Project Sun
LNG Project, Gladstone

Initial Advice Statement

January 2008

RLMS
ABN 33 633 826 804
Level 5 379 Queen Street
GPO Box 2292
Brisbane 4001

TABLE OF CONTENTS

1 Introduction 1
1.1 Purpose 1
1.2 Scope 1
2 Project Background 2
2.1 Project Overview 2
2.2 Proponents 2
2.3 Project Rationale 4
2.4 Major Approvals Required 4
2.4.1 Petroleum Approvals 4
2.4.2 Environmental Regulation of Petroleum Activities 4
2.5 Project Alternatives considered 5
2.5.1 LNG Plant Site Alternatives 5
2.5.2 Feed Gas Delivery Alternatives 6
3 Description of Activities 7
3.1 Site description 7
3.2 Gas Supply 8
3.3 Gas Pipeline Design and Construction 8
3.4 Gas Pipeline Operation 10
3.5 LNG Plant Design 10
3.6 LNG Plant Operation 11
3.6.1 General Process Description 11
3.6.2 Process Inputs and Outputs 13
3.6.3 Waste management 14
3.6.4 Utilities 15
3.7 LNG Plant Construction 15
3.8 LNG Shipping 15
4 Air Values 16
4.1 Climate 16
4.2 Existing Air Environment Values 16
4.3 Project Air Emissions 17
5 Land Values 19

5.1 Topography, Geology and Soils 19
5.2 Potential Impacts on Soils 19
5.3 Potential impact on surrounding land uses 20
6 Ecological Values 21
6.1 Marine Environment 21
6.2 Potential Impacts from LNG Facility 21
6.3 Potential Impacts from Gas pipeline 21
7 Water Values 23
7.1 Existing values 23
7.2 Potential impacts from construction activities 23
7.3 Potential impacts from operational activities 24
8 Social Values 25
8.1 LNG Safety 25
8.2 Noise 25
8.3 Visual 26
8.4 Cultural Heritage 26
8.5 Socio-economics 26
8.6 Proposed consultation with Interested Persons 27

Abbreviations

ºC	degrees Celsius
$\mu g/m^3$	micrograms per cubic metre
$\mu S/cm$	micro Siemens per centimetre
APIA	Australian Pipeline Industry Association
ASS	Acid Sulfate Soil
barg	bar gauge
BOG	Boil Off Gas
CAMBA	China-Australia Migratory Bird Agreement
CO_2	Carbon dioxide
CQPA	Central Queensland Port Authority
CSM	Coal Seam Methane
DME	Department of Mines and Energy (Queensland)
EA	Environmental Authority
EIS	Environmental Impact Statement
EMP	Environmental Management Plan

EPA	Environmental Protection Agency (Queensland)
EP Act	*Environmental Protection Act 1994*
EPP (Air)	*Environmental Protection (Air) Policy 1997*
EP Reg	*Environmental Protection Regulation 1998*
ERA	Environmentally Relevant Activity
FLW	Fisherman's Landing Wharf
GAWB	Gladstone Area Water Board
GSDA	Gladstone State Development Area
ha	hectare
HAT	Highest Astronomical Tide
IAS	Initial Advice Statement
JAMBA	Japan-Australia Migratory Bird Agreement
kg/h	kilograms per hour
km	kilometre
kW	kilowatt
LNG	Liquefied Natural Gas
m^3	cubic metre
MDEA	Methyldiethanolamine solution
mg/L	milligrams per litre
mm	millimetres
Mt/y	Million tonnes per year
NEPM	National Environment Protection (Ambient Air Quality) Measure
NO_2	Nitrogen dioxide
NTU	Nephelometric Turbidity Units
P&G Act	Petroleum and Gas (Production and Safety) Act 2004
PAM	Pre-assembled Module
PM_{10}	Particulate Matter less than 10µm in diameter
ppm	parts per million
QCL	Queensland Cement Limited
QER	Queensland Energy Resources
QGP	Queensland Gas Pipeline
RE	Regional Ecosystem
RTA	Rio Tinto Australia
SO_2	Sulphur dioxide

1 INTRODUCTION

1.1 PURPOSE

Sunshine Gas Ltd, in association with Sojitz Corporation, is investigating the development of a Liquefied Natural Gas (LNG) facility at Fisherman's Landing Wharf (FLW) near Gladstone.

The purpose of this Initial Advice Statement (IAS) is to provide supporting material for an application to prepare a voluntary Environmental Impact Statement (EIS) under Chapter 3, Part 2 of the *Environmental Protection Act 1994* (EP Act).

1.2 SCOPE

This document will:

- describe the proposal including any options being considered and ancillary activities to be carried out;
- describe the project site;
- describe the processes involved in the proposal and how they relate to energy and water inputs and waste outputs;
- discuss the environmental values that may be affected by the project; and
- outline design and technical investigations being carried out.

2 PROJECT BACKGROUND

2.1 PROJECT OVERVIEW

It is proposed to develop a LNG processing plant at FLW near Gladstone. The first stage will produce 500,000 tonnes per year of LNG. Stage 2 will increase the capacity of the LNG plant to 1,000,000 tonnes per year (equivalent to 2,200,000 m^3 LNG per year).

The project (to be known as Project Sun LNG Plant) involves the following components (see Figure 2-1):

- a natural gas liquefaction plant on land located at FLW.
- loading facilities for export of LNG located on an upgraded berth 5 at FLW;
- a 5km lateral gas pipeline (underground) from the Gladstone City Gas Gate of the Queensland Gas Pipeline (QGP) to the LNG plant; and
- associated infrastructure and facilities for the LNG plant site (e.g. power supply, water supply, road upgrades, etc.).

The proposed project timetable is provided in Table 2-1.

Table 2-1 Proposed Project Timetable

Milestone	Target
Environmental Assessment Studies	May/June 2008
Front End Engineering Design	October 2008
Major Approvals	November 2008
Commence Construction	January 2009
Commence Commissioning	November/December 2011
Commercial Operation	January/February 2012

2.2 PROPONENTS

The Project Proponents are:

Sunshine Gas Ltd	Sojitz Corporation
Level 19, Waterfront Place	Kokusai Shin-Akasaka Building 1-20
1 Eagle Street	Akasaka 6-chome, Minato-ku
BRISBANE QUEENSLAND 4000	TOKYO 107-8655
Australia	Japan

Sunshine Gas

Sunshine Gas is an Australian publicly listed oil and gas exploration, appraisal and development company focused on onshore Australia and offshore United Kingdom. Sunshine Gas has extensive holdings of prospective Coal Seam Methane (CSM) acreage in Queensland which are in varying stages of exploration, appraisal and development. Currently, Sunshine Gas is focused on developing the significant proven and probable (2P) reserves recently attributed to its 100% owned Lacerta CSM project near Roma in ATP 795P.

Map Projection: MGA94 Zone 56

LEGEND

- Route Options for pipeline from Gas Gate to Project Site
- Existing Gas Pipeline
- LNG Load Out Pipeline

0 250 500 750 1,000
Metres

NOTES
Existing pipelines: RLMS database
Aerial Photography: Aerometrex, 2005

PROJECT: SUN

MAP TITLE: Figure 2-1: Project Components and Location

DATE: JANUARY 2008

Produced by RLMS A.B.N. 33 633 826 804
Level 5 379 Queen Street Brisbane QLD 4000
GPO Box 2292 Brisbane QLD 4001 Australia
Phone: 07 3229 8472 Fax: 07 3221 3234
Email: rlms@rlms.com.au
Internet: www.rlms.com.au

WKSP Z:\clients\Sunshine_Gas\07-0097_ProjectSUN\Mapping\Workspaces\A4_Report_Figure2.mxd
Created on 22/01/2008 by CL

Sojitz Corporation

Sojitz Corporation is a Japanese general trading group and operates in a diverse range of business fields, formats and regions. Among some of Sojitz's major business interests cover mineral resources, chemicals and plastics, machinery and aerospace. In Australia, Sojitz has offices in Perth, Sydney and Melbourne.

2.3 PROJECT RATIONALE

There is strong demand for LNG, particularly from Asia. Sojitz Corporation has identified that a market window exists for additional LNG in Asia from late 2011 and wishes to meet that additional demand by utilising Queensland's significant CSM assets. The project will enable the significant value of Queensland's CSM resources to be realised by creating a market for that gas.

The LNG plant, combined with the upgraded wharf facilities, 5km gas pipeline lateral to the plant and associated infrastructure is expected to have a capital cost in the order of US$400-500 million.

The project will have a number of positive economic benefits including:

- Providing a market for Queensland's CSM reserves;
- Producing export income for Australia;
- Providing tax, royalty and port income for Queensland;
- Employing a peak construction workforce of 400.

