources and to construct a pipeline to supply gas to the proposed Liquefied Natural Gas Limited's Gladstone LNG (GLNG) project at Fishermans Landing and the then named Shell Australia LNG Project on Curtis Island (now the Arrow LNG

Plant). Arrow was also investigating the development of its Bowen Basin gas resources and pipeline options for delivering gas from the Bowen Basin to Gladstone. Following the acquisition, Arrow and Shell Australia projects were brought together as components of the larger Arrow LNG Project. Separate approval is being sought for each component as described below:

- Surat gas project—the proposed upstream gas field development is located approximately 160 kilometres west of Brisbane in Queensland's Surat Basin. The 8600 square kilometres project development area extends from the township of Wandoan in the north towards Goondiwindi in the south, in an arc through Dalby. The project is presently undergoing an EIS process in accordance with the *Environmental Protection Act 1994* (Qld) (EP Act). The proponent is currently reviewing the submissions made to the EIS. The project is a controlled action under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act).
- Arrow Surat pipeline (formerly the Surat to Gladstone Pipeline Project)—the proposed 470-kilometres-long, high pressure gas transmission pipeline will extend from the Kogan area of the Surat Basin to Fishermans Landing at Gladstone. An EIS process for the project was completed on 17 January 2010 under the EP Act, and a petroleum pipeline licence (PPL 144) was granted in February 2010.
- Surat header pipeline—the proposed 110-kilometres-long, high pressure gas transmission pipeline will connect the Arrow Surat Pipeline to the gas production facilities. Production facilities will be located in the southern region of the Surat Gas Project development area. A Level 2 Environmental Authority (EA) has been issued for the project under the EP Act.
- Bowen gas project—the proposed upstream gas field development in the Bowen Basin is located between Collinsville in the north and to the south of Middlemount, approximately 475 kilometres north of Brisbane and 75 kilometres from Mackay. The proposed project includes the existing Moranbah Gas project. The project is presently undergoing an EIS process in accordance with the EP Act.
- Arrow Bowen pipeline—the proposed 600-kilometres-long, high-pressure gas transmission pipeline consists of a main pipeline and several lateral pipelines to convey coal seam gas from Arrow's gas fields in the Bowen Basin to Gladstone for eventual export as LNG. The project is undergoing an EIS process in accordance with Chapter 3 of the EP Act. The EIS process was completed on 22 March 2013.

The Arrow LNG Plant is one of four LNG facilities proposed for the Curtis Island Industry Precinct (CIIP). Three other LNG projects have been approved and are under construction on the island. Details as follows:

- Australia Pacific LNG (APLNG) project—Origin Energy and ConocoPhillips are progressing with construction of the first stage of an 18 Mtpa LNG plant on the northern allotment of the CIIP, involving construction of two LNG trains with a combined capacity of 9 Mtpa.
- GLNG project—Santos and its partners Petronas, Total and KOGAS are progressing with construction of the LNG plant component on the allotment located between the Queensland Curtis LNG (QCLNG) Project and the Arrow LNG Plant.

The two initial LNG trains of the proposed 10 Mtpa development will have a capacity of 7.8 Mtpa.

- QCLNG project—Queensland Gas Company (QGC), a BG Group business, are progressing with construction of a 12 Mtpa LNG plant on Curtis Island. The two train 8.5 Mtpa initial stage is being constructed on the allotment adjacent to the APLNG Project site and first shipments of LNG are scheduled for 2014.

2.3. Project rationale

The proponent predicts that the construction and operation of the project will provide benefits at the regional, state and national levels including:

- estimated capital expenditure of $15 billion
- employment opportunities through job creation at the facility, and indirectly through the provision of goods and services. The project will create approximately 3500 jobs during stage 1 of project construction, a further 2300 jobs during stage 2 of the construction, and up to 600 long-term jobs during the project's operational phase
- developing Queensland's gas reserves for the export market, leading to the provision of increased revenue from taxation and royalty payments to state and federal governments
- contributing indirectly to the growth in Gladstone's economy through increased employment opportunities, provision of goods and services, and stimulation of other industry development
- providing training and employment opportunities for a long-term workforce with high levels of technical expertise
- potentially encouraging government and private investment in community services and infrastructure. The expansion of services will be of social benefit to local and regional communities.

3. Impact assessment process

3.1. Overview

This section of the report details the steps involved in the project's EIS assessment process. For a detailed explanation of the EIS process, refer to **www.dsdip.qld.gov.au/coordinator-general**

In undertaking this evaluation, I have considered the following:

- initial advice statement (IAS)
- EIS
- issues raised in submissions relating to the EIS
- additional information provided subsequent to the EIS
- advice from Commonwealth, state and local government agencies
- advice from GPC
- comments and properly made submissions[2] from private organisations and members of the public.

Table 3.1 below shows the steps taken in the project's EIS process.

Table 3.1 Overview of EIS process

Date	Process
11 May 2009	IAS and request for project declaration received
4 June 2009	Project declared 'coordinated project' by Coordinator-General, requiring preparation of a EIS
21 August 2009	Australian Government determined project is a 'controlled action'
3 October 2009 – 2 November 2009	Submission period on draft terms of reference (TOR)
22 January 2010	TOR finalised
11 April 2012	EIS provided to Coordinator-General for evaluation
14 April 2012 – 28 May 2012	EIS released for public and agency comment
31 July 2012	Additional information sought
25 January 2013	Additional information provided to Coordinator-General for evaluation
8 February 2013 – 8 March 2013	Additional project information available for agency comment

[2] For a definition of a 'properly made submission', refer to the Glossary on page 294 of this report.

3.2. Coordinated project declaration

On 4 June 2009, the Coordinator-General declared the project to be a 'coordinated project' under section 26(1)(a) of the Queensland *State Development and Public Works Organisation Act 1971* (SDPWO Act). This declaration initiated the statutory environmental impact evaluation process pursuant to Part 4 of the Act, which required the proponent to prepare an EIS for the project.

3.3. Controlled action

The Commonwealth Environment Minister determined on 21 August 2009 that the project is a 'controlled action'[3] to be assessed under the EPBC Act (EPBC ref 2009/5007 – LNG plant on Curtis Island) (EPBC ref 2009/5008 – high pressure feed gas pipeline from Gladstone City Gate to Curtis Island).

The relevant controlling provisions under the EPBC Act are:

- sections 12 and 15(a) world heritage properties
- sections 15B and 15(c) national heritage places
- sections 18 and 18(a) listed threatened species and ecological communities
- sections 20 and 20(a) migratory species protected under international agreements.

The project is being assessed under a bilateral agreement existing between the Australian and Queensland governments that allows the Queensland Government to conduct one EIS assessment process to meet the needs of both jurisdictions.

3.4. Terms of reference

Comments were sought on the draft TOR from 3 October 2009 to 2 November 2009. Fifteen submissions were received, including 12 from advisory agencies and 3 from members of the public, conservation and other organisations.

The main issues raised in submissions related to:

- hazard and risk
- emergency management
- workforce and accommodation
- transport and traffic
- pipeline route selection
- conservation and great barrier reef world heritage values
- air and water quality
- social impacts
- waste management.

[3] For a definition of 'controlled action', refer to the Glossary on page 294 of this report.

A final TOR was prepared having regard to submissions received and was issued to Arrow on 22 January 2010.

3.5. Review of the EIS

The EIS prepared by the proponent was released for public and advisory agency comment from 14 April 2012 to 28 May 2012.

Twenty-nine submissions were received on the EIS and copies provided to the proponent.

Table 3.2 below summarises the public and agency submissions on the EIS. For an assessment of the environmental impacts of the project, refer to Sections 5–16 of this report.

Table 3.2 Public and agency comments received on the EIS

Agency	No. submissions	Issue
Queensland Government • Department of Aboriginal & Torres Strait Islander and Multicultural Affairs • Department of Communities • Department of Community Safety • Department of Education Training and Employment • Department of Environment and Heritage Protection including Natural Resources and Water • Department of Housing and Public Works • Department of Justice and Attorney-General – Hazardous Industry and Chemicals Branch • Department of State Development, Infrastructure and Planning • Department of Transport and Main Roads • Gladstone Area Water Board • Gladstone Ports Corporation • Qld Health • Qld Police • Qld Treasury • Skills Qld	**15**	• Community health and safety • Community investment and wellbeing • Dredging • Feed gas transmission pipeline • Freshwater ecology • Hazard and risk • Health services • Housing and accommodation • Indigenous housing • Land contamination and acid sulfate soils • Land use and planning • Marine water quality and sediment • Noise & vibration • Population and growth • Social impacts • Surface water hydrology and water quality • Traffic and transport • Waste management • Water supply • Workforce

Australian Government • Department of Sustainability, Environment, Water, Population and Communities	**1**	• Dredging • Freshwater ecology • Impacts on Great Barrier Reef World Heritage Area • Offsets • Port Curtis crossing method • Protected species • Terrestrial ecology
Local Government • Gladstone Regional Council	**1**	• Housing • Traffic and transport • Workforce
Private organisations/community groups/stakeholders • Asia Pacific Strategy • Capricorn Conservation Council • Fitzroy Basin Association • Grenatech • Qld Seafood Industry Association • Tenement to Terminal • The Australia Institute	**7**	• Dredging • Feed gas transmission pipeline • Greenhouse gases • Location of feed gas transmission pipeline • Marine construction traffic • Marine environment • Marine facilities • Surface water hydrology and water quality
Private individuals	**5**	• Greenhouse gases • Marine water quality and sediment • Social impacts
TOTAL	**29**	

3.6. Additional information required

On 31 July 2012, I requested that the proponent submit additional EIS information to address the following areas and ensure that a satisfactory EIS was conducted. This included:

- an update of the cumulative traffic impact assessment, taking into account all project elements
- greater detail on maritime traffic and port operations associated with:
  - transporting materials and workers to Curtis Island
  - importation of pipe
  - interaction of launch site 1 with the Wiggins Island Coal Terminal construction works and other port operations
- further impact assessment on marine megafauna in the study area, including:
  - information on the incidence of dolphin species in the study area
  - all available evidence on interactions of marine megafauna with construction activities and vessel traffic in Port Curtis

- further definition, including site surveys, relating to potential impacts on MNES
- an updated impact assessment on other coastal resources including:
  - further investigation of dredge material and the proposed disposal location(s), including management of potential acid sulfate soils
  - cumulative impacts of dredging works and proposed point source water discharges to Port Curtis
  - impacts associated with the proposed Calliope River dredging including, the effects of altered tidal flows and water levels
  - a draft environmental offset strategy, addressing State and Commonwealth requirements
- provision of water, sewerage and power supply to the Curtis Island site
- co-location of project activities with services corridors and the proposed Yarwun Coal Terminal footprint
- the proposed use of Gladstone marina
- housing and accommodation issues in general, but with a need to better understand the mitigation and management strategies for housing for all groups of workers and contractors associated with the project
- preparation of a Local Industry Participation Plan
- commitments to contribute to the Gladstone Foundation.

3.7. Review of additional EIS information

On 25 January 2013, the proponent provided additional information for the EIS. I approved the release of this additional information for agency comment between 8 February 2013 and 8 March 2013. Fifteen submissions were received from government agencies. Copies of the submissions were forwarded to the proponent.

4. Project approvals

4.1. Local approvals

The project development site is wholly located within the GRC area. The GRC was formed on 15 March 2008 following amalgamation of the shires of Calliope and Miriam Vale, Gladstone City and the Calliope Aerodrome Board.

Under the transitional arrangements for the amalgamated councils, the planning schemes for the former shires remain applicable in assessing development, until a new regional council planning scheme comes into effect. Therefore, the project will require approval for any material change of use (MCU) and operational works permits under the Calliope Shire Planning Scheme 2007 and Gladstone City Council Plan 2006 for activities outside of the GSDA and the proponent's petroleum facility and pipeline licences. GRC is the assessment manager for these approvals.

4.2. State approvals

The principal statutory approvals necessary for the development of the project, that will need to be sought subsequent to this EIS evaluation include:

- petroleum facility licence for the construction and operation of the LNG plant—*Petroleum and Gas (Production and Safety) Act 2004* (Qld) (DNRM)
- petroleum pipeline licence for the construction and operation of the proposed feed gas pipeline and tunnel—*Petroleum and Gas (Production and Safety) Act 2004* (Qld) (DNRM)
- environmental authorities for Chapter 5 activities—EP Act (DEHP)
- development permit for a major hazard facility—*Sustainable Planning Act 2009* (SPA) and *Work Health and Safety Act 2011* (Qld) (Department of Justice and Attorney-General)
- development approval for an MCU—*State Development and Public Works Organisation Act 1971* (DSDIP)
- development permit for operational works under SPA in conjunction with other legislation including:
  - tidal works and works within a coastal management district—*Coastal Protection and Management Act 1995*
  - to remove, destroy or damage marine plants, or to construct or raise waterway barrier works—*Fisheries Act 1994*
  - clearing of native vegetation—*Vegetation Management Act 1999* (VM Act)
  - taking or interfering with surface water, groundwater or overland flow or remove quarry material from a watercourse or lake—*Water Act 2000*

- environmental authorities for environmentally relevant activities (ERAs)—SPA, EP Act
- licence, permit or other authority is required for dredging; the removal or placement of quarry material below the high water mark and damaging or removing vegetation on state coastal land—*Coastal Protection and Management Act 1995*
- licence, permit or other authority is required for the disturbance of native wildlife (plants and animals)—*Nature Conservation Act 1992*
- licence, permit or other authority for taking or interfering with water—*Water Act 2000*
- riverine protection permit—*Water Act 2000*
- approval to take, destroy or interfere with forest products—*Forestry Act 1959*
- cultural heritage management plan or indigenous land use agreement—*Aboriginal Cultural Heritage Act 2003*
- permit to develop on a reserve, road or unallocated state land and permit for vegetation clearing on state land—*Land Act 1994*.

4.3. Australian Government approvals

The delegate of the Commonwealth Environment Minister determined the proposed project to be a controlled action pursuant to section 75 of the EPBC Act on 21 August 2009. The EIS assessment process has been conducted under the bilateral agreement and the Commonwealth Environment Minister will consider project approvals in relation to impacts on MNES after the Coordinator-General has concluded his evaluation.

The *Environment Protection (Sea Dumping) Act 1981* may be triggered if the Western Basin Reclamation Area and East Banks sea disposal site within the WBDD project is exhausted and alternative dredge spoil dumping locations are required.

5. Land use

5.1. Context

The 284-hectare Curtis Island project site comprises three parcels of land and an unused government road, which the proponent, as the adjoining landowner, has received approval from the Queensland Government to purchase. The site, which will house the LNG facility, lies within the CIIP of the GSDA. The CIIP was established to provide for LNG facilities for processing operations (including liquefaction and storage).

Other uses associated with the proposed plant are to be located on the mainland, temporary workers accommodation, tunnel launch site, laydown, storage and car parking areas.

5.2. Relevant state and local government planning

5.2.1. Gladstone Regional Council planning schemes

Development within the GRC area is currently managed by three existing planning schemes developed in accordance with SPA. The Gladstone City Council Plan 2006 and the Calliope Shire Planning Scheme may apply to aspects of the project.

Within the GRC area, development may also be managed by the Coordinator-General and/or GPC. This is due to the Coordinator-General managing land use within state development areas and GPC managing land use on Strategic Port Land.

5.2.2. Development scheme for the GSDA

An MCU application under the SDPWO Act is required for the project. The development scheme for the GSDA applies to land within the SDA. The development scheme is a regulatory document that controls land use in the GSDA and is prepared and administered by the Coordinator-General under the SDPWO Act. The Coordinator-General assesses and approves all MCU applications in the GSDA. The development scheme overrides local and state government planning instruments related to the use of land however it doesn't replace the need for an environmental authority under the EP Act.

I recommend, in accordance with section 52 of the SDPWO Act, conditions that achieve the following outcomes be stated on any MCU approval for uses within the Curtis Island sub-precinct of the GSDA:

- the visual impact of the construction and operation of the LNG facility is minimised
- that the workforce accesses Curtis Island in an appropriate manner
- a decommissioning plan for the construction workforce accommodation includes a rehabilitation plan for the construction workforce accommodation site.

I have stated conditions in this report to ensure the appropriate management of the impacts to the GSDA (Appendix 2, Schedule 2, conditions 2–4).

I anticipate that in addition to the conditions above, I will state further conditions under section 84 of the SDPWO Act on any MCU application following the review of the more detailed design during the MCU assessment process.

5.2.3. Gladstone Ports Corporation Land Use Plan

Parts of the project area are proposed to be developed on Strategic Port Land at Hamilton Point and Fishermans Landing. The *Transport Infrastructure Act 1994* provisions require GPC to gazette a land use plan. The GPC Land Use Plan 2012 provides a strategic framework for the management and assessment of development on Strategic Port Land, through identifying land use precincts and appropriate land uses and defining the outcomes sought to ensure sustainable growth and development to the port.

To facilitate management and assessment of development on port authority land, GPC undertakes the responsibilities of assessment manager under the SPA for assessable development on Strategic Port Land. New assessable development proposed on Strategic Port Land will be assessed in accordance with the provisions of SPA and the GPC Land Use Plan.

5.2.4. Regional plan

The current regional plan for the project area is the non-statutory Central Queensland Regional Growth Management Framework 2002.[4] Of relevance to the project is the plan's desired outcome of promoting processing activities that meet existing and emerging markets. The plan also identifies that there 'is an increased capacity of the region to engage directly with international markets which increases our global perspective and enhances the viability of organisations based in the region'.

At the time of writing this report, the Queensland Government had recently released a draft statutory Central Queensland Regional Plan for consultation. It is anticipated that, following consultation, the plan will be finalised by the end of 2013. The new regional plan seeks to support a strong resource sector, helping to drive the state's economic growth and security, and balance resource and energy industry development with agricultural, community and industry needs.

[4] Central Queensland Regional Planning Advisory Committee 2002, Central Queensland Regional Growth Management Framework, Department of Local Government and Planning, Rockhampton, viewed 13 May 2013, www.dsdip.qld.gov.au/resources/plan/regional-growth/cqrgfm.pdf.

5.3. Tenure and ownership

The majority of the project area on the mainland and Curtis Island is freehold land tenure. The proponent owns the LNG plant site and has entered into a contract to purchase the mainland tunnel launch site. The proponent will be required to enter into a lease/licence for sites over which other infrastructure is to be built including a volumetric lease for the feed gas pipeline under Port Curtis to be granted by DNRM.

6. Marine and coastal environment

6.1. Overview

6.1.1. Port Curtis

Port Curtis is a shallow coastal basin, separated from the Coral Sea by Facing Island and Curtis Island, which protect the port from ocean swells. Port Curtis is connected to the Coral Sea via South Channel to the south of Facing Island, North Channel between Facing and Curtis Islands and The Narrows, which extends north-west and separates Curtis Island and the mainland.

Strong tidal currents that flush the numerous creeks and tributaries maintain naturally high levels of turbidity and suspended sediments within Port Curtis.

The relatively large tidal range (up to 5 metres) of Port Curtis influences the ecology of the area, resulting in a typical pattern of intertidal and coastal zonation including extensive intertidal banks, mangrove and saltpan areas, seagrass beds and rock and reef habitats. Water depths have been modified over time by the development of shipping channels, land reclamation and coastal armouring.

Water currents within the port are controlled by the tidal cycle. Current speeds within the port are high, with spring tide currents typically reaching two metres per second in dredged shipping channels.

Water infrastructure

The proponent's preferred water supply option is a pipeline from the Gladstone reticulated water system to Curtis Island. Construction of the water supply pipeline has commenced in order to serve existing LNG projects under construction and is anticipated to be operational prior to the construction of and operation of the LNG plant. Should mains water be unavailable or restricted, I recognise that the proponent has retained an option to develop a reverse osmosis desalination plant to ensure the project is self-sufficient.

The brine outfall would be located on the eastern side of Boatshed Point at a depth of approximately 12 metres. Brine discharged into Port Curtis off Boatshed Point could locally increase salinity at and around the point of discharge. If the GRC-installed sewer mains are not used, this discharge may also include process water and under circumstances exceeding design (e.g. extreme rainfall events), treated effluent from the LNG plant sewage treatment plant. Modelling shows that water quality criteria will be achieved within 10 metres from the point of discharge.

If a reverse osmosis plant is adopted, the proponent has committed to designing the brine discharge outfall to include a three-port diffuser (Appendix 4, C31.36) at the end of the pipeline located close to the water surface (or angle the ports towards the surface) to maximise dilution of the negatively buoyant discharge stream. Should the proponent exercise its option to build a reverse osmosis plant, I note further information will need to be provided to the Department of Environment and Heritage Protection (DEHP) prior to obtaining an EA.

GRC has installed two sewer mains under Port Curtis to service the LNG plants on Curtis Island. The sewer mains can accept both category A (the sewer) and category B (trade waste) waste water and are expected to have a capacity of 864 cubic metres per day. The EIS reported that this capacity is sufficient to meet peak construction demands of both the LNG plant and the construction camp. Disposal of wastewater and effluent via the GRC sewerage system is the proponent's preferred option. Should the sewer mains be unavailable to the proponent, I accept that the proponent retains an option to develop an effluent treatment plant. Should the proponent exercise its option to build an effluent treatment plant, further information will need to be provided to DEHP prior to obtaining an EA.

6.1.2. Calliope River and other tributaries

Several waterways drain into Port Curtis, the main waterways being the Calliope and Boyne Rivers. The tidal cycle influences water levels up to 25 kilometres upstream of the Calliope River mouth. A bar at the entrance to the river significantly reduces the ability of water to leave the river during ebb tide.

6.2. Existing marine water quality

In accordance with the terms of reference, an assessment was made of the marine water quality and sediment characteristics of the existing environment within the project area at Port Curtis.

The proponent developed a set of marine water quality criteria specifically for the project, from the *Queensland Water Quality Guidelines* and the ANZECC/ARMCANZ (2000) guidelines (refer Table 6.1 below). DEHP accepted that the project criteria were appropriate, and recommended that the proponent adopt the interim working levels for toxicity-based trigger values in the ANZECC/ARMCANZ (2000) during the initial stage of the project. The project water quality criteria sets water quality targets to ensure that environmental values are protected.

A marine water quality study was undertaken in Port Curtis to determine existing water quality, which included a desktop review of previous water quality studies in the area, including the WBDD project EIS, and a two-part water sampling program. Figure 6.1 below (on page 22) shows the sites at which a water quality sample was taken.

The results of the water quality study indicated that existing marine water quality within Port Curtis is already generally below guideline levels, with a number of parameters not meeting project water quality criteria.

Table 6.1 Queensland Water Quality Guideline values for waters in the project area

Parameter	Units	Water body type		
		Enclosed coastal	Mid estuarine	Lowland stream
Ammonia Nitrogen	µg/L	8	10	20
Oxidised Nitrogen	µg/L	3	10	60
Organic Nitrogen	µg/L	180	260	420
Total Nitrogen	µg/L	200	300	500
FRP	µg/L	6	8	20
Total Phosphorus	µg/L	20	25	50
Chlorophyll-*a*	µg/L	2	4	5
Dissolved Oxygen (% saturation)	lower	90	85	85
	upper	100	100	110
Turbidity	NTU	6	8	50
Light penetration (Secchi)	m	1.5	1	N/A
Suspended solids	mg/L	15	20	N/A
pH	lower	8	7	6.5
	upper	8.4	8.4	8.0

Source: Department of Environment and Resource Management 2009

Copper

Concentrations of copper exceeded project water quality criteria (1.3 micrograms per litre) on 47 occasions during the monitoring program for the EIS. Concentrations varied from below the limit of detection (one microgram per litre) to a maximum concentration of eight micrograms per litre at Hamilton Point. Exceedances of copper tend to be higher during the spring tidal phase and occur more frequently in Port Curtis (41 exceedances) than the Calliope River (6 exceedances).

Cobalt

Concentrations of cobalt ranged from below the limit of detection (0.2 micrograms per litre) up to 1.6 micrograms per litre at Hamilton Point. Samples were found to exceed project criteria (one microgram per litre) on 25 occasions during spring tides at 9 of the 15 sampling sites offshore from Curtis Island.

Phosphorus

Values for filtered reactive phosphorus were found to be twice the project criteria in the upper Calliope River sites. Exceedances were found to be unrelated to the time of the day, tide or depth, indicating a constant supply, likely from upper catchment runoff. Values for total phosphorus were up to five times the project criteria at five locations in Port Curtis. Results were unrelated to the time of the day, tide or depth.

pH

Most sampling sites within Port Curtis recorded pH values between 7.45 to 7.97. Only samples taken at Boatshed Point and Hamilton Point recorded pH outside the project water quality criteria (8 to 8.4).

Chlorophyll-*a*

Concentrations for chlorophyll-*a* exceeded project water quality criteria (2–4 micrograms per litre) at a majority of sites. Concentrations ranged from 1.4 micrograms per litre offshore from the mainland tunnel launch site to 4.7 micrograms per litre in the Calliope River. Most exceedances occurred at sites in the lower Calliope River. Chlorophyll-*a* concentrations generally decreased slightly with depth, indicating a well-mixed water column.

Dissolved oxygen

Project water quality criteria for dissolved oxygen (90 per cent to 100 per cent in Port Curtis and 85 per cent to 100 per cent in the Calliope River) were exceeded at sampling sites adjacent to the mainland tunnel launch site and at Curtis Island. Results indicate that the dissolved oxygen percentage was highly dependent on the site and tidal state.

Turbidity

Turbidity exceeded project water quality criteria at the majority of sites within Port Curtis. Turbidity was approximately eight times the project water quality criteria (of 8 Nephelometric Turbidity Units (NTU)) offshore from Boatshed Point and Hamilton Point with levels between 26 and 65 NTU recorded at these sites. Turbidity within the Calliope River was lower than in Port Curtis. A majority of exceedances within the Calliope River occurred in the lower reaches during neap tides. The water sampling program recorded higher turbidity levels in Port Curtis than those reported in the EIS, although they are within the range of turbidity measured by DEHP in 2012.

Figure 6.1 Water quality sampling sites

6.2.2. Sediment quality

Studies into the existing sediment quality of Port Curtis conducted by the Cooperative Research Centre for Coastal Zone, Estuary and Waterway Management and WBDD project in 2005 and 2009, respectively, found low concentrations of anthropogenic contaminants, herbicides, organochlorine (OC), and organophosphate (OP) pesticides; whereas arsenic, cadmium and copper concentrations were found to exceed sediment quality guidelines. The *National Assessment Guidelines for Dredging* (NAGD) recognise that sediments in Australia commonly have high levels of naturally occurring arsenic compounds. Samples containing arsenic that exceeded the project sediment quality criteria are likely to represent geological material with naturally-elevated occurrences of arsenic.

Further sediment sampling was conducted in May 2010 and February 2011, which found that:

- polycyclic aromatic hydrocarbons (PAH), OC and OP pesticides in all samples were below laboratory detection limits
- organic carbon content was generally below 2 per cent at sampling sites but higher at sites along the Calliope River and mainland launch site 4N where organic carbon content reached 11 per cent
- intertidal sediments at most sediment sampling sites were composed of 60–90 per cent silts and mud and 20–40 per cent sands and gravels. Two sites at the mouth of the Calliope River recorded a ratio of 80 per cent sands and gravels
- intertidal sites along the Calliope River were composed of 30–60 per cent silts and mud and subtidal sites were largely composed of sand and coarser materials
- metal concentrations did not exceed sediment quality criteria in the Calliope River.

The NAGD provides that sediments are categorised as uncontaminated where no analytes exceed the 95 per cent upper confidence limit of the project sediment quality criteria. Uncontaminated sediments are considered suitable for ocean disposal, and by inference to approved onshore and offshore disposal sites. No samples from the sediment quality study exceeded the 95 per cent upper confidence limits for contaminants.

Analysis of samples from each of the dredge and marine construction sites has found that the sediments meet project sediment quality criteria.

These results, together with results from ongoing geotechnical investigations, will inform the development of the dredge management plan for the project.

6.3. Dredging

Improved shipping access is required for development of the Port of Gladstone and construction of the LNG facilities on Curtis Island. GPC began undertaking the deepening, widening and extension of existing shipping channels, swing basins and berth pockets through the WBDD project in May 2011. At the time of writing, this

project was nearing completion of the dredging and disposal of 25 million cubic metres of material.

Construction and operation of the Arrow LNG project requires further dredging to provide and maintain shipping access to marine infrastructure sites on Curtis Island and the mainland. Construction of wharf and jetty structures to enable the loading of the Arrow LNG vessels is proposed, along with a mainland launch site to transport personnel, equipment and materials to Curtis Island.

The project proposes four possible capital dredge sites including dredging options presented for both of the proposed mainland launch sites (refer Table 6.2 and Figure 6.2 below). The estimated dredging volumes based on in-situ material, dredge depth and dredger type is 1 344 000 cubic metres. Depending on launch site options chosen as part of the final design, the total dredge volume ranges from 446 500 cubic metres if launch site 4N is chosen, to 1 344 000 cubic metres if launch site 1 is chosen. Dredging for construction of the project will be governed and strictly controlled by a dredge management plan that will detail measures at each site to limit the impacts of dredging, including increases in turbidity and impacts on marine fauna.

Table 6.2 Dredging volumes as stated in EIS

Component	Volume of in-situ material (m^3)	Depth	Likely dredging method*	Proposed dredge material disposal location
LNG jetty	131 000	–5.5 m LAT	Backhoe or cutter suction	Western Basin Reclamation Area or East Banks Sea Disposal Site
Boatshed Point MOF	148 000	–2.5 m to –3.5 m LAT	Backhoe or cutter suction	East Banks Sea Disposal Site
Boatshed Point access channel and swing basin	165 000	–8.0 m LAT	Backhoe or cutter suction	East Banks Sea Disposal Site
Launch site 1 channel and jetties	900 000	–5.0 m LAT	Cutter suction	Wiggins Island Coal Export Terminal Area B and C (or alternatively the Western Basin Reclamation Area / East Banks Sea Disposal Site)
Launch site 4N channel and jetties (option)	2500	–5.0 m LAT	Backhoe	Western Basin Reclamation Area / East Banks Sea Disposal Site
Maximum total dredge volume^	1 344 000	–	–	–

* Typically backhoe dredged material will be disposed offshore and cutter suction dredge material will be disposed to the Western Basin Reclamation Area of the Wiggins Island Coal Export Terminal disposal areas.
^ Note that the maximum volume does not include launch site 4N as it is a project option.

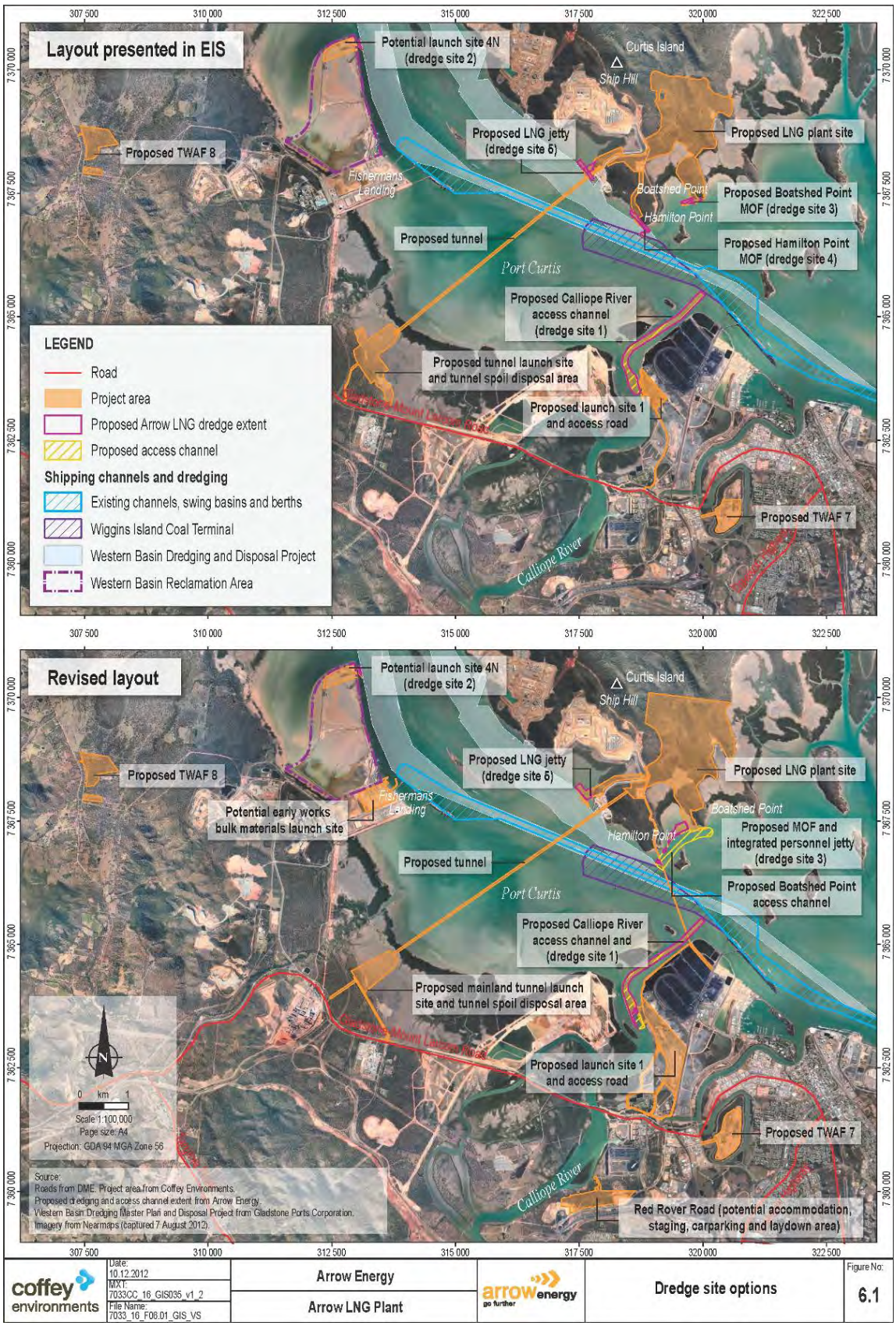

Figure 6.2 Dredge site options

Maintenance dredging will be required to maintain navigable water depths at the above facilities. The largest volumes are expected to be dredged from the Boatshed Point swing basin and berth areas. Modelling reported in the EIS suggests that the maximum rate of siltation is up to 0.14 metres per month in the manoeuvring basin and up to 0.2 metres per month near the roll-on, roll-off berth. Modelling of the Calliope River shows that the maximum siltation rate in a navigation area is up to 0.06 metres per month and that fine sediment is likely to accumulate outside the dredging area.

GPC advised in its response to the EIS that areas used for disposal of capital dredging, particularly onshore disposal sites, may not be available for maintenance dredging disposal due to ongoing development activities. It is likely that maintenance dredging material will be disposed of at an offshore site. The EIS reported that dredging and disposal requirements will, where possible, be integrated with dredging being undertaken as part of the WBDD project.

GRC requested that the proponent provide assistance in revising flood models for the Calliope River, given that dredging of the river mouth is expected to alter flood dynamics of the Calliope River. I note that hydrodynamic modelling of the Calliope River undertaken for the project identifies a lowering of lowest low-tide levels, resulting in a reduced risk of flooding impacts as a result of the dredging. In response to the GRC request, the proponent has advised that relevant Calliope River dredging modelling data and outputs from the EIS would be made available to GRC as an input to flood modelling undertaken by GRC in the future as part of their ongoing flood management processes.

6.3.2. Dredging impacts to coastal processes

A baseline assessment of coastal processes in the EIS was comprised of a literature review and site inspection, wave climate assessment, extreme water levels assessment, sediment transportation and siltation assessment and shoreline processes assessment.

Dredging activities were assessed to determine the extent of change to the existing tidal regime and water current patterns in Port Curtis, which in turn may affect shoreline processes. Capital dredging at dredge site 1 at the mouth of the Calliope River could lead to potential sedimentation if supply exceeds transportation and potential erosion if transport exceeds supply. Maintenance dredging of the channel could result in upstream bed deepening and bank slumping.

Tidal modelling indicated that water levels in Port Curtis will not be affected by project activities. High tide levels in the Calliope River will not change but low tide levels will be lower by up to 0.8 metres during spring tides.

During ebb spring tides, current speeds could increase by up to 0.6 metres per second (72 per cent increase) at the mouth of the newly dredged channel and decrease by up to 0.7 metres per second (60 per cent decrease) to the west of the new channel. Under flood spring tidal conditions, current speeds are forecast to increase by up to 0.6 metres per second (59 per cent increase) to the west of the dredged channel and decrease by up to 0.7 metres per second (42 per cent decrease) within the dredged channel along its eastern bank.

Further modelling for the EIS found intertidal banks between the river mouth and a point near the Gladstone Power Station may be exposed by up to an additional 0.5 metres on the lowest low tide. This may restrict upstream access to some vessels on the lowest low tides for a few hours each month. Lower reaches of the river that currently experience restricted access will now be accessible under all tidal regimes.

The EIS reported negligible expected change to the wave climate.

Pre-dredging and post-dredging scenarios for the Calliope River were modelled during spring tides when maximum sediment transport is likely to occur. Results show a small reduction in sand transport potential, not large enough to alter the overall net sand transport within the river.

6.3.3. Coordinator-General's conclusions

I am satisfied that the proponent has adequately identified and assessed the impacts of the dredging potentially required for the project.

I note the proponent's commitments (C15.02 to C15.05) and have set conditions requiring that all dredging not covered under the WBDD project be undertaken under a dredge management plan to be developed for the project. The plan must take into account the indirect impact of sediment plumes on marine plants.

Outcomes I require as part of the proposed construction works include:

- best practice dredge and construction management, that complies with the requirements of a risk assessment
- if found, the excavation and placement of acid sulfate soils (ASS) or potential ASS (PASS) is managed to ensure that no untreated material is released to marine waters
- development and implementation of a receiving environment monitoring program (REMP) that includes water quality monitoring within Port Curtis and the Calliope River before, during and after the works.

I have stated conditions in this report to ensure the appropriate management of impacts to water quality during project construction (Appendix 2, conditions D3–D8 and E4).

6.4. Marine water quality impacts

The proponent has committed to several mitigation measures and management plans to reduce the occurrence and magnitude of potential impacts to marine water quality, including erosion and sediment control measures (Appendix 4, C11.11), dredge management plan (Appendix 4, C15.02) and to design outfalls to maximise dilution of discharge (Appendix 4, C16.01, C31.36). The main potential impacts can be categorised as either dredging or effluent discharge and include the following:

- formation of suspended sediment plumes in the water column from dredging works during construction and subsequent deposition of material on the seafloor
- formation of sediment plumes as a result of maintenance dredging during operations

- discharge of brine from the desalination plant (if that option proceeds)
- process water and, under circumstances exceeding design (e.g. extreme rainfall events), treated sewage effluent to Port Curtis through the possible outfall at Boatshed Point
- accidental discharge of hazardous substances during construction and operations
- discharge of sediment-laden runoff from dewatering processes
- discharge of hydrostatic test water and associated sediments during the feed gas pipeline testing process
- discharge of treated sewage from the construction camp, if sewer to mainland is not utilised.

6.4.1. Potential water quality impacts—construction

Sediment plumes during dredging, jetty and MOF construction

The revised estimated dredging volumes in the EIS state the maximum total dredge volume for the project area to be 1 344 000 cubic metres utilising backhoes and/or a dredge cutter suction. The primary source of suspended sediment during the construction of the LNG jetty and dredging of the Calliope River will be seabed sediments disturbed directly at the dredge site. The rate of suspended sediment generated during dredging activities will depend on the proportion of fines in bed material, the size and type of dredge plant and the skill and experience of the dredge operator.

Further investigation of marine sediment using geotechnical drill cores is required to characterise material that will be disturbed during the dredging and construction of marine facilities. The results are to inform the development of a dredge management plan.

Modelling of fine sediment deposition in the vicinity of launch site 1 indicates that deposition will occur largely outside the dredge channel with rates up to 0.06 metres per month near the site.

Potential disturbance of ASS and/or contaminated sediments

ASS are a characteristic feature of low lying coastal environments in Queensland. Undisturbed, these soils can be present in an anaerobic state within marine mud and sand in the form of PASS. When exposed to air either by direct excavation or by indirect changes to the surrounding water table, pyritic material inherent in the ASS is oxidised by sulphur oxidising bacteria leading to the formation of sulfuric acid.

High concentrations of contaminants and acid released into receiving waters can potentially cause significant impacts on ecosystem health. These impacts are dependent on the type of contaminant and the extent of the disturbance.

Most soils in and adjacent to Boatshed Point and adjacent to the LNG jetty site are PASS with moderate to extremely high acid generating capacity. The net acid generating capacity is more than 100 times the Queensland Acid Sulfate Soils Investigation Team (QASSIT) indicator levels in some soils and is 40 times this limit

based on average values. Results of testing on samples taken from the Calliope River suggest that PASS is restricted to two localised areas.

The proponent has committed to develop an ASS management plan (Appendix 4, C12.17) to manage and reduce impacts from any disturbance of ASS. The plan will detail strategies for the management and disposal of ASS/PASS, including options for offshore management, as is currently being undertaken for materials dredged as part of the other LNG projects. Offshore disposal is likely to minimise PASS oxidation and potential acid generation.

Coordinator-General's conclusions

The sediment quality analysis conducted for the EIS indicated that the proposed dredge material is considered to be largely uncontaminated and the works would not be expected to result in the introduction of contaminants into marine waters. Further assessment is required prior to construction commencing to fully define the extent of PASS that may be present.

6.4.2. Potential water quality impacts—operations

Maintenance dredging

Maintenance dredging will be required during the operational stages of the project to maintain the minimum navigable depths required at the mainland launch site, Boatshed Point and LNG jetty. The largest volumes are expected to be dredged from around the Boatshed Point swing basin and berth areas. Indicative modelling forecasts that the maximum rate of siltation is up to 0.14 metres per month in the manoeuvring basin and up to 0.2 metres per month near the roll-on, roll-off berth. Calliope River indicative modelling shows that fine sediment is likely to accumulate largely outside the area of dredging with the maximum siltation rate in a navigation area forecast to be no more than 0.06 metres per month.

The proponent has committed to scheduling the timing of maintenance dredging to favourable tidal and wind conditions to minimise impacts to water quality and sediment (Appendix 4, C16.11). Management measures from the dredge management plan will also be implemented to address impacts from maintenance dredging.

The coastal sediments that would require maintenance dredging from Boatshed Point are likely to be predominantly mud and silt with some sand and gravel. The material requiring regular removal from the Calliope River would be largely sand and gravel with some mud and silt.

Any maintenance dredging required is likely to be uncontaminated. However, sediments may be affected by anthropogenic contaminants. A full assessment of sediment quality will be required before any maintenance dredging is undertaken.

Best practice plant management is required to be implemented to ensure risks of accidental spills and discharges to Port Curtis are minimised.

Effluent discharge

The main source of discharge to the waters of Port Curtis from the project is the hydrostatic test water. Hydrostatic testing of plant equipment will be conducted at the completion of construction. Discharge modelling assumed a maximum rate of discharge to be approximately 4870 cubic metres per day over a continuous 74-day period.

The worst-case total volume for hydrostatic test water has been estimated at 360 000 cubic metres for three LNG tanks. The EIS stated that the actual volume will be less than the worst-case scenario and that the final volume, discharge rate and discharge location will be developed during detailed design.

Dilution modelling used salinity as the key water quality parameter and indicated that rapid dilution will be achieved within a short distance from the outfall. Salinity returned to ambient levels (90th percentile) within no more than 17 metres in the most saline conditions and no more than two metres in the least saline conditions. Both scenarios were modelled during neap tides.

Coordinator-General's conclusions

To ensure the risks of potential impacts to marine water quality are minimised, the following outcomes are required:

- prevention and minimisation of adverse impacts to marine water quality (compared to existing conditions) and on species richness and species diversity of aquatic fauna and flora within any receiving waters
- identified ASS and PASS that are disposed on land must be done in accordance with all relevant guidelines
- development and implementation of a REMP.

I have stated conditions in this report to ensure the appropriate management of impacts to water quality during project operation based on achieving these outcomes (Appendix 2, conditions D1–D4, D6–D8).

6.5. Marine habitats

Wetlands adjacent to the project area have formal conservation status including:

- Port Curtis wetlands—31 232 hectares that includes all tidal areas in the vicinity of Gladstone, from a line between Laird Point and Friend Point (southern end of The Narrows), to a line between Gatcombe Head and Canoe Point, including the seaward side of Facing Island and Sable Chief Rocks, and southern Curtis Island west of a line between North Point and Connor Bluff
- The Narrows wetlands—20 902 hectares that includes the passage between Curtis Island and the mainland, including the tidal wetlands on the north western end of Curtis Island, and Graham Creek east of Deception Creek
- Great Barrier Reef World Heritage Area—refer Section 16 (Matters of national environmental significance).

The mainland tunnel construction site and launch site 1, both on the mainland, and some LNG plant infrastructure at Boatshed Point are located within the Port Curtis wetlands. Project activities are not proposed within The Narrows wetlands. The entire LNG plant site at Curtis Island is within the Great Barrier Reef World Heritage Area (GBRWHA).

The EIS identified areas of marine habitat that could be affected by dredging and marine infrastructure during construction and operation of the LNG plant.

Desktop studies and field investigations addressed the areas of potential marine and estuarine disturbance from the Arrow LNG Plant at Boatshed Point, Calliope River, Fishermans Landing, North China Bay, South Hamilton Point and The Narrows. Figure 6.3 below shows the marine and estuarine habitats in the Port Curtis region.

Benthic zone and intertidal mudflats

The EIS outlined that the benthic zone (seabed) and intertidal mudflats within Port Curtis support a high biodiversity and high biomass of small and microscopic organisms. Mudflats also support fisheries productivity and act as feeding grounds for migratory birds.

The EIS reported that 5.64 hectares of benthic zone and intertidal mudflats could be directly impacted by the project. This area is to be cleared during construction at the Boatshed Point MOF, LNG jetty sites and associated dredging sites.

Reef and rock substrate

Port Curtis supports approximately 3341.28 hectares of reef[5] and a broad range of organisms including bivalves (molluscs), ascidians (sea squirts), bryozoans (polyp colonies) and hard corals. Rubble reef areas and coral bommies can be found in a deep channel at the entrance of The Narrows to the north of the study area near Graham Creek and extending south to Fishermans Landing.

Rock substrate is widespread throughout Port Curtis and is typically composed of oyster-encrusted boulders and rubble in the coastal margins. It supports an array of organisms including algal flora, barnacles, oysters and tubeworms. It is widespread throughout Port Curtis and is known to occur at the intertidal zone immediately south of Laird Point and Hamilton Point. The maximum direct loss of reef and rock habitat is predicted to be 0.14 hectares and would be localised to launch site 4N.

[5] M Rasheed, R Thomas, A Roelofs, K Neil and S Kerville 2003, *Port Curtis and Rodds Bay seagrasses and benthic macro-invertebrate community baseline survey*, November/December 2002, Department of Primary Industries and Fisheries, Queensland.

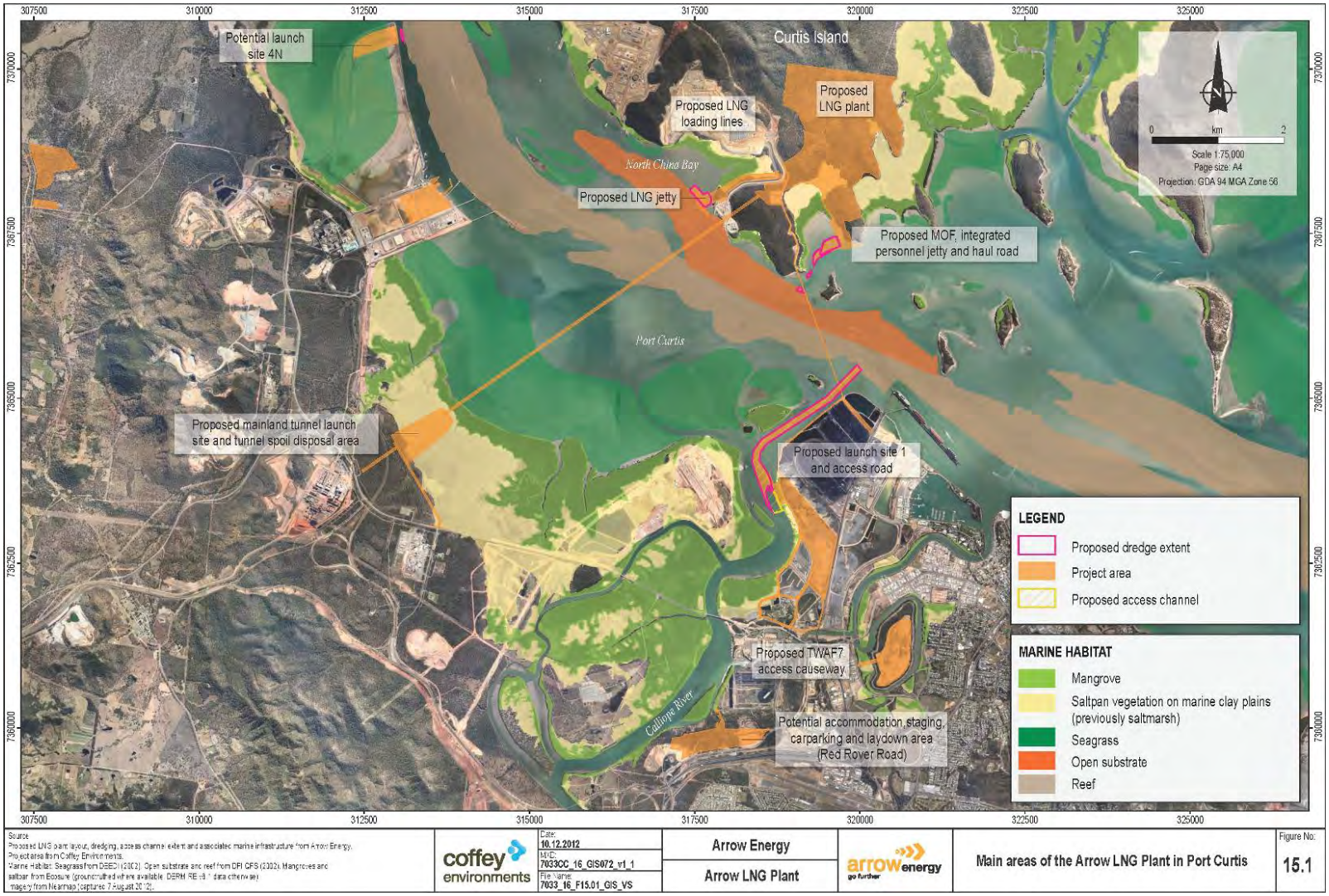

Figure 6.3 Marine habitat distribution in Port Curtis

Saltpan vegetation

The most extensive areas of saltpan vegetation in Port Curtis are around Targinie Creek and in the inner embayments of North China Bay and Boatshed Point. The Port Curtis region has approximately 4573 hectares of saltpan vegetation.[6] Species present include halophytic grasses such as salt couch (*Sporobolus virginicus*) and saltmarsh species such as the bead weed (*Sarcocornia quiniqueflora*). The estimated maximum direct loss of saltpan vegetation due to the project is around 55 hectares. The majority of loss would be associated with the mainland tunnel launch site and the Curtis Island marine infrastructure.

Mangroves

Mangroves occupy the intertidal margins of much of Port Curtis. Extensive areas of mangroves occur around Port Curtis and Curtis Island. The largest extent, 306 hectares, occurs within Targinie Creek.

Five mangrove species were recorded in Port Curtis including red mangrove (*Rhizophora stylosa*), yellow mangrove (*Ceriops tagal*), grey or white mangrove (*Avicennia marina*), myrtle mangrove (*Osbornia octodonta*), and black or river mangrove (*Aegiceras corniculatum*). Of these, the red mangrove is the most widespread and dominant.

The Port Curtis Ecosystem Health Report Card suggests that the mangroves within Port Curtis are generally resilient where normal tidal inundation occurs. The EIS states that the maximum direct loss of mangrove habitat would be 5.1 hectares.

Seagrass

Seagrass beds are scattered throughout Port Curtis. The main beds are in the west close to Gladstone and Fishermans Landing. The combined area of all intertidal seagrass beds in Port Curtis is approximately 4500 hectares. Six seagrass species are present in Port Curtis.

Annual monitoring of seagrass beds within Port Curtis has been conducted since 2004. In 2006, the seagrass beds were generally healthy and had recovered from the low of 2005.

Seagrass beds are not expected to be directly affected by construction activities because they are situated outside the project construction and dredging footprints. Indirect impacts by sediment plumes from dredging could affect seagrass beds, particularly at Boatshed Point. The EIS states that any impacts on the Boatshed Point seagrass beds will be short term and localised.

Fish habitat areas

The EIS reported that the project does not contain and therefore will not disturb any areas of fish habitat declared under the Fisheries Regulation 2008. The closest areas of declared fish habitat are the Colosseum Inlet, 20 kilometres south of Gladstone, and

[6] K Danaher, M Rasheed and R Thomas 2005, *The intertidal wetlands of Port Curtis*, Department of Primary Industries and Fisheries, Queensland.

the Fitzroy River, near the northern end of Curtis Island and south-east of Rockhampton.

Table 6.3 below outlines the estimated loss of marine habitats as a result of project construction at each project location.

Table 6.3 Estimated loss of marine habitats for project construction

Wetland classification	Location	Area (ha) potentially affected during construction
Coastal/subcoastal floodplain tree swamps	LNG plant	11.3
	Launch site 1	1.7
Estuarine salt flats and salt marshes	LNG plant	1.7
	TWAF 7	1.3
	Mainland tunnel launch site	55.2
Estuarine mangrove and related tree communities	Boatshed Point MOF	<0.1
	TWAF 7	<0.1
	LNG plant	5.78

Source: Arrow EIS, Table 13.9

6.5.2. Impact mitigation measures

The proponent has committed to several mitigation measures to reduce impacts to marine habitats including keeping dredging and construction activities within the designated boundaries of work sites (Appendix 4, C19.08). These activities will be managed through dredge and construction management plans. A rehabilitation management plan will also be developed and implemented for intertidal areas that will be used temporarily during construction activities.

The proponent has committed (Appendix 4, C17.02A) to developing and implementing an offsets plan that includes marine habitat offsets.

6.5.3. Coordinator-General's conclusions

I am satisfied that the proposed construction and operation activities as defined, are necessary for the project. Detailed development plans will need to demonstrate that the extent of habitat loss is minimised.

All habitat types could be directly affected by the project with the exception of seagrass beds (refer to 'Seagrass' on page 33) which are likely to be indirectly impacted by sediment plumes from dredging.

I note that the proponent has identified several mitigation strategies in the EIS, including an offsets strategy and construction, dredge and rehabilitation management plans. An offset package is currently being developed by the proponent.

I have stated conditions to ensure the appropriate management of marine habitat (Appendix 2, conditions D1, D6-D8).

6.6. Marine fauna

6.6.1. Baseline assessment

Marine fauna studies involved database searches and reviews of literature and aerial imagery and marine megafauna sighting survey conducted by Coffey Geotechnics between June and October 2012.

The EIS also detailed studies on the spatial and temporal use of the Calliope River and adjacent areas by marine fauna.

6.6.2. Cetaceans

Cetaceans most likely to be found regularly within Port Curtis are the Australian snubfin dolphin (*Orcaella heinsohni*) and the Indo-Pacific humpback dolphin (*Sousa chinensis*).

Australian snubfin and Indo-Pacific humpback dolphins occupy shallow coastal waters in or adjacent to modified environments within Port Curtis. These habitats support foraging and mating activities.

A survey conducted between February to April 2011 and in June 2011 suggests that approximately 65 humpback dolphins live in Port Curtis. The blue whale (*Balaenoptera musculus*) has been previously sighted in the Port Curtis region but is only likely to occur offshore on the continental shelf where there is upwelling and significant krill production.

During the 2009/10 financial year, 1430 marine vessels had travelled through Port Curtis. Between 2001 and 2010, one to three marine megafauna mortalities from boat strike were recorded in Port Curtis.[7] At least one humpback dolphin mortality, due to boat strike, was recorded over a four-month period in 2011.

Possible boat strike and impacts from underwater noise are the main project-related concerns for cetaceans in Port Curtis. Increased shipping activity could increase the risk of injury to cetaceans. Underwater noise from pile driving and shipping activity can disrupt cetacean behaviour.

6.6.3. Dugongs

The dugong (*Dugong dugon*) is listed as a protected migratory species under the EPBC Act and as a vulnerable species by IUCN (2010) and the Nature Conservation Act. The entire study area falls within a dugong protection area.

Thirteen separate sightings of dugongs were recorded between June and October 2012 within Port Curtis. Most were sighted close to the entrance channel to the Calliope River. There is anecdotal evidence of dugong activity in waters near the power station. At least one of three dugong mortalities was identified as a result of boat strike between January 2011 and September 2012.

[7] D. Orgill, DNPRSR, 2012

Dugongs are vulnerable to boat strike, underwater noise and destruction or fragmentation of habitat from project activities. Sediment plumes affecting seagrass beds may indirectly impact dugongs.

6.6.4. Marine turtles

Three species of marine turtles nest and forage within the GBRMP and the GBRWHA around Curtis Island. They are the flatback turtle (*Natator depressus*), green turtle (*Chelonia mydas*) and loggerhead turtle (*Caretta caretta*). The flatback turtle is the most common species in the Port Curtis region with 51 females nesting at Connor Bluff, Curtis Island.

Between June and October 2012, 49 marine turtles were recorded within Port Curtis and the Calliope River. Some individuals nest within Port Curtis. Both flatback and green turtles occasionally nest on the beaches near Southend. Loggerhead turtles nest intermittently in the Port Curtis region.

Forty turtle mortalities were recorded between January 2011 and September 2012 that were identified as being a result of boat strike.

Marine turtles in Port Curtis are vulnerable to direct impacts from boat strike and underwater noise. They are also likely to be exposed to project lighting at the nesting beaches of Curtis Island and Facing Island. Marine turtles may also be indirectly impacted by seagrass habitat affected by sedimentation from dredging.

6.6.5. Impact management strategies

The EIS assessment showed that the construction and operation of the project could involve direct and indirect impacts on marine fauna within Port Curtis. Sedimentation and turbidity plumes, underwater noise, risk of boat strike and project lighting have been identified as the likely potential impacts.

Habitat loss

Habitat loss and degradation is to be managed by restricting dredging activities to within the identified dredge footprint area and by complying with an approved dredge management plan. Indirect impacts from construction activities are also to be managed by keeping activities within the designated work boundaries. A rehabilitation management plan is also to be developed and implemented for intertidal areas that are used during construction works.

Shipping operations

Risk of boat strike would be minimised through compliance with the applicable speed limits for the Port of Gladstone-Rodds Bay Zone B dugong protection area (C19.04) and by installing propeller guards on high-speed vessels (C19.05).

Underwater noise

Underwater noise is to be managed by implementing soft-start procedures prior to pile driving activity. The proponent has also committed (Appendix 4, C19.13) to evaluate the use of bubble curtains during pile driving. Additionally, pile driving activities are to

temporarily stop to allow animals to move away from the area if they are sighted within 500 metres or within the relevant distance at which point underwater noise levels reach 183 decibels.

Lighting

Lighting impacts on turtles are to be managed by directing the light source onto the working area and shielding the light from the habitat areas. A light mitigation plan will be developed by the proponent. The proponent has also committed (Appendix 4, C19.15) to participate in monitoring programs established to assess the impact of current and future industrial lighting in the Gladstone region on hatchlings emerging on the beaches of Curtis and Facing islands.

Active fauna-spotting will be conducted during shipping, pile driving and dredging activities. Pile driving and dredging will temporarily cease until the animal has moved away from the area.

In its response to the EIS, SEWPaC recommended the following impact management measures, that I support:

- the proponent implement procedures such as stopping activities or using soft-start procedures for pile driving if marine mammals, turtles or crocodiles are spotted in the area of pile driving or dredging
- pile driving and dredging be restricted to daylight hours only
- indirect offsets should be provided for underwater noise impacts, for example through conducting research into cumulative noise impacts on marine species in Gladstone Harbour.

DEHP advised that the proponent should consider bubble curtains and active fauna sighting during pile driving activities. The agency also suggested that two underwater noise loggers are to be deployed within Port Curtis, and data must be retrieved during and after piling operations.

SEWPaC and DEHP suggested similar measures to mitigate impacts of pile driving on marine fauna. They recommended that pile driving should be suspended if dolphins, dugongs or turtles are sighted by a suitably qualified person, until the animal has left the buffer zone.

6.6.6. Coordinator-General's conclusions

Dugongs and turtles are at risk of injury from boats due to increased shipping activity. The proponent has committed to prepare a construction environmental management plan that will include detailed information about significant fauna species and their management and ongoing conservation (Appendix 4, C17.01). The proponent has also committed (Appendix 4, C19.07) to implementing a marine fauna observation system during all shipping activity to reduce the risk of incidence. Propeller guards are to be installed on vessels (Appendix 4, C19.05) and the proponent commits (Appendix 4, C19.04) to comply with requirements for operating vessels for the Port of Gladstone-Rodds Bay Zone B dugong protection area, as detailed in the management plan. I also note the proponent's commitment to consider the use of bubble curtains (Appendix 4, C19.13) and minimise lighting impacts (Appendix 4, C17.47).

I agree with DEHP and SEWPaC's recommendations regarding measures to minimise underwater noise impacts to marine megafauna.

Indirect impacts to seagrass beds due to sedimentation from dredging may affect dugongs and turtles. The impacts are expected to be temporary due to strong tidal currents moving sediment from potentially affected seagrass habitats.

I require the following overall outcomes:

- impacts from underwater noise to dolphins, dugongs and turtles minimised to the greatest extent practicable
- the construction environmental management plan address impacts to marine megafauna from shipping activity and pile driving.

I have stated conditions in this report to ensure the appropriate management of underwater noise impacts to marine fauna (Appendix 2, Condition C8).

6.7. Cumulative impacts

The EIS investigated the potential cumulative impacts on the marine environment of the project with existing and planned industrial, dredging and shipping activities.

The EIS stated that the potential cumulative impacts of project dredging activities are limited. Dredging for the project may be undertaken at the same time as dredging for Stage 2 of the WBDD project however the works would be located more than five kilometres apart. The dredge management plan will consider the location and timing of all dredging activities in Port Curtis. Additional modelling work may be necessary to determine the likely extent of any dredge plume interaction and associated impacts.

Increases in vessel frequency and varying navigation routes may interfere with the feeding and movement of marine fauna with some species susceptible to boat strike and underwater noise. The main shipping channel is located away from the seagrass feeding areas and the zones of impact risk are not increased; however, the level of risk to animals that cross shipping channels will increase relative to increased shipping activity. The EIS stated that the potential cumulative impacts of boat strike will be

identified and managed as part of the development of a shipping activity management plan, which will include adherence to speed limits.

Increased lighting emanating from the LNG projects on Curtis Island also has the potential to modify the behaviour of turtles in the study area. Of the LNG projects, the proposed Arrow project has closest proximity and a direct line of view to the nearest turtle nesting beach at Southend, eight kilometres away. The EIS assessed cumulative impacts to be low, given the distance from the source and assuming other LNG projects implement similar mitigation measure to those proposed by Arrow.

6.7.1. Coordinator-General's conclusions

I am satisfied that the EIS has adequately investigated the project's cumulative impacts on the marine environment to the extent possible at this stage of the project's development. I consider that residual cumulative impacts can be reduced to acceptable levels with the implementation of mitigation measures and commitments proposed by the proponent in the EIS and the conditions of the EA.

7. Water resources

7.1. Surface water

The EIS acknowledged that wetlands are important to surface water hydrology and have a role in regulating drainage and overland flow. Riparian vegetation is important in maintaining the morphology of watercourses by stabilising banks and moderating flows by increasing roughness and subsequently reducing velocities.

Construction works will involve vegetation clearing and earthworks, potentially increasing surface water flows. This increases the risk of soil erosion and could result in sedimentation of downstream waterways. Without mitigation measures, erosion and sedimentation of waterways could result in reduced water quality such as an increase in fine sediment loads and associated nutrients and contaminants, and loss of in-stream habitat, which could have a detrimental impact on aquatic ecology.

The EIS identified potential for soil erosion and sedimentation to occur following vegetation clearing and earthworks. To manage potential impacts the proponent has committed to implementing sediment and erosion control measures upslope of watercourses, wetlands and coastal areas or in areas with sodic soils to minimise increases in natural sediment discharge (Appendix 4, C11.11). Measures would include sediment traps, silt fencing, riprap, contour banks, detention dams, sediment ponds and vegetation and diversion berms.

In its submission on the EIS, DEHP advised that more details of a surface water quality monitoring program and auditing process need to be provided by the proponent. In response to DEHP's submission, the proponent advised that a number of detailed site environmental monitoring programs and management plans will be developed for the project during detailed design, prior to construction commencing.

7.1.1. Coordinator-General's conclusions

I require the proponent to meet its commitment in the EIS to develop and implement detailed site environmental monitoring programs and management plans. I require the following outcomes in relation to the management of surface water:

- prevention or minimisation of the release of contaminants to waters
- water quality not adversely impacted by discharges to receiving waters
- species richness and diversity of aquatic flora and fauna within receiving waters not adversely impacted
- development and implementation of a REMP to monitor, identify and describe adverse impacts to surface water quality, water flows and aquatic flora and fauna of any receiving waters.

I have stated conditions that ensure the appropriate management of surface water (Appendix 2, conditions D1–D2, D6–D8).

7.2. Groundwater resources

The EIS assessed groundwater impacts for the LNG plant site and marine infrastructure on Curtis Island, the proposed TWAFs, launch site 1 and the feed gas pipeline and mainland tunnel entrance. Launch site 4N and dredge sites were excluded from the impact assessment as these sites are in the marine environment where groundwater impacts are not relevant. No registered groundwater entitlements are allocated within the study area as groundwater is not regulated in the study area.

7.2.1. Existing environment

Groundwater recharge

The EIS reported that diffuse recharge is likely to be the dominant recharge process for shallow aquifer systems, due to relatively high rainfall in the study area. Diffuse recharge involves deep percolation of infiltrated rainwater through the subsurface to the watertable. Long-term average (2000 to 2009) recharge rates on the mainland have previously been measured as approximately 14 mm per year in upland tree covered areas to approximately 49 millimetres per year in lower lying grassland areas.[8] Groundwater recharge on Curtis Island has been estimated to be 1 millimetre per year for shallow aquifers and 3 millimetres per year for deep aquifers.[9]

Groundwater levels and bore yields

The EIS study of the existing environment found groundwater levels within the shallow aquifer system on Curtis Island inside the project area between 0.01 and 3.2 metres below ground level.[10] Groundwater levels in the adjacent Santos GLNG project area range from 1.6 to 4.6 metres below ground level in the shallow alluvial/estuarine deposits and 2.4 to 22.5 metres below ground level in bedrock aquifers.[9]

Previous studies have identified groundwater levels on the mainland (along a coastal strip to the northwest of the study area) between 0.7 and 2.8 metres below ground level.[8]

Groundwater quality

The EIS reported that groundwater resources, as assessed from data for boreholes located in the vicinity of the study area are limited and mainly of poor quality, ranging from marginally fresh to brackish and saline water.

Groundwater in the shallow alluvial/estuarine deposits on the mainland can be classified as sodium-chloride type. Measured electrical conductivity (EC) values ranged from 6900 to 61 900 microsiemens per centimetre indicating brackish to saline groundwater.[8] Measurements of pH ranged from neutral to slightly acidic. The high EC indicates that the groundwater within the mainland study area is generally unsuitable for drinking, stock watering and irrigation.

---

[8] GHD 2009
[9] URS 2009
[10] Coffey Geotechnics 2009

Groundwater on Curtis Island within the study area is sodium-chloride type. Data from groundwater bores indicate a broad range of salinity ranging from about 22 000 to 158 000 microsiemens per centimetre indicating a range of brackish and saline, to hypersaline.[11]

Elevated levels of dissolved chromium, cobalt, copper and zinc in concentrations exceeding ANZECC/ARMCANZ (2000) guidelines for freshwater and marine ecosystems were observed for some shallow and deep groundwater systems.

7.2.2. Impacts to groundwater resources

A number of groundwater impacts were identified in the EIS as potentially having very low to moderate significance. These impacts are discussed below.

Groundwater disturbance and dewatering

Clearing of vegetation, resurfacing with impermeable materials and ground compaction during construction of all project areas may reduce infiltration rates and recharge to shallow unconfined groundwater systems on Curtis Island and the mainland. Changes to overall groundwater recharge will be minimal due to the relative small area of aquifer affected, compared with aquifer extent. The bulk of aquifer recharge on Curtis Island and the mainland most likely occurs in locations outside the project footprint.

Groundwater contamination

Shallow groundwater quality could be affected through unintentional spills and leaks of hazardous materials. Contaminants entering the groundwater system can migrate to deeper groundwater systems vertically and horizontally through the aquifer. Contaminated shallow groundwater could migrate to deeper groundwater systems and impact groundwater-dependent ecosystems.

Leaks of brine water from the reverse osmosis plant and the sanitation and domestic wastewater systems could contaminate groundwater systems at the LNG plant site. Contaminated groundwater could migrate off site and affect groundwater-dependent ecosystems in discharge wetlands, streams and estuaries in the lower lying areas of the LNG plant.

Unintentional spills and leaks of drilling fluids, chemicals and hydrocarbons used during construction of the tunnel and pipeline could contaminate shallow groundwater systems and persist over time. Any contamination in shallow aquifers could migrate off site through the groundwater system. No groundwater-dependent ecosystems are likely to be impacted in the vicinity of the feed gas pipeline.

At the TWAFs and launch site 1, unintentional spills and leaks from petroleum-based fuels from excavators and construction machinery, chemicals and wastewater could reach shallow groundwater and degrade its quality. Potential spills in the management of waste from sanitation and domestic waste systems could degrade groundwater quality in shallow aquifers. At launch site 1, TWAF 7 and TWAF 8, impacts could occur both on and off site and across aquifers; impacts could persist over time.

[11] Coffey Geotechnics 2011

Degradation of groundwater quality through disturbance to acid sulfate soils

The construction of marine infrastructure and haul roads on Curtis Island will involve excavation in low lying areas where marine/estuarine sediments may generate acid from oxidation of sulfide minerals in the potential ASS. This may cause the acidification and degradation of shallow groundwater quality. The resultant low pH conditions could lead to the mobilisation of metals in groundwater and subsequent discharge to the sea.

Excavation activities for the feed gas pipeline and mainland tunnel entrance have the potential to cause deterioration in groundwater quality due to the exposure of ASS where they occur. Construction of TWAF 7 and launch site 1 near low-lying areas along Auckland Creek may generate acid groundwater conditions due to exposure of ASS.

7.2.3. Management of impacts to groundwater

The proponent stated in the EIS that a groundwater monitoring program will be established prior to construction. A construction management plan that includes monitoring requirements will be prepared prior to commencement of construction. Groundwater level monitoring will be undertaken on a quarterly basis during the operational stage.

The proponent has made several commitments to mitigate the impacts to groundwater including:

- design of the facility drainage system such that accidental releases of hazardous substances are collected to reduce the chance of contamination seeping into the groundwater system (C14.01)
- preparation of a materials handling and waste management plan to manage any potential contaminants, soils or materials that might result in impacts on shallow groundwater through either short-term or long-term leaching (C14.02)
- minimisation of the extent and duration of construction dewatering (C14.03)
- development of an ASS management plan prior to construction work commencing (C12.17)
- minimise the storage of brine products (C14.07)
- implementation of engineering controls to minimise the extent of aquifer drawdown and saline encroachment (C14.09).

In response to the EIS, DNRM recommended that the groundwater monitoring program also include monitoring of the deeper bedrock aquifers (20–40 metres). This is due to uncertainty in relation to the functioning and interaction of the aquifers and the potential for dewatering effects during construction of infrastructure, such as the tunnel. DNRM recommended that the deeper monitoring bores be located where the larger impacts are likely to be felt, such as near the entry and exit points of the proposed tunnel. I concur with DNRM's recommendation on this matter and have made a recommendation to this effect (Appendix 3, Part D, Recommendation 9).

DNRM also recommended that the proponent review existing monitoring bores to see if they would be suitable for monitoring the bedrock aquifers (e.g. GW1, GW2D and GW4D on the island and BH35 on the mainland). I note the proponent has advised that

these existing monitoring bores have now been decommissioned and will not be available for further monitoring.

In response to the EIS, DNRM also recommended that construction and operational works maintain adequate freshwater outflows to The Narrows and the natural wetlands in the plan area. DNRM also recommended that the proponent's statutory environment management plan (EM plan) take into account the Water Resource (Calliope River Basin) Plan 2006 and the Calliope River Basin Resource Operations Plan 2006.

