8.5 Surface Water

8.5.1 Introduction

This section of the EIS identifies the potential risks to the surface water environmental values as a result of the proposed LNG facility and potential bridge.

The proposed LNG facility site catchment area is approximately 3.8km^2 and is located to the south west coast of Curtis Island. The site stretches from the hills to the east at approximately 124 m AHD in elevation, down to the flat salt marsh of the China Bay coast. Within this area eight drainage features have been identified. The features are all ephemeral in nature, with small catchments (less than 5 km^2 in size). An initial desktop review, undertaken as part of the pipeline assessment, determined that there are no major watercourses along the pipeline route to the north west of the facility study area. As such, no specific watercourse assessment was conducted on Curtis Island outside of the facility's catchment.

The potential bridge is proposed to cross the Narrows at Friend Point on the mainland to Laird Point on Curtis Island. The potential bridge abutments are to be constructed on the foreshore where the dominant soils are coastal estuarine tidal marine flats, which consist mainly of deep soft saline clay, silt and muddy sand soils. Surface water flows will only be potentially impacted at the downstream point before entering the marine environment.

8.5.2 Methodology

An assessment of the water resources of the LNG facility in the context of environmental values as defined by the *Environmental Protection (Water) Policy 1997* (EPP (Water)) was undertaken. *The Water Act 2000* (Water Act) and the *Integrated Planning Act 1997* (IP Act) are the principal legislation governing approvals and licensing of water supply schemes and associated structures. The Fitzroy Basin and Calliope Basin Water Resource Plan's cover the management of all surface water in the basin including overland flow.

The assessment also included:

- A hydrological assessment considering the catchment characteristic and local hydrological patterns, for a range of event probabilities was undertaken for local drainage features. A basic hydraulic assessment of the drainage features was also undertaken using hydraulic modeling software, HEC-RAS V3.
- A water quality assessment was undertaken using relevant water quality objectives for the area being identified from Queensland Water Quality Guidelines (QWQG) and compared with median values of various physico-chemical parameter data gathered from two sources.

Major planned activities on the LNG facility during the construction, commissioning, operation and decommissioning phases have been considered and potential impacts are discussed and management measures to minimise those impacts have been outlined. This has been undertaken using a qualitative risk assessment approach.

A detailed description of the existing surface water environment including physical integrity and fluvial processes, and potential impacts of the project is provided in the Appendix O3.

8.5.3 Regulatory Framework

Key legislation governing the management of surface water identified with regards to the LNG facility component of the GLNG Project includes:

- *Water Act 2000* (Qld);
- *Water Supply (Safety and Reliability) Act 2008* (Qld);

- *Environment Protection Act 1994* (Qld);
- *Environmental Protection (Water) Policy 1997* (Qld)[1];
- *Petroleum and Gas (Production and Safety) Act 2004* (Qld); and
- *Coastal Protection and Management Act 1995* (Qld)

Refer to Section 6.5.3 for details on the legislation itemised above except for the Coastal Protection and Management Act which is outlined below.

8.5.3.1 Coastal Protection and Management Act 1995 and the Integrated Planning Act 1997

A development permit is required for any of the following operational work carried out completely or partly within a coastal management district (in this case, the Curtis Coast Regional Management District) to:

- Interfere with quarry material on State coastal land above high-water mark;
- Dispose of dredge spoil or other solid waste material in tidal water;
- Drain or allowing drainage or flow of water or other matter across State coastal land above high-water mark; and
- Reclaim land under tidal water.

Where stormwater is proposed to discharge across State coastal land within the Curtis Coast Coastal Management District, (which will finalised in the FEED stage), Santos will seek the appropriate development permit to undertake such operational work. The application will be made in accordance with the relevant EPA Guideline for such development.

8.5.4 Existing Environmental Values

The EPP (Water) seeks to protect and/or enhance the suitability of Queensland's waters for various beneficial uses. The policy identifies environmental values for waters within Queensland and guides the setting of water quality objectives to protect the environmental values of any water resource. The environmental values include the biological integrity of the aquatic ecosystem and recreational, drinking water supply, agricultural and/or industrial uses.

Within the proposed LNG facility study area there are no named watercourses or minor tributaries. However watercourses on Curtis Island (such as Graham Creek) and waters surrounding Curtis Island will be protected under the (Water). Port Curtis is the receiving water for any discharge from the site.

Local government, industry and the Gladstone Ports Corporation are involved in a collaborative project as part of the Gladstone Harbour Protection and Enhancement Strategy that has identified preliminary environmental values for some waterways in the Curtis Coast region.

Environmental values which have been identified through these preliminary studies (BCC, 2002) and from site assessments are summarised in Table 8.5.1.

[1] Note that at the time of technical report preparation (December 2008) the EPP (Water) was still in force. However, on 1 January 2009 the Environmental Protection Act 1994 Environmental Protection (Water) Amendment Policy (No.1) 2008 came into effect. The amendment allowed for the identification of additional environmental values with respect to water.

Table 8.5.1 Environmental Values for the Watercourses and Receiving Environment of the LNG Facility

Environmental Values	Relevance to Curtis Coast Region
Protection of high ecological value aquatic habitat	✓
Protection of slightly to moderately disturbed aquatic habitat	✓
Protection of highly disturbed aquatic habitat	X
Suitability for primary contact recreation (e.g. swimming)	✓