Project Sun is expected to add additional economic diversity to Gladstone consolidating its position as the leading industrial complex on the eastern seaboard, whilst the Lacerta CSM Field will take its place as a major gas field further enhancing the economic prosperity of the Roma region.

2.4 MAJOR APPROVALS REQUIRED

All approvals applied for will be for the expanded Stage 2 project.

2.4.1 Petroleum Approvals

Petroleum activities in Queensland are regulated by the Department of Mines and Energy (DME) under the *Petroleum and Gas (Safety and Production) Act 2004* (P&G Act).

A petroleum facility is defined under the P&G Act as a facility for the distillation, processing, refining, storage or transport of petroleum, other than a distribution pipeline. DME have confirmed that processing of petroleum gas to produce LNG will require a petroleum facility licence under the P&G Act. A gas pipeline will be constructed as part of the project therefore a point to point pipeline licence will also be required. Where the facility and pipeline are owned by the same entity they can be included on a single licence.

2.4.2 Environmental Regulation of Petroleum Activities

Environmental regulation of petroleum activities in Queensland is the responsibility of the EPA under the *Environmental Protection Act 1994* (EP Act).

A summary of the likely Environmentally Relevant Activities (ERAs) and levels for Project Sun is presented in Table 2-1 below:

Table 2-1 Project Sun ERAs

ERA	Description	Level
21D	LNG Process Plant - A petroleum activity otherwise prescribed under Schedule 1 (of EP Reg) as a Level 1 ERA	Level 1
21E	5km Gas Lateral - A petroleum activity not otherwise prescribed under Schedule 1 as a Level 1 ERA	Level 2

To provide sufficient information to support an application for an Environmental Authority (EA) (petroleum activities) it is necessary to assess the environmental impacts of the project and prepare an Environmental

Management Plan (EMP). These studies will be undertaken at the same time as the front end engineering design for the Project is being completed.

In a pre-design conference held with the EPA on 28 November 2007, the Proponents were advised that it was likely, upon consideration of the Standard Criteria, that the EPA would require an EIS to be completed before a decision on an application for an environmental authority for the Project could be made. The basis of this advice was that the LNG Industry is new to Queensland and therefore the public interest was likely to be high. Therefore, the Proponents have decided to commence the EIS process by applying to prepare a voluntary EIS under Chapter 3, Part 2 of the EP Act.

The Project will be referred to the Commonwealth Department of the Environment, Water, Heritage and the Arts for determination whether assessment and approval is required under the *Environment Protection And Biodiversity Conservation Act 1999*.

2.5 PROJECT ALTERNATIVES CONSIDERED

2.5.1 LNG Plant Site Alternatives

A total of five potential plant sites were investigated. These are described below.

Port Alma

Port Alma is a natural deep-water harbour located on the southern tip of the Fitzroy River delta. Whilst potential sites near the port are well separated from other facilities, the limited size of ships that can use the port, the soft ground of the coastal plain and the lack of infrastructure are disadvantages for this site.

Gladstone - Mainland

North of Gladstone, the Queensland Government owns and controls approximately 21,000ha of land, known as the Gladstone State Development Area (GSDA). This land is designed to accommodate large scale industrial development. The land near to FLW between the coast and the Mt Larcom coastal range is reasonably flat and provides good access to FLW. Material transportation and services corridors have been established by Government to connect the port to industrial areas. Distances to the port depend on the site but are a minimum of 3km. This is not optimal for transporting LNG via cryogenic pipelines from the plant to the ship.

Mining leases and mineral development lease applications affect land to the immediate west of FLW and limit the industrial development opportunity of much of this land.

Unconstrained shipping access to FLW and the plant and ship loading facilities' affect on the existing and future port activities at FLW are potential constraints to the use of these sites.

Gladstone – Curtis Island

Land on or near Hamilton Point, on Curtis Island is presently undeveloped and not serviced. A bridge, road and service corridors are required to provide a connection to the mainland. There are no existing port facilities established on Curtis Island.

There is flat land with good access to a future port on Curtis Island, although there may be environmental issues with development sites and infrastructure routes to development sites. The timing and certainty of access, infrastructure and port facilities for any site on Curtis Island is not consistent with this project timetable of delivering gas by late November 2011.

Bundaberg

Bundaberg Port is in reasonable proximity to existing and proposed urban development located and planned to be located in the Coral Coast area between Burnett Heads and Elliott Heads. This development, may compromise the long term operation of the LNG facility. The limited size of ships that can use the port is also a drawback for the port.

Incompatibility with surrounding residential and other sensitive land uses, existing and proposed, is a disadvantage to this site.

Fisherman's Landing Wharf

This site is located close to export port facilities, suitable for the type of vessel proposed to be used. The site is reclaimed land that is flat, cleared and generally free of environmental constraints. The site is also large enough to meet the plant's needs and has reasonable separation from other existing wharf based activities. The site is also well separated from residential uses and is capable of being serviced with necessary infrastructure. The site is also available in the time frame required for this project.

Unconstrained shipping access to FLW, and the plant and ship loading facilities' affect on the existing and future port activities at FLW are potential constraints to the use of this site.

This site is considered the most suitable. It is currently zoned as Strategic Port Land and is being developed expressly for the purpose of providing additional port facilities.

2.5.2 Feed Gas Delivery Alternatives

It is proposed that the gas supply for the facility will be sourced from the Gladstone City Gas Gate of the Queensland Gas Pipeline, located approximately 5km south of the plant site (refer to Section 3.2 for additional information regarding gas supply). A final route for the underground lateral pipeline required to deliver the gas to the plant site has not been determined. Four options, as described below, have been identified from preliminary investigations;

- Option A - A pipe running east from the Gladstone City Gas Gate crossing under the conveyors servicing the RTA alumina refinery and the Queensland Cement Limited rail line and then running north along the GSDA designated Materials Transportation and Services Corridor to the east of the RTA conveyors; or
- Option B - A pipe running east from the Gladstone City Gas Gate to the GSDA designated Materials Transportation and Services Corridor then turning north to FLW within the GSDA designated Materials Transportation and Services Corridor (west of the RTA conveyors and pipelines and east of the QCL rail line. For part of the route, this will coexist with the proposed PAMs route. The gas pipeline would therefore need to be underground and designed to withstand heavy vehicles running over it. This is a similar route to Orica's ammonia pipeline.
- Option C - A pipe running west and then north from the Gladstone City Gas Gate west of Landing Road, adjacent (or in) the easement of the existing gas pipeline servicing the former Ticor site and Queensland Energy Resources (QER) oil shale pilot plant and then running along Serrant Road (Material Transportation and Services Corridor) to FLW.
- Option D - A route aligning north from the Gladstone City Gas Gate and generally following the powerline on the east side of Landing Road, turning east at Serrant road to FLW

Option D is the preferred route as it limits the crossing of existing infrastructure, avoids existing buildings and dams, and follows the existing road and powerline. However there are outstanding issues to resolve with this route such as its impact on the Stuart oil shale resource and the ability of the Materials Transportation and Service Corridor between Serrant Road and FLW, west of the RTA conveyor, to accommodate a gas pipeline. Therefore further assessment of these options will be undertaken to determine the final route.

3 DESCRIPTION OF ACTIVITIES

3.1 SITE DESCRIPTION

The proposed LNG plant site is located within the FLW precinct on land currently being reclaimed by the Central Queensland Port Authority (CQPA). It will be approximately 25 ha in area and located west of Berth 5 (see Figure 2-1). Attributes of the site are summarised in Table 3-1 below.

Table 3-1 Site Attributes

CHARACTERISTIC	FISHERMANS LANDING WHARF
Availability	CQPA have advised the site could be made available on a long term lease provided the development does not detrimentally affect the operations of the port.
Proximity to residents	The closest dwelling to FLW is approximately 2km to the south west. The closest urban township to FLW is located approximately 6.4km away at Yarwun.
Power Access	Closest transmission line is a 132kV line on Landing Road approx 500m from the site. Powerlink has identified a number of options to increase power supply to the Gladstone State Development Area.
Water Access	Gladstone Area Water Board (GAWB) supplies industrial users at Targinie and Yarwun with raw water. Ability to supply water from existing infrastructure will depend on system capacity and demand. Currently, a 500mm pipeline reducing to 450mm pipeline runs along Landing Road and a 300mm pipeline runs along Serrant Road and onto FLW.
Road Access	A good road network exists in the Yarwun/FLW area. Hanson Road and Port Curtis Way located to the south are State controlled roads. Current access to the FLW is by Serrant Road however the Gladstone Port, Road, Rail Land Study Stage 2 currently underway may identify other options for FLW access.
Port Berth Available	Berth 5 at FLW has been identified as available to the project with upgrades to provide for larger vessels. CQPA advises the berth is and would remain common user, but the equipment on the wharf would be owned by the project.
Ship size	80,000DWT (part laden) 228 length berth required, depth 12.9m at FLW. CQPA has acknowledged and indicated that upgrades would be undertaken to FLW Berth 5 to accommodate this project. The responsibility for the upgrade would rest with CQPA.
Potential for expansion – land area	25ha of land on FLW is available which is sufficient for the maximum proposed plant capacity.
Pipeline Route Constraints	It is likely that the gas pipeline will be located within the GSDA. The State Government has identified multi-user transport corridors for the purpose of materials transport and these will be utilised where possible. Other infrastructure contained within the corridors and elsewhere within the GSDA may constrain the pipeline route. A comprehensive pipeline route selection process is being undertaken.