Arrow provided further information in response to the DNRM submission, advising that the project proposes no direct extraction of water from resources within the Calliope River Basin and that the project proposes no activity that is likely to impact on the freshwater outflows to The Narrows. Arrow further advised that where the project proposes facilities such as launch sites and TWAFs, potential contamination to freshwater resources will be managed through appropriate environmental controls that will be fully detailed in a statutory EM Plan to be submitted at the time of application for EA to conduct ERAs.

I am satisfied that Arrow will adhere to the outcomes of the Water Resource (Calliope River Basin) Plan 2006 and the Calliope River Basin Resource Operations Plan 2006 and will address potential contamination to freshwater resources in detail when applying for an EA.

7.2.4. Coordinator-General's conclusions

I consider that the assessment contained within the EIS adequately demonstrated that the impacts of project activities on groundwater are expected to be minor. I note that the proponent has made several commitments in this regard and I am satisfied that potential impacts to groundwater will be adequately mitigated. However, due to uncertainty in relation to the functioning and interaction of the aquifers, I recommend that the groundwater monitoring program proposed by Arrow be extended to include deeper monitoring bores. I expect the following outcomes:

- water sampling undertaken in accordance with all relevant guidelines
- management and monitoring of groundwater to minimise the potential for contamination seeping into the groundwater system
- extension of the ground water monitoring program to include deeper aquifers at higher risk locations.

I have stated conditions that ensure the appropriate monitoring of groundwater (Appendix 2, Condition H4) and made a recommendation to monitor deeper aquifers (Appendix 3, Part D, Recommendation 9).

8. Terrestrial flora and fauna

8.1. Existing environment

A detailed literature review and field surveys for the EIS, recorded a total of 199 vertebrates, 293 native flora species and 56 introduced flora species. None of the flora species and a minority of fauna species are listed under state or Commonwealth conservation legislation.

8.1.1. Curtis Island

The LNG plant site is predominantly eucalypt woodland with saltpan and mangrove vegetation occupying the intertidal zones (refer Figure 8.1 below). Two broad overland drainage basins occur within the central and northern portions of the site, that support relatively intact sclerophyllous open forest.

A potential new taxon (*Cupaniopsis sp. indet.*) that appears to be closely related to a threatened flora species (*Cupaniopsis shirleyana*) was identified within the LNG plant site at Curtis Island.

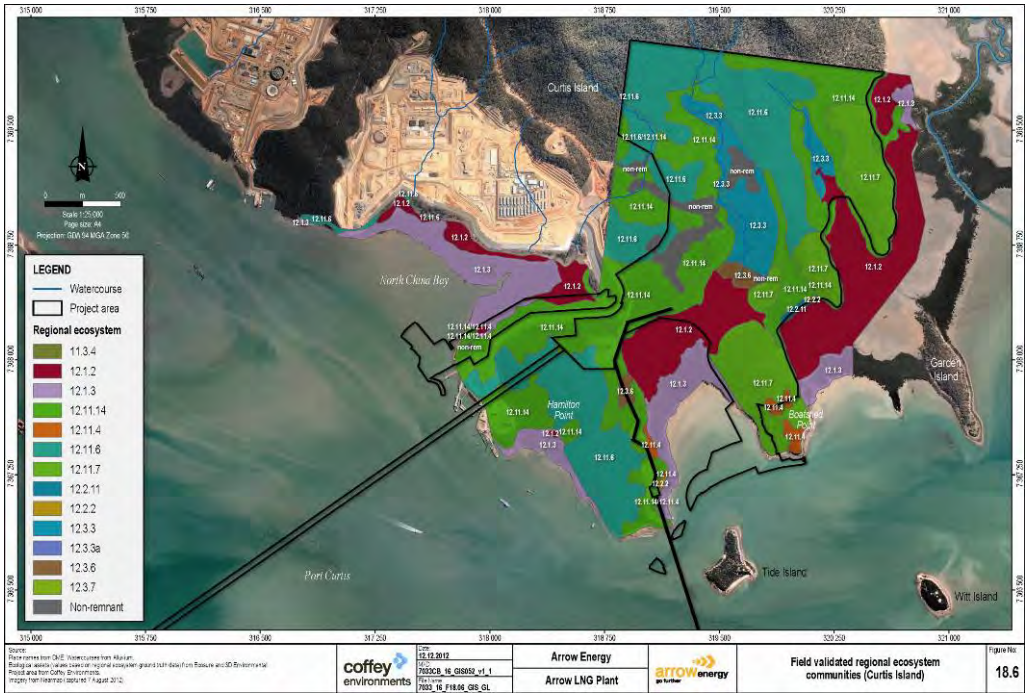

Figure 8.1 Field validated RE communities (Curtis Island)

8.1.2. Mainland

Mainland tunnel launch site and spoil disposal area

The area surrounding the mainland tunnel launch site and spoil disposal area contains predominantly intact sclerophyllous open forest inland of the high water mark (refer Figure 8.2). Areas of the forest contain essential habitat for the koala (*Phascolarctos cinereus*), which was listed as 'vulnerable' under the EPBC Act in 2012. Neither koalas

nor evidence of their presence were identified during field surveys. Local advice suggests that the species is extremely rare along the coast near Gladstone.

Saltpan is the predominant habitat at the project site. Mangroves occupy the coastline, separating the saltpan habitat from the mudflats on the eastern side of the mangroves. The saltpan is potential shorebird roosting and feeding habitat, but is not considered to be significant to the species.

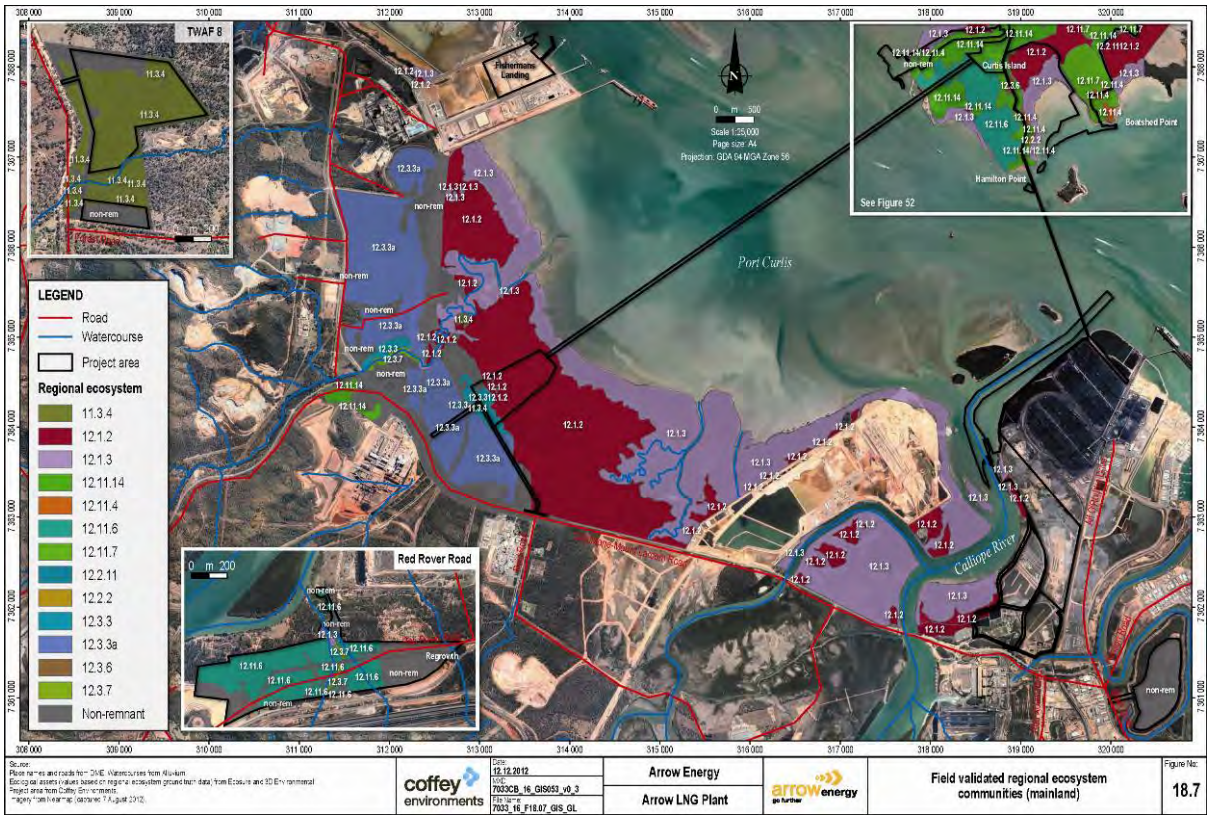

Figure 8.2 Field validated RE communities (mainland)

Temporary workers accommodation facilities

TWAF 7 on the western bank of Auckland Creek, does not contain any remnant vegetation. The EIS reported that the site is considered to be of low conservation significance.

TWAF 8 contains woodland to open forest habitat types. The site contains essential habitat for coastal sheath-tail bat (*Taphozous australis*) and koala and potential habitat for the squatter pigeon (*Geophaps scripta scripta*), grey-headed flying fox (*Pteropus poliocephalus*) and square-tailed kite (*Lophoictinia isura*).

Launch site 1

Potential habitat for the water mouse (*Xeromys myoides*), which is listed as 'vulnerable' under both state and Commonwealth legislation, is present at launch site 1.

Shorebirds may use the habitat at launch site 1 and an important shorebird roosting habitat is located nearby at Clinton ash ponds.

8.2. Terrestrial flora

Native vegetation proposed to be cleared within the project area is listed in tables 8.1, 8.2 and Table 8.3 below according to conservation status.

The EIS reported that the potential new taxon (*Cupaniopsis sp.indet.*) is unlikely to be directly impacted by the project but the vegetation patch at Boatshed Point could be indirectly impact through edge effects.

The vine thicket and *Cupaniopsis* communities will not be cleared for the project but may be impacted indirectly from weed and pest invasion, incidental clearing and degradation. The proponent has committed (Appendix 4, C17.03A) to reduce these impacts by clearly marking prohibited access zones around the margins of the communities. Weed management and pest control measures will also be implemented to reduce indirect impacts.

Table 8.1 'Endangered' RE to be cleared within the proposed project area (maximum)

RE	Short description	Location on project site	Area (ha)
12.3.3	*Eucalyptus tereticornis* woodland to open forest on alluvial plains	Curtis Island	29.86
		Mainland tunnel launch site	7.87
Total area			37.73

Table 8.2 'Of concern' REs to be cleared within the proposed project area (maximum)

RE	Short description	Location on project site	Area (ha)
11.3.4	Eucalyptus tereticornis and/or Eucalyptus spp. tall woodland on alluvial plains	TWAF 8	23.91
12.11.4	Semi-evergreen vine thicket on metamorphics ± interbedded volcanics	Curtis Island	0.66
12.11.14	*Eucalyptus crebra, Eucalyptus tereticornis* woodland on metamorphics ± interbedded volcanics	Curtis Island	74.74
Total area			99.31

Table 8.3 'Least concern' REs to be cleared within the proposed project area (maximum)

RE	Short description	Location on project site	Area (ha)
12.1.2	Saltpan vegetation including grassland, herbland and sedgeland on marine clay plains	Mainland tunnel launch site	32.5
		Launch site 1	4.5
		Curtis Island	17.49
		TWAF 7	0.52
		Total	**55.01**
12.1.3	Mangrove shrubland to low closed forest on marine clay plains and estuaries	Red Rover Road	0.61
		Launch site 1	2.01
		Curtis Island	2.48
		TWAF 7	0.21
		Total	**5.1**
12.2.11	*Corymbia spp., Eucalyptus spp., Acacia spp.* Open forest to low closed fores on beach ridges in northern half of bioregion	Curtis Island	0.47
12.3.6	*Melaleuca quinquenervia, Eucalyptus tereticornis, Lophostemon suaveolens* woodland on coastal alluvial plains	Curtis Island	2.62
12.11.6	*Corymbia citriodora, Eucalyptus crebra* open forest on metamorphics ± interbedded volcanics	Red Rover Road	22.71
		Curtis Island	68.14
		Total	**90.85**
12.11.7	*Eucalyptus crebra* woodland on metamorphics +/- interedded volcanics	Curtis Island	59.45
Total area			**213.5**

The proponent has committed to several mitigation measures to minimise impacts to terrestrial flora including demarcating and restricting access to an area of semi-evergreen vine thicket community that contains *Cupaniopsis*, and connecting it to the environmental management precinct via a wildlife corridor (Appendix 4, C17.03A and C17.04).

Vegetation clearing will be reduced where practicable and only after all other options, such as selective clearing and trimming of vegetation, have been considered (C17.27). Trees to be retained will be clearly marked to avoid accidental clearing and the root zone of such trees will be protected (C17.28). Access tracks are to be clearly marked prior to initiation of works to prevent secondary tracks becoming established (C17.14).

If TWAF 8 is selected, it will be designed to minimise disturbance to the 'of concern' RE 11.3.4 (refer Table 8.2) to maintain connectivity of habitat along the Targinie Creek riparian zone (C13.04).

8.2.2. Terrestrial ecology cumulative impacts

The EIS reported on the combined impact on regional ecosystems from 16 major projects in the Gladstone area, including the Arrow LNG project. In summary:

- Less than 0.5 per cent of the overall area of each regional ecosystem in the south-eastern Queensland bioregion will be cleared as a result of the combined project impacts. RE 11.3.4 'of concern' *Eucalyptus tereticornis* and/or *Eucalyptus spp.* tall woodland on alluvial plains, would be the most significant loss of RE type within the GRC area. The loss would be approximately 0.26 per cent at the state level. RE 12.11.14 'of concern' *Eucalyptus crebra, Eucalyptus tereticornis* woodland on metamorphics with or without interbedded volcanics, will be reduced by approximately 0.5 per cent at a bioregion level. The 'endangered' RE 12.3.3, *Eucalyptus tereticornis* woodland to open forest on alluvial plains will be reduced by approximately 0.5 per cent at the bioregion level.
- The three existing LNG projects (APLNG, GLNG, QCLNG) and the Arrow LNG Plant proposed be developed in the CIIP, covers less than three per cent of Curtis Island.

8.2.3. Coordinator-General's conclusions

I accept that the proposed clearing of native vegetation would be a necessary part of the project and will have a minor impact overall on the representation of individual vegetation associations on Curtis Island. I am also satisfied that the proponent has adequately investigated the project's cumulative impacts on terrestrial ecology. Detailed development plans will need to demonstrate that the extent of clearing is minimised.

I consider that residual impacts can be reduced to acceptable levels with the implementation of mitigation measures and commitments (C13.04, C17.03A, C17.04, C17.14, C17.27, C17.28) proposed by the proponent in the EIS and supplementary material and the conditions of the EA.

I note that the proponent has investigated vegetation offsets. An offsets plan that includes vegetation offsets must to be developed and approved by SEWPaC and the Coordinator-General.

I expect the following outcomes:

- adverse impacts on terrestrial flora minimised
- development of an offsets plan to include impacts of clearing native vegetations (further detail on vegetation offsets is provided in Section 13).

I have stated conditions in this report to ensure the appropriate management of impacts to terrestrial flora (Appendix 1, Condition 2 and Appendix 2, Condition F1(a)).

8.3. Terrestrial fauna

EIS desktop studies identified a total of 54 fauna species as potentially occurring within the study area, of which 12 are endangered, vulnerable, or near-threatened (EVNT) under the NC Act or EPBC Act. The EVNT species are presented in Table 8.4 below.

Field assessments were undertaken between 2009 and 2013. A total of 199 vertebrate species was identified in all field surveys. The majority of the species identified are not listed under the NC Act or EPBC Act. The presence of two EVNT species were recorded during field surveys, including the glossy-black cockatoo (*Calyptorhynchus lathami*) and the water mouse (*Xeromys myoides*).

Table 8.4 EVNT species potentially occurring in the project area

Species	NC Act status	EPBC status
Paradelma orientalis Brigalow scaly-foot	Vulnerable	Vulnerable
Ephippiorhynchus asiaticus Black-necked stork	Near-threatened	Not applicable
Accipiter novaeholliandiae Grey goshawk	Near-threatened	Not applicable
Lophoictinia isura Square-tailed kite	Near-threatened	Not applicable
Geophaps scripta scripta Squatter pigeon	Vulnerable	Vulnerable
Calyptorhynchus lathami Glossy-black cockatoo	Vulnerable	Not applicable
Ninox strenua Powerful owl	Vulnerable	Not applicable
Chalanolobus pictatus Little pied bat	Near-threatened	Not applicable
Pteropus poliocephalus Grey-headed flying fox	Not applicable	Vulnerable
Phascolarctos cinerus Koala	Vulnerable	Vulnerable
Dasyurus hallucatus Northern quoll	Not applicable	Endangered
Xeromys myoides Water mouse	Vulnerable	Vulnerable

The EIS reported that no habitat critical to the survival of any of the species listed in the table above was identified in the project area. However, the 'critically endangered' Littoral Rainforest and Coastal Vine Thickets of Eastern Australia habitat is known to support the grey-headed flying fox and the black-breasted button-quail (*Turnix melanogaster*).

Impacts to the patch of this vegetation community adjacent to the project area on the eastern side of Hamilton Point have been minimised through plant layout design. A wildlife corridor will be established to maintain connectivity between the habitat and the environmental management precinct adjacent to the project site (C17.04).

8.3.2. Water mouse

Records of water mouse activity suggest that the species is distributed throughout mangroves along the south-western shores of Curtis Island. These mangrove habitats were connected or at least separated by short distances allowing movement between habitat patches. No evidence of water mice was detected at mangrove habitat to the west of the LNG site. Suitable prey was abundant, large hollows suitable for nesting were common and disturbance was minimal, if any. Figure 8.3 below shows the potential water mouse habitat near the project area.

Habitat loss

The most significant project-related impact on water mice at Boatshed Point is habitat loss. The maximum total area of mangroves to be cleared for the project is 5.1 hectares. No nesting structures were identified in the areas proposed to be cleared. Mangroves are proposed to be cleared at launch site 1, the LNG jetty at North China Bay and west of Boatshed Point. Up to 1.7 and 0.8 hectares of mangroves will be cleared at North China Bay and Boatshed Point, respectively. On the mainland, up to 2.6 hectares of mangroves is proposed to be cleared at launch site 1.

Habitat fragmentation

Construction of the access road and maritime infrastructure for the LNG plant would substantially isolate 16.6 hectares of mangrove habitat in the embayment between Boatshed Point and Hamilton Point from habitat areas to the east. Fragmentation of habitat to the west of Boatshed Point is already taking place although the indirect disturbance caused by the existing infrastructure on Hamilton Point may have affected habitat quality. The effect of existing and further fragmentation is unknown without knowledge of the inter-relationship between habitat areas. If a water mouse population is present to the west of Boatshed Point, the viability of the population could be reduced if the loss of connectivity is permanent.

Infrastructure will be designed to reduce impacts on shoreline habitat and the risk of unnecessary clearing will be reduced by demarcating disturbance areas (C17.49). Where impacts cannot be mitigated, they will be offset.

Introduced predators

Introduced predators including feral dogs/dingoes, foxes and feral cats were recorded during field surveys. Observations suggest that they are reluctant to enter mangrove habitat. A pest management program to be developed by the proponent is proposed to mitigate this impact (C17.10).

Lighting

Lighting from project structures and operations may impact the water mouse by increasing predation affecting movement, reducing prey abundance and potentially leading to abandonment of nesting hollows. Light impacts will be localised to areas in close proximity to infrastructure. Impacts will be mitigated and managed by installing and operating low-impact lighting and screens (C17.50).

Changes to hydrology

Changes to natural hydrology, modified water levels and salinity in tidal waterways as a result of project infrastructure, may impact the water mouse and its prey. Crab communities are highly sensitive to changes in water quality. Impacts on crab communities will indirectly affect the water mouse. Potential sources of water quality contamination include increased sedimentation and contaminant runoff. Sediment and erosion control measures will be implemented to reduce impacts to water quality (C11.11).

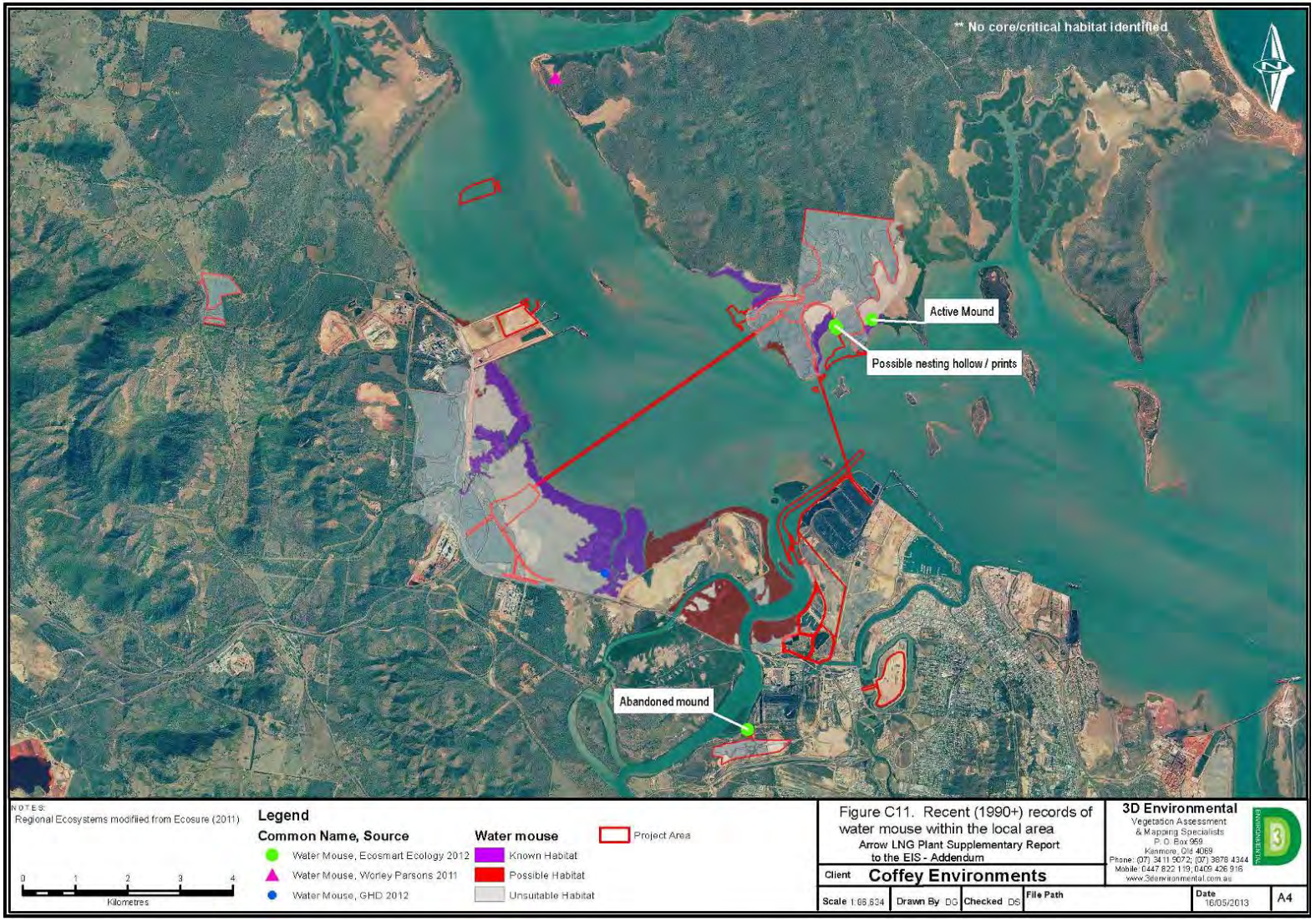

Figure 8.3 Records of water mouse activity adjacent to project area

8.3.3. Coordinator-General's conclusions

I am satisfied that all field surveys and fauna assessments have been carried out appropriately. Mitigation and management strategies to reduce impacts to fauna species are appropriate and adequate. I acknowledge the commitments made by the proponent to reduce and manage impacts to the water mouse. I note that the proponent has offered to offset impacts to water mouse habitat (refer Section 13) that will need to be approved by SEWPac and the Coordinator-General. To manage residual impacts, I therefore require the following outcomes:

- adverse impacts on the water mouse minimised
- development of an offset plan to address impacts to the water mouse.

I have stated conditions in this report to ensure the appropriate management of impacts to terrestrial fauna (Appendix 1, Condition 2, and Appendix 2, conditions F1–3).

8.4. Shorebird ecology

A literature review and five field surveys conducted by the proponent recorded a total of 15 migratory shorebird species in the project area.

'Least concern' species include birds that apply to any of the following:

- *Agreement between the Government of Australia and the Government of Japan for the Protection of Migratory Birds in Danger of Extinction and their Environment* (JAMBA)
- *Agreement between the Government of Australia and the People's Republic of China for the Protection of Migratory Birds and their Environment* (CAMBA)
- *Convention on the Conservation of Migratory Species of Wild Animals* (CMS).

'Least concern' bird species identified during surveys that apply to these agreements include:

- whimbrel (*Numenius phaeopus*)
- white-bellied sea-eagle (*Haliaeetus leucogaster*)
- lesser crested tern (*Thalasseus bengalensis*)
- grey-tailed tattler (*Tringa brevipes)*.

8.4.1. Habitat loss

Approximately 48 hectares of foraging and roosting habitat would be lost due to project construction at launch site 1, MOF at Boatshed Point and the mainland tunnel launch site (refer Figure 8.4 below). However, proposed habitat loss will not have a significant impact on the species as the clearing is minimal and is restricted to secondary habitat.

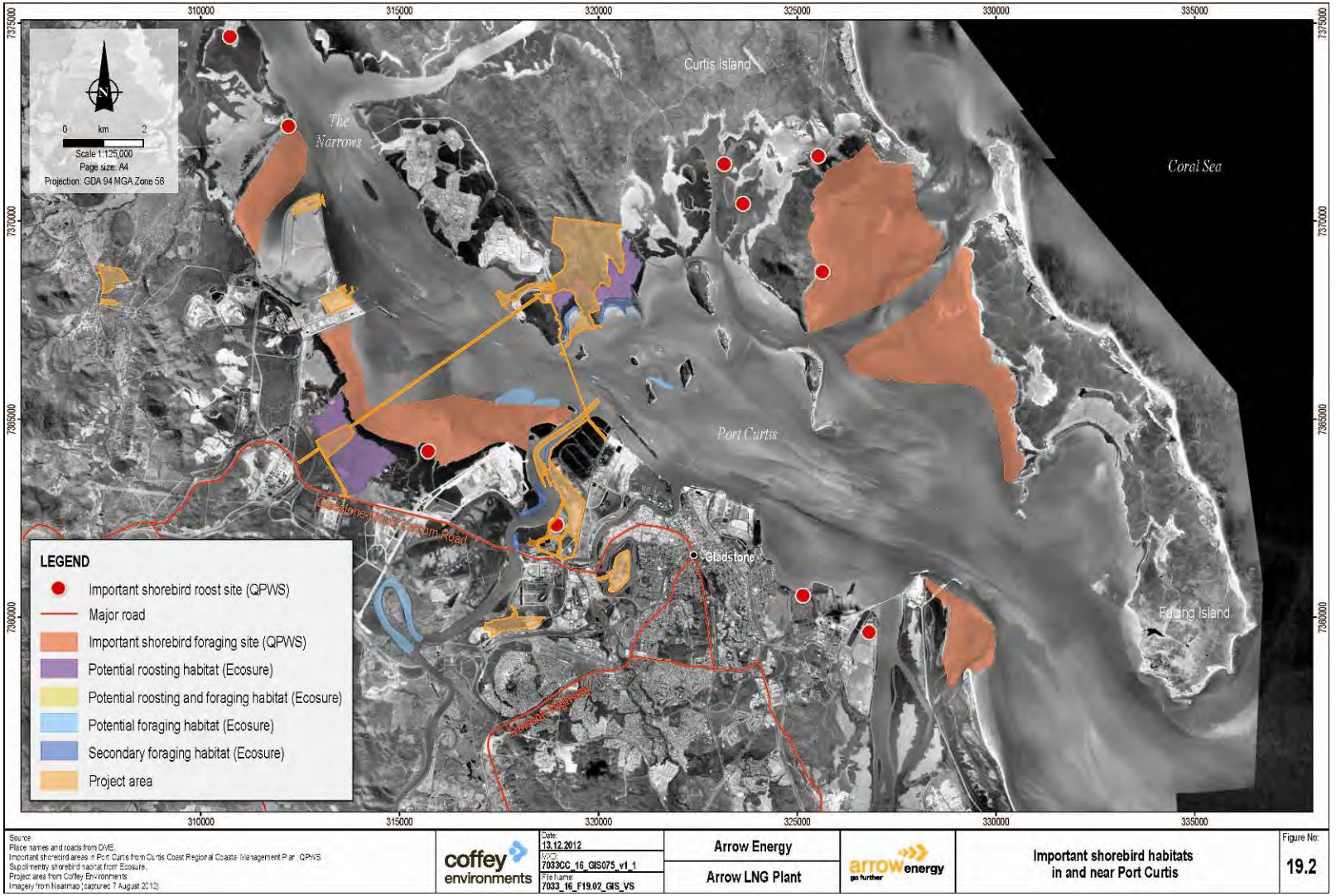

Figure 8.4 Important shorebird habitats in and near Port Curtis

8.4.2. Habitat disturbance

Roosting habitat at the Clinton ash ponds, adjacent to launch site 1, could be indirectly impacted by project lighting and noise. Shorebird studies for the EIS identified that the habitat is already subject to disturbance by other industrial activities and that shorebird populations at the habitat have declined over time. The proponent has committed to reduce indirect impacts to shorebirds roosting at the habitat through several lighting and disturbance mitigation measures (Appendix 4, C17.20, C17.21 and C17.52).

Shorebirds are likely to be displaced from the tidal flats immediately adjacent to the mainland tunnel launch site. The habitat is of secondary quality and does not support large numbers of shorebirds. Impacts to shorebirds at this site are not likely to be significant as there is alternative suitable habitat present within Port Curtis.

Potentially important foraging habitat at the Targinie wetlands, located to the east of mangroves adjacent to the mainland tunnel launch site, may be disturbed or degraded by project activities (refer Figure 8.4 above). The main potential impact on the habitat is erosion, although the mangroves separating the wetlands and the project site will act as a buffer, thus reducing erosion impacts. The proponent has committed to manage erosion by designing the mainland tunnel launch site and spoil disposal area to minimise adverse impacts associated with ground compaction, erosion and surface water runoff (Appendix 4, C11.04).

8.4.3. Coordinator-General's conclusions

I am satisfied that shorebird surveys have been conducted adequately. I acknowledge that no important habitat will be cleared for the project. Up to 48 hectares of secondary habitat will be cleared on the mainland and at Boatshed Point. Shorebirds will also be displaced from the habitat adjacent to the mainland tunnel launch site. I expect the following outcomes:

- minimise any adverse impacts to shorebirds
- development of an offset plan to address impacts to shorebird habitat (further detail on offsets is provided in Section 13).

I have stated conditions in this report to ensure the appropriate management of impacts to shorebird ecology (Appendix 1, Condition 2 and Appendix 2, conditions F1–3).

8.5. Weed and pest management

Unless carefully managed, the importation of materials and machinery to the island has the potential to spread or introduce weeds and pest animal species.

8.5.1. Weed management

A desktop review of the HERBRECS database identified three exotic flora species as likely to occur within the project area. They include the rubber vine (*Cryptostegia grandiflora*), common lantana (*Lantana camara var. camara*) and salvinia

(*Salvinia molesta*), which are recognised as weeds of national significance. Subsequent field surveys confirmed the presence of 56 introduced plant species.

Unless appropriately controlled weeds may displace native species therefore potentially reducing biodiversity, altering hydrological and fire regimes and geomorphic processes.

The EIS pest management plan (EIS, Appendix 10) outlines measures to manage these risks including:

- all vehicles and machinery must be washed down prior to presenting to site
- staff inductions
- inspection of vehicles, materials and clothing by qualified personnel
- planning to minimise vegetation and soil disturbance and to utilise existing road and track networks wherever practicable
- ensuring procedures for treatment and control of pests are current and in accordance with best practice.

8.5.2. Pest management

Ecological surveys located two declared pest fauna species:

- cane toad (*Rhinella marina*)—widely recorded on Curtis Island, it is a key threatening process under the EPBC Act due to biological effects to native species including lethal toxic ingestion
- wild dog (*Canis familiaris*)—recorded at two locations on the mainland, it is a threat to native fauna species as a result of predation. It is declared a Class 2 species under the Land Protection (Pest and Stock Management) Act.

9. Curtis Island precinct

9.1. Overview

The LNG plant will be located at the southern end of Curtis Island adjacent to Boatshed Point, within the CIIP of the GSDA. The plant layout is shown in Figure 9.1 below.

Stage 1 of the development will involve the construction and operation of the first two LNG trains (trains 1 and 2), associated utilities, two LNG storage tanks and ancillary facilities. Site preparation during stage 1 will include development of cut benches for all four LNG trains. The cut benches for trains 3 and 4 will commence during stage 1 only so far as fill material is required for stage 1 and then will be completed during stage 2 when LNG trains 3 and 4, additional utilities and a third LNG tank will be constructed.

GPC will provide the dredging required for shipping access to the LNG facility as part of the WBDD project. Arrow dredging and disposal requirements will, where possible, be integrated with dredging being undertaken as part of the WBDD project.

9.2. Earthworks

Arrow reported in the EIS that construction of the LNG plant will involve extensive earthworks to transform a naturally undulating landscape to a series of platforms. Ridges will be cut into and saddles and gullies will be filled to achieve these level platforms, proposed to be between 10 metres Australian Height Datum (AHD) and 18 metres AHD approximately. The EIS identified that impacts include a large-scale topographic alteration of the project area, with consequent potential erosion, reduction in soil quality and increased sedimentation.

The LNG plant area will be designed to accommodate up to four LNG trains. The site preparation in Stage 1 will be such that only limited site preparation will be required during future expansion for trains 3 and 4. The EIS detailed the construction cut and fill land reclamation requires an estimated 5 820 000 cubic metres of cut and 3 140 000 cubic metres of fill.

Earthworks require infilling of ephemeral waterways which, if found to be defined as ‘watercourses’ under either the *Fisheries Act 1994* or the *Water Act 2000*, must obtain approval from DAFF or DNRM, respectively prior to works commencing.

The EIS stated that areas that will remain exposed until construction of trains 3 and 4, including laydown areas and the LNG train bench, will be stabilised to ensure the exposed soils do not erode. Surface water and stormwater runoff collection and discharge systems will be regularly inspected to ensure they are functioning effectively. Rehabilitation will be regularly inspected and remedial works undertaken to address any failed or failing works or revegetation.

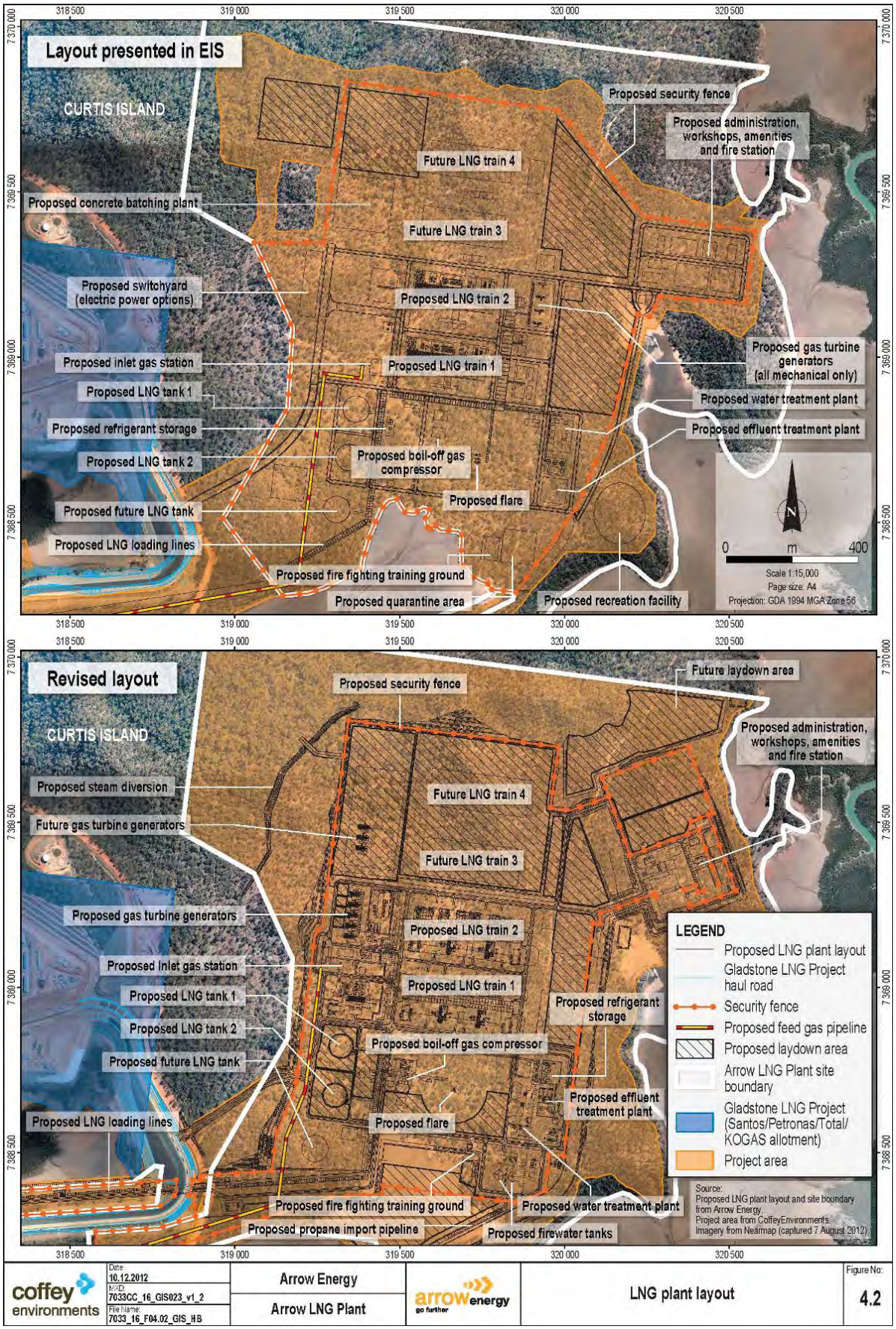

Figure 9.1 LNG plant layout

9.2.2. Coordinator-General's conclusions

I am satisfied that the proposed earthworks are a necessary part of the project. Detailed development plans will need to demonstrate that the extent of cut and fill is minimised. I expect that the cut benches for trains 3 and 4 excavated as part of stage 1 construction will be managed to prevent stormwater run-off and infestation by weeds and pests.

I require the following outcomes to be achieved as part of the proposed development:

- best practice erosion and sediment control measures
- ASS or PASS managed in accordance with relevant guidelines
- dams or levees are designed, constructed, operated and maintained to accepted engineering standards
- management of fill material at LNG plant site to ensure no displacement of sediments to surrounding waters.

I have stated conditions in this report to ensure the appropriate construction and management of dams and levees (Appendix 2, conditions E4 and F2–F8).

9.3. Noise and vibration

The EIS reported that noise and vibration objectives for the project were established from guidelines and policies including:

- World Health Organisation guidelines for community noise to protect people from annoyance during daytime (7:00 am to 6:00 pm) and night-time hours (6:00 pm to 7:00 am)
- Environmental Protection (Noise) Policy 2008 that defines the environmental noise values for sensitive receptors.

Modelling results reported in the EIS showed that construction noise will not exceed the standard for night-time construction noise limits of 40 decibels (A) at most sensitive receptor assessment locations (AL). Noise limits at sensitive receptor AL 6 at Witt Island and AL 1 at Tide Island would be exceeded if dredging is being undertaken at Boatshed Point at night-time. Where noise from a construction activity would exceed the night-time maximum noise limit of 40 decibels (A) at a sensitive receptor, the proponent has committed to scheduling, where practicable, construction activities to occur between 7.00 am and 10.00 pm (Appendix 4, C22.05).

The EIS reported that predicted noise levels will exceed noise limits at AL 1 and AL 6 for both the all mechanical and mechanical/electrical power options without additional acoustic treatment being applied. The proponent has committed to ensure that noise generated during operation complies with noise limits at all assessment locations (Appendix 4, C22.07).

Vibration impacts for construction and operation of the LNG plant were outlined in the EIS and found to be well below the threshold of human detection.

9.3.1. Coordinator-General's conclusions

I am satisfied that the modelling of noise and vibration impacts, both direct and cumulative has been conducted satisfactorily and is appropriate for the development phase of the project. There is sufficient evidence presented in the EIS and supplementary material to conclude that the mitigation measures proposed would contain noise and vibration within the established noise and vibration limits.

The EIS and supplementary material describe a range of management and mitigation measures to achieve the environmental objectives for nearby sensitive receptors while permitting construction activities to proceed at a reasonable rate of progress.

I acknowledge that adequate noise mitigation will be difficult to achieve during some short phases of construction at certain locations because it may not be feasible to install primary or secondary noise reduction measures for short-duration events. The most notable examples of these activities are works that must be conducted before acoustic screens or enclosures can be erected, such as demolition, pile driving and rock breaking.

I consider that the goals outlined in the EIS and supplementary material adequately reflect the noise environment of a facility in an area zoned for industrial use. I expect the following outcomes:

- noise levels must not exceed prescribed noise limits at sensitive places
- noise, vibration and blast monitoring and recording is undertaken in accordance with prescribed guidelines
- emission of noise during blasting operations does not exceed prescribed limits at any sensitive place.

I am satisfied that the noise and vibration impacts of the project on sensitive receptors can be managed within acceptable limits.

I have stated conditions in this report to ensure the appropriate management of noise and vibration impacts (Appendix 2, conditions C5-C7 and C10–11).

9.4. Air quality

The EIS reported that air quality objectives for the project were established from legislation, regulations, guidelines, policies and methods including:

- current methods in preparing mobile source port-related emission inventories, which provide emission factors required to characterise emissions from LNG carriers[12]
- air pollution emission factors, which describe emission factors to be used for flaring activities at the LNG plant[13]
- Montreal treaty on substances that deplete the ozone layer[14]
- National Environment Protection (Ambient Air Quality) Measure

[12] US EPA 2009
[13] US EPA 1995
[14] UNEP 2009

- EP Act
- Environmental Protection (Air) Policy 2008.

The air quality impact assessment included baseline assessments of potential sensitive receptors and existing sources and types of air pollutants using the project criteria for air quality. An emissions inventory for all applicable emission sources resulting from project activities (routine and non-routine operations) was prepared and the EIS assessed the potential impacts on the Gladstone region with regard to air dispersion models that were generated using the Gladstone Airshed Modelling System (Version 3) (GAMS).

The EIS assessment showed that the majority of emissions to air will be produced during the operation of the LNG plant rather than during construction. The main emissions from the LNG plant will be nitrogen dioxide (NO_2) from the combustion of gas in the turbine generators and sulphur dioxide (SO_2) from the LNG carriers and tugs.

The results of air quality studies for the project found that the project would comply with air quality limits at all sensitive receptor locations. The studies also indicated that project activities would comply with air quality limits at all sensitive receptor regions except Gladstone. One of the air quality limits for NO_2 (for the 99.9^{th} percentile one-hour average ground-level concentration) is exceeded at the Gladstone sensitive receptor region. This particular air quality limit of 250 micrograms per cubic metre is currently exceeded at Gladstone under existing conditions (i.e. not including the project's emissions) and is assessed as 257.1 micrograms per cubic metre. The contribution of the LNG plant emissions would bring the total to 257.7. The impact of the project is therefore considered to be negligible.

Arrow's commitments register (Appendix 4, C11.21) states that air quality impacts during construction will be mitigated through dust suppression and appropriate management and maintenance of vehicles and equipment (Appendix 4, C21.08). The air quality assessment found that project air quality limits are not exceeded at the construction camp at Boatshed Point and the other LNG project construction camps on Curtis Island. The assessment found that the highest NO_2 concentration of 148.7 micrograms per cubic metre attributed to the Arrow LNG Plant in isolation is predicted at the Curtis Island construction camps. This is well within the project limits of 250 micrograms per cubic metre.

9.4.1. Coordinator-General's conclusions

I am satisfied that the direct and cumulative air quality impacts of the project have been adequately assessed. I expect the following outcomes:

- project design and activities minimise the release of contaminants to the atmosphere
- authorised contaminant releases to the atmosphere are within prescribed limits
- contaminants from the LNG trains, generators and flare stack are monitored and released in accordance with prescribed criteria.

I am satisfied that the air quality impacts of the project on sensitive receptors can be managed within acceptable limits.

I have stated conditions in this report to ensure the appropriate management of air quality impacts (Appendix 2, conditions B1–10).

9.5. Visual amenity and lighting

The majority of the visual and lighting impacts of the project are associated with the LNG plant facilities on Curtis Island. Although the feed gas pipeline could impact on lighting and visual amenity, the impacts would be temporary and relate to activities such as open trenching, the establishment of a pipeline right-of-way and other construction works. The feed gas pipeline and tunnel will not be visible during operation.

9.5.1. Visual amenity

The visual impact of the project will be most prevalent on Curtis Island where large-scale industrial uses would replace the existing rural and natural landscapes. The LNG plant and its associated infrastructure would form part of the emerging industrial landscape within the CIIP of the GSDA.

From the mainland, the most significantly affected views would be those from the vantage points of Auckland Point, Round Hill, Mount Larcom and Gladstone with the project likely to be viewed by a large number of people living or working in Gladstone.

During construction, potential impacts on visual amenity will result from vegetation clearing, presence of a construction camp and crews, infrastructure associated with the construction of the project and the presence of temporary construction roads and heavy haul roads.

Impacts during operation are likely from the introduction of LNG plant infrastructure, its associated marine infrastructure and buildings into the Curtis Island landscape. The plant is to be constructed on several benches or terraces that will lower the height of the various structures and buildings in the landscape, minimising the overall visibility of the facility. The LNG trains and associated utilities and ancillary infrastructure will be located on a bench with a nominal elevation of 14 metres AHD. The higher structures, including the LNG storage tanks and flare, will be located on a lower bench at 11 metres AHD. The administration buildings, workshops, fire station and construction laydown areas located to the east of the LNG trains will be located on a bench at an elevation of 14 metres AHD.

Ship Hill provides a backdrop to the facility and when viewed from Gladstone and the islands of Port Curtis, this would help to ameliorate the potential visual impact of the facility on the landscape. Views from Southend towards the site will be marginally affected with the flare stack visible above the ridge line.

At decommissioning, temporary impacts will include the presence of decommissioning infrastructure, construction crews and activities such as vegetation planting.

Coordinator-General's conclusions

The proponent has provided detailed commitments to avoid or minimise visual impacts including:

- retention of vegetation and the use of vegetation or screening where possible (Appendix 4, C23.05)
- consideration of the potential landscape and visual impacts where there are options for siting infrastructure (Appendix 4, C23.03)
- shore protection designed to reflect natural forms where practical (Appendix 4, C23.12)
- development of landscape and rehabilitation plans for all project sites (Appendix 4, C23.14)
- selection of materials that are sensitive to the site context, where plant operability is not impacted (Appendix 4, C23.07).

9.5.2. Lighting

Lighting associated with the LNG plant would impact on the project area. During construction, key light sources on Curtis Island will be perimeter security lights, construction vehicles and lighting associated with the construction camp. During operation, the key sources will be fixed permanent lights (perimeter fencing, operational and maritime lighting) and the pilot light from the flare and intermittent emergency flaring. Following plant decommissioning it is not anticipated that any lighting impact would remain.

Curtis Island itself is not a remote site and is currently influenced by artificial light sources, including neighbouring industry; therefore, activities relating to the Arrow plant will appear less noticeable. There are no sensitive local viewing locations at a close distance on Curtis Island. The most significant night-time effects could be experienced by residents living on Turtle, Witt and Tide Islands. For most visual receptors in Gladstone, over four kilometres away, the plant would result in an increase in sky glow.

Coordinator-General's conclusions

The proponent has provided detailed commitments to minimise the impact of lighting on sensitive receptors including:

- detailed lighting design in accordance with Australian standards (Appendix 4, C23.10)
- shielding/directing of light sources onto work areas (Appendix 4, C17.16A)
- use of passive lighting measures such as reflective markers and signs (Appendix 4, C23.21)
- consideration of the use of solar powered studs or similar as an alternative to permanent lighting (Appendix 4, C23.22)
- minimising night-time working and associated lighting impacts (Appendix 4, C23.20).

9.5.3. Visual amenity and lighting cumulative impacts

The EIS reported there will be cumulative impacts on a number of landscapes and visual receptors. These include:

- contrast with the current local landscape from the presence of construction traffic and crews, construction compounds, large-scale machinery including tall cranes and exposed soil due to cut and fill activities
- changes to the landscape character and views from the mainland as the forested Curtis Island is cleared and construction equipment is introduced.

The three LNG projects underway on Curtis Island and the proposed Arrow project will extend industrial development from the mainland to the island. Curtis Island is currently viewed as an inherently natural landscape feature and cumulative impacts on views of the island could be significant. Opportunities to mitigate the cumulative impacts to landscape and visual values are limited and are confined to mitigating impacts directly associated with the LNG plant. These include retaining vegetation where practicable and using colour palette for the built form that blends in with predominant background colours.

Increases in lighting from the respective projects will increase the overall artificial light levels resulting in an increase in the level of light throughout Port Curtis. The EIS reported that mitigation measures for cumulative impacts of lighting are limited to mitigating impacts directly associated with the LNG plant. These include minimising night-time works and shielding the light source onto work areas where practicable.

Coordinator-General's conclusions

I am satisfied that the EIS has adequately investigated the project's cumulative impacts on the visual amenity and lighting to the extent possible at this stage of the project's development. I consider that residual cumulative impacts can be reduced to acceptable levels with the implementation of mitigation measures and commitments proposed by the proponent in the EIS and supplementary material.

I have stated conditions for the project which require the proponent to minimise the visual impact of the construction and operation of the LNG facility by ensuring the colour scheme of the LNG facility and related infrastructure blends with the scenery and disturbance is minimised. (Appendix 2, Schedule 2, Condition 2a).

9.6. Indigenous cultural heritage

The *Aboriginal Cultural Heritage Act 2003* (Qld) requires an approved cultural heritage management plan (CHMP) for any project that also requires completion of an EIS. The EIS reported that indigenous cultural heritage places and objects are situated within, or in close proximity to areas that will be disturbed by the project. As many of the archaeological sites identified in the disturbance footprint can be found elsewhere in the region, the impact of the project on cultural heritage is considered low.

The proponent has committed (Appendix 4, C24.01) to develop an approved CHMP or a native title agreement that addresses Aboriginal cultural heritage in consultation with

the endorsed Aboriginal parties for the project. As part of the CHMP development, the proponent has stated it will work with the Indigenous parties to develop key performance indicators to promote the implementation of best practice cultural heritage management.

9.7. Non-Indigenous cultural heritage

Non-Indigenous cultural heritage impacts associated with the project generally relate to the clearing of land and earthworks for the construction of the LNG plant and ancillary facilities. The EIS lists ten known or likely non-Indigenous cultural heritage sites that will be disturbed, partially destroyed or completely destroyed during the construction of the LNG plant, Boatshed Point construction camp and Boatshed Point MOF. Arrow has proposed mitigation and management measures including avoidance, relocation, salvage, archival recording and interpretation.

I note that the grave of William Alfred Prince, deceased 1905 at an unknown location, is listed as a non-Indigenous cultural heritage site that is near to the proposed LNG plant site. I acknowledge the proponent's commitment (Appendix 4, C25.04) to employ remote sensing techniques prior to construction to try to locate the grave and if discovered, to relocate it to an alternative location. I also note the proponent's commitment (Appendix 4, C25.05) to implementing a procedure for accidental discovery of remains in this area in the event the grave is not located prior to construction.

I am satisfied with the proponent's commitments in this regard.

9.8. Hazard and risk

9.8.1. Issues of concern

The principal hazard and risk scenarios for the LNG facility relate to the operation of the plant, loading of LNG, unloading of LPG and shipping of LNG through the port of Gladstone. The Hazardous Industries and Chemicals Branch (HICB) within the Department of Justice and Attorney-General has commented on the hazards associated with the shipping to and storage of propane on Curtis Island.

9.8.2. Risk assessment

The EIS undertook a systematic hazard identification study considering the potential hazards and risks and environmental pollution issues that could arise from the project. Consideration was given to both construction and operational hazards along with aviation hazards, traffic and transport hazards and the risk from bushfire and other natural events. The bulk of these hazards and risks have been addressed in other sections of this report. This section deals specifically with the operation of the plant and shipping risks.

LNG plant operation

A key potential hazard is a leak or uncontrolled release during handling of a flammable gas, LNG or refrigerant and the risk of injury or damage if there was an ignition. The EIS examined the hazards from the operations of the LNG plant and analysed them through fatality risk contours, overpressure from explosions, heat radiation and vapour cloud explosion.

Fatality risk contours were developed to represent the likelihood of fatality to notional individuals at locations outside the LNG plant site in the event of a fire or explosion due to a loss of containment. Individual risk at a given location is generally expressed as the peak individual fatality risk, i.e. the risk of fatality to the most exposed individual situated at a location for 24 hours of the day for 365 days of the year.

A quantitative risk assessment was undertaken in accordance with Australian Standard AS/NZS ISO 31000:2009. The fatality risk contours from all hazards were drawn on the plant site layout, covering probabilities for 50×10^{-6} per year (individual risk criteria) down to 0.5×10^{-6} per year (sensitive developments). The accepted risk criteria for land use planning are drawn from the *New South Wales Department of Planning Hazardous Industry Planning Advisory Paper No 4, 2008 Risk Criteria for Land Use Planning* also adopted in the *Guidelines for Major Hazard Facilities, C – Systematic Risk Assessment*. The acceptable risk for residential areas is 1×10^{-6} per year.

The EIS reported the risk contour for industrial facilities remains contained within the boundary of the site. The risk contour for residential areas remains largely contained within the boundaries of the site and does not encroach onto any residential areas on the island or at Gladstone. The risk fatality at the nearest residence is low and well below the maximum tolerability criteria for residential or sensitive development. Figure 9.2 below shows the fatality risk contours for the LNG plant and associated LNG carrier loading and unloading.

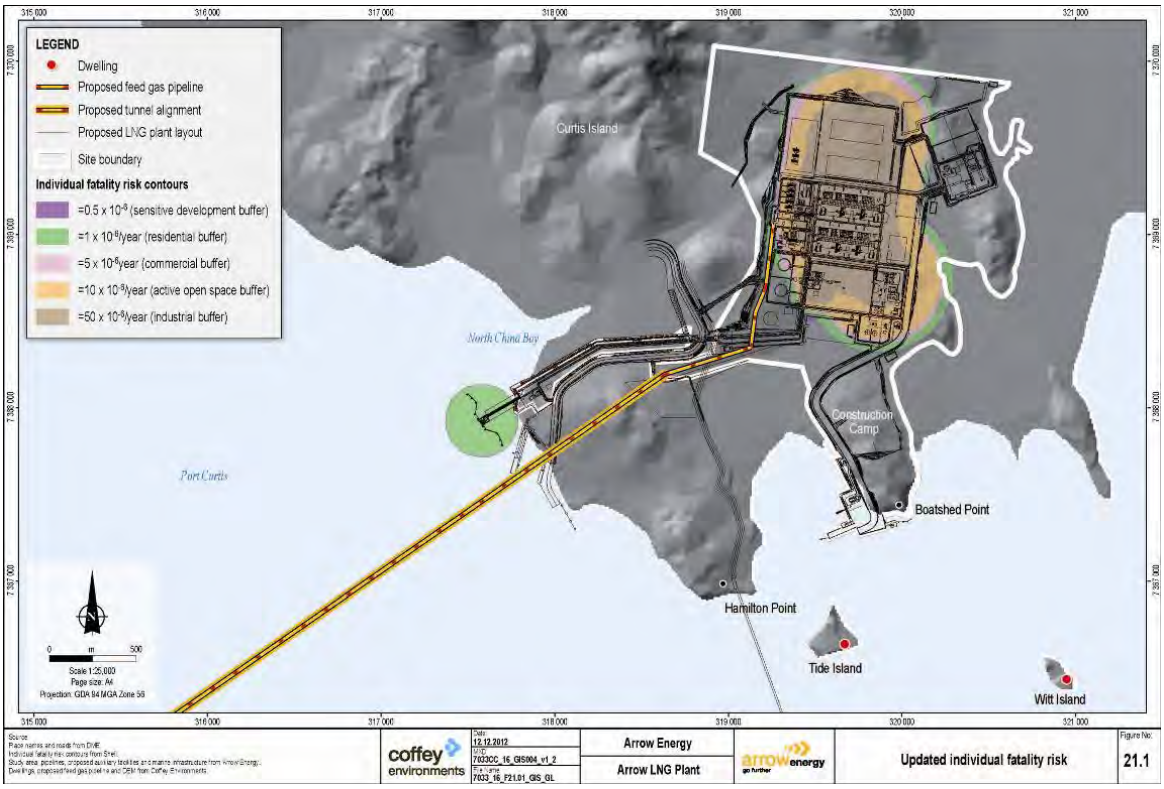

Figure 9.2 LNG plant fatality risk

The 50×10^{-6} per year injury risk contours from heat radiation and overpressure (4.7 kilowatts per square metre and seven kilopascals respectively) remains substantially contained within the site boundary and well below the criterion for new installations of fifty chances per million years. The 50×10^{-6} per year risk contour for propagation to neighbouring industrial facilities from heat radiation and overpressure (23 kilowatts per square metre and 14 kilopascals respectively) also remain contained within the site boundary.

The fatality risks to process and maintenance workers adhere to the target risk criterion of 1×10^{-4} per year. Construction personnel will be located well away from hazardous effects of possible fires, explosions or vapour explosions during purging and start-up activity, ensuring minimal risk from these events. The construction camp is located away from the hazards of the LNG plant and outside the fatality risk contours and injury risks and propagation risks from heat radiation and explosion overpressure.

The EIS reported that the risks associated with the loading lines were assessed through a study to demonstrate and document that the risk associated with the LNG loading lines are as low as reasonably practicable. The LNG loading lines will be designed in accordance with Australian Standard for Pipelines – *Gas and liquid petroleum* AS2885. The realignment of the LNG loading lines and increased separation from the GLNG haul road has minimised the risk associated with an uncontrolled release of flammable gas or LNG as a result of a vehicle accident (or loss of load) on the haul road.

The introduction of a propane import pipeline and associated unloading and transport during commissioning and potentially during operation would generate additional

hazards and risks. Materials and equipment associated with the propane import pipeline will comply with code requirements and be designed to prevent a release of propane. Shipping will comply with international standards. It is noted that the propane pipeline will be treated as a cryogenic pipeline as per the LNG product lines and is not included in the quantitative risk assessment. On completion of a transfer of propane the pipeline will be cleared with nitrogen and purged with inert gas to ensure that the line is free of hydrocarbons.

The *Work Health and Safety Act 2011* and Work Health and Safety Regulation 2011 (The Act and Regulation) will apply to the facility at all times during construction, commissioning and operation of the project. As the facility will hold or is likely to hold quantities greater than the threshold amounts specified in Schedule 15 of the Regulation, the facility would be classified as a major hazard facility. The proponent will need to prepare, in accordance with Chapter 9 of the Regulation, a safety case and submit a licence application six months before the introduction of Schedule 15 chemicals to the facility. As a licensed major hazard facility, the operator of the facility must at all times have in place the capability of exerting management control and the power to direct that the whole facility be shutdown in response to safety issues involving Schedule 15 chemicals as per the requirement of Regulation 533.

Shipping

The key risk associated with LNG carrier transport is a breach of a cargo tank due to collision or grounding, which could lead to a loss of containment injury and/or pollution of the receiving environment. The risk of a shipping accident involving an LNG carrier is considered low due to the operating parameters and safety controls that will apply to LNG vessels. Key controls include the establishment of a 250-metre exclusion zone around LNG vessels within the channel and a 250-metre radius when berthed. Each carrier will be escorted by four tugs with a 30-minute departure distance between vessels.

The individual fatality risk contours associated with LNG carrier loading and unloading can be seen in Figure 9.2 above. Risks will be controlled through a range of measures including compliance with the Port Procedures Manual,[15] relevant legislative requirements and industry standards as agreed by Maritime Safety Queensland (MSQ). An emergency shutdown system will also be put in place during loading and unloading and will activate automatically in the event of a loss of containment.

9.8.3. Coordinator-General's conclusions

In considering the hazard and risk assessment of the LNG facility I note that studies undertaken in the EIS and supplementary material of the Preliminary Hazard and Risk Assessment have been conducted in accordance with the Australian standard. The results of this analysis represent the risk information applying to the project as it is designed, and are sufficient to assess its risks.

The proponent's risk assessment in the EIS in relation to the operation of the LNG plant shows that the fatality risk contours for residential criteria and the injury risk

[15] Maritime Safety Queensland, 2010

criteria for fire, explosion and vapour flammability result in only very minor excursions from site boundaries. However residential safety criteria is satisfied at neighbouring residential properties.

I acknowledge that the proponent has undertaken work to provide assurances of safety associated with the introduction of a propane import pipeline and has developed a plan to control the associated risks.

Potential cumulative risks include the potential that an incident at the LNG plant could cause a flow-on effect at a neighbouring facility. The injury and propagation risk calculations show that the risk of flow-on effects from the LNG plant and LNG carrier complies with the most stringent criteria for maximum acceptable risk at neighbouring facilities.

I expect the following outcomes:

- the plant will be designed to meet the prescribed risk criteria
- construction, operation and decommissioning of the plant meets prescribed risk criteria
- a contingency plan for emergency environmental incidents is developed and implemented prior to construction commencing.

I am satisfied that harbour management by GPC and the LNG shipping provisions of Maritime Services Queensland, through the Regional Harbourmaster, can effectively manage the transit of LNG ships through Gladstone harbour in a safe manner.

The proponent must fully meet its commitments to manage hazard and risk by undertaking qualitative and quantitative hazard and risk assessments (C29.01) and working with relevant agencies, proponents and contractors to develop traffic management plans (Appendix 4, C28.01), including marine activity management plans (Appendix 4, C28.09A).

I have stated a condition outlining acceptable solutions for any off-site impact from a foreseeable hazard scenario (Appendix 2, Schedule 2, Condition 1).

I have stated conditions in this report to ensure the appropriate management of emergency environmental incidents (Appendix 2, Schedule 1, conditions A2–6).

9.8.4. Air safety

The proposed LNG plant consists of a number of stacks that would emit industrial exhausts with the potential to generate significant vertical plume velocities as well as potential vertical plumes arising from flaring events. The Gladstone airport is located around nine kilometres south of the plant and the operations of the LNG plant could affect air safety.

In the EIS Volume 1, Chapter 9 and Volume 3, Appendix 2, the proponent provided details of an assessment of the vertical velocities associated with stack exhaust plumes at the proposed LNG plant. The assessment was based on the revised draft guidelines

for aviation safety published by the Civil Aviation Safety Authority (CASA) in *Guidelines for conducting plume rise assessments*.[16]

CASA requires that plume rise assessments determine the height at which a plume or plumes could exceed the average in-plume vertical velocity thresholds of 10.6 metres per second and 4.3 metres per second, in order to assess the potential hazard to aviation posed by vertical exhaust plumes.

In relation to aviation safety, during normal plant operations for four LNG trains, the following conclusions can be drawn from the assessment:

- For routine operations, the higher threshold velocity of 10.6 metres per second was not exceeded in any of the scenarios assessed. The lower threshold velocity of 4.3 metres per second was exceeded at heights above the Procedures for Air Navigation Services – Aircraft Operations Surfaces (PANS-OPS) in four of the seven scenarios assessed. The worst-case scenario was the operation of five power generation gas turbines, where the plumes merged. In this scenario, the critical plume height exceeded the 4.3 metres per second threshold at heights below 692 metres AHD.
- For non-routine operations, both threshold velocities were exceeded at heights above the PANS-OPS under all conditions of release from a flare. The critical plume height exceeded the 4.3 metres per second threshold at heights below 1641 metres AHD and exceeded the 10.6 metres per second threshold at heights below 725 metres AHD.
- Plumes associated with the power generation gas turbines are likely to cause the vertical velocity to be greater than 4.3 metres per second for an average of 17 hours per year or 0.2 per cent of the time. Plumes associated with the compressor gas turbine drives are not predicted to exceed the PANS-OPS at any time.

Due to the likely exceedence of the PANS-OPS, an application for operational assessment of a proposed plume rise would be required by CASA. I expect Arrow to consult with CASA to ensure that all relevant requirements are met and appropriate management measures and maintenance programs that minimise the need for flaring are adopted. The risk that plumes pose to aviation is to be addressed by Arrow and CASA.

Coordinator-General's conclusion

The proponent has addressed air safety impacts through participation in *The Cumulative Impact of LNG Project Gas Flares and Plumes on Air Traffic* study, together with other LNG proponents. The study found that cumulative impacts could be mitigated by an upgrade to Gladstone Airport's instrument landing system. APLNG, QCLNG and Santos have provided $10.5 million towards the instrument landing system which is expected to be fully operational by 2014. I note Arrow has committed to provide a share of funding towards the new instrument landing system at Gladstone Airport (Appendix 4, C28.08) upon project financial investment decision (FID).

[16] Civil Aviation Safety Authority 2012

While I am satisfied that the potential cumulative impacts of LNG project gas flares and plumes on air traffic have been adequately addressed, I expect the proponent to supply further detailed information as required by CASA and airport authorities.

9.9. Natural hazards

The EIS reported on a preliminary assessment of the key hazards and risks associated with the construction, operation and decommissioning of the LNG plant. The assessment of natural events including bushfires, cyclones, flooding, seismic activity, subsidence and lightning strike was assessed to be a medium residual risk.

A bushfire hazards and risk assessment (EIS, Appendix 26) found that there were low to medium bushfire risks associated with the project. A firebreak of at least 30 metres in accordance with State Planning Policy 1/03: Mitigating the adverse impacts of flood, bushfire and landslide (SPP 1/03) requirements, will prevent an upper limit of 15 kilowatts per square metre radiant heat flux on the metal outer surface of an LNG tank in accordance with European standard EN 1473:2007.

I expect the following outcome:

- adequate investigations of the bushfire risk at the detailed design stage in accordance with the relevant state planning policy.

I have made a recommendation to ensure that the appropriate management of the bushfire risk on Curtis Island is addressed (Appendix 3, Part C, Recommendation 8).

9.10. Waste

A strategy for managing wastes generated during all phases of the proposed LNG plant has been developed in accordance with the principles of the waste management hierarchy specified in the Environmental Protection (Waste Management) Policy 2000 (i.e. avoidance, re-use, recycling, treatment and disposal).

The EIS reported that waste types generated by the project during construction will comprise:

- vegetation from clearing and site preparation activities
- left over, off-specification or quarantined construction materials
- domestic waste.

The operational stage of the project will generate a range of solid, liquid and gaseous wastes.

The EIS concluded that the residual risk to the environmental values of the project area for the majority of proposed waste management strategies was categorised as low when relevant control measures are implemented.

In its submission on the EIS, GRC sought further clarity on the type and volume of waste produced by the project along with outcomes that will minimise waste to landfill. In response, Arrow reiterated its commitment (Appendix 4, C31.02) to implement a waste management plan.

9.10.1. Coordinator-General's conclusions

The project will generate a range of wastes both during construction and operation and I require the following outcomes:

- waste from project activities is managed appropriately
- waste is managed in accordance with the prescribed hierarchy and principles
- waste is transported off site for lawful re-use, remediation, recycling or disposal, unless otherwise authorised.

I have stated conditions in this report to achieve these outcomes and ensure the appropriate management of waste (Appendix 2, conditions E1–E3).

I am aware that GRC has experience with mixed wastes being received from large projects (i.e. waste concrete with general construction and demolition waste). In addition to complying with the waste management conditions, I recommend that the proponent appropriately segregate regulated waste prior to delivery to approved refuse sites by a licensed contractor.

10. Mainland precinct

10.1. Overview

10.1.1. Feed gas pipeline and tunnel launch site

A single, nominal 48 inch (1219 millimetres) internal diameter, high-pressure gas pipeline is proposed to deliver feed gas to the LNG plant from the Arrow Surat Pipeline on the mainland. The 9.45-kilometre-long pipeline will be installed using a combination of conventional pipe-laying techniques, and the excavation of a tunnel beneath Port Curtis using a tunnel boring machine (TBM).

The feed gas pipeline connects to the proposed Arrow Surat Pipeline north of the Gladstone-Mount Larcom Road crossing. The proposed alignment crosses the Cement Australia railway and Yarwun Alumina Refinery pipelines en route to the proposed tunnel launch site (refer figures 10.1 and 10.2 below).

The tunnel launch site is a 35-hectare allotment approximately 900 metres long by 450 metres wide at the edge of the mudflats, narrowing to 300 metres wide near the tunnel launch shaft. The site is located on proposed Lot 102/SP239339 of the proposed subdivision of Lot101/SP235026. Lot 102 is adjacent to proposed Lot 101/SP239339, the site for the proposed Yarwun Coal Terminal Project (refer Figure 10.2 below). Land-use conflict with the Yarwun Coal Terminal Project proposed by Tenement to Terminal Limited is avoided.

The tunnel reception shaft is located south of the GLNG haul road and on the eastern side of the low hills of Hamilton Point. The feed gas pipeline runs south of the haul road to the LNG plant site, crossing the LNG loading lines inside the LNG plant site.

The pipeline network has been designed to meet the 18 Mtpa ultimate capacity of the LNG plant. The design complies with applicable Australian and industry standards including *AS2885: Pipelines – Gas and Liquid Petroleum.*

Construction of the 10-metre-wide tunnel launch and reception shafts and boring of the tunnel is expected to take 33 months. An additional six months is required for the installation and commissioning of the feed gas pipeline resulting in an overall construction program of approximately 40 months.

In the Coordinator-General's evaluation report for the APLNG project of November 2010, the Coordinator-General noted the potential cumulative impacts from up to four gas transmission pipeline routes from LNG projects crossing the Kangaroo Island wetlands and The Narrows, all located within the GBRWHA. The report stated that co-location of pipelines would minimise potential ASS disturbances, reduce significant harm to flora and fauna and allow for effective environmental management and monitoring. The Coordinator-General indicated that a bundled pipeline trenched construction methodology should be adopted as far as practicable.

Arrow advised in the EIS that it had investigated working with the other LNG proponents to locate its feed gas pipeline in a bundled crossing at The Narrows.

Investigations led to Arrow instead proposing a direct crossing of Port Curtis. Arrow outlined the following reasons for its tunnel proposal:

- alignment with project timeframes (Arrow's schedule is 24–36 months behind other LNG projects that are already under construction, including pipeline crossings)
- avoidance of significant environmental and cultural issues
- shortest distance (approximately nine kilometres of pipeline required to cross Port Curtis as opposed to between 28 and 38 kilometres of pipeline required to cross at The Narrows)
- avoidance of future infrastructure conflict.

The proposed feed gas pipeline and associated tunnel crossing Port Curtis will avoid environmentally sensitive areas, including the wetland adjacent to Targinie Creek.