Prior to reclamation activities by CQPA, the land at FLW was unallocated state land under the administration of the Department of Natural Resources and Water. Once the land is reclaimed, CQPA intends to gain freehold tenure over the land and obtain approval from the Minister for Transport for designation of the land as Strategic Port Land.

3.2 GAS SUPPLY

The Proponents are currently negotiating a gas purchase agreement. It is proposed that the feed gas for the Project will be supplied from Sunshine Gas's Lacerta Field in the Surat Basin. Approximately 25 petajoules per year will be required for Stage 1. The Lacerta Field would be developed whether the Project Sun goes ahead or not as Sunshine Gas has other potential customers for the gas. Sunshine Gas reserves (independently certified) in the Lacerta Field are:

Reserve Class	Petajoules
1P Reserve (Proven)	44
2P Reserve (Proven + Probable)	469
3P Reserve (Proven + Probable + Possible)	1097

The Lacerta CSM is predominantly methane (>95%) and has very low levels of contaminants (mainly carbon dioxide and nitrogen).

Although a gas purchase agreement will be signed, the Lacerta gas will be fed into the Queensland Gas Pipeline. The Queensland Gas Pipeline carries a mixture of gas from numerous sources, therefore the feed gas delivered to the LNG Plant site will have a composition that is different to the Lacerta Gas. The Queensland Gas Pipeline specifies a standard for gas within its pipeline and the design of the plant will be based on that specification. The plant will be designed to accommodate the likelihood that the supply of CSM will increase in the Queensland Gas Pipeline, with a subsequent change in the composition of the gas to the plant.

The Queensland Gas Pipeline, with concomitant upgrades, has the capacity to supply the LNG Plant. Any upgrades of the Queensland Gas Pipeline will be the responsibility of the Queensland Gas Pipeline operator (Alinta Infrastructure Ltd) and are considered to be outside the impact assessment for this project.

3.3 GAS PIPELINE DESIGN AND CONSTRUCTION

Preconstruction activities for the gas pipeline generally include desktop analysis of local features, such as flora and fauna, geology, soil, weed infestations, cultural heritage, land access issues to determine the most suitable route. These studies are supplemented by field surveys as required, in order to clarify any issues, negotiate access to land and to fine tune route selection.

As previously discussed, the pipeline route has not been finalised. The criteria to be considered during route selection is summarised in Table 3-2.

Table 3-2 Pipeline route selection criteria[1]

Safety	Relevant safety standards
	Assessment of safety risks
Commercial	Present market requirements
	Ability to meet future consumer needs
	Construction and operating costs
Engineering	Relevant engineering construction and operation standards
	Terrain, seismic and geotechnical constraints and hazards
	Climatic implications – cyclones, flooding, storm surges

[1] APIA Code of Environmental Practice – Onshore pipelines 2005

	Access requirements for construction and operation
Environmental, including social aspects	Conservation of terrestrial and aquatic flora and fauna
	Protection of habitat and ecosystem integrity
	Protection of surface and ground water quality
	Maintenance of surface stability
	Potential for successful rehabilitation
	Air and noise pollution
	Management of historical and cultural heritage values
	Impact on local residents, traditional owners, existing land uses and infrastructure
	Zoning requirements
	Protection of landscape values

Construction of an underground gas pipeline can be characterised as a moving assembly line. In general the stages of pipeline construction can be summarised as below in Table 3-3.

Table 3-3 Stages of pipeline construction

Clearing	The removal of vegetation and debris to allow safe pipeline construction.
Grading	The removal of topsoil and rootstock from the trench line area. This material is stored and used in the rehabilitation of the easement.
Trenching	The excavation of the surveyed centreline for installation of the pipe. The trench dimensions will meet specified standards. Erosion control measures will be taken.
Stringing	The ordered delivery and unloading of pipe lengths to the site, in preparation for the welding of the lengths into pipeline strings. Usually occurs post-trenching to prevent possible damage to the pipeline coating.
Pipe installation	The insertion of the pipeline strings into the trench, after welds are visually inspected and x-rayed. The protective coating of the pipe is checked for cracks or defects, and any necessary repairs are made.
Back Filling	The excavated material is replaced in the trench to bury the pipeline. The pipeline is padded to protect the pipe coating from damage. Topsoil and rootstock is redistributed over the back-fill.
Hydrostatic testing	The integrity of the pipeline is tested by filling with water in accordance with Australian Standards AS 2885.5. The internal dimensions of the pipeline are gauged.
Clean up and restoration	The project area is restored. Line-of-sight markers are installed.
Commissioning	The pressurisation of the pipeline. Testing the pipeline system for function, including valve and scraper stations, cathodic protection, leak detection and SCADA systems.

3.4 GAS PIPELINE OPERATION

Operations and maintenance activities commonly include pipeline corridor patrols (at least annually); maintenance of the pipeline, pipeline corridor and associated facilities (such cathodic protection equipment); and pigging of the pipeline for cleaning or inspection. In particular, operations aim to manage four key issues:

- The pipeline structure and integrity;
- Pipeline operating conditions and practices;
- The pipeline corridor; and
- Activities that could affect the above issues.

Regular inspections are carried out on the pipeline corridor, either on land or from the air, to check on the condition of the corridor, including but not limited to:

- Activity on the pipeline corridor and in the vicinity;
- Use of access tracks and pipeline corridor and any unauthorised traffic;
- Access track condition and maintenance requirements;
- Evidence of erosion, washouts or land subsidence;
- Evidence of pipeline exposure;
- Vegetation cover;
- Excess vegetation on the pipeline corridor;
- Weed infestation;
- Water quality and protection of natural flows;
- Disturbance to protected heritage sites;
- Indications of leaks or spills; and
- The presence of refuse or litter.

Internal pipeline inspections to monitor the integrity of the pipe are carried out by intelligent pigs on an as required basis. There is no longer a legislative requirement under the *P&G Act* to inspect the pipeline at specific intervals, except for certain identified strategic pipelines, listed in Schedule 5 of the *Petroleum and Gas (Production and Safety) Regulation 2004*. However, a common schedule would be to inspect after five years, then seven years after that depending on the condition of the line. An example of a pipeline inspection checklist is included in the APIA Code of Environmental Practice.[2]

Maintenance is carried out as required.

An environmental management plan will be developed for the construction and operations phases of the gas pipeline development and submitted with the EIS and the application for an environmental authority.

3.5 LNG PLANT DESIGN

The purpose of the LNG process plant is to take feed gas and condense the gas by cooling it to a liquid, hence the term Liquefied Natural Gas or LNG.

The design of the plant being considered by the proponents is based on a single mixed refrigerant process that has previously been used in both baseload and peak shaving applications. The process is proposed to be modular in design. The process design will handle a wide range of feed gas compositions, ambient temperatures and other operating parameters. Stage 1 will consist of a single processing train with a single compressor refrigeration system and main exchanger cold box. The single train will be duplicated for Stage 2. One LNG storage tank with 160,000m^3 capacity will be constructed in Stage 1 and will have capacity for both Stage 1 and 2. Table 3-4 below provides a summary of the LNG plant design criteria.