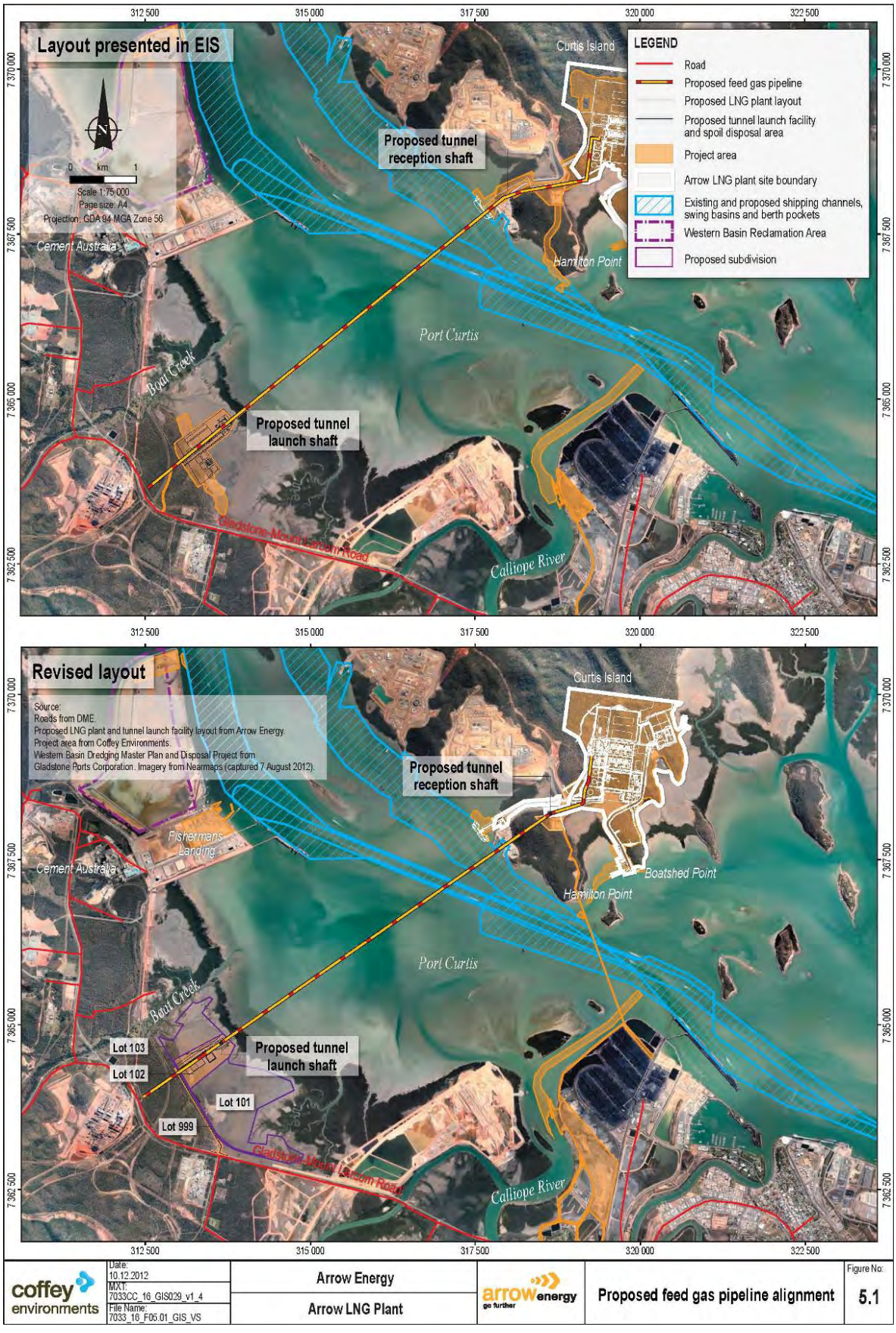

Figure 10.1 Proposed feed gas pipeline alignment

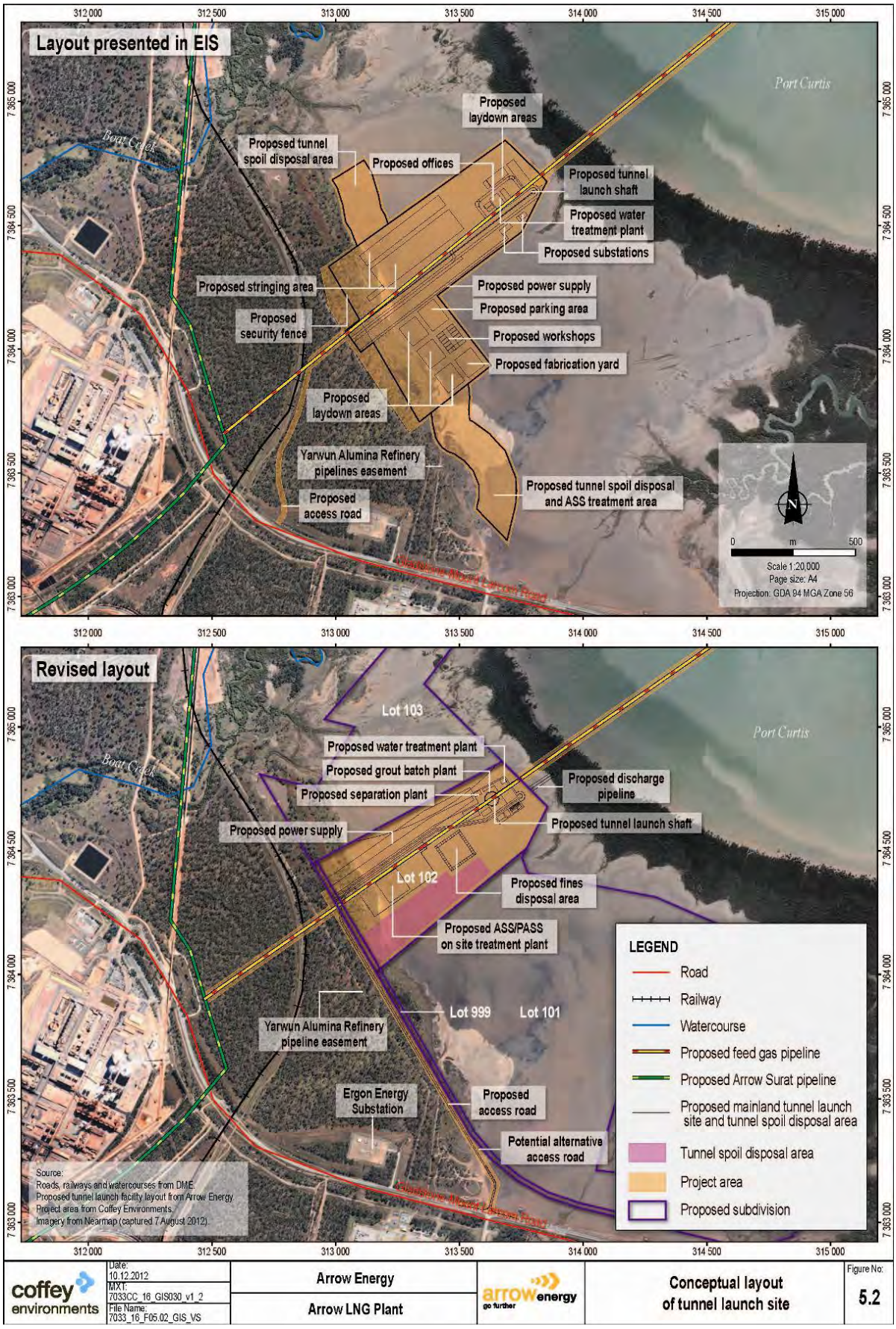

Figure 10.2 Conceptual layout of tunnel launch site

Mainland infrastructure

The project will require supporting infrastructure to be provided on the mainland including:

- a mainland launch site to provide for the storage, loading and unloading of aggregate and materials, and for the transfer of materials, aggregate, vehicles, plant, equipment and personnel to and from Curtis Island
- a pioneer mainland launch site for personnel, materials and equipment and for bulk materials transport to and from Curtis Island
- a staging area to reduce the traffic entering and leaving the preferred mainland launch site 1 on Calliope River. Staging areas would comprise car and bus parking, personnel transfer facilities, warehouses and laydown areas. Should Red Rover Road be utilised as a staging area, a TWAF may be included.

The proposed infrastructure is located both inside and outside the GSDA (refer Figure 10.3 below).

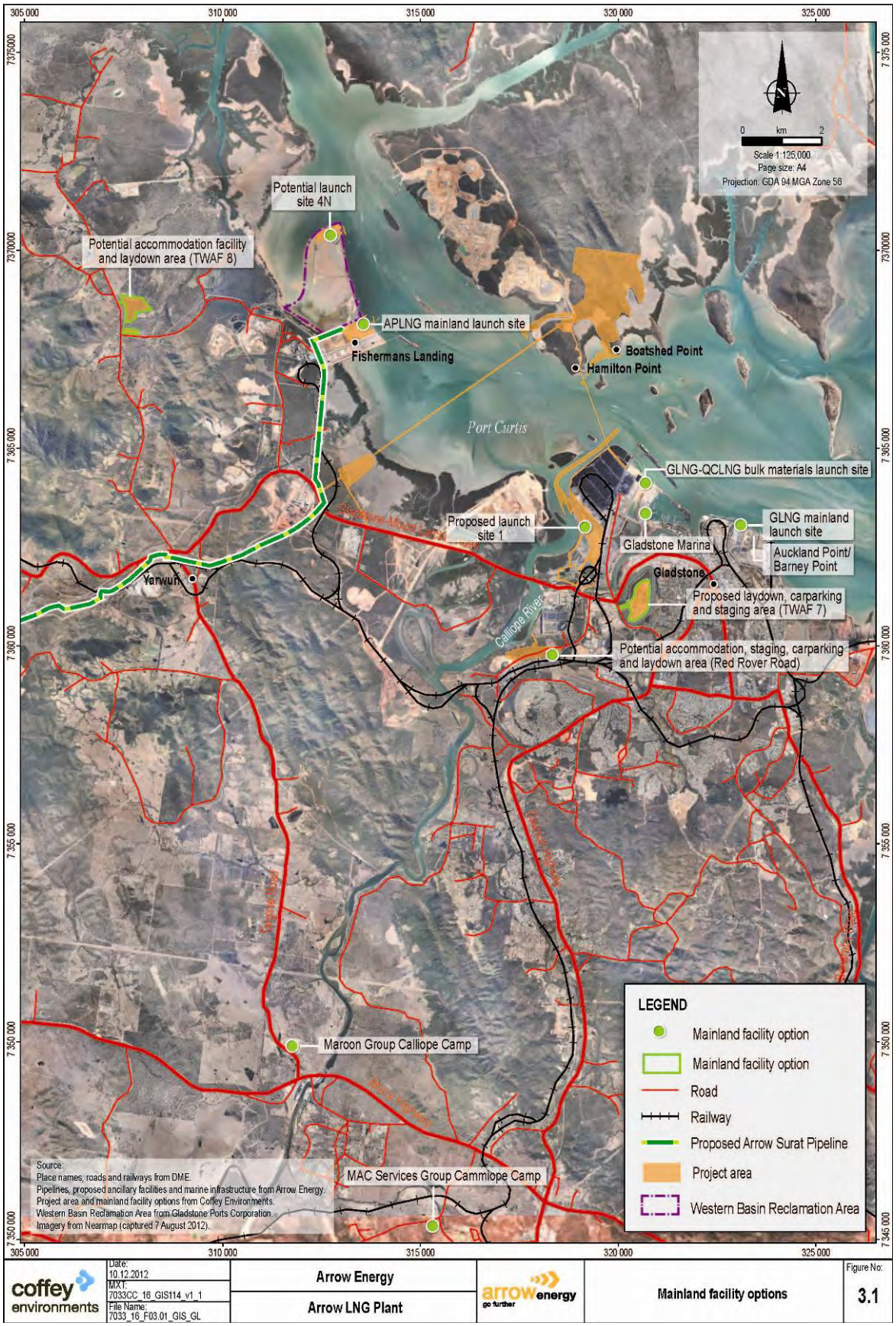

Figure 10.3 Mainland facilities options (services launch sites, laydown areas and TWAFs)

10.2. Earthworks

The EIS anticipates that impacts on the landform, soils and water of the study area from the mainland tunnel entrance and tunnel spoil disposal area for the feed gas pipeline have the potential to be significant if not mitigated. Construction of the feed gas pipeline will disturb terrain identified as contemporary coastal flats, and coastal rises and plains. The tunnelling of the feed gas pipeline will produce 223 000 cubic metres of spoil which will be deposited in a contained stockpile adjacent to the mainland entry shaft. Deposition of spoil material onto the mudflat could cause sedimentation to flow to surrounding areas and chemical contamination of the existing topsoil. The EIS stated that the contained stockpile will be shaped to direct stormwater runoff to retention ponds from where, if necessary, it will be pumped to a water treatment plant to be treated before discharge to the intertidal mudflats or directly to Port Curtis (Appendix 4, C13.08 and C16.03).

An ASS treatment pad will be located adjacent to the tunnel spoil disposal area to treat ASS material exposed or excavated during construction of the site formation and launch shaft. ASS material will be treated then disposed of in the adjacent tunnel spoil disposal area in accordance with relevant guidelines. It is estimated that up to 450 cubic metres of ASS material will require treatment and disposal.

The tunnel spoil disposal areas have been sized to accept this volume of material and the estimated 223 000 cubic metres of weathered and competent rock to be excavated by the TBM.

The tunnel launch site pad will be constructed from imported fill from the mainland, which will be contained within an engineered structure. The pad will be shaped to direct stormwater runoff to retention ponds located adjacent to the southern boundary of the site where, if necessary, runoff will be treated before discharge to the intertidal mudflats. This will ensure adequate separation of discharge points from Boat Creek and its associated estuarine ecosystem

The launch site pad and spoil disposal areas are proposed to remain as permanent features after construction. This land will be designed to be largely self-maintaining with adequate drainage and vegetation to ensure a stable landform.

The success of rehabilitation will be monitored for evidence of subsidence, poor soil management and failed revegetation for up to two years following completion of pipeline construction. Monitoring will be conducted on a quarterly basis and following major storm events and incorporate the use of photo reference points to document rehabilitation progress. Any areas not demonstrating successful rehabilitation will undergo further soil treatment, erosion protection works, weed control and revegetation until the vegetation is self sustaining. Successful rehabilitation will be indicated by measurable growth in the native vegetation communities.

Also, during operations, the top of the launch shaft will be fenced off and covered with a load-bearing steel grate floor supported by cross beams to prevent unauthorised access. An access gate and trapdoor will allow access to the launch shaft and main tunnel for feed gas pipeline inspection and maintenance activities

10.2.1. Coordinator-General's conclusions

I am satisfied with the proponent's commitment to design the tunnel spoil placement area to minimise adverse impacts associated with possible ground compaction, erosion and surface water runoff such that a self sustaining landform is achieved (Appendix 4, C11.04). I consider the assessment of impacts to land resulting from the feed gas pipeline construction to be appropriate. Detailed development plans will need to demonstrate that the extent of excavation and extent of final landform is also minimised. Outcomes required include:

- minimise adverse impacts to soil structure and soil quality
- dams or levees are designed, constructed, operated and maintained to an accepted engineering standard
- dams or levees must contain contaminants except where permitted to be released
- structural and hydraulic integrity of dams and levees must be monitored.

I have stated conditions in this report to ensure the appropriate construction and management of dams and levees (Appendix 2, conditions F1(b) and F2–F7).

10.3. Hazard and risk

Key hazards and risks identified include generic threats to the feed gas pipeline (e.g. corrosion of the pipeline) and natural events leading to a loss of containment, injury or the destruction of property and damage to the environment.

The preliminary safety management study (SMS) for the feed gas pipeline identified potential health and safety threats associated with the construction, commissioning and operation of the feed gas pipeline including the section of the pipeline that is enclosed in the Curtis Island Link to be bored under Port Curtis. The preliminary SMS was undertaken in accordance with *AS2885.1-2007, Pipelines – Gas and Liquid Petroleum – Design and Construction.* Risks to the health and safety of personnel working in the Curtis Island Link were also assessed. All risks have been reduced to 'as low as reasonably practicable'.

The undetected corrosion of the gas feed pipeline leading to a full bore rupture is considered the worst possible event that could occur if all threat mitigation measures failed. In accordance with AS2885.1-2008 the entire pipeline will be designed such that a rupture event would not be a credible failure mode.

During operation the key risks to workers' health and safety relate to working in or on the pipeline or in the tunnel. Risks include being exposed to gas leak, fire, excessive heat or flooding. To minimise the risk of worker injury, the pipeline and tunnel will be designed and constructed in accordance with applicable codes and standards. The proponent's Health Safety and Environmental Management System includes a range of standard operating procedures and will also direct how works are undertaken on site to ensure safe work practices are adopted.

10.4. Natural hazards

There is a risk that a natural event could damage the feed gas pipeline and/or tunnel and result in the loss of containment of flammable gas. Preliminary analysis undertaken in the EIS shows no fatal flaws associated with active faulting, liquefaction potential seismic induced slope instability or tsunami hazard. The design of the tunnel and feed gas pipeline will incorporate measures to manage seismic risks and the risks associated with cyclones and major storms. It is noted that steel pipelines have been shown to be very resistant to failure in these circumstances.

The EIS reported that the proposed mainland launch site is located at the mouth of the Calliope River which has experienced numerous floods. Gladstone and surrounding areas are expected to experience increased storm tide risks as a result of climate change. The proponent has committed to considering changes to natural tidal inundation and storm tide levels due to climate change when siting permanent facilities (Appendix 4, C10.03). The EIS also reported that a design storm tide maximum level of 4.06 metres AHD will be adopted and, flood and storm surge immunity strategies may be implemented at project sites situated below 4.06 metres AHD, including the mainland tunnel launch site and TWAF 7.

I expect the following outcome:

- adequate investigations of the flooding risk at the detailed design stage in accordance with the relevant state planning policy and mitigation of all flooding risk.

I have stated a recommendation in this report to ensure the appropriate management of the mainland flooding risk (Appendix 3, Part C, Recommendation 7).

10.5. Non-Indigenous cultural heritage

In its submission on the EIS, DEHP noted that no fieldwork was undertaken for the EIS that investigated the heritage potential of TWAF 8, where heritage features associated with the Targinie gold field may occur. I note that should the proponent wish to proceed with the development of accommodation facilities at TWAF 8, compliance with the EPBC Act and *Queensland Heritage Act 1992* will be required.

11. Traffic and transport

The EIS estimated the construction workforce requirements would peak at approximately 3500 workers during the construction of trains 1 and 2. A construction camp for up to 2500 workers at Boatshed Point on Curtis Island remains the preferred option for fly-in, fly-out (FIFO) and drive-in, drive-out (DIDO) workforce accommodation during construction. At peak construction, up to 600 additional workers for the LNG plant, tunnel, pipeline and dredging will need to be accommodated. Options for TWAFs on the mainland include TWAF 8 at the corner of Forest Road and Targinie Road and TWAF 7 at Red Rover Road, south of the Gladstone Power Station. These options are being further investigated by the proponent.

The operations workforce will comprise of 250 employees and 200 contractors engaged on routine maintenance for the initial two train development. Employee numbers will increase to 400 employees for the ultimate four train development bringing the maximum number of operational personnel to 600.

11.1. Road transport

11.1.1. Context

A preliminary assessment of road impacts was undertaken in Volume 2, Chapter 28 of the EIS with the technical report in Volume 8, Appendix 23 underpinning the outcomes summarised in the EIS. Further information was supplied in Chapter 20 of the EIS.

Both state-controlled roads and local government roads were included in the assessment. State-controlled roads that were assessed included the Bruce Highway, Dawson Highway, Gladstone-Benaraby Road, Gladstone-Mount Larcom Road and Gladstone Port Access Road. Local government roads such as Blain Drive, Glenlyon Road, Hanson Road, Kirkwood Road, Landing Road, Phillip Street and Reid Road provide access for the construction of the feed gas pipeline and tunnel launch site as well as the proposed mainland launch site.

11.1.2. Road network

Road link assessment

The supplementary road link assessment identified roads utilised in sequence when transporting personnel, materials and equipment. It considered potential impacts to sections of the Dawson Highway, Gladstone-Mount Larcom Road, Blain Drive, Bruce Highway, Landing Road, Red Rover Road and Gladstone Port Access Road. The proponent found that all roads are expected to operate within design standards when assessed in accordance with the *Guidelines for Assessment of Road Impacts of Development*.[17]

[17] Department of Transport and Main Roads 2006

Intersection performance

An intersection assessment encompassing the design years 2014, 2016, 2024 and 2026 found that 11 intersections in the Gladstone region could experience an increase of approximately five per cent in peak hour volumes as a result of project traffic. Seven of these intersections are likely to require upgrades due to baseline traffic growth but are anticipated to operate within acceptable limits for all project affected design years. The proponent has identified Department of Transport and Main Roads (DTMR) future planned intersection upgrades and assessed their suitability for accommodation of project traffic. DTMR intersection upgrade plans were presented in Appendix E of the Traffic and Transport Impact Assessment, presented as Appendix 23 of the EIS.

Road network impacts

Upgrades (or the bringing forward of already planned upgrades) may be required at the following intersections as a result of the cumulative impact of four LNG projects including the Arrow LNG Plant project, APLNG project, QCLNG project and the GLNG project:

- Intersection A: Hanson Road/Alf O'Rourke Drive/Blain Drive
- Intersection E: Dawson Highway/Blain Drive/Herbertson Street
- Intersection Q: Gladstone Port Access Road/Glenlyon Road/Railway Street
- Intersection R: Dawson Highway/Glenlyon Road/Bramston Street.

Workforce transport

GRC expressed concern in its EIS submission about the availability of car parking for Arrow LNG staff and contractors, and that 1000 personnel commuting daily to the launch site 1 is considered to be too high. In response, the proponent advised in the EIS that car parking at the launch site 1 had been reduced as forecast traffic congestion at roundabouts on Port Curtis Way (particularly at its intersection with Blain Drive and Red Rover Road) makes it prudent to develop a staging area from which workers are bussed to and from the mainland launch facility. Potential sites for staging areas at Red Rover Road and TWAF 7 or other approved locations (such as private car parks) are under consideration and will be clearly identified in the Traffic Management Plan.

Coordinator-General's conclusion

I note an initial pavement impact assessment for state-controlled roads has been undertaken by the proponent, in accordance with DTMR Central District's *Assessment of Road Impacts of Development Proposals – Notes for Contribution Calculations*.[18]

A final road impact assessment (RIA) will be carried out by the proponent in conjunction with the drafting of a road-use management plan (RMP), logistics plan and traffic management plan (TMP). The final assessment is to be prepared by the proponent and the engineering, procurement and construction contractor in consultation with DTMR and GRC. The results of the assessment will form the basis for

[18] Department of Transport and Main Roads 2009

entering into infrastructure agreements with DTMR and GRC and establishing road maintenance contributions.

I require Arrow to manage its road transport impacts and achieve the following outcomes:

- construction of required road works is completed prior to the commencement of project construction
- the preparation and implementation of a RIA and RMP in consultation with DTMR Central Queensland (Rockhampton) Regional Office and GRC
- an infrastructure agreement containing outcomes of the RIA is entered into with DTMR
- relevant licences and permits are obtained and relevant plans and detailed drawings are submitted no later than three months prior to the commencement of project construction.

I have stated recommendations in this report to ensure the finalisation of required road works prior to project construction (Appendix 3, recommendations 1–4).

I acknowledge that forecast congestion on Port Curtis Way, particularly at its intersections with Blain Drive and Red Rover Road, necessitates that the local construction workforce source alternative parking away from pioneer launch sites and launch site 1 during construction. I note that the proponent has committed to implementing a formal local workforce car-pooling or bussing strategy (Appendix 4, C28.03) to minimise the number of project personnel using the roads during peak hour and proposed the use of TWAF 7 or a Red Rover Road site to facilitate this outcome.

The proponent has advised that the formal local workforce car-pooling or bussing strategy will be developed by the engineering, procurement and construction (EPC) contractor during the construction phase and later updated by Arrow for the operations phase of the project. The formal local workforce car-pooling or bussing strategy is one of the plans the EPC contractor will be required to provide to the proponent as part of the EPC contract. It is likely to be included in the induction material for staff and contractors and could be included in the Code of Conduct. The objective of the plan and strategy is to ensure that the impact on local roads and associated infrastructure is minimised and reduce the safety risks to staff and contractors from road transport (Appendix 4, C28.03)

11.2. LNG, material and personnel transport

11.2.1. Construction transport

Personnel transport between the mainland and Port Curtis is proposed to be undertaken by fast passenger ferries with 150 or 250-person capacity operating initially from a pioneer launch site at Gladstone Marina or Auckland/Barney Point. The preferred permanent mainland launch facility is launch site 1 at the mouth of Calliope River rather than launch site 4N at the Western Basin Reclamation Area. At peak, ferry movements from that location are expected to reach eight return trips per day.

The transport of heavy loads of construction equipment and consumables to the site will be undertaken by barges and heavy purpose cargo vessels. Sixty to seventy barge trips per year are anticipated along with around 30–40 deliveries utilising heavy purpose cargo vehicles. Gladstone Marina, Auckland/Barney Point and Fishermans Landing adjacent to the APLNG project mainland launch site have been identified as potential launch sites for materials and equipment.

In its response to the EIS, MSQ noted the proponent's commitments to a marine activity management plan (Appendix 4, C28.09A). MSQ advised that it requires plans covering the two distinct phases of the LNG project. Plans for the construction phase should address construction fleet safety, scheduling, pollution prevention and heavy weather procedures. MSQ noted that ship-sourced pollution was only mentioned in the EIS and supplementary material with respect to the International Convention for the Prevention of Pollution from Ships (MARPOL) and the Australian Quarantine and Inspection Service (AQIS) requirements and advised that these are relevant for vessels on an international voyage but not the Gladstone harbour construction fleet.

Plans for the operational phase should address LNG vessel harbour transits to and from the terminal.

MSQ noted that the proponent had not assessed the vessel transport impacts of the development with respect to provision of infrastructure or port services, including pilotage, in conjunction with other LNG developments currently in progress.

Coordinator-General's conclusion

I note that the LNG Maritime Movement Scheduling Committee has been established to manage marine construction traffic movements. Membership of the committee includes MSQ's Regional Harbour Master (Gladstone), GPC, the four LNG proponents and other authorities the Regional Harbour Master deems necessary. I am satisfied that the proponent has undertaken adequate consultation with the committee in regards to compliance with Port of Gladstone requirements for safe project shipping and marine construction vessel movement and scheduling. I expect the following outcomes:

- preparation of a marine traffic management plan for the construction phases of the project to ensure marine safety and related marine operational issues can be effectively planned and efficiently managed.

I have stated recommendations in this report to ensure the issues raised by MSQ are addressed in a satisfactory matter (Appendix 3, Part B, recommendations 5 and 6).

11.2.2. Operational transport

During major maintenance activities, personnel numbers are predicted to increase to 800 persons for trains 1 and 2, and up to 950 persons when all four trains are operational. Movement of between 800 and 950 persons will necessitate a ferry schedule similar to that proposed for construction.

It is estimated that vessels required during normal operations will include a fast passenger ferry with a capacity of 250 people per shift for a maximum of six return trips per day. In addition to passenger transport it is estimated that RoPax ferries (roll-on,

roll-off ferry approximately 80 metres long with a capacity of 200 people and 80 cars) will make four return trips to Curtis Island to deliver materials and equipment, and to transport waste and equipment back to the mainland. A barge will be required for occasional deliveries of fuel, lubricants, equipment and plant direct to the MOF. Project-related shipping movements are expected to be able to operate without significant impact on bulk shipping operations or recreational users of the waterways.

LNG will be exported by specially designed LNG carriers from the LNG facility on Curtis Island. They will be guided on their approach to and exit from the Port of Gladstone by up to four LNG escort tugs and will enter and exit through the recommended shipping channel within the Great Barrier Reef Marine Park (GBRMP). LNG carrier movements for two LNG trains are forecast to number up to 120 arrivals each year if 145 000 cubic metre carriers are utilised, doubling to 240 arrivals per year for four trains. Alternatively, if 215 000 cubic metre carriers are used, 88 arrivals per year are projected for two trains, doubling to 176 arrivals per year for four trains. The number of LNG carrier movements and the type of carriers used will be finalised in the shipping transport management plan.

Coordinator-General's conclusion

I accept that the risk of LNG shipping activities affecting other operational activities of the port is low. I note that, since 2004, a simulation model of the shipping operations at the Port of Gladstone has been used to analyse the performance of the port under various trade, channel and berth configurations. GPC has modelled the trading scenarios for the four LNG proponents using this model with the proponents jointly commissioning a due diligence report on the model and findings. Results demonstrate that channel infrastructure is expected to be sufficient to maintain existing port performance.

I recognise that the LNG industry has a sound safety record over the last 50 years. Since international commercial LNG shipping began in 1959, carriers have carried over 33 000 LNG shipments without a serious accident at sea or in port.

I expect the following outcomes:

- preparation of a shipping transport management plan for LNG shipping during the operations component of the project to ensure marine safety and related marine operational issues can be effectively planned and efficiently managed.

I have stated a recommendation in this report to ensure the issues raised by MSQ are addressed in a satisfactory matter (Appendix 3, Part B, Recommendation 6).

11.3. Calliope River boat ramp

The EIS indicated that marine facilities such as the boat ramp in the Calliope River may be temporarily unavailable to local boating and fishing users at certain times during construction of launch site 1. DSDIP, DTMR and GPC each lodged submissions on the EIS requesting more detail on potential boat ramp closures. In the EIS, Arrow advised that there is no expectation that the Calliope River boat ramp near the NRG Gladstone Power Station will be closed at any time during construction. The proponent anticipates

that dredging will impact on this boat ramp's use during the lowest of low tides for approximately 88 hours per year. This equates to five days per month when there may be a short period of time where the tide is too low to allow access at the boat ramp.

Public access to the boat ramp immediately adjacent to launch site 1 would be permanently restricted as the site is developed.

11.3.1. Coordinator-General's conclusion

I note the proponent's commitment that the Calliope River boat ramp near the Gladstone power station will not be closed at any time and acknowledge the proponent's commitment to providing a $500 000 upgrade to the boat ramp in consultation with GRC and other relevant stakeholders. I am satisfied that permanent restrictions to the unnamed boat ramp immediately adjacent to launch site 1 are an unavoidable part of the project.

Cumulative traffic and transport impacts have been identified and I am satisfied that the EIS has adequately investigated the impacts of the project to the extent possible at this stage of the project's development. I consider that residual cumulative impacts can be reduced to acceptable levels with the implementation of mitigation measures and commitments proposed by the proponent in the EIS and supplementary material.

12. Greenhouse gases

12.1. Overview

The greenhouse gas (GHG) impact assessment estimated GHG emissions that may result from the construction and operation of the Arrow LNG Plant and its associated marine and mainland infrastructure. It estimated the project's contribution to national and global carbon emissions in three types of emissions associated with the project: scope 1, scope 2 and scope 3 emissions. Direct scope 1 emissions sources were assumed to include:

- generation of electricity, where emissions result from fuel combustion in stationary sources, such as gas turbines and diesel electricity generators
- transport of materials, waste and employees, where emissions result from fuel combustion in Arrow owned or controlled mobile combustion sources such as vehicles and vessels
- construction activities, where emissions result from fuel combustion in Arrow-owned or controlled industrial vehicles and equipment
- planned or unplanned releases of gas from venting or flaring
- fugitive emissions from equipment
- vegetation clearance.

Indirect scope 2 emissions were assumed to include emissions from electricity produced from third parties. The indirect scope 2 emissions will not occur at the LNG plant site but will occur at the third party facility producing electricity. Indirect scope 3 source emissions were assumed to include all other emissions not included in scope 1 and 2 emissions such as emissions associated with fuel production through to end use of the produced LNG.

12.2. Construction

The EIS reported total direct and indirect GHG emissions associated with construction of the project for the all mechanical power option (gas turbine generators) have been estimated at approximately 95 kiloton CO_2-e/annum (excluding one-off vegetation clearing), as described in Table 12.1 below. The total direct and indirect GHG emissions associated with construction of the project for the mechanical/electrical power option (gas turbine generators and grid power) have been estimated at approximately 139 kt CO_2-e/annum (excluding one-off vegetation clearing).

Table 12.1 Direct and indirect construction greenhouse gas emissions

Scope	Category	Activity	Total[1] updated CO_2-e [2]
All mechanical option			
Scope 1	Fuel combustion	Construction power, dredging equipment and passenger and marine vessels	45 800
	Land clearing	Vegetation removal	(67 753[2])
Scope 2	Energy consumption	Electricity consumption at the TWAF	16 894
Scope 3	Energy consumption or production	Full fuel cycle (marine vessels, TWAF and construction activities)	32 322
Overall			**95 017**
Mechanical/electrical option			
Scope 1	Fuel combustion	Dredging, passenger and marine vessels, and passenger transport	19 362
	Land clearing	Vegetation removal	(67 753[2])
Scope 2	Energy consumption	Electricity consumption for power generation and LNG trains and energy consumption at the TWAF	80 506
Scope 3	Energy consumption or production	Full fuel cycle (electricity at TWAF, marine vessels, and electricity for construction power)	39 182
Overall			**139 050**

[1] Total CO_2-e emissions (tonnes CO_2-e/annum) include carbon dioxide, methane and nitrous oxide.
[2] Any discrepancy between the sum of the rows in this table and the totals themselves are due to differences in rounding between data sets.
[3] Vegetation removal is only included in Year 1 and is excluded from the overall total.
Source: Adapted from EIS Table 10.3.

12.3. Operations

The EIS reported that total direct and indirect GHG emissions associated with operations (excluding start-up flaring) have been estimated to be approximately 59.6 megatons CO_2-e per annum for the all-mechanical option, as described in Table 12.2 below. The total direct and indirect GHG emissions associated with operation of the project for the mechanical/electrical option have been estimated to be approximately 59.6 megatons CO_2-e per annum also.

Emissions from operation of the Arrow LNG Plant under the all-mechanical and mechanical/electrical power options were reported in the EIS to be 4 to 4.7 megatons CO_2-e per annum, respectively, as described in Table 12.3 below.

The proponent has committed to develop a GHG Standard (Appendix 4, C20.01) to mitigate potential impacts. The standard will cover items such as:

- reducing the greenhouse intensity of Arrow operations
- complying with relevant greenhouse legislation

- setting targets, including evaluation and reporting
- preparing for changes relating to carbon constraints
- venting and flaring commitments.

The proponent has also committed to identifying measures to reduce emissions intensity throughout the design process (Appendix 4, C20.02) and to minimise GHG emissions through the progressive clearing of land and subsequent rehabilitation as soon as practicable (Appendix 4, C20.03).

These commitments may be in addition to requirements that the Australian Government (Clean Energy Regulator) requires under the *National Greenhouse and Energy Reporting Act 2007* and associated Regulation 2008. This legislation requires the reporting of greenhouse gas emissions, energy production, energy consumption and other points as described in the Act and may be applicable in regard to reporting greenhouse gas.

Table 12.2 Direct and indirect operations greenhouse gas emissions

Scope	Category	Activity	All mechanical option	All electrical option
			Total updated CO_2-e	
Scope 1	Fuel combustion	Stationary engines – power generation for utilities and LNG trains, passenger and marine vessels, and passenger transport	4 684 793 (43 879[2])	4 589 442 (43 384[2])
	Fugitive emissions	Venting from acid gas removal unit, start-up flaring, [2] pilot and maintenance flaring, facility-level fugitives and transmission		
Scope 2	Energy consumption	Electricity consumption for power generation and LNG trains	0	143 189
Scope 3	Energy consumption and production	End use LNG, full fuel cycle (coal seam gas processed), full fuel cycle (marine vessels), and full fuel cycle (operations power and accommodation)	54 919 313	54 874 502
Overall[3]			**59 604 106**	**59 607 132**

[1] Total CO_2-e emissions (tonnes CO_2-e/annum) include carbon dioxide, methane and nitrous oxide
[2] Start-up flaring is only included in Years 1 and 9 and is excluded from the overall total
[3] Any discrepancy between the sum of the rows in this table and the totals themselves are due to differences in rounding between the two data sets.
Source: Adapted from EIS, Table 10.4

Table 12.3 Estimates of greenhouse gas emissions

Geographic Area	Source Coverage	Time Scale	Emissions per annum (Mt CO_2-e/annum)
Global[1]	Consumption of fossil fuels	2009	30 086
Australia[2]	Energy sector	2009	420.3
Queensland	Total greenhouse gas emissions including land use, land use change and forestry	2009	155.1
Arrow LNG Plant	Scope 1 operational emissions	All mechanical option	4.6
	Scope 2 operational emissions		0.14
	Total operational emissions		**1.7**
	Scope 1 operational emissions	Mechanical/ electrical option	4.7
	Scope 2 operational emissions		0
	Total operational emissions		**4.7**

[1] UNSD (2012)
[2] DCCEE (2011)
Source: EIS Table 10.5

12.4. Coordinator-General's conclusions

I am satisfied that the preliminary assessment of greenhouse gases for the project is adequate and that the proponent's commitments are satisfactory to minimise the release of greenhouse gases to the atmosphere. I note that further information has been requested by DEHP upon application for an EA. I require the following outcomes:

- petroleum activities minimise the release of contaminants, including greenhouse gases to the atmosphere.

Given the above, I have not stipulated specific conditions in regard to greenhouse gas, as I am satisfied that the minimisation of contaminant release to the atmosphere, which includes GHG emissions, is adequately addressed by Appendix 2, Condition B1.

13. Offsets

13.1. Environmental offsets—regulatory framework

The Queensland Government Environmental Offsets Policy (QGEOP) provides an overarching framework setting the principles and requirements for delivery of state offsets. Under the framework of the QGEOP, there are currently four offsets policies that address specific environmental issues. The specific-issue offsets policies, and their regulating agencies are:

- *Policy for Vegetation Management Offsets* (version 3), 2011, DEHP
- *Queensland Biodiversity Offset Policy* (version 1), 2011, DEHP
- *Marine fish habitat offset policy,* 2012, DAFF
- *Nature Conservation (Koala) Conservation Plan 2006 and Management Program 2006-2016,* 2006, DEHP.

Offsets conditioned by SEWPaC are determined using the Policy Statement: Use of Environmental Offsets under the EPBC Act (2012). The statement provides principles for offsetting unavoidable impacts on MNES.

13.2. Coordinator-General requirements and approval

The QGEOP does not bind the Coordinator-General in assessing coordinated projects or activities from a holistic perspective under the SDPWO Act. The Coordinator-General has the discretion to consider the need for and decide on all types of offset conditions (and conditions in general).

The Coordinator-General has all the powers necessary to decide on offsets as part of his broad conditioning powers under the SDPWO Act. For example, sections 39 and 47C of the SDPWO Act provide the Coordinator-General with the general power to state conditions for development approvals and EAs respectively.

The Coordinator-General can take advice from relevant state agencies on offsets and will consider existing state offset policies but is the sole decision-maker on coordinated projects and will determine and approve any state offset conditions that are considered necessary over and above Commonwealth requirements to address significant residual impacts for matters of national environmental significance.

13.3. Proposed offsets strategy

Habitat loss and disturbance is to be minimised as much as practical through project site selection and design. The proponent has committed to provide offsets for direct residual project impacts where possible with like-for-like habitat.

A final offset proposal will be presented to the Coordinator-General and Australian government for approval following further detailed investigations. The proponent has advised that it seeks to discharge its offset liabilities under state and Commonwealth approvals within the same offset, if the characteristics of the property satisfy the requirements of both jurisdictions. I support this objective as it minimises duplication. The proponent advised that it would preferably seek offset properties in the GBRWHA with opportunities for the properties to be incorporated in National Parks or conservation parks or reserves.

13.3.1. Offsets for direct impacts

The EIS identified that the maximum potential area of remnant vegetation to be cleared is 278.16 hectares (including least concern REs). Table 13.1 below provides a summary of the project's proposed direct impacts on regional ecosystems and species, including conservation status.

Table 13.1 Conservation status of habitats and species potentially impacted by the project

Regional ecosystem (VM Act)	Area to be cleared (ha)	VM Act (Qld)	
RE 11.3.4 *Eucalyptus tereticornis* and/or *Eucalyptus sp.* tall woodland on alluvial plains	23.91	of concern	
RE 12.3.3 *Eucalyptus tereticornis* woodland to open forest on alluvial plains	37.73	endangered	
RE 12.11.4 Semi-evergreen vine thicket on metamorphics ± interbedded volcanics	0.66	of concern	
RE 12.11.14 *Eucalyptus crebra, Eucalyptus tereticornis* woodland ± interbedded volcanics	74.74	of concern	
Habitat for fauna species	**Area to be cleared (ha)**	**EPBC Act (Cwlth)**	**NC Act (Qld)**
Beach stone curlew (*Esacus magnirostris*) habitat	48 (shorebird habitat)		vulnerable
Eastern curlew (*Numenius madagascariensis*) habitat			near-threatened
Squatter pigeon (*Geophaps scripta scripta*) habitat	32	vulnerable	vulnerable
Water mouse (*Xeromys myoides*) habitat	5.1	vulnerable	vulnerable

A total of approximately 2.5 hectares of mangroves will be cleared from water mouse habitat at Curtis Island. Habitat will be cleared west of Boatshed Point (0.8 hectares) and North China Bay (1.7 hectares). Indirect impacts to water mouse habitat covers an additional 16.6 hectares of mangroves west of Boatshed Point.

Small areas of mangroves may also be cleared at the mainland (0.6 hectares at Red Rover Road, 0.2 hectares at TWAF 7); however, they are not considered to be viable water mouse habitat.

Other compensatory measures are proposed for indirect impacts to the water mouse. SEWPaC recommends that the proponent conducts research into the water mouse to improve knowledge of the species, in particular on Curtis Island, as a potential compensatory measure.

Offsets for significant residual impacts arising from the project may be able to be facilitated on Curtis Island in the environmental management precinct, an area adjacent to the impact area. The Coordinator-General retains ownership of almost 1400 hectares of land within this precinct. This land has been retained with the potential to facilitate the provision of environmental offsets for development within the CIIP and to provide a buffer to industrial development. Once the proponent has reached agreement with SEWPaC regarding the suitability of this land for the required offsets has been determined, the Coordinator-General will consider the necessary arrangements to secure the offsets.

13.3.2. Offsets for indirect and cumulative impacts

The project will contribute to underwater noise impacts within Port Curtis through shipping activity and marine construction activities (e.g. pile driving). Underwater noise can potentially disturb or cause harm to marine megafauna. The proponent advised that it would contribute to research on potentially affected listed marine species. SEWPaC has suggested that the proponent's contribution to research should focus on cumulative impacts of underwater noise on marine megafauna within Port Curtis to offset the impact.

Cumulative impacts from industry development and activity within Port Curtis include lighting impacts. Artificial lighting and light glow from infrastructure can disorient nesting turtles and hatchlings. The EIS identified that the proponent will participate in a Long Term Marine Turtle Management Plan with GPC and other port users to offset residual impacts of lighting on marine turtles within Port Curtis.

Project impacts on the water mouse in Port Curtis include habitat loss and fragmentation. A cumulative total of up to 20 hectares of mangrove vegetation will be lost across all four LNG facility developments on Curtis Island. The EIS reported that the proponent will develop a water mouse management plan to manage indirect impacts to the species within the project area.

13.4. Coordinator-General's conclusion

The proponent's draft environmental offsets proposal provided information on their estimated maximum loss of remnant vegetation, conservation listed species to be affected by habitat clearing and direct disturbance to marine habitats. Estimates of offset liabilities and potentially available offset sites were also provided.

The final environmental offsets plan must be provided for approval by the Coordinator-General, after the Commonwealth's decision.

I am satisfied with the assessment undertaken by the proponent to determine possible broad offset obligations. These obligations are considered the maximum that I would impose on the project. I am also satisfied that mechanisms exist within the Curtis Island Environmental Management Precinct Contribution and Maintenance Deed, of which the proponent is a signatory, to provide offsets, should they be required by an approval under the EPBC Act.

I have facilitated the conversion of almost 3000 hectares of land within the Curtis Island Environmental Management Precinct to protected estate. Approximately 1912 hectares of land will be added to the existing Curtis Island National Park with approximately 1000 hectares added to Curtis Island Conservation Park, increasing the protected area to more than 17 100 hectares. The 3000 hectares was made available by financial contributions from the four current LNG proponents on Curtis Island as per the Deed outlined above.

While Arrow is not able to receive any offset benefit from this conversion at this point in time, I retain ownership of almost 1400 hectares of land within the precinct to facilitate the provision of environmental offsets for development and to provide a buffer for industrial development.

As a result, the proponent must now undertake relevant ecological equivalence assessment on the impacted sites and proposed offset sites and conclude offset arrangements with the Commonwealth on MNES. Once this work is complete, I will make my final determination on state offsets.

I have imposed a condition (Appendix 1, Condition 2) requiring the proponent to submit an environmental offset plan, including the results of the ecological equivalence assessments and taking into account outcomes of the Commonwealth MNES assessment for my assessment and final approval on state offsets.

14. Environmental management plans

14.1. Introduction

This section of the report provides an overview of the Environmental Management plan (EM plan) for the project. After the release of a Coordinator-General's evaluation reports, EM plans become the key reference documents that convert the undertakings and recommendations made in the EIS and SEIS into actions and commitments to be implemented by the designers, construction operators and subcontractors of the project. The plans specify:

- proposed environmental management strategies, actions and procedures to be implemented to mitigate adverse and enhance beneficial environmental impacts
- monitoring, reporting and auditing requirements
- the entity responsible for implementing proposed actions
- proposed timing
- corrective actions, if monitoring indicates that performance requirements have not been met.

DEHP made a submission regarding the EM plan in the EIS comment period. Issues that were raised included:

- requirement to provide two draft EM plans, one for the petroleum facility licence and another for the petroleum pipeline license
- requirement to provide background air quality monitoring data
- requirement to provide adequate detail on the expected type and quantity of waste to be generated
- requirement for further information on the quality and quantity of wastewater to be disposed to land (potentially to sea) or reused on the site
- requirement to specify maximum disturbance area
- updating the EM plans as a result of supplementary studies and information.

I have considered these comments and how the proponent has responded to these issues as part of my evaluation of the project.

14.2. Management plans

The proponent has prepared a EM plan for all project components (EIS, Attachment 3) in accordance with former section 203 of the EP Act (provision retained under section 683 of the EP Act amended by the *Greentape Environmental Protection (Greentape Reduction) and Other Legislation Amendment Act 2012*).

The proponent's draft EM plan provides strategic and specific commitments that will inform the development of management plans to be subsequently prepared for components of the project. The statutory requirement for an EM plan was repealed on 31 March 2013. However, much the same information is required with each application

for an EA for the project. The proponent stated in the EIS that EM plans would need to be submitted in support of two applications for EAs—one relating to the Petroleum Pipeline Licence (PPL) and one relating to the Petroleum Facility Licence (PFL).

The PPL and PFL EM plans will need to be further refined and expanded with information provided in the draft EM plan after this report is finalised, during the detailed design phase of the project and through ongoing consultation with the relevant regulatory and advisory agencies.

In addition to the draft EM plan, to address specific regulatory issues, the proponent has made commitments to prepare additional management plans for the project (see Appendix 4). It should be noted that the following management plans may be revised after this assessment stage:

- Aboriginal and Torres Strait Islander action plan (C26.28A)
- ASS management plan (C12.17)
- Australian industry participation plan (C26.29A)
- community investment and wellbeing action plan (C26.62)
- construction and operations environmental management plans (17.01)
- decommissioning plan (C16.13)
- dredge management plan (C15.02)
- emergency management plan (aka emergency response plan) (C26.54)
- environmental offsets operational management plan (C17.02A)
- fauna management plan (C17.08)
- heritage management plan (C25.01)
- housing and accommodation plan (aka worker accommodation plans) (C26.75A)
- light mitigation plan (C19.14)
- local content plan (C26.77A)
- marine activity management plan (C28.09A)
- materials handling and waste management plan (aka waste management plan) (C14.02)
- mosquito management plan (C17.11)
- pest management plan (C17.13)
- Port of Gladstone shipping activity strategy and management plan (C19.04)
- recruitment and retention plan (C26.35)
- recycled water management plan (C31.35)
- rehabilitation plans (aka landscape and rehabilitation plans) (C23.14)
- site drainage plan (C11.16)
- site management plan for ash in settling ponds (C12.08)
- site-specific vegetation management plans (C13.19)
- species management plan(s)
- spill prevention and response plans (C13.12)
- traffic management plans (C26.56)

- wildlife corridor management plan (C17.41)
- workforce and training plan (C26.29A).

14.3. Coordinator-General's conclusions

Based on my assessment of the EIS, supplementary material and advice from DEHP, I am satisfied that the draft EM plan has been developed sufficiently for my report to state draft EA conditions for the project. I recognise that further information will need to be provided to DEHP prior to finalisation of the EA.

The proponent will be required to implement measures contained within its EM plans in accordance with provisions of the EP Act and other legislation referred to in Section 4.2 above.

I consider that the effective implementation of the EM plans and proponent commitments would ensure that environmental impacts of the project can be managed appropriately.

15. Social impacts

15.1. Overview

A social impact assessment (SIA) for the project has been completed by the proponent in accordance with the TOR. Matters that have been considered included the project's social and cultural area of influence, community and stakeholder engagement, a social baseline study, workforce profile, potential impacts, and mitigation and management strategies. The study area focused on the communities that will be impacted in the region covered by the GRC local government area.

The project's close proximity to the existing APLNG, QCLNG and GLNG projects and the same area of influence has resulted in similar issues for stakeholders that were considered when the previous three LNG projects were investigated. Many of the impacts identified involve the same stakeholders and partners for the development and implementation of management and mitigation strategies. Refer to Section 15.3.4 of this report for details of the consultation undertaken during the EIS process.

The SIA found that the potential negative impacts arising from the project can be managed or mitigated, with appropriate strategies required to be to developed and implemented prior to and during construction. There were no key impacts identified that suggested the project should be delayed, postponed or restructured due to social or economic issues.

The SIA showed that the majority of the negative impacts were assessed as moderate or of low significance.

Impacts of high significance include:

- positive—increased local, regional and Indigenous employment training and development opportunities within the project and across other businesses.
- positive—local industry participation and the ability for businesses to provide goods and services directly to the project.
- negative—potential increased housing costs
- negative—reduced housing affordability for low- to moderate-income families.

The subsections below provide more detail on the potential impacts that the SIA identified for enhancement or mitigation; the proponent's strategies to enhance, mitigate and manage the potential impacts arising from the project, along with my analysis, reporting requirements and conclusions.

15.2. Government policy

The Queensland Government has committed to streamlining regulatory and approval processes, including the cost and complexity of the EIS process for coordinated projects as a means of reducing costs to industry and helping to grow a four-pillar economy.

In pursuing these objectives, the Queensland Government works with industry and local government through the *Managing the impacts of major projects in resource communities* framework to:

- streamline processes to provide greater certainty for proponents and reduce costs. SIA mitigation measures will focus on impacts identified through better social impact assessment
- deliver better outcomes for resource communities through clear roles for state and local government, working closely with proponents

The framework is available on the Department of State Development, Infrastructure and Planning website at **www.dsdip.qld.gov.au/resources/plan/managing-impacts-major-projects-resource-communities.pdf**

As part of this framework, I have developed a new SIA guideline to assist proponents to effectively identify, assess and propose measures to mitigate the social impacts of coordinated projects. Notwithstanding this, the requirement to complete a SIA as part of the EIS process remains unchanged.

The new SIA policies and guideline are part of a broader suite of actions that have been developed to support the state's objectives to reduce red tape, strengthen the resource sector and empower local government, whilst providing greater certainty and better local outcomes for resource communities. The components of a SIA include:

- housing and accommodation
- workforce management
- health and community wellbeing
- local community and stakeholder engagement
- local business and industry content.

The guideline is available on the Department of State Development, Infrastructure and Planning website at **www.dsdip.qld.gov.au/assessments-and-approvals/social-impact-assessment.html**

Proponents were previously required to develop a social impact management plan (SIMP) for major resource development projects requiring an EIS. As this projects' EIS was initiated under these arrangements, the proponent provided a draft SIMP as Attachment 4 of the EIS outlining the potential impacts arising from the project and the proponent's responses.

Despite the change in government policy in regard to social impact management, the proposed mitigation strategies remain relevant and have been summarised in Appendix 5, Schedule 1 of this report.

The Queensland Government supports economic growth and infrastructure provision across regional communities through its Royalties for the Regions initiative. Royalties for the Regions aims to ensure regional communities get genuine long-term royalty benefits through better planning and targeted infrastructure investment, resulting from royalties paid by major resource projects. The program provides support to local governments in responding to critical needs arising from resource sector growth, and

will help regional communities better manage the consequences of resource sector development, seize economic opportunities and encourage growth.

15.3. Social impact assessment

A SIA was undertaken by the proponent as a component of the EIS. The SIA identifies and assesses social and economic impacts and defines the roles of the proponent, government, community and other key stakeholders. It also proposes measures to enhance mitigate and manage impacts throughout the construction, operation and decommissioning phases of the project.

Appendix 5, Schedule 2 of this report provides a summary of the impacts along with the ranking for each impact derived from the impact assessment framework. The assessment framework is outlined in Appendix 5, Schedule 3 of this report.

Potential negative impacts identified in the EIS:

- supply, cost and affordability of housing for purchase or rent
- increased demand on existing social infrastructure, facilities and services
- community concerns about the management of social issues, the effect on lifestyle, cost of living pressures and community cohesion
- labour market drain from other sectors into the LNG Industry and the ability to replace these workers and the affordability of housing in the region for workers
- road safety issues as a result of increased traffic associated with project and increased population
- community safety in relation to crime, antisocial behaviour, drug and alcohol-related activities.

The proponent has responded to potential impacts identified during consultation and the EIS process with a series of action plans and these are summarised in Appendix 5, Schedule 1 of this report.

These actions are further supported by a range of plans, procedures and policies that address specific issues or impacts in greater detail and include:

- Community and Stakeholder Engagement Strategy
- Aboriginal and Torres Strait Islander Action Plan
- Complaints and Dispute Resolution Management System
- Emergency Management Plan
- Equal Opportunities Policy
- Fit for Work – Drug and Alcohol Procedure
- Fit for Work – Fatigue Management Procedure
- Gladstone Regional Community Consultative Committee
- Integrated Housing Strategy
- Local Employment Plan
- Local Industry Participation Plan (adopting the Queensland Resources Council's Code of Conduct for Local Content 2013)

- Social Investment Strategy (Brighter Futures Program)
- Traffic Management Plan
- Workforce and Training plan
- Workforce Code of Conduct.

Further engagement with stakeholders is required to finalise the baseline data, targets and indicators needed to ensure that actions and supporting documents listed above are completed and implemented prior to the commencement of construction.

The subsequent sections of this report consider the extent to which the actions, commitments and supporting mechanisms enhance, avoid, mitigate and manage the impacts of the project.

15.3.1. Housing and accommodation

Housing availability and affordability are critical issues across the project area. With the commitment of three LNG projects in the last two years, a major influx of workers has eventuated, placing pressures on accommodation and housing. This has increased demand, reduced supply and increased housing costs for low- to medium-income households not employed in the resources industry.

As other LNG projects reach peak employment during construction, pressure on the housing market has slowed. However, this has the potential to escalate before construction begins as investors speculate in anticipation of increased rents and capital growth, lengthening the duration of increased housing costs. Employers in other industries experience difficulties in attracting and retaining key workers as house prices and rents become unaffordable.

Whilst housing strategies to support, increase and maintain supply and affordability have been made by other proponents, governments and housing providers, there is a need for this project to implement mitigation and management strategies that respond to its specific impacts to enhance housing market supply and affordability.

The EIS identified housing costs in the Gladstone Region as requiring mitigation and management. A range of agencies, including the Department of Housing, Department of Communities, Child Safety and Disability Services and GRC noted the need for an integrated housing plan for temporary and permanent workers, responses to impacts on the affordable housing market and that these should be developed in collaboration with other LNG proponents, GRC, state agencies and non-government providers. A range of suggested mitigation strategies was identified including commitments to:

- involvement with the collaborative housing model and preventative strategies operating in Gladstone
- the need for early intervention strategies for the housing of temporary workers prior to and during commencement of construction to limit impact on the private rental housing market
- updated and accurate information on workforce numbers and profiles during the various phases of the project and adaptive management strategies to respond to changes.

The proponent's approach to a range of integrated housing solutions for its workforce and its commitment to fund and deliver housing market options and services will assist in mitigating housing market impacts arising from local employment in the project. The proponent has also committed to collaborating with Queensland Government, GRC, housing providers and other LNG proponents to identify cooperative strategies to address housing impacts. The proponent will monitor the level of demand on the housing market by its workforce and is committed to providing replacement housing stock based on the state of the housing market to meet this demand and will use market interventions to minimise adverse impacts. The proponent has also committed to contribute to housing market research that identifies and informs on the state of the market to assist it in making housing choices that minimise impacts on the community. In addition the proponent will provide accommodation for 2500 workers in the TWAF on Curtis Island and if required will construct or use an existing commercial accommodation facility on the mainland for a further 1000 workers.

Coordinator-General's conclusions

I require the proponent to meet the temporary and permanent housing and accommodation needs of its workforce during the construction and operational phases of the project, whilst taking responsibility for avoiding, managing or mitigating project-related impacts on housing supply and affordability in the Gladstone region.

I note the proponent's intention to develop an integrated housing plan prior to construction and operation. This will incorporate an early works workforce accommodation strategy, for the period of the construction of the Curtis Island construction workers camp, and also construction and operational workforce accommodation strategies. This plan will utilise a range of housing options, reflecting current housing market conditions at each phase, to mitigate and manage impacts. The proponent has also committed funding of $7.5 million for the supply of affordable housing and housing support services and will work collaboratively with GRC, housing providers and other stakeholders to identify opportunities for housing and service development.

With Gladstone experiencing increased housing pressure, exacerbated by the existing LNG projects during the last two years, there is the potential for these cost pressures to continue.

For this reason, I have imposed a condition at Appendix 1, Condition 1 requiring the proponent to provide an annual report to the Coordinator-General for a period of five years from the commencement of construction for trains 1 and 2 of the project. The report must describe the actions, outcomes and adaptable management strategies to avoid manage or mitigate project-related impacts on housing markets in the Gladstone region.

The annual report should also report on actions and management strategies addressing direct impacts arising from operational activities undertaken during the five year reporting period.

15.3.2. Workforce management

The construction phase of the project is scheduled for four years for trains 1 and 2 commencing in 2014. The total construction workforce is expected to peak at 3500 in 2016. For trains 3 and 4, construction is expected to commence in 2022 and be completed in 2026. The total workforce will peak at 2300 in 2024.

From the commencement of operations it is expected that there will be an ongoing operational workforce of 450 personnel in 2018 for trains 1 and 2 and a peak of 600 in 2025 when all four trains are operational. Planned maintenance programs will require either an additional 50 or 350 personnel for a three-week period depending on the nature of the maintenance being undertaken.

The Gladstone region has a significant locally skilled workforce and there is a high level of competition for these workers. Arrow has a commitment to achieve 20 per cent local employment during construction, which would result in 700 local workers. With the anticipated completion of the construction phases of two LNG projects between early to mid 2014, there is potential to enhance Arrow's ability to recruit both locally and regionally. It is expected that, during operations, the percentage of local employment will rise to 40 per cent, which would be a total of 200 workers.

The remaining construction and operational workers would be FIFO and will be accommodated in the Curtis Island construction camp which will have a capacity of 2500. If required, a 1000-bed mainland TWAF may be constructed by the proponent or an existing commercial accommodation facility could be used.

The employment, training and skill development opportunities that the project provides for both local and regional communities were the subject of comment by a number of agencies, including the Department of Education and Training, Department of Communities, Child Safety and Disability Services and Gladstone Regional Council, when reviewing the EIS and included:

- the need for increased local employment both directly and indirectly within the project and across other business
- increased training, skills development, apprenticeships, traineeships and scholarships
- employment outcomes for vulnerable groups including women, people with a disability and members of the Indigenous community
- the enhancement of the overall skill base of the region.

In response, the proponent has developed a framework of mitigation and management strategies that commits to the development, funding and implementation of specific workforce management initiatives and also utilises existing partnerships to respond to identified project impacts.

The framework includes developing a recruitment plan for the project to include consultation and negotiation with all key stakeholders to identify what positions will be targeted, to minimise the impact on local business but maximise local employment opportunities. The plan will also identify gaps in the skill sets required for the project and propose appropriate strategies to fill the gaps. Where local business is impacted by recruitment of workers to the project, the proponent will review non-project labour

requirements and skills and will implement training strategies to meet these needs. The proponent will also develop a program to target under-represented groups including women, the unemployed, unskilled workers, members of the Indigenous community and people with a disability to deliver work readiness and skills development training.

Coordinator-General's conclusions

I require the proponent to maximise local employment opportunities over the life of the project, including opportunities for under-represented and disadvantaged groups, and provide training and development opportunities for people locally and regionally to improve skills and gain employment in the LNG/CSG sector.

The proponent has committed to a recruitment and retention plan for local and Indigenous employment that will provide access to training programs and initiatives, to improve, develop and enhance workforce skills and also provide a range of management strategies to deliver employment outcomes across the community. I also note that the proponent has committed to employ an education and training coordinator to work with state and local government agencies and other training and skills providers to identify gaps and minimise the impact on local business due to the loss of skilled workers.

A number of programs and local training strategies have been developed, identified and committed to by the proponent. These include:

- community-based trainee, apprenticeship, graduate and scholarship programs
- workforce training to fill project vacancies and minimise labour drain on local business
- industry pathway programs in collaboration with local schools, TAFE, university and training providers to create, improve and enhance local and regional employment opportunities.

The mitigation and management framework provided represents a satisfactory response to local and regional workforce issues. Given that the workforce issues and requirements of the project will change over time, I have imposed a condition (Appendix 1, Condition 1) requiring the proponent to provide an annual report to the Coordinator-General for a period of five years from the commencement of construction for trains 1 and 2 of the project. The report must describe the actions, outcomes and adaptable management strategies to enhance local and regional employment, training and development opportunities.

The annual report should also report on actions and management strategies addressing direct impacts arising from operational activities undertaken during the five year reporting period.

15.3.3. Health and community wellbeing

This section of the report is concerned with the opportunities and impacts arising from the project on a broad range of social and community infrastructure and services.

During the EIS and SIA stakeholder and community engagement process, the community expressed that, while supportive of industrial development, it is concerned

that the community values have the potential to be eroded. These values relate to lifestyle choices, good educational opportunities, the family friendly nature of the area, the environment and the growing multiculturalism of the community.

Given the concerns expressed, the community expects:

- protection of these values while encouraging industrial development
- industry and all levels of government contributing to the region
- to be involved in decisions about how their community develops
- increased services as a result of economic growth associated with the LNG industry.

The EIS acknowledged that increased population during construction could place additional demand for and access to existing social and community infrastructure and services. It identified the following potential impacts for enhancement, mitigation or management:

- increased demand on all levels of educational services
- increased demand on social infrastructure and services including medical, emergency, community facilities and community support services
- reduced housing affordability and higher housing costs
- community concern about health and safety impacts from the project
- reduced access and heightened health and safety risks associated with water-based recreation
- community safety including crime, antisocial behaviour and increased traffic and road use
- potential reduction in community cohesion associated with income disparity
- concerns about management of cumulative social issues and the need for a collaborative approach with other LNG projects and stakeholders.

Emergency service agencies identified the need for collaborative and effective emergency management planning strategies to mitigate concerns about community health and safety impacts. Agencies also highlighted that their capacity to respond to increased service demand is linked to their ability to recruit and retain staff in an environment of increased housing costs.

Community concerns about the potential for increased demand for health services as a result of increased population was highlighted by Queensland Health and the SIA acknowledged and recognised the need for there to be collaboration and agreement on mitigation strategies in relation to increased pressure on the delivery of health services during construction.

GRC stated that the Social Investment Strategy commitments should be adopted as soon as possible after FID is reached and prior to the commencement of construction. where appropriate, to ensure that impacts identified in the SIA are actioned in a timely and effective manner.

Coordinator-General's conclusions

I require the proponent to:

- avoid, manage or mitigate project-related impacts on local community services, social infrastructure and community safety and wellbeing
- engage and collaborate with key government and industry stakeholders to minimise the impact on emergency services in the region and optimise the safety of the community and its employees for the life of the project
- seek to facilitate discussion and agreement on potential impacts on the delivery of health services during the construction phase of the project
- implement agreed investment and strategy development commitments where appropriate, prior to the commencement of construction to ensure impacts are mitigated or managed.

The establishment of a fourth LNG project will continue to enhance the growth of the local economy, employment opportunities and the business confidence of the Gladstone region. However, it is clear from the SIA that social impacts on local regional and community infrastructure which have been identified and recognised by the proponent also need to be effectively managed in order to maintain a strong and sustainable community.

I acknowledge that the development of the proponent's Social Investment Strategy, to be delivered through its Brighter Futures Program, provides opportunities to contribute to social infrastructure priorities identified by stakeholders and the community, through funding, partnerships and sponsorships. I note that the proponent has committed $3.5 million for direct social infrastructure impacts along with one-off and ongoing investment contributions, as well as the development of a range of strategies to address potential impacts identified in the SIA.

Health and safety concerns and the potential impact on services have resulted in the proponent committing to collaborating with relevant stakeholders to develop and implement:

- emergency response plans and traffic management plans, to minimise impacts on service providers and the community
- Workforce Code of Conduct, Health and Fit to Work procedures in relation to drugs, alcohol and fatigue management for its workforce
- safety initiatives in relation to health, policing, recreation, marine and road safety and community and multicultural support services
- collaboration and negotiation mechanisms to monitor and respond to potential project impacts on the delivery of government and non-government services including health, police, emergency services, childcare and counselling services.

In addition, I note that the proponent has committed $2.5 million in partnership with other LNG companies for the aero-medical retrieval service Care Flight to provide 100 hours of service to Queensland Health for community-based recovery services.

I have imposed a condition at Appendix 1, Condition 1 requiring the proponent to provide an annual report to the Coordinator General for a period of five years from the commencement construction for trains 1 and 2 of the project. The report must describe the actions to avoid, manage or mitigate project-related impacts on local community services, social infrastructure and community safety and wellbeing.

The annual report should also report on actions and management strategies addressing direct impacts arising from operational activities undertaken during the five year reporting period.

15.3.4. Community and stakeholder engagement

Engagement activities undertaken by the proponent have included a broadscale community consultation program for the overall EIS as well as a specific community consultation process, which have directly informed the SIA. These activities included direct correspondence and meetings with landowners, community information sessions, stakeholder briefings, meetings with regional councils, state government agencies and targeted consultation with a range of local organisations and local business.

The proponent has committed to ongoing community and stakeholder engagement during construction and operation of the project. This includes a range of specific engagement strategies with GRC, state government agencies and key stakeholders to develop and implement committed mitigation and management strategies associated with impacts identified in the SIA. It also includes engagement with local and regional planning processes and the development of links with local and state government programs to assist in mitigating impacts. In addition, the proponent will participate and report to the Gladstone Regional Consultative Committee on social impact issues and outcomes in collaboration with all other LNG proponents.

Coordinator-General's conclusions

I require the proponent to:

- engage and consult with the community to ensure it is well informed about the project impacts and have opportunities to communicate any concerns
- collaborate and consult with other proponents, regional council, state agencies and the range of stakeholders identified by the proponent to maximise opportunities, address impacts and implement agreed outcomes.

The proponent's level of engagement with the community and stakeholders during the SIA is acknowledged and I consider the methods adopted have been sufficient to identify the potential impacts arising from the project. The proponent has developed actions and strategies to ensure that community and stakeholder engagement continues in an effective manner to provide good access to local and regional information mechanisms, for all interested parties, during all phases of the project.

These actions include the community and stakeholder engagement plan and a complaints and dispute resolution process.

My expectation is that the community and stakeholder engagement plan will be implemented by the proponent along with the complaint and dispute resolution mechanisms during construction and operation. The commitment by the proponent to maintain a community liaison presence in Gladstone and be the first point of contact for complaints and dispute resolution are critical to good engagement practices.

I expect the proponent to engage and consult as required with all project stakeholders to complete the actions and supporting documents, and that baseline data, targets and indicators will demonstrate the effectiveness of these actions and will be publicly available.

As a result I have imposed a condition at Appendix 1, Condition 1 requiring the proponent to provide an annual report to the Coordinator-General for a period of five years from the commencement construction for trains 1 and 2 of the project. The report must describe the actions to inform the community about project impacts and show that community concerns about project impacts have been taken into account when reaching decisions.

The annual report should also report on actions and management strategies addressing direct impacts arising from operational activities undertaken during the five year reporting period.

15.3.5. Local business and industry content

The Gladstone region is highly industrialised with manufacturing and construction the predominant industries of employment with a total of 49 per cent of the project area workforce employed in these occupations. With the continued growth in the LNG industry local and regional business faces competition for the recruitment and retention of workers while seeking to respond to opportunities for growth, increased trade and local employment. The EIS identified the following opportunities and challenges to maximise local business participation:

- skill drain from local business to the project
- ability for local and regional business to benefit economically from increased trade generated by the project
- increased employment opportunities both direct and in direct
- increased local training opportunities
- local industry participation and the ability for business to provide goods, services and support directly to the project
- as a result of increased population associated with the project there is the potential for an increase in the range of services and business opportunities the project area can support.

The proponent has committed to adopting a Local Industry Participation Plan utilising the Queensland Resources and Energy Sector Code of Practice for Local Content. In addition, the proponent has committed to promoting, encouraging and engaging local service providers and business by implementing the following strategies:

- providing information to assist local business improve their skill bases and to adjust their operations to meet the project's needs

- developing processes and engaging with key business bodies to ensure that local business are considered in project procurement practices and have appropriate opportunities to enable them to compete for the supply of goods and services
- providing technical assistance and briefings to local and regional business on the range of opportunities and requirements, including tender readiness programs, business systems and procurement process
- communicating information about local content policy, including procurement requirements, overview of goods and services packages and supply chain information
- providing information to the tertiary sector to inform small business solutions programs about requirements to provide goods and services to the LNG industry
- encouraging contractors to source local goods and services
- encouraging business to consider Indigenous procurement to maximise Indigenous business growth and employment opportunities.

These strategies will be developed and implemented in conjunction with all levels of government and key stakeholders identified in the SIA.

Coordinator-General's conclusions

I require the proponent to be a signatory to the Queensland Resources and Energy Sector Code of Practice for Local Content 2013 and to ensure that Queensland suppliers, contractors and manufacturers are given every opportunity to tender for project-related business activities

I acknowledge the commitments made by the proponent to implement a range of local content strategies to assist local and regional businesses to achieve business growth and provide additional employment opportunities.

15.4. Cumulative social impacts

The TOR established a requirement for a cumulative impact assessment of a range of issues including social impacts. In the EIS information provided to key stakeholders, submitters including GRC, Queensland Health, Queensland Police and Department of Housing who raised issues in relation to the potential cumulative impacts of multiple LNG projects being developed simultaneously in the Gladstone Region.

The cumulative impacts identified, include:

- housing supply and affordability
- labour market drain into the LNG industry
- social infrastructure, facilitates and services
- need for a collaborative approach by all LNG proponents to manage cumulative impacts with stakeholders
- community health and safety.

The proponent is part of the LNG industry and government collaboration in relation to housing impacts and has committed to a range of investment and support strategies to

respond to the identified impacts. The strategies are reflective of the current housing environment but also align with the integrated housing strategies developed and implemented by the other LNG companies.

The proponent will also take up membership on the joint Regional Community Consultative Committee (RCCC) with the three existing LNG companies. The RCCC includes representatives from the community groups and associations, regional councils, state agencies, volunteer groups, landowner's representative, advisory bodies and representative from the Aboriginal and Torres Strait Islander community. It provides a mechanism for reporting, discussing and negotiating resolutions and outcomes on cumulative social issues.

The issue of how cumulative impacts will impact on the community in Gladstone has resulted in the proponent clearly outlining its commitment to a range of collaborative and coordinated partnerships with key stakeholders, to continue to monitor impacts, develop solutions and deliver outcomes in response to impacts on infrastructure and services that are beyond the scope of individual project assessment.

15.4.1. Coordinator-General's conclusions

The cumulative impacts arising from multiple LNG projects in Gladstone, in addition to other major development projects in the region, have the potential to place demands on essential services and facilities.

In addressing cumulative impacts, there is a need for effective collaboration to manage outcomes and maximise the benefits arising from cumulative impacts.

While proponents are only responsible for the impacts occurring from individual projects, I note the range of commitments contained in the SIA to engage with other proponents, GRC, state agencies, community and industry organisations and representatives to consider cumulative issues and to work collaboratively to address all the issues associated with projects and generate good regional outcomes.

15.5. Coordinator-General's conclusion—social impacts

The proponent has satisfactorily addressed the requirements of the TOR for the project EIS to undertake a SIA. I conclude that the SIA has been completed to a satisfactory standard having regard to the project's social and cultural area of influence, community engagement, a social baseline study, a workforce profile, potential impacts, and mitigation and management strategies. The proponent has committed to a wide range of mitigation measures to address potential social impacts including:

- housing and accommodation
- workforce management, employment, training and development
- health and community wellbeing
- local business and industry content.

I note the proponent has committed to provide the local community with open and transparent engagement mechanisms to discuss matters arising from or related to the construction and operation of the project. This commitment is reflected in the condition that I have imposed on the proponent to report annually to the Coordinator-General for a period of five years on its community engagement actions to inform the community about project impacts and show that community concerns about project impacts have been taken into account when reaching decisions during the five year reporting period.

Beyond the imposed five year reporting period and for the life of the project I recommended that the proponent continue to regularly publish a report that informs the community and key stakeholders about actions and management strategies as part of their social licence to operate.

16. Matters of national environmental significance

16.1. Project assessment and approvals

On 21 July 2009, the proponent referred the two components of the project separately to the Commonwealth Environment Minister (referral number 2009/5007 (LNG plant); and 2009/5008 (pipeline)) for a determination as to whether they would constitute 'controlled actions'[19] with respect to potential impacts on MNES under section 75 of the EPBC Act.

The EPBC Act establishes an Australian Government process for assessing environmental impacts and approving proposed actions that are likely to have a significant impact on MNES.

On 21 August 2009, the Commonwealth Environment Minister determined that both components of the project are 'controlled actions' under the EPBC Act. The relevant controlling provisions under the EPBC Act are:

- sections 12 and 15(a) world heritage properties
- sections 15B and 15(c) national heritage places
- sections 18 and 18(a) listed threatened species and ecological communities
- sections 20 and 20(a) migratory species protected under international agreements.

The Australian Government has accredited the State of Queensland's EIS process, conducted under the SDPWO Act, as part of a bilateral agreement between the Australian and Queensland governments. Under the agreement (made under section 45 of the EPBC Act), if a controlled action is a coordinated project for which an EIS is required under the SDPWO Act, then the project does not require assessment under Part 8 of the EPBC Act. The agreement enables the EIS to meet the impact assessment requirements of both Commonwealth and Queensland legislation.

Under Part 4 of the SDPWO Act and section 36 of the State Development and Public Works Organisation Regulation 2010 (SDPWO Regulation), the Coordinator-General must ensure the assessment report evaluates all relevant impacts that the action has, will have, or is likely to have, and provide enough information about the action and its relevant impacts to allow the Commonwealth Environment Minister to make an informed decision whether or not to approve the action under the EPBC Act.

This section of the report addresses the requirements of the TOR and Queensland Government's assessment as specified by Schedule 1 of the bilateral agreement and Part 13 of the SDPWO Regulation.

[19] For a definition of 'controlled action', refer to the Glossary on page 294 of this report.

The proponent's assessment of impacts on MNES is available in the EIS and SEIS, and in particular at:

- EIS – MNES, Attachment 4
- SEIS – MNES update, Attachment 2.

16.2. Description of the proposed actions

16.2.1. LNG plant (EPBC 2009/5007)

Arrow proposes to develop an LNG plant on the south-western corner of Curtis Island off the coast of Gladstone. The total area of disturbance for the plant is expected to be up to 533.7 hectares, with the entire area potentially needing to be developed. Within the Great Barrier Reef World Heritage Area, 430.7 hectares of terrestrial and marine habitat will be cleared for infrastructure, including within the 284 hectare allotment on Curtis Island.

The plant is proposed to produce up to 18 million tons per annum of LNG through a staged development process. The Arrow LNG Plant is contained within the GBRWHA, which is both a World Heritage Property and a National Heritage Place (refer Figure 16.1 below). The plant also has other associated facilities such as temporary workers accommodation facilities and launch site options on the mainland.

Construction

Construction of the LNG plant will involve vegetation clearing and earthworks at Curtis Island. Up to 262 hectares of vegetation is proposed to be cleared at the LNG plant site, including 235.94 hectares of remnant vegetation on Curtis Island. Major earthworks will level the landscape into benches, proposed to be between 10 metres AHD and 18 metres AHD approximately, on which the LNG plant, utilities and ancillary infrastructure and the Boatshed Point construction camp will be constructed. Excavation works will also be conducted to construct the haul road from the materials offloading facility (MOF) and personnel jetty to the LNG plant site, the quarantine inspection area and the formation that will carry the LNG loading lines.

Construction of the first LNG train is predicted to take approximately 44 months, with the first LNG cargo targeted for 2017. The second train will commence construction approximately a year after the start of construction for train 1, with the first LNG cargo from trains targeted in late 2018 or early 2019. Trains 3 and 4 will be constructed in stage 2. The proponent advised that market conditions will determine the timing of construction of stage 2, with similar timing expected between trains 3 and 4 commencing construction.

Cut and fill volumes are estimated at 5 820 000 cubic metres of cut and 3 140 000 cubic metres of fill. Approximately 2 500 000 cubic metres of surplus cut material will be used to prepare laydown areas for construction, landscaping mounds and reclamation of the intertidal mudflats north of Boatshed Point. The reclaimed area will be used as a construction laydown area and a radiation exclusion zone around the flare during operation.

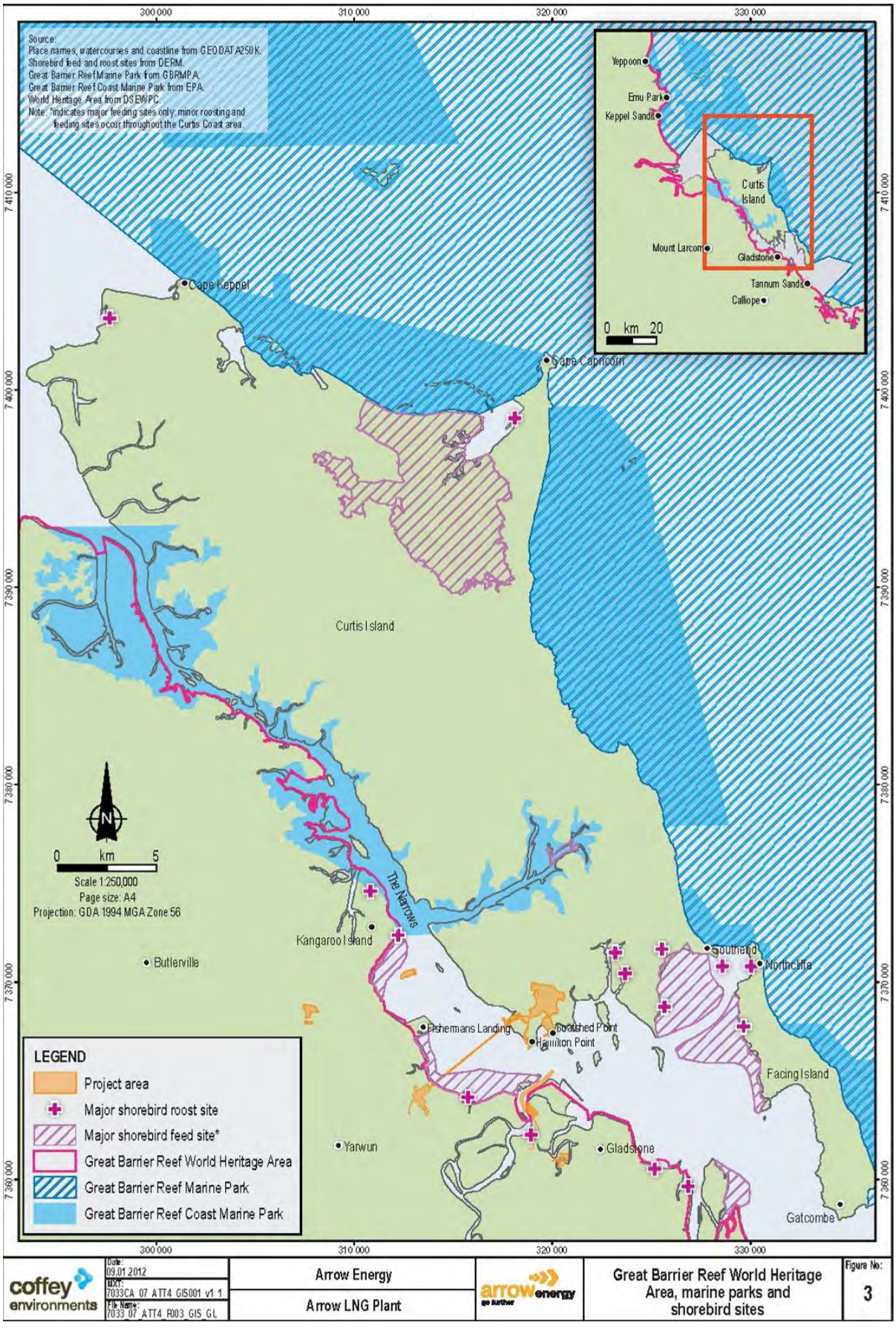

Figure 16.1 Great Barrier Reef World Heritage Area, marine parks and shorebird sites

Proposed land reclamation for marine logistics facilities at Curtis Island includes the intertidal mudflats at North China Bay, to extend the land required to accommodate the loading lines formation. Land reclamation at this site will extend from near the LNG jetty along the north side of the haul road to the proposed crossing of the haul road where it turns north to the GLNG LNG plant site.

A single LNG flare will function for routine maintenance and operation and unplanned emergency situations. The flare stack will be the maximum height of the LNG plant, standing at 115 metres tall.

Dredging is required to improve shipping access to marine infrastructure sites on Curtis Island and the mainland. Four capital dredge sites have been proposed, including dredging options presented for both the potential launch sites at the mouth of the Calliope River and at the Western Basin Reclamation area north of Fishermans Landing. The other dredge locations are at Hamilton Point and Boatshed Point. The minimum dredge volume is 430 000 cubic metres and the maximum is in the order of 1.35 million cubic metres. Maintenance dredging will also be required, particularly at Boatshed Point where the volume and frequency of dredging is yet to be determined by the proponent. Annually, up to 10 000 cubic metres of maintenance dredging at the Calliope River is expected to be required.

Several sites are under consideration for dredged material disposal including the Western Basin Reclamation area, East Banks Sea Disposal site and Wiggins Island Coal Export Terminal Area B or C. These sites are all subject to existing approval processes, and any disposal would be within approval limits for these sites. GPC has advised that maintenance dredge material may need to be disposed of at an offshore site.

A peak construction workforce of 3500 persons is expected during construction of trains 1 and 2. It is anticipated that between 5 and 20 percent of construction workers would be sourced from the local community. Up to 2500 workers will be housed at the construction camp, located at Boatshed Point. Other workers will live in existing residential properties in the community or at a TWAF on the mainland.

TWAF 8 on the mainland is being considered as an option to house workers on the mainland; however the site is remote from proposed launch site 1 and is therefore less logistically attractive. A site on Red Rover Road, south of the Gladstone Power Station is being investigated as a potential alternative TWAF.

Other mainland components of the LNG plant include a mainland launch site that is required to provide for the storage, loading and unloading of aggregate materials and for the transfer of materials, aggregate, vehicles, plant and equipment, and personnel to and from Curtis Island. Launch site 1 will be situated adjacent to the RG Tanna Coal Terminal and Calliope River is the preferred option to launch site 4N at the northern end of the Western Basin Reclamation Area. Construction of launch site 1 is expected to require approximately 53 hectares of land for laydown areas.

Construction of the LNG plant will contribute to increased shipping activity within Port Curtis and through the Great Barrier Reef. Shipping activity during construction will involve transport of workforce and goods to the LNG plant site, delivering imported construction and prefabricated LNG plant components to the site, and undertaking

dredging activities to improve shipping access. Shipping rates during construction are yet to be confirmed by the proponent; however estimates are provided in Table 16.1 below.

Table 16.1 Estimated type, number and frequency of marine vessels—peak construction

Type	Indicative Description	Indicative Frequency
Fast Cat ferry	High speed people movers with a capacity of up to 200 to 250 people; up to four fast passenger ferries will be required during construction	38 trips per day[a]
RoPax ferry	Roll-on, roll-off ferry approximately 80 m long with a capacity of 200 people and 80 cars	18 trips per day[a]
Barges[b]	Typically 80 m long and 20 m wide with a capacity of 5000 to 6000 m^3. Require tugs to manoeuvre. Will be used to transport bulk materials	60 to 70 trips per year
Heavy purpose cargo vessels[c]	Capable of transporting modules and major components (gas turbines, cryogenic heater exchanger, acid gas removal absorption column and refrigerant storage spheres) to the MOF on Curtis Island	30 to 40 deliveries in total
Cutter suction dredging vessel	Size and specifications will not be determined until closer to construction	To be confirmed[d]
Support vessel	Medium sized support vessel	To be confirmed[d]
Backhoe dredging barge	Size and specifications will not be determined until closer to construction	To be confirmed[d]
Backhoe dredger support tugs	Standard tugs	To be confirmed[d]

[a] Indicative ferry movement assuming worst-case scenario for transferring 2100 personnel on a daily basis, based on a staggered shift arrangement.
[b] Barges and heavy purpose vessels may be engaged on an ad-hoc basis or chartered
[c] Alternatively, ships might be roll-on, roll-off vessels.
[d] Frequency of dredge vessels (including tugs and support vessels) will be specified in the dredge management plan.
Adapted from EIS Table 28.18

Operation

Operation of the LNG plant will involve LNG processing and loading equipment, and supporting power, water supply, fuel gas and nitrogen systems. The plant will operate continuously and will be lit at night.

Waste and wastewater is proposed to be managed on site. Arrow's preferred option for wastewater disposal is to use the two sewer mains installed under Port Curtis by GRC. The alternative option is to use an effluent treatment plant. Treated effluent from the treatment plant would only be discharged to Port Curtis under extreme circumstances

(e.g. extreme rainfall events) and to be controlled under strict environmental standards. Brine from the desalination plant is also proposed to be discharged into Port Curtis.

Shipping activities related to operation of the LNG plant involves transporting LNG via specialised carriers, and maintenance dredging. The proponent has estimated that approximately 200 LNG carriers will service the LNG plant in a year when two LNG trains are operating. When four LNG trains are operating, up to approximately 400 LNG carriers will service the LNG plant. These vessels will travel through defined shipping channels in the GBRMP to and from overseas LNG markets.

16.2.2. Gas transmission pipeline (EPBC 2009/5008)

The LNG plant is proposed to be connected to the Arrow Surat Pipeline via a 9.45-kilometre-long feed gas pipeline, beginning at the mainland south of Fishermans Landing and traversing beneath the seafloor of Port Curtis in a tunnel to a reception shaft on Hamilton Point. The reception shaft intersects with the GBRWHA and comes to the surface within the EPBC 2009/5007 footprint. The mainland tunnel launch site and feed gas pipeline on the mainland are not within the boundaries of the GBRWHA. The EPBC 2009/5008 referral has no actual disturbance within the GBRWHA.

Construction of the tunnel launch site on the mainland will require earthworks. The site area will be 35 hectares and located at the mudflats south of Boat Creek on the other side of the mangroves from the Targinie Wetlands. The launch site pad will be constructed from imported fill and suitable tunnel spoil and will be designed to be largely self-maintaining with adequate drainage and vegetation to ensure a stable landform. The disposal area is not designed to be inundated by tides.

Construction at Hamilton Point for the pipeline reception shaft will require cutting and filling earthworks to level the topography within the proposed common infrastructure corridor. The footprint of the reception shaft is minimal (400 square metres) compared with the LNG plant.

Security lighting and fencing will be installed around the reception shaft.

Security lighting will also be installed for operations at the reception shaft, contributing to light pollution in the evening. The proposed operation of the reception shaft includes regular inspections, maintenance and repairs to infrastructure and remediation of unsuccessful rehabilitation.

16.3. Great Barrier Reef World Heritage property and National Heritage place

The Great Barrier Reef is the world's most extensive reef system, covering 348 000 square kilometres. The entire ecosystem was listed as a World Heritage property in 1981 and includes waters up to the low water mark on the mainland.

The Great Barrier Reef extends over 2000 kilometres along the north-eastern coast of Australia. The Great Barrier Reef coastal zone covers a vast area that is acknowledged by UNESCO as a mixed-use area and was listed as a World Heritage Area on that basis. In addition to sustaining a population of around one million people, it also

supports industries such as tourism, commercial fishing, mining and agriculture. These industries are vital to the ongoing viability and strength of the Queensland economy; collectively contributing more than $40 billion a year.

The ecological integrity of the Great Barrier Reef is enhanced by the unparalleled size and good state of conservation across the property. Natural occurrences, like extreme weather events, and human uses of the reef add pressure to the property. World-wide phenomena such as climate change are having a significant impact on the ecosystem health of the Great Barrier Reef. Some sections of the GBRWHA are suffering from a range of impacts that are a legacy of European settlement.

At a time when the health of reef systems worldwide is declining, the Great Barrier Reef remains one of the best managed in the world. A combination of improved management practices, the end to past actions such as broadscale clearing, and current actions to improve water quality are halting the decline in biodiversity and building the resilience of the reef.

The Great Barrier Reef is one of only a small number of World Heritage properties worldwide that has been adopted for all four natural criteria, which follow, and meet the conditions of integrity and authenticity:

- Criterion VII—contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance
- Criterion VIII—be outstanding examples representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features
- Criterion IX—be outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems an communities of plants and animals
- Criterion X—contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation.

The outstanding universal values (OUV) for the GBRWHA are listed in Appendix 6 of this report.

In Australia, an action that has, will have, or is likely to have a significant impact on the world heritage values of a declared World Heritage property requires approval under the EPBC Act. The *Matters of National Environmental Significance: Significant Impact Guidelines*[20] consider an action is likely to have a significant impact on the OUV of a declared World Heritage property if there is a real chance or possibility that it will cause one or more of the values to be lost; degraded or damaged; or notably altered, modified, obscured or diminished.

The Gladstone region is a significant industrial centre, comprising an existing major bulk port for the export of coal and grain, as well as processing of bauxite and other bulk commodities. Development projects currently under construction include the emerging LNG industry centred on Curtis Island and other coal export project

[20] Department of Sustainability, Environment, Water, Population and Communities 2009

expansions, which have facilitated the arrival of an increasingly skilled industrial workforce in recent years. An independent review of environmental management arrangements and governance of the Port of Gladstone was commissioned in February 2013. On 30 July 2013 an initial report on findings for the Independent Review of the Port of Gladstone was released for public comment. The Report is publically available at **http://www.environment.gov.au/coasts/gbr/gladstone/gladstone-review-initial-report.html**

The EIS reported that the proposed LNG plant and associated pipeline will be designed, constructed and managed to avoid, to the greatest extent possible, potential adverse impacts on the marine and terrestrial habitats of the GBRWHA within the project area. Where impacts cannot be avoided, the proponent has committed to environmental management plans and management measures to mitigate impacts. The proponent has also provided an offsets proposal to address significant residual impacts.

Primary matters for the GBRWHA with respect to the LNG plant and pipeline, include visual impacts, potential impacts to the water mouse (*Xeromys myoides*) and marine fauna species, proposed dredging works and cumulative underwater noise impacts on marine fauna.

As some of the impacts on OUVs for the LNG plant (EPBC Act 2009/5007) and pipeline (EPBC Act 2009/5008) are similar, particularly during construction, specific information on each matter will not be repeated in full for each action in this chapter. Greater detail on listed threatened flora and fauna is addressed in Section 16.4.5 of this report. Mitigation measures committed to by the proponent will be referenced for example by (Appendix 4, C1.01). These references refer to the items outlined in the proponent's Commitments Register.

16.3.1. Criterion VII

Contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance

The Great Barrier Reef is of superlative natural beauty above and below the water, and provides some of the most spectacular scenery on earth. It is one of a few living structures visible from space, appearing as a complex string of reef structures along Australia's north-east coast.

The OUV relating to this criterion includes visual aesthetics of landscape and seascapes, naturalness and the abundance and diversity of marine fauna and colonies of seabirds. The full description of OUVs is listed in Appendix 6 of this report.

The Gladstone region is characterised by contrasting landscapes of industry and natural coastal environments. The project is located over a variety of landscapes including existing natural landscapes on Curtis Island and a variety of mainland land uses such as open space, rural, strategic port and major industry and infrastructure. It is anticipated that large-scale industrial land use will continue to occur in the Port of Gladstone. This will change the remaining areas of rural or natural landscape characteristics to a landscape characterised by heavy and high-impact industrial development.

LNG plant (EPBC 2009/5007)

Visual amenity

The LNG plant footprint covers terrestrial and marine environments within Port Curtis. It is situated adjacent to three LNG plants on Curtis Island currently under construction. This recent development on Curtis Island has changed the landscape of the area from a previously undisturbed area to an increasingly industrialised landscape.

Project construction and operation activities will impact on the natural values of this part of Curtis Island through clearing up to 262 hectares of native vegetation and reclaiming the intertidal mudflats north of Boatshed Point, with a total clearance footprint (terrestrial and marine) of 430.7 hectares in the GBRWHA. The LNG plant will contribute to the change in landscape from natural to industrial with large structures and lighting visible from several viewpoints on the mainland (refer Figure 16.2 below). The site is adjacent to existing well-lit industrial facilities including the Clinton Coal Terminal, four kilometres south of the project, and the neighbouring GLNG and QCLNG projects, which are currently under construction. This proposed additional development in the LNG precinct on Curtis Island would incrementally increase the industrial nature of the landscape, progressively reducing the visual attributes of Curtis Island and the GBRWHA.

The flare stack and pilot flare will be visible from the mainland. The pilot flare will be one metre high and continuously flaring.

The flare flame will be visible from the ocean-side of Curtis Island during maintenance and emergency flaring. The maintenance flare will be five metres high and will operate between 15 minutes and up to a week at a time depending on the maintenance situation. The proponent has advised that maintenance of the LNG plant requiring flaring will be planned to begin in the morning to minimise lighting impacts at night-time. The emergency flare will be up to 20 metres in height at full throttle. This worst-case scenario would only occur if operations of more than two trains fail, which is highly unlikely.

Project infrastructure will be visible from a range of view points on the mainland, from the air and from adjacent waters. The facility would impact on views towards Curtis Island from Port Curtis and popular and frequently visited vantage points in the Gladstone area including Tide Island, Witt Island, Round Hill Lookout and Auckland Point.

The proponent has committed to minimising visual impacts through retaining vegetation to provide some screening of the plant (Appendix 4, C23.01 and C23.02) and investigating opportunities for further planting of a forested landscape buffer around the eastern, southern and western boundaries of the LNG plant site (Appendix 4, C23.06). The plant will also utilise a colour palette that blends with the predominant background colours and which reflects natural hues from the surrounding landscape (Appendix 4, C23.08).

Visual amenity is also likely to be impacted by project lighting, including flaring, by contributing to artificial light glow. Light from the plant will increase the extent of horizon illumination which will add to the existing artificial illumination at Port Curtis.

The proponent has committed to implement a detailed lighting mitigation plan (Appendix 4, C19.14) to manage light pollution. Artificial light glow is to be mitigated by screening and implementing design features such as shielding or directing the light source onto work areas to reduce light emissions (Appendix 4, C17.47).

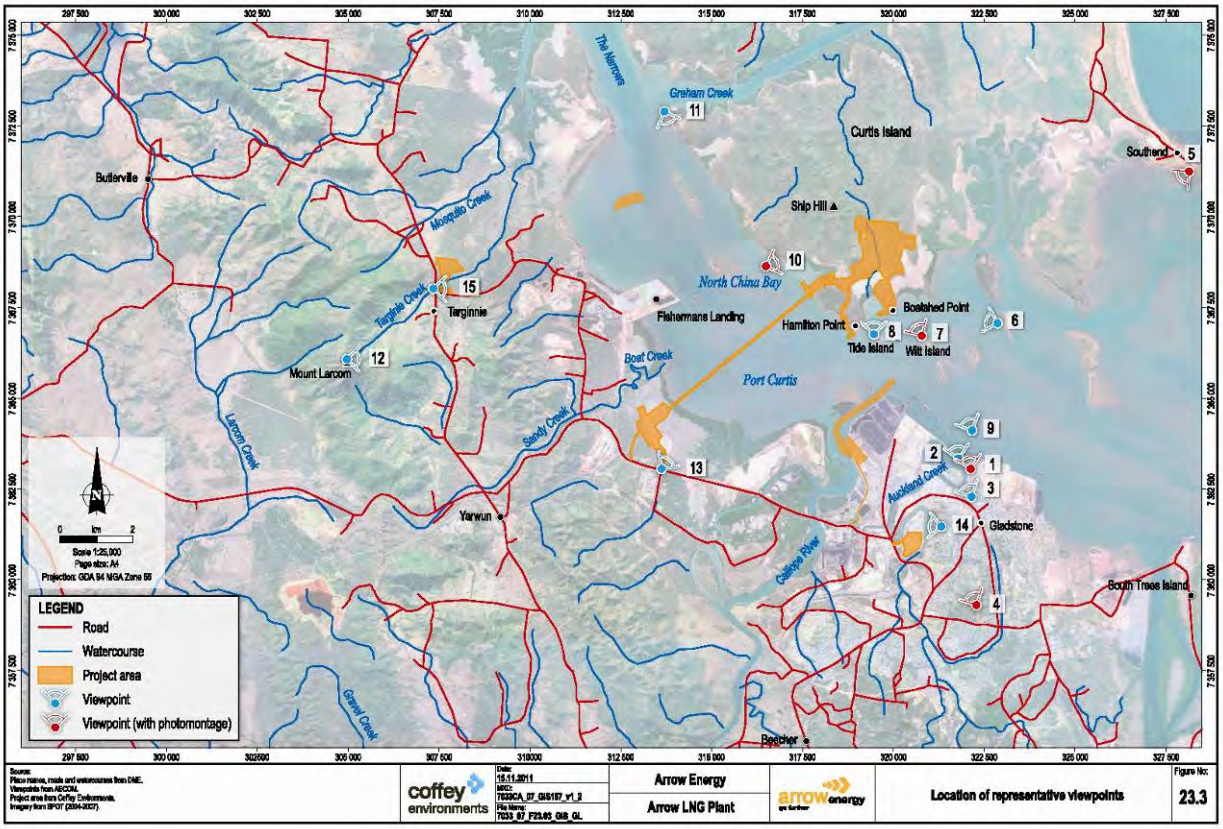

Figure 16.2 Location of representative viewpoints within Port Curtis

Noise, vibration and emissions to air

The naturalness of the area would be affected by noise and vibration impacts associated with the construction and operation of the project. Sources of impacts from project activities may include pile driving and heavy machinery during construction. Fixed equipment at the LNG plant, such as LNG trains and gas turbines, will be the main source of continuous noise during operations. Pile driving and shipping movements would contribute to increased underwater noise within Port Curtis.

Conditions stated in this report require the monitoring and management of noise and vibration impacts, including underwater noise. The proponent has committed to identify specific acoustic treatments to be applied and to ensure that noise from project operations complies with project noise criteria at all assessment locations (Appendix 4, C22.01). The proponent has also committed to developing a construction management plan (Appendix 4, C17.01) which will detail mitigation measures for underwater noise, including a buffer zone from dredging and pile driving activities as a requirement under a fauna spotting program. Conditions for underwater noise limits set out in Appendix 2, (Schedule 1, conditions C8-9) will further reduce impacts.

Excavation activities and construction machinery and vehicles will temporarily contribute to locally increased concentrations of airborne particulate matter and combustion gases. During operation, the gas turbine generator and LNG carriers will emit oxides of nitrogen and sulfur dioxides to the atmosphere. These emissions may also cause odours that should be indistinguishable from the odours emanating from the neighbouring LNG facilities.

Stated conditions require the plant to limit air emissions during operations, including the control of dust and odours. The proponent has committed to comply with all relevant air quality standards and objectives (Appendix 4, C21.01). Compliance with these criteria will ensure protection of environmental values within the air quality impact assessment study area and all sensitive receptor areas. The proponent has also committed to further mitigation measures to reduce impacts to air quality such as applying low-emission technology to equipment with high-combustion rates (Appendix 4, C21.02) and using low-sulfur diesel fuel in diesel-powered equipment, where practicable (Appendix 4, C21.09).

Water quality

The natural condition of tidal waters in Port Curtis is relatively turbid due to the proximity of sediment inputs from mainland catchments and the semi-enclosed nature of the waterway. Monitoring data reported in the EIS indicated turbidity levels within Port Curtis exceeded project water quality criteria (8 NTU), derived from DEHP (2009) and the ANZECC/ARMCANZ (2000) guidelines, by up to eight times at some water quality sampling sites.

Water quality may be impacted by suspended sediment caused by capital and maintenance dredging and potentially, wastewater discharges from the proposed outfall at Boatshed Point.

The EIS reported that impacts from dredging, including dredge plumes, will be managed according to a dredge management plan (Appendix 4, C15.02). The proponent has committed to implement spill prevention and response plans (Appendix 4, C13.12) to manage spills and to meet ANZECC (2000) guidelines and the Environmental Protection (Water) Policy 2009 (Qld). Erosion and sediment control measures will be implemented in terrestrial parts of the project area to minimise impacts to water quality (Appendix 4, C11.11, C11.23 and C13.03).

Conditions stated in this report require the monitoring and management of receiving waters in Port Curtis. These include controls on dredging activities and erosion run-off. Contingency plans for accidental spills from project activity such as LNG loading at the LNG jetty are also required. Wastewater from the effluent treatment plant would only be discharged to Port Curtis under extreme circumstances, and in this unlikely event all discharge water would be in compliance with regulated criteria. No seagrass or other sensitive environmental value is located within 10 metres of the discharge location, with the nearest seagrass beds located approximately 500 metres away.

Migratory species

The area of Curtis Island and the waters of Port Curtis in the vicinity of the project site are not known to support significant populations of iconic or otherwise important species.

Three species of marine turtles nest and forage within the GBRWHA around Curtis Island. They are the flatback turtle (*Natator depressus*), green turtle (*Chelonia mydas*) and loggerhead turtle (*Caretta caretta*). Marine turtle nesting has been reported at Connor Bluff and Southend on the eastern side of Curtis Island. Light glow may impact on marine turtles (refer Section 16.4.5)

Other marine megafauna including dugong and dolphin species are known to occur in Port Curtis. Dugongs and marine turtles forage in the seagrass beds and dolphins forage and breed in shallow coastal waters of Port Curtis.

The coastal zone of Curtis Island and intertidal mudflats of Port Curtis provides foraging and roosting habitat for a number of shorebird species.

Seagrass beds would not be directly affected by construction activities; however, indirect impacts from dredging could degrade seagrass beds, particularly at Boatshed Point. Sedimentation impacts on the Boatshed Point seagrass beds will be short-term and localised, due to strong tidal flushing within Port Curtis.

Conditions stated in this report require the management of underwater noise as part of the project's construction. The proponent has committed to fauna observations prior to and during pile driving and dredging activities to check for the presence of dugongs, turtles and cetaceans (Appendix 4, C19.07 and C19.12).

The proponent has committed to mitigation measures to minimise impacts from boat strike and underwater noise on marine megafauna within Port Curtis. The proponent will contribute to the development of a shipping activity strategy and management plan for the Port of Gladstone and to comply with speed limits within the dugong protection area (Appendix 4, C19.04). Propeller guards are also to be installed on marine vessels to minimise the impact of injury from boat strike (Appendix 4, C19.05).

Shipping

Shipping associated with the project's construction and operations would also contribute to impacts on the visual amenity of the area.

Shipping is highly regulated in Australia, with a number of State and Commonwealth agencies enforcing legislation that regulates shipping activity. Great Barrier Reef waters are subject to stringent regulatory regimes in respect of shipping. Special protective measures implemented to manage shipping through the multi-use park include a ship reporting system, coastal vessel tracking service, compulsory pilotage, navigational aids, marine pollution response plans and designated shipping areas. Other improvements to shipping management include establishing defined shipping routes, limiting shipping to specific zones within the reef as well as extending the compulsory pilotage area to include Torres Strait.

The proponent has committed to further shipping management measures to minimise impacts to the reef. Marine vessel operators for the project must to comply with Arrow's

rules for marine vessels and existing industry guidelines (Appendix 4, C28.12). The proponent will also contribute to the development of the Port of Gladstone shipping activity strategy (Appendix 4, C28.09A). Legislation and related management arrangements provide a high degree of regulatory control over ship movements within the GBRWHA and, together with Arrow's commitments, create a robust risk management system for shipping activities.

Strict shipping rules in the Port of Gladstone reduce the likelihood of collisions between LNG carriers. Two LNG carriers will not able to transit within the harbour at any one time. Groundings of LNG carriers in the vicinity of the LNG jetty are also unlikely, as vessels will be travelling slowly under escort of four tugs.

Increased visitation to the World Heritage Area

The project workforce would marginally increase the population of Gladstone, in the order of five per cent at the peak of construction and one per cent during operations. I note SEWPaC's concerns that this increased population would contribute to increased use and visitation to the reef and indirectly add to the recreational pressure on the GBRWHA.

Given the population of Gladstone has been growing at a rate of more than two per cent year on year over the past decade, the effect of the project's workforce on the population of the region is relatively minor. In addition, the existing management systems (marine park rangers and boating fishing patrols) are sufficiently resourced to limit the impacts of any increased use and visitation to the reef associated with the project's workforce.

Pipeline (EPBC 2009/5008)

Visual amenity

The majority of the pipeline and associated cross-harbour tunnel is located outside the World Heritage Area. Construction of the mainland tunnel launch site will involve heavy machinery and project lighting and will affect visual and landscape amenity from viewpoints within Port Curtis. Construction of the reception shaft at Hamilton Point, Curtis Island will involve heavy machinery and project lighting will involve a relatively minor area of vegetation clearing (less than 35 hectares). Vegetation clearing at Curtis Island will be limited to a 40-metre construction right-of-way (ROW) and associated access.

Lighting during construction of both the mainland tunnel launch site and Hamilton Point will impact on visual amenity by contributing to artificial light glow within Port Curtis. Key light sources on Curtis Island during construction are the perimeter security lights and construction vehicles. Construction lighting at the mainland largely will not be visible from visual receptors at Gladstone, although it would still contribute to artificial light glow.

Lighting impact mitigation measures are the same as those for the LNG plant, described above, which include a light mitigation plan that details the use of screening and light shielding.

Dry sclerophyll forest (7.87 hectares) and fringing coastal grasses (32.5 hectares) are required to be cleared at the mainland for construction of the pipeline. The area is already significantly industrialised with much infrastructure present, therefore the impacts of the project on visual amenity are cumulative.

Noise and emissions to air and water

The impacts from the construction of the pipeline on noise, air and water pollution in Port Curtis are similar to those of the LNG plant but at a smaller scale and are limited to the mainland tunnel launch site and at the reception shaft at Hamilton Point on Curtis Island. The same mitigation and management measures apply.

Erosion and sediment controls as described previously will be implemented at the mainland tunnel launch site to mitigate impacts.

Migratory species

The construction of the pipeline and associated cross-harbour tunnel would not affect significant populations of iconic or otherwise important species associated with the GBRWHA.

Construction and operation of the mainland tunnel launch site may disturb shorebirds roosting at Flying Fox creek and foraging at Targinie wetlands, adjacent to the project site. Shorebirds may also be displaced from the mudflats adjacent to the mainland tunnel launch site as a result of project activities. Neither Flying Fox creek nor Targinie wetlands are within the GBRWHA.

Conclusion

The LNG plant would further change the natural landscape of Curtis Island from natural to industrial. The plant would be visible from inside the Port of Gladstone from a number of different vantage points, including from the air. The LNG plant would not be visible from the eastern side of the island; however there would be a small increase in light glow at night.

The pipeline will also add to the industrial landscape at the mainland, although the majority of the structure is to be buried beneath Port Curtis. An area of clearing is required for the tunnel reception shaft on Curtis Island, however the impacts are expected to be relatively minor, particularly in comparison to the LNG plant.

The project would also affect the natural values of the area by contributing to noise and emissions to air and water. Dredging activities in particular would increase concentrations of suspended sediment in Port Curtis, although it is noted that background levels are already relatively high in this area. Conditions stated in this report would limit the impact of these disturbances to acceptable standards.

The proponent has committed to a number of mitigation and management measures to reduce these impacts on the natural beauty and aesthetic importance of the GBRWHA at Port Curtis, and to this criterion more generally.

Considering the above, including the proponent's mitigation and management commitments, the LNG plant (EPBC 2009/5007) and pipeline (EPBC 2009/5008) would not have an unacceptable impact on the GBRWHA for the purposes of this criterion.

I note that the proponent has advised that it will provide an offset for impacts to world heritage values in accordance with the EPBC Act Environmental Offsets Policy.

I note that SEWPaC considers that an increased workforce in Gladstone would indirectly add to visitor numbers and the recreational pressure on the GBRWHA. I consider that, compared to recent trends of Gladstone's residential population, the predicted increases are relatively minor and any impacts would be appropriately controlled by existing recreational management resources.

16.3.2. Criterion VIII

Representing major stages of earth's history, including the recording of life, significant ongoing geological processes in the development of landforms, or significant geomorphic or physiographic features

The Great Barrier Reef is a globally outstanding example of an ecosystem that has evolved over millennia. It forms the world's largest coral reef ecosystem, ranging from inshore fringing reefs to mid-shelf reefs, and exposed outer reefs, including examples of all stages of reef development.

The OUV relating to this criterion include the uniqueness of landforms and evidence of geological evolution including:

- reef morphologies of the Great Barrier Reef
- record of climate and sea level changes and history of the reef's evolution
- distinctive formations such as dune systems and tidal deltas.

LNG plant (EPBC 2009/5007)

The project area does not contain any landform sites listed on the Australian Heritage Register. The adjacent landscape at Curtis Island has already been altered through recent industrial development, which will be further developed by the proposed LNG plant through earthworks and shoreline modification.

The site will be changed from a naturally undulating landscape to a series of levelled platforms between 10 metres AHD and 18 metres AHD. Ridges will be cut into, and saddles and gullies will be filled to achieve these level platforms. The shoreline will be modified by a material offloading facility (MOF) and integrated personnel jetty to be constructed on the west side of Boatshed Point and intertidal mudflats will be reclaimed to the north of Boatshed Point.

Construction of the LNG plant will result in topographic and landscape changes, including disruption or removal of landform and soils across the entire site. The impacts to landscape features will be localised and confined within the CIIP.

The EIS states that the project would be designed to limit the amount of excavation on Curtis Island as far as practical to reduce topographic impact. Erosion and sediment control measures (Appendix 4, C11.06, C11.07 and C11.11) have been developed to reduce impacts on geological processes within the project area.

Earthworks for the LNG plant, including reclamation, would have a minor impact upon geological processes by affecting the natural rate of erosion, while several ephemeral

waterways will be infilled during construction, also altering existing geological processes.

Water bodies within GBRWHA

The LNG plant site on Curtis Island does not contain freshwater wetlands and does not connect to any higher order streams, wetlands or lakes. However, several ephemeral waterways of limited aquatic habitat value on the island will be infilled during construction. Subsequent stream diversions are needed to control overland flow from three of the subcatchments within the area.

The waterway diversions on the LNG plant would be designed to function as a natural stream not exceeding the natural rates of erosion and deposition (Appendix 4, C13.02). The proponent has committed to considering post-decommissioning channel form in the stream diversion design and to provide a self-sustaining waterway, without the need for maintenance beyond the life of the project (Appendix 4, C13.30).

Pipeline (EPBC 2009/5008)

On Curtis Island, the topography at Hamilton Point will be modified to make way for the pipeline reception shaft. The impacts are similar to those of the LNG plant but at a smaller scale. The same mitigation and management measures apply.

The launch pad at the mainland tunnel launch site will comprise tunnel spoil and other suitable material to be contained within an engineered structure. All works are located outside the GBRWHA, therefore impacts relating to this criterion will not be unacceptable.

Conclusion

Earthworks for the LNG plant will change the landforms at Curtis Island from a vegetated, hilly landscape to levelled platforms. Ephemeral waterways will be infilled during construction of the LNG plant, and stream diversions will be constructed that will be designed to maintain natural flows. Land reclamation of intertidal mudflats at Boatshed Point will modify the shoreline and interfere with the landscape's natural rates of erosion.

Construction of the pipeline launch site on the mainland will further contribute to the existing industrialised landscape at this location, however all works are located outside the GBRWHA. The reception shaft at Hamilton Point will require vegetation clearing and earthworks to level the land.

The project site on Curtis Island contains no important geological features associated with the GBRWHA.

The proponent has committed to a number of mitigation and management measures to reduce potential erosion, therefore limiting any potential for alteration of shoreline sedimentation processes. Conditions stated in this report would limit the potential for soil erosion on the project site to acceptable standards.

Considering the above, including the proponent's mitigation and management commitments, the LNG plant (EPBC 2009/5007) and pipeline (EPBC 2009/5008) will not have an unacceptable impact on the GBRWHA for the purposes of this criterion.

16.3.3. Criterion IX

Representing significant ongoing ecological and biological processes in the evolution and development of terrestrial, freshwater, coastal and marine ecosystems and communities of plants and animals

The OUV for this criterion focus on ecological processes, interconnectivity and biological evolution of the Great Barrier Reef ecosystem, including inshore coastal waters and continental islands.

The OUVs describe the extent of diversity of flora and fauna and the important habitat areas for resident species including shorebirds, cetaceans, sea turtles and dugongs.

LNG plant (EPBC 2009/5007)

Marine and intertidal habitats

Port Curtis contains a variety of marine and intertidal habitats including benthic zone and intertidal mudflats, reef and rock substrate, saltpan vegetation, mangroves, seagrass and fish habitat areas. Construction and operation of the project will disturb approximately 65 hectares of marine and intertidal habitat.

The EIS indicated that the benthic zone and intertidal mudflats within Port Curtis support a high biodiversity and high biomass of small and microscopic organisms. Mudflats also support fisheries productivity and act as feeding grounds for migratory birds. Up to 5.64 hectares of benthic zone and intertidal mudflats would be directly impacted by the project. This area is proposed to be cleared during construction at the Boatshed Point MOF, LNG jetty sites and associated dredging sites.

Reef habitat is not a major feature of the Port Curtis area but contributes to the community assemblage and overall population and diversity of the GBRWHA. Port Curtis supports approximately 3341.28 hectares of reef[21] and a broad range of organisms including bivalves, ascidians, bryozoans and hard corals. Rubble reef areas and coral bommies can be found in a deep channel at the entrance of The Narrows to the north of the study area near Graham Creek and extending south to Fishermans Landing.

Rock substrate is widespread throughout Port Curtis and is typically composed of oyster-encrusted boulders and rubble in the coastal margins. It supports an array of organisms including algal flora, barnacles, oysters and tubeworms. The precise distribution of rock substrate within the study area has not been mapped. It is widespread throughout Port Curtis and is known to occur at the intertidal zone immediately south of Laird Point and Hamilton Point. The maximum direct loss of reef and rock habitat will be 0.14 hectares and will be localised to launch site 4N.

[21] M Rasheed, R Thomas, A Roelofs, K Neil and S Kerville 2003, *Port Curtis and Rodds Bay seagrasses and benthic macro-invertebrate community baseline survey, November/December 2002*, Department of Primary Industries and Fisheries, Queensland.

The Port Curtis region has approximately 4573 hectares of saltpan vegetation[22]. The most extensive areas of saltpan vegetation in Port Curtis are around Targinie Creek and in the inner embayments of North China Bay and Boatshed Point. Species present in this habitat include halophytic grasses such as salt couch (*Sporobolus virginicus*) and saltmarsh species such as the bead weed (*Sarcocornia quiniqueflora*). The estimated maximum direct loss of saltpan vegetation as a result of the LNG plant is 17.5 hectares. The majority of this loss would be associated with the construction of marine infrastructure at Curtis Island.

Extensive areas of mangroves occupy the intertidal margins around Port Curtis and Curtis Island. The largest extent, 306 hectares in area, occurs within Targinie Creek.

Five mangrove species were recorded in Port Curtis including red mangrove (*Rhizophora stylosa*), yellow mangrove (*Ceriops tagal*), grey or white mangrove (*Avicennia marina*), myrtle mangrove (*Osbornia octodonta*), and black or river mangrove (*Aegiceras corniculatum*). Of these, the red mangrove is the most widespread and dominant.

The Port Curtis Ecosystem Health Report Card suggests that the mangroves within Port Curtis are generally resilient where normal tidal inundation occurs. The EIS states that the maximum direct loss of habitat 5.1 hectares.

Seagrass beds are scattered throughout Port Curtis. The main beds are in the west close to Gladstone and Fishermans Landing. The combined area of all intertidal seagrass beds in Port Curtis is approximately 4500 hectares. Six seagrass species are present in Port Curtis.

Annual monitoring of seagrass beds within Port Curtis has been conducted since 2004. In 2006, the seagrass beds were generally healthy and had recovered from the low of 2005. Seagrass beds provide a foraging resource for a range of species including dugongs and marine turtles. Dugong feeding trails have been recorded in many of the seagrass beds, notably in the vicinity of Wiggins Island. Close to the project site, seagrass beds have been recorded in the areas directly east of Boatshed Point.

Seagrass beds would not be directly affected by construction activities. Indirect impacts by sediment plumes from dredging could affect seagrass beds, particularly at Boatshed Point. The EIS stated that any impacts on the Boatshed Point seagrass beds will be short-term and localised, due to strong tidal flushing within Port Curtis.

The EIS reported that the project does not contain and will therefore not disturb any fish habitat areas declared under the Fisheries Regulation 2008. The closest declared fish habitat areas are the Colosseum Inlet, 20 kilometres south of Gladstone, and the Fitzroy River, near the northern end of Curtis Island and south-east of Rockhampton.

Terrestrial ecology

The EIS reports a relatively limited diversity of terrestrial fauna species within the project site on Curtis Island. A total of 199 vertebrates were recorded, the majority of

[22] K Danaher, M Rasheed and R Thomas 2005, *The intertidal wetlands of Port Curtis*, Department of Primary Industries and Fisheries, Queensland.

which do not have higher levels of conservation status and a total of five introduced species were observed. Large areas of similar habitat would remain available in the area, including the 4590 hectare Environmental Management Precinct of the SDA adjacent to the LNG plant site.

Water mouse habitat at Boatshed Point would be degraded and fragmented, potentially hindering the movement of the animals between foraging and nesting habitat. Project lighting may also impact on the habitat, leading to an increased risk of predation on the water mouse. Project impacts to the water mouse are discussed further in Section 16.4.5 below.

The proponent proposes to mitigate these impacts on the water mouse by reducing project lighting in locations where movement between foraging and nesting habitat occurs (C17.50). Arrow has also proposed to offset significant residual impacts to the water mouse as part of the project's offsets package.

Potential shorebird habitat is also present on the west side of Boatshed Point. Approximately 15 hectares would be cleared at Boatshed Point for marine infrastructure facilities. Indirect impacts to shorebird habitat adjacent to project sites are likely to occur during construction and operation activities including noise and lighting.

The proponent has committed to develop management plans to minimise impacts to shorebirds including exclusion zones or screens around shorebird habitat (Appendix 4, C17.52).

Artificial lighting from the project may disorient nesting turtles and hatchlings at Connor Bluff and Southend at Curtis Island. Green turtles nest at the beaches near Southend and flatback turtles nest at the beach at Connor Bluff. Turtles at Connor Bluff in particular, will be exposed to lighting from the project. Impacts on marine turtles from artificial light are discussed further in Section 16.4 below.

The proponent has designed the site layout to minimise light emissions and committed to light screening measures such as lowering the height of light sources to reduce the amount of light directed at Connor Bluff (Appendix 4, C17.19 and C17.47).

Terrestrial flora

The LNG plant is proposed to be located in the Curtis Island Industrial Precinct. The site is required to be cleared and the landscape would be levelled into a series of platforms for project infrastructure. Development of the industry precinct on Curtis Island has already commenced, and disturbance to ecological processes has already begun in the area.

Construction of the LNG plant will involve clearing native vegetation. Proposed clearing will result in the extent of existing habitat and vegetation being reduced in the long-term from Curtis Island.

Most of the vegetation to be cleared at the LNG plant site comprises of eucalyptus woodland. Mangroves and saltpan vegetation would be cleared at the intertidal zones at Boatshed Point for marine facilities infrastructure.

Terrestrial and intertidal vegetation subject to clearing as part of the project is relatively common across Curtis Island and other continental islands within the southern section of the GBRWHA.

Two small patches of the critically endangered Littoral Rainforest and Coastal Vine Thickets of Eastern Australia, totalling 0.14 hectares, were identified near the LNG plant site at Boatshed Point. These patches are located outside the project area and will not be subject to clearing for the project. The proponent has proposed management measures to avoid edge effects, such as erecting fences around the community and implementing restricted access (Appendix 4, C17.03A, C17.23A). No impacts are expected on this community.

Residual impacts to remaining vegetation and habitat will be managed by the proponent by implementing mitigation measures including establishing a wildlife corridor to connect the patch of Semi-Evergreen Vine Thicket Community with the environmental management precinct (Appendix 4, C17.04). Remaining vegetation and habitat is to be fenced off and access will be prohibited beyond the boundary (Appendix 4, C17.23A and C17.03A).

Mitigation and management measures

The proponent has committed to implement erosion and sedimentation control measures (Appendix 4, C11.06, C11.07 and C11.11) and stormwater management plans (Appendix 4, C11.16) to mitigate impacts to sediment and pollutant concentrations in Port Curtis. The proponent also proposes to manage dredge plumes through a dredge management plan (Appendix 4, C15.02, C15.03 and C15.04) that details water quality monitoring and actions to be taken to minimise impacts should water quality criteria be exceeded. Accidental spills from shipping will be managed through a spill prevention and response plan (Appendix 4, C13.12).

The proponent has committed to general mitigation measures that apply to clearing reef habitat, including developing a construction environmental management plan to minimise impacts to marine ecological values (Appendix 4, C19.01A).

Pipeline (EPBC 2009/5008)

Potential impacts on GBRWHA terrestrial and marine habitats from the pipeline construction are generally similar to those described for the LNG plant although over a more limited footprint. The pipeline reception shaft requires clearing of a relatively small area of native vegetation (400 square metres). Construction works at the mainland launch site may contribute to minor water quality impacts.

The same mitigation and management measures that apply to the LNG plant would be used including control of lighting, noise, sediment erosion and impacts on marine water quality.

Conclusion

The proposed clearing of up to 256 hectares of eucalyptus woodland and mangrove/saltpan areas on the LNG project site, and a total impact on 430.7 hectares (from terrestrial and marine infrastructure) is not considered to have an unacceptable impact on the diversity of terrestrial flora and fauna of the GBRWHA.

Similarly, the extent of mangrove and intertidal areas proposed to be cleared is relatively small in comparison with the areas of similar habitat type around the Port Curtis coastline. However, the habitat that will be lost does contribute to the ecological and conservation values of the GBRWHA.

Relatively minor indirect impacts on populations of shorebirds and marine turtles are predicted to be caused by project lighting. Foraging habitat of marine fauna may be indirectly impacted by dredging activities for the project.

Pipeline (EPBC 2009/5008) infrastructure on the mainland involves construction and earthworks in the coastal zone that may negatively impact on the water quality of Port Curtis.

The proponent has committed to a number of mitigation and management measures to reduce these impacts on the ecological and biological processes of the GBRWHA, and to this criterion more generally.

Considering the above, including the proponent's mitigation and management commitments, the LNG plant (EPBC 2009/5007) and pipeline (EPBC 2009/5008) will not have an unacceptable impact on the GBRWHA for the purposes of this criterion.

I note the proponent's commitment to provide an offset for impacts to water mouse habitat in accordance with the EPBC Act Environmental Offsets Policy. I also note that the proponent has advised that it will provide an offset for impacts to world heritage values in accordance with the EPBC Act Environmental Offsets Policy.

16.3.4. Criterion X

Contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science and conservation

The enormous size and diversity of the Great Barrier Reef means it is one of the richest and most complex natural ecosystems on earth, and one of the most significant for biodiversity conservation. The extensive diversity supports tens of thousands of marine and terrestrial species, many of which are of global conservation significance.

The OUVs of this criterion focus on the presence of a range of rare and endangered species within GBRWHA (refer to Appendix 6 of this report). The project areas support both marine and terrestrial species of conservation significance that form part of the OUV of the GBRWHA, including:

- two terrestrial species of conservation significance reported to occur within the LNG project site. They are the water mouse (*Xeromys myoides*) (vulnerable) and the grey-headed flying fox (*Pteropus poliocephalus*) (vulnerable)
- three species of marine turtles, listed under the EPBC Act, nest and forage within the GBRWHA around Curtis Island. They are the flatback turtle (*Natator depressus*) (vulnerable), green turtle (*Chelonia mydas*) (vulnerable) and loggerhead turtle (*Caretta caretta*) (endangered)
- dugong, Australian snubfin dolphin and Indo-Pacific humpback dolphin are all listed as migratory species under the EPBC Act and either occur or have the potential to

occur in the project area. Dugong (*Dugong dugon*), Australian snubfin (*Orcaella heinsohni*) and Indo-Pacific humpback dolphins (*Sousa chinensis*) occur within shallow coastal waters in or adjacent to modified environments within Port Curtis. These habitats support foraging and breeding activities for the species

- the koala (*Phascolarctos cinereus*) (vulnerable) is rare in the local area and is considered to be absent from Curtis Island. It was added to the EPBC threatened species list after the project was determined to be a controlled action but is relevant to the OUVs of the GBRWHA.

The project avoids impacts to endangered ecological communities.

LNG plant (EPBC 2009/5007)

Construction of the LNG plant and the associated infrastructure will require clearing of terrestrial and intertidal habitats within a limited area, with a total of 430.7 hectares (terrestrial and marine) to be cleared in the GBRWHA. Areas adjacent to the project sites will be indirectly impacted by project activities. Some of the habitat to be cleared is known to serve as foraging or nesting habitat for certain conservation-listed fauna species, such as the water mouse. Other conservation-listed species may be impacted by other project operations such as project lighting and shipping.

Impacts to seagrass beds and mangroves are discussed in detail above.

Terrestrial habitat

No important populations, breeding or roosting camps of the grey-headed flying fox were found within the project area of the LNG plant. However, suitable foraging resources are present within the project sites, particularly at Curtis Island. An estimated total of 127 hectares of foraging habitat would be cleared for the LNG plant.

Substantial tracts of foraging habitat are present in the Curtis Island Environmental Management Precinct and on the mainland and it is not expected that the proposed action would have an unacceptable impact upon the local population of grey-headed flying-fox.

Intertidal habitat

The mangroves to be cleared at Boatshed Point are considered to be water mouse habitat. Records of water mouse activity suggest that the species is distributed throughout mangroves along the south-western shores of Curtis Island. No specimens were directly identified, but an active nesting hollow and feeding signs were found to the east of Boatshed Point during field surveys for the EIS. Field surveys for the project also found an abandoned nesting hollow and footprints to the west of Boatshed Point. On this basis, the significant impact guidelines for the water mouse consider any individuals in the area immediately west of Boatshed Point to be an important population.

Project impacts on the species include habitat loss and fragmentation. Up to 0.8 hectares of mangrove will be cleared to the west of Boatshed Point and up to 1.7 hectares will be cleared at North China Bay. Approximately 16 hectares of potential water mouse habitat will be fragmented between Hamilton Point and Boatshed Point. Potential indirect impacts from the project include habitat degradation from project

activity such as lighting, which may increase vulnerability to predation. The proponent has identified that the LNG plant has the potential to result in the loss of this local population of water mouse.

The proponent has committed to several mitigation measures to minimise impacts to the water mouse, including reducing lighting in locations where movement between water mouse habitats occurs (Appendix 4, C17.50) and weed and pest management programs (Appendix 4, C17.09, C17.10 and C17.13).

Arrow has proposed to provide offsets for impacts to mangrove habitat in accordance with the EPBC Act Environmental Offsets Policy.

Marine turtles nesting on beaches at Connor Bluff and Southend on the eastern side of Curtis Island may be impacted by project lighting. Artificial light can disturb the behaviour of nesting females and hatchlings. Impacts on marine turtles from artificial light are discussed further in Section 16.4.

The proponent has committed to reduce lighting impacts on turtles by avoiding routine flaring at night during sensitive turtle reproductive periods (Appendix 4, C17.19) and designing buildings to limit light emissions reaching nesting beaches (Appendix 4, C17.47). Arrow has also committed to participating in monitoring programs to assess the impacts of industrial lighting in the Gladstone region on turtle hatchlings (Appendix 4, C19.15).

Potential shorebird roosting habitat is also present on the west side of Boatshed Point. Approximately 15 hectares will be cleared at Boatshed Point for marine infrastructure facilities. Indirect impacts to shorebird habitat adjacent to project sites are likely to occur during construction and operation activities including noise and lighting.

The proponent has committed to develop management plans to minimise impacts to shorebirds including exclusion zones or screens around shorebird habitat (Appendix 4, C17.52).

Marine megafauna

Marine megafauna including dugongs, cetaceans and turtles are known to occur in Port Curtis. Dugong and marine turtles forage in the seagrass beds and dolphins forage and breed in shallow coastal waters of Port Curtis. These species may be impacted by the project by shipping activity and underwater noise, and also by degradation to habitat from dredging and spills. Shipping, dredging and pile driving activities are the main sources of possible impact.

The proponent has committed to several mitigation measures to minimise impacts from shipping and underwater noise on marine megafauna within Port Curtis. The proponent will contribute to the development of a shipping activity strategy and management plan for the Port of Gladstone and to comply with speed limits within the dugong protection area (Appendix 4, C19.04). Propeller guards are also to be installed on marine vessels to minimise the impact of injury from boat strike (Appendix 4, C19.05). Fauna observations will also be recorded and conducted before and during pile driving and dredging activities to check for presence of dugong, turtles and cetaceans (Appendix 4, Appendix 4, C19.07 and C19.12). If marine megafauna are identified within the area of works, the proponent has committed to implement procedures to minimise impact, such

as reverting to soft-start piling or stopping temporarily to allow animals to move away from the area (Appendix 4, C19.07).

Impacts to EPBC listed threatened and migratory species are discussed in more detail in Sections 16.4 and 16.5.

Pipeline (EPBC 2009/5008)

Habitat diversity

Construction of the pipeline does not require clearing of grey-headed flying fox habitat on Curtis Island. Similarly, the pipeline construction would not affect habitat for the water mouse.

Construction of the pipeline tunnel under the Port Curtis seabed will not affect seagrass beds. However construction of the mainland tunnel launch site may indirectly impact on marine water quality and therefore seagrass beds that are foraging habitat for marine fauna. Suspended sediment may settle on seagrass beds, however this impact is likely to be short-term and localised, as discussed above.

The proponent has committed to manage erosion and sedimentation at the mainland tunnel launch site (Appendix 4, C11.04) and implement a construction environmental management plan (Appendix 4, C19.01A). Conditions stated in this report would limit the impact on marine water quality to acceptable standards.

Conclusion

Construction of the LNG plant (EPBC 2009/5007) and the associated infrastructure will require clearing of terrestrial and intertidal GBRWHA habitat for species of conservation significance, and clearing of mangroves. Clearing would include an estimated 127 hectares of grey-headed flying fox foraging habitat and 5.1 hectares of water mouse habitat (mangroves and saltpan). Intertidal foraging habitat for shorebirds would also be degraded by noise and lighting from project activities.

Nesting behaviour of marine turtles using Connor Bluff and Southend may be negatively affected by artificial lighting from the project. Dugongs, cetaceans and marine turtles are at risk of boat strike and underwater noise from shipping, dredging and pile driving activities.

There will not be an unacceptable impact on populations of any of the species of conservation significance due to the availability of large areas of suitable habitat within the region.

Construction and operation of the pipeline (EPBC 2009/5008) at the mainland tunnel launch site may lead to degradation of seagrass beds adjacent to the site through erosion and sedimentation. Shorebird habitat would be lost and degraded as a result of construction at the site. Project lighting may also degrade roosting shorebird habitat nearby.

Considering all the above, including the proponent's mitigation and management commitments, the LNG plant (EPBC 2009/5007) and pipeline (EPBC 2009/5008) will not have an unacceptable impact on the GBRWHA for the purposes of this criterion.

The proponent has committed to a number of mitigation and management measures to reduce these impacts to the biodiversity values of the GBRWHA, and to this criterion more generally. The proponent has also committed to providing offsets to direct impacts on the water mouse and its habitat, which are to be finalised in accordance with the EPBC Act Environmental Offsets Policy.

16.3.5. Coordinator-General's conclusions—GBRWHA properties

I have reviewed the EIS and associated documentation, including the additional information on MNES and conclude that the proponent has adequately identified the impacts of the project on world heritage properties and national heritage places.

LNG plant (EPBC 2009/5007)

The proposed action requires the clearing of vegetation across a 248-hectare site on Curtis Island and extensive earthworks to level the existing undulating terrain. The total direct impact footprint in the GBRWHA, including both terrestrial and marine areas, is 430.7 hectares.

The action also includes the construction of an export terminal capable of loading LNG product to 215 000 cubic metre LNG carriers and an integrated materials offloading facility and personnel jetty. Associated actions include the deepening of navigable areas by dredging to support maritime infrastructure both on Curtis Island and in the Calliope River estuary.

The proposed works all lie within the GBRWHA and therefore affect its aesthetic values and the ecosystem processes that underpin the OUV of the property. The EIS has undertaken a comprehensive assessment of the potential impacts on the GBRWHA, including detailed consideration of the four listing criteria.

The project site and adjacent areas comprise habitat for a range of native flora and fauna including several listed conservation species. Direct impacts include the clearing of vegetation on Curtis Island, loss of habitat for the water mouse and the clearing of foraging habitat for the grey-headed flying-fox. Indirect impacts associated with the project's construction and operation include disturbances to the surrounding acoustic environment (including underwater), lighting, emissions to air and water and shipping movements. These disturbances would affect the naturalness of the area and impact on habitat of native fauna including listed species of conservation value such as marine turtles, dugongs, dolphins and shorebirds. The EIS found that the location of the proposed integrated materials offloading facility and personnel jetty could cause fragmentation of approximately 16 hectares of water mouse habitat.

The project's residual impacts are considered to be acceptable. The site is located within the Port of Gladstone and is directly adjacent to three similar LNG facilities currently under construction. The visual qualities of the site are considered to be a very minor part of the overall aesthetic values of the region and the overall GBRWHA. The large volume of shipping and the extensive industrial activities already taking place in the area detract from the natural character and expression of OUV in this location.

The proposed vegetation clearing on the project site is considered to be a relatively minor impact on the overall OUV of the GBRWHA given the extensive areas of remnant woodland that remain on Curtis Island and noting its continuing conservation status under Queensland's regulatory system. Similarly, the small areas of terrestrial and coastal habitat that would be affected are considered to be relatively minor in terms of the extent of remaining high value equivalent ecosystem throughout Port Curtis and Curtis Island in particular.

However, SEWPaC has advised that offsets are required for residual impacts to the OUV's of the GBRWHA. In accordance with the EPBC Act Offsets Policy, offsets should improve the integrity and resilience of the heritage values of the GBRWHA.

Pipeline (EPBC 2009/5008)

The proposed action requires the clearing of approximately 40 hectares of saltpan vegetation at the mainland for construction of the tunnel launch site.

The action also includes the construction of a subterranean pipeline that will traverse Port Curtis at a depth of 35 metres below the seabed and will resurface at Curtis Island within the footprint of the LNG plant (EPBC 2009/5007).

The proposed works lie outside the GBRWHA but may indirectly impact on the OUV of the World Heritage property. The EIS included a comprehensive assessment of the potential impacts on the GBRWHA including detailed consideration of the four listing criteria.

Habitat adjacent to the project site support a range of native flora and fauna including several listed conservation species and the Targinie wetland. Indirect impacts associated with the project's construction and operation include disturbances to the surrounding environment from lighting and emissions to air and water. These disturbances would affect the naturalness of the area and impact on approximately 65 hectares of potential habitat of migratory fauna including shorebirds, marine turtles and dugongs.

The project's residual impacts are not considered to be unacceptable. The site is located within the Port of Gladstone just south of Fishermans Landing.

Overall conclusion

I note the proponent's commitments to minimise impacts on the GBRWHA through a range of mitigation measures. I have stated conditions in the appendices of this report that give effect to these commitments and regulate the extent of potential impacts to the maximum extent possible. I am of the view that the proposed LNG Plant (EPBC 2009/5007) and pipeline (EPBC 2009/5008) will not have an unacceptable impact on the GBRWHA.

16.4. Threatened species and ecological communities

16.4.1. Threatened ecological communities

An ecological community is a naturally occurring group of plants, animals and other organisms that are interacting in a unique habitat. Its structure, composition and distribution are determined by environmental factors such as soil type, position in the landscape, altitude, climate and water availability. An ecological community becomes threatened when it is at risk of extinction.

The EIS identified the following four ecological communities listed as endangered under the EPBC Act as potentially occurring within the region of the project area:

- Littoral Rainforest and Coastal Vine Thickets of Eastern Australia (critically endangered)
- Brigalow (*Acacia harpophylla* dominant and co-dominant) (endangered)
- Semi-evergreen Vine Thickets of the Brigalow Belt (North and South) and Nandewar Bioregions (endangered)
- Weeping Myall Woodlands (endangered).

The proponent undertook field floristic surveys of the project site. Only the Littoral Rainforest and Coastal Vine Thickets of Eastern Australia was confirmed present. Two small patches of the threatened ecological community (TEC), totalling 0.14 hectares, were identified near the LNG plant site (EBPC 2009/5007) at Boatshed Point (refer Figure 16.3).

Littoral Rainforest and Coastal Vine Thickets of Eastern Australia—critically endangered

This TEC represents a complex of rainforest and coastal vine thickets, including some that are deciduous, on the east coast of Australia. Typically, the ecological community occurs within two kilometres of the coast or adjacent to a large saltwater body, such as an estuary and, thus, is influenced by the sea.

The community provides important habitat along the eastern Australian coast for various migratory and marine birds. It is known to support the grey-headed flying fox (*Pteropus poliocephalus*) and black-breasted button quail (*Turnix melanogaster*), which are listed threatened species under the EPBC Act.

LNG plant (EPBC 2009/5007)

This TEC is present at Curtis Island and has the potential to be impacted by the LNG plant (EPBC 2009/5007).

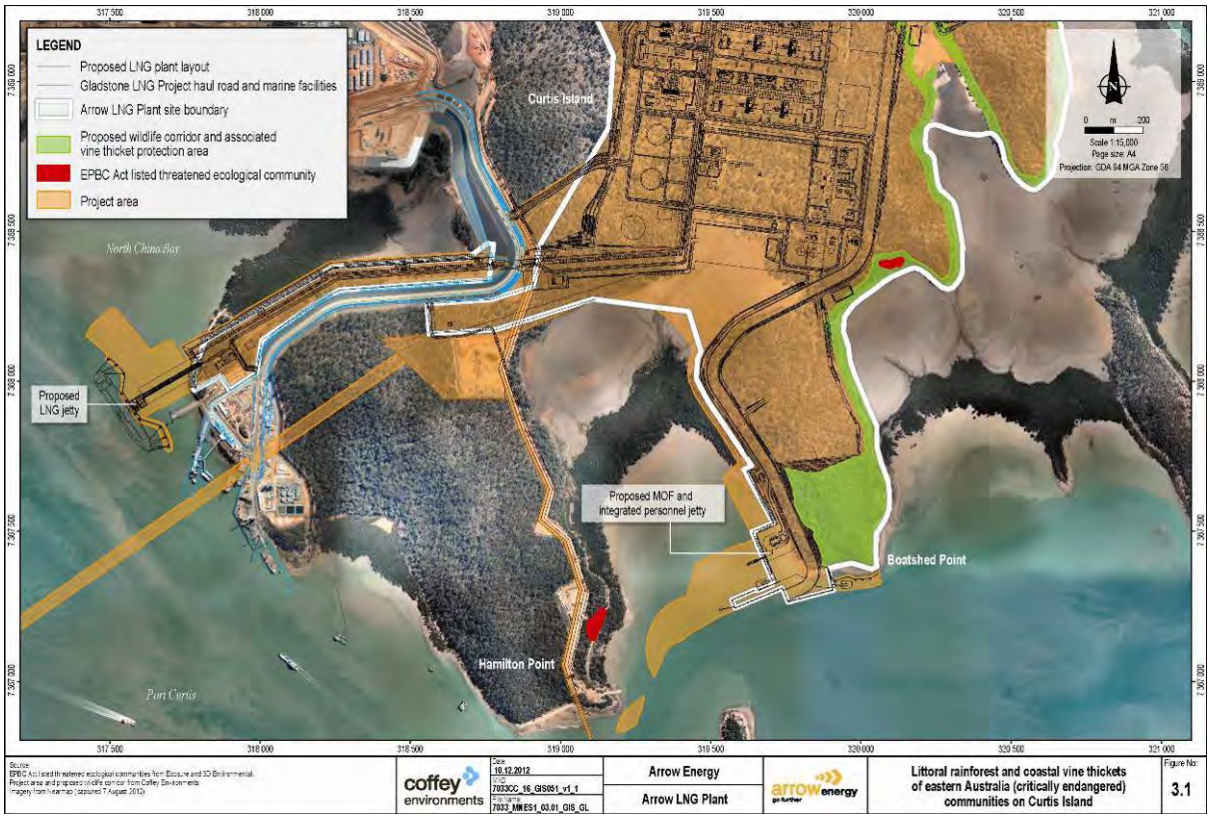

Figure 16.3 Littoral Rainforest and Coastal Vine Thickets of Eastern Australia (critically endangered) communities on Curtis Island

The patches of the TEC are located outside the project area (refer Figure 16.3 above) and will not be subject to clearing or fragmentation from the project. However, the TEC is vulnerable to increased edge effects such as weed ingress, trampling from increased personnel movement and potentially increasing fire frequency. The proponent has developed management measures to mitigate indirect impacts such as weed infestation. The proponent listed mitigation measures relevant to terrestrial ecology of the project area in Table 4.10 of the Strategic Environmental Management Plan, Attachment 3 of the EIS and specifically for the TEC in Table C.1 of Attachment 2 (MNES) of the EIS.

Pipeline (EPBC 2009/5008)

The TEC is not present in any of the project sites associated with the pipeline (EPBC 2009/5008), therefore this referral will have no impacts on the TEC.

Table 16.2 below outlines the likely impacts and corresponding mitigation measures for the TEC.

Table 16.2 Impacts and mitigation measures relevant to the Littoral Rainforest and Coastal Vine Thickets of Eastern Australia

Predicted maximum disturbance to habitat	Potential impacts	Mitigation measures
0 ha	Incidental clearing	• Induct all personnel prior to entering a project site, including measures for managing the impacts on flora and fauna likely to be present (C17.22) • Detail the need to protect EPBC Act listed communities and explain mitigation measures that are to be implemented in workforce inductions (C17.43)
	Increased access	• Clearly mark no-go zones, where required, including the semi-evergreen vine thicket (*Cupaniopsis*) fenced area on Boatshed Point, and the critically endangered TEC on the eastern margin of Hamilton Point, and northeast of Boatshed Point. Signage will be erected around the margins of the communities to indicate restricted access (C17.23A) • Workers and machinery will be prohibited from accessing the area containing the TEC (C17.03A) • Clearly delineate clearing boundaries prior to clearing commencing to avoid unnecessary vegetation loss (C17.44) • The boundary of the semi-evergreen vine thicket community will be fenced off with a 20 metre buffer between the semi-evergreen vine thicket community (including the *Cupaniopsis* vegetation community) and the fence and area of disturbance (C17.03A)
	Increased fire frequency	• Implement fire control measures to prevent wildfire incursion into the TEC. This may include construction of firebreaks of asset protection burning outside of the TEC and its associated buffer (C17.42)
	Weed invasion	• Develop weed management measures prior to initiation of construction activities in accordance with local and regional management guidelines and best practice advice prescribed in DEHP's pest control factsheet series (C17.09) • Employ low impact methods of weed control within and adjacent to the TEC (C17.40) • Establish a management buffer of suitable width and of contiguous natural vegetation, around the TEC north east of Boatshed Point to minimise the potential for edge effects and weed invasion (C17.41)

16.4.2. Coordinator-General's conclusions—TECs

I have reviewed the EIS and supplementary MNES material and conclude that the proponent has adequately assessed impacts on TECs under the EPBC Act.

I expect the following outcomes:

- development to avoid impacts on areas of the Littoral Rainforest of Coastal Vine Thickets of Eastern Australia

- establish a buffer zone with contiguous natural vegetation around the Littoral Rainforest TEC
- fence off the wildlife corridor that connects the environmental management precinct and the vine thicket protection area.

I note the proponent has made a number of commitments to avoid and mitigate impacts on the Littoral Rainforest TEC. The proponent must fully implement all relevant measures contained within the EM plans.

In light of these avoidance and mitigation measures, the impacts to TECs are not considered unacceptable.

16.4.3. Threatened flora

Threatened flora are plants that have been assessed as being at risk of extinction. The EPBC Act lists flora considered to be threatened. Their recovery is promoted using conservation advice, recovery plans, and the EPBC Act's assessment and approval provisions.

The EIS reported that no species possessing a conservation status under the EPBC Act are present in the project area. The Arrow LNG Plant will not impact on EBPC Act listed flora species.

Undescribed taxon (*Cupaniopsis)*

The EIS confirmed that a potential new taxon (*Cupaniopsis sp.indet.*) was identified at Boatshed Point. It is closely related to the vulnerable wedge-leaf tuckeroo (*Cupaniopsis shirleyana*). It is unlikely to be impacted by the project but residual impacts are likely to have potential edge effects on the *Cupaniopsis sp. indet.* population at Boatshed Point.

The area of semi-evergreen vine thicket community containing the *Cupaniopsis* vegetation community at Boatshed Point will be retained. The proponent has committed to demarcate the area prior to commencing construction and workers and machinery will be prohibited from accessing the area (Appendix 4, C17.03A).