[2] Appendix 4 APIA Code of Environmental Practice – Onshore pipelines Revision 1 2005

Table 3-4 Design Basis for Project Sun LNG Plant

Parameter	Design
Stage 1 design capacity	1400 metric tonnes/day of product LNG (0.5 Mt/y)
Stage 2 design capacity	2800 metric tonnes/day of product LNG (1 Mt/y, 2.2 Mm^3/y)
Feed Gas Rate (temperature and pressure)	1,625 tonnes/day natural gas (30°C, 40 barg)
Feed Gas Composition (mole %)	Nitrogen 2.2731 Carbon dioxide 1.5053 (designed for 2) Methane 93.1877 Ethane 2.0403 Propane 0.5686 i-C4 0.1333 n-C4 0.1298 i-C5 0.0536 n-C5 0.033 n-C6 0.0755
Process cooling	Air cooling used
LNG Storage	Tank net capacity 160,000m^3 Construction material – high nickel steel Full Containment with concrete outer wall and roof Tank design pressure 290 mbarg Tank operating pressure 260 mbarg Boil off rate 0.05% per day
LNG load out to ship	8,000 m^3/hour of LNG
LNG transport/export	125,000 m^3 LNG carrier and/or other size LNG carriers as required

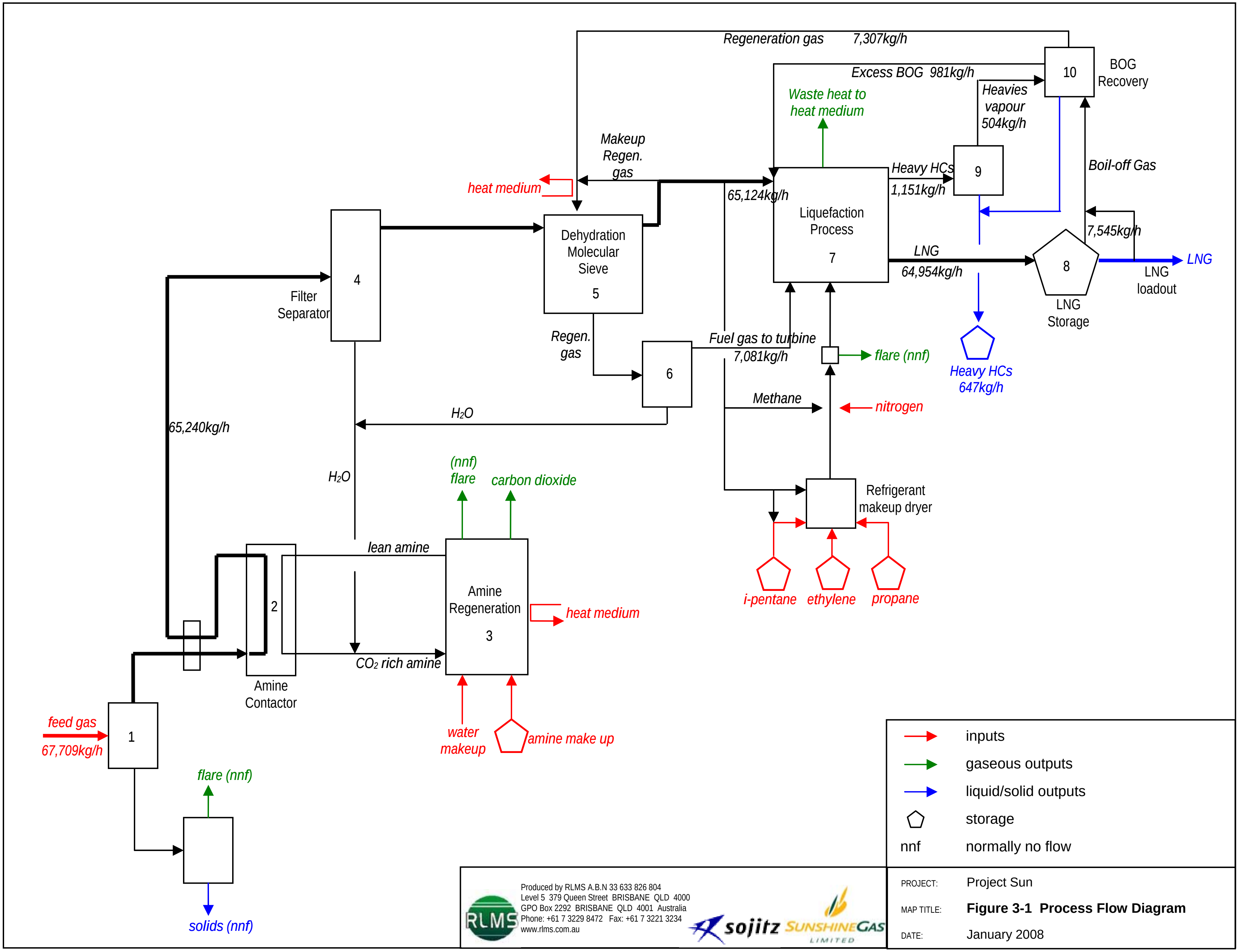
3.6 LNG PLANT OPERATION

3.6.1 General Process Description[3]

In general, carbon dioxide, water and heavy hydrocarbons need to be removed from the feed gas before it is liquefied at a temperature of approximately -160°C, as these other components will solidify at that temperature. The process train can be separated into sequential processes of CO_2 removal, dehydration and the liquefaction process. A simplified flow diagram is provided in Figure 3-1 with unit numbers identified for reference.

Solids and liquids in the feed gas are removed initially in a filter separator (Unit 1). It is expected that the gas will be dry with no liquids present and therefore the flow of vapour to the flare will not normally occur. Removal of CO_2 is then achieved by an amine system using a Methyldiethanolamine (MDEA) solution. The MDEA solution flows down through a tower (Unit 2) and makes contact with the gas to remove the CO_2 to below 50ppm. The CO_2 rich amine solution is then heated in an exchanger and fed to the amine stripper for amine regeneration (Unit 3). Water condensed in various separators within the plant is sent for use in the CO_2 removal process. CO_2 is vented to the atmosphere from the stripper at a rate of approximately 84 tonnes per day.

[3] Process information obtained from a project feasibility study prepared for the proponents by Black & Veatch Corporation, November 2007



PROJECT: Project Sun

MAP TITLE: **Figure 3-1 Process Flow Diagram**

DATE: January 2008

After CO_2 removal the gas is fed to the dehydration process where initially a filter/separator (Unit 4) removes any condensed water. The gas then goes to one of two pressure vessels containing molecular sieve (Unit 5) which preferentially removes water from the gas. The adsorption cycle time for the dehydration process is 12 hours. Therefore, as one vessel is adsorbing the water, the other is being regenerated in a heating and cooling cycle. Regeneration gas, made up of LNG storage tank boil-off gas and other gas from the heavy hydrocarbon handling system, is used to heat the molecular sieve to drive off the water.

The regeneration gas is then cooled with the water condensed and removed in a separator (Unit 6). Finally the water-free gas passes through a dust filter to remove sandy dust and sieve fines from entering the liquefaction process.

During normal operations of the cold box in the liquefaction process, a positive internal pressure is maintained by a continuous nitrogen purge venting to the atmosphere. Hydrocarbon monitoring is undertaken to detect any leaks from the exchanger to the cold box. Feed gas to the liquefaction process (Unit 7) is cooled to approx -59°C and then goes to the heavy hydrocarbon separator where the heavy hydrocarbons are removed. The resultant gas is cooled further and liquefied and sent to LNG storage (Unit 8) at about 0.1barg and -163°C.

The pressure of the heavy hydrocarbon stream is reduced and the stream heated (Unit 9) to remove heavy hydrocarbon liquids to storage and the vapour joins the boil-off gas from the storage tank to become regeneration gas in the dehydration process and fuel gas.

The cooling of the gas in the liquefaction process is performed by a closed loop refrigerant circuit. The refrigerant is a mixture of nitrogen, methane, ethylene, propane and iso-pentane. The refrigeration is performed with a centrifugal compressor driven by a gas turbine (Unit 7). The circuit also includes a compressor suction drum, refrigerant condensers and refrigerant separators.

The boil-off gas (BOG) system (Unit 10) handles a combination of flash gas from the liquefaction process, gas displaced from the tanks during LNG production and BOG from the LNG tank due to heat leak. The vapour from the tanker loading is also returned to the BOG system. BOG gas is used to regenerate the dehydration molecular sieves and is then used as fuel for the refrigeration turbine. Additional feed gas can be used to supplement the fuel balance if required.

3.6.2 Process Inputs and Outputs

A summary of the inputs and outputs from the LNG Process Plant is provided in Table 3-5 below. Additional information will be available once the detailed engineering design has been completed.