16.4.4. Coordinator-General's conclusions—threatened flora

I have reviewed the EIS and supplementary MNES material and conclude that the proponent has adequately assessed impacts on threatened flora under the EPBC Act.

I note the proponent has made a number of commitments to avoid and mitigate impacts on vegetation in general that would apply equally to threatened flora. The proponent must fully implement all measures contained within the EM plans.

16.4.5. Threatened fauna

Threatened fauna are those species and subspecies of birds, fish, frogs, insects, mammals, molluscs, crustaceans and reptiles which have been assessed as being at risk of extinction. The EPBC Act lists threatened fauna species and promotes their recovery using conservation advice, recovery plans, threat abatement plans and assessment and approval provisions.

The EIS reported that four terrestrial species of conservation significance under the EPBC Act potentially occur within the project area. These species are listed in Table 16.3 below.

Table 16.3 Threatened species likely to occur in the project area

Species common name	Scientific name	EPBC Act status	Likelihood of occurrence (EIS)
Water mouse	*Xeromys myoides*	Vulnerable	High
Grey-headed flying fox	*Pteropus poliocephalus*	Vulnerable	Moderate
Squatter pigeon	*Geophaps scripta scripta*	Vulnerable	High (mainland only)
Brigalow scaly-foot	*Paradelma orientalis*	Vulnerable	Low

Adapted from EIS, Attachment 2, Table 3.2.

The water mouse (*Xeromys myoides*), grey-headed flying fox (*Pteropus poliocephalus*) and squatter pigeon (*Geophaps scripta scripta*) are discussed in this section. The brigalow scaly-foot (*Paradelma orientalis*) is not discussed because it is unlikely to occur at the project sites on Curtis Island or the mainland. In addition, the species was delisted from the EPBC Act threatened species list on 15 May 2013.

Three species of marine turtles, all of which are listed under the EPBC Act, are known to nest in the Port Curtis region, in particular at Connor Bluff and Southend beaches on Curtis Island. The proponent has committed to mitigation measures to avoid or reduce potential adverse effects resulting from the project on marine turtles (refer to Table 16.6 on page 159).

The koala does not constitute one of the controlling provisions for the project, and was added to the EPBC threatened species list after the project was determined to be a controlled action. Therefore, it is not considered further in respect of the listed threatened species controlling provision. The proponent has, however, committed to develop and implement appropriate mitigations in the species management plan if koalas are found during pre-clearance surveys (Appendix 4, C17.48).

Water mouse (*Xeromys myoides*)—vulnerable

The water mouse is listed as 'vulnerable' under the EPBC Act. It is the only member of the genus. This species will be impacted by the LNG plant (EPBC 2009/5007).

The Queensland population of the native rodent is found in coastal saltmarsh, mangrove and adjacent freshwater wetland habitats from Proserpine to the Queensland/New South Wales border. They also occur in the Northern Territory and in Papua New Guinea. The water mouse forages in the inter-tidal saltmarsh habitats for invertebrate prey including crabs, inter-tidal crustaceans, snails and marine gastropods.

The main threats to the survival of the species, as listed in the species recovery plan, are:

- habitat removal and loss as a result of development actions
- habitat degradation and disturbance due to recreational activities and cattle grazing
- chemical control of insects and weeds
- fire in the supralittoral zone
- feral predators.

Field survey results

The presence of an individual water mouse has been confirmed on Curtis Island, in the vicinity of Boatshed Point.

A water mouse survey was undertaken from August to September 2011 for the EIS at both the mainland and Curtis Island study areas. Intense trapping yielded no individuals. As the species typically has very low capture rates, habitat assessment and active searching were also undertaken. An active nesting hollow and feeding signs were detected to the east of Boatshed Point, indicating species presence (see Figure 16.4). An abandoned nesting hollow and footprints were found to the west of Boatshed Point. Population abundance estimates were not possible.

Records from field surveys conducted by the other LNG projects on Curtis Island, suggest that the species is distributed throughout mangroves in the bays between headlands along the south-western shores of Curtis Island. One water mouse was identified to the northwest of Arrow's LNG site during field surveys for the APLNG EIS. These mangrove habitats were connected or at least separated by short distances allowing movement between habitat patches prior to construction commencing on other LNG projects. Construction of neighbouring LNG facilities on Hamilton Point may have indirectly disturbed habitat quality in this area.

As defined under the Commonwealth Government's 'significant impact guidelines' for the species, the water mouse population to the east and west of Boatshed Point is regarded as an 'important population' because an active nesting mound, which is evidence of recent activity, was found.

Mangrove systems at mainland sites appeared less suitable for water mice due to heavy disturbance, isolation, smaller extent and fewer hollows. The minor clearing of mangroves on the mainland (maximum 0.6 hectares) is not considered to be suitable habitat for the water mouse.

Project impacts

Key project-related impacts on water mice are habitat loss and fragmentation of suitable habitat at Boatshed Point. Project lighting may also impact on the species by increasing the risk of predation. Changes to natural hydrology (including from sedimentation or pollutants) could also indirectly impact the water mouse by reducing the abundance of their prey. Other indirect impacts include potential increases in feral predators and the potential for competition from introduced rodents.

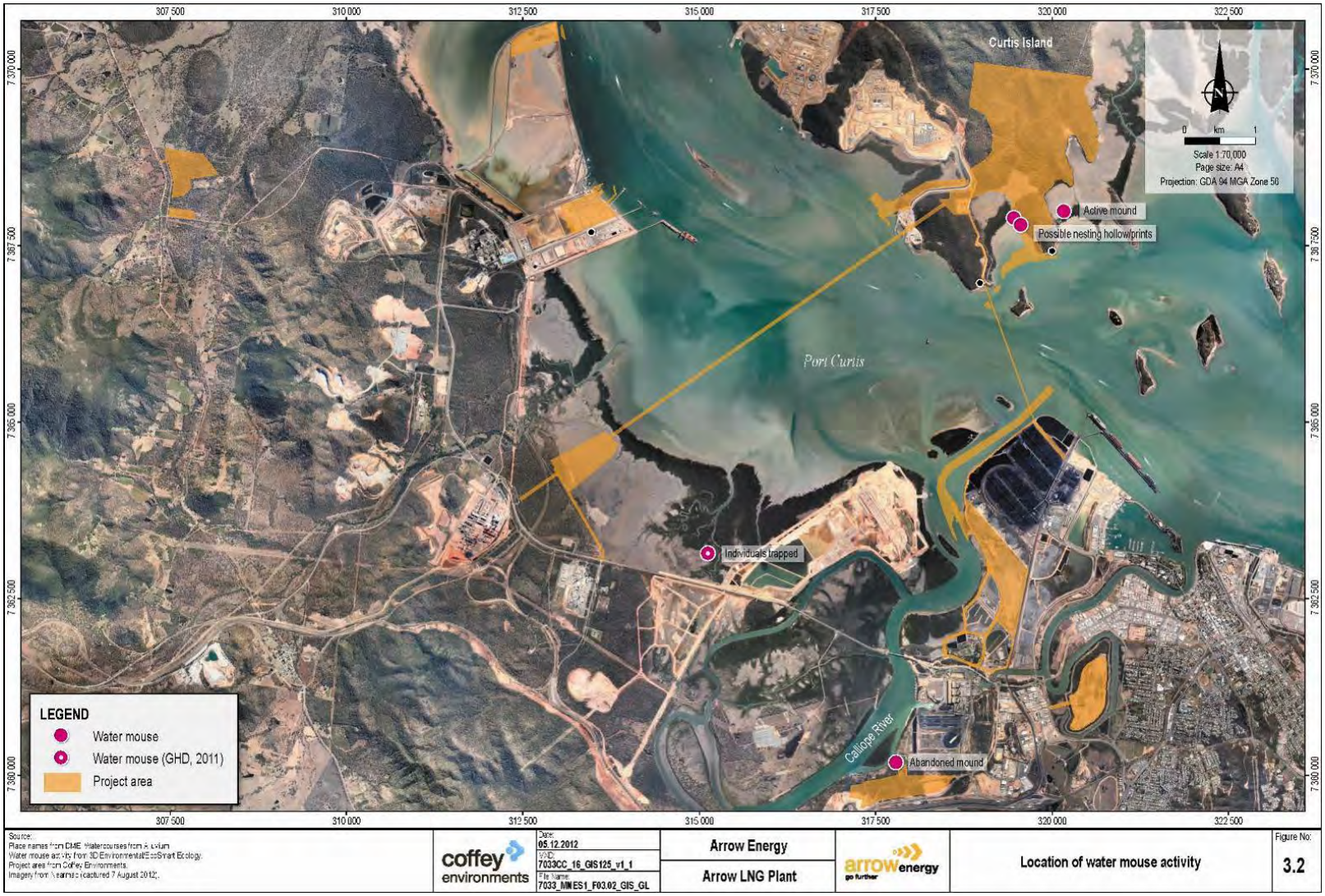

Figure 16.4 Location of water mouse activity

Cumulative impacts

The Arrow project contributes to the cumulative impact of LNG developments on Curtis Island and is likely to reduce the connectivity between larger, less disturbed areas of

habitat to the north from habitats to the south. This will reduce the value of this locality to the water mouse and isolate local populations. Combined, the four facilities will clear approximately 20 hectares of mangrove habitat.

LNG plant (EPBC 2009/5007)

Habitat clearance

The total area of mangroves to be cleared for the project is up to 5.1 hectares, with approximately 2.48 hectares to be cleared at Curtis Island. Mangroves will be cleared at launch site 1, the LNG jetty at North China Bay and west of Boatshed Point.

Up to 1.7 hectares of mangrove habitat would be cleared on the western margin of Hamilton Point at North China Bay. This habitat is considered to be of low value for the water mouse. It is unlikely that a population exists in this area as it is already isolated from more extensive areas of mangrove by industrial development to the east and west and is subject to heavy industrial disturbance on all sides from the already approved GLNG plant.

Up to 0.8 hectares of mangrove habitat is proposed to be cleared at Boatshed Point. This area is likely to support an important population of the water mouse

Up to 2.6 hectares of mangrove habitat is proposed to be cleared at launch site 1 at the Calliope River mouth. The area proposed to be cleared is unlikely to represent suitable habitat for the water mouse as this habitat is already isolated, heavily modified and disturbed. Therefore the impact to the water mouse from habitat loss at this location is expected to be negligible.

Habitat fragmentation

The EIS reports that the construction of the access road and maritime infrastructure for the LNG plant would substantially isolate the 16.6 hectares of mangrove habitat in the embayment between Boatshed Point and Hamilton Point from habitat areas to the east. Fragmentation of habitat to the west of Boatshed Point is already taking place although the indirect disturbance caused by the existing infrastructure on Hamilton Point may have affected habitat quality. The effect of existing and further fragmentation is unknown without knowledge of the inter-relationship between habitat areas.

The EIS states that re-establishment of natural structures encouraging movement following plant decommissioning has a reasonable chance of success, although it has not been tested. If a water mouse population is present to the west of Boatshed Point, the viability of the population could be reduced if the loss of connectivity is permanent.

Increased predation

Introduced predators including feral dogs, foxes and feral cats were recorded during field surveys. The Terrestrial Ecology Wet Season Technical Study states that observations of predators suggest that they are reluctant to enter water mouse habitat.

The proponent has committed to a pest management program to mitigate this potential impact.

Lighting

Project infrastructure at Hamilton Point and Boatshed Point will increase light on the ground, possibly reducing movement potential of the water mouse between habitat patches.

Lighting from project structures and operations may impact the water mouse by reducing habitat quality and prey abundance and potentially leading to abandonment of nesting hollows. Table 16.4 outlines the mitigation and management measures the proponent proposes to implement to minimise these impacts. Light impacts will be localised to areas in close proximity to infrastructure.

Changes to hydrology

Changes to natural hydrology, modified water levels and salinity in tidal waterways as a result of project infrastructure, may impact the water mouse and its prey. Crab communities are highly sensitive to changes in water quality. Impacts on crab communities may indirectly affect the water mouse. Potential sources of water quality contamination include increased sedimentation and contaminant runoff, which may impact on uncleared mangrove habitat. The proponent has committed to implement erosion and sediment controls and a stormwater management plan to mitigate impacts on water quality.

Pipeline (EPBC 20009/5008)

The water mouse is not expected to be present at mangrove habitat adjacent to the mainland tunnel launch site, as the habitat has little value for the species due to heavy disturbance, small extent and isolation.

Mitigation and management commitments

The table below outlines the mitigation and management measures committed to by the proponent to reduce impacts on the water mouse.

The proponent has committed to developing a detailed water mouse management and monitoring plan which will be approved by a suitably qualified ecologist with a working knowledge of the species.

Table 16.4 Impact and mitigation measures relevant to the water mouse

Predicted maximum disturbance to habitat	Impact	Mitigation measures
5.1 ha (EPBC 2009/5007 - direct) 16.6 ha (EPBC 2009/5007 - indirect)	Habitat loss and degradation	• Prohibit access to saltpans and fringing mangroves • Conduct pre-clearance surveys across project areas to be cleared of vegetation. The surveys will aim to determine whether any threatened species are present at each site. Appropriate mitigation measures will be implemented if threatened species are confirmed • Design infrastructure to minimise impacts on shoreline habitat • Demarcate disturbance areas
	Habitat fragmentation	• Decommissioning plan to be developed for the project, investigate an appropriate after use of project areas including any rehabilitation requirements as appropriate
	Lighting	• Installing and operating low-pressure sodium and long wavelength lights as a first-choice light source, and use high-pressure sodium lights were low-pressure sodium lights are not possible • Replace short-wavelength light with long-wavelength light and exclude short-wavelength light with the use of filters • Avoid using halogen, metal halide or fluorescent lights (white lights) where possible, and only use white lights in contained areas where colour rendition is required • Minimise the number and wattage of lights, and recess lighting into structures where possible • Use timers and motion-activated light switches • Use reflective materials to delineate equipment or pathways and use embedded lighting for roads • Design infrastructure to reduce impacts on shoreline habitat, where possible, and reduce the risk of unnecessary clearing by demarcating disturbance areas • Reduce lighting wherever possible, in locations where movement between water mouse foraging and nesting habitats (e.g. between mangroves and supralittoral zone) occurs • A light mitigation plan for construction and operation will be developed and will include specific light management and reduction measures and a commitment to routine light audits
	Introduced predators	• Pest management program to be developed with Biosecurity Queensland and GRC

Predicted maximum disturbance to habitat	Impact	Mitigation measures
	Changes to water quality	• Implement sediment and erosion control measures upslope of watercourses, wetlands and coastal areas or in areas with sodic soils to minimise increases in natural sediment discharge. Measures may include sediment traps, silt fencing, riprap, contour banks, detention dams, sediment ponds and vegetation and diversion berms • Design and construct a barrier and sediment control pond to trap sediment leaving the LNG plant site before it enters the Port Curtis marine environment or other surface waters • Develop an ASS management plan prior to construction work. In the plan, specify how onsite ASS disturbances should be managed in accordance with SPP2/02 and the methods set out in Queensland acid sulfate soil technical manual soil management guidelines (Dear et al. 2012).
	Residual impacts	• Develop measures to prevent fauna entrapment and implement prior to construction where practical • Develop trench inspection procedures to remove trapped fauna, establish protection and refuge areas for wildlife trapped in the trench and methods to assist trapped fauna left in the trench

Coordinator-General's conclusions—water mouse

The proponent has committed to offsetting significant residual impacts to the water mouse in accordance with the EPBC Act Environmental Offsets Policy, and will take into consideration recovery plan priorities for the water mouse. SEWPaC recommends that the offset proposal for the water mouse include other compensatory measures including research to improve knowledge of the species, in particular on Curtis Island.

LNG plant (EPBC 2009/5007)

Construction of the LNG plant and associated infrastructure at Curtis Island and the mainland will directly impact on water mouse habitat, particularly at Boatshed Point. A maximum total of 5.1 hectares of mangrove habitat is proposed to be cleared for the project with only 0.8 hectares to be cleared at Boatshed Point. Along with this direct loss of habitat, the clearing would fragment up to a further 16.6 hectares of water mouse habitat between Boatshed Point and Hamilton Point. As defined by significant impact guidelines, the area is considered to be an important population of the water mouse on Curtis Island due to evidence of recent activity.

Mangroves to be cleared at the mainland are less suitable for water mouse habitation; therefore impacts on the mainland are not unacceptable.

Project activities may increase pressure on the water mouse through lighting, potentially increasing predation, and negatively impacting on water mouse prey through changes to hydrology, potentially reducing viability of the water mouse at the project site.

Pipeline (EPBC 2009/5008)

Construction and operation of the pipeline will not directly impact on the water mouse. Mangrove habitat for the species will not be cleared as a result of the pipeline at either the mainland or Curtis Island.

Cumulative impacts of the four LNG facilities at Curtis Island will decrease connectivity and quality of water mouse habitat.

I have reviewed the EIS and supplementary MNES material and conclude that the proponent has adequately identified impacts on the water mouse under the EPBC Act.

I note the proponent will:

- develop a water mouse management plan to be implemented during construction and operation of the project. The plan will include strategies to manage and minimise impacts to water mouse habitat and populations, including timelines and responsibility for implementing identified measures
- design infrastructure to reduce impacts on shoreline habitat, where possible, and reduce the risk of unnecessary clearing by demarcating disturbance areas prior to the disturbance commencing (Appendix 4, C17.49)
- reduce lighting, wherever possible, in locations where movement between water mouse foraging and nesting habitat occurs (e.g. between mangroves and the supralittoral zone) (Appendix 4, C17.50).

In light of the above, I consider that the impacts to the water mouse are not unacceptable.

I note that the proponent has committed to offsetting significant residual impacts to the water mouse in accordance with the EPBC Act Environmental Offsets Policy.

Grey-headed flying fox *(Pteropus poliocephalus)*—vulnerable

The grey-headed flying fox is listed as 'vulnerable' under the EPBC Act and is Australia's only endemic flying fox species. It is a canopy-feeding frugivore and nectarivore utilising rainforests, open eucalypt forests, woodlands, melaleuca swamps and Banksia woodlands.[23] The species is highly tolerant of disturbance but the population has significantly declined in the northern portion of its range, from Central Queensland to northern New South Wales, and has expanded in the southern portion of its range, possibly due to habitat degradation or changes in average temperatures.

Grey-headed flying foxes are a highly mobile species, frequently moving between roosting camps between breeding periods.

Field survey results

Sightings of grey-headed flying foxes were recorded four times during the study period, once on Curtis Island and three times on the mainland. No flying fox roosting camps were detected within the project area, suggesting that the vegetation within the project

[23] Eby, P. 1991. Seasonal movements of grey-headed flying foxes, Pteropus poliocephalus (Chiroptera: Pteropodidae), from two maternity camps in northern New South Wales. *Wildlife Research*: 18, 547-549.
Duncan, A., Baker, G.B., & Montgomery, N. 1999. The action plan for Australian bats. *Environment Australia*, Canberra.

area is only a foraging resource for the species. Extensive foraging resources are present in communities such as *Eucalyptus tereticornis* and *Melaleuca quinquenervia*.

A large temporary camp, between 50 000 and 60 000 bats, is known in the Calliope area. The species is highly mobile, but may be affected by the loss of foraging resources in the project area. A combined total of 20 218 hectares of suitable habitat is present within the Burnett-Curtis Hills and Ranges sub-region.

The grey-headed flying fox is also known to use the Littoral Rainforest and Coastal Vine Thickets of Eastern Australia; areas of this TEC will be avoided by the LNG plant (EPBC 2009/5007) as discussed previously.

Project impacts and mitigation and management commitments

The EIS concluded that project impacts on the species are restricted to the loss of approximately 176 hectares of suitable foraging habitat to facilitate infrastructure construction.

LNG plant (EPBC 2009/5007)

Construction of the LNG plant is proposed to clear approximately 127 hectares of this habitat at Curtis Island. Approximately 24 hectares of habitat associated with the flying fox is proposed to be cleared at TWAF 8 on the mainland. Habitat loss on the mainland is likely to be prolonged and possibly irreversible. No further impacts resulting from project operations are expected.

In total, approximately 906 hectares of suitable foraging habitat for the grey-headed flying-fox will be lost as a result of the four LNG plants on Curtis Island.

The proponent proposes that habitat loss and degradation be managed by clearly delineating project area boundaries to avoid unnecessary vegetation loss (C17.44), and determining habitat offsets in consultation with myself and SEWPaC prior to commencement of construction.

Pipeline (EPBC 2009/5008)

Construction of the pipeline is proposed to clear approximately eight hectares of habitat for the construction right-of-way leading to the mainland tunnel launch site.

Coordinator-General's conclusions—grey-headed flying fox

No important populations, breeding or roosting camps were found within the project area. A total of 176 hectares of suitable habitat will be cleared for the project.

LNG plant (EPBC 2009/5007)

Suitable foraging resources are present at Curtis Island. A total of 127 hectares of this habitat will be cleared for the LNG plant and an additional approximately 24 hectares on the mainland at TWAF 8.

Pipeline (EPBC 2009/5008)

Construction of the pipeline (EPBC 2009/5008) is proposed to clear grey-headed flying fox habitat for construction right-of-way.

I have reviewed the EIS and supplementary MNES material and conclude that the proponent has adequately assessed impacts on the grey-headed flying fox under the EPBC Act.

I note the proponent will:

- conduct pre-clearance surveys across project areas to be cleared of vegetation. The surveys will aim to determine whether any threatened species are present at each site. Appropriate mitigation measures will be implemented if threatened species are confirmed within the area (Appendix 4, C17.25)
- clearly delineate clearing boundaries prior to clearing commencing to avoid unnecessary vegetation loss (Appendix 4, C17.44)
- develop a water mouse management plan detailing procedures during construction and operation of the Arrow LNG Plant. Timelines and responsibility for completing the work will be included, and the plan developed and approved by a suitably qualified ecologist with a working knowledge of the species.

I note the proponent has made a number of commitments to avoid and mitigate impacts on vegetation in general that would apply equally to the grey-headed flying fox. The proponent would be expected to implement all measures contained within the EM plans.

In light of these mitigation measures, I consider that the impacts to the grey-headed flying fox are not unacceptable.

Squatter pigeon *(Geophaps scripta scripta)*—vulnerable

The squatter pigeon is listed as 'vulnerable' under the EPBC Act. The species occurs on the inland slops of the Great Dividing Range, with a distribution that extends from the Burdekin-Lynd divide in Central Queensland, west to Charleville and Longreach, east to the coast from Proserpine to Port Curtis, and south to scattered sites in south-eastern Queensland.

Squatter pigeons occur in open dry sclerophyll woodland with grassy understorey, nearly always near permanent water.

The main threats to the squatter pigeon include ongoing clearance of habitat for farming or development purposes, grazing of habitat by livestock and feral herbivores, and predation, especially by feral cats and foxes.

Field survey results

EIS fauna surveys recorded squatter pigeons at several sites on the mainland, within five kilometres of the project area. Spatial distribution studies suggest that the squatter pigeon is likely to be found at the TWAF 8 option at Calliope-Targinie Road, although no individuals were recorded at the site during field surveys. Squatter pigeons most typically inhabit open woodland habitat on the mainland.

It is unclear whether the squatter pigeon's Gladstone population is an 'important population'. No local or regional populations of the species have been identified as being especially important to the long-term survival or recovery of the species.[24]

Project impacts and mitigation and management commitments

LNG plant (EPBC 2009/5007)

Construction at TWAF 8 will clear approximately 31.7 hectares of woodland habitat. The squatter pigeon is highly mobile and it is likely that the species will move over a broad area on the mainland. Habitat is not expected to become fragmented or isolated by clearing actions at TWAF 8. Edge effects (particularly exotic weed invasion) may be amplified by clearing actions, however these impacts are likely to be relatively localised and restricted to the immediate vicinity of disturbance.

Pipeline (EPBC 2009/5008)

Project sites associated with the pipeline do not contain squatter pigeon habitat, therefore no impacts to the squatter pigeon from construction or operation of the pipeline are expected.

The following table outlines the mitigation measures to be applied to minimise project impacts on habitat loss and degradation of the squatter pigeon within the project area.

Table 16.5 Impact and mitigation measures relevant to the squatter pigeon

Predicted maximum disturbance to habitat	Impact	Mitigation measures
31.7 ha (EPBC 2009/5007)	Habitat loss and degradation	• Weed management measures will be implemented • Wash-down strategies and procedures will be developed • Where practicable, stockpile cleared vegetation in 'wind-rows' around the edge of retained vegetation.

Coordinator-General's conclusions—squatter pigeon

LNG plant – EPBC 2009/5007

Up to 31.7 hectares of squatter pigeon habitat will be cleared for project construction if TWAF 8 is developed. Habitat clearing at this site will not have an unacceptable impact on this species.

Pipeline – EPBC 2009/5008

The pipeline will not impact on the squatter pigeon as the species was not identified as occurring on the project sites and no suitable habitat is present.

[24] Commonwealth of Australia 2012, *Geophaps scripta scripta* in Species Profile and Threats Database, Department of Sustainability, Environment, Water, Population and Communities, Canberra, viewed 20 August 2013, www.environment.gov.au/sprat

I have reviewed the EIS and supplementary MNES material and conclude that the proponent has adequately assessed impacts on the squatter pigeon under the EPBC Act.

I concur with the advice given by SEWPaC and expect the following outcome:

- management plans (including offsets if appropriate) to be developed if this species if found on site during pre-clearance surveys
- offsets for impacts to species, such as the squatter pigeon, should be consistent with the EPBC Act Environmental Offsets Policy.

I note the proponent has made a number of commitments to avoid and mitigate impacts on vegetation and habitats in general that would apply equally to the squatter pigeon if TWAF 8 is to be developed. The proponent must implement all measures contained within the EM plans.

In light of these mitigation measures, I consider that the impacts to the squatter pigeon are not unacceptable.

Marine turtles

The following three marine turtle species are known to nest at the beaches adjacent to the project area (see Figure 16.5 below):

- flatback turtle (*Natator depressus*), vulnerable under EPBC Act
- green turtle (*Chelonia mydas*), vulnerable under EPBC Act
- loggerhead turtle (*Caretta caretta*), endangered under EPBC Act

The flatback turtle is one of only two species of marine turtle without a global distribution. It is found only in the tropical waters of northern Australia, Papua New Guinea and West Papua. Nesting is confined to Australia.

Important foraging grounds and juvenile habitat for green turtles in Queensland include the Capricorn Bunker region of the Great Barrier Reef between Rockhampton and Gladstone. Curtis Island and Facing Island are known nesting areas for the green turtle.

There are two genetically distinct populations of loggerhead turtles in Australia (eastern Australian and Western Australia). Based on the percentage of nesting females per year, approximately 2-4% of the total global population of loggerhead turtles occur in Australia.

Field survey results

Flatback turtles are the most common of the three marine turtle species found in the Port Curtis region. As of 2006, a nesting population of 51 females utilised the beach at Connor Bluff north of Southend on Curtis Island. Nesting green turtle females occasionally use the beaches near Southend, Curtis Island. Loggerhead turtles nest intermittently within the Port Curtis region with the nearest breeding site 60 km away at Deepwater National Park.

No nesting sites for any turtle species were found within the study area during field surveys. Flatback turtles nest at Connor Bluff, approximately 9 kilometres from the project site. Connor Bluff will not be directly impacted by the project.

Port Curtis is recognised as providing important foraging habitat for the flatback turtle, loggerhead turtle and green turtle. Port Curtis is particularly important for the green turtle as it supports large amounts of seagrass, an important food source.

Project impacts and mitigation and management commitments

The main threats to marine turtles in Australia include disturbance to nesting and hatchling behaviour (e.g. from artificial light), habitat degradation and injury or mortality from boat strike.

LNG plant – EPBC 2009/5007

Behaviour disturbance

Light glow during construction and operation may disorientate and disrupt the behaviour of turtles, particularly those nesting at Connor Bluff, i.e. flatback turtles. Hatchlings may also be disoriented by artificial light glow, increasing fatalities due to dehydration or predation. Project lighting may cause nesting turtles to utilise other nesting sites, reducing site fidelity at Connor Bluff.

A study of the impacts of industrial lighting on turtles nesting on islands within Port Curtis (SEIS Appendix 9) was conducted to validate proposed management measures. The study found that marine turtles utilising the nesting beaches of Curtis Island and Facing Island in Port Curtis are likely to be exposed to some project lighting. Light glow from the project flare and infrastructure will be indistinguishable from the mainland sources of glow. Sea-finding behaviour in hatchling turtles and nesting beach selection in adult (novice) females are the behaviours most impacted by artificial light.

Marine turtles will be most sensitive to lighting during peak nesting and hatching periods, which occur from November to April. This peak activity coincides with Queensland's wet season, which is characterised by regular cloud cover and high aerosol content in the air. These conditions increase the light reflection in the sky and may increase the impacts to hatchling behaviour.

The proponent has committed to several mitigation and management measures (refer Table 16.6) to reduce impacts of lighting on marine turtles. Arrow has also committed to participating in a monitoring program established to assess the impact of current and future industrial lighting in the Gladstone region on hatchlings emerging on the beaches of Curtis and Facing Islands.

Residual impacts from project lighting following implementation of the light mitigation plan are likely to include an increased extent of horizon illumination at some locations on Facing Island and Curtis Island beaches.

Figure 16.5 Turtle nesting sites in the Gladstone region

Habitat degradation

Seagrass beds represent foraging habitat for marine turtles. The area impacted by the LNG plant does not support seagrass. However, seagrass beds are present to the east of Boatshed Point.

Sediment plumes from dredging and erosion and sedimentation from project activities may indirectly affect the seagrass beds. Sedimentation impacts on seagrass beds will be temporary and the proponent concluded that very little, if any, sediment accumulation will occur at these sites. Mitigation and management measures for habitat loss and degradation are listed in Table 16.6 below.

Boat strike

Increased shipping activity in Port Curtis as a result of the project is likely to increase the chance of boat strike that may be injurious or fatal to marine turtles. Between January 2011 and September 2012, a total of 292 turtle mortalities were identified in the Gladstone region; 40 of them resulting from interactions with vessels and two from dredging operations. Injuries to turtles are expected to rise as vessel traffic increases within Port Curtis. The proponent stresses that compliance with speed limits remains the foremost mitigation measure for boat strike. Other mitigation measures are listed in the table below. The proponent has committed to establishing a system for the recording of opportunistic observations of marine turtles spotted during marine operations, including transport, where these activities occur within the Calliope River (Appendix 4, C19.12).

Underwater noise

Underwater noise from shipping activity and pile driving can injure and disorientate turtles. It is likely that marine turtles will pass within the vicinity of pile driving during project construction. Behavioural changes and physiological damage to auditory sensors of marine turtles impacted by underwater noise may occur. Discussions between the proponent and SEWPaC have indicated that a buffer zone may be an appropriate mitigation measure as a way of managing underwater noise impacts on marine turtles, together with the commitments made by the proponent, which are listed in Table 16.6. The conditions for underwater noise limits in Appendix 2 (Schedule 1, conditions C8-9) reflects a buffer distance for underwater noise.

The EIS identifies that underwater noise from pile driving may result in turtles avoiding travelling within an area of up to 1500 metres of the activity. This area may include some seagrass beds within Port Curtis and could result in marine turtles avoiding these feeding areas.

Conditions for underwater noise limits in Appendix 2, state that underwater noise tests should be conducted for each specific piling rig prior to commencing operations to determine the distance from the rig at which the underwater noise level reduces to 183 decibels (an acceptable limit) (Appendix 2, Schedule 1, Condition C8c). This distance will be used as the observation distance for fauna observations, to be carried out by an appropriately qualified person during pile driving activities. In the absence of underwater noise tests, the observation distance must be at least 500 metres from the pile driving works site (Appendix 2, Schedule 1, Condition C8d).

Pipeline – EPBC 2009/5008

Habitat degradation

Seagrass beds are present in the west of Port Curtis adjacent to the mainland tunnel launch site. This habitat may be indirectly impacted by erosion and sedimentation from the project. Impacts from sediment plumes from dredging are discussed above.

Table 16.6 Impacts and mitigation and management measures relevant to marine turtles

Impact	Mitigation measures
Habitat loss and degradation	• Dredge management plan that considers appropriate water and sediment monitoring data • Construction management plan which contains specific mitigation measures, performance indicators and management actions required to reduce impacts to the marine and estuarine ecological values • Keep dredging activities within the identified dredge footprint area
Underwater noise	• Implement soft-start procedures where a sequential build-up of warning pulses will be carried out prior to commencement of full-power pile-driving activities • Fauna observations to be undertaken prior to and during pile driving and dredging activities to check for presence of marine megafauna. Should fauna be present, implement procedures to minimise impact, such as reverting to soft-start piling or stopping temporarily to allow animals to move away from the area • Maintain fauna-spotting function (where practical) during dredging activities. Do not commence dredging if marine mammals, turtles or crocodiles are spotted within the area of dredging, and stop temporarily if fauna is spotted within the area of the dredge head. In both cases, resumption of dredging must wait until fauna has moved away • Evaluate the use of bubble curtains for each method of piling, and deploy where they are demonstrated to be effective in aiding the rapid attenuation of underwater noise and deterring marine fauna from approaching, or remaining, at pile-driving sites
Boat strike	• Contribute to development of a Port of Gladstone shipping activity strategy and management plan • Comply with the applicable speed limits for the Port of Gladstone-Rodds Bay Zone B dugong protection area, as detailed in the management plan • Install (where feasible) propeller guards on high-speed vessels to reduce the impact of injury • System for recording opportunistic marine megafauna observations spotted during marine operations including where these activities occur in the Calliope River

Impact	Mitigation measures
Lighting	• Shield/direct the light source onto work areas where practical and avoid light spill onto habitat areas where practical • Use long-wavelength lights, where practical, including use of red, orange or yellow lights • Lower the height of the light sources as far as practical • Avoid planned routine maintenance flaring at night during sensitive turtle reproductive periods (where practical) • Consider measures to minimise light emitted from the LNG plant during the detailed design of the LNG plant, including: o Assess the necessity and choice of lighting in the plant area: ▪ use low-pressure sodium (LPS) lights as a first-choice light source and high-pressure sodium (HPS) lights where LPS is not practical ▪ replace short-wavelength light with long-wavelength light and exclude short-wavelength light with the use of filters ▪ avoid using halogen, metal halide or fluorescent lights (white lights) where possible, and only use white lights in contained areas where colour rendition is required ▪ minimise the number and water of lights, and recess lighting onto structures where possible o use timer and motion-activated light switches o position doors and windows on the sites of buildings facing away from marine turtle nesting beaches and install and use window coverings to reduce light emissions o maintain elevated horizons (such as topographic features, vegetation or barriers) to screen rookery beaches from light sources • A light mitigation plan for construction and operation will be developed and will include specific light management and reduction measures and a commitment to routine light audits • The proponent will participate in monitoring programs established to assess the impact of current and future industrial lighting in the Gladstone region on hatchlings emerging on the beaches of Curtis and Facing Islands

Coordinator-General's conclusions – marine turtles

LNG plant – EPBC 2009/5007

Construction and operations of the LNG plant, including dredging, lighting and marine transport, are likely to impact on marine turtles through habitat loss and degradation, behavioural change, injury and potential fatalities.

Seagrass beds will not be cleared for the project, but may be temporarily impacted by sediment plumes from dredging activities. Project lighting, including the flare, may disturb the behaviour of nesting females and hatchling turtles at Connor Bluff and Southend potentially reducing the viability of these beaches for nesting. Turtles are at risk of boat strike from shipping activity within Port Curtis that may lead to injury and mortality to the turtles. These species are also at risk of underwater noise impacts from shipping and pile driving activities that may result in physiological damage and behaviour change to turtles.

Pipeline – EPBC 2009/5008

Impacts to marine turtles from the pipeline and associated infrastructure are considered minor. Impacts include potential degradation of seagrass beds adjacent to the mainland tunnel launch site from erosion, and contribution to light glow in Port Curtis.

I have reviewed the EIS and Supplementary MNES material and conclude that the proponent has adequately assessed impacts on marine turtles under the EPBC Act.

I note the following proponent commitments:

- management of dredging and pile driving activities to reduce impacts on marine turtles and their habitat
- contribution to marine turtle monitoring and management initiatives with other LNG facilities on Curtis Island
- lighting mitigation measures, including a light management plan
- fauna observations during marine transport, dredging and pile driving activities.

The proponent must implement all measures contained within the EM plans, including a marine activity management plan, dredge management plan and construction environmental management plan.

In light of these mitigation measures, I consider that the impacts to marine turtles are not unacceptable.

Other listed threatened species

On 15 May 2013 the brigalow scaly-foot (*Paradelma orientalis*) was delisted from the EPBC Act threatened species list. Although 240 hectares of potential habitat will be impacted by the project, this is not considered to be critical habitat for the species.

An assessment of impacts on listed threatened species is available in the assessment documentation at:

- EIS – MNES, Attachment 4, Section 6.3
- EIS – Appendix 9 – Terrestrial Ecology Impact Assessment
- SEIS – Appendix 11 – Terrestrial Ecology Supplementary EIS Study.

16.5. Listed migratory species

Many animals migrate to Australia and its external territories, or pass through or over Australian waters during their annual migrations. Many migratory species listed under international conventions and agreements that Australia is party to, are protected under the EPBC Act. These species include migratory birds and marine megafauna.

Many different species of migratory birds utilise the same habitat areas, therefore the impacts to migratory bird habitat are likely to impact a range of migratory bird species in a similar manner. Impacts to migratory birds are discussed below according to habitat preference, i.e., shorebirds and terrestrial birds.

Likewise, impacts to different species of marine megafauna, in particular cetaceans and dugongs, are likely to be similar.

The EIS reported that shorebird species will be impacted by clearing and disturbance of foraging and roosting habitats by project construction and activities. Marine megafauna will be directly impacted by increased shipping activity and pile driving, and temporarily impacted by dredge plumes settling over seagrass beds.

16.5.1. Migratory shorebirds

Australia provides critical non-breeding habitat for millions of migratory shorebirds each year. These birds make round trip migrations of up to 26 000 kilometres each year between their breeding grounds in the northern hemisphere and their non-breeding grounds in the south. Wetland habitat loss and degradation is a significant threat to migratory shorebirds.

Port Curtis contains large areas of foraging and roosting sites for shorebirds. Table 16.7 below lists the migratory shorebird species with important habitat within Port Curtis. Within Port Curtis, habitat sites additional to those listed in the table below are frequented by migratory shorebird species but insufficient numbers of shorebirds (less than one per cent of the individuals in a population of one species, or a total abundance of at least 20 000 shorebirds) use these sites for them to be deemed important habitat as defined by the EPBC Act Significant Impact Guidelines for migratory shorebirds.

Table 16.7 Migratory shorebirds and corresponding important habitat sites within Port Curtis

Species	Important habitat site(s)
Eastern curlew (*Numenius madagascariensis)*	Chinaman's Island Clinton ash ponds* Pelican Banks Southend
Whimbrel (*Numenius phaeopus*)	Chinaman's Island Pelican Banks
Bar-tailed godwit (*Limosa lapponica)*	Chinaman's Island Clinton ash ponds* Pelican Banks
Grey-tailed tattler (*Tringa brevipes)*	Chinaman's Island Pelican Banks Queensland Alumina Southend
Red-necked stint (*Calidris ruficollis)*	Clinton ash ponds* Friend Point

*Denotes habitat sites within project area

Field survey results

Important shorebird roosting habitat was found at Clinton ash ponds (EPBC 2009/5007). Shorebird presence here has declined over time as a result of disturbance from increasing industry within the area. Clinton ash ponds is located adjacent to launch site 1.

A shorebird roost site was found at Flying Fox Creek. Project activities are unlikely to directly disturb this site as it is located one kilometre from the project site.

Important shorebird foraging habitat is located on the eastern side of the mangroves adjacent to the mainland tunnel launch site (EPBC 2009/5007) (refer Figure 16.6 below). The mangroves at this location will act as a visual buffer between the project and shorebird foraging sites.

The EIS classified the Targinie Wetlands, located to the east of the mangroves adjacent to the mainland tunnel launch site, as secondary foraging habitat. The wetlands are unlikely to be disturbed by construction and operation of the mainland tunnel launch site.

Shorebirds are likely to be displaced from the tidal flats immediately adjacent to the mainland tunnel launch site during construction and operation due to noise and disturbance from project activities. The EIS states that a total of 1094 hectares of habitat is present in Port Curtis at Pelican Banks and Southend Claypan at Curtis Island, Friend Point, Facing Island, and North China Bay (refer Figure 16.6 below).

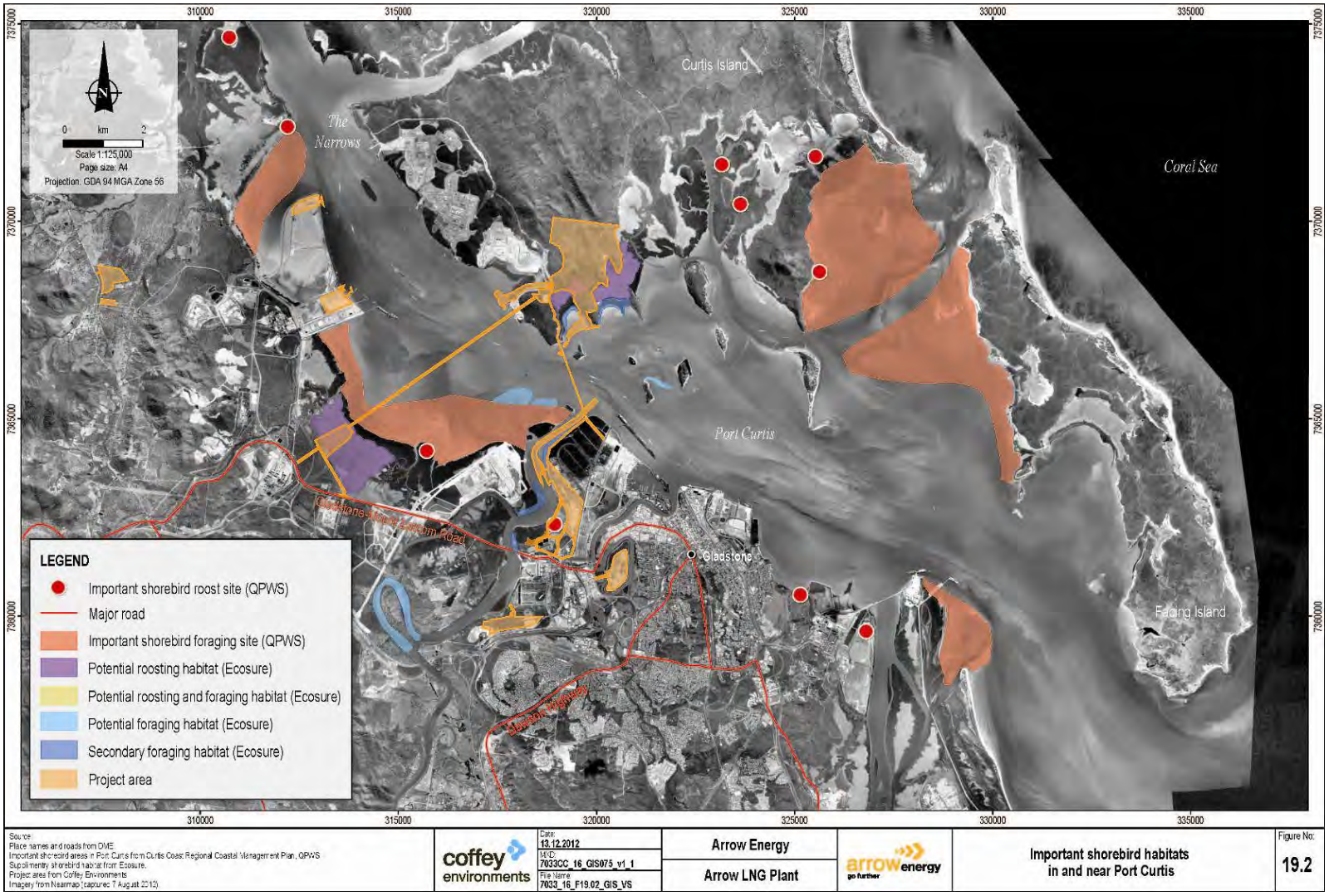

Figure 16.6 Important shorebird habitats in and near Port Curtis

Project impacts and mitigation and management commitments

LNG plant (EPBC 2009/5007)

Habitat loss

Approximately 15 hectares of potential roosting shorebird habitat is proposed to be cleared for the LNG plant at Curtis Island. An additional approximately eight hectares of shorebird habitat will be cleared at mainland sites for this referral.

Habitat degradation

Degradation of shorebird habitat may occur from indirect impacts from the project, including pollution, runoff and sedimentation from construction and operation activities, weed invasion and changed hydrology. Intertidal vegetation, adjacent to saltpan and mangrove habitats that are proposed to be cleared, is also likely to be indirectly impacted from project construction and operation activities. Habitat clearing is likely to result in increased erosion and sedimentation, thus degrading nearby intertidal vegetation that may represent shorebird habitat.

Shorebirds may be displaced from habitat exposed to project lighting and disturbed by increased vehicle and personnel movement (e.e. if an access track to launch site 1 is constructed that passes the adjacent Clinton ash ponds). Artificial lighting may degrade the quality of habitat through reducing the occurrence and abundance of shorebird prey.

Project lighting from launch site 1 at the mouth of the Calliope River, may reach the important roosting habitat at the Clinton ash ponds. The EIS reported that shorebirds using this site are likely to be habituated to high levels of disturbance. Impacts from the project on shorebirds at the Clinton ash ponds are not considered to be unacceptable.

Pipeline (EPBC 2009/5008)

Habitat loss and degradation

Construction of the mainland tunnel launch site requires clearing of approximately 33 hectares of largely bare saltpan tidal flats, which is considered to be largely degraded and of poor habitat quality for shorebirds.

The EIS concluded that impacts to shorebird species resulting from saltpan habitat loss at the mainland tunnel launch site will be minimal as suitable alternative habitat for foraging and roosting is present in Port Curtis.

Habitat degradation

Habitat degradation, as discussed above, may also occur to intertidal vegetation adjacent to the mainland tunnel launch site.

Proposed habitat loss will not have an unacceptable impact on shorebirds. All the shorebird species identified during desktop surveys and field surveys have wide ranges within Port Curtis as sufficient quality habitat is present in the area.

Project lighting from the mainland tunnel launch site may reach foraging habitat at the Targinie wetlands. However, the mangrove habitat between the project site and the

wetland will act as a buffer, reducing the amount of light pollution reaching the wetland. Therefore, the impacts of lighting from the mainland tunnel launch site to shorebirds using the wetland are not considered to be unacceptable.

The following Table 16.8 outlines the mitigation strategies to be implemented to reduce impacts on migratory shorebirds potentially affected by the project within Port Curtis.

Table 16.8 Impact and mitigation measures relevant to migratory shorebirds

Predicted maximum disturbance to habitat	Impact	Mitigation measures
23 ha (EPBC 2009/5007) 33 ha (EPBC 2009/5008)	Habitat loss and degradation	• Prohibit access to the saltpans and fringing mangroves outside the planned area of disturbance of the mainland tunnel entry shaft and tunnel spoil disposal area • Design infrastructure to reduce impacts on shoreline habitat, where possible, and reduce the risk of unnecessary clearing by demarcating disturbance areas • Develop measures to minimise disturbance around important shorebird habitat, during construction and operation. Measures could include exclusion zones or screens as recommended
	Sedimentation	• Limit clearing of vegetated areas to the project area. Areas will be stabilised and progressively rehabilitated to reduce prolonged exposure of soils • Implement sediment and erosion control measures upslope of watercourses, wetlands and coastal areas or in areas with sodic soils to minimise increases in natural sediment discharge. Measures may include sediment traps, silt fencing, riprap, contour banks, detention dams, sediment ponds and vegetation and diversion berms
	ASS	• Develop and ASS management plan prior to construction work. In the plan, specify how onsite ASS disturbances should be managed in accordance with SPP2/02 and the methods set out in Queensland acid sulfate soil technical manual soil management guidelines
	Pollution	• Future chemicals and fuel use storage: Immediately clean up any spills and conduct investigations into any relevant releases • Develop appropriate spill prevention and response plans to cover project activities and the types and quantities of fuel, oil and chemicals held at each site • Train all relevant personnel in spill response and recovery procedures

Predicted maximum disturbance to habitat	Impact	Mitigation measures
	Lighting	• Design lighting around the perimeter of the LNG plant to minimise impacts on roosting shorebirds, where practical. Lowest possible luminescent globes should be used in sensitive areas, particularly around intertidal zones, where practicable. • Consider measures to minimise light emitted from the LNG plant during the detailed design of the LNG plant (see Appendix 4, C17.47) • A light management plan for construction and operation will be developed and will include specific light management and reduction measures and a commitment to routine light audits

Coordinator-General's conclusions—migratory shorebirds

LNG plant (EPBC 2009/5007)

The LNG plant will clear approximately 15 hectares on Curtis Island and eight hectares on the mainland, of shorebird habitat; however these habitats are not considered to be important habitat as defined by the significant impact guidelines for shorebirds.

Project activities including lighting may degrade important habitat adjacent to launch site 1 on the mainland (Clinton ash ponds) and other habitat at Curtis Island. However, the habitat adjacent to launch site 1 is already degraded and with the implementation of light mitigation measures, impacts from the project to shorebirds at this site will not be unacceptable.

Pipeline (EPBC 2009/5008)

The pipeline will not clear any important shorebird habitat but will clear saltpan habitat for construction of the mainland tunnel launch site. This habitat is considered to be poor quality for shorebirds and thus the project will not result in an unacceptable impact.

Shorebird habitat is present in the Targinie wetlands, adjacent to the mainland tunnel launch site. Indirect project impacts such as lighting and sedimentation to the wetlands will be minimised due to the presence of a mangrove habitat buffer between the wetland and the project site.

I have reviewed the EIS and supplementary MNES material and conclude that the proponent has adequately assessed impacts on migratory shorebirds under the EPBC Act.

I note the proponent will:

- develop a shorebird management and monitoring plan for approval prior to construction commencing. The plan will take into account similar programs developed for other similar projects being undertaken within the study area and surrounds, and will include mitigation measures outlined in the additional information to the EIS

- minimise incidental clearing impacts and degradation to shorebird habitats adjacent to the project site
- mitigate impacts on migratory shorebirds.

The proponent would be expected to implement all measures contained within the EM plans.

In light of these mitigation measures, I consider that the impacts to migratory shorebirds are not unacceptable.

16.5.2. Migratory terrestrial birds

Five of eight migratory terrestrial bird species potentially occurring in the area, listed below, were identified in field surveys for the EIS.

- barn swallow (*Hirundo rustica*)*
- black-faced monarch (*Monarcha melanopsis*)*
- fork-tailed swift (*Apus pacificus*)
- rainbow bee-eater (*Merops ornatus*)
- rufous fantail (*Rhipidura rufifrons*)
- satin flycatcher (*Myiagra cyanoleuca*)
- spectacled monarch (*Monarcha trivirgatus*)*
- white-throated needletail (*Hirundapus caudacutus*).

*Denotes species not identified in EIS field surveys

No important habitat or populations for any of these species was identified in the project area.

Monarchs, rufous fantail, rainbow bee-eater and satin flycatcher are primarily associated with a variety of woodland habitats, although they may also occur in mangrove habitat near the project area.

Barn swallow, fork-tailed swift and white-throated needletail are aerial foraging species, which will potentially forage in air space over the entire project area.

LNG plant (EPBC 2009/5007)

Invasive species

The rainbow bee-eater was identified in the project area at Curtis Island. It is the only migratory terrestrial bird species that is likely to be impacted by invasive species as it nests on the ground. Feral fauna such as cane toads, red fox and feral cats may prey on rainbow bee-eater eggs and young. The proponent has committed to developing a pest management plan to mitigate these impacts.

Pipeline (EPBC 2009/5008)

Habitat loss

Construction of the pipeline is proposed to involve linear clearance of less than 20 hectares of woodland vegetation. Impacts from habitat clearing are not unacceptable,

as cumulative loss of migratory terrestrial bird habitat for all projects within the Gladstone region is small in comparison to the overall habitat available within the region. Available habitat near the project area includes the Curtis Island Environmental Management Precinct on Curtis Island (4592 hectares) and Targinie State Forest on the mainland (approximately 880 hectares). Therefore, the project is unlikely to have unacceptable impacts to any of the migratory terrestrial species listed above.

Invasive species

The rainbow bee-eater was also located at the mainland tunnel launch site, and may be impacted by invasive species at this location. The impacts are discussed above.

The proponent has not provided any species-specific management plans relating to migratory terrestrial birds, but general mitigation measures committed to by the proponent would reduce impacts to migratory terrestrial birds.

Table 16.9 Impact and mitigation measures relevant to migratory terrestrial birds

Predicted maximum disturbance to habitat	Impact	Mitigation measures
Less than 20 ha (EPBC 2009/5008)	Residual impacts	• Design TWAF 8 to minimise disturbance to the 'of concern' RE 11.3.4 (*Eucalyptus tereticornis* and/or Eucalyptus spp. tall woodland on alluvial plains) to maintain connectivity of habitat along the Targinie Creek riparian zone • Include measures in the pest management plan to control invasive plant species that may colonise the mudflats and degrade remaining habitat.

Coordinator-General's conclusions—migratory terrestrial birds

LNG plant (EPBC 2009/5007)

No important habitat or populations for any of these species was identified in the project area.

The LNG plant will not require clearing of migratory terrestrial bird habitat. However, invasive species may impact on the rainbow bee-eater, as it nests on the ground.

Pipeline (EPBC 2009/5008)

No important habitat or populations for any of these species was identified in the project area.

Construction of the pipeline will require clearing of 20 hectares of terrestrial migratory bird habitat. However, this is minimal compared to the available habitat within the Gladstone region.

Impacts from invasive species are also possible at the project sites associated with the pipeline.

I have reviewed the EIS and supplementary MNES material and conclude that the proponent has adequately assessed impacts on migratory terrestrial birds under the EPBC Act.

I note the proponent has committed to avoid and mitigate impacts on vegetation in general that would apply equally to migratory terrestrial bird habitat (refer Table 16.9 above). The proponent must implement all measures contained within the EM plans.

In light of these mitigation measures, I consider that the impacts to migratory terrestrial birds are not unacceptable.

16.5.3. Migratory marine fauna

Migratory marine fauna that occur within the GBRWHA include species of cetaceans, dugongs (*Dugong dugon*) and marine turtles. Impacts to marine turtles are discussed in Section 16.4.5 above, and impacts to dugongs and cetaceans likely to be present in Port Curtis are discussed below.

Dugongs, Australian snubfin dolphins (*Orcaella heinsohni*) and Indo-Pacific humpback dolphins (*Sousa chinensis*) occur or have the potential to occur in the project area and are all listed as protected migratory species under the EPBC Act.

Australian snubfin and Indo-Pacific humpback dolphins occupy shallow coastal waters in or adjacent to modified environments within Port Curtis. These habitats support foraging and mating activities for the dolphins listed above. The EIS stated that a survey conducted in 2011 suggests that approximately 65 humpback dolphins live in Port Curtis although populations of both species in Queensland are likely to be in the thousands.

In addition to being listed as a migratory species under the EPBC Act, the dugong (*Dugong dugon*) is listed as a vulnerable species by IUCN (2010). Project activities may encroach on the Port of Gladstone-Rodds Bay Zone B dugong protection area.

Project impacts and mitigation and management commitments

Seagrass beds, that represent foraging habitat for dugong, will not be cleared for the project. However, the habitat may be temporarily impacted by dredge plumes.

LNG plant – EPBC 2009/5007

Habitat degradation

Seagrass beds at Boatshed Point may be impacted by sedimentation from dredging activities. However, the EIS states that impacts to seagrass beds will be temporary due to the strong currents in Port Curtis flushing sediments from the area.

The proponent has committed to develop a dredge management plan that will monitor and manage impacts to seagrass beds (Appendix 4, C15.02).

Boat strike

Dugongs and the Australian snubfin and Indo-Pacific humpback dolphins are at risk of boat strike in Port Curtis. Between January 2011 and October 2012, three dugongs were identified as fatality victims of vessel interactions, disease and net entanglement.

Between 2001 and 2010, prior to the commencement of the first LNG plant projects, one to three marine wildlife mortalities from boat strike were recorded per year.

The likelihood of boat strike will be proportional to the frequency of vessel movements. High-speed vessels will be used to transport workers to Curtis Island on a daily basis, while other marine vessels for project activity will operate at a low frequency and at low speeds.

The proponent has committed to several mitigation and management measures to reduce impacts and occurrence of boat strike on marine megafauna. Propeller guards are to be installed on marine vessels to reduce propeller cuts (Appendix 4, C19.05). The proponent will contribute to the development of a Port of Gladstone shipping activity strategy and management plan, and will comply with speed limits for the Port of Gladstone-Rodds Bay Zone B dugong protection area.

Underwater noise

Underwater noise from pile driving may also impact these species by causing injury and interfering with their behaviour and reducing their ability to communicate, hunt and navigate. Marine megafauna may also be displaced from habitat within Port Curtis due to underwater noise from these activities.

The proponent has committed to implement soft-start procedures (Appendix 4, C19.06) and to conduct fauna spotting and recording systems during pile driving activities (Appendix 4, C19.07). If any marine megafauna are recorded within a buffer zone of the pile-driving area, pile driving would cease until the animal has left the buffer zone (refer to Section 16.5.3). Conditions have been stated in Appendix 2 regarding underwater noise parameters for marine fauna, including recommended buffer zones and underwater noise limits to protect marine fauna.

Pollution

Pollution from spillage or discharge of oil, chemicals, sewage, black or grey water and ballast water could occur in Port Curtis and the GBRMP. Dugongs and dolphins may be temporarily displaced from the locally affected area as a result of such an incident, potentially excluding the species from valuable habitat.

Shipping is highly regulated in Australia, with a number of State and Commonwealth agencies enforcing legislation that regulates shipping activity. Shipping, including proposed mitigation measures by the proponent, is discussed in Section 16.3.1.

Pipeline (EPBC 2009/5008)

Construction and operation of the pipeline are unlikely to impact on marine megafauna as they do not involve pile driving, shipping or dredging.

Table 16.10 below outlines project impacts and mitigation measures relevant to migratory marine fauna.

Table 16.10 Impacts and mitigation measures relevant to migratory marine fauna

Impact	Mitigation measures
Habitat degradation	• Dredge management plan that considers appropriate water and sediment monitoring data • Environmental Offsets Operational Management Plan that addresses terrestrial and marine offset requirements in consultation with relevant government stakeholders prior to commencement of construction • Construction management plan which contains specific mitigation measures, performance indicators and management actions required to reduce impacts to the marine and estuarine ecological values • Keep dredging activities within the identified dredge footprint area • Develop and implement a rehabilitation management plan (EIS – included in EM Plan).
Boat strike	• Contribute to development of a Port of Gladstone shipping activity strategy and management plan • Comply with the applicable speed limits for the Port of Gladstone-Rodds Bay Zone B dugong protection area, as detailed in the management plan • Install (where feasible) propeller guards on high-speed vessels to reduce the impact of injury • System for recording opportunistic marine megafauna observations spotted during marine operations including where these activities occur in the Calliope River
Underwater noise	• Implement soft-start procedures where a sequential build-up of warning pulses will be carried out prior to commencement of full-power pile-driving activities • Fauna observations to be undertaken prior to and during pile driving and dredging activities to check for presence of marine megafauna. Should fauna be present, implement procedures to minimise impact, such as reverting to soft-start piling or stopping temporarily to allow animals to move away from the area • Maintain fauna-spotting function (where practical) during dredging activities. Do not commence dredging if marine mammals, turtles or crocodiles are spotted within the area of dredging, and stop temporarily if fauna is spotted within the area of the dredge head. In both cases, resumption of dredging must wait until fauna has moved away • Evaluate the use of bubble curtains for each method of piling, and deploy where they are demonstrated to be effective in aiding the rapid attenuation of underwater noise and deterring marine fauna from approaching, or remaining, at pile-driving sites
Pollution	• Test and treat all discharges to Port Curtis to meet water quality criteria, as required, prior to discharge • Develop spill response plans to cover marine activities, including all vessel operations.

Coordinator-General's conclusions—migratory marine fauna

LNG plant (EPBC 2009/5007)

The LNG plant construction may impact on marine megafauna through underwater noise from pile driving and shipping activities. Shipping is also likely to result in boat strike incidents for marine megafauna. Dredging activities for the project may potentially degrade dugong-foraging habitat. Pollution from shipping activities and other project-sourced spills may displace animals from the critical habitats.

Pipeline (EPBC 2009/5008)

Impacts from the pipeline are unlikely as operations do not involve pile driving, shipping or dredging.

I have reviewed the EIS and supplementary MNES material and conclude that the proponent has adequately identified impacts on migratory marine mammals under the EPBC Act.

I note the proponent has made a number of commitments to avoid and mitigate impacts on migratory marine mammals. The proponent would be expected to implement all measures contained within the EM plans.

In light of these mitigation measures, I consider that the impacts to migratory marine mammals are not unacceptable.

16.6. Cumulative impacts

16.6.1. Visual amenity

Cumulative impacts from industrial development associated with the four LNG facilities at Curtis Island will result in changes to the landscape character and views from the mainland, which is an outstanding value of the GBRWHA. The Gladstone area is already characterised by significant industrial development. The four LNG facilities on Curtis Island and other industrial developments in the Port of Gladstone are proposed to be developed on undeveloped land, resulting in an intensification and extension of industrialisation in the Gladstone area.

Vegetation clearing and earthworks for the project will change the landscape of Curtis Island from natural, forested mountains and plains to cleared platforms for LNG facilities and associated infrastructure. The LNG projects will extend the industrial landscape of the Gladstone area from the mainland to Curtis Island.

The industrial development on Curtis Island will also result in an additional source of light glow within Port Curtis. In the evening, the LNG facilities at the CIIP will contribute to a new horizon of artificial light. The proposed LNG developments will result in an increase in artificial light levels, an increase in sky glow, glare and light trespass through Port Curtis. Residual light pollution from all four proposals will progressively reduce the visual attributes of this corner of Curtis Island and the associated world heritage values.

16.6.2. Terrestrial ecology

Project construction and operational impacts on terrestrial ecology values include vegetation clearance and habitat fragmentation, particularly on Curtis Island.

The combined clearing of less than three per cent of vegetation on Curtis Island (approximately 58 000 hectares in size) is unlikely to have an unacceptable cumulative impact on the flora and fauna of the region.

The proportion of habitat to be cleared within the GRC area is low, with less than or equal to eight per cent of existing habitat within the region proposed to be cleared.

Key impacts from cumulative vegetation clearing could include:

- reduced habitat and the loss of habitat function potentially resulting in reduced fauna abundance and diversity in the Gladstone region
- loss of hollow-bearing trees required by a wide range of terrestrial fauna species for shelter and breeding, potentially resulting in impacts on several threatened species, (refer to Section 16.4.5).
- cumulative loss of 20 hectares of mangrove habitat that supports several threatened fauna species, including the water mouse, resulting in fragmented habitat
- increased fragmentation that may exacerbate impacts on the water mouse (refer Section 16.4.5).

The cumulative effect of several adjoining LNG facilities on Curtis Island would result in the loss of a total of approximately 1500 hectares of open eucalypt woodland forest and approximately 20 hectares of mangrove forest.

The clearing of several adjacent sites at the CIIP will create a strip of unnatural and degraded habitat along the south-west coast of Curtis Island, at an area of 1563 hectares and 8 kilometres long.

16.6.3. Marine ecology

Cumulative impacts on the marine ecology will occur on both listed species and biological values. Increased shipping traffic for the projects is likely to result in increase risk of boat strike. Shipping and pile driving will result in underwater noise. Lighting for the project may also impact on nesting turtles at Connor Bluff and Southend beaches. Habitat loss and degradation may also indirectly impact on marine megafauna species and the values of habitat diversity within the GBRWHA, through reducing the quality and availability of foraging habitat.

Cumulative shipping activity within Port Curtis from the four LNG proposals is likely to result in more frequent boat strike incidences to marine megafauna (refer Section 16.5.3) and an increased risk of collision and spills. Shipping activity is to be managed by a Port of Gladstone shipping management plan that includes details on complying with speed limits within dugong protection zones.

Shipping and pile-driving activities will increase underwater noise within Port Curtis. Background noise in marine environments is already high. Existing underwater noise combined with pile-driving activities may disorient marine megafauna (refer Section 16.5.3). Construction, involving pile driving, is already underway for the other LNG

facilities. Cumulative impacts from pile driving activities for Arrow's LNG project will not be unacceptable, as construction is proposed to start in 2014, by which time the other LNG facilities are expected to have completed construction.

Cumulative impacts of artificial light from industrial development may disorient nesting turtles and hatchlings utilising the beaches at Connor Bluff and Southend on Curtis Island (refer Section 16.4.5) potentially reducing nesting viability of the beaches. The proponents of the LNG facilities have committed to contributing to studies into the impacts of industrial lighting on nesting turtles at Curtis Island, in addition to light mitigation measures to reduce impacts on the species.

Cumulative unavoidable loss and degradation of marine habitat within Port Curtis will occur if all proposed projects are constructed. The WBDD project and Fishermans Landing Northern Expansion Project in Port Curtis are expected to cause some of the highest potential loss and disturbance to marine and estuarine habitat. Combined with the impacts of the LNG facilities and other industry, the direct and indirect cumulative impact on marine habitat equates to a total loss of 11 702 hectares, of which the Arrow LNG Plant (EPBC 2009/5007) contributes 67 hectares or 0.57 per cent, which reduces the availability and quality of marine habitats.

16.6.4. Coordinator-General's conclusions—cumulative impacts

Visual amenity

The cumulative impacts from the LNG plant (EPBC 2009/5007) and pipeline (EPBC 2009/5008) and other industrial development within Port Curtis on visual amenity are considered to be not unacceptable. The change from a natural environment to an industrial landscape at Curtis Island will be visible from several frequented locations on the mainland. Project lighting from the industrial developments will also increase artificial light and light glow within Port Curtis. Arrow has committed to provide offsets to visual amenity values of the GBRWHA in accordance with the EPBC Act Environmental Offsets Policy. In light of the commitments made by the proponent to reduce and manage impacts to visual amenity, the cumulative impacts are considered to not be unacceptable.

Terrestrial ecology

The cumulative impacts from the LNG plant (EPBC 2009/5007) and pipeline (EPBC 2009/5008) and other industrial development within Port Curtis on terrestrial ecology are considered to be not unacceptable. Vegetation clearing on Curtis Island for the LNG facilities will be long-term and potentially permanent. This will reduce available habitat for several threatened species, including the water mouse. However, there is abundant suitable habitat available on Curtis Island. In light of the commitments made by the proponent to reduce and manage impacts to terrestrial ecology and the water mouse, in particular, the cumulative impacts are considered to not be unacceptable. Arrow has also committed to provide offsets to ecology and habitat values of the GBRWHA and for residual impacts to the water mouse in accordance with the EPBC Act Environmental Offsets Policy.

Marine ecology

The additional impacts from the LNG plant (EPBC 2009/5007) and pipeline (EPBC 2009/5008) on marine ecology, in association with the other industrial developments within Port Curtis, are considered to be not unacceptable. Arrow's marginal contribution to marine habitat loss is minimal. Impacts to marine megafauna from boat strike and underwater noise are expected to increase with intensified development. The LNG proponents have committed to collaborative management plans to mitigate and manage shipping impacts to marine megafauna. SEWPaC advises that Arrow should contribute to studies into the impacts of underwater noise in Port Curtis on marine megafauna as a compensatory measure for impacts to marine megafauna from underwater noise. In light of the commitments made by the proponent to reduce and manage impacts to marine ecology, the cumulative impacts are considered to not be unacceptable.

16.7. Coordinator-General's overall conclusions

I have reviewed the EIS and associated material, including the supplementary MNES report, and conclude that the proponent has adequately assessed the impacts of the project on the OUVs of the GBRWHA, TECs, threatened flora and fauna and migratory species listed under the EPBC Act. I am satisfied that the mitigation and management measures committed to by the proponent will ensure the project will not result in unacceptable impacts on MNES.

I note the proponent has made a number of commitments to avoid and mitigate impacts on OUV, TECs, threatened flora and fauna and migratory species. The proponent must fully implement all measures contained within its EM plans. I acknowledge that the impacts from the project to the OUVS of the GBRWHA and the EPBC-listed threatened flora and fauna are managed and acceptable.

I note the proponent's commitments to provide offsets for significant residual impacts to the water mouse and World Heritage OUVs.

17. Conclusion

The proponent is seeking approval for the possible ultimate development of its project involving four trains producing a total of 18 million tons per annum of LNG. The proponent states that construction of stage one comprising trains 1 and 2 is scheduled to commence in 2014 with first gas from train 1 planned for 2017. Train 2 is expected to enter operation six months later. Construction of stage two comprising trains 3 and 4 is anticipated to commence in 2022.

In undertaking my evaluation of the EIS, I have considered the following:

- the EIS and supplementary material prepared for this project
- submissions on the EIS and SEIS
- additional information provided on the project and its environmental assessment.

I am satisfied that the requirements of the SDPWO Act have been adequately met and that sufficient information has been provided to allow me to evaluate the potential impacts of the project, and the development of mitigation strategies and conditions of approval.

The environmental assessment commenced with the declaration of this project in June 2009 and has involved a comprehensive body of work by the proponent. More detailed work will occur in the detailed design phase of the project.

The potential impacts identified in the EIS documentation and submissions have been assessed. I consider that the mitigation measures proposed by the proponent and required by the conditions stated in this report would result in acceptable overall outcomes. Further, an offsets package will be further developed and considered to address any significant residual impacts.

The currency of this report will lapse three years after its date unless it is extended pursuant to section 35A of the SDPWO Act. In the absence of an extension, the report will lapse in September 2016 and if material change of use approvals for a subsequent train or trains have not been sought, a new application for coordinated project declaration under the SDPWO Act would be required to cover subsequent trains.

I am satisfied that the proponent has undertaken the necessary environmental investigations to identify the project impacts associated with up to four LNG trains. I note that further information and supporting documentation will need to be submitted to regulatory authorities regarding detailed design and logistics planning for the subsequent construction and operation of further trains.

The project is anticipated to provide a significant boost to industry in the Gladstone region and would further assist to deliver employment and economic activity in the region and state.

Accordingly, I approve that the project as described in this evaluation report proceed, subject to the conditions in appendices 1 and 2. In addition, I expect the proponent's commitments to be fully implemented as presented in the EIS documentation and summarised in Appendix 4 of this report.

To proceed further, the proponent will be required to:

- obtain the relevant development approvals under SPA
- finalise and implement the construction and operations environmental management plans
- finalise the environmental offsets requirements.

If there are any inconsistencies between the project (as described in the EIS documentation) and the conditions in this report, the conditions shall prevail.

A copy of this report will also be available on the Department of State Development, Infrastructure and Planning's website at **www.dsdip.qld.gov.au**

Appendix 1. Imposed conditions

This appendix includes conditions imposed by the Coordinator-General under section 54B of the SDPWO Act.[25] The conditions are relevant to applications for development approvals for those parts of the project where there is no relevant approval applicable under other legislation.

All of the conditions imposed in this appendix take effect from the date of this Coordinator-General's report.

These conditions do not relieve the proponent of the obligation to obtain all approvals and licences from all relevant authorities required under any other Act.

In accordance with section 54B(3) of the SDPWO Act, I have nominated an entity to have jurisdiction for the conditions in this schedule. The entity is shown in each condition.

Pursuant to section 54D of the SDPWO Act, these conditions apply to anyone who undertakes the project, such as the proponent and an agent, contractor, subcontractor or licensee of the proponent, and any public utility providers undertaking public utility works as a result of the project.

Condition 1. Social impacts

The Coordinator-General is to have jurisdiction for this condition.

(a) The proponent must provide an annual report to the Coordinator-General for a period of five years from the commencement of construction. The report should describe the actions, outcomes and adaptive management strategies:

  (i) to avoid, manage or mitigate project-related impacts on local and regional housing markets.

  (ii) to enhance local employment, training and development opportunities.

  (iii) to avoid, manage or mitigate project-related impacts on local community services, social infrastructure and community safety and wellbeing.

  (iv) to inform the community about project impacts and show that community concerns about project impacts have been taken into account when reaching decisions.

The annual report should also report on actions and management strategies addressing direct impacts arising from operational activities undertaken during the five year reporting period. It will be made publicly available on the Coordinator-General's website.

Condition 2. Offset plan

The Coordinator-General is to have jurisdiction for this condition.

(a) The proponent must prepare a site based offset plan to address significant residual impacts that are not covered by Commonwealth requirements.