Table 3-5 Project Inputs and Outputs for Stage 1

Input	Volume required	Source/Storage
Feed Gas (vapour)	67,709 kg/h	QGP, delivered by 5km lateral.
Makeup Water and potable water	5,000 kg/d	GAWB supplied by dedicated pipeline
Amine makeup (liquid)	54 kg/d	Approximately one month storage onsite, supply trucked in.
Nitrogen (liquid)	One complete refrigerant charge - 1300kg 160 N m^3/hr required for nitrogen purge in liquefaction process	Storage onsite, supply trucked in
Ethylene (refrigerant make up)	Varies between 10% and 50% of system inventory (complete charge) per year	One complete charge stored - 9,440kg
Propane (refrigerant make up)	Varies between 10% and 50% of system inventory (complete charge) per year	One complete charge stored - 3,200kg
i-Pentane (refrigerant make up)	Varies between 10% and 50% of system inventory (complete charge) per year	One complete charge stored - 25,100kg
Heat medium for waste heat recovery	Initial volume of 16 m^3 required.	Closed system so very little makeup

system (liquid)		required.
Output	Volume	Management
LNG product (liquid)	64,954 kg/h	LNG stored in 160,000m^3 tank until shipped out
Heavy Hydrocarbons (liquid)	647 kg/h	133 m^3 Carbon Steel storage tank onsite, one truck per day to market
Emission from CO_2 removal stage (vapour)	84 t/d CO_2	Emission to atmosphere from vent
Exhaust from waste heat recovery system and gas turbine (vapour)	NOx 12.5 kg/h CO 7.6 kg/h unburnt HC 2.6 kg/h	Emission to atmosphere from stack (15m high)
Spent dehydration media (molecular sieve)	30,600 kg charge replaced approx. every 5 years	Disposed of at an approved landfill
Spent MDEA solution (liquid)	Usually no spent MDEA solution unless becomes contaminated	If contaminated, solution is trucked to an approved treatment and disposal site
Water removed in dehydration unit	Usually recycled to amine regeneration system. If contaminated, max volume requiring treatment is 2,800 kg/d.	Recycled to amine regeneration unit.

The LNG process would be designed for total containment of the refrigerant during shutdown periods. A storage drum is provided for storage of refrigerant liquids taken out of the system to allow maintenance to vessels within the system. During shutdown without maintenance, the refrigerant stream is kept in the refrigeration loop.

If it is the case that the water removed from the regeneration gas after dehydration (Unit 5) is not clean enough to be recycled to the amine regeneration system (Unit 3), then a treatment system will be provided. The maximum volume of water needing treatment would be 2,800 kg/d. Typically, however, this situation does not occur.

3.6.3 Waste management

In addition to the above inputs and outputs, there would be non-hazardous and hazardous wastes generated at the facility as is typical of most chemical processing plants. These may include but not be limited to[4]:

- general office and packaging wastes;
- waste oils and oil contaminated rags;
- hydraulic fluids;
- oily sludge from oil separators
- used batteries;
- scrap metals.

The waste will be segregated into non-hazardous and hazardous wastes and considered for recycling prior to disposal. A waste management plan will be prepared, including waste tracking, for the environmental authority application. Storage, handling and disposal of all wastes from the project will be undertaken in accordance with good industry practice for waste management.

The wastewater management system will consist of two separate drainage systems: a closed drain system for water from process areas that could be contaminated with hydrocarbons and an open drain system for water from non-process areas. The open drain system will be fitted with oil/water separators. Opportunities for reusing the water onsite will be investigated, with the remainder discharged to Port Curtis.

All process areas will be bunded to avoid uncontrolled runoff and directed to the closed drain system. All washdown water will also be directed to the closed drain system. If fire test water is contaminated with

[4] Environmental, Health and Safety Guidelines for Liquefied Natural Gas (LNG) Facilities, International Finance Corporation, World Bank Group, April 30, 2007.

hydrocarbons, it will be directed to the closed drain system. The wastewater treatment system will be designed to meet applicable water guidelines and licence conditions before the water is either reused onsite or discharged to Port Curtis.

Options for sewage treatment and disposal will be investigated. A package sewage treatment plant may be constructed onsite or sewerage infrastructure provided to an existing sewage treatment plant.

During commissioning, there will be a need to hydrostatically test the LNG storage tank. Approximately 100,000m^3 of hydrotest water, which may contain chemical additives, will require one-off disposal. Options for beneficial use of the water will be explored in consultation with the EPA prior to commencing construction. Other measures to minimise the impact of disposal include reducing the time the test water is in the tank thereby reducing the need for chemical additives, selection of the chemical additives for the potential impact on aquatic biota, and using the test water multiple times.

3.6.4 Utilities

Potable and non-potable water is required for office/ablutions needs, general plant use, and for fire and deluge systems. A maximum of 5,000 L/d is required and will be purchased from GAWB.

Fuel requirements are internally generated and consumed. The plant requires 8,800kW connected power load.

Other utilities required include compressed air, instrument air, and battery backup for critical control systems.

3.7 LNG Plant Construction

The construction phase will be managed by an integrated joint venture of a local general construction company and an international and experienced engineering contractor.

The construction phase of the project will involve site clearing, civil works, erection of steelwork, installation of machinery, pipework and equipment and the integration of management and process systems. The overall construction phase is expected to be in the region of 32 months and will employ a peak workforce of around 400. The joint venture construction team will seek to source the majority of labour from Queensland, with specialists brought from other states and overseas.

The major on site construction activity is the construction of the LNG storage tank, which will use standard construction techniques that have been used for many years in the LNG industry. It is expected that the majority of the process plant will be modularised and delivered to site as preassembled modules (PAM) using the proposed PAM facility on FLW. It is expected that these PAM's will be sourced from other parts of Australia and Asia.

All construction materials and practices will be in accordance with relevant Australian and/or international standards and the joint venture construction team will be responsible for the development and implementation of a construction phase environmental management plan.

3.8 LNG Shipping

Sojitz Corporation owns a 50% share in LNG Japan Corporation who will be responsible for the shipping of the LNG from Gladstone to Japan. LNG Japan has been in the LNG shipping business for over 30 years. For Project Sun, it is currently proposed to use an LNG carrier with a capacity of up to 125,000m^3. The dimensions of the carrier will be: length 285m, width 44m, draft 10.9m. However, there is a possibility that a larger or smaller carrier will be used.

Loading the LNG carrier will take approximately 24 hours, including cooling the loadout pipe and arms at the Berth.

During Stage 1 operations, approximately 8 ships of LNG will be exported per year. This will double to 16 ships per year for Stage 2. Discussions are being held with the Gladstone Harbour Master and Marine Safety Queensland on the expected shipping restrictions to be imposed for the Project.

4 AIR VALUES

4.1 CLIMATE

The climate of Gladstone is defined as sub-tropical. The mean daily maximum temperature in the summer months is over 30ºC while the mean daily minimum temperature during the winter months is approximately 15ºC. Gladstone has an average annual rainfall of approximately 1000mm which typically falls in the summer months.

Predominant winds for the project site are from the east, south-east.

4.2 EXISTING AIR ENVIRONMENT VALUES

Major industries that discharge emissions into the Gladstone airshed include Boyne Smelters, NRG Gladstone Power Station, Rio Tinto Alumina Refinery, Queensland Alumina, Orica, and Cement Australia. Air quality monitoring is undertaken in Gladstone by the EPA with the objective to check compliance with ambient air quality guidelines, to identify long term trends in air quality, and assess the effectiveness of air quality management strategies. Monitoring is undertaken at sites in Targinie, Clinton and South Gladstone. Targinie is the closest monitoring location to the project site.

Monitoring data from the Targinie site, as reported in the Central Queensland Air Quality Bulletin for August 2007 is summarised in Table 4-1. The Air Quality Bulletin presents monthly summaries of air quality data for the preceding 12 months.

Table 4-1 Summary of 12 months ambient air quality monitoring at Targinie (Sep 2006 - Aug 2007)

Parameter	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Guideline
NO_2 monthly max 1-hour av. (ppm)	0.035	0.030	0.038	0.029	0.019	0.022	0.030	0.027	0.028	0.029	0.036	0.036	0.12[1]
NO_2 annual average (ppm)	0.004												0.03[1]
SO_2 monthly max 24-hour av. (ppm)	0.010	0.007	0.004	0.004	0.004	0.004	0.007	0.003	0.004	0.007	0.005	0.008	0.08[1]
SO_2 monthly max 1-hour av. (ppm)	0.033	0.037	0.045	0.027	0.025	0.030	0.043	0.029	0.028	0.031	0.037	0.072	0.20[1]
SO_2 annual average (ppm)	0.002												0.020[1]
PM_{10} monthly max 24-hour av. (µg/m^3)	23.0	38.1	78.6	27.1	39.1	26.8	24.9	24.4	18.1	16.3	17.9	30.0	50[1]
PM_{10} annual average (µg/m^3)	14.5												

Visibility-reducing particles[3] monthly max 1-hour av. (Mm^{-1})	54	224	198	61	358	31	30	72	74	36	42	51	235[2]

[1] *National Environment Protection (Ambient Air Quality) Measure* (NEPM) air quality standards

[2] *Environmental Protection (Air) Policy 1997* (EPP (Air)) air quality goal. Goal for visibility-reducing particles is 20km visibility equating to light scattering coefficient values of 235 Mm^{-1} or less

[3] Visibility-reducing particles reported as light scattering coefficient values (Mm^{-1})

reference: Air Quality Bulletin Central Queensland, EPA, August 2007.

None of the ambient air quality standards were exceeded at this monitoring location within the last 12 months.

The EPA undertook a review of fine particle levels in Gladstone by looking at air monitoring data from 2001 to 2006. They found that trends in fine particle levels in Gladstone over this period have been downward overall, although levels have been static or increasing slightly in the last two years. The monitoring indicated that industrial particle emissions did not result in exceedences of PM_{10} (particles less than 10µm in diameter) and visibility-reducing particle (particles typically less than 2.5µm in diameter) air quality goals and standards at EPA monitoring site locations. Exceedences of goals and standards only occurred during atypical particle events such as dust storms, grass fires and bushfires (*Fine particle levels in Gladstone - Review of EPA air monitoring data 2001 - 2006*, EPA, 2007).

In addition, the EPA's *Ambient air quality monitoring in Queensland 2005 annual summary and trend report* reports the following:

- No exceedences of the EPP (Air) goal (0.16ppm) or the NEPM standard (0.12ppm) for the 1 hour average NO_2 concentration in the Gladstone region for 1996 - 2005;
- No exceedences of EPP (Air) goal or the NEPM standard (both 0.20ppm) for the 1 hour average SO_2 concentration in the Gladstone region for 1996 - 2005;
- No exceedences of the NEPM standard (0.08ppm) or the EPP (Air) goal (0.04ppm) for the 24 hour average SO_2 concentration in Gladstone region for 1996 - 2005;
- In the period 1996 - 2005, the 24 hour average PM_{10} concentration in Gladstone region:
  - exceeded the EPP (Air) goal of 150µg/m³ on 2 days in 2002 and on 1 day in 2005; and
  - exceeded the NEPM standard of 50µg/ m³ on 1 day in 1997, 4 days in 2000, 10 days in 2001, 15 days in 2002, 1 day in 2004 and 5 days in 2005.
- In the period 1996 - 2005, each year had days where the 1 hour average visibility reduction due to airborne particulates in Gladstone region was less than the EPP (Air) goal of 20km or greater (maximum was 19 days in 2001).

4.3 PROJECT AIR EMISSIONS

Air emissions from the project during construction will be principally dust and exhaust emissions from machinery and vehicles. These emissions will occur at both the plant site and within the pipeline construction corridor. Standard construction control measures will be implemented to minimise these emissions.

At this stage of the design, it is expected that the gas pipeline will not have any above ground vents or valves, therefore during normal operations there is not expected to be any emissions. Small quantities of vehicle and machinery emissions may be generated during pipeline inspections and maintenance.

The major air emissions during normal operations of the LNG plant are expected to be from:

1. Carbon dioxide stripper unit (estimate maximum 84 t/d of CO_2);
2. Gas turbine and waste heat recovery system through 15m stack (estimate total nitrogen oxides 12.5 kg/hr, carbon monoxide 7.6 kg/hr and unburnt hydrocarbons 2.6 kg/hr).
3. Flare system pilot light.

Other potential emissions are fugitive emissions from the plant, storage tank and loading activities. A vapour recovery system will be installed on the LNG storage tank and for the loading of LNG tankers. The captured gas will be returned to the plant as regeneration gas and fuel gas for the turbines.

The composition and volume of atmospheric emissions from the LNG plant will vary during abnormal operations such as startup or shut down of the plant and emergency venting. The flare systems are installed on an LNG plant as a safety precaution to release gases from high pressure vessels. The highly efficient flaring system will be designed to minimise the amount of unburnt hydrocarbons released to the atmosphere. The EIS will provide information on the amount of time it is expected that flares will occur and the combustion emissions expected during abnormal plant operating conditions.

As required by the EPP (Air), air pollution dispersion modeling will be carried out to investigate the impact that operating Project Sun, under all operating conditions, will have on the Gladstone area air shed. Cumulative effects of emissions and potential to reduce the air quality value will be investigated.

An assessment of the projected annual emissions for each relevant greenhouse gas, with total emissions expressed in 'CO_2 equivalent' terms will be undertaken. The estimated greenhouse gas emissions will be provided in the EIS and the application for an environmental authority.

5 LAND VALUES

5.1 TOPOGRAPHY, GEOLOGY AND SOILS

The topography of the general area is broadly undulating land with intervening lower lying drainage flats and stream terraces. Lower lying poorly drained areas occur. Areas to the east may be subject to periodic flooding or tidal inundation and tidal mangrove flats occur.[5]

The LNG plant site consists of imported fill from dredging operations. No geotechnical investigations on this fill have been completed. However, geotechnical and stability studies will be undertaken on the reclaimed area to determine the design and construction constraints for the project.

The proposed pipeline routes traverse areas of Tertiary-Quaternary lateritised colluvial deposits (TQr), Quaternary residual soils and alluvial fan deposits (Qr), Quaternary creek and flood plain alluvial deposits (Qa), and Quaternary marine deposits (Qm).

The soils associated with the Quaternary residual soils and alluvial fan deposits usually comprise dark brown slightly acidic gravelly sandy loam to clay loam which grade to gravelly sandy clay loam or light clayey subsoils.[1] The Quaternary alluvial deposits generally consist of silty to loamy surface duplex soils underlain by slightly acidic to slightly alkaline, grey to yellowish brown sodic clay subsoils occurring on the higher alluvial plains and terraces. On the lower lying alluvial flats, the deep cracking clay soils occur in association with silty to clay loamy surface duplex soils and neutral to slightly alkaline brown sodic clayey subsoils. The cracking clays are highly reactive and subject to swelling and shrinkage. The soils associated with the Quaternary marine deposits generally comprise uniform fine or medium textured crusting surface dark grey brown and mottled grey saline clays, saline muds and sands.

The silty and clayey fines of the majority of these soils exhibit slight to moderate dispersion characteristics and have low salinity levels.

The pipeline routes in the northern section close to FLW are in an area mapped as containing indicative acid sulfate soils (ASS) and the likelihood of ASS occurring is high.

Further identification of soil type along the selected pipeline route will be carried out to determine the likely construction method, timing and cost.

5.2 POTENTIAL IMPACTS ON SOILS

The construction and operation of the LNG plant on the FLW site will have minimal impact on the fill used to reclaim the site. Driven piles will be used to support the 160,000m^3 LNG storage tank, process equipment and administration building.

The construction of the underground gas pipeline will disturb both topsoil and subsoil along the pipeline corridor. Industry best practice control measures for the management of topsoil and soil will be implemented during the construction phase. Particular attention will be paid to investigating the existence of ASS and development of control measures if it is likely that ASS will be disturbed. Measures may include:

- Minimising the time spoil is stockpiled;
- Neutralising spoil with lime;
- Containing runoff from stockpile areas in holding ponds or bunded areas;
- Disposing of contained runoff water only after analysis;
- Verification testing of potential or actual acid sulfate soils post liming and prior to reburial;

[5] Information in this section is referenced from "Chlor Alkali/Ethylene Dichloride Plant Gladstone - Environmental Impact Statement - Volume 1 of 2", prepared for LG Chem, URS, February 2003.

- Burying of soil below the water table; and
- Compacting the backfill to prevent acid leach migration.

An ASS investigation will be undertaken in accordance with State Planning Policy SPP 2/02 and the Guidelines for Sampling and Testing ASS produced by the Queensland Acid Sulfate Soils Investigation Team. Monitoring and maintenance of the pipeline corridor will be required to ensure erosion is minimised. Restoration of the pipeline construction corridor will be required.

5.3 POTENTIAL IMPACT ON SURROUNDING LAND USES

A preliminary risk assessment workshop was undertaken on 28 November 2007 to discuss potential impacts on surrounding land users and impacts on the operations within the Port of Gladstone from the proposed activities for this project, including shipping of LNG. A more detailed risk assessment will be undertaken before and during the front end engineering design phase and presented as supporting information for the EIS and applications for a petroleum facility licence and environmental authority. The assessment will include a hazard identification exercise in order to identify the nature and scale of all hazards which might occur during the Project, a preliminary analysis of the consequences of these incidences on people, property and the biophysical environment, and a risk analysis including generation of risk contours.

Depending on the final route, the gas pipeline may have an impact on the proposed mining of oil shale deposits within existing mineral development licence areas. Further consultation with QER about their proposed activities and how the gas pipeline may impact on them will be undertaken.

6 ECOLOGICAL VALUES

6.1 MARINE ENVIRONMENT

Port Curtis is a natural deepwater harbour protected by Facing Island and the southern portion of Curtis Island. The salinity of Port Curtis is between 3 and 3.5%. During heavy rainfall and cyclonic events, pulses of freshwater flush from Calliope River and the smaller creek systems along the coastal fringe in a south easterly direction. For the majority of the year, the freshwater inflows to Port Curtis are low. The large tidal range within the Port results in high flow velocities.