[25] For a definition of 'imposed conditions', refer to the Glossary on page 294 of this report.

(b) The offset plan must be lodged with the Coordinator-General no later than 60 days after a Commonwealth decision on offsets to address MNES.

(c) The offset plan must be approved by the Coordinator-General.

(d) The approved offset plan must be implemented within one year of commencement of construction.

Appendix 2. Stated conditions

This appendix includes the Coordinator-General's stated conditions, stated under section 39, 45, 47C, 49, 49B and 49E of the SDPWO Act.[26]

Schedule 1.

Department of Environment and Heritage Protection (EHP)—Stated conditions for the Feed Gas Pipeline and LNG Facility under the EP Act

ADDITIONAL ADVICE ABOUT THE CONDITIONS

(1) This approval pursuant to the *Environmental Protection Act 1994* does not remove the need to obtain any additional approval for this activity, which might be required by other State and/or Commonwealth legislation. Other legislation for which a permit may be required includes but is not limited to the:

- (a) *Aboriginal Cultural Heritage Act 2003*
- (b) *Queensland Heritage Act 1992*
- (c) Contaminated land provisions of the *Environmental Protection Act 1994*
- (d) *Forestry Act 1959*
- (e) *Nature Conservation Act 1992*
- (f) *Water Act 2000*
- (g) *Water Supply (Safety and Reliability) Act 2008.*

Applicants are advised to check with all relevant statutory authorities and comply with all relevant legislation.

(2) These conditions do not authorise environmental harm unless a condition contained within explicitly authorises that harm. Where there is no condition, the lack of a condition shall not be construed as authorising harm.

(3) Terms defined in Schedule J are **bolded** in this document. Where a term is not defined, the definition in the *Environmental Protection Act 1994*, its regulations and Environmental Protection Policies, then the *Acts Interpretation Act 1954* then the Macquarie Dictionary then the *Petroleum and Gas (Production and Safety) Act 2004* or its regulation must be used in that order.

(4) These conditions do not authorise the taking of protected animals or the tampering with an animal breeding place as defined under the *Nature Conservation Act 1992* and its regulations.

(5) It is a requirement under the *Environmental Protection Act 1994* that if an owner or occupier of land becomes aware of a Notifiable Activity (as defined by Schedule 3 of the *Environmental Protection Act 1994)* is being carried out on the land or that the land has been affected by a hazardous contaminant, they must,

[26] For a definition of 'stated conditions', refer to the Glossary on page 294 of this report.

within 22 **business days** after becoming so aware, give notice to the Department of Environment and Heritage Protection.

(6) Separate to the requirements found in the conditions, the holder must also meet their obligations under the *Environmental Protection Act 1994*, and the regulations made under that Act. For example, the holder must comply with the following provisions of the Act:

(a) s319 – general environmental duty

(b) s440 – offence of causing environmental nuisance

(c) s440ZG – offence of depositing prescribed water contaminants in waters and related matters

(d) s443 – offence to place contaminant where environmental harm or nuisance may be caused

(7) The duty to notify of environmental harm is a requirement of the *Environmental Protection Act 1994* that applies to all persons. The duty to notify arises where a person carries out activities and becomes aware of the act of another person arising from or connected to those activities that causes or threatens serious or material environmental harm. For more information about the duty to notify, refer to Chapter 7, Division 2 of the *Environmental Protection Act 1994* and/or the guideline, *The Duty to Notify of Environmental Harm* (EM467), published by the Department of Environment and Heritage Protection.

(8) These conditions consists of the following schedules:

Schedule A – General

Schedule B – Air

Schedule C – Environmental Nuisance

Schedule D – Water

Schedule E – Waste

Schedule F – Land

Schedule G – Decommissioning and Rehabilitation

Schedule H – Monitoring and Reporting

Schedule I – Notification

Schedule J – Definitions

SCHEDULE A – GENERAL

Authorised Petroleum Activities

(A1) These conditions authorise the construction and operation of the petroleum activities specified as the Arrow LNG Feed Gas Pipeline, Arrow LNG Facility, ancillary work sites, **infrastructure** and environmentally relevant activities associated with the relevant petroleum authorities.

Contingency Plan for Emergency Environmental Incidents

(A2) A Contingency Plan for Emergency Environmental Incidents must be developed and implemented prior to the carrying out of the petroleum activity.

(A3) The Contingency Plan for Emergency Environmental Incidents must include but not necessarily be limited to:

(a) a clear definition of what constitutes an environmental emergency incident or near miss for the petroleum activity;

(b) identification of the types of environmental incidents that may occur, including but not limited to flooding impacts, relevant to the petroleum activity authorised to be carried out;

(c) response procedures to minimise the extent and duration of environmental harm caused by environmental emergency incidents;

(d) the resources to be used in response to environmental emergency incidents;

(e) procedures to avoid and/or minimise discharges resulting from any overtopping or loss of structural integrity of a dam;

(f) procedures to investigate the cause of any incidents including releases or near misses, and where necessary, the remedial actions to be implemented to reduce the likelihood of recurrence of similar events;

(g) the practices and procedures to be employed to restore the environment or mitigate any environmental harm caused;

(h) procedures for accessing monitoring locations during emergency environmental incidents;

(i) a receiving environment monitoring program (REMP), to be specifically implemented in the event of any unauthorised release to **waters** or land to examine and assess potential environmental impacts. For monitoring of **waters** and sediments, the REMP must include an adequate number of reference or control sites (unimpacted) and concern sites (impacted) to reliably account for the zone of influence of the release, and include monitoring procedures developed in accordance with the *Australian Guidelines for Water Quality Monitoring and Reporting* (ANZECC & ARMCANZ, 2000), the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality,* (ANZECC & ARMCANZ, 2000), the *Queensland Water Quality Guidelines* (Department of Environment and Resource Management (DERM) 2009), the *Monitoring and Sampling Manual* (DERM, 2009), the relevant Australian Standards, the relevant Australian and New Zealand Standards and any other relevant operational policy, technical guideline (e.g. *Wastewater release to Queensland waters* (DEHP, 2013) or procedural guideline **documents** produced by the **administering authority** or other relevant government departments or agencies;

(j) communication procedures and lines of communication within and beyond the organisation, including but not limited to Local Government, to be employed in responding to environmental emergency incidents;

(k) training of staff that will be called upon to respond to emergency

environmental incidents to enable them to respond effectively;

(l) timely and accurate reporting of the circumstance and nature of emergency environmental incidents to the **administering authority** and any affected landholder, occupier or their nominated representative in accordance with the conditions;

(m) notification of any air emission incident that has or has the potential for adverse impacts beyond the site boundary to the administering authority and other emergency services agencies within two (2) hours of the incident occurring;

(n) dispersion modelling to be implemented for any air emission incident that has or has the potential for adverse impacts beyond the site boundary, including the capacity to provide a report on the dispersion modelling to the **administering authority** and other emergency services agencies within twenty-four (24) hours of the incident occurring; and

(o) contingency plans for managing water used to fight fires to the extent that all firewater is managed so as to avoid environmental nuisance or material or serious environmental harm.

(A4) The Contingency Plan for Emergency Environmental Incidents must be reviewed at the following minimum frequency:

(a) on completion of any verification studies to incorporate any change to hazards identified, including any new or increased hazards identified;

(b) on any changes or alteration to processes or equipment that is likely to increase the risk of environmental nuisance or material or serious environmental harm from the petroleum activities;

(c) within twenty (20) **business days** of an event or an incident that has triggered the Contingency Plan for Emergency Environmental Incidents; and

(d) at least once every five (5) **years**.

Financial Assurance

(A5) Petroleum activities that will result in **significant disturbance to land** must not be carried out until **financial assurance** has been given in an amount and form acceptable to the **administering authority** as security for compliance with these conditions and any costs or expenses, or likely costs or expenses, as specified in section 298 of the *Environmental Protection Act 1994*.

(A6) Prior to any changes in petroleum activities which would result in an increase to the maximum disturbance since the last financial assurance calculation was submitted, a revised calculation must be submitted to the **administering authority** and the **administering authority** must have approved, an application to amend the financial assurance.

SCHEDULE B – AIR

General

(B1) The proponent must ensure that petroleum activities are undertaken in a way that minimises the release of contaminants to the atmosphere.

Contaminant Release to the Atmosphere

(B2) The sulfur content of any fuel burned must be less than 0.01% by mass.

(B3) Contaminants must not be directly or indirectly released to the atmosphere except at the release points specified in condition (B5).

(B4) Contaminant releases to air emitted from fuel burning and combustion equipment, capable of burning at least 500kg of fuel in an hour, must be directed vertically upwards without any impedance or hindrance.

(B5) The release of contaminants to the atmosphere from the following release points must be in accordance with the criteria specified in *Schedule B, Table 1 – Release of Contaminants to Air.*

Schedule B, Table 1 – Release of Contaminants to Air

Release Point(s)	Minimum release height (m)[27]	Minimum release velocity (ms^{-1})[28]	Minimum release temperature (^oC)[29]	Oxides of Nitrogen (as NO_2)	
				Maximum concentration release limit (mg/Nm^3)[30]	Maximum mass release limit (gs^{-1})[31]
Train 1 Compressor 1	52	15	200	52	8.7
Train 1 Compressor 2	52	15	200	52	8.7
Train 2 Compressor 1	52	15	200	52	8.7
Train 2 Compressor 2	52	15	200	52	8.7
Train 3 Compressor 1	52	15	200	52	8.7
Train 3 Compressor 2	52	15	200	52	8.7
Train 4 Compressor 1	52	15	200	52	8.7
Train 4 Compressor 2	52	15	200	52	8.7
Generator 1	39	15	520	52	3.4
Generator 2	39	15	520	52	3.4
Generator 3	39	15	520	52	3.4
Generator 4	39	15	520	52	3.4
Generator 5	39	15	520	52	3.4
Generator 6	39	15	520	52	3.4
Generator 7	39	15	520	52	3.4
LNG Facility Flare stack	119	-	-	-	-

[27] Minimum release height measured in metres relative to the **AHD**.
[28] Minimum release velocity measured at 100% maximum continuous rating (MCR) in metres per second.
[29] Minimum release temperature measured in degrees Celsius (^oC) at 100% MCR.
[30] Maximum concentration release measured in mg/Nm^3 at 0^oC and 101.3 kilopascals.
[31] Maximum mass release limit in grams per second (gs-1).

Note: All other contaminants than heat and oxides of nitrogen emitted from those release points must not cause environmental nuisance, or material or serious environmental harm.

(B6) A monitoring program must be conducted of the release of contaminants to the atmosphere at the release points specified in *Schedule B, Table 1 – Release of Contaminants to Air*, at a continuous frequency, except for the LNG Facility Flare.

(B7) Monitoring of the release of contaminants to the atmosphere from the release points specified in *Schedule B, Table 1 – Release of Contaminants to Air* must also include, but not necessarily be limited to:

(a) testing and sampling of the following:

(i) gas velocity, volume and mass flow rate;

(ii) contaminant concentration and mass emission rate;

(iii) temperature;

(iv) water vapour concentration;

(b) representative samples of the contaminants discharged when operating under maximum operating conditions; and

(c) the collection of production rate and plant status during sampling periods.

(B8) When requested in writing by the **administering authority**, any ambient air monitoring program must be contributed to and undertaken in consultation with the **administering authority**.

(B9) All reasonable and practicable measures must be taken to ensure that the **LNG Facility Flare** stack is designed, operated and maintained in a manner that minimises the release of contaminants to the atmosphere.

(B10) When requested by the administering authority, a site-wide Emissions Verification Study must be undertaken in consultation with the administering authority to quantify all point sources and fugitive emissions to the atmosphere from the petroleum activities.

SCHEDULE C – ENVIRONMENTAL NUISANCE

General

(C1) The proponent must ensure petroleum activities are undertaken in a way that minimises the occurrence of environmental nuisance at a **sensitive place**.

Odour, Dust and Other Airborne Nuisance

(C2) Petroleum activities must not cause environmental nuisance from dust, odour, light or smoke at a **sensitive place**, other than where an **alternative arrangement** is in place.

Nuisance Monitoring

(C3) When the **administering authority** provides advice of a **valid complaint** alleging nuisance other than noise, an investigation must be undertaken of the complaint and advise the **administering authority** in writing of the action proposed or undertaken to resolve the complaint.

(C4) When requested by the **administering authority**, monitoring must be undertaken as specified by the **administering authority**, within a reasonable and practical timeframe nominated by the **administering authority** to investigate any complaint of environmental harm at any **sensitive place**.

Noise

(C5) Other than where an **alternative arrangement** is in place, the emission of noise from the petroleum activities must not result in levels greater than those specified in *Schedule C, Table 1 – Construction Noise Limits* and *Schedule C, Table 2 – Operational Noise Limits* at a **sensitive place** in the event of a **valid complaint** about noise being made to the **administering authority**.

Schedule C, Table 1 – Construction Noise Limits[32]

Metric	**Monday to Sunday (including Public Holidays)**		
	7am to 6pm	6pm to 10pm	10pm to 7am
$L_{A\ eq,\ adj,\ 15mins}$	-	-	40dBA

Schedule C, Table 2 – Operational Noise Limits[33]

Metric	**Monday to Sunday (including Public Holidays)**		
	7am to 6pm	6pm to 10pm	10pm to 7am
$L_{A90,\ adj,\ 15mins}$	40dBA	40dBA	40dBA

(C6) If the noise subject to a **valid complaint** is tonal or **impulsive**, the adjustments detailed in *Schedule C, Table 3 – Adjustments to be Added to Noise Levels at Sensitive Places* are to be added to the measured noise level(s) to derive the relevant metric used in *Table 1 – Construction Noise Limits* and *Schedule C, Table 2 – Operational Noise Limits.*

[32] Construction noise limits apply to the construction, modification, maintenance and replacement of the petroleum activities.
[33] Operational noise limits apply to the use and operation of the petroleum activities.

Schedule C, Table 3 – Adjustments to be Added to Noise Levels

Noise Characteristic	Adjustment to Measured Noise Level
Tonal characteristic is just audible	+ 2dBA
Tonal characteristic is clearly audible	+ 5dBA
Impulsive characteristic is just audible	+ 2dBA
Impulsive characteristic is clearly audibly	+ 5dBA

Low Frequency Noise

(C7) Notwithstanding (C6), the emission of any noise below 315Hz must not exceed 60dB(C) when measured outside the sensitive receptor in the event of a **valid complaint** being made to the **administering authority**.

Underwater Noise Impacts

(C8) Any pile driving activities undertaken when the pile is partly submerged in tidal **waters** must be undertaken in the following way:

(a) underwater noise impacts to dolphins, dugongs and turtles must be minimised to the greatest extent practicable;

(b) underwater noise tests should be conducted for each specific piling rig prior to commencing operation to determine the distance from the rig at which the underwater noise level reduces to 183 dB (referenced to **1uPa**). That distance will be the observation distance;

(c) in the absence of underwater noise tests for each specific piling rig, the observation distance must be at least 500m from the pile driving works site;

(d) piling may only commence following an initial 30 minute observation period during which no dolphins, dugongs and turtles are sighted by an **appropriately qualified person** within the observation distance (referenced C8 (c) or (d)) of the pile driving works site;

(e) if during piling a sighting is made within the observation distance, piling must stop and not recommence until a 10 minute period has passed since any dolphin, dugong or turtle was last seen by an **appropriately qualified person** within the observation distance of the pile driving work site; and

(f) underwater noise from pile driving must be recorded at a distance not greater than 500m from the pile driving work site, and continually monitored to ensure that noise is below acceptable limits as specified in an underwater noise management plan. If the noise is recorded above 183 dB (referenced to **1uPa**), pile driving must cease until a revised observation distance is implemented in accordance with C8(c).

Noise Monitoring

(C9) All noise monitoring and recording required under these conditions must include, but not necessarily be limited to:

(a) $L_{AN,T}$;

(b) $L_{Aeq, adj, 15 mins}$;

(c) background noise level as $L_{A90, 15 mins}$;

(d) Max $Lp_{A, 15 mins}$;

(e) the level and frequency of occurrence of impulsive or tonal noise and any adjustment and penalties to measured noise levels;

(f) atmospheric conditions including temperature, relative humidity and wind speed and directions;

(g) effects due to any extraneous factors such as traffic noise;

(h) location, date and time of monitoring;

(i) if the complaint concerns low frequency noise, Max $Lp_{Z, 15 mins}$;

(j) if the complaint concerns low frequency noise, one third octave band measurements in dB(LIN) for centre frequencies in the 10–200Hz range for both the noise source and the background noise in the absence of the noise source; and

(k) underwater sound level pressure level during pile driving activities as dB (referenced to 1µPa).

Blasting and Vibration

(C10) Emission of noise during blasting operations associated with the petroleum activities must not exceed the following limits when measured at or extrapolated to any **sensitive place**:

(a) airblast overpressure level of 120dB (linear peak) for one out of the maximum 10 blasts per day; and

(b) the 9 other blasts per day not exceeding an airblast overpressure level of 115dB (linear peak) at any time.

(C11) Ground-borne vibration peak particle velocity caused by blasting operations must not exceed 10 mm/s at any time, when measured at or extrapolated to any **sensitive place**.

Blast and Vibration Monitoring

(C12) Monitoring and recording of the air blast overpressure and ground borne vibration of every blast must be undertaken.

(C13) Blast and vibration monitoring must include but not necessarily be limited to:

(a) maximum instantaneous charge;

(b) location of the blast within the site (including any bench level);

(c) airblast overpressure level (dB Linear Peak);

(d) peak particle velocity (mm/s);

(e) location, date and time of recording;

(f) measurement instrumentation and procedure;

(g) meteorological conditions for blast monitoring (including temperature, relative humidity, temperature gradient, cloud cover, wind speed and direction); and

(h) distance from the blast site(s) to potentially affected **sensitive places**.

SCHEDULE D – WATER

General

(D1) The proponent must ensure that petroleum activities are undertaken in a way that:

(a) prevents and/or minimises the release of contaminants to **waters**;

(b) does not cause an adverse impact on the quality of any receiving **water(s)**; and

(c) does not cause an adverse impact on the **species richness** and **species diversity** of aquatic fauna and flora within any receiving water(s).

Erosion and Sediment Control

(D2) The petroleum activities must not cause the release of sediment-laden water to **waters**, except where authorised by conditions (D3) and (D5).

Dredging

(D3) Notwithstanding condition (D1), the petroleum activities that involve dredging must comply with:

(a) the outcome of a risk assessment determined in accordance with the *National Assessment Guidelines for Dredging* (DEWHA, 2009); and

(b) if **acid sulfate soil** or potential **acid sulfate soil** sediments have been identified and will be disposed of to land, as per the *Draft Guidelines for the Assessment and Management of Contaminated Land in Queensland* (EPA, 1998).

(D4) Dredging associated with the petroleum activities must:

(a) cease if the **14-day rolling average Benthic PAR** level at a monitoring site used in the monitoring required by (D7) falls below 6mol/m^2/day for more than seven continuous days at that site; and

(b) not recommence until the **14-day rolling average Benthic PAR** level at all monitoring sites used in the monitoring required by (D7) is more than or equal to 6mol/m^2/day.

Limit of Dredging Approved

(D5) Dredging activities which constitute environmentally relevant activity (ERA) 16(1)(d)) are limited to:

(a) the removal of up to XX cubic metres of dredge material from areas within the relevant petroleum authorities as shown in Map X;

(b) placement of dredge spoil at XX location as shown on Map X;

(c) placement of dredge material at XX location, as shown in Map X.

Receiving Environment Monitoring Program (REMP)

(D6) A REMP must be developed and implemented to monitor, identify and describe any adverse impacts to surface water quality, water flows and aquatic fauna and flora of any receiving waters due to the petroleum activity.

(D7) The REMP must include periodic monitoring for the effects of any release on the receiving environment (under natural flow conditions) as a result of contaminant releases to **waters** from the site.

(D8) The REMP must:

(a) assess the condition or state of receiving **waters**, including upstream conditions, spatially within the REMP area, considering background water quality characteristics based on accurate and reliable monitoring data that takes into consideration temporal variation (e.g. seasonality);

(b) be designed to facilitate assessment against water quality objectives for the relevant environmental values that need to be protected;

(c) detail monitoring locations and water quality indicators pertinent to the sensitive receptor types and locations that has been designed to:

(i) determine the baseline condition of water quality and sensitive receptors (i.e., corals and seagrass meadows) within the zone of influence to a sufficient resolution to be capable of reliably detecting lethal and sublethal (stress) impacts;

(ii) develop or adopt locally-relevant trigger values for key water quality indicators including turbidity;

(iii) provide on-line real-time monitoring capability for key sediment plume-related indicators (i.e., turbidity);

(d) specify the frequency and timing of sampling required in order to reliably assess ambient conditions and to provide sufficient data to derive site specific background reference values in accordance with the *Queensland Water Quality Guidelines* (DERM, 2009);

(e) include, where appropriate, monitoring of metals/metalloids in sediments (in accordance with ANZECC & ARMCANZ 2000, BATLEY and/or the most recent version of **Australian Standard 5667.1**);

(f) apply procedures and/or guidelines from ANZECC and ARMCANZ 2000 and other relevant guideline **documents**; and

(g) describe sampling and analysis methods and quality assurance and control.

SCHEDULE E – WASTE

General

(E1) The proponent must ensure that petroleum activities are undertaken in a way that ensures that waste is managed appropriately.

Waste Management

(E2) Measures must be implemented so that all wastes are managed in accordance with the **waste and resource management hierarchy** and the **waste and resource management principles**.

(E3) Waste, including waste fluids, must be transported off-site for lawful reuse, remediation, recycling or disposal, unless otherwise authorised by these conditions.

Acid Sulfate Soils

(E4) **Acid sulfate soils** or potential **acid sulfate soils** encountered while undertaking the petroleum activities must be managed in accordance with the Queensland Government's *Instructions for the Treatment and management of acid sulfate soils, 2001* or a later version as it becomes available.

SCHEDULE F – LAND

General

(F1) The proponent must ensure that petroleum activities are undertaken in a way that:

(a) minimises any adverse impacts to the functioning and biodiversity of ecosystems to the greatest extent possible; and

(b) minimises any adverse impacts to soil structure and soil quality to the greatest extent possible.

Structures that are Dams or Levees

(F2) All **dams** or **levees** must be designed, constructed, operated and maintained to an **accepted engineering standard** appropriate to the nature of the contents of the dam

Note: Information in relation to the design, construction, operation and maintenance of dams or levees is outlined in the latest version of the Queensland Government Manual for Assessing Hazard Categories and Hydraulic Performance of Dams.

(F3) All **dams** or **levees** must be designed, constructed, operated and maintained to an **accepted engineering standard** appropriate for the environment in which it is located.

(F4) All **dams** or **levees** must be designed, constructed, operated and maintained to an **accepted engineering standard** appropriate for the use.

(F5) The construction, operation, maintenance and modification of all **dams** or **levees** must result in the containment of contaminants except as permitted by condition (D1).

(F6) The details of all **dams** or **levees** must be entered into a Register of Regulated Dams in the approved form.

(F7) All **dams** or **levees** and their construction and operation must be monitored for early signs of loss of structural or hydraulic integrity.

(F8) The **decommissioning** of all **dams** or **levees** must result in the removal of all contaminants or the secure encapsulation of all contaminants in perpetuity.

SCHEDULE G – DECOMMISSIONING AND REHABILITATION

General

(G1) The proponent must ensure that the land affected by the petroleum activities, including temporary work areas associated with the petroleum activities is **decommissioned** and **rehabilitated** in a way that:

(a) prevents and/or minimises any adverse impacts to environmental values to the greatest extent possible; and

(b) in accordance with agreed rehabilitation success criteria.

Pipeline Reinstatement and Revegetation

(G2) Pipeline trenches must be backfilled and topsoils **reinstated** within three (3) **months** after pipe laying.

(G3) **Reinstatement** and **revegetation** of the pipeline right of way must commence within six (6) **months** after completion of petroleum activities for the purpose of pipeline construction.

(G4) Backfilled, reinstated and **revegetated** pipeline trenches and right of way must be:

(a) a **stable** landform;

(b) re-profiled to a level consistent with surrounding soils;

(c) re-profiled to original contours and established **drainage lines**; and

(d) vegetated with groundcover which is not a **declared pest species**, and which is established and self-sustaining.

Rehabilitation – General

(G5) **Significantly disturbed areas** that are no longer required for the ongoing conduct of the petroleum activities must be progressively rehabilitated within six (6) **months** (unless an exceptional circumstance in the area to be rehabilitated (e.g. a flood event) prevents this timeframe being met) so that:

(a) the areas are reshaped to a **stable** landform;

(b) the areas are re-profiled to contours consistent with the surrounding landform;

(c) surface **drainage lines** are re-established; and

(d) **top soil** is reinstated.

(G6) All **significantly disturbed land** caused by the carrying out of the petroleum activity must be rehabilitated to meet condition (G1) and the following final acceptance criteria:

(a) For all land use(s):

(i) any contaminated land (e.g. contaminated soils) is remediated and rehabilitated;

(ii) **rehabilitation** is undertaken in a manner such that any actual or potential **acid sulfate soils** on the area of significant disturbance are treated to prevent or minimise environmental harm in accordance with the Queensland Government's *Instructions for the Treatment and management of acid sulfate soils, 2001* or a later version as it becomes available.

(iii) all **significantly disturbed land** is reinstated to the pre-disturbed soil suitability class;

(iv) the landform is safe for humans and fauna;

(v) the landform is **stable** with no subsidence or erosion gullies for at least three (3) **years**;

(vi) there is no ongoing contamination to **waters**;

(vii) the maintenance requirements for rehabilitated land is no greater than that required for the land prior to its disturbance caused by carrying out the petroleum activity;

(b) Additional requirements for sites that are being reinstated to native ecosystems:

(i) groundcover, that is not a **declared pest species** is established and self-sustaining; and

(ii) vegetation of similar **species richness** and **species diversity** to pre-selected **analogue sites** is established and self-sustaining.

(G7) Monitoring of performance indicators must be carried out on **rehabilitation** activities until final acceptance criteria in (G6) have been met for the rehabilitated area.

SCHEDULE H – MONITORING AND REPORTING

General

(H1) The proponent must ensure that the monitoring of environmental impacts of the petroleum activities is undertaken.

(H2) All **documents** required by these conditions must be kept for a minimum of five (5) **years**.

Monitoring

(H3) An **appropriately qualified person**(s) must monitor, interpret and record all parameters that are required to be monitored by these conditions.

(H4) Monitoring undertaken must be in accordance with the following guidelines where relevant:

(a) water sampling required by these conditions must comply with the methods set out in the *Queensland Monitoring and Sampling Manual*;

(b) groundwater sampling required by these conditions must comply with the Australian Government's *Groundwater Sampling and Analysis – A Field Guide* (2009:27 GeoCat #6890.1);

(c) noise must be measured in accordance with the prescribed standards in the Environmental Protection Regulation 2008; and

(d) the measurement of ambient air quality or point source contaminant releases to air must comply with the *Queensland Air Quality Sampling Manual* and/or **Australian Standard 4323**, whichever is appropriate for the relevant measurement.

(H5) All laboratory analyses and tests required to be conducted under these conditions must be carried out by a laboratory that has **NATA accreditation** for such analyses and tests, except as otherwise authorised by the **administering authority**.

Reporting

(H6) The annual return must include an update report detailing activities during the annual return period, including:

(a) significant disturbance during the period;

(b) rehabilitation undertaken;

(c) a list of all valid complaints made including the date, source, reason for the complaint and a description of investigations undertaken in resolving the complaint; and

(d) an annual monitoring report for all monitoring required under these conditions that includes, but is not necessarily limited to:

(i) the date on which each sample was taken;

(ii) the time at which the sample was taken;

(iii) the monitoring point at which the sample was taken;

(iv) a summary of the previous twelve (12) **months** monitoring results obtained under any monitoring programs required under these conditions;

(v) a comparison of the previous twelve (12) **months** monitoring results to both the limits set in these conditions and to relevant prior results;

(vi) the results of all monitoring and details of any exceedences with the conditions and the dates and times these exceedences were reported to the **administering authority**;

(vii) an evaluation/explanation of the data derived from any monitoring programs;

(viii) data analyses and interpretation to assess the nature and extent of any contamination and, if so, the level of environmental harm caused as a result of the contamination and the environmentally relevant activity; and

(ix) an outline of actions taken or proposed to minimise the risk of environmental harm from any condition or elevated contaminant level identified by the monitoring or recording programs; and

(x) a summary of the record of equipment failures or events recorded for any site under these conditions that resulted in notification being given under conditions (I1) or (I2).

Third Party Audit

(H7) Notwithstanding the annual return reporting requirements of condition (H6), a third party auditor must audit compliance with the conditions of these conditions at least at the following frequency:

(a) within six (6) **months** of the commencement of petroleum activities of the project;

(b) every two (2) **years** during the construction of **infrastructure** of the project;

(c) every three (3) **years** during the operation of the petroleum activities; and

(d) following the **decommissioning** and **rehabilitation** of the project.

(H8) An audit report must be prepared and certified by the third party auditor presenting the findings of each audit carried out.

(H9) A copy of the audit report must be provided to the **administering authority** no later than twenty (20) **business days** from completion of the third party audit.

SCHEDULE I – NOTIFICATION

(I1) The **administering authority** and any affected landholder, occupier or their nominated representative must be notified as soon as practicable, but within 24 hours after becoming aware of:

(a) any release of contaminants not in accordance with these conditions; or

(b) any event where unauthorised environmental harm has been caused or may be caused.

Note: Notification of any emergency or incident which occurs outside of normal business hours must be notified through the administering authority's pollution

hotline (Telephone 1300 130 372) where notification to the relevant regional office cannot occur.

(I2) Subject to condition (I1), spills of contaminants of the following volumes or kind must be reported:

(a) releases of any volume of contaminants to water not authorised by these conditions;

(b) releases of volumes greater than 200 litres of hydrocarbons to land; and

(c) releases of any volumes of contaminants where potential serious or material environmental harm has occurred or may occur.

(I3) The notification of emergencies or incidents as required by conditions (I1) and (I2) must include but not be limited to the following information:

(a) the environmental authority for the authorised petroleum activities number and name of the holder;

(b) the tenure type and number where the emergency or incident;

(c) the name and telephone number of the designated contact person;

(d) the location of the emergency or incident;

(e) the date and time that the emergency or incident occurred;

(f) the date and time the holder of the environmental authority for the authorised petroleum activities became aware of the emergency or incident;

(g) details of the nature of the event and the circumstances in which it occurred;

(h) the estimated quantity and type of any contaminants involved in the incident;

(i) the actual or potential suspected cause of the emergency or incident;

(j) a description of the land and/or waterway use at the site of the emergency or incident (e.g. grazing, pasture, forest, etc.) and/or the name of any relevant surface **waters** and other environmentally sensitive features;

(k) a description of the possible impacts from the emergency or incident;

(l) a description of whether stock and/or wildlife were exposed to any contaminants released and measures taken to prevent access for the duration of the emergency or incident;

(m) any sampling conducted or proposed, relevant to the emergency or incident;

(n) landholder details and details of landholder consultation;

(o) immediate actions taken to control the impacts of the emergency or incident and how environmental harm was mitigated any immediate environmental harm caused at the time of the emergency or incident by

the release; and

(p) whether further examination or root cause analysis is required and if so, the expected date by when this work will be completed and reported to the **administering authority**.

(I4) Within ten (10) **business days** following the initial notification of an emergency or incident or receipt of monitoring results or completion of the examination/root cause analysis, whichever is the later, a written report must be provided to the **administering authority**, including the following (where relevant to the emergency or incident):

(a) the root cause of the emergency or incident the confirmed quantities and types of any contaminants involved in the incident;

(b) results and interpretation of any analysis of samples taken at the time of the emergency or incident;

(c) a final assessment of the impacts from the emergency or incident including any actual or potential environmental harm that has occurred or may occur in the longer term as a result of the release;

(d) the success or otherwise of actions taken at the time of the incident to prevent or minimise environmental harm;

(e) results and current status of landholder consultation, including commitment to resolve any outstanding issues or concerns; and

(f) actions and/or procedural changes to prevent a recurrence of the emergency or incident.

(I5) As soon as practicable, but not more than six (6) weeks following the conduct of any environmental monitoring performed in relation to the emergency or incident, which results in the release of contaminants not in accordance, or reasonably expected to be not in accordance with the conditions of this authority, written advice must be provided of the results of any such monitoring performed to the **administering authority**.

SCHEDULE J – DEFINITIONS

1µPa means one-millionth of a Pascal.

14-day rolling average Benthic PAR means the mean total daily Benthic PAR calculated over a 14-day period, or if data is unavailable for less than 24-hours at a monitoring site specified in *Schedule B – Table 2a: Monitoring of Photosynthetically Active Radiation (PAR) at Receiving Water*, the mean total daily Benthic PAR calculated over a 14-day period which includes a replicate of the total daily Benthic PAR from the 24-hour period immediately preceding the period of the missing data.

accepted engineering standards, in relation to dams, means those standards of design, construction, operation and maintenance that are broadly accepted within the profession of engineering as being good practice for the purpose and application being considered. In the case of dams, the most relevant **documents** would be publications of the *Australian National Committee on Large Dams* (ANCOLD), guidelines published

by Queensland Government departments and relevant Australian and New Zealand Standards.

acid sulfate soils means soil or sediment containing highly acidic soil horizons or layers affected by the oxidation of iron sulfides (actual acid sulfate soils) and/or soil or sediment containing iron sulfides or other sulfidic material that has not been exposed to air and oxidised (potential acid sulfate soils). The term acid sulfate soil generally includes both actual and potential acid sulfate soils. Actual and potential acid sulfate soils are often found in the same soil profile, with actual acid sulfate soils generally overlying potential acid sulfate soil horizons.

administering authority means:

(a) for a matter, the administration and enforcement of which has been devolved to a local government under section 514 of the *Environmental Protection Act 1994* – the local government; or

(b) for all other matters – the Chief Executive of the Department of Environment and Heritage Protection; or

(c) another State Government Department, Authority, Storage Operator, Board or Trust, whose role is to administer provisions under other enacted legislation.

AHD means Australian Height Datum and is the datum used for the determination of elevations in Australia. The determination uses a national network of benchmarks and tide gauges and sets mean sea level at zero elevation.

alternative arrangement means a written agreement about the way in which a particular nuisance impact will be dealt with at a **sensitive place**, and may include an agreed period of time for which the arrangement is in place. An **alternative arrangement** may include, but is not limited to, a range of nuisance abatement measures to be installed at the **sensitive place**, or provision of alternative accommodation for the duration of the relevant nuisance impact.

analogue site means an area of land which contains values and characteristics representative of an area to be rehabilitated prior to disturbance. Such values must encompass land use, topographic, soil, vegetation and other ecological characteristics. Analogue sites can be the pre-disturbed site of interest where significant surveying effort has been undertaken to establish benchmark parameters such as the ground truthing assessment which may be required under these conditions.

appropriately qualified person(s) means a person or persons who has professional qualifications, training, skills or experience relevant to the nominated subject matter and can give authoritative assessment, advice and analysis to performance relative to the subject matter using the relevant protocols, standards, methods or literature.

Australian Standard 2885 means Australian Standard 2885.0:2008 *Pipelines – Gas and Liquid Petroleum General Requirements*, Australian Standard 2885.1:2007 *Pipelines – Gas and Liquid Petroleum Design and Construction* and Australian Standard 2885.3:2001 *Pipelines – Gas and Liquid Petroleum Operation and Maintenance*, or any updated versions that become available from time to time.

Australian Standard 4323 means Australian Standard 4323.1:1995 Stationary source emissions method 1: Selection of sampling positions.

Australian / New Zealand Standard 5667.12 means Australian / New Zealand Standard 5667.12:1999 Guidance on Sampling of Bottom Sediments for permanent, semi-permanent water holes and water storages.

background noise level or **bg** means the sound pressure level, measured in the absence of the noise under investigation, as the $\mathbf{L_{A90,T}}$ being the A-weighted sound pressure level exceeded for 90% of the measurement time period T of not less than 15 minutes, using Fast response.

bed and banks for a watercourse or wetland means land over which the water of the watercourse or wetland normally flows or that is normally covered by the water, whether permanently or intermittently; but does not include land adjoining or adjacent to the **bed or banks** that is from time to time covered by floodwater.

business day has the meaning in the *Acts Interpretation Act 1954* and means a day that is not—

- a Saturday or Sunday; or
- a public holiday, special holiday or bank holiday in the place in which any relevant act is to be or may be done.

clearing for vegetation means removing, cutting down, ringbarking, pushing over, poisoning or destroying in any way including by burning, flooding or draining; but does not include destroying standing vegetation by stock, or **lopping** a tree.

concern site is a monitoring site where there is the potential for an impact to occur as a direct or indirect result of the activity, e.g., as a result of an authorised controlled or unauthorised uncontrolled wastewater discharge.

control site is a monitoring site that is not directly impacted by the authorised controlled discharge from the activity, but may be influenced by other anthropogenic activities in the vicinity, and which does not strictly adhere to the definition of a 'reference site' as provided by key guidance **documents** (e.g. in relation to wastewater discharge to **waters**, the *Queensland Water Quality Guidelines* (DERM, 2009) or the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC & ARMCANZ – NWQMS, 2000).

dam means a land-based **structure** or a void that is designed to contain, divert or control flowable substances, and includes any substances that are thereby contained, diverted or controlled by that land-based **structure** or void and associated works. A **dam** does not mean a fabricated or manufactured tank or container, designed and constructed to an Australian Standard that deals with strength and structural integrity of that tank or container.

dB(LIN) means unweighted decibels.

decommissioning in relation to pipelines means the actions undertaken in accordance with the requirements of **Australian Standard 2885**, as amended from time to time, to prepare the pipeline and peripheral facilities for pending suspension or abandonment.

declared pest species has the meaning in the Land Protection (Pest and Stock Route Management) Regulation 2003 and is a live animal or plant declared to be a declared pest under section 36 (Declaring Pests by Regulation) or section 37(2) (Declaring Pest under Emergency Pest Notice) of that Act and includes reproductive material of the animal or plant.

document has the meaning in the *Acts Interpretation Act 1954* and means:

- any paper or other material on which there is writing; and
- any paper or other material on which there are marks; and
- figures, symbols or perforations having a meaning for a person qualified to interpret them; and
- any disc, tape or other article or any material from which sounds, images, writings or messages are capable of being produced or reproduced (with or without the aid of another article or device).

drainage lines means diversion drains, channels, batter chutes and any other feature conveying concentrated storm flows. This excludes sediment basin spillways.

financial assurance means financial assurance given for the

authority under Chapter 5, Part 12, Division 2 of the *Environmental Protection Act 1994*.

flowable substance means matter or a mixture of materials which can flow under any conditions potentially affecting that substance. Constituents of a **flowable substance** can include water, other liquids fluids or solids, or a mixture that includes water and any other liquids fluids or solids either in solution or suspension.

foreseeable future means the period used for assessing the total probability of an event occurring. Permanent structures and ecological sustainability should be expected to still exist at the **end** of a 150 year **foreseeable future** with an acceptably low probability of failure before that time.

impulsive noise means sound characterised by brief excursions of sound pressure (acoustic impulses) that significantly exceed the background sound pressure. The duration of a single impulsive sound is usually less than one second.

infrastructure means plant or works including for example, communication systems, compressors, powerlines, pumping stations, reservoirs, roads and tracks, water storage dams, evaporation or storage ponds and tanks, equipment, buildings and other structures built for the purpose and duration of the conduct of the petroleum activity including temporary structures or structures of an industrial or technical nature, including, for example, mobile and temporary camps. Infrastructure does not include other facilities required for the long term management of the impact of those petroleum activities or the protection of potential resources. Such other facilities include dams other than water storage dams, pipelines and assets, that have been decommissioned, rehabilitated, and lawfully recognised as being subject to subsequent transfer with ownership of the land.

$L_{Aeq, adj, 15 mins}$ means the A-weighted sound pressure level of a continuous steady sound, adjusted for tonal character, that within any 15 minute period has the same square sound pressure as a sound level that varies with time.

$L_{A90, adj, 15 mins}$ means the A-weighted sound pressure level, adjusted for tonal character that is equal to or exceeded for 90% of any 15 minutes sample period equal, using Fast response.

$L_{AN, adj, T}$ means the A-weighted sound pressure level, adjusted for tonal character, that is equal to or exceeded for 1%, 10% and 90% of any 15 minutes sample period equal using fast response.

leachate means a liquid that has passed through or emerged from, or is likely to have passed through or emerged from, a material stored, processed or disposed of on-site which contains soluble, suspended or miscible contaminants likely to have been derived from the said material.

levee means a dyke or bund that is designed only to provide for the containment and diversion of stormwater or flood flows from a contributing catchment, or containment and diversion of flowable materials resulting from unplanned releases from other works of **infrastructure**, during the progress of those stormwater or flood flows or those unplanned releases; and does not store any significant volume of water or **flowable substances** at any other times.

LNG facility flare means the flare to be used at the LNG Facility only during:

- unscheduled plant upsets occurring as a result of equipment malfunction and process upset; or
- scheduled shutdowns.

lopping a tree, means cutting or pruning its branches, but does not include—

- removing its trunk; and
- cutting or pruning its branches so severely that it is likely to die.

Max $L_{pA, 15 min}$ means the absolute maximum instantaneous A-weighted sound pressure level, measured over 15 minutes.

Max $L_{pZ, 15 min}$ means the maximum value of the Z-weighted sound pressure level measured over 15 minutes.

month has the meaning in the *Acts Interpretation Act 1954* and means a calendar **month** and is a period starting at the beginning of any day of one (1) of the 12 named **months** and ending—

- immediately before the beginning of the corresponding day of the next named **month**; or
- if there is no such corresponding day—at the end of the next named **month**.

NATA accreditation means accreditation by the National Association of Testing Authorities Australia.

pest means species:

- declared under the Land Protection (Pest and Stock route Management) Act 2002;

- declared under Local Government model local laws; and
- which may become invasive in the future.

PAR means photosynthetically active radiation and is measured as mol/m^2/day.

pre-disturbed areas means areas where environmental values have been negatively impacted as a result of anthropogenic activity and these impacts are still evident. Areas of pre-disturbance may include areas where legal clearing, logging, timber harvesting, or grazing activities have previously occurred, where high densities of weed or **pest** species are present which have inhibited re-colonisation of native regrowth, or where there is existing **infrastructure** (regardless of whether the **infrastructure** is associated with the petroleum activities). The term 'areas of pre-disturbance' does not include areas that have been impacted by wildfire/s, controlled burning, flood or natural vegetation die-back.

rehabilitation means the process of reshaping and revegetating land to restore it to a **stable** landform and in accordance with the acceptance criteria set out in these conditions and, where relevant, includes remediation of contaminated land.

sensitive place means:

- a dwelling (including residential allotment, mobile home or caravan park, residential marina or other residential premises, motel, hotel or hostel; or
- a library, childcare centre, kindergarten, school, university or other educational institution;
- a medical centre, surgery or hospital; or
- a protected area; or
- a public park or garden that is open to the public (whether or not on payment of money) for use other than for sport or organised entertainment; or
- a work place used as an office or for business or commercial purposes, which is not part of the petroleum activity and does not include employees accommodation or public roads; and
- for noise, a place defined as a sensitive receptor for the purposes of the Environmental Protection (Noise) Policy 2008.

significantly disturbed land or **significant disturbance to land or significant disturbance** means disturbance to land as defined in section 28 of the *Environmental Protection Regulation 2008*.

species richness means the number of different species in a given area.

species diversity means the diversity within an ecological community that incorporates both species richness and the evenness of species' abundances.

spring means the land to which water rises naturally from below the ground and the land over which the water then flows.

stable in relation to land, means landform dimensions are or will be **stable** within **tolerable limits** now and in the **foreseeable future**. Stability includes consideration of geotechnical stability, settlement and consolidation allowances, bearing capacity

(trafficability), erosion resistance and geochemical stability with respect to seepage, **leachate** and related contaminant generation.

structure means a **dam** or **levee**.

third party auditor means an **appropriately qualified person** who is either a certified third party auditor or an internal auditor employed by the holder of the environmental authority for the authorised petroleum activities and the person is independent of the day to day management and operation of the petroleum activities covered by these conditions.

tolerable limits means a range of parameters regarded as being sufficient to meet the objective of protecting relevant environmental values (e.g. a range of settlement for a tailings capping, rather than a single value, could still meet the objective of draining the cap quickly, preventing damage and limiting infiltration and percolation).

valid complaint means a complaint the **administering authority** considers is not frivolous, nor vexatious, nor based on mistaken belief.

waste and resource management hierarchy has the meaning provided in section 9 of the *Waste Reduction and Recycling Act 2011*.

waste and resource management principles has the meaning provided in section 4(2)(b) of the *Waste Reduction and Recycling Act 2011*.

waters includes all or any part of a creek, river, stream, lake, lagoon, swamp, wetland, **spring**, unconfined surface water, unconfined water in natural or artificial watercourses, **bed and bank** of any **waters**, non-tidal or tidal **waters** (including the sea), stormwater channel, stormwater drain, roadside gutter, stormwater run-off, and underground water.

watercourse has the meaning provided in Schedule 12, section 8 of the Environmental Protection Regulation 2008 and means a river, creek or stream in which water flows permanently or intermittently—

(a) in a natural channel, whether artificially improved or not; or

(b) in an artificial channel that has changed the course of the watercourse.

A watercourse includes the **bed and banks** and any other element of a river, creek or stream confining or containing water.

year means a period of 12 **months**.

Schedule 2.

Department of Justice and Attorney-General—Stated conditions for the major hazard facility under the Work Health and Safety Act and Regulation 2011

Condition 1. Major hazard facility

Prior to the commencement of project construction and to ensure that identified risks associated with a major hazard facility (MHF) will not exceed acceptable limits, the proponent will ensure the plant design meets the risk criteria outlined in Module 13 major hazard facilities (State development assessment provisions 21 June 2013). The plant must be constructed, operated, and decommissioned in such a way that the risk criteria are met at all times and risks to health and persons are minimised.

The Coordinator-General—Stated conditions that apply for any MCU in the GSDA under the *State Development and Public Works Organisation Act 1971*

Condition 2. Visual impact of construction and operation

Minimise the impacts of the construction and operation of the LNG facility by:

(a) ensuring the colour scheme of the LNG facility and other built structures on site is selected from the palette of predominant colours found in the locality to minimise the visual intrusion of the structures and except for the LNG storage tanks and where plant operability could be impacted or health and safety requirements dictate colours

(b) minimising clearing

(c) ensuring stabilisation and rehabilitation works on disturbed areas, not intended for future construction, are completed within twelve months of commissioning of each train

(d) maintaining the integrity of the land and navigational systems, minimising light spill and avoiding direct views of lights from outside the LNG facility boundary.

Condition 3. Marine traffic impacts

To minimise marine traffic impacts on the efficient and safe use of Gladstone Harbour, construction and operational workers must not use any personal motor vehicle or personal water craft, to access the LNG facility site, unless authorised in writing by the Port of Gladstone Harbour Master. Where approval has been issued a copy of that approval must be kept with the vehicle or water craft at all times.

Condition 4. Decommissioning

Decommissioning of the construction workforce accommodation must be undertaken in accordance with a decommissioning plan prepared by the proponent and approved by the Coordinator-General. The decommissioning plan *must include a rehabilitation plan for the construction workforce accommodation site* and be submitted to the Coordinator-General at the date of the commissioning of Train 1. The decommissioning plan must contain an updated project schedule detailing the construction timetable for

subsequent trains up to 4 trains. The Coordinator-General may require the decommissioning of the construction workforce accommodation following the construction of Train 1 if the proponent's construction timetable for subsequent trains is delayed significantly from the timing outlined in the EIS.

Appendix 3. Coordinator-General's recommendations

This appendix includes recommendations made under section 35(4) of the SDPWO Act. The recommendations relate to the applications for development approvals for the project

While the recommendations guide the assessment managers in assessing the development applications, they do not limit their ability to seek additional information, or power to impose conditions on any approval required for the project.

Schedule 1. Recommendations under the *Transport Infrastructure Act 1994*

Recommendation 1. Pre-construction roadworks

In accordance with the agreed schedule of works between the proponent and DTMR, the construction of required road works must be completed prior to the commencement of significant construction[34] works for the project. Commencement of significant construction works is to be confirmed in writing by the proponent with DTMR Central Queensland (Rockhampton) Regional Office.

The Department of Transport and Main Roads (DTMR) is designated as the agency responsible for this recommendation.

[34] Significant construction works: Works associated with major above ground construction of industrial plant and equipment such as LNG plant processing components and the LNG export jetty. Site access works, land clearing and bulk earthworks are not included.

Schedule 2. General recommendations

The recommendations below are general recommendations. While the recommendations guide the administering authorities in assessing the applications, they do not limit their ability to either seek additional information or power to impose conditions on any approval required for the project.

Part A. Transport

Recommendation 2. Road impact assessment and road-use management plan

To identify and deal with transport impacts on the safety, efficiency and condition of state-controlled and local roads, the proponent must consult with DTMR Central Queensland (Rockhampton) Regional Office and Gladstone Regional Council (GRC) with regard to the preparation, approval and implementation of a road impact assessment (RIA) and a road-use management plan (RMP).

(a) For each stage of the project a RIA must:

(i) be developed in accordance with the DTMR Guidelines for Assessment of Road impacts of Development (2006) (GARID) and include a competed DTMR "Transport Generation proforma" detailing project-related traffic and transport generation information for road, rail and sea modes.

(ii) clearly indicate where detailed information is not available and utilise assumptions and methodologies that have been previously agreed in writing with DTMR and GRC, prior to RIA finalisation.

(iii) detail the final impact mitigation proposals, listing infrastructure-based mitigation strategies, including contributions to roadworks/maintenance and summarising key road-use management strategies.

(iv) be approved in writing by DTMR and GRC no later than six (6) months prior to the commencement of significant construction works, or as otherwise agreed between the proponent, DTMR and GRC.

(v) in the event that trains three (3) and four (4) proceed to construction; be updated in accordance with points (i)–(iv).

(b) For each phase of the project a RMP must:

(i) be developed in accordance with DTMR's Guide to Preparing a Road-use Management Plan[3] and with a view to optimising project logistics and minimising road-based trips on all state-controlled and local roads

(ii) incorporate DTMR's Table for listing RMP commitments[35] and detail how and when the identified commitments will be achieved.

[35] Available from TMR regional contacts or Planning Management Branch, Brisbane.

(iii) include a complete list of RMP strategies, and provide confirmation that all works and road-use management strategies have been designed and/or will be undertaken in accordance with all relevant DTMR manuals and practices.[36]

(iv) be approved in writing by DTMR and GRC no later than six (6) months prior to the commencement of significant construction works, or as otherwise agreed between the proponent, DTMR and GRC.

DTMR and GRC are designated as the agencies responsible for this recommendation.

Recommendation 3. Infrastructure agreements

To formalise infrastructure works and contributions detailed and required under approved RIA and RMP, the proponent should enter into infrastructure agreements with DTMR and GRC.

(a) The infrastructure agreement/s should identify all required works and contributions, and incorporate the following:

(i) Project-specific works and contributions required to upgrade impacted road infrastructure and access project sites as a result of the proponent's use of state-controlled and local roads by project traffic.

(ii) Project-specific contributions towards the cost of maintenance and rehabilitation to mitigate road or pavement impacts on state-controlled and local road infrastructure.

(iii) Infrastructure works and contributions associated with shared (cumulative) use of state-controlled and local road infrastructure by other projects subject to an EIS. The proponent should use DTMR's "Notes for contribution calculations" to calculate contribution requirements.

(iv) Performance criteria that detail protocols for consultation and for reviewing and updating of project-related traffic assessments and impact mitigation measures that are based on actual traffic volume and impacts, should previously advised traffic volume and/or impacts change.

(v) The proponent's undertaking to fulfil all commitments as detailed in the "Table for listing RMP commitments".

(b) Any infrastructure agreement between the proponent, DTMR and GRC should be concluded three (3) months prior to commencement of significant construction works, or as otherwise agreed between the proponent, DTMR and GRC.

DTMR and GRC are designated as the agencies responsible for this recommendation.

[36] Available at: http://www.tmr.qld.gov.au/business-industry/Technical-standards-publications.aspx

Recommendation 4. Advice about permits, approvals and traffic management plans

To ensure efficient processing of required project permits and approvals prior to the commencement of project-related traffic, the proponent must, no later than three (3) months prior to the commencement of significant construction works, or other such period as agreed with DTMR and GRC and/or prior to undertaking movements:

(a) submit detailed drawings of any works required to mitigate the impacts of project-related traffic for DTMR and GRC review and approval

(b) obtain all relevant licenses and permits required under the *Transport Infrastructure Act 1994* for works within the state-controlled road corridor (s33 for works approval and s62 for approval of location of works such as accesses to state roads)

(c) prepare a Heavy Vehicle Haulage Management Plan for any excess mass or over-dimensional loads for all phases of the project in consultation with DTMR's Heavy Vehicles Road Operation Program Office, the Queensland Police Service and GRC.

(d) prepare Traffic Management Plan/s (TMP) in accordance with DTMR's *Guide to preparing a Traffic Management Plan*. TMP must be implemented during the construction and commissioning of any required roadworks, including site access points, road intersections or other works undertaken in the state-controlled road corridor.

DTMR and GRC are designated as the agencies responsible for this recommendation.

Part B. Maritime Safety Queensland

Marine management plans under the *Transport Operations (Marine Safety) Act 1994*

Recommendation 5. Marine traffic management plan

To ensure marine safety and related marine operational issues can be effectively planned and efficiently managed; prior to the commencement of significant construction works the proponent must:

(a) consult with Marine Safety Queensland (MSQ) in the preparation of a marine traffic management plan. The plan must:

  (i) use terminology consistent with the Transport Operations (Marine Safety) Regulations 2004; and

  (ii) outline vessel traffic management services required in Gladstone harbour throughout the construction phase of the project.

(b) submit the plan to MSQ for review, and MSQ must approve the plan prior to implementation of the plan by the proponent.

(c) enter into a funding agreement with MSQ to provide and/or upgrade all aids to navigation and/or vessel traffic management services required as a result of this project and as detailed in the plan.

MSQ as a division of Department of Transport and Main Roads (DTMR) is designated as the agency responsible for this recommendation.

Recommendation 6. Shipping transport management plan

To ensure marine safety and related marine operational issues can be effectively planned and efficiently managed; 12 months prior to the first operations of LNG shipping tankers the proponent must:

(a) consult with MSQ and the Gladstone Regional Harbour Master in the preparation of a shipping transport management plan. The plan must:

  (i) use terminology consistent with the Transport Operations (Marine Safety) Regulations 2004.

  (ii) identify and detail whole-of-project life mitigation measures specific to navigational safety.

  (iii) provide an initial outline of required navigational and/or vessel traffic management services and infrastructure.

(b) submit the plan to MSQ and the Gladstone Regional Harbour Master for review.

(c) MSQ and the Gladstone Regional Harbour Master must approve the plan prior to implementation of the plan by the proponent.

(d) enter into a funding agreement with MSQ to provide and/or upgrade all aids to navigation and/or vessel traffic management services required as a result of this project and as detailed in the plan.

(e) implement the approved plan and monitor the outcomes.

MSQ as a division of Department of Transport and Main Roads (DTMR) is designated as the agency responsible for this recommendation.

Part C. Department of State Development, Infrastructure and Planning

Natural hazards mitigation under the *Sustainable Planning Act 2009*

Recommendation 7. Mitigating the adverse impacts of flood, bushfire and landslide

To mitigate the adverse impacts of flood, bushfire and landslide, the proponent must fully investigate the risk of river/creek flooding according to the now expired State Planning Policy 1/03: Mitigating the adverse impacts of flood, bushfire and landslide (SPP 1/03), which has now been replaced by the draft State Planning Policy which includes mandatory requirements relating to flooding, bushfire, landslide and coastal hazards. If flood hazard is present the proponent must ensure that the plant layout is designed to manage a minimum one per cent Annual Exceedance Probability flood and other requirements outlined in the draft State Planning Policy for buildings and structures.

Department of State Development, Infrastructure and Planning is designated as the agency responsible for this recommendation.

Recommendation 8. Mitigating the adverse impacts of bushfire

To mitigate the adverse risk of bushfire, the proponent must effectively investigate the risk of bushfire according to the draft State Planning Policy mandatory requirements. If medium and/or high bushfire hazard is present, the proponent must address these requirements for buildings and structures.

Department of State Development, Infrastructure and Planning is designated as the agency responsible for this recommendation.

Part D. Department of Natural Resources and Mines

Bore monitoring network and program under the *Water Act 2000*

Recommendation 9. Groundwater monitoring

Due to uncertainty in relation to the future functioning and interaction of aquifers and the potential for dewatering effects during construction of infrastructure, such as the tunnel, it is recommended that deeper aquifers be included in the monitoring bore network and monitoring program and be located where the larger impacts are likely to occur, such as near the entry and exit points of the proposed tunnel.

The Department of Natural Resources and Mines is designated as the agency responsible for this recommendation.

Appendix 4. Commitments register

Number	Commitment
Climate and Climate Change Adaptation	
C10.01	Design the plant in accordance with the most current Australian standards addressing climatic factors including wind, bushfires, and sea level rise for maritime structures.
C10.02	Consider climate change induced increases in ambient air temperature when specifying the design operating conditions for plant and equipment.
C10.03	Consider changes to natural tidal inundation and storm surge levels due to climate change when siting permanent facilities.
C10.04	Seek ways to lower water consumption through water-efficient technologies and practices or by installation of water efficient devices.
C10.05	Deploy preventative and responsive measures for bushfire management.
C10.06	Incorporate climate change induced health risks into workplace health, safety and environmental management plans.
C10.07	Engage in government or industry climate change programs.
C10.08	Estimate and include climate change costs in business cost projection and, at the same time, take advantage of emerging business opportunities that climate change may generate.
Geology, landform and soils	
C11.01	Prior to construction, carry out detailed geotechnical ground investigations to assess site specific ground conditions and provide recommendations on slope placement, geometry and drainage.
C11.02	Prior to construction, carry out geo-environmental investigations to identify the depths at which saline soils occur in terrain unit 1, and coastal areas of terrain units 2 and 3a. The cut and fill program will be designed to segregate saline soils from non-saline soils, where these soils are intended for stockpiling for future rehabilitation of the site.
C11.03	Prior to construction, prepare topsoil stripping guidelines, which include a schedule and location of areas to be stripped. Quantify the soil type, depth and resources and establish a handling method. Nominate appropriate, site specific stripping depths and characterise for suitability for use in rehabilitation works.
C11.04	Design the tunnel spoil placement area to minimise adverse impacts associated with ground compaction, erosion and surface water runoff such that a self sustaining landform is achieved. Incorporate appropriate drainage measures into the design.
C11.05	Limit clearing of vegetated areas to the project area. Areas will be stabilised and progressively rehabilitated to reduce prolonged exposure of soils.
C11.06	Consider use of erosion matting (jute mesh) or sediment socks (sand-filled, UV-resistant fabric tubes) in areas of ground disturbance outside of purpose built drainage channels.
C11.07	Manage surface runoff to reduce concentration of surface flow, particularly in erodible soils. Provide drainage channels with suitable design features to minimise erosion where surface runoff is disrupted by roads, tracks, fencing and buildings. Place structures within drainage channels to reduce flow velocity where appropriate. Common with Chapter 13, Surface Water Hydrology and Water Quality.
C11.08	Do not create slopes that are steeper than is appropriate for the material encountered. Consider the orientation of cut batters compared with the orientation of bedrock defects. Where batters exceed 10 m in height and 3 m wide, construct

Number	Commitment
	benches at 10 m intervals, unless local conditions dictate otherwise.
C11.09	Avoid works near stream banks during periods of heavy rainfall where practical. If works cannot be timed to avoid heavy rainfall, adopt additional measures, such as the use of berms and silt fences. Common with Chapter 13, Surface Water Hydrology and Water Quality and Chapter 18, Freshwater Ecology.
C11.10	Exclude vehicles from operating in areas not in use for construction or operation and, in general, restrict vehicles to designated access tracks.
C11.11	Implement sediment and erosion control measures upslope of watercourses, wetlands and coastal areas or in areas with sodic soils to minimise increases in natural sediment discharge. Measures may include sediment traps, silt fencing, riprap, contour banks, detention dams, sediment ponds and vegetation and diversion berms. Common with Chapter 13 Surface Water Hydrology and Water Quality.
C11.12	Use control measures such as drains, swales, silt fencing and sediment traps around the lower slopes of erodible stockpiles. Common with Chapter 13, Surface Water Hydrology and Water Quality.
C11.13	Where sodic soils are encountered, implement control measures (such as soil ameliorants) to soils and soil stockpiles to reduce dispersion, waterlogging and crusting.
C11.14	For pipeline trenching activities reinstate soil profiles to predisturbance orientation, where practical, using excavated topsoil.
C11.15	Design saline and sodic subsoil stockpiles to reduce ponding and salt migration to non-saline soils.
C11.16	Prior to construction commencing, develop a site drainage plan to define how the civil construction will address site drainage, stormwater management, erosion control and stockpile placement. Risks relating to flood events will also be addressed with appropriate mitigation measures to minimise erosion and surface water quality issues. Common with Chapter 13, Surface Water Hydrology and Water Quality.
C11.17	Store topsoil, subsoil and sediment trap soil in separate stockpiles to avoid mixing soil types and introducing salinity to non-saline soils.
C11.18	Design topsoil stockpiles to allow for nutrient cycling.
C11.19A	Where insufficient topsoil is available at the site, use comparable imported topsoil as a preference, or other proprietary systems (e.g., spray mulch) for rehabilitation. Marine clays, skeletal soils, rock or gravelly soils will not be used in the rehabilitation of topsoil layers.
C11.20	Control speed limits on site via posted speed limit signs and confine vehicles generally to marked trafficable areas. Common with Chapter 21, Air Quality.
C11.21	Keep trafficked surfaces damp during construction with sprayed water when conditions are dry to suppress dust generation. Use water of a similar quality to that which is available in the locality and do not spray as concentrated flow. Common with Chapter 21, Air Quality.
C11.22	Design and construct a barrier and sediment control pond to trap sediment leaving the LNG plant site before it enters the Port Curtis marine environment or other surface waters. Common with Chapter 13, Surface Water Hydrology and Water Quality.
C11.23	Protect stream channels in soils prone to gully erosion with rock armouring or other appropriate structures and material to reduce erosion potential. Common with Chapter 13, Surface Water Hydrology and Water Quality.

Number	Commitment
C11.24	Consider the thickness of colluvium, orientation and gradient of cut batters and orientation of bedrock defects when designing cut and fill locations to reduce the potential for slope destabilisation.
C11.25	Batter or shore trench walls in soft, waterlogged soils (particularly in terrain unit 1) to increase stability.
C11.26	Do not use saline, acidic or sodic soils for backfill padding of trenched pipelines where alternatives are available.
C11.27	Cap excavated sodic or saline subsoils with non-sodic or non-saline topsoil material, during reinstatement.
C11.28	Rehabilitate batters, embankments and borrow pits and revegetate as soon as practical after construction. Reinstate areas no longer required for construction or support services and revegetate as per planting and seeding rehabilitation plans to be developed for the project.
C11.29	Re-profile and reinstate topsoil, vegetation and re-establish a stable surface, where practical, during decommissioning and rehabilitation of the LNG plant site. Common with Chapter 13, Surface Water Hydrology and Water Quality.
Land Contamination and Acid Sulfate Soils	
C12.01	Prior to construction, the extent of contamination will be further defined where required, and mitigation measures will be refined as appropriate.
C12.02	Former cattle dip: Undertake additional assessment of the area of potential contamination and develop management or remediation via a DERM-accepted method. Validate the impacted area as per the draft guidelines for the assessment and management of contaminated land in Queensland 1998 (DoE, 1998) and national environment protection (assessment of site contamination) measure (NEPC, 1999).
C12.03	Former cattle dip: Remove livestock dip and spray race structure.
C12.04	Former cattle dip: Manage or remediate impacted soil and groundwater in accordance with current Queensland and national guidelines.
C12.05	Ash in settling ponds: Undertake Stage 2 assessment of ash to determine contamination status.
C12.06	Ash in settling ponds: Where practical, avoid disturbance of buried ash during construction.
C12.07	Ash in settling ponds: Establish effective management methods for disturbed ash during construction activities including erosion and sediment controls and dust suppression. Use of appropriate personal protective equipment will be required.
C12.08	Ash in settling ponds: Place suitable capping material and develop a site management plan if required.
C12.09	Waste battery stockpiles: Remove batteries from site for recycling.
C12.10	Waste battery stockpiles: Undertake shallow surface soil validation sampling.
C12.11	Chemicals and fuel use or storage: Construct facilities in accordance with relevant Australian standards.
C12.12	Chemicals and fuel use or storage: Appropriately train staff in the use of hazardous materials.
C12.13	Future chemicals and fuel use or storage: Immediately clean up any spills and conduct investigations into any relevant releases.
C12.14	Fires and emergency releases of hazardous materials: Provide emergency response training to staff handling dangerous goods.
C12.15	Fires and emergency releases of hazardous materials: Construct facilities and spill

Number	Commitment
	containment in accordance with current Australian standards.
C12.16	Fires and emergency releases of hazardous materials: Regularly inspect infrastructure using or storing hazardous materials, or test for integrity.
C12.17	Develop an ASS management plan prior to construction work. In the plan, specify how onsite ASS disturbances should be managed in accordance with SPP2/02 and the methods set out in Queensland acid sulfate soil technical manual soil management guidelines (Dear et al., 2002). Common with Chapter 14, Groundwater.
C12.18	Remediate areas of contamination that have resulted from the project to a level that protects human health and the environment.
Surface Water Hydrology and Water Quality	
C13.01	Locate sensitive project infrastructure to avoid the 1:100 yr ARI where practical.
C13.02	Design stream diversions and adjacent flood corridors to manage a minimum of a 1:100 year ARI event.
C13.03	Design the stream diversion at the LNG plant site; to prevent erosion or deposition at greater than natural rates; as a corridor, which may contain a formalised channel and constructed flood plain zone; and to allow for the transport of sediment.
C13.04	Design TWAF 8 to minimise disturbance to the of concern RE 11.3.4 ('Eucalyptus tereticornis and/or Eucalyptus spp. tall woodland on alluvial plains') to maintain connectivity of habitat along the Targinie Creek riparian zone. Common with Chapter 17, Terrestrial Ecology and Chapter 18, Freshwater Ecology.
C13.05	Where practical, align the perimeter fence at TWAF 8 to adopt the alignment of the existing fence where it crosses Targinie Creek. Common with Chapter 17, Terrestrial Ecology and Chapter 18, Freshwater Ecology.
C13.06	Design any intra-site access road crossing of Targinie Creek at TWAF 8 to include box culverts (or similar) to enable fauna movement under the road and along the wildlife corridor. Common with Chapter 17, Terrestrial Ecology and Chapter 18, Freshwater Ecology.
C13.07	Keep the footprint of the mainland tunnel entry shaft and tunnel spoil disposal area to a minimum of 500 m clear of Boat Creek. Common with Chapter 18, Freshwater Ecology.
C13.08	Treat stormwater generated from TWAF 7, TWAF 8, launch site 1, the tunnel shaft entry site and tunnel spoil disposal area in temporary sediment basins located at each site.
C13.09	Divert sediment-laden water from disturbed areas at the LNG plant site to temporary sedimentation ponds.
C13.10	Manage all surface water generated from the LNG plant site by a stormwater treatment system to ensure discharged water complies with regulatory requirements. Common with Chapter 31, Waste Management.
C11.12	Use control measures such as drains, swales, silt fencing and sediment traps around the lower slopes of erodible stockpiles. Common with Chapter 11, Geology, Landform and Soils.
C11.11	Implement sediment and erosion control measures upslope of watercourses, wetlands and coastal areas or in areas with sodic soils to minimise increases in natural sediment discharge. Measures may include sediment traps, silt fencing, riprap, contour banks, detention dams, sediment ponds and vegetation and diversion berms. Common with Chapter 11, Geology, Landform and Soils.
C11.16	Prior to construction commencing, develop a site drainage plan to define how the civil construction will address site drainage, stormwater management, erosion

Number	Commitment
	control and stockpile placement. Risks relating to flood events will also be addressed with appropriate mitigation measures to minimise erosion and surface water quality issues. Common with Chapter 11, Geology, Landform and Soils.
C11.23	Protect stream channels in soils prone to gully erosion with rock armouring or other appropriate structures and material to reduce the erosion potential. Common with Chapter 11, Geology, Landform and Soils.
C11.07	Manage surface runoff to reduce concentration of surface flow, particularly in erodible soils. Provide drainage channels with suitable design features to minimise erosion where surface runoff is disrupted by roads, tracks, fencing and buildings. Place structures within drainage channels to reduce flow velocity where appropriate. Common with Chapter 11, Geology, Landform and Soils.
C11.22	Design and construct a barrier and sediment control pond to trap sediment leaving the LNG plant site before it enters the Port Curtis marine environment or other surface waters. Common with Chapter 11, Geology, Landform and Soils.
C11.09	Avoid works near stream banks during periods of heavy rainfall where practical. If works cannot be timed to avoid heavy rainfall, adopt additional measures, such as the use of berms and silt fences. Common with Chapter 11, Geology, Landform and Soils and Chapter 18, Freshwater Ecology.
C13.11	Provide secondary containment for any fuel, oil or chemicals in above ground storage facilities in accordance with applicable Australian standards.
C13.12	Develop appropriate spill prevention and response plans to cover project activities and the types and quantities of fuel, oil and chemicals held at each site. Common with Chapter 14, Groundwater, Chapter 16, Marine Water Quality and Sediment and Chapter 31, Waste Management.
C13.13	Train all relevant personnel in spill response and recovery procedures. Common with Chapter 31, Waste Management.
C13.14	Maintain live capacities of storage bunds to maximise capacity in the event of a storm or spill.
C13.15	Do not abstract freshwater from watercourses, or dispose of effluent directly into freshwater watercourses, except clean stormwater. Common with Chapter 18, Freshwater Ecology.
C13.16	Where waterway crossings are necessary, cross ephemeral streams in preference to permanent streams, where practical. Where pipeline waterway crossings are necessary, approach stream crossings perpendicular to the stream where possible, to reduce bank erosion risk and minimise the footprint within the bed and riparian zone. Common with Chapter 18, Freshwater Ecology.
C13.17	Where practical, ensure that grasses and other ground cover remain in place to assist with trapping mobilised sediments.
C13.18	Avoid the use of herbicides within riparian zones or directly over watercourses. Where this is not possible, use products specifically approved for this purpose.
C13.19	Develop site-specific vegetation management plans to reinstate native plant species to areas to be rehabilitated, including riparian margins. Exotic sterile grasses may be used in areas where temporary cover is required to aid in soil stabilisation.
C13.20	Undertake earthworks and rehabilitation activities to facilitate drainage and reduce the potential for standing water to accumulate. Common with Chapter 18, Freshwater Ecology.
C13.21	Avoid discharging tail water from the tunnel spoil disposal area into Boat Creek.

Number	Commitment
	Common with Chapter 18, Freshwater Ecology.
C13.22	Where works are required in watercourses, they will be confined to reduced width construction right of ways that preserve, to the extent possible, the integrity of the riparian vegetation and any associated wildlife corridors. Common with Chapter 18, Freshwater Ecology.
C13.23	Routinely inspect and maintain the stormwater treatment system.
C13.24	Treat all surface water and stormwater generated within the LNG plant site in a stormwater system to ensure discharged water meets regulatory requirements.
C13.25	Collect contaminated stormwater for treatment before discharge.
C13.26	Only treat surface water generated within the LNG plant site in the stormwater treatment system. Divert runoff generated outside the LNG plant site away from the LNG plant site stormwater system via the proposed stream diversion.
C13.27	Place structures within drainage channels to reduce flow velocity where appropriate.
C13.28	Remove litter and other debris from within the treatment system, especially around the inlet and outlet structures.
C13.29	Keep areas within and around the stormwater treatment system free of weeds, and other undesired overgrowth.
C13.30	Consider post-decommissioning channel form for the stream diversion design and provide for a self-sustaining waterway, without the need for maintenance beyond the life of the project.
C11.29	Re-profile and reinstate topsoil, vegetation and re-establish a stable surface, where practical, during decommissioning and rehabilitation of the LNG plant site. Common with Chapter 11, Geology, Landform and Soils.
Groundwater	
C14.01	Design the facility drainage system such that accidental releases of hazardous substances are collected to reduce the chance of contamination seeping into the groundwater system.
C14.02	Prepare a materials handling and waste management plan to manage any potential contaminants, soils or materials that might result in impacts to shallow groundwater through either short term or long term leaching.
C14.03	Minimise the extent and duration of construction dewatering required.
C12.17	Develop an ASS management plan prior to construction work. In the plan, specify how onsite ASS disturbances should be managed in accordance with SPP2/02 and the methods set out in Queensland acid sulfate soil technical manual soil management guidelines (Dear et al., 2002). Common with Chapter 12, Contaminated Land and Acid Sulfate Soils.
C14.04	Store fuels, chemicals and hazardous wastes in appropriately sized, bunded storage facilities (in leak proof sealed containers). Common with Chapter 31, Waste Management.
C14.05	Where fuel or oil is contained in above ground storage facilities, ensure they are constructed with suitable secondary containment in accordance with Australian standards.
C14.06	Maintain accurate records of fuels and oils stored in underground storage tanks to enable leak detection through quantity auditing.
C13.12	Develop appropriate spill prevention and response plans to cover project activities and the types and quantities of fuel, oil and chemicals held at each site. Common with Chapter 13, Surface Water Hydrology and Water Quality, Chapter 16, Marine Water Quality and Sediment and Chapter 31, Waste Management.