The intertidal and supratidal zones shoreline of Port Curtis, close to the Project land areas, include the following marine habitats[6]:

- poorly vegetated high tidal salt marsh and/or bare saline mudflats in the supratidal/supralittoral zone.
- upper to mid intertidal zones that are typically colonised by mangrove forest.
- lower intertidal sand, shelly-mud, and soft mudflats, sometimes colonised by linear bands or patches of seagrass meadow.

Seaward of the intertidal zone is the benthic zone.

Port Curtis is located within the boundary of the Great Barrier Reef World Heritage Area but not within the Great Barrier Reef Marine Park. Port Curtis is also listed in the Directory of Important Wetlands in Australia. The area surrounding the Port Curtis Wetland is in the Curtis Coast catchment and is protected by the Curtis Coast Regional Management Plan as required by the *Coastal Protection and Management Act 1995*.

The seagrass beds within Port Curtis provide vital habitat for aquatic fauna and feeding grounds for several JAMBA and CAMBA listed migratory waders, dugong and marine turtles.

6.2 POTENTIAL IMPACTS FROM LNG FACILITY

The proposed plant site will be reclaimed land and as such will not contain terrestrial flora or fauna. The site is adjacent to environmentally sensitive areas within Port Curtis, such as the Great Barrier Reef World Heritage Area, Port Curtis Nationally Important Wetlands, and areas of marine plants. The operation of the LNG facility is unlikely to impact on these areas under normal operating conditions (refer to Section 7.3). The facility will be designed to ensure that the risk to these areas during emergency situations is minimised.

6.3 POTENTIAL IMPACTS FROM GAS PIPELINE

Environmentally sensitive areas in the vicinity of the pipeline route options include the Great Barrier Reef World Heritage Area and Port Curtis Nationally Important Wetlands. Implementation of standard pipeline construction controls will ensure that these areas are protected from potential sediment runoff during pipeline construction and operations.

Mapping by the Queensland Herbarium shows endangered Regional Ecosystem (RE) RE 12.3.3 (*Eucalyptus tereticornis*) as occurring along Boat Creek and essential habitat for the Little Pied Bat (*Chalinolobus pictatus*). While some clearing of the endangered RE may be required (to be confirmed through field examination), the pipeline route will be selected to minimise the disturbance and avoid clearing mature and hollow bearing trees as far as possible. The majority of the pipeline route options are cleared or partially cleared.

[6] Information in this section is referenced from "Gladstone Nickel Project Environmental Impact Statement", prepared for Gladstone Pacific Nickel Ltd by URS, April 2007

As Boat Creek is tidal, the crossing of Boat Creek is expected to require disturbance to marine vegetation in this area. Disturbance will be limited to the area necessary to construct the crossing and will be confirmed during field studies and pipeline design.

Potential impacts from the construction of the gas pipeline include clearing of vegetation and associated impacts on fauna habitat and movement corridors. Such impacts will generally be limited to the immediate area of the pipeline route, which will be selected to make use of existing disturbance as far as practical. The potential for sedimentation associated with pipeline construction to impact into downstream wetland areas and affecting migratory birds is considered low as construction controls will limit any downstream flow of sediment during construction and these will be clearly documented within the Construction EMP.

There is potential for a number of declared weeds and environmental weeds to exist within the vicinity of the pipeline and controls will be prepared to ensure that weeds are not introduced or spread as a result of pipeline construction.

Further investigation will be undertaken on the potential impacts on ecological values from the Project and appropriate control measures proposed in the Project's EMP.

7 WATER VALUES

7.1 EXISTING VALUES

Ecological values of the marine environment are described in the previous section. The values of waters in Port Curtis also include water quality and recreational and commercial values of activities such as fishing. The environmental values of the Port Curtis Wetlands Area include:

- extensive mangrove forests (3,300 ha), seagrass beds (2,430 ha) and salt flats (2,800 ha);
- one species of seagrass (*Halophila tricostata*) and several species of mangrove (*Acanthus ilicifolia*, *Avicennia eucalyptifolia*, *Xylocarpus australasicus* and *Bruguiera exaristata*) at the limits of their distribution;
- habitat for significant species including Beach Stone-curlew (*Esacus neglectus*), Radjah Shelduck (*Tadoma radjah*), Eastern Curlew (*Numenius madagascariensis*), Chestnut Teal (*Anas castanea*), Little tern (*Sterna albifrons*), Sooty Oystercatcher (*Haematopus fuliginosus*) and Black-necked Stork (*Ephippiorhynchus asiaticus*);
- significant feeding areas for Dugongs (*Dugong dugon*);
- habitat for significant marine turtle species, including Green Turtle (*Chelonia mydas*), Flatback Turtle (*Natator depressus*), Loggerhead Turtle (*Caretta caretta*) and Hawksbill Turtle (*Eretmochelys imbricata*); and
- Colonies of Flying Foxes (*Pteropus scapulatus*, *Pteropus alecto* and *Pteropus poliocephalus*)

The construction of the gas pipeline will involve the crossing of Boat Creek. A summary of median water quality values for the freshwater reaches of Boat Creek is provided in Table 7-1.

Table 7-1 Boat Creek Median Water Quality Data[1]

Parameter	Units	No. of samples	Median Value	Queensland Water Quality Criteria (2006) Lowland Streams
Conductivity	µS/cm	18	805	20 - 250[2]
pH		18	7.5	6.5 - 8.0
Total Dissolved Solids	mg/L	18	350	not available
Turbidity	NTU	18	64	50
Total Suspended Solids	mg/L	9	40	10
Total Nitrogen as N	mg/L	10	0.66	0.5
Total Phosphorus	mg/L	10	0.10	0.05

1 - reference: Chlor Alkali/Ethylene Dichloride Plant Gladstone EIS (2003) prepared for LG Chem by URS

2 - criteria from Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000) for a lowland river in Northern Australia.

7.2 POTENTIAL IMPACTS FROM CONSTRUCTION ACTIVITIES

Potential impacts to water quality during construction are largely associated with the potential for increased sediment runoff from the construction areas. Measures to minimise the potential for any significant runoff during pipeline construction will include:

- Minimising the quantity and duration of soil exposure;
- Protecting topsoil and seed stock by:
    - Topsoil - separation; stockpiling; grading away from watercourses; re-spreading last; scarification; and brush spreading to protect the topsoil;
    - Seed - separation and stockpiling of topsoil to preserve seed stock; brush spreading to provide additional seed stock if necessary;

- Selection of the pipeline route to avoid areas of side slope;
- Protecting critical areas post construction by development of structures to reduce the velocity of water and redirecting runoff to stable ground;
- Installing diversion banks at the crest of the stream approach slope to divert sheet flow away from backfilled trenches;
- Re-contouring landforms to their original condition as soon as practicable, including removing any erosion controls established prior to construction;
- Installing and maintaining permanent erosion and sediment control measures (e.g. contour banks, earth banks, turn off drains, silt fences) as appropriate and advised by the soils expert;
- Reinstating the construction corridor as soon as practicable after completion of backfilling;
- Limiting vehicle movement on reinstated construction corridor; and
- Inspecting the construction corridor and maintaining erosion and sediment controls as necessary, during and after construction, until stabilisation is achieved.

Construction of the LNG Process Plant and Berth Loading Facilities is unlikely to have a significant impact on the waters of Port Curtis, provided adequate controls are put in place to manage sediment and stormwater runoff from the construction area, fuel or chemical storage and disposal of hydrotest water if required.

Best practice construction control measures will be incorporated into the Project's Construction EMP and implemented during the construction phase to minimise the potential impacts.

7.3 POTENTIAL IMPACTS FROM OPERATIONAL ACTIVITIES

Impacts on water values from the operation of the gas pipeline may occur from erosion of the pipeline easement, particularly at the Boat Creek crossing. Regular maintenance and periodic inspection of the easement will reduce the likelihood of this occurring.

No liquid discharges from the LNG liquefaction process to surrounding waters are expected. However, treated stormwater and other wastewater from the site may be discharged if it cannot be reused onsite. Appropriate water quality targets will be proposed for any discharges.

There are no LNG or vapour releases as a result of normal operations of the LNG Plant. The potential for impact on the surrounding environment from an LNG release is very low. LNG is colourless, odourless, non-toxic and leaves no residue after evaporation[7]. LNG and LNG vapour are not soluble in water therefore water contamination should not occur. The buoyancy of LNG vapour enhances the dispersion in the atmosphere with no long-term hazardous effects.

Potential damage to the environment is limited to the immediate vicinity of the release. For example, any fish in the immediate vicinity (a few hundred meters) of an LNG ship release would unlikely be frozen or otherwise harmed as any freezing of the water would be at the surface[6]. If an LNG pool on water is ignited ("pool fire"), marine mammals will likely stay away.

[7] "Risk Assessment Grassy Point LNG", ICF International, July 2007

8 SOCIAL VALUES

8.1 LNG SAFETY[8]

The potential impact of the Project on public safety will be assessed. Hazards at the LNG plant site and wharf facilities include:

- fire from ignition of LNG vapour;
- asphyxiation by vapour cloud from lack of oxygen; and
- injury from low temperatures of LNG liquid/vapour and cryogenic equipment.

Only fire has the potential to impact on safety off the site, therefore the elimination of vapour releases and the elimination of ignition sources will be the primary control measures.

LNG is not flammable in its liquid form. However, if LNG is released from the process, storage tank or during transfer to the LNG carrier, it will evaporate and mix with air. When the fuel concentration is between 5% and 15% it will burn if there is an ignition source. The refrigerant cycle includes the vaporization and condensation of the refrigerant, usually under pressure. A leak from this system has the potential to also produce a flammable vapour cloud.

If the ignition is immediate or relatively soon after the start of the release of LNG, the fire size is determined by the LNG release rate which fuels the fire. If the ignition is delayed, an LNG vapour cloud will develop and disperse as it expands and/or moves downwind. For ignition to occur, the concentration of vapour in the atmosphere must be at less than 15%. At concentrations above this there is not enough air to sustain combustion. As the cloud expands, eventually the concentration drops below 5% vapour in the atmosphere. At concentrations below 5% vapour in the atmosphere there is not enough fuel to sustain combustion. The vapour cloud will burn back to the source of vapour. This source can be either the release itself or a pool of LNG accumulated prior to ignition.

Standards applied to overseas LNG Projects require a "vapour dispersion exclusion zone" and a "thermal radiation exclusion zone" to be calculated. Ideally the boundaries of the exclusion zones are located within the site boundary.

Typical control measures implemented during design, construction and operational phases of an LNG Project include:

- meeting international design standards for structural integrity and operational performance of equipment;
- storage tank designed with adequate secondary containment;
- regular maintenance and periodic inspection of equipment for corrosion and structural integrity;
- loading of LNG carrier by trained personnel;
- monitoring for gas leaks;
- emergency shutdown and detection system in the case of a significant leak

A more detailed risk assessment, leak prevention and control plan and emergency response plan will be prepared as supporting information for the EIS and the environmental authority application.

8.2 NOISE

Major industry in the immediate area of the LNG plant site includes Cement Australia, Comalco Alumina Refinery, Ticor and Orica. Planned developments include the Gladstone Pacific Nickel Refinery and possibly

[8] Information in this section obtained from "Risk Assessment Grassy Point LNG", ICF International, July 2007, and "Environmental Health and Safety Guidelines - Liquefied Natural Gas Facilities", International Finance Corporation World Bank Group, April 2007.

a redesigned oil shale plant. These major industries, other local industries and local roads contribute to the noise emissions in the vicinity of the LNG plant site. The closest sensitive receptor (residence) is more than 2km from the plant site. Depending on the final gas pipeline route, this sensitive receptor will also be the closest to the pipeline at 500m.

Noise emission data for each piece of equipment used in the plant will be obtained and used in noise modeling. Typically, the main noise sources in an LNG plant are pumps, compressors, turbines, dryers, heaters, air coolers and the loading of LNG carriers. In emergency situations or plant start up and shut down, the loudest noise source will be the flare systems.

Potential noise emissions during the construction of the plant and pipeline will also be modeled. Worst case scenario meteorological conditions will be investigated and modeled.

8.3 VISUAL

From the Gladstone Industrial Land Study (Connell Wagner 1992) the visual quality of the area was found to lie in the:

- Naturalness of the area;
- The contrasts in the landform and vegetation;
- Presence of views of landmark hills and ranges such as Mt Larcom; and
- The cultural landscape of open, undulating grasslands by woodlands.

Mt Larcom with its slopes and undulating forested foothills plays a dominant role in forming the landscape character of the GSDA and the high scenic quality of the landscape. Areas that make a significant contribution to the locality are:

- Mt Larcom and the slopes and foothills of its range; and
- The landscape in outlooks to Mt Larcom and Mt Sugarloaf from the Mt Larcom Road.

The FLW has always been designated for industry and ship berthing activities. Therefore the impact of the project on the visual amenity of the area would be no more than what was expected when the FLW development was approved.

8.4 CULTURAL HERITAGE

There is an existing agreement between the Traditional Owner Claimants and the Minister for State Development for Cultural Heritage Management of the GSDA. If the final pipeline route extends beyond the GSDA border, further Cultural Heritage studies and liaison with the Traditional Owners will be required. A Cultural Heritage Management Plan will be prepared to cover monitoring during pipeline construction and procedures if any finds are made.

8.5 SOCIO-ECONOMICS

In the Gladstone Region Overview, January 2005, the estimated population in the Gladstone region was reported as 62,666. The demographics of the region indicate that the median age in Gladstone City is 32 and in Calliope Shire is 35. Over the next 20 years the demographics of the region are forecast to change so that the median age in Gladstone City is 35 and in Calliope Shire is 38. The population growth in the Gladstone/Rockhampton Region in recent times has occurred as a result of the establishment of major industry. Australian Bureau of Census data shows manufacturing is the most important employer in Calliope Shire and manufacturing and wholesale/retail industries are the major employers in Gladstone.

The Gladstone Region provides the following general services:

- Gladstone General Hospital, choice of general practitioners and specialist doctors, dentists and other medical services;
- A variety of childcare, primary schools, special schools, high schools and tertiary education facilities; and
- Gladstone Airport with regular air services to Brisbane, Rockhampton, Mackay, Townsville and Cairns.

With an estimated operational workforce of 34, and no more than 10 people onsite at any one time, the potential impact on local facilities and services during operations of the Project is not expected to be significant. The peak construction workforce is estimated to be approximately 400 with an average construction workforce of 300. Housing for the construction workforce will be required. The capacity of the existing housing market and the need to provide a construction camp will depend on housing availability in the Gladstone and Calliope area. Availability of housing will depend on the timing of other projects in the area including the Stage 2 upgrade of Rio Tinto Australia (RTA) Yarwun Alumina Refinery and the commencement of the Gladstone Nickel Project. A study will be undertaken to assess housing availability anticipated at the time of construction and what construction housing options are available. If needed, the site for the construction camp will be discussed with the local councils and State agencies with a view to providing facilities that are acceptable to the local authorities, State agencies and the community, and not duplicating facilities that are already provided.

A good road network exists in the FLW area. Minor upgrades to the existing road network and sealing of existing road access to FLW may be required, depending on volume and type of road movements proposed. There may also be a need to upgrade road intersections at Landing Road and Port Curtis Way and Landing Road and Hansen Road depending on volume and type of road movements proposed. The need to upgrade and the form of the road upgrades will be assessed as part of the project's development.

A community consultation program will be undertaken and the results reported in the EIS and application for an environmental authority. The demand on facilities and services of the region and potential impact on traffic during construction activities will be assessed.

8.6 PROPOSED CONSULTATION WITH INTERESTED PERSONS

Section 41(3) of the EP Act requires that a list stating the name and address of each person the proponents propose as an interested person for the Project be submitted to the EPA. It also requires a list of the affected persons for the project (defined under section 38 of the EP Act) to be submitted. These lists are not included in this IAS but rather have been forwarded in a separate document to the EPA.

Consultation to be undertaken as part of the statutory EIS process for Project Sun will involve the following:

- Draft Terms of Reference:
  - newspaper advertisement of public notice;
  - public notice sent to each affected and interested person;
  - public display of Initial Advice document and draft Terms of Reference at local library and on EPA website; and
  - meetings with community groups, stakeholders and regulatory agencies.
- EIS:
  - newspaper advertisement of public notice;
  - public notice sent to each affected and interested person;
  - public display of EIS document at various locations;
  - EIS summary document distributed to stakeholders;
  - meetings with community groups, stakeholders and regulatory agencies.

In addition to the above, a comprehensive community consultation program will be implemented during the EIS preparation phase. This will include consultation with interested and affected persons and other stakeholders. The purpose of the community consultation program will be to:

- facilitate understanding of the project and it's components;
- establish a communication network;
- identify community and stakeholder concerns; and
- provide feedback on how concerns and issues are being addressed;

The methods for consultation will include face-to-face stakeholder meetings, newspaper articles and advertisements advising study team contact details, meetings with regulatory agencies, public display and project updates.

Community consultation will also be developed as an ongoing program for the life of the project to provide opportunities for the community to raise issues and concerns. A monitoring and reporting system will be developed for inclusion in the Project's Environmental Management Plan.