Number	Commitment
C14.07	Minimise site storage of brine products.
C14.08	Collect sewage and greywater generated from the pioneer camp in portable disposal units or other mobile collection facilities. Use a licensed waste contractor to service the sewage facilities and dispose of effluent at a licensed waste management facility. Dispose of sewage from the mainland TWAF through a connection to the local sewerage network or ensure that it is collected in portable disposal units or other mobile collection facilities. Common with Chapter 31, Waste Management.
C14.09	Implement engineering controls to minimise the extent of aquifer drawdown and saline water encroachment such as sheet piling of excavations or groundwater reinjection.
C14.10	Follow standard guidelines for decommissioning of all monitoring bores including the Manual of Water Well Construction Practices (US EPA, 1977) and Minimum Construction Requirements for Water Bores in Australia (DNRME, 2003).
Coastal Processes	
C15.01	Stabilise the shoreline, where required, at the high tide level where marine infrastructure is installed.
C15.02	Develop a dredge management plan that considers the appropriate water and sediment monitoring data (e.g., current WBDD Project data) and will include:
C15.03	• Requirements for monitoring of water quality. Common with Chapter 16, Marine Water Quality and Sediment and Chapter 19, Marine and Estuarine Ecology.
C15.04	• Actions to be taken to minimise impacts of dredging on sensitive areas should water quality monitoring data show performance criteria are exceeded. Finalise specific actions in the dredge management plan. Common with Chapter 16, Marine Water Quality and Sediment and Chapter 19, Marine and Estuarine Ecology.
C15.05	Implement management measures from the dredge management plan to address impacts from maintenance dredging.
C15.06A	Subject to Landlord requirements, decommission the LNG jetty and loading facilities in a similar manner to the LNG Plant.
C15.07	Leave the MOF and shore protection works at the LNG jetty (local benthic habitat and associated flora and fauna will have adapted to its presence over the operational life of the project).
C15.08	Only demolish the mainland launch site if another use is not identified.
Marine Water Quality and Sediment	
C16.01A	If an RO plant is adopted, the design of the brine discharge outfall from the LNG Plant will include a three-port diffuser at the end of the pipeline located close to the water surface (or the ports angled towards the surface) to maximise dilution of the negatively buoyant discharge stream. Common with Chapter 31, Waste Management.
C16.02	Obtain sediment samples from geotechnical drill cores to further characterise marine sediments disturbed during construction. Use the results to inform the development of the dredge management plan.
C15.02	Develop a dredge management plan that considers the appropriate water and sediment monitoring data (e.g., current WBDD Project data) and will include:
C15.03	• Requirements for monitoring of water quality. Common with Chapter 16, Marine Water Quality and Sediment and Chapter 19, Marine and Estuarine Ecology.

Number	Commitment
C15.04	• Actions to be taken to minimise the impacts of dredging on sensitive areas should water quality monitoring data show performance criteria are exceeded. Finalise specific actions in the dredge management plan. Common with Chapter 15, Coastal Processes and Chapter 19, Marine and Estuarine Ecology.
C16.03	Prior to discharge to Port Curtis, test and treat excess water at the mainland tunnel launch site in an onsite water treatment plant to meet water quality criteria.
C16.04	Test and treat all discharges to Port Curtis to meet water quality criteria, as required, prior to discharge.
C16.05	Develop spill response plans to cover marine activities, including all vessel operations.
C16.06	Refuel vessels in designated areas where spill response kits are located.
C13.13A	Train all relevant personnel in spill response and recovery procedures. Common with Chapter 13, Surface Water Hydrology and Water Quality, Chapter 14, Groundwater and Chapter 31, Waste Management.
C16.07	Limit activities on vessels that may cause spillages to the deck to areas where deck water can be routed to and passed through oil/water separators (to meet water quality criteria) before discharge overboard.
C16.08	Store solvents and other oil-based or flammable materials in accordance with applicable Queensland regulations.
C16.09	Maintain a minimum practical inventory of hazardous materials on board vessels.
C16.10	Store on board wastes produced by vessels that cannot be discharged under the MARPOL Convention and then transfer to an approved onshore facility for treatment, reuse, recycling or disposal.
C16.11	Where practical, schedule the timing of maintenance dredging to coincide with the most favourable climatic conditions for minimising impacts to water quality and sediment (i.e., during neap tides when water currents are weakest or periods of calm winds and waves).
C16.12	Source hydrostatic test water from Port Curtis, the town water supply or from fresh water generated in the reverse osmosis plant. Test and treat water to meet water quality criteria as necessary prior to discharge to Port Curtis.
C16.13	Develop a detailed decommissioning plan for the site to include procedures and methods for managing effluent during decommissioning.
C16.14	Develop water quality criteria in consultation with the regulator that reflect existing water quality conditions in the receiving environment, and implement these criteria through the conditioning process associated with statutory approvals such as the dredge management plan and specific environmental authorities.
Terrestrial Ecology	
C17.01	Prepare construction and operations environmental management plans. These documents are to include detailed information about significant flora and fauna species and their management and ongoing conservation. Include site-specific mitigation and details of monitoring and inspection to be undertaken, in the environmental management plans consistent with advice provided by government.
C17.02A	Develop an Environmental Offsets Operational Management Plan that addresses terrestrial and marine offset requirements in consultation with relevant government stakeholders prior to commencement of construction. The plan will provide details on offset options and opportunities, and details on how the offset meets relevant policies and how it will be managed over the life of the offset. Common with Chapter 19, Marine and Estuarine Ecology.

Number	Commitment
C17.03A	An area of semi-evergreen vine thicket community (containing the *Cupaniopsis* vegetation community) will be retained by the project on Boatshed Point. This area will be demarcated prior to the commencement of construction and workers and machinery will be prohibited from accessing the area. The boundary of the semi-evergreen vine thicket community to be retained will be fenced off with a 20-m buffer between the semi-evergreen vine thicket community (including the *Cupaniopsis* vegetation community) and the fence and area of disturbance. The retained vine thicket area is designed to protect a viable semi-evergreen vine thicket vegetation community and a viable population of *Cupaniopsis* sp. indet. on Boatshed Point. Do not develop within the fenced area of the retained semi-evergreen vine thicket community. Establish roles and responsibilities for the management of the retained semi-evergreen vine thicket community.
C17.04	A wildlife corridor of 20 m will be established on the eastern side of Boatshed Point to maintain connectivity between the semi-evergreen vine thicket community and the environmental management precinct.
C13.04	Design TWAF 8 to minimise disturbance to the of concern RE 11.3.4 ('Eucalyptus tereticornis and/or Eucalyptus spp. tall woodland on alluvial plains') to maintain connectivity of habitat along the Targinie Creek riparian zone. Common with Chapter 13, Surface Water, Hydrology and Water Quality and Chapter 18, Freshwater Ecology.
C13.05	Where practical, align the perimeter fence at TWAF 8 to adopt the alignment of the existing fence where it crosses Targinie Creek. Common with Chapter 13, Surface Water, Hydrology and Water Quality and Chapter 18, Freshwater Ecology.
C13.06	Design any intra-site access road crossing of Targinie Creek at TWAF 8 to include box culverts (or similar) to enable fauna movement under the road and along the wildlife corridor. Common with Chapter 13, Surface Water, Hydrology and Water Quality and Chapter 18, Freshwater Ecology.
C17.06	Develop requirements for ecological watching briefs/wildlife spotter-catchers as well as procedures for addressing ecological issues as they arise during construction, operation and rehabilitation works.
C17.07	Develop fauna relocation protocols as part of fauna management measures including procedures if fauna is found during clearing activities, including in hollows of trees to be felled.
C17.08	Prepare a fauna management plan for the project.
C17.09	Develop weed management measures prior to initiation of construction activities in accordance with local and regional management guidelines and best practice advice prescribed in DERM's pest control factsheet series.
C17.10	Liaise with Biosecurity Queensland and Gladstone Regional Council on project biosecurity and pest management programs. Notify Gladstone Regional Council of any new declared or notifiable pest species. These programs should particularly focus on the boundaries of the project site with the Environmental Management Precinct.
C17.11	Develop and implement a mosquito management plan prior to construction that includes measures to control the occurrence of stagnant pools of water on the site especially after rainfall.
C17.12	Develop and implement washdown strategies and procedures to prevent the spread of weeds.
C17.13	Include measures in the pest management plan to control invasive plant species that may colonise the mudflats and degrade remaining habitat.

Number	Commitment
C17.14	Prior to initiation of works, clearly mark access tracks to prevent secondary tracks becoming established. Use existing access tracks where practical. Where practical, the location and design of access tracks should avoid sites of high ecological value.
C17.15	Locate construction equipment, laydown areas, turn-around areas, stockpiles and working areas within areas of existing disturbance where practical.
C17.16A	Implement measures to reduce the impacts of light from the LNG plant and ancillary facilities including: • Shield/direct the light source onto work areas where practical, and avoid light spill on to habitat areas (such as mangroves and Clinton ash ponds) where practical. Common with Chapter 19, Marine and Estuarine Ecology and Chapter 23, Landscape and Visual.
C17.17	• Use long-wavelength lights, where practicable, including use of red, orange or yellow lights. Common with Chapter 19, Marine and Estuarine Ecology.
C17.18	• Lower the height of the light sources as far as practical. Common with Chapter 19, Marine and Estuarine Ecology.
C17.19	• Avoid planned routine maintenance flaring at night during sensitive turtle reproductive periods (where practicable). Common with Chapter 19, Marine and Estuarine Ecology.
C17.20	Design lighting around the perimeter of the LNG plant to minimise impacts on roosting shorebirds, where practical. Lowest possible luminescent globes should be used in sensitive areas, particularly around intertidal zones, where practical.
C17.21	Design construction lighting on the causeway at the mainland tunnel entry shaft and tunnel spoil disposal area to minimise impacts on roosting shorebirds. The lowest possible luminescent globes should be used in sensitive areas, particularly around intertidal areas, where practical.
C17.22	Induct all personnel prior to entering a project site, including on measures for managing the impacts on flora and fauna likely to be present. Common with Chapter 18, Freshwater Ecology.
C17.23A	Clearly mark no go zones, where required, including the semi-evergreen vine thicket (*Cupaniopsis*) fenced area on Boatshed Point and the critically endangered EPBC Act listed vine thicket communities on the eastern margin of Hamilton Point and northeast of Boatshed Point. Signage will be erected around the margins of the communities to indicate restricted access.
C17.24	Prohibit access to the saltpans and fringing mangroves (RE 12.1.2 and 12.1.3) outside the planned area of disturbance of the mainland tunnel entry shaft and tunnel spoil disposal area.
C17.25	Conduct preclearance surveys across project areas to be cleared of vegetation. The surveys will aim to determine whether any threatened species are present at each site. Appropriate mitigation measures will be implemented if threatened species are confirmed within the area.
C17.27	Reduce vegetation clearing where practical and only after all other options such as selective clearing and trimming of vegetation have been considered.
C17.28	Clearly mark trees for retention to avoid accidental clearing and develop clearance procedures prior to construction. The root zone should be adequately protected.
C17.29	In areas where trees are planned to be left in place, take care to minimise damage to surrounding trees when felling trees into cleared areas or in natural slots between retained trees.
C17.30	Inspect plants, soil, fill and any other such materials to be used in

Number	Commitment
	construction/rehabilitation works prior to entry to site. If supplied from within the fire-ant restricted area, these materials must be accompanied by a movement certificate or fire-ant declaration form. This also applies for the yellow crazy ant.
C17.31	Prohibit pets of staff and contractors from entering the project area (unless assistance animals).
C17.32	Adopt waste control measures to avoid introducing new external seed sources for exotic flora.
C17.33	Prohibit hunting and trapping unless required for pest management.
C17.34	Undertake all handling and management of fauna in compliance with permits issued by DERM.
C17.35	Develop measures to prevent fauna entrapment and implement prior to construction where practical (e.g., the use of pipe caps if piping stored at ground level, string pipes with gaps for wildlife access).
C17.36A	Develop trench management procedures to prevent access of fauna into trenches. These procedures will include measures such as trench breakers and covers. In addition, inspection procedures will be established in order to remove trapped fauna, create protection and refuge areas for wildlife trapped in the trench and develop methods to assist trapped fauna left in the trench.
C17.37	Prohibit construction and operation activities within 'field' areas that are outside of the construction area of disturbance, i.e., areas exposed to bushfire fuels, during days of total fire ban.
C17.38	Identify areas to be rehabilitated and develop procedures for restoration and maintenance.
C17.39	Rehabilitate construction access tracks not required for operations.
C17.40	Protect the EPBC Act listed community northeast of Boatshed Point and employ low impact methods of weed control within and adjacent to EPBC Act listed communities.
C17.41	Establish a management buffer of suitable width and of contiguous natural vegetation, around the EPBC Act listed community northeast of Boatshed Point to minimise the potential for edge effects and limit the potential for weed invasion. The buffer will be defined in the Wildlife Corridor Management Plan to be developed prior to construction.
C17.42	Implement fire control measures to prevent wildfire incursion into the EPBC Act listed communities. This may include construction of firebreaks or asset protection burning outside of the community and its associated buffer.
C17.43	Detail the need to protect EPBC Act listed communities and explain mitigation measures that are to be implemented in workforce inductions.
C17.44	Clearly delineate clearing boundaries prior to clearing commencing to avoid unnecessary vegetation loss.
C17.45	Where practical, stock-pile cleared vegetation in 'wind-rows' around the edge of retained vegetation. In addition to providing shelter, this will also provide some physical barrier reducing edge impact severity and the risk of weed spread.
C17.46	Minimise the duration trenches are open, ensure daily trench inspections are undertaken by suitably qualified spotter/catchers and ensure that the length of open trench does not exceed that which can be inspected by the available spotter/catchers in any one daily period.
C17.47	Consider measures to minimise light emitted from the LNG plant during the detailed design of the LNG plant including: • Assess the necessity and choice of lighting in the plant area:

Number	Commitment
	– Use low-pressure sodium (LPS) lights as a first-choice light source and high-pressure sodium (HPS) lights where LPS is not practical. – Replace short-wavelength light with long-wavelength light and exclude short-wavelength light with the use of filters. – Avoid using halogen, metal halide or fluorescent lights (white lights) where possible, and only use white lights in contained areas where colour rendition is required. – Minimise the number and wattage of lights, and recess lighting into structures where possible. • Use timers and motion-activated light switches. • Use reflective materials to delineate equipment or pathways and use embedded lighting for roads. • Position doors and windows on the sides of buildings facing away from marine turtle nesting beaches and install and use window coverings to reduce light emissions. • Maintain elevated horizons (such as topographic features, vegetation or barriers) to screen rookery beaches from light sources. Common with Chapter 19, Marine and Estuarine Ecology.
C17.48	If koalas are found during wet season surveys to be undertaken in early 2013 or pre-clearance surveys, develop and implement appropriate mitigations in the species management plan which could include fauna spotter/catchers, limiting vehicle speed limits and habitat rehabilitation.
C17.49	Design infrastructure to reduce impacts on shoreline habitat, where possible, and reduce the risk of unnecessary clearing by demarcating disturbance areas prior to the disturbance commencing.
C17.50	Reduce lighting wherever possible, in locations where movement between water mouse foraging and nesting habitats (e.g., between mangroves and the supralittoral zone) occurs.
C17.51	Review the need for an ongoing program to monitor the shorebird population at project sites following the completion of survey work in 2013.
C17.52	Develop measures to minimise disturbance around important shorebird habitat, during construction and operation. Measures could include exclusion zones or screens as recommended in Rohweder et al., (2011).
Freshwater Ecology	
C13.04	Design TWAF 8 to minimise disturbance to the of concern RE 11.3.4 (‘*Eucalyptus tereticornis* and/or *Eucalyptus* spp. tall woodland on alluvial plains’) to maintain connectivity of habitat along the Targinie Creek riparian zone. Common with Chapter 13, Surface Water Hydrology and Water Quality and Chapter 17, Terrestrial Ecology.
C13.05	Where practical, align the perimeter fence at TWAF 8 to adopt the alignment of the existing fence where it crosses Targinie Creek. Common with Chapter 13, Surface Water Hydrology and Water Quality and Chapter 17, Terrestrial Ecology.
C13.06	Design any intra-site access road crossing of Targinie Creek at TWAF 8 to include box culverts (or similar) to enable fauna movement under the road and along the wildlife corridor. Common with Chapter 13, Surface Water Hydrology and Water Quality and Chapter 17, Terrestrial Ecology.
C18.01	Implement strategies and protocols relevant to the protection of freshwater aquatic communities, habitat and processes, as detailed in the Australian Pipeline Industry Association Code of Environmental Practice: Onshore Pipelines (APIA, 2009) as

Number	Commitment
	part of the project.
C13.07	Keep the footprint of the mainland tunnel entry shaft and tunnel spoil disposal area to a minimum of 500 m clear of Boat Creek. Common with Chapter 13, Surface Water Hydrology and Water Quality.
C17.22	Induct all personnel prior to entering a project site, including on measures for managing the impacts on flora and fauna likely to be present. Common with Chapter 17, Terrestrial Ecology.
C13.22	Where works are required in watercourses, they will be confined to reduced width construction right of ways that preserve, to the extent practical, the integrity of the riparian vegetation and any associated wildlife corridors. Common with Chapter 13, Surface Water Hydrology and Water Quality.
C18.02	Limit the clearing of riparian vegetation to that necessary for safety.
C13.16	Where waterway crossings are necessary, cross ephemeral streams in preference to permanent streams, where practical. Where pipeline waterway crossings are necessary, approach stream crossings perpendicular to the stream where practical, to reduce bank erosion risk and minimise the footprint within the bed and riparian zone. Common with Chapter 13, Surface Water Hydrology and Water Quality.
C11.09	Avoid works near stream banks during periods of heavy rainfall where possible. If works cannot be timed to avoid heavy rainfall, adopt additional measures, such as the use of berms and silt fences. Common with Chapter 11, Geology, Landform and Soils and Chapter 13, Surface Water Hydrology and Water Quality.
C18.03	Prevent staff and contractors from camping, fishing or carrying out other recreational activities in waterways in the project area while on shift, to prevent the accidental introduction of aquatic pest species on fishing gear or bait.
C13.20	Undertake earthworks and rehabilitation activities to facilitate drainage and reduce the potential for standing water to accumulate. Common with Chapter 13, Surface Water Hydrology and Water Quality.
C13.21	Avoid discharging tail water from the tunnel spoil disposal area into Boat Creek. Common with Chapter 13, Surface Water Hydrology and Water Quality.
C18.04	Define and adhere to machinery hygiene protocols to prevent the translocation of pest species, particularly weeds such as salvinia, cumbungi and para grass.
C13.15	Do not abstract freshwater from watercourses, or dispose of effluent directly into freshwater watercourses, except clean stormwater. Common with Chapter 13, Surface Water Hydrology and Water Quality.
Marine and Estuarine Ecology	
C19.01A	Develop a construction environmental management plan, which contains specific mitigation measures, performance indicators and management actions required to reduce impacts to the marine and estuarine ecological values.
C17.02A	Develop an Environmental Offsets Operational Management Plan that addresses terrestrial and marine offset requirements in consultation with relevant government stakeholders prior to commencement of construction. The plan will provide details on offset options and opportunities, and details on how the offset meets relevant policies and how it will be managed over the life of the offset. Common with Chapter 17, Terrestrial Ecology.
C17.16A	Implement measures to reduce the impacts of light from the LNG plant and ancillary facilities including:
	• Shield/direct the light source onto work areas where practical, and avoid light spill on to habitat areas (such as mangroves and Clinton ash ponds) where practical.

Number	Commitment
	Common with Chapter 17, Terrestrial Ecology and Chapter 23, Landscape and Visual.
C17.17	• Use long-wavelength lights, where practical, including use of red, orange or yellow lights. Common with Chapter 17, Terrestrial Ecology.
C17.18	• Lower the height of the light sources as far as practical. Common with Chapter 17, Terrestrial Ecology.
C17.19	• Avoid routine planned maintenance flaring at night during sensitive turtle-reproductive periods (where practical). Common with Chapter 17, Terrestrial Ecology.
C15.02	Develop a dredge management plan that considers the appropriate water and sediment monitoring data (e.g., current WBDD Project data) and will include:
C15.03	• Requirements for monitoring of water quality. Common with Chapter 15, Coastal Processes and Chapter 16, Marine Water Quality and Sediment.
C15.04	• Actions to be taken to minimise impacts of dredging on sensitive areas should water quality monitoring data show performance criteria are exceeded. Finalise specific actions in the dredge management plan. Common with Chapter 15, Coastal Processes and Chapter 16, Marine Water Quality and Sediment.
C19.03	Comply with environmental and legal criteria of the Queensland Government environmental offsets policy as the overarching framework for a specific-issue offset policy.
C19.04	Contribute to the development of a Port of Gladstone shipping activity strategy and management plan. Comply with applicable speed limits for the Port of Gladstone-Rodds Bay Zone B dugong protection area, as detailed in the management plan.
C19.05	Install (where feasible) propeller guards (or equivalent) on high-speed vessels to reduce the impact of injury in the event of boat strike.
C19.06	Implement soft-start procedures where a sequential build-up of warning pulses will be carried out prior to commencement of full-power pile-driving activities. Common with Chapter 22, Noise and Vibration.
C19.07	Undertake fauna observations prior to and during pile-driving and dredging activities to check for the presence of marine turtles, dugongs and cetaceans. Should fauna be spotted within the area of the works, implement procedures to minimise impact, such as reverting to soft-start piling or stopping temporarily to allow animals to move away from the area.
C19.08	Keep dredging activities within the identified dredge footprint area.
C19.09	Maintain a fauna-spotting function (where practical) during dredging activities. Do not commence dredging if marine mammals, turtles or crocodiles are spotted within the area of dredging, and stop temporarily if fauna is spotted within the area of the dredge head. In both cases, resumption of dredging must wait until fauna has moved away.
C19.10	Project vessels servicing the LNG plant that originate from overseas ports must comply with Commonwealth and local government ballast water management systems and implement Australian Quarantine and Inspection Service hull hygiene measures.
C19.11	All project vessels must comply with all applicable maritime law, especially when passing through the GBRMP. Project vessels will traverse the marine park via designated navigation routes with pilotage as required within port boundaries.

Number	Commitment
C19.12	Establish a system for the recording of opportunistic observation of marine megafauna (turtles, salt-water crocodiles, dugong and cetaceans) spotted during marine operations such as dredging, pile driving and marine transport including where these activities occur within the Calliope River. Common with Chapter 22, Noise and Vibration.
C19.13	Evaluate the use of bubble curtains for each method of piling, and deploy where they are demonstrated to be effective in aiding the rapid attenuation of underwater noise and deterring marine fauna from approaching, or remaining at, pile driving sites. Common with Chapter 22, Noise and Vibration.
C17.47	Consider measures to minimise light emitted from the LNG plant during the detailed design of the LNG plant including: • Assess the necessity and choice of lighting in the plant area: – Use low-pressure sodium (LPS) lights as a first-choice light source and high-pressure sodium (HPS) lights where LPS is not practical. – Replace short-wavelength light with long-wavelength light and exclude short-wavelength light with the use of filters. – Avoid using halogen, metal halide or fluorescent lights (white lights) where possible, and only use white lights in contained areas where colour rendition is required. – Minimise the number and wattage of lights, and recess lighting into structures where possible. • Use timers and motion-activated light switches. • Use reflective materials to delineate equipment or pathways and use embedded lighting for roads. • Position doors and windows on the sides of buildings facing away from marine turtle nesting beaches and install and use window coverings to reduce light emissions. • Maintain elevated horizons (such as topographic features, vegetation or barriers) to screen rookery beaches from light sources. Common with Chapter 17, Terrestrial Ecology.
C19.14	A light mitigation plan for construction and operation will be developed and will include specific light management and reduction measures and a commitment to routine light audits.
C19.15	Arrow Energy will participate in monitoring programs established to assess the impact of current and future industrial lighting in the Gladstone region on turtle hatchlings emerging on the beaches of Curtis and Facing islands.
Greenhouse Gas	
C20.01	Develop and implement a greenhouse gas standard as part of Arrow's HSEMS.
C20.02	Identify and consider measures to reduce emissions intensity and improve the energy efficiency of the different project components throughout the design process.
C20.03	Minimise greenhouse gas emissions through the progressive clearing of areas and implement rehabilitation as soon as practical.
Air Quality	
C21.01	Design the LNG plant to comply with the air quality assessment criteria, which are based upon all relevant air quality standards and objectives. Compliance with these criteria will ensure protection of environmental values within the air quality impact assessment study area and all sensitive receptor areas.
C21.02	Where feasible, apply low-emission technology to equipment with high combustion rates (e.g., gas turbines).

Number	Commitment
C21.03	Fit compressors and boil-off gas recovery systems with dry gas seals and where practical, hydrocarbon pumps will be fitted with double seals.
C21.04	Minimise fugitive emissions from sources such as pumps, seals, valves, connectors and pipe work via the application of the latest proven stage of development processes, facilities and methods of operation. These include using closed drainage, where practical, minimising the number of flanges, installing dry gas seals on compressors and vapour recovery systems and where applicable, double seals for hydrocarbon pumps.
C21.05	Incorporate waste heat recovery units on the compressor drive gas turbine exhausts to provide process heat to use elsewhere in the LNG plant, thereby reducing operational requirements for gas-fired heaters.
C21.06	Fit all stacks with emissions monitoring ports suitable for continuous monitoring even if continuous monitoring is not currently required to facilitate future monitoring should the need arise.
C21.07	Reduce exposure time of bare soils on the ground surface as far as practicable, and undertake revegetation of bare surfaces as soon as practical following construction.
C11.20	Control speed limits on site via posted speed limit signs and confine vehicles generally to marked trafficable areas. Common with Chapter 11, Geology, Landform and Soils.
C11.21	Keep trafficked surfaces damp during construction with sprayed water when conditions are dry to suppress dust generation. Use water of a similar quality to that which is available in the locality and do not spray as concentrated flow. Common with Chapter 11, Geology, Landform and Soils.
C21.08	Maintain construction vehicles and equipment regularly to reduce exhaust emissions.
C21.09	Where practical, use low-sulfur diesel fuel in diesel-powered equipment (i.e., not more than 0.01% sulfur by mass).
C21.10	Do not use chlorofluorocarbons (CFC), halogens or related materials listed as banned under the Montreal Protocol in new installations.
C21.11	Where practical, limit the volume of hydrocarbons flared or vented to the atmosphere from the LNG plant. Ensure that the flare is luminous and bright (i.e., show smokeless combustion at operating design gas flow rate) and the relative density of emitted smoke does not exceed No.1 Ringelmann Number.
C21.12	Do not vent boil-off gas to the atmosphere; instead route it to the feed gas inlet for reprocessing or sent to the end flash gas compressor for use in the high-pressure fuel gas system.
C21.13	Use low-sulfur fuel in diesel-powered generators (not more than 0.01% sulfur by mass).
C21.14	Maintain equipment in accordance with manufacturer specifications in order to minimise fugitive emissions.
Noise and Vibration	
C22.01	Identify during the detailed design of the LNG plant, specific acoustic treatment to be applied to each noise source.
C22.02	Where practical, locate noise-making equipment to maximise the distance between noise sources (e.g., diesel generators) and sensitive receptors. The use of structures or natural topography to create barriers to noise may be used to lessen the noise impacts on sensitive receptors.
C22.03	Include appropriate methods to manage blasting activities in the construction environmental management plan. If required, carry out blasting activities in

Number	Commitment
	accordance with the guidelines for blasting noise and vibration.
C22.04	Regularly maintain all machinery and equipment and check for excessive noise generation.
C22.05A	Where noise from a construction activity would exceed the project night-time noise criteria of 40 dB(A) at a sensitive receptor, schedule, where practical construction activities to occur between 7.00 a.m. and 10.00 p.m.
C22.06	Continually review the timing of construction activities to identify opportunities to reschedule concurrent activities where excessive noise is expected.
C22.07	Ensure that project-related noise generated during operation complies with the project noise criteria at all assessment locations.
C22.08	If blasting is considered necessary, standard practices will be followed so that all blasting activities will be designed to meet the relevant overpressure and ground-vibration criteria at sensitive receptor locations.
C19.06	Implement soft-start procedures where a sequential build-up of warning pulses will be carried out prior to commencement of full-power pile-driving activities. Common with Chapter 19, Marine Ecology.
C19.12	Establish a system for the recording of opportunistic observation of marine megafauna (turtles, salt-water crocodiles, dugong and cetaceans) spotted during marine operations such as dredging, pile driving and marine transport including where these activities occur within the Calliope River. Common with Chapter 19, Marine Ecology.
C19.13	Evaluate the use of bubble curtains for each method of piling, and deploy where they are demonstrated to be effective in aiding the rapid attenuation of underwater noise and deterring marine fauna from approaching, or remaining at, pile driving sites. Common with Chapter 19, Marine Ecology.
Landscape and Visual	
C23.01	Protect the tip of Boatshed Point from clearing and cutting to preserve areas of vegetation that help screen lower parts of the LNG plant and construction camp.
C23.02	Where practical, retain the vegetation along the eastern boundary of the LNG plant site to provide some screening to views from the east.
C23.03	Consider potential landscape and visual impacts where there are options for the siting of infrastructure.
C23.04	Where practical, undertake further modifications to the development footprint during detailed design to minimise cutting into the high ground of the Curtis Island strike ridge system and to assist in maintaining a vegetated backdrop and visually absorbing the built form of the development.
C23.05	Investigate potential areas for further retention of vegetation cover at all sites where practical.
C23.06	Investigate opportunities for further planting of a forested landscape buffer around the eastern, southern and western boundaries of the LNG plant site, using bush regeneration techniques and endemic tree species of local provenance consistent, to the greatest extent, with the bushfire strategy.
C23.07	Select materials that are sensitive to the site context where plant operability is not impacted.
C23.08	Use a colour palette for built form that blends with the predominant background colours and which reflects natural hues from the surrounding landscape where plant operability is not impacted.
C23.09	Investigate the use of new insulating paints that may allow greater flexibility in the

Number	Commitment
	colour of LNG structures without compromising plant operability or safety aspects.
C23.10	Undertake the detailed lighting design in line with Australian standards.
C23.11	Design aviation lighting to be consistent with the Gladstone Airport Obstacle Limitation Surface Plan (Randl, 2011).
C23.12	Design shore protection to reflect natural forms, where practical.
C23.13	Use industry standards for the construction camp to minimise landscape and visual impacts.
C23.14	Develop landscape and rehabilitation plans for all project sites, particularly the selected TWAF site, which will require remediation after the first construction phase.
C23.15	Consider visibility of stockpiles when siting these within laydown areas, i.e., use laydown areas that are more enclosed in preference to more open areas, wherever practical.
C23.16	Investigate planting at the top, toe and on the retaining structure where terracing is undertaken.
C23.17	Consider planting of bands of screening vegetation parallel with the shoreline between elements of the LNG plant if terracing is considered impractical on Curtis Island.
C23.18	Remove temporary structures following completion of construction works and where appropriate, undertake detailed grading of disturbed surfaces to achieve appropriate ground levels.
C23.19	Undertake planting rehabilitation works at the earliest opportunity to minimise erosion and the presence of areas of bare soil (except where technical studies indicate an alternative approach).
C23.20	Minimise night-time working and associated lighting impacts for activities (including construction of the LNG plant). Limit construction activities that need to be highly lit to daytime hours (to the greatest extent practical).
C17.16A	• Shield/direct the light source onto work areas where practical, and avoid light spill on to habitat areas (such as mangroves and Clinton ash ponds) where practical. Common with Chapter 17, Terrestrial Ecology and Chapter 19, Marine and Estuarine Ecology.
C23.21	Use ‘passive’ lighting methods, where practical. These include reflective roadway markers, lines, warnings or information signs and furnishing reflectors.
C23.22	Consider use of solar-powered LED studs, or similar, in roadways and paths of travel as an alternative to permanent lighting, where practical.
C23.23	As part of the decommissioning plan to be developed for the project, investigate an appropriate after use of project areas including any rehabilitation requirements as appropriate.
Indigenous Cultural Heritage	
C24.01	Develop an approved CHMP or a native title agreement that addresses Aboriginal cultural heritage in consultation with the endorsed Aboriginal parties for the project.
C24.02	Comply with the approved CHMP or native title agreement that addresses Aboriginal cultural heritage.
C24.03	Consider the cultural heritage management principles set out in Section 7.2.3 of Appendix 18, Indigenous Cultural Heritage Impact Assessment, completed for the project when developing a CHMP or native title agreement that addresses Aboriginal cultural heritage. Agree final principles with the relevant Aboriginal parties or native title parties.
Non-Indigenous Cultural Heritage	

Number	Commitment
C25.01	Prepare a heritage management plan prior to construction and which specifies how known and unknown heritage sites are to be managed during construction.
C25.02	Record the following sites in detail prior to construction and destruction: • Site No. 3: Post-cutting site. • Site No. 4: Old yards. • Site No. 5: Stock enclosure. • Site No. 6: Historic fence line. • Site No. 7: Pre-1870 track alignment. • Site No. 8: Ruins of rendered brick building. • Site No. 11: Various fence alignments (Targinie).
C25.03	Map the "Birkenhead" outstation (Site No. 1) and record in detail prior to construction activities. Archaeological traces of this site may exist and remote sensing and excavation may be employed prior to construction to identify the extent of cultural heritage.
C25.04	The location of the grave (Site No. 2) at "Birkenhead" outstation is unknown. Employ remote sensing techniques prior to construction to try to locate the grave. Relocate the grave to an alternative location if discovered, to protect it from construction activities.
C25.05	If the grave is not discovered prior to construction, implement a procedure for accidental discovery of remains in this area.
C25.06	Include in the heritage management plan prepared prior to construction, requirements for accidental discovery and management of cultural heritage items or human remains. Conflict resolution and other contingencies will also be addressed in the plan.
Social	
C26.01A	Continue to liaise with other LNG proponents to determine cumulative workforce housing requirements and to determine whether the private market is able to provide sufficient dwellings in the local area for the construction and operation workforces. This will be informed by house price and rental data from the REIQ's Queensland Market Monitor and Department of Communities, Child Safety and Disability Services Housing Market Report.
C26.02A	Identify options to meet the demand for dwellings, which minimises the use of rental properties unless vacancy rates increase to 3% or higher. Possible options could include: • Providing rental guarantees or other incentives to private investors to encourage the construction of new housing stock which can be used by project staff. • Encouraging all non-local employees to live in company facilitated housing unless they have families or other circumstances that make this impractical. • Providing direct and indirect investment in the housing market. • Providing accommodation advice services for workers and their families. Common with Chapter 27, Economics.
C26.03	Continue to engage with the Office of the Coordinator-General and other LNG proponents to identify co-operative strategies that address cumulative housing impacts.
C26.04	Collect data on where workers are residing and whether they have a family with them. Determine the level of local employment and the likely number of non-local workers and their families seeking accommodation in the study area. Common with Chapter 27, Economics.
C26.05	Continue to provide data to state and local government to facilitate the creation of a

Number	Commitment
	common data set across all major projects. The data collected will be in the format already agreed between existing proponents and the Office of the Coordinator General.
C26.06A	Develop a construction workforce accommodation strategy within 12 months of awarding the EPC contract. The strategy will identify the preferred approach for facilitating up to 90 houses during the construction phase. This will be based on the state of the market to meet this project generated demand and required market interventions to minimise adverse impacts upon the community. Common with Chapter 27, Economics.
C26.07A	Through the construction workforce accommodation strategy, include a commitment to company facilitated accommodation to meet the anticipated demand for up to 380 beds during construction of trains 1 and 2. It is anticipated that all of these beds will be provided in company facilitated communal accommodation which may be met directly by the project, either through the development of purpose built accommodation or through agreements with third party providers. Examples of the company facilitated communal accommodation include: • Medium to high density developments. • Third party construction camps already operational in the Gladstone Region. • Pioneer workers camp on the mainland. • Rental properties where market conditions allow. Common with Chapter 27, Economics.
C26.08A	Identify opportunities through the construction workforce accommodation strategy to bring forward facilitation of housing intended for the operations workforce that can be used for the construction workforce. Common with Chapter 27, Economics.
C26.09A	Provide information on the Arrow Energy website on actions taken to meet project housing needs Common with Chapter 27, Economics.
C26.10	Collaborate with other proponents in the region and identify opportunities to share temporary accommodation where possible for the construction and maintenance workforces. Common with Chapter 27, Economics.
C26.11	Inform the tourist industry and other peak business bodies of anticipated time frames for peak temporary accommodation demand. Common with Chapter 27, Economics.
C26.12A	Work with the Queensland Government, Gladstone Regional Council and affordable housing providers to identify opportunities in the study area to bring additional affordable housing to market for existing residents. Common with Chapter 27, Economics.
C26.14A	Provide $6.5 million towards the development of affordable housing options in Gladstone. Arrow Energy has met with and agreed to contribute to GAH following FID. This includes a position on the reference group. Common with Chapter 27, Economics.
C26.15	Provide information on the Arrow Energy website on actions taken to support affordable housing initiatives to offset housing impacts. Common with Chapter 27, Economics.
C26.16A	Provide $1 million for emergency rental assistance to GRC for distribution. Arrow Energy has commenced discussions with GRC and will continue to work with them to develop the criteria and distribution processes for access to ERA funding.

Number	Commitment
	This is intended to ensure that it reflects local community needs and compliments the current agreements within the ERA program with the other proponents. Common with Chapter 27, Economics.
C26.18A	Design the workers camp to have sufficient social and recreational facilities to cater for recreational, fitness and entertainment requirements.
C26.19	Develop and provide workers with an induction and welcome kit which includes a statement of community expectations for new arrivals. Where FIFO workers come from overseas, ensure they are provided with an adequate Australian cultural awareness briefing and information on how to undertake day to day activities, for example banking or shopping.
C26.20A	Consult with the GRC and RCCC to identify which social, community or recreational infrastructure is being directly impacted by the project and to what extent. Work with the Office of the Coordinator General and Gladstone Regional Council to identify the most suitable mechanism to coordinate efforts across all proponents and identify projects that may provide an equivalent offset or mitigation of impacts. Invest up to $3.5 million in identified projects to offset or mitigate the impacts of the project (comparative with the other LNG proponents).
C26.21	Ensure that there are no ongoing restrictions on the Calliope River boat ramp or Gladstone Marina during the operation of the project.
C26.22	Prohibit non local construction workers and operators from engaging in fishing, crabbing or boating in any exclusion zone.
C26.23	Prohibit all FIFO workers (with the exception of traditional owners) from fishing, crabbing and boating in the Gladstone Regional Council area, whilst on shift/ living in the construction camps.
C26.24	Continue to provide state and local government departments responsible for educational, health and other social infrastructure with forecasts of workforce numbers and projected families to assist in their future service planning. This information will be provided in an agreed format that will allow these departments to plan for cumulative population change.
C26.25A	Arrow Energy acknowledges it has a shared responsibility with government, and society more broadly, to help facilitate the development of strong and sustainable communities. It is committed to managing the residual social impacts of its activities that cannot be avoided or sufficiently minimised and to contributing to the social and economic wealth of the communities in which it operates through its social investment program. This program is comprised of the Brighter Futures Program, community funding, sponsorships and partnerships and has been running in Brisbane, Gladstone, the Surat and Bowen Basins and its exploration tenements since 2011. Arrow Energy is committed as a part of this action plan to support and expand its social investment in the areas in which it operates to support projects and initiatives in areas identified in the SIMP. Information will also be provided on projects that receive funding or in kind support to offset or mitigate direct project impacts.
C26.26A	Details of the Brighter Future program for Gladstone will be released on the Arrow Energy website. This will include information on criteria for funding, funds expended, processes for applying and how often funding will be available for applications.
C26.27A	Register the Indigenous Land Use Agreement (ILUA) that was negotiated for the project site, harbour and port area in March 2012.
C26.28A	Implement Arrow Energy's Aboriginal and Torres Strait Islander Action Plan, including those actions that focus on employment for Indigenous Australians, including:

Number	Commitment
	• Recruiting and retaining Aboriginal and Torres Strait Islander staff. • Connecting Aboriginal and Torres Strait Islander people with business and employment opportunities. • Arrow Energy has engaged in preliminary discussions with DSDIP, the Department of Aboriginal and Torres Strait Islander and Multicultural Affairs (DATSIMA) and DEEWR in relation to Indigenous employment, training and business development opportunities associated with the project. The focus of these discussions has been on developing Indigenous employment within Arrow Energy's supply chain. Actions being considered include: • Identifying apprenticeships or traineeships that could be made available to Indigenous people. For underemployed or unemployed Indigenous people skills set summaries for these positions will be provided to work ready programs to allow them to tailor their training. These roles will be quarantined for successful Indigenous participants in the work ready programs. • Identifying the most appropriate opportunities for Indigenous businesses to competitively tender to provide goods or services to the project during the operations stage. • Sending information about the opportunities identified above to relevant businesses, or business groups.
C26.29A	Ensure that Indigenous persons and businesses will be able to take advantage of initiatives outlined in both the Australian Industry Participation Plan and the workforce and training plan.
C26.30A	Continue the Arrow Energy Whanu Binal project and provide assistance, such as business mentoring, to Traditional Owners and other interested members of the Indigenous community with developing business opportunities and capacity. Arrow Energy's Whanu Binal project targets Indigenous businesses and helps them develop the capacity and capability to successfully tender for major projects, including Arrow Energy projects. It also aims to help build the skills and knowledge of existing and potential workforces. Examples of the type of activities that occur as part of this project include: • Identification of opportunities to allow joint partnering. • Briefings on what business systems and insurances are required to work on the project. • Information on government programs that exist to help Indigenous businesses. • Information on how to pool resources across businesses to tender on larger parcels of work.
C26.31A	Ensure major contractors develop a plan that clearly identifies Indigenous opportunities (employment and business) on the project.
C26.33A	Ensure that appropriate cultural awareness training is provided to all workers on the project. Arrow Energy is committed to providing a workplace where all personnel are treated fairly and with dignity and respect. To facilitate this, it has been mandatory since 2011 for all Arrow Energy personnel (including contractors) to participate in cultural awareness training within the first three months of employment or engagement by the company Training is delivered by Indigenous presenters from Corporate Culcha, an Indigenous-owned and operated company specialising in building capacity to engage with, recruit and retain Indigenous Australians. The intended outcomes are that staff and contractors can engage and work effectively with Indigenous people, suppliers and communities. This in turn is intended to ensure that Indigenous staff are understood, respected and retained in

Number	Commitment
	the organisation, and that Arrow Energy maintains positive relationships with Indigenous communities. Arrow will ensure that an appropriate cultural heritage training will be developed and delivered to all workers on the project, consistent with the principles in the current corporate cultural heritage training.
C26.34A	Identify the range of skill sets required for the labour force and provide this information to relevant agencies. Undertake a gap analysis against existing skills availability and identify in consultation with relevant agencies, appropriate strategies to fill these gaps, e.g., FIFO/DIDO or training. Common with Chapter 27, Economics.
C26.35	Determine how to maximise local employment opportunities and develop a recruitment plan to identify what positions will be targeted without negatively impacting on the availability of local services. Common with Chapter 27, Economics.
C26.36	Develop a policy that facilitates equal opportunity for all suitably qualified persons.
C26.37	Where appropriate, identify opportunities where training provided by the project or other training providers will be able to meet skills gaps in the community for the project to assist in maximising local employment opportunities. Common with Chapter 27, Economics.
C26.38A	Develop a policy identifying training pathways for students and school leavers to assist students in gaining employment upon graduation. This will be done in consultation with SAIN, EQIP, Education Queensland and QMEA. Where relevant training programs have been initiated by other proponents, Arrow Energy will consider coordinating support with these where appropriate. Existing Arrow Energy training programs and initiatives that will fall within this policy include: • Go Women in Engineering and Science and Technology (Go WEST) which conducts networking and/or mentoring activities for female staff and students and enhances collaborative partnerships between regional industry, Queensland Office for Women, local government and USQ Student Services. • The Arrow Energy Aiming for a Brighter Future Program which aims to inspire, motivate and support women in rural and remote communities to return to education as mature age students to pursue distance learning pathways in science, technology, engineering and mathematics disciplines. • Education Queensland Industry Partnership (EQIP) – Gladstone which delivers courses designed to enable high school students to successfully transition into the local workforce and provide employers in the resource sector with new graduates who possess relevant skill sets. EQIP acts as a centralising body for government and industry to deliver a range of work-ready and pre-trade training courses to high school students. Arrow Energy entered into a three year partnership with EQIP in October 2012. • Queensland Minerals and Energy Academy (QMEA) which, in partnership with the Queensland Government, the Queensland Resource Council and major coal seam gas (CSG) proponents, designs and facilitates a range of programs to encourage students to pursue careers in Queensland's CSG industry. Arrow Energy entered into a three year partnership with QMEA in the Surat Basin in 2011 and the partnership was expanded in 2012 to include the Gladstone region. • Working with group training organisations and encouraging contractors to recruit and retain apprentices or trainees during operations. Common with Chapter 27, Economics.
C26.39A	Engage an Education and Training Coordinator to undertake regular reviews of labour requirements and current skills sets to ensure that training strategies meet these needs. It will be the responsibility of the coordinator to work within the Social Investment Team and various state agencies and other skills bodies to conduct

Number	Commitment
	assessments of existing community skills.
C26.41A	Continue existing Arrow Energy programs to provide entry level positions within the business and opportunities for women, young people and people with a disability. The programs currently operational are: • Graduate Program. • Vacation Employment. • Indigenous Scholarships. • Traineeships. • Apprenticeships.
C26.42	The following Arrow Energy programs will be expanded to suitably qualified local employees: • Executive and Management Development Programs. • External Education Program. • Vocational/Trade Training. • Specialist Training.
C26.43	Arrow Energy will work with Skills Queensland to deliver work readiness and skills development training programs for vulnerable local people such as the long term unemployed or under skilled, in order to assist them to gain employment. Common with Chapter 27, Economics.
C26.44A	Finalise and implement the Australian Industry Participation Plan (AIPP), which provides detailed information about the strategies and approaches to be undertaken by Arrow Energy to: • Encourage contractors to source local goods and services where possible. • Encourage business to consider Indigenous procurement to maximise Indigenous employment opportunities. • Engage with key business bodies regarding appropriate opportunities for local businesses to supply goods and services to the project. The AIPP is being developed in consultation with the Federal government and the Coordinator General.
C26.45A	Provide ICN Queensland and DSDIP with the information they require to assist local businesses improve their skills base and tailor their operations to meet the project's needs.
C26.46	Develop processes to ensure local business opportunities are considered in project procurement practises. These processes will allow capable local business to be given fair and reasonable opportunities to compete for the supply of goods or services to the project.
C26.47	Encourage contractors to source local goods and services where possible.
C26.48	Encourage businesses who provide goods and services to the project to consider Indigenous procurement in order to maximise Indigenous employment opportunities.
C26.49	Arrow Energy will continue to engage with key business bodies regarding appropriate opportunities for local businesses to supply goods and services to the project.
C26.50A	Facilitate the communication of the Local Content Policy to local service providers. This will involve ongoing communication of project procurement requirements, regular project updates during construction, overview of goods and services packages and supply chain. This will be communicated through initial procurement information sessions in Gladstone for potential suppliers and ongoing on the Arrow Energy website.
C26.51	Participate in existing programs that provide technical assistance and briefings to

Number	Commitment
	potential local and regional businesses about opportunities and requirements (e.g., Gladstone Region Leaders in Business – Speakers Series and the Gladstone Tender Readiness Program). Briefings will contain information on management systems and other requirements.
C26.52	Collaborate with the existing job service that has been set up by other proponents for local businesses and use this to advertise for local positions. This will allow applicants to choose between industry and non-industry jobs.
C26.53	Provide information to the TAFE system to inform the specialised small business solutions programs on what is required to provide goods and services to the LNG industry.
C26.54	In accordance with project requirements an emergency management plan will be developed that will cover joint emergency response planning in collaboration with emergency service providers and local neighbours (e.g., in response to boating or traffic accidents).
C26.55	Ensure monitoring results of workplace health and safety are communicated to the public and to the RCCC as part of Arrow Energy's annual reporting.
C26.56	Details of the approved traffic management plans will be made available on the Arrow Energy website.
C26.57	Continue to liaise with Maritime Safety QLD regarding their safety education campaign for boat users and anglers.
C26.58	The project will collaborate with other proponents to coordinate communications and responses to safety concerns such as increased activity in Gladstone Harbour or other activities associated with the LNG industry.
C26.59A	Arrow Energy will engage with landholders in close proximity to construction works in advance of works.
C26.60	Arrow Energy will publicly release information on how environmental impacts are being offset by the project.
C26.61A	Continue support for a Gladstone Gas Industry aero-medical retrieval service CareFlight. Arrow Energy, in collaboration with Origin Energy, Queensland Gas Company and Santos, has agreed to fund Gladstone Gas Industry aero-medical retrieval service in the region, commencing in mid-2013. The service is provided by CareFlight who are one of only two fully integrated aero-medical retrieval operations in the world. CareFlight employs its own full time emergency doctors, paramedics and flight crews to perform approximately 3000 retrievals a year in Queensland alone. The Aero-Medical Retrieval Service will assist in providing 100 free hours to Queensland Health for community based aeromedical recovery services.
C26.62	Complementing the induction and welcome kit provided at induction (in the community investment and wellbeing action plan), non-local employees will also be provided with relevant information on sexual health and fatigue management at induction.
C26.63A	Implement policies and programs to maintain the wellbeing of personnel, including: • Provision of welfare and recreation facilities. • Provision of a counselling service (including drug and alcohol services*). • Implementation of a range of Arrow Energy policies including the OHS Policy, Drug, Alcohol and Contraband Policy, Duty to Stop Work Policy and Fit for Duty Policy. • Enforcement of smoking regulations on site. • Restrictions on working hours to reduce worker fatigue. • Provision of nutritionally balanced food to all personnel living within construction

Number	Commitment
	camps in line with guidance issued by Queensland Health. *At all times Arrow Energy's Drug, Alcohol and Contraband and Fit For Duty Policies will apply to the workforce whilst on Arrow Energy sites and whilst engaged in Arrow Energy work.
C26.64A	A project code of conduct, based on Arrow Energy's existing Code of Conduct and 'drug and alcohol' policy will cover workforce behaviour while on shift or on site. This code will be made available to the community on the website.
C26.65	Arrow Energy will explore the opportunity to stagger rostering with other proponents to avoid staff from all LNG projects passing through Gladstone simultaneously.
C26.66	Arrow Energy will provide an onsite health service for the workforce on Curtis Island and will liaise with emergency services and Queensland health in the planning of this facility.
C26.67	Arrow Energy will support programs that contribute to the health and wellbeing of Indigenous employees.
C26.68	Arrow Energy will communicate information about measures to reduce the impact on air quality through the Arrow Energy website.
C26.69	Details of measures to address impacts on visual amenity will be communicated on the Arrow Energy website.
C26.70	Details of measures to address noise impacts will be available on the Arrow Energy website.
C26.71	Continue to participate in the Industry Leadership Group for CSG Resource Projects.
C26.72	Participate in the existing RCCC for Gladstone.
C26.73	Participate in CSG Industry Monitoring Group established by APLNG and QCLNG.
C26.74A	As per the community investment and wellbeing plan work with key stakeholders to coordinate investment efforts.
C26.75A	As per the housing and accommodation plan, continue to engage the Office of the Coordinator-General, other proponents and state agencies to manage housing and accommodation across the industry.
C26.76	As per the workforce and training plan, continue to work with existing training providers to coordinate assistance for relevant training programs.
C26.77A	As per the local content plan, collaborate with the job service established by other proponents for local businesses.
26.78	Develop an operations accommodation strategy 24 months prior to the completion of construction. This strategy will include a commitment to company facilitated accommodation to meet the anticipated demand for up 225 beds during operation of trains 1 and 2. It is anticipated that all of these beds will be provided in company facilitated communal accommodation which may be met directly by the project, either through the development of purpose built accommodation or through agreements with third party providers. Examples of the company facilitated communal accommodation include: • Medium to high density developments. • Third party construction camps already operational in the Gladstone Region. • Pioneer workers camp on the mainland. • Rental properties where market conditions allow. The strategy will identify the preferred approach for facilitating 130 houses during operation of trains 1 and 2. This will be based on the state of the market to meet this project generated demand and required market interventions to minimise adverse impacts upon the community.

Number	Commitment
26.79	Participate in OESR surveys to monitor housing and worker accommodation in Gladstone undertaken for the Gladstone Housing Report.
26.8	Develop an early works workforce accommodation strategy covering the period from construction commencement until final commissioning of the Curtis Island construction camp. This strategy will identify options for accommodating all project workers who will need to be accommodated on the mainland prior to the establishment of the Curtis Island Camp. Options that will be considered for the accommodation of these workers will include: • Residential properties. • Third party provided construction camp facilities. • Other forms of accommodation facilitated by the project, depending on accommodation availability.
26.81	Design the Curtis Island Camp to provide sufficient accommodation for up to 2,500 workers and ensure it has a design life of approximately five years to cover the entire construction phase of the project. Following the completion of Stage 1 of the project, consider decommissioning the camp or maintaining the camp for the Stage 2 construction phase, depending on expected timing. Decommission the construction camp following all project construction phases and stabilise, reinstate and rehabilitate the site to a self-sustaining landform.
26.82	Consider options for the accommodation of the tunnel workforce, including residential properties, third party provided construction camp facilities, another form of accommodation facilitated by the project or TWAF, depending on accommodation availability.
26.83	Ensure that workers associated with dredging are housed onboard the dredge vessel, or are considered as part of the early works and construction accommodation strategies.
26.84	Design the TWAF to accommodate a sufficient capacity (up to 1,000 people) to act as an overflow camp for FIFO workers if the construction camp reaches capacity. The camp will also provide accommodation for workers associated with mainland based activities, e.g., pipeline and tunnel construction. This facility will have a shorter lifespan to the main construction camp on the island, during the peak construction period.
26.85	Implement Arrow Energy's Aboriginal and Torres Strait Islander Action Plan which outlines Arrow Energy's commitment to Indigenous Australians, working with Traditional Owners and negotiating Indigenous Land Use Agreements (ILUA's), around the four goals of: • Ensuring Arrow Energy is culturally safe and culturally competent. • Recruiting and retaining Aboriginal and Torres Strait Islander staff. • Connecting Aboriginal and Torres Strait Islander people with business and employment opportunities. • Supporting Aboriginal and Torres Strait Islander education. This action plan can be found on the Arrow Energy website, www.arrowenergy.com.au
26.86	Implement actions within Arrow Energy's Aboriginal and Torres Strait Islander Action Plan relating to the provision of educational opportunities for Indigenous students. Existing initiatives within the Action Plan include the following: • The Queensland Aboriginal and Torres Strait Islander Foundation (QATSIF) providing support to 69 Indigenous students entering year 11 or 12 in 2013 by providing bursaries that cover school-related expenses such as uniforms, IT levies, and VET expenses.

Number	Commitment
	• The Yalari Foundation, providing support to three Indigenous students commencing high school in 2013 to obtain a high quality education at a boarding school suited to their education and cultural needs. • Partnering with six of Queensland's leading universities (University of Southern Queensland, Central Queensland University, James Cook University, University of Queensland, Queensland University of Technology and Griffith University) to provide a total of 25 scholarships to Indigenous students across a range of fields. These scholarships include a package of financial support, mentoring and peer support. • Encouraging Indigenous Australians to apply for its graduate program, vacation employment, traineeships and apprenticeships.
26.87	Continue to work with industry groups that are focused on increasing the engagement of women in the industry and developing pathways for women to work in non-traditional roles. Arrow Energy is already committed to: • Attending the Women in Mining Industry network. • Attending the quarterly meeting hosted by the University of Central Queensland.
26.88	Continue to support the careers in gas website or other similar initiatives.
26.89	Emergency management planning for the project will be undertaken in accordance with the requirements of the relevant codes and standards such as the National Standard for the Control of Major Hazard Facilities, the National Code of Practice and the Dangerous Goods Safety Management Act. All emergency management planning will be undertaken in consultation with relevant Queensland government authorities and emergency services organisations (including the Department of Community Safety and Emergency Management Queensland, Queensland Ambulance Service, Queensland Fire and Rescue Service and Emergency Management Queensland). A wider program of consultation will be undertaken to inform the development of emergency response plans. Representatives from the Curtis Island LNG projects, the LNG Incident Response Group Captains, Maritime Safety Queensland, Regional Harbour Master (Gladstone), Gladstone Ports Corporation, Queensland Police Service, Queensland Fire and Rescue Service and Queensland Ambulance Service will be consulted on the development of these plans.
26.90	Continue to participate in a number of safety initiatives in Gladstone including: • Meet (as required) with Council, Industry, local businesses, police and hospital to help address alcohol fuelled anti-social behaviour. • Contribute to LNG funded extra police in the CBD during peak times. • Work with Volunteer Marine Rescue and Maritime Safety Queensland on boating safety awareness. This involves working with recreational boat users (at boat ramps) to ensure they are up to date with maritime rules. • Arrow Energy is aware that other groups are operating in the region on programs relating to road safety awareness, multicultural issues and domestic violence and are exploring opportunities to participate in these initiatives.
26.91	Communicate project activities, milestones, workforce numbers and other relevant information to appropriate state departments and agencies as well as local government to help plan for demand on services.
26.92	Develop a detailed medical emergency response plan which outlines key areas of responsibility for personnel on site and the medical emergency facilities and resources available. A range of medical emergency facilities and resources will be made available in accordance with the minimum standards set out in the Shell Exploration and Production Medical Emergency Response Guidelines (2005). These will be detailed in the medical emergency response plan and include: • An appropriately designed on-site medical facility.

Number	Commitment
	• Trained medical personnel. • First aid equipment. • An appropriate method of transport from facility to shore. • Remote medical support. A detailed medical emergency response study will be undertaken to assess transport times between the LNG plant and the mainland and determine whether required response times can be met. Arrow Energy will also contribute to a common Curtis Island local emergency response strategy being developed by the various stakeholders involved in the Curtis Island LNG projects.
26.93	Issues of concern in respect to air quality, visual amenity and noise will be addressed in accordance with the complaints management system. The RCCC for Gladstone will also serve as a vehicle through which these issues can be raised, actioned and addressed.
26.94	As per the housing and accommodation action plan, take a position on the GAH reference group upon the commitment of funding at FID.
Economics	
C26.02A	Identify options to meet the demand for dwellings, which minimises the use of rental properties unless vacancy rates increase to 3% or higher. Possible options could include: • Providing rental guarantees or other incentives to private investors to encourage the construction of new housing stock which can be used by project staff. • Encouraging all non-local employees to live in company facilitated housing unless they have families or other circumstances that make this impractical. • Providing direct and indirect investment in the housing market. • Providing accommodation advice services for workers and their families. Common with Chapter 26, Social.
C26.04	Collect data on where workers are residing and whether they have a family with them. Determine the level of local employment and the likely number of non local workers and their families seeking accommodation in the study area. Common with Chapter 26, Social.
C26.06A	Develop a construction workforce accommodation strategy within 12 months of awarding the EPC contract. The strategy will identify the preferred approach for facilitating up to 90 houses during the construction phase. This will be based on the state of the market to meet this project generated demand and required market interventions to minimise adverse impacts upon the community. Common with Chapter 26, Social.
C26.07	Through the construction workforce accommodation strategy, include a commitment to company facilitated accommodation to meet the anticipated demand for up to 380 beds during construction of trains 1 and 2. It is anticipated that all of these beds will be provided in company facilitated communal accommodation which may be met directly by the project, either through the development of purpose built accommodation or through agreements with third party providers. Examples of the company facilitated communal accommodation include: • Medium to high density developments. • Third party construction camps already operational in the Gladstone Region. • Pioneer workers camp on the mainland. • Rental properties where market conditions allow.

Number	Commitment
	Common with Chapter 26, Social.
C26.08A	Identify opportunities through the construction workforce accommodation strategy to bring forward facilitation of housing intended for the operations workforce that can be used for the construction workforce. Common with Chapter 26, Social.
C26.09A	Provide information on the Arrow Energy website on actions taken to meet project housing needs Common with Chapter 26, Social.
C26.10	Collaborate with other proponents in the region and identify opportunities to share temporary accommodation where possible for the construction and maintenance workforces. Common with Chapter 26, Social.
C26.11	Inform the tourist industry and other peak business bodies of anticipated time frames for peak temporary accommodation demand. Common with Chapter 26, Social.
C26.12A	Work with the Queensland Government, Gladstone Regional Council and affordable housing providers to identify opportunities in the study area to bring additional affordable housing to market for existing residents. Common with Chapter 26, Social.
C26.14A	Provide $6.5 million towards the development of affordable housing options in Gladstone. Arrow Energy has met with and agreed to contribute to GAH following FID. This includes a position on the reference group. Common with Chapter 26, Social.
C26.15	Provide information on the Arrow Energy website on actions taken to support affordable housing initiatives to offset housing impacts. Common with Chapter 26, Social.
C26.16A	Provide $1 million for emergency rental assistance to GRC for distribution. Arrow Energy has commenced discussions with GRC and will continue to work with them to develop the criteria and distribution processes for access to ERA funding. This is intended to ensure that it reflects local community needs and compliments the current agreements within the ERA program with the other proponents. Common with Chapter 26, Social.
C26.12A	Work with the Queensland Government, Gladstone Regional Council and affordable housing providers to identify opportunities in the study area to bring additional affordable housing to market for existing residents. Common with Chapter 26, Social.
C26.34A	Identify the range of skill sets required for the labour force and provide this information to relevant agencies. Undertake a gap analysis against existing skills availability and identify in consultation with relevant agencies. Appropriate strategies to fill these gaps, e.g., FIFO/DIDO or training. Common with Chapter 26, Social.
C26.35	Determine how to maximise local employment opportunities and develop a recruitment plan to identify what positions will be targeted without negatively impacting on the availability of local services. Common with Chapter 26, Social.
C26.37	Where appropriate, identify opportunities where training provided by the project or other training providers will be able to meet skills gaps in the community for the project to assist in maximising local employment opportunities. Common with Chapter 26, Social.
C26.38A	Develop a policy identifying training pathways for students and school leavers to assist students in gaining employment upon graduation. This will be done in consultation with SAIN, EQIP, Education Queensland and QMEA. Where relevant

Number	Commitment
	training programs have been initiated by other proponents, Arrow Energy will consider coordinating support with these where appropriate. Existing Arrow Energy training programs and initiatives that will fall within this policy include: • Go Women in Engineering and Science and Technology (Go WEST) which conducts networking and/or mentoring activities for female staff and students and enhances collaborative partnerships between regional industry, Queensland Office for Women, local government and USQ Student Services. • The Arrow Energy Aiming for a Brighter Future Program which aims to inspire, motivate and support women in rural and remote communities to return to education as mature age students to pursue distance learning pathways in science, technology, engineering and mathematics disciplines. • Education Queensland Industry Partnership (EQIP) – Gladstone which delivers courses designed to enable high school students to successfully transition into the local workforce and provide employers in the resource sector with new graduates who possess relevant skill sets. EQIP acts as a centralising body for government and industry to deliver a range of work-ready and pre-trade training courses to high school students. Arrow Energy entered into a three year partnership with EQIP in October 2012. • Queensland Minerals and Energy Academy (QMEA) which, in partnership with the Queensland Government, the Queensland Resource Council and major coal seam gas (CSG) proponents, designs and facilitates a range of programs to encourage students to pursue careers in Queensland's CSG industry. Arrow Energy entered into a three year partnership with QMEA in the Surat Basin in 2011 and the partnership was expanded in 2012 to include the Gladstone region. • Working with group training organisations and encouraging contractors to recruit and retain apprentices or trainees during operations. Common with Chapter 26, Social.
C26.43	Arrow Energy will work with Skills Queensland to deliver work readiness and skills development training programs for vulnerable local people such as the long term unemployed or under skilled, in order to assist them to gain employment. Common with Chapter 26, Social.
C27.01	Engage and collaborate with Construction Skills Queensland to identify potential strategies for increasing the capacity of local job seekers to develop appropriate skills for construction.
C27.02	Inform and advise stakeholders of project goods and services requirements, and of opportunities and requirements for securing service provision and supply contracts. This will include implementation of a Local Content Strategy to aid suitable businesses in the tender process.
C27.03	Inform council and economic development organisations of goods and services required by the Arrow LNG Plant that are not currently available or are under-serviced from within Gladstone to attract investment and develop the supply chain.
C27.04	Investigate options to develop relevant networks to connect local business and enable collaboration in meeting service supply requirements of the LNG industry.
C27.05	Develop a detailed worker accommodation plan to accommodate workers during the period between final investment decision and commissioning of the construction camps. This will include continuing to liaise with the other proponents, housing providers and state and local government to determine the cumulative housing demand and cooperative strategies which address this demand.
C27.06	Develop construction worker camps as soon as practical following final investment decision.
C27.07	Make the local residential development market aware of the scale and timing of

Number	Commitment
	project accommodation requirements and construction and operations activities.
Traffic and Transport	
C28.01	Develop a traffic management plan for the project in consultation with DTMR and Gladstone Regional Council. Methods to ensure public safety at project sites, avoid obstruction to other road users, address seasonal weather influences on transport arrangements and manage any issues including driver fatigue will be detailed in the plan. The traffic management plan will address the movement of oversized loads. Common with Chapter 29, Hazard and Risk.
C28.02	Undertake a pavement intersection assessment and bridge capacity assessment when preferred transport routes are identified.
C28.03	Implement a formal local workforce car-pooling or busing strategy to minimise the number of local project personnel using the roads during peak hour and to maximise usage of accommodation on Curtis Island. A busing strategy may comprise a number of small buses travelling from areas central to where personnel live. A staff matching or car pooling strategy will also be considered.
C28.04	Use DTMR/Gladstone Regional Council preferred freight routes where practical.
C28.05	Separate pedestrian access from vehicle access in access to construction and operational work sites (where practical).
C28.06	Consult DTMR and Gladstone Regional Council on the scope and timing of already identified upgrades and project-specific upgrades (including potential contributions) that may be required when final routes for freight and workforce bus routes are confirmed. This process will take place during the preparation of the detailed traffic management plan for the project and may include, subject to final TWAF/mainland launch site selection and completion of the detailed logistics strategy: • Timing of Gladstone–Mount Larcom Road upgrades and whether upgrades need to be brought forward. • Design of a new intersection accessing the proposed tunnel entry site from Gladstone–Mount Larcom Road. • Intersection A: Hanson Road/Blain Drive/Alf O'Rourke Drive (all transport scenarios). DTMR have identified works to this intersection; however, the project may necessitate additional works. Timing of DTMR works may need to be brought forward. • Intersection B: Gladstone–Mount Larcom Road/Landing Road (transport scenario 3). The existing intersection layout is not expected to accommodate project-related traffic at 2024 and 2026. DTMR has identified works at this intersection (four lanes required between 2020 and 2030). Timing of DTMR works may need to be brought forward to early in the 2020 to 2030 period to accommodate project traffic. • Intersection C: Gladstone–Mount Larcom/Red Rover Road (transport scenario 3). DTMR have identified works to this intersection; however, the project may necessitate additional works. Timing of works may need to be brought forward due to the project.
C28.07	Consult with providers of air services to Gladstone on the timing of construction and operations weekly shifts to aid commercial decision making by service providers on the frequency of services and capacity of aircraft.
C28.08	Provide a share of funding toward the new instrument landing system at Gladstone Airport upon project FID.
C28.09A	Develop a marine activity management plan (incorporating a Port of Gladstone shipping activity strategy and management plan) in consultation with Gladstone Regional Council, Gladstone Ports Corporation, Maritime Safety Queensland and all contractors operating within the Gladstone Port. Common with Chapter 29, Hazard and Risk.

Number	Commitment
C28.10	Operators of project vessels, Arrow Energy staff and contractors, to comply with the Gladstone port procedures manual, which details LNG operating parameters.
C28.11A	Ensure that operators of project vessels, Arrow Energy staff and contractors comply with the marine activity management plan if/when this plan is agreed between Maritime Safety Queensland, Gladstone Ports Corporation and the other LNG proponents. Common with Chapter 29, Hazard and Risk.
C28.12	Ensure that operators of project vessels, Arrow Energy staff and contractors comply with Arrow Energy rules for marine vessels and LNG shipping operations in addition to following the Oil Companies International Marine Forum (OCIMF) and Society of International Gas Tanker and Terminal Operators guidelines (SIGTTO). Rules will address crew competencies, a three-stage approvals process for each LNG vessel (i.e., vetting of ships and operators prior to engagement to transport LNG), scheduling and other requirements and quality assurance. For the construction period, additional rules will address safety and competency requirements of smaller marine vessels and vessel operators involved with the project.
C28.13	Provide support for tug and LNG carrier pilot training organised by all proponents, the Gladstone Ports Corporation, Maritime Safety Queensland and SMIT tugs.
Hazard and Risk	
C29.01	Undertake qualitative and quantitative hazard and risk assessments (including process safety studies) in accordance with applicable regulations and standards as a part of the ongoing design process and throughout the life of the project.
C29.02	Consult with relevant Queensland government agencies including emergency services organisations and maritime safety authorities on the management of hazards and risks in accordance with relevant legislative requirements, codes and standards.
C28.01	Develop a traffic management plan for the project in consultation with DTMR and Gladstone Regional Council. Methods to ensure public safety at project sites, avoid obstruction to other road users, address seasonal weather influences on transport arrangements and manage any issues including driver fatigue will be detailed in the plan. The traffic management plan will address the movement of oversized loads. Common with Chapter 28, Traffic and Transport.
C28.09A	Develop a marine activity management plan (incorporating a Port of Gladstone shipping activity strategy and management plan) in consultation with Gladstone Regional Council, Gladstone Ports Corporation, Maritime Safety Queensland and all contractors operating within the Gladstone Port. Common with Chapter 28, Traffic and Transport.
C28.11A	Ensure that operators of project vessels, Arrow Energy staff and contractors comply with the marine management plan if/when this plan is agreed between Maritime Safety Queensland, Gladstone Ports Corporation and the other LNG proponents. Common with Chapter 28, Traffic and Transport.
Land Use and Planning	
C30.01	Design the feed gas pipeline to minimise the project land requirement and extent of potential disruption to existing and alternate land uses.
C30.02	Site, design, construct and operate project components having regard to legislation, policy, and statutory instruments and guidelines. Compliance with design codes and standards of the project components during construction, operation and decommissioning will be assessed and determined through a range of post EIS applications for approvals, permits and licences.
C30.03	Establish exclusion zones around the LNG plant and maritime areas to ensure the safety of LNG personnel, the public, shipping and maritime assets and do not

Number	Commitment
	unnecessarily prevent public access to areas of coastline.
C30.04	Prior to construction, consult landowners within the project area on the potential direct impacts to their assets, land use activities, and any temporary disruption to supporting utility services and infrastructure. This consultation will inform the final property-specific design and mitigation measures.
C30.05	Liaise with the Regional Harbour Master of Gladstone on the potential for telecommunications devices to affect aids to navigation infrastructure or services.
Waste Management	
C31.01	Implement employee training and other programs that encourage employees to reduce waste.
C31.02	Ensure that contractors comply with Arrow's Health, Safety and Environmental Management System (HSEMS) and implement a waste management plan in accordance with the procedure.
C31.03	Substitute raw materials or inputs with an equivalent, less hazardous or toxic material, where practical.
C31.04	Institute good housekeeping and operating practices, including substituting materials for an equivalent and more environmentally friendly option and inventory control to reduce the amount of waste resulting from materials that are out of date, off specification, contaminated, damaged, or excess to project needs.
C31.05	Implement stringent waste segregation processes to prevent the co-mingling of water and waste streams.
C31.06	Clear the smallest construction footprint practical, thereby reducing the generation of green waste, acid sulfate soils, overburden, topsoil and greenhouse gases.
C31.07	Evaluate waste production processes and identify potentially recyclable materials.
C31.08	Identify and recycle products that can be reintroduced into the process or activity at the site.
C31.09	Establish recycling objectives and formal tracking of waste generation and recycling rates.
C31.10	Install dedicated skip bins for designated wastes around the construction site.
C31.11	Establish a dedicated waste sorting or laydown area early in the project. Store inert material such as concrete in this area, and periodically crush and screen when sufficient quantity has been gathered. Use crushed material as rock base and fill, or dispose to landfill.
C31.12	Mulch leaves, branches and timber on site and use this for site stabilization or erosion control and landscaping.
C31.13	Collect and recycle ferrous and non-ferrous metals, paper and cardboard, glass, spent sulfuric acid and batteries, and waste oils. Dispose of solid wastes that cannot be recycled or re-used at a landfill or licensed facility.
C31.14	Require suppliers to consider measures and options to reduce packaging and increase recycling. Include this requirement in the tendering and contracting process.
C31.15	Store wastes in a manner that prevents the co-mingling of, or contact between incompatible wastes and that allows for inspection between containers to monitor leaks or spills.
C31.16	Provide adequate ventilation where volatile wastes are stored.
C31.17	Provide hardstanding surfaces at oil storage areas, fuel filling points and the mechanical repair shop.
C14.04	Store fuels, chemicals and hazardous wastes in appropriately sized bunded storage

Number	Commitment
	facilities (in leak-proof sealed containers). Common with Chapter 14, Groundwater.
C31.18	Install drainage and sump systems in appropriately sized bunded compounds to assist with the removal of any waste materials released into the containment system.
C31.19	Locate stockpiles of waste materials (such as concrete, tyres and waste polyethylene) in dedicated laydown areas with appropriate drainage.
C31.20	Label all storage containers for clear identification of the contents, as per the appropriate regulations.
C13.12	Develop appropriate spill prevention and response plans to cover project activities and the types and quantities of fuel, oil and chemicals held at each site. Common with Chapter 13, Surface Water Hydrology and Water Quality and Chapter 14, Groundwater and Chapter 16, Marine Water Quality and Sediment.
C13.13	Train all relevant personnel in spill response and recovery procedures. Common with Chapter 13, Surface Water Hydrology and Water Quality.
C31.21	Cover waste storage bins for domestic and food wastes.
C31.22	Use an appropriately licensed contractor to collect (on a regular basis) waste generated from accommodation quarters.
C31.23	Strip topsoil from areas of planned soil disturbance to provide material for rehabilitation, where practical.
C31.24	Stockpile excess overburden (that is not suitable for hardstand use or site fill) on site, where practical. Overburden will be managed to ensure runoff is controlled and erosion is minimised.
C31.25	Handle waste chemicals in accordance with the appropriate material safety data sheet (MSDS).
C31.26	Provide sufficient space to allow for the segregation and storage of wastes.
C31.27	Treat the following wastes in the effluent treatment plant, with the exception of sewage from the pioneer camp and the TWAF: • Contaminated or potentially contaminated stormwater from process areas at the LNG plant. • Dry weather flow such as water from wash-down bays and liquids wastes from the laboratory. • Effluent from LNG operations such as wastewater and slops oil from the boil-off gas compressor area and the flare knock-out water. • Gas turbine wash water. • Oily water from the slops oil tank. • Sewage and greywater from the accommodation areas and the LNG plant.
C14.08	Collect sewage and greywater generated from the pioneer camp in portable disposal units or other mobile collection facilities. Use a licensed waste contractor to service the sewage facilities and dispose of effluent at a licensed waste management facility. Dispose of sewage from the mainland TWAF through a connection to the local sewerage network or ensure that it is collected in portable disposal units or other mobile collection facilities. Common with Chapter 14, Groundwater.
C31.28	Design the effluent treatment plant package units to meet the final effluent discharge requirement.
C31.29	Design the effluent treatment plant based on the first 30 minutes of peak rainfall flow estimation from process areas.
C31.30	Monitor treated effluent and reroute any discharge that is off-specification back to

Number	Commitment
	the effluent treatment plant for retreatment.
C31.31	Make alternative storage and disposal options available during times of system failure and in conditions preventing discharge to land such as rain events. Distribute the effluent treatment plant discharge to tanks for re-use on site. The tanks can be by-passed and the treated effluent discharged to the marine outfall if necessary.
C31.32	Maintain records of inspection, maintenance, sampling, and cleaning of the effluent treatment plant.
C31.33	Do not dispose of any waste in landfills or by incineration on Curtis Island.
C31.34	Irrigate to land or re-use on site treated wastewater from the effluent treatment plant.
C31.35	Develop a recycled water management plan for the project. Undertake a site assessment and desktop study to select appropriate sites, vegetation and irrigation methods to support the development of the plan.
C31.36	Direct brine from the reverse osmosis plant into Port Curtis via a diffuser outfall pipe located a sufficient distance offshore to ensure free flowing current conditions to adequately disperse the brine.
C31.37	Collect the clean catchment runoff through peripheral drains at the LNG plant site discharging to Port Curtis.
C16.01	If an RO plant is adopted, the design of the brine discharge outfall from the LNG Plant will include a three-port diffuser at the end of the pipeline located close to the water surface (or the ports angled towards the surface) to maximise dilution of the negatively buoyant discharge stream. Common with Chapter 16, Marine Water Quality and Sediment.
C31.38	Install signs on site clearly indicating drains that discharge directly to the marine environment.
C31.39	Transport excess concrete to the mainland for disposal or re-use if there is no use for the material on site.
C13.10	Manage all surface water generated from the LNG plant site by a stormwater treatment system to ensure discharged water complies with regulatory requirements. Common with Chapter 13, Surface Water Hydrology and Water Quality.
C31.40	Engage an appropriately licensed waste contractor (on an as-required basis) to remove from site those specific liquid wastes that cannot be processed on site.
C31.41	Engage an appropriately licensed waste contractor to transport off site all solid waste that cannot be reprocessed or recycled on site, for disposal at a recycler, reprocessor or other waste management facility such as a landfill. The majority of the solid waste will be disposed of at the Benaraby Regional Landfill. Agreement for the disposal of solid waste at this landfill will be obtained from Gladstone Regional Council.
C31.42	Ensure all vehicles entering and leaving Curtis Island are clean, and loads securely stowed, and covered where practical.
C31.43	Record all regulated wastes removed from the site in a waste register.
C31.44	Dispose of all regulated wastes at licensed waste management sites within Queensland, unless a specialised treatment is required that is not available in Queensland at the time treatment and disposal is required.
C31.45	Transport all regulated wastes by a waste transporter with the appropriate DERM authority to collect and dispose of the waste.
C31.46	Ensure that vehicles transporting regulated waste are licensed to carry the particular type of waste and that operators complete appropriate waste tracking documentation.
C31.47	Develop an emergency response plan for the project and include spill contingency or

Number	Commitment
	emergency measures. Make material safety data sheets available at the LNG plant and other project sites to aid in the identification of appropriate spill clean-up and disposal methods.
C31.48	Ensure that specific spill prevention procedures cover the unloading and loading activities at the LNG jetty and MOF in accordance with applicable international standards and guidelines. Spill prevention procedures will specifically address advanced communications and planning with the receiving terminal.
C31.49	Manage combustible wastes and ignition sources appropriately to eliminate fire hazards.
C31.50	Divert firewater generated in process areas or other areas draining to the controlled discharge facility to the effluent treatment plant. Additional firewater will be directly discharged through the marine outfall.

Appendix 5. Social impact assessment

Schedule 1. Social impact assessment action plans

HOUSING AND ACCOMMODATION

Introduction		
Purpose	The purpose of this plan is to identify actions that: ■ Manage the increased pressure placed by the project on the GRC housing market for renters and those seeking to purchase dwellings. ■ Manage the impact of increased utilisation by project workers of temporary accommodation such as hotels, motels and serviced apartments.	
Objectives	■ To adequately house the non-local project workforce. ■ To minimise inflationary pressure on the local housing market. ■ To minimise displacement of vulnerable groups including low and middle income households and Indigenous persons in the GRC. ■ To reduce the potential for the project workforce to displace other users of temporary accommodation.	
Stakeholders	Arrow Energy Chamber of commerce DETE Department of Communities, Child Safety and Disability Services EPC contractor GAPDL GRC Housing industry Indigenous community representatives	Local communities Non government social housing providers Office of the Coordinator General Other proponents Other tourism and business bodies RCCC Traditional Owners Urban Land Development Authority
Scope	All actions in the housing and accommodation plan cover Arrow Energy employees, the EPC contractor and sub-contractors during the construction and operations stages.	

Impacts							
Impact	**Nature**	**Phase**	**Extent**	**Duration**	**Severity**	**Likelihood**	**Significance**
Increased housing costs	Negative	Construction Operation	Local	Long term	Medium	Probable	High
Reduced housing affordability for Indigenous people	Negative	Construction Operation	Local	Long term	Medium	Definite	High

Reduced availability of staff at existing social infrastructure.	Negative	Construction	Local	Medium term	Low	Possible	Moderate

Mitigation		
Mitigation Actions	**Responsibility**	**Timeframe**
Construction Workforce Accommodation		
Develop a construction workforce accommodation strategy within twelve months of awarding the EPC contract. This strategy will include a commitment to company facilitated accommodation to meet the anticipated demand for up 380 beds during construction of trains 1 and 2. It is anticipated that all of these beds will be provided in company facilitated communal accommodation which may be met directly by the project, either through the development of purpose built accommodation or through agreements with third party providers. Examples of the company facilitated communal accommodation include: ▪ Medium to high density developments. ▪ Third party construction camps already operational in the Gladstone Region. ▪ Pioneer workers camp on the mainland. ▪ Rental properties where market conditions allow. The strategy will identify the preferred approach for facilitating up to 90 houses during the construction phase. This will be based on the state of the market to meet this project generated demand and required market interventions to minimise adverse impacts upon the community. It will also identify opportunities to bring forward facilitation of housing intended for the operations workforce that can be used for the construction workforce.	Arrow Energy EPC contractor Housing industry GRC	Twelve months of awarding the EPC contract
Identify options to meet the demand for dwellings, which minimises the use of rental properties unless vacancy rates increase to 3% or higher. Possible options could include: ▪ Providing rental guarantees or other incentives to private investors to encourage the construction of new housing stock which can be used by project staff. ▪ Encouraging all non local employees to live in company facilitated housing unless they have families or other circumstances that make this impractical. ▪ Providing direct and indirect investment in the housing market. ▪ Providing accommodation advice services for workers and their families.	Arrow Energy EPC contractor	Twelve months of awarding the EPC contract
Operations Workforce Accommodation		
Develop an operations accommodation strategy 24 months prior to the completion of construction. This strategy will include a commitment to company facilitated accommodation to meet the anticipated demand for up 225 beds during operation of trains 1 and 2. It is anticipated that all of these beds will be provided in company facilitated communal accommodation which may be met directly by the project, either through the development of purpose built accommodation or through agreements with third party providers. Examples of the company facilitated communal accommodation include: ▪ Medium to high density developments. ▪ Third party construction camps already operational in the Gladstone Region.	Arrow Energy EPC contractor Housing industry GRC	24 months prior to the completion of construction

■ Pioneer workers camp on the mainland. ■ Rental properties where market conditions allow. The strategy will identify the preferred approach for facilitating 130 houses during operation of trains 1 and 2. This will be based on the state of the market to meet this project generated demand and required market interventions to minimise adverse impacts upon the community.		
Identify options to meet the demand for dwellings, which minimises the use of rental properties unless vacancy rates increase to 3% or higher. Possible options could include: ■ Providing rental guarantees or other incentives to private investors to encourage the construction of new housing stock which can be used by project staff. ■ Encouraging all non local employees to live in company facilitated housing unless they have families or other circumstances that make this impractical. ■ Providing direct and indirect investment in the housing market. ■ Providing accommodation advice services for workers and their families.	Arrow Energy EPC contractor	Twelve months prior to operations
Reporting and liaison		
Continue to engage with the Office of the Coordinator-General and other LNG proponents to identify co-operative strategies that address cumulative housing impacts.	Arrow Energy Other proponents Office of the Coordinator General	Ongoing
Continue to liaise with other LNG proponents to determine cumulative workforce housing requirements and to determine whether the private market is able to provide sufficient dwellings in the local area for the construction and operation workforces. This will be informed by house price and rental data from the REIQ's Queensland Market Monitor and Department of Communities, Child Safety and Disability Services Housing Market Report.	Arrow Energy Other proponents	Ongoing
Collect data on where workers are residing and whether they have a family with them. Determine the level of local employment and the likely number of non local workers and their families seeking accommodation in the study area.	Arrow Energy EPC contractor GRC	Every three months during construction
Participate in OESR surveys to monitor housing and worker accommodation in Gladstone undertaken for the Gladstone Housing Report.	Arrow Energy EPC contractor OESR	Ongoing
Continue to provide data to state and local government to facilitate the creation of a common data set across all major projects. The data collected will be in the format already agreed between existing proponents and the Office of the Coordinator General.	Arrow Energy EPC contractor Office of the Coordinator General GRC	Every three months during construction

Provide information on the Arrow Energy website on actions taken to meet project housing needs.	Arrow Energy	Every six months during construction
Temporary Accommodation		
Develop an early works workforce accommodation strategy covering the period from construction commencement until final commissioning of the Curtis Island construction camp. This strategy will identify options for accommodating all project workers who will need to be accommodated on the mainland prior to the establishment of the Curtis Island Camp. Options that will be considered for the accommodation of these workers will include: ■ Residential properties. ■ Third party provided construction camp facilities. ■ Other forms of accommodation facilitated by the project, depending on accommodation availability.	Arrow Energy EPC contractor	Four months prior to construction
Design the Curtis Island Camp to provide sufficient accommodation for up to 2,500 workers and ensure it has a design life of approximately five years to cover the entire construction phase of the project. Following the completion of Stage 1 of the project, consider decommissioning the camp or maintaining the camp for the Stage 2 construction phase, depending on expected timing. Decommission the construction camp following all project construction phases and stabilise, reinstate and rehabilitate the site to a self-sustaining landform.	Arrow Energy EPC contractor	Pre construction to completion of construction
Consider options for the accommodation of the tunnel workforce, including residential properties, third party provided construction camp facilities, another form of accommodation facilitated by the project or TWAF, depending on accommodation availability.	Arrow Energy EPC contractor	Pre construction
Ensure that workers associated with dredging are housed onboard the dredge vessel, or are considered as part of the early works and construction accommodation strategies.	Arrow Energy EPC contractor	Ongoing during construction
Design the TWAF to accommodate a sufficient capacity (up to 1,000 people) to act as an overflow camp for FIFO workers if the construction camp reaches capacity. The camp will also provide accommodation for workers associated with mainland based activities, e.g., pipeline and tunnel construction. This facility will have a shorter lifespan to the main construction camp on the island, during the peak construction period.	Arrow Energy EPC contractor	During detailed design
Collaborate with other proponents in the region and identify opportunities to share temporary accommodation where possible for the construction and maintenance workforces.	Arrow Energy EPC contractor	Ongoing
Inform the tourist industry and other peak business bodies of anticipated time frames for peak temporary accommodation demand.	Arrow Energy EPC contractor Chamber of commerce GAPDL Other tourism and business bodies	Construction and every 12 months regarding key maintenance activities

Affordable Housing		
Work with the Queensland Government, Gladstone Regional Council and affordable housing providers to identify opportunities in the study area to bring additional affordable housing to market for existing residents	GRC DSDIP Arrow Energy	EPC award and during construction
Provide $6.5 million towards the development of affordable housing options in Gladstone. Arrow Energy has met with and negotiated with Gladstone Affordable Housing (GAH) to provide this funding. The GAH is committed to providing housing to key target groups including Aboriginal and Torres Strait Islander people. Arrow Energy will take a position on the GAH reference group upon the commitment of funding at FID.	GAH DOC Arrow Energy	EPC award
Provide information on the Arrow Energy website on actions taken to support affordable housing initiatives to offset housing impacts.	Arrow Energy	Every six months during construction
Provide $1 million for Emergency Rental Assistance (ERA) to Gladstone Regional Council (GRC) for distribution. Arrow Energy has commenced discussions with GRC and will continue to work with them to develop the criteria and distribution processes for access to ERA funding. This is intended to ensure that it reflects local community needs and compliments the current agreements within the ERA program with the other proponents.	Arrow Energy GRC	EPC award

HEALTH AND COMMUNITY WELLBEING

Introduction	
Purpose	The purpose of this plan is to identify actions that: ■ Enhance the community. ■ Manage impacts on existing social infrastructure, services and recreation.
Objectives	Enhance the community through targeted investment in projects, events and initiatives that; improve the safety, healthy lifestyles and liveability of the community, build sustainable learning and employment opportunities and increase awareness of the environment around us. ■ Minimise impacts on social infrastructure and services. ■ Fund projects that directly offset impacts of the project. ■ Arrow Energy's relationship with the community is maintained or improved.
Stakeholders	Arrow Energy Arrow LNG Plant workforce and contractors. Boating and fishing groups Community and not-for-profit organisations. Community service providers DETE. DOC. Education providers Education Queensland EPC contractor GRC Local communities

Impacts

Impact	Nature	Phase	Extent	Duration	Severity	Likelihood	Significance
Reduction in recreational opportunities.	Negative	Construction Operation	Local	Long term	Low	Probable	High
Increased demand on existing social infrastructure and services.	Negative	Construction Operation	Local	Long term	Low	Probable	Moderate
Increased demand on formal and informal recreational facilities.	Negative	Construction operation	Local	Medium term	Low	Possible	Moderate

Mitigation

Mitigation Actions	Responsibility	Timeframe
Social Investment program		
Arrow Energy acknowledges it has a shared responsibility with government, and society more broadly, to help facilitate the development of strong and sustainable communities. It is committed to managing the residual social impacts of its activities that	Arrow Energy	Ongoing

cannot be avoided or sufficiently minimised and to contributing to the social and economic wealth of the communities in which it operates through its social investment program. Arrow Energy has committed to each of the following social investment activities: ■ Brighter Futures Program, providing funding for community, sponsorships and partnership opportunities. ■ $3.5 million to offset or mitigate impacts of the project (comparable to other LNG Proponents). ■ $1 million for Emergency Rental Assistance to Gladstone Regional Council (GRC) for distribution. ■ $6.5 million to Gladstone Affordable Housing to develop affordable housing options. These commitments are comparative with those made by other LNG proponents. Details of the Brighter Future program for Gladstone will be released on the Arrow Energy website. This will include information on criteria for funding, funds expended, processes for applying for funding and how often funding will be available for applications. Information will also be provided on projects that receive funding or in kind support to offset or mitigate direct project impacts.		
The workforce and planning		
Design the workers camp to have sufficient social and recreational facilities to cater for recreational, fitness and entertainment requirements.	Arrow Energy EPC contractor	Prior to pioneer works
Develop and provide workers with an induction and welcome kit which includes a statement of community expectations for new arrivals. Where FIFO workers come from overseas, ensure they are provided with an adequate Australian cultural awareness briefing and information on how to undertake day to day activities, for example banking or shopping.	Arrow Energy EPC contractor GRC	EPC award
Consult with the GRC and RCCC to identify which social, community or recreational infrastructure is being directly impacted by the project and to what extent. Work with the Office of the Coordinator General and Gladstone Regional Council to identify the most suitable mechanism to coordinate efforts across all proponents and identify projects that may provide an equivalent offset or mitigation of impacts. Invest up to $3.5M for projects to offset or mitigate the impacts of the project.	Arrow Energy GRC Other relevant bodies	During construction and 12 months after commencement of operations
Ensure that there are no ongoing restrictions on the Calliope River boat ramp or Gladstone Marina during the operation of the project.	Arrow Energy	Ongoing
Prohibit non local construction workers and operators from engaging in fishing, crabbing or boating in any exclusion zone.	Arrow Energy EPC contractor	Ongoing
Prohibit all FIFO workers (with the exception of traditional owners) from fishing, crabbing and boating in the Gladstone Regional Council area, whilst on shift/ living in the construction camps.	Arrow Energy EPC contractor	During construction

Continue to provide state and local government departments responsible for educational, health and other social infrastructure with forecasts of workforce numbers and projected families to assist in their future service planning. This information will be provided in an agreed format that will allow these departments to plan for cumulative population change.	Arrow Energy DOC DETE GRC Education Queensland	construction and 12 months after commencement of operations
Indigenous Engagement		
Implement actions within Arrow Energy's Aboriginal and Torres Strait Islander Action Plan relating to the provision of educational opportunities for Indigenous students. Existing initiatives within the Action Plan include the following: ■ The Queensland Aboriginal and Torres Strait Islander Foundation (QATSIF) providing support to 69 Indigenous students entering year 11 or 12 in 2013 by providing bursaries that cover school-related expenses such as uniforms, IT levies, and VET expenses. ■ The Yalari Foundation, providing support to three Indigenous students commencing high school in 2013 to obtain a high quality education at a boarding school suited to their education and cultural needs. ■ Partnering with six of Queensland's leading universities (University of Southern Queensland, Central Queensland University, James Cook University, University of Queensland, Queensland University of Technology and Griffith University) to provide a total of 25 scholarships to Indigenous students across a range of fields. These scholarships include a package of financial support, mentoring and peer support. ■ Encouraging Indigenous Australians to apply for its graduate program, vacation employment, traineeships and apprenticeships.	Arrow Energy	Ongoing
Register the Indigenous Land Use Agreement (ILUA) that was negotiated for the project site, harbour and port area in March 2012.	Arrow Energy Traditional owners	Prior to construction
Implement Arrow Energy's Aboriginal and Torres Strait Islander Action Plan which outlines Arrow Energy's commitment to Indigenous Australians, working with Traditional Owners and negotiating Indigenous Land Use Agreements (ILUA's), around the four goals of: ■ Ensuring Arrow Energy is culturally safe and culturally competent. ■ Recruiting and retaining Aboriginal and Torres Strait Islander staff. ■ Connecting Aboriginal and Torres Strait Islander people with business and employment opportunities. ■ Supporting Aboriginal and Torres Strait Islander education. This action plan can be found on the Arrow Energy website, **www.arrowenergy.com.au**	Arrow Energy	Ongoing

Community Health and Safety		
In accordance with project requirements an emergency management plan will be developed that will cover joint emergency response planning in collaboration with emergency service providers and local neighbours (e.g. in response to boating or traffic accidents).	Arrow Energy Emergency service providers Local landholders	Prior to construction
Ensure monitoring results of workplace health and safety are communicated to the public and to the RCCC as part of Arrow Energy's annual reporting.	Arrow Energy EPC contractor RCCC	Annually
Details of the approved traffic management plans will be made available on the Arrow Energy website.	Arrow Energy EPC contractor	Ongoing during construction
Continue to liaise with Marine Safety QLD regarding their safety education campaign for boat users and anglers.	Arrow Energy Marine Safety Queensland	Ongoing
The project will collaborate with other proponents to coordinate communications and responses to safety concerns such as increased activity in Gladstone Harbour or other activities associated with the LNG industry.	Arrow Energy Other proponents	Ongoing
Arrow Energy will engage with neighbouring landholders to construction works in advance of works.	Arrow Energy EPC contractor Local landholders	As required during construction
Arrow Energy will publically release information on how environmental impacts are being offset by the project.	Arrow Energy	Annually during construction
Emergency management planning for the project will be undertaken in accordance with the requirements of the relevant codes and standards such as the National Standard for the Control of Major Hazard Facilities, the National Code of Practice and the Dangerous Goods Safety Management Act. ■ All emergency management planning will be undertaken in consultation with relevant Queensland government authorities and emergency services organisations (including the Department of Community Safety and Emergency Management Queensland, Queensland Ambulance Service, Queensland Fire and Rescue Service and Emergency Management Queensland). ■ A wider program of consultation will be undertaken to inform the development of emergency response plans. Representatives from the Curtis Island LNG projects, the LNG Incident Response Group Captains, Maritime Safety Queensland, Regional Harbour Master (Gladstone), Gladstone Ports Corporation, Queensland Police Service, Queensland Fire and Rescue Service and Queensland Ambulance Service will be consulted on the development of these plans.	Arrow Energy GRC Other proponents Emergency services	Prior to construction and ongoing

Continue to participate in a number of safety initiatives in Gladstone including: ■ Meet (as required) with Council, Industry, local businesses, police and hospital to help address alcohol fuelled anti-social behaviour. ■ Contribute to LNG funded extra police in the CBD during peak times. ■ Work with Volunteer Marine Rescue and Maritime Safety Queensland on boating safety awareness. This involves working with recreational boat users (at boat ramps) to ensure they are up to date with maritime rules. Arrow Energy is aware that other groups are operating in the region on programs relating to road safety awareness, multicultural issues and domestic violence and are exploring opportunities to participate in these initiatives.	Arrow Energy GRC Maritime Safety Queensland Other proponents	Prior to construction and ongoing
Continue support for a Gladstone Gas Industry aero-medical retrieval service CareFlight. Arrow Energy, in collaboration with Origin Energy, Queensland Gas Company and Santos, has agreed to fund Gladstone Gas Industry aero-medical retrieval service in the region, commencing in mid 2013. The service is provided by CareFlight who are one of only two fully integrated aero-medical retrieval operations in the world. CareFlight employs its own full time emergency doctors, paramedics and flight crews to perform approximately 3000 retrievals a year in Queensland alone. The Aero-Medical Retrieval Service will assist in providing 100 free hours to Queensland Health for community based aeromedical recovery services.	Arrow Energy Other LNG proponents	Ongoing
Through the Gladstone Region Community Development Committee or other mechanisms, continue to engage with local service providers and community organisations across the Gladstone region. Arrow Energy will consult with the Office for Women and the Centre for Domestic and Family Violence Research to monitor impacts of alcohol, violence and impacts on families.	Gladstone Region Community Development Committee	Ongoing
Community Amenity		
Arrow Energy will communicate information about measures to reduce the impact on air quality through the Arrow Energy website.	Arrow Energy	Within three months of the end of detailed engineering
Details of measures to address impacts on visual amenity will be communicated on the Arrow Energy website.	Arrow Energy	Within three months of FID
Details of measures to address noise impacts will be available on the Arrow Energy website.	Arrow Energy	Within three months of FID
Arrow Energy will publically release information on how environmental impacts are being offset by the project.	Arrow Energy	Annually during construction
Issues of concern in respect to air quality, visual amenity and noise will be addressed in accordance with the complaints management system. The RCCC for Gladstone will also serve as a vehicle through which these issues can be raised, actioned and addressed.	Arrow Energy	Ongoing

WORKFORCE MANAGEMENT

Introduction	
Purpose	The purpose of this plan is to identify actions that: ■ Allow for the maximum amount of local employment. ■ Provide local training opportunities.
Objectives	To create opportunities for up to 20% local employment To provide increased employment opportunities for school leavers and other people wishing to join the LNG industry. Opportunities are provided for qualified females and people from other underrepresented groups. Training opportunities are provided by the project. The overall skills base of the region is enhanced.
Stakeholders	Arrow Energy Chamber of Commerce CSG/LNG Skills Taskforce CSG/LNG Steering Committee DETE DEEWR DET Education Queensland Employment agencies and training providers Energy Skills Queensland – CSG/LNG taskforce EPC contractor EQIP GRC Industry Leadership Group LNG Industry Training Program Construction Skills Queensland – CSG/LNG Local businesses. SAIN TAFE and University Training Providers

Impacts							
Impact	**Nature**	**Phase**	**Extent**	**Duration**	**Severity**	**Likelihood**	**Significance**
Increased local employment.	Positive	Construction operation	Regional	Long term	High	Definite	High
Increased local employment opportunities with non LNG employers	Positive	Construction and operation	Regional	Medium term	Medium	Probable	High
Increased local training opportunities.	Positive	Construction operation	Regional	Long term	Medium	Probable	High

Mitigation		
Mitigation Actions	**Responsibility**	**Timeframe**
Workforce planning		
Identify the range of skill sets required for the labour force and provide this information to relevant agencies in a format consistent with the templates provided by Skills Queensland. Undertake a gap analysis against existing skills availability and identify, in consultation with relevant agencies, appropriate strategies to fill these gaps, e.g. FIFO/drive-in, drive out (DIDO) or training.	DET DETE CSG/LNG Skills Taskforce CSG/LNG Steering Committee	EPC award
Determine how to maximise local employment opportunities and develop a recruitment plan to identify what positions will be targeted without negatively impacting on the availability of local services.	Arrow Energy DETE CSG/LNG Skills Taskforce CSG/LNG Steering Committee	EPC award
Engage an Education & Training Coordinator to undertake regular reviews of non project-related labour requirements and current skills sets to ensure that training strategies meet these needs. The Coordinator will work within the Social Investment Team and various state agencies and other skills bodies to conduct assessments of existing community skills to minimise impacts on local businesses.	Arrow Energy Energy Skills Queensland – CSG/LNG taskforce LNG Industry Training Program Construction Skills Queensland – CSG/LNG DET	Ongoing
Develop a policy that facilitates equal opportunity for all suitably qualified persons.	Arrow Energy EPC contractor	Prior to construction
Communicate project activities, milestones, workforce numbers and other relevant information to appropriate state departments and agencies as well as local government to help plan for demand on services.	Emergency services DET Queensland	Quarterly during construction and biannually during operation

	Health DOC	
Training		
Where appropriate, identify opportunities where training provided by the project or other training providers will be able to meet skills gaps in the community for the project to assist in maximising local employment opportunities.	Arrow Energy DETE CSG/LNG Skills Taskforce CSG/LNG Steering Committee DET	EPC award
Develop a policy identifying training pathways for students and school leavers to assist students in gaining employment upon graduation. This will be done in consultation with SAIN, EQIP, Education Queensland and QMEA. Where relevant training programs have been initiated by other proponents, Arrow Energy will consider coordinating support with these where appropriate. Existing Arrow Energy training programs and initiatives that will fall within this policy include: ■ Go Women in Engineering and Science and Technology (Go WEST) which conducts networking and/or mentoring activities for female staff and students and enhances collaborative partnerships between regional industry, Queensland Office for Women, local government and USQ Student Services. ■ The Arrow Energy Aiming for a Brighter Future Program which aims to inspire, motivate and support women in rural and remote communities to return to education as mature age students to pursue distance learning pathways in science, technology, engineering and mathematics disciplines. ■ Education Queensland Industry Partnership (EQIP) – Gladstone which delivers courses designed to enable high school students to successfully transition into the local workforce and provide employers in the resource sector with new graduates who possess relevant skill sets. EQIP acts as a centralising body for government and industry to deliver a range of work-ready and pre-trade training courses to high school students. Arrow Energy entered into a three year partnership with EQIP in October 2012. ■ Queensland Minerals and Energy Academy (QMEA) which, in partnership with the Queensland Government, the Queensland Resource Council and major coal seam gas (CSG) proponents, designs and facilitates a range of programs to encourage students to pursue careers in Queensland's CSG industry. Arrow Energy entered into a three year partnership with QMEA in the Surat Basin in 2011 and the partnership was expanded in 2012 to include the Gladstone region. ■ Working with group training organisations and encouraging contractors to recruit and retain apprentices or trainees during operations.	Arrow Energy EPC contractor EQIP QMEA SAIN, Education Queensland	Prior to operation
Continue to work with industry groups that are focused on increasing the engagement of women in the industry and developing pathways for women to work in non-traditional roles. Arrow Energy is already committed to: ■ Attending the Women in Mining Industry network. ■ Attending the quarterly meeting hosted by the University of Central Queensland.	Arrow Energy	Ongoing

Continue existing Arrow Energy programs to provide entry level positions within the business and opportunities for women, young people and people with a disability. The programs currently operational are: ■ Graduate Program. ■ Vacation Employment. ■ Indigenous Scholarships. ■ Traineeships. ■ Apprenticeships.	Arrow Energy	Ongoing
The following Arrow Energy programs will be expanded to suitably qualified local employees: ■ Executive and Management Development Programs. ■ External Education Program. ■ Vocational/Trade Training. ■ Specialist Training.	Arrow Energy	Ongoing
Arrow Energy will work with Skills Queensland to deliver work readiness and skills development training programs for vulnerable local people such as the long term unemployed or under skilled, in order to assist them to gain employment.	Arrow Energy DETE Training Providers	Ongoing
Continue to support the careers in gas website or other similar initiatives.	Arrow Energy Other proponents Energy Skills QLD	Ongoing
Standards, Policies & Management		
Communicate Project activities, milestones, workforce numbers and other relevant information tp appropriate state departments and agencies as well as local government to help plan for demand on services.	Emergency services DET Queensland Health DOC	Quarterly during construction and biannually during operation
Complementing the induction and welcome kit provided at induction (in the community investment and wellbeing action plan), non local employees will also be provided with relevant information on sexual health and fatigue management at induction.	Arrow Energy EPC contractor Queensland Health Emergency services GRC	Prior to construction
Implement policies and programs to maintain the wellbeing of personnel, including: ■ Provision of welfare and recreation facilities.	Arrow Energy EPC contractor	Prior to construction and ongoing

■ Provision of a counselling service (including drug and alcohol services*). ■ Implementation of a range of Arrow Energy policies including the OHS Policy, Drug, Alcohol and Contraband Policy, Duty to Stop Work Policy and Fit for Duty Policy. ■ Enforcement of smoking regulations on site. ■ Restrictions on working hours to reduce worker fatigue. ■ Provision of nutritionally balanced food to all personnel living within construction camps in line with guidance issued by Queensland Health. *At all times Arrow Energy's Drug, Alcohol and Contraband and Fit For Duty Policies will apply to the workforce whilst on Arrow Energy sites and whilst engaged in Arrow Energy work.		
A project code of conduct, based on Arrow Energy's existing Code of Conduct and 'drug and alcohol' policy will cover workforce behaviour while on shift or on site. This code will be made available to the community on the website.	Arrow Energy EPC contractor	EPC award
Arrow Energy will explore the opportunity to stagger rostering with other proponents to avoid staff from all LNG projects passing through Gladstone simultaneously.	Arrow Energy Other Proponents EPC Contractor	Ongoing during construction
Arrow Energy will provide an on-site health service for the workforce on Curtis Island and will liaise with emergency services and Queensland health in the planning of this facility.	Arrow Energy EPC contractor	Ongoing during construction
Arrow Energy will support programs that contribute to the health and well-being of Indigenous employees.	Arrow Energy	Ongoing
Develop a detailed medical emergency response plan which outlines key areas of responsibility for personnel on site and the medical emergency facilities and resources available. A range of medical emergency facilities and resources will be made available in accordance with the minimum standards set out in the Shell Exploration and Production Medical Emergency Response Guidelines (2005). These will be detailed in the medical emergency response plan and include: ■ An appropriately designed on-site medical facility. ■ Trained medical personnel. ■ First aid equipment. ■ An appropriate method of transport from facility to shore. ■ Remote medical support. A detailed medical emergency response study will be undertaken to assess transport times between the LNG plant and the mainland and determine whether required response times can be met. Arrow Energy will also contribute to a common Curtis Island local emergency response strategy being developed by the various stakeholders involved in the Curtis Island LNG projects.	Arrow Energy Emergency services EPC Contractor	Prior to construction
Indigenous Employment and Training		
Implement Arrow Energy's Aboriginal and Torres Strait Islander Action Plan, including those actions that focus on employment for Indigenous Australians, including: ■ Recruiting and retaining Aboriginal and Torres Strait Islander staff. ■ Connecting Aboriginal and Torres Strait Islander people with business and employment opportunities.	Arrow Energy EPC contractor DETE	Prior to construction

▪ Arrow Energy has engaged in preliminary discussions with DSDIP, the Department of Aboriginal and Torres Strait Islander and Multicultural Affairs (DATSIMA) and DEEWR in relation to Indigenous employment, training and business development opportunities associated with the project. The focus of these discussions has been on developing Indigenous employment within Arrow Energy's supply chain. Actions being considered include: ▪ Identifying apprenticeships or traineeships that could be made available to Indigenous people. For underemployed or unemployed Indigenous people skills set summaries for these positions will be provided to work ready programs to allow them to tailor their training. These roles will be quarantined for successful Indigenous participants in the work ready programs. ▪ Identifying the most appropriate opportunities for Indigenous businesses to competitively tender to provide goods or services to the project during the operations stage. ▪ Sending information about the opportunities identified above to relevant businesses, or business groups.	Traditional Owners DOCSDS (OATSIP) Other Indigenous community representatives	
Ensure that appropriate cultural awareness training to all workers on the project. Arrow Energy is committed to providing a workplace where all personnel are treated fairly and with dignity and respect. To facilitate this, it has been mandatory since 2011 for all Arrow Energy personnel (including contractors) to participate in Cultural Awareness Training within the first three months of employment or engagement by the company. Training is delivered by Indigenous presenters from Corporate Culcha, an Indigenous-owned and operated company specialising in building capacity to engage with, recruit and retain Indigenous Australians. The intended outcomes are that staff and contractors can engage and work effectively with Indigenous people, suppliers and communities. This in turn is intended to ensure that Indigenous staff are understood, respected and retained in the organisation, and that Arrow Energy maintains positive relationships with Indigenous communities. Arrow Energy will ensure that appropriate cultural heritage training will be developed and delivered to all workers on the project.	Arrow Energy DETE Traditional Owners	Ongoing

LOCAL CONTENT

Introduction		
Purpose	The purpose of this plan is to identify actions that: ■ Help local businesses to understand the requirements of supplying to the project. ■ Provide processes to support local businesses in competing for opportunities.	
Objectives	Actively support the opportunities for local businesses to provide goods and services to the project. Provide guidance to local businesses to better enable them to tender to provide good and services to the project. Reduce the impact that competition for staff for the project will have on other businesses.	
Stakeholders	Arrow Energy Chamber of Commerce DETE EPC contractor GAPDL GILG Gladstone Chamber of Commerce and Industry	GRC Industry Capability Network Local businesses Local communities Other proponents QMI TAFE

Impacts							
Impact	**Nature**	**Phase**	**Extent**	**Duration**	**Severity**	**Likelihood**	**Significance**
Ability for local business to benefit from the additional trade.	Positive	Construction Operation	Regional	Long term	Low	Probable	Moderate

Mitigation		
Mitigation Actions	**Responsibility**	**Timeframe**
Finalise and implement the Australian Industry Participation Plan (AIPP), which provides detailed information about the strategies and approaches to be undertaken by Arrow Energy to: ■ Encourage contractors to source local goods and services where possible. ■ Encourage business to consider Indigenous procurement to maximise Indigenous employment opportunities. ■ Engage with key business bodies regarding appropriate opportunities for local businesses to supply goods and services to the project. The AIPP is being developed in consultation with the Federal government and the Coordinator General with commitment to adopting Queensland Resources Council Code of Conduct for Local Content.	Arrow Energy DETE EPC contractor	Within 3 months of FID
Provide ICN Queensland and DSDIP with the information they require to assist local businesses improve their skills base and tailor their operations to meet the project's needs.	Arrow Energy EPC contractor	Within 3 months of FID

	ICN DSDIP	Annually during construction
Develop processes to ensure local business opportunities are considered in project procurement practises. These processes will allow capable local business to be given fair and reasonable opportunities to compete for the supply of goods or services to the project.	Arrow Energy EPC contractor DETE	Ongoing
Encourage contractors to source local goods and services where possible.	Arrow Energy EPC contractor	Ongoing
Encourage businesses who provide goods and services to the project to consider Indigenous procurement in order to maximise Indigenous employment opportunities.	Arrow Energy	Ongoing
Arrow Energy will continue to engage with key business bodies regarding appropriate opportunities for local businesses to supply goods and services to the project.	Arrow Energy Gladstone Chamber of Commerce and Industry Gladstone Engineering Alliance GAPDL	Ongoing
Facilitate the communication of the Local Content Policy to local service providers. This will involve ongoing communication of project procurement requirements, regular project updates during construction, overview of goods and services packages and supply chain. This will be communicated through initial procurement information sessions in Gladstone for potential suppliers and ongoing on the Arrow Energy website.	Arrow Energy DSDIP Gladstone Engineering Alliance EPC contractor	Within 3 months of FID for the information sessions Ongoing for information on the website
Participate in existing programs that provide technical assistance and briefings to potential local and regional businesses about opportunities and requirements (e.g. Gladstone Region Leaders in Business – Speakers Series and the Gladstone Tender Readiness Program). Briefings will contain information on management systems and other requirements.	Arrow Energy DETE GRC EPC contractor Industry Capability Network	Ongoing
Collaborate with the existing job service that has been set up by other proponents for local businesses and use this to advertise for local positions. This will allow applicants to choose between industry and non industry jobs.	Arrow Energy EPC contractor Other proponents	Ongoing

Provide information to the TAFE system to inform the specialised small business solutions programs on what is required to provide goods and services to the LNG industry.	Arrow Energy DETE TAFE EPC contractor	Annually during construction and 12 months prior to the commencement of operation of trains 1 and 2 and trains 3 and 4
Ensure major contractors develop a plan that clearly identifies Indigenous opportunities (employment and business) on the project.	Arrow Energy EPC contractor Maintenance contractor	Ongoing
Indigenous persons and businesses will also be able to take advantage of initiatives outlined in both the Australian Industry Participation Plan and the workforce management action plan.	Arrow Energy	Ongoing
Continue the Arrow Energy Whanu Binal project and provide assistance, such as business mentoring, to Traditional Owners and other interested members of the Indigenous community with developing business opportunities and capacity. Arrow Energy's Whanu Binal project targets Indigenous businesses and helps them develop the capacity and capability to successfully tender for major projects, including Arrow Energy projects. It also aims to help build the skills and knowledge of existing and potential workforces. Examples of the type of activities that occur as part of this project include: ■ Identification of opportunities to allow joint partnering. ■ Briefings on what business systems and insurances are required to work on the project. ■ Information on government programs that exist to help Indigenous businesses. ■ Information on how to pool resources across businesses to tender on larger parcels of work.	Arrow Energy DETE Traditional Owners DOCSDS (OATSIP) Other Indigenous community representatives	Ongoing during construction, briefings every six months

CUMULATIVE IMPACTS

Introduction		
Purpose	Cumulative impacts are addressed in the previous action plans where the potential for specific cumulative impacts have been identified. The purpose of this plan is to identify organisations charged with coordinating and managing cumulative impacts that Arrow Energy can coordinate with.	
Objectives	To collaboratively address cumulative impacts.	
Stakeholders	Arrow Energy Education Queensland EPC contractor EQIP Industry Leadership Group	Office of the Coordinator General Origin Other Proponents QGC RCCC SAIN

Impacts							
Impact	**Nature**	**Phase**	**Extent**	**Duration**	**Severity**	**Likelihood**	**Significance**
Increased housing demand putting pressure on housing costs.	Negative	Construction and operation	Regional	Long term	High	Probable	High
Increased employment and training opportunities.	Positive	Construction and operation	Regional	Long term	High	Probable	High
Increased demand on social infrastructure (excluding recreation).	Negative	Construction and operation	Regional	Long term	Moderate	Probable	High
Increased demands on recreation facilities/ increased restrictions placed on recreational activities.	Negative	Construction and operation	Regional	Long term	Moderate	Probable	High

Mitigation		
Mitigation Actions	**Responsibility**	**Timeframe**
As per the housing and accommodation action plan, take a position on the GAH reference group upon the commitment of funding at FID.	Arrow Energy GAH	FID
Continue to participate in the Industry Leadership Group for CSG Resource Projects.	Arrow Energy	On-going

	Other Proponents Industry Leadership Group	
Participate in the existing RCCC for Gladstone.	Arrow Energy Other Proponents RCCC	EPC award
Participate in CSG Industry Monitoring Group established by APLNG and QCLNG.	Arrow Energy Other Proponents Origin QGC	EPC award
As per the community investment and wellbeing plan work with key stakeholders to identify the most suitable mechanism to coordinate investment efforts.	Arrow Energy Other Proponents	Ongoing during construction 12 months after the commencement of operation of trains 1 and 2 and trains 3 and 4
As per the housing and accommodation plan, continue to engage the Office of the Coordinator General, other proponents and state agencies to manage housing and accommodation across the industry.	Arrow Energy Other Proponents Office of the Coordinator General	EPC award Every six months during construction Prior to the commencement of operation of trains 1 and 2 and trains 3 and 4
As per the workforce and training plan, continue to work with existing training providers to coordinate assistance for relevant training programs.	Arrow Energy EQIP SAIN Education Queensland	Within six months of FID
As per the local content strategy, collaborate with the job service established by other proponents for local businesses.	Arrow Energy EPC contractor Other proponents	Ongoing

Arrow Stakeholder Engagement Strategy

Arrow Energy has an ongoing commitment to engage with the community. As part of this commitment, Arrow Energy recognises that effective and transparent consultation will be essential in building and maintaining the community's trust and in developing a positive ongoing relationship for the life of the project.

Underpinning the stakeholder engagement strategy for the project are the following objectives:

- Enhance Arrow Energy's position as a contributor to the community in Gladstone.
- Improve awareness and understanding of Arrow Energy's activities in the Gladstone region.
- Enhance and protect Arrow Energy's reputation and social license to operate.
- Support and improve the operations and activities of the broader Gladstone team through increased understanding of the role and services that are provided by the Community and Corporate Affairs team.
- Minimise undue impact on stakeholders.
- Maintain and build relationships with key stakeholders and address stakeholders concerns in order to achieve mutually beneficial outcomes.
- Provide a consistent and systematic approach for managing the interaction with stakeholders across all stages of the Arrow LNG Project.

For the construction and operation of the LNG Plant a stakeholder engagement plan will be developed. This plan is likely to contain a number of actions, including those from the current action plans. The plan will also provide mechanisms through which Arrow Energy will participate in the existing RCCC and engage the community.

Participation in the Regional Community Consultative Committee

A key tool in facilitating community and key stakeholder input into the progress of this SIMP will be Arrow Energy's participation in the existing RCCC for Gladstone. The RCCC will provide an effective mechanism for community feedback across the Gladstone region.

Engagement mechanisms

To achieve the objectives stated above, the stakeholder engagement strategy for the project will involve the following key actions:

- maintenance of a community information centre in Gladstone City

- an 1800 number for landholders that will be staffed 24 hours a day for emergencies
- a maximum of a 48 hour acknowledgement of community complaints with stakeholders regularly advised of progress in addressing their complaint
- establishment of a project page on the Arrow Energy website with key information about the project
- the establishment of a CMS and complaints register which will allow for easy and regular reporting
- periodic presentations to the Gladstone Regional Council's Community Consultation Group
- a community newsletter to provide the community and other stakeholders with updated information about Arrow Energy's operations
- 360° degree feedback review – A process to evaluate the effectiveness of stakeholder engagement activities undertaken annually to measure performance and outcomes
- qualitative and quantitative market research to measure community satisfaction with engagement activities undertaken
- meetings with key stakeholders and members of the community
- freepost service for community correspondence relating the construction or operation of the LNG Plant.

The effectiveness of these methods will be monitored and revised if found unsatisfactory, with successful methods preferred over less successful methods as the project proceeds.

Stakeholders

Stakeholders currently understood to be impacted by the project. These include:

- Proponents
- Local government authorities
- State government agencies
- Directly affected landholders
- Industry representatives
- Community groups.

This list will continue to grow as the project proceeds. Table below provides a summary of key stakeholder interests in the project and the engagement mechanisms that will be used to engage with them. These mechanisms will be modified to respond to changing needs over time.

Key stakeholder engagement mechanisms

Stakeholder group	Primary interest in project	Engagement mechanisms
Federal Government	■ Sustainable resource development ■ Economic development	■ Newsletters and fact sheets ■ Arrow Energy website ■ One on one meetings ■ Briefing sessions
State Government	■ Sustainable resource development ■ EIS compliance ■ Economic development ■ Employment and training opportunities for the community ■ Indigenous opportunities ■ Impact on social infrastructure ■ Housing affordability ■ Impact on road networks ■ Community safety	■ One on one meetings ■ Briefing sessions ■ Newsletters and fact sheets ■ Arrow Energy website
Local Government	■ Opportunities for local business ■ Employment opportunities for locals ■ Impact on local road networks ■ Impact on social infrastructure ■ Impact on affordable housing ■ Local lifestyles and livelihoods ■ Impact on other businesses	■ Briefing sessions ■ One on one meetings ■ Newsletters and fact sheets ■ Community information sessions ■ Arrow Energy website ■ 1800 number ■ Community Information Centre ■ Community information sessions

Stakeholder group	Primary interest in project	Engagement mechanisms
Traditional owners	■ Employment opportunities ■ Training opportunities ■ Business opportunities ■ Cultural heritage	■ Cultural Heritage Management Plan ■ Community survey ■ Business survey ■ Briefing sessions ■ One on one meetings ■ Newsletters and fact sheets ■ Community information sessions ■ Arrow Energy website ■ 1800 number ■ Project email ■ Community Information Centre ■ Freepost service
Landholders	■ Property acquisition arrangements ■ Environmental impacts on amenity ■ Access and connectivity	■ One-on-one meetings ■ Telephone calls ■ Letters, faxes and emails ■ Annual community survey ■ Arrow Energy website ■ Community information sessions ■ 1800 number ■ Project email ■ Community Information Centre ■ CMS ■ Freepost service
Resident community	■ Employment opportunities ■ Business opportunities ■ Training opportunities ■ Workforce behaviour ■ Workforce integration with local activities ■ Impact on affordable housing ■ Cost of living ■ Access to community services ■ Community cohesion ■ Maintenance of existing lifestyles	■ Community newsletters ■ Community information sessions ■ Community survey ■ Business survey ■ CMS ■ Arrow Energy website ■ Community information sessions ■ 1800 number ■ Project email ■ Community Information Centre ■ Freepost service

Stakeholder group	Primary interest in project	Engagement mechanisms
Community and environmental groups	■ Preservation of environmental values ■ Maintenance of existing lifestyles ■ Community cohesion ■ Local amenity	■ Community newsletters ■ Community information sessions ■ Community survey ■ CMS ■ 1800 number ■ Project email ■ Community information sessions ■ Community Information Centre ■ Arrow Energy website ■ Freepost service
Project workforce	■ Shifts and rosters ■ Family health and wellbeing ■ Equality in opportunities ■ Road safety ■ Living conditions in workers camp ■ Ability to secure housing in the community ■ Recreational opportunities ■ Support services and social infrastructure for their families	■ Regular meetings ■ Induction ■ Education and training ■ Workforce survey ■ Newsletters and notices ■ Internal grievance mechanism ■ Project intranet

Schedule 2. Summary of Positive and Negative Impacts identified in Social Impact Assessment

Social Impact Management Plan (SIMP) Theme	Social Impact	Description	Project Phase	Nature	Extent (1 – 5)	Duration (1-5)	Severity (1-5)	Probability (1-5)	Significance (0-20 low 20 -35 moderate 35+ = high)
Workforce and Training	Increased local employment	During construction up to 633 workers will be local equivalent to 2.0% of the 2006 workforce. During operation up to 200 workers will be local.	Construction and operation	Positive	3	4	4	5	High (55)
Housing and Accommodation	Increased housing costs	The project will result in a small increase in demand for housing stock (90 during construction and 130 during operation) which will reduce the availability of exiting accommodation. This may be sufficient to sustain housing costs growth that had already occurred under previous projects	Construction and operation	Negative	2	4	3	5	High (45)
Indigenous Community	Reduced housing affordability for Indigenous people	With lower incomes than the non Indigenous community, Indigenous people are more vulnerable to increased private rents	Construction and operation	Negative	2	4	3	5	High (45)

Social Impact Management Plan (SIMP) Theme	Social Impact	Description	Project Phase	Nature	Extent (1 – 5)	Duration (1-5)	Severity (1-5)	Probability (1-5)	Significance (0-20 low 20 -35 moderate 35+ = high)
Workforce and Training	Increased local training opportunities	The project will provide training opportunities for students through Arrow Energy's scholarship, vacation employment and school based training and Graduate programs. Employees working directly for Arrow Energy will also potentially be able to benefit from internal training, vocational/trade training and specialist training. Arrow Energy staff and contractors may take on apprentices and trainees providing opportunities for younger people.	Construction and operation	Positive	3	4	3	4	High (36)

Social Impact Management Plan (SIMP) Theme	Social Impact	Description	Project Phase	Nature	Extent (1 – 5)	Duration (1-5)	Severity (1-5)	Probability (1-5)	Significance (0-20 low 20 -35 moderate 35+ = high)
Workforce and Training	Increased local employment opportunities with non LNG employers	The project will create additional positions in other businesses that service the project, expand to cater to the increased population or back fill positions. Continued increased patronage of existing hotels/ motels is likely to contribute to local employment and benefit the financial wellbeing of business operators in the hospitality industry.	Construction and operational	Positive	3	3	3	4	High (36)
Local Content and investment	Ability for local business to benefit from the additional trade	Existing businesses have the potential to provide goods and services directly to the project. While they will have already increased their staffing to do this for other projects, the LNG Plant presents an opportunity to maintain or increase their workload. Some businesses ability to benefit from the project will be constrained due to an inability to compete on wages or higher living costs.	Construction and Operation	Positive	3	4	2	4	High (36)

Social Impact Management Plan (SIMP) Theme	Social Impact	Description	Project Phase	Nature	Extent (1 – 5)	Duration (1-5)	Severity (1-5)	Probability (1-5)	Significance (0-20 low 20 -35 moderate 35+ = high)
Recreation	Reduction in recreational opportunities	The project will have a limited impact on recreational boating and related activities in the harbour. In addition, workers and their families based on the mainland will place limited demand on formal and informal recreational facilities.	Construction and operation	Negative	2	4	2	4	Moderate (32)
Property and Land Use	Changes to land uses	Existing land uses at the TWAF and project site on Curtis Island will cease.	Construction and ongoing	Negative	1	4	1	5	Moderate (30)
Community Values	Community concerns about the management of social issues	The project may create or amplify existing community concerns about the pressures on housing in the study area and the provision of social infrastructure and maintenance of exiting lifestyles.	Construction and operation	Negative	2	3	2	4	Moderate (28)
Community Values	Increased income inequality in the community	The project will contribute to an increased income disparity between people working in or for the LNG industry and those not. Significant increases in income disparity can be a contributing factor to a loss of community cohesion.	Construction and operation	Negative	2	3	2	4	Moderate (28)

Social Impact Management Plan (SIMP) Theme	Social Impact	Description	Project Phase	Nature	Extent (1 – 5)	Duration (1-5)	Severity (1-5)	Probability (1-5)	Significance (0-20 low 20 -35 moderate 35+ = high)
Community Health and Safety	Strain on workers and their families	Shift work is perceived by some stakeholders to be a risk factor that may contribute to incidents of domestic violence. However, it is anticipated that the proposed Monday to Friday shift will mitigate the potential incidence of this risk. However, the FIFO, component of the workforce will be subject to two weeks on site, potentially placing a strain on their relationship with their families. It is commonly reported that another risk factor for domestic violence is financial stress, which can be exacerbated by cost of living increases.	Construction and ongoing	Negative	4	3	2	3	Moderate (27)
Community Investment and wellbeing	Increased demand on existing social infrastructure and services	The small proportion of worker's living in the study area outside of construction camps and their families will place increased demand on social infrastructure and services (e.g. medical, educational).	Construction and operation	Negative	2	2	2	4	Moderate (24)

Social Impact Management Plan (SIMP) Theme	Social Impact	Description	Project Phase	Nature	Extent (1 – 5)	Duration (1-5)	Severity (1-5)	Probability (1-5)	Significance (0-20 low 20 -35 moderate 35+ = high)
Indigenous Community	Employment opportunities	The project is likely to result in employment opportunities for the Indigenous community to work directly or indirectly for the project or in filling other positions in the community.	Construction and operation	Positive	3	3	2	3	Moderate (24)
Indigenous Community	Business opportunities for Indigenous people	The project may be of benefit to Indigenous contractors or other businesses. These operators may take on more employees in response to business growth providing further benefit to the community.	Construction and operation	Positive	3	3	2	3	Moderate (24)
Community Values	Increases in the public risk as a result of increased traffic, people and the project.	There will potentially be an increase in the level of risk resulting from increased traffic movements. This increased risk will also extend to the harbour, with changed harbour conditions and congestion increasing the likelihood of accidents.	Construction and ongoing	Negative	2	4	5	2	Moderate (22)
Community Investment and wellbeing	Reduced availability of staff at existing social infrastructure	By placing limited pressure on housing stock, the project will place some pressure on affordable housing limiting the ability of entry level police, council officers, teachers and other workers to reside in the area.	Construction and operation	Negative	2	3	2	3	Moderate (21)

Social Impact Management Plan (SIMP) Theme	Social Impact	Description	Project Phase	Nature	Extent (1 – 5)	Duration (1-5)	Severity (1-5)	Probability (1-5)	Significance (0-20 low 20 -35 moderate 35+ = high)
Community Investment and wellbeing	Increased demand on formal and informal recreational facilities.	Workers and their families based on the mainland will place limited demand on formal and informal recreational facilities.	Construction and operation	Negative	2	3	2	3	Moderate (21)
Amenity	Visual Impact	The project will impact on existing visual amenity but this will be diminished by the presence of a number of other industrial facilities	Construction and operation	Negative	2	4	1	3	Moderate (21)
Amenity	Noise and vibration impacts	There will be increased noise levels, however it will not be sufficient to create sleep disturbance.	Construction and operation	Negative	2	4	1	3	Moderate (21)
Community Values	Balancing environmental concerns and industrial development	Clearing of part of Curtis Island and works within the harbour are likely to be of community concern. Sensitivity to this will be diminished by activities that will take place prior to this such as the port's dredging program and other LNG projects. Activities that balance industrial development with environmental protection are likely to be well received.	Construction and operation	Neutral	3	2	2	3	Moderate (21)

Social Impact Management Plan (SIMP) Theme	Social Impact	Description	Project Phase	Nature	Extent (1 – 5)	Duration (1-5)	Severity (1-5)	Probability (1-5)	Significance (0-20 low 20 -35 moderate 35+ = high)
Community Values	Increased services	Population increase associated with the project and cumulatively with all the projects is likely to lead to an increase in the overall range of services and retail opportunities that the study area's population can support.	Operation	Positive	2	4	1	3	Moderate (21)
Indigenous Community	Construction workforce not respecting Indigenous values	The construction workforce may not understand Indigenous values.	Construction and operation	Negative	2	3	2	3	Moderate (21)
Amenity	Changes in air quality	The project will impact on air quality very infrequently. Infrequent change in air quality could be expected to be of concern to the community.	Construction	Negative	2	4	1	3	Moderate (21)
Housing and Accommodation	Reduced availability of hotel/motel accommodation	High utilisation of temporary accommodation may impact on businesses or other users who will find it more difficult to access temporary accommodation	Construction	Negative	2	1	2	3	Low (18)

Social Impact Management Plan (SIMP) Theme	Social Impact	Description	Project Phase	Nature	Extent (1 – 5)	Duration (1-5)	Severity (1-5)	Probability (1-5)	Significance (0-20 low 20 -35 moderate 35+ = high)
Community Investment and wellbeing	Reduced level of volunteering and participation in community groups	Increases in the proportion of locals employed as shift workers will negatively impact on their ability to volunteer or participate in sporting or interest groups, or engage in normal social activities.	Construction and operation	Negative	2	2	2	3	Low (18)
Housing and Accommodation	Impact on property values	Increased demand for housing as a result of the LNG industry will increase property values; however, the Arrow LNG project following the early projects is likely to only sustain existing price increases. This will make it harder for first home buyers to purchase property but benefit those who are seeking to sell their dwellings.	Construction and operation	Neutral	2	3	1	3	Low (18)
Property and Land Use	Reduced access to private property	There may be some temporary loss of access as a result of construction traffic or activities	Construction	Negative	2	2	1	3	Low (15)
Community Health and Safety	Increased risk of anti social behaviour	The influx of a construction workforce will likely result in increased risk of alcohol related offences.	Construction and ongoing	Negative	2	3	2	2	Low (14)

Social Impact Management Plan (SIMP) Theme	Social Impact	Description	Project Phase	Nature	Extent (1 – 5)	Duration (1-5)	Severity (1-5)	Probability (1-5)	Significance (0-20 low 20 -35 moderate 35+ = high)
Community Health and Safety	Perceived increased risk of alcohol / anti social related offences	The influx of a construction workforce will likely be perceived to result in an increased risk of alcohol related offences or crime/anti-social behaviour in the study area.	Construction and ongoing	Negative	2	2	2	2	Low (12)

Schedule 3. Social impact assessment framework

Key issues and impacts were identified in consultation with community, local and state government. These issues and impacts were given an initial ranking according to nature, extent, duration, severity and likelihood of each impact in accordance with the methodology below. They were then given an overall significance of impact rating of: low, medium or high.

Nature	Description
Positive	Impacts have a positive effect on the project affected community a nd stakeholders. The quality of life of affected individuals, households or the community is improved.
Negative	Impacts have a negative effect on the project affected community and stakeholders. The quality of life of individuals, households or the community is diminished.
Neutral	Impacts are neither positive nor negative in nature and have no meaningful effect on project-related communities or stakeholders.
Extent	**Description**
5	International scale
4	National Scale
3	Regional Scale
2	Areas adjacent to project site - Local
1	Site specific
Duration	**Description**
5	Permanent / irreversible – more than 50 years
4	Long term – 25 to 50 years
3	Medium term – 5 to 25 years
2	Short – medium term – 1 to 5 years
1	Short term – less than 1 year
Severity	**Description**
5 – very high	• Significant loss of human, social, financial or built capital • Significant enhancement of human, social, financial or built capital
4- high	• Large loss of human, social, financial or built capital • Large enhancement of human, social, financial or built capital
3 - medium	• Moderate loss of human, social, financial or built capital • Moderate enhancement of human, social, financial or built capital
2 -low	• Limited loss of human, social, financial or built capital • Limited enhancement of human, social, financial or built capital
1- negligible	• Negligible loss of human, social, financial or built capital • Negligible enhancement of human, social, financial or built capital

Likelihood	Description
5	Definite (>90%)
4	Probable (50-90%)
3	Possible (10 -50%)
2	Unlikely (<10%)
1	Impossible

Positive and negative impacts were then grouped based on the significance of impact for further analysis to assist in the development of actions and strategies to enhance, avoid, mitigate or manage impacts. Key social components were.

- increased employment and training opportunities
- increased housing costs and reduced affordability
- reduction in available accommodation
- increased business opportunities
- reduction in recreational opportunities
- change to land use
- increased demand on existing social infrastructure
- community concern about the management of social issues
- increased income equality in the community
- strain on workers and there family
- increased risk of anti-social behaviour
- community health and safety concerns.

Appendix 6. World Heritage values for the Great Barrier Reef World Heritage Area

Criterion: (VII) Contains superlative natural phenomena

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; and
- migrating whales, dolphins, dugong, whale sharks, sea turtles, seabirds and concentrations of large fish.

Criterion: (VIII) Outstanding examples of stages of earth's 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 055km2;
- 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"; and
- record of sea level changes reflected in distribution of continental island flora and fauna.

Criterion: (IX) Outstanding examples of on-going evolution

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" and;
- terrestrial fauna, including:

Criterion: (IX) Outstanding examples of on-going evolution

- 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); and
- 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; and
- feeding and/or breeding grounds for international migratory seabirds, cetaceans and sea turtles.

Criterion: (X) Important habitats for conservation of biological diversity

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 broadscale 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; and
- coral cays with 300-350 plant species in 2 distinct floristic regions;
- seagrass beds (over 5000km2) comprising 15 species, 2 endemic;
- mangroves (over 2070km2) including 37 species;
- Halimeda banks in the northern region and the unique deep water bed in the central region; and
- large areas of ecologically complex inter-reefal and lagoonal benthos; and
- species of plants and animals of conservation significance

Acronyms and abbreviations

Acronym	Definition
AHD	Australian height datum
AL	Assessment location
ANZECC	Australian and New Zealand Environment Conservation Council
APLNG	Australia Pacific Liquefied Natural Gas
AS/NZS	Australian standard/New Zealand standard
ASS	Acid sulfate soils
CAMBA	China–Australia Migratory Bird Agreement
CASA	Civil Aviation Safety Authority
CHMP	cultural heritage management plan
CIIP	Curtis Island Industry Precinct
CSG	coal seam gas
dB(A)	decibels measured at the 'A' frequency weighting network
DERM	Department of Environment and Resource Management (now the Department of Environment and Heritage Protection) (Qld)
DEWHA	Australian Government Department of Environment, Water, Heritage and the Arts (now SEWPaC)
DIDO	drive-in drive-out (workforce)
DOC	Department of Communities (Qld)
EA	environmental authority
EC	electrical conductivity
EIS	environmental impact statement
EM plan	environmental management plan
EP Act	*Environmental Protection Act 1994* (Qld)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cwlth)
EPC	engineering, procurement and construction
ERA	environmentally relevant activity
EQIP	Education Queensland Industry Partnership
EVNT	endangered, vulnerable, or near-threatened
FID	financial investment decision
FIFO	fly-in fly-out
GAMS	Gladstone Airshed Modelling System
GBRMP	Great Barrier Reef Marine Park
GBRWHA	Great Barrier Reef World Heritage Area
GHG	greenhouse gas
GLNG	Gladstone Liquefied Natural Gas project
GPC	Gladstone Ports Corporation
GR	Gladstone Regional Council
GSDA	Gladstone State Development Area

Acronym	Definition
HSEMS	health, safety and environment management system
IAS	initial advice statement
JAMBA	Japan–Australia Migratory Bird Agreement
LAN,T	statistical descriptor for the variation of noise
LAT	lowest astronomical tide
LNG	liquefied natural gas
MCU	material change of use
mg/L	milligrams per litre of liquid/gaseous liquid
MNES	matters of national environmental significance
MOF	materials offloading facility
MSQ	Maritime Safety Queensland
Mtpa	million tons per annum
NAGD	National Assessment Guidelines for Dredging
NC Act	*Nature Conservation Act 1992* (Qld)
NO_2	nitrogen dioxide
NTU	nephelometric turbidity units
OC	organochlorine
OP	organophosphate
PAH	polycyclic aromatic hydrocarbons
PANS-OPS	Procedures for air navigation services—aircraft operations
PASS	potential acid sulfate soils
pH	potential of hydrogen
QASSIT	Queensland Acid Sulfate Soils Investigation Team
QCLNG	Queensland Curtis Liquefied Natural Gas project
QGEOP	Queensland Government Environmental Offsets Policy
QMEA	Queensland Minerals and Energy Academy
RCCC	regional community consultation committee
RE	regional ecosystem
RIA	road impact assessment
RMP	road-use management plan
RO	reverse osmosis
ROKAMBA	Republic of Korea–Australia Migratory Bird Agreement
ROW	right of way
SDA	state development area
SDPWO Act	*State Development and Public Works Organisation Act 1971* (Qld)
SDWPO Regulation	State Development and Public Works Organisation Regulation 2010 (Qld)
SEIS	supplementary environmental impact statement
SEWPaC	Australian Government Department of Sustainability, Environment, Water, Population and Communities
SIA	social impact assessment

Acronym	Definition
SIMP	social impact management plan
SPA	*Sustainable Planning Act 2009* (Qld)
SPP	state planning policy
TMP	traffic management plan
DTMR	Department of Transport and Main Roads (Qld)
TOR	terms of reference
TWAF	temporary workers accommodation facility
VM Act	*Vegetation Management Act 1999* (Qld)
WBDD	Western Basin Dredging and Disposal

Glossary

Term	Definition
assessment manager	For an application for a development approval, means the assessment manager under the *Sustainable Planning Act 2009* (Qld).
bilateral agreement	The agreement between the Australian and Queensland governments that accredits the State of Queensland's EIS process. It allows the Commonwealth Environment Minister to rely on specified environmental impact assessment processes of the state of Queensland in assessing actions under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth).
controlled action	A proposed action that is likely to have a significant impact on a matter of national environmental significance; the environment of Commonwealth land (even if taken outside Commonwealth land); or the environment anywhere in the world (if the action is undertaken by the Commonwealth). Controlled actions must be approved under the controlling provisions of the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth).
controlling provision	The matters of national environmental significance, under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth), that the proposed action may have a significant impact on.
Coordinator-General	The corporation sole constituted under section 8 of the *State Development and Public Works Organisation Act 1971*
coordinated project	A project declared as a 'coordinated project' under section 26 of the SDPWO Act.
environment	As defined in Schedule 2 of the SDPWO Act, includes: a) ecosystems and their constituent parts, including people and communities b) all natural and physical resources c) the qualities and characteristics of locations, places and areas, however large or small, that contribute to their biological diversity and integrity, intrinsic or attributed scientific value or interest, amenity, harmony and sense of community d) the social, economic, aesthetic and cultural conditions that affect, or are affected by, things mentioned in paragraphs (a) to (c).
environmental effects	Defined in Schedule 2 of the SDPWO Act as the effects of development on the environment, whether beneficial or detrimental.
environmentally relevant activity (ERA)	An activity that has the potential to release contaminants into the environment. Environmentally relevant activities are defined in Part 3, section 18 of the *Environmental Protection Act 1994* (Qld).
imposed condition	A condition imposed by the Queensland Coordinator-General under section 54B of the SDPWO Act. The Coordinator-General may nominate an entity that is to have jurisdiction for the condition.

initial advice statement (IAS)	A scoping document, prepared by a proponent, that the Coordinator-General considers in declaring a significant project under Part 4 of the SDPWO Act. An IAS provides information about: • the proposed development • the current environment in the vicinity of the proposed project location • the anticipated effects of the proposed development on the existing environment • possible measures to mitigate adverse effects.
matters of national environmental significance	The matters of national environmental significance protected under the *Environment Protection and Biodiversity Conservation Act 1999*. The eight matters are: a) world heritage properties b) national heritage places c) wetlands of international importance (listed under the Ramsar Convention) d) listed threatened species and ecological communities e) migratory species protected under international agreements f) Commonwealth marine areas g) the Great Barrier Reef Marine Park h) nuclear actions (including uranium mines).
nominated entity (for an imposed condition for undertaking a project)	An entity nominated for the condition, under section 54B(3) of the SDPWO Act.
properly made submission (for an EIS or a proposed change to a project)	Defined under section 24 of the SDPWO Act as a submission that: a) is made to the Coordinator-General in writing b) is received on or before the last day of the submission period c) is signed by each person who made the submission d) states the name and address of each person who made the submission e) states the grounds of the submission and the facts and circumstances relied on in support of the grounds.
proponent	The entity or person who proposes a significant project. It includes a person who, under an agreement or other arrangement with the person who is the existing proponent of the project, later proposes the project.

Site based offset plan	A site-specific plan prepared to address the significant residual impacts to significant biodiversity values identified in the EIS that are not covered by Commonwealth requirements and includes, but is not necessarily limited to: • the applicant(s) name, postal address, contact details • lot/plan, stage (or area) to which the plan relates, GPS coordinates for the stage (or area) • a detailed description of the significant biodiversity values affected and the extent of impact on each • the offset delivery mechanism(s): – direct land based offsets: o an offset area management plan describing the activities that will be undertaken to maintain and enhance biodiversity values, including the management/control of weeds, site access, erosion and sediment and fire management; o an assessment of ecological equivalence of the offset area taking into account the management plan outcomes o an annual monitoring and reporting programme, including estimated time until the achievement of management outcomes. o legally binding mechanism. – offset transfer: o evidence that significant biodiversity values to be impacted can be offset within the landscape; o Brokers Agreement or applicant letter that ensures protection and management of offset areas of ecological equivalence; and o identification of financial surety amount – offset payment amount and calculation method.
stated condition	Conditions stated (but not enforced by) the Coordinator-General under sections 39, 45, 47C, 49, 49B and 49E of the SDPWO Act. The Coordinator-General may state conditions that must be attached to a: • development approval under the *Sustainable Planning Act 2009* • proposed mining lease under the *Mineral Resources Act 1989* • draft environmental authority (mining lease) under Chapter 5 of the *Environmental Protection Act 1994* • proposed petroleum lease, pipeline licence or petroleum facility licence under the *Petroleum and Gas (Production and Safety) Act 2004* • non-code compliant environmental authority (petroleum activities) under Chapter 4A of the EPA.

works	Defined under the SDPWO Act as the whole and every part of any work, project, service, utility, undertaking or function that: a) the Crown, the Coordinator-General or other person or body who represents the Crown, or any local body is or may be authorised under any Act to undertake, or b) is or has been (before or after the date of commencement of this Act) undertaken by the Crown, the Coordinator-General or other person or body who represents the Crown, or any local body under any Act, or c) is included or is proposed to be included by the Coordinator-General as works in a program of works, or that is classified by the holder of the office of Coordinator-General as works.

The Coordinator-General
PO Box 15517, City East Qld 4002
tel 13 QGOV (13 74 68)
fax +61 7 3225 8282
info@dsdip.qld.gov.au

www.dsdip.qld.gov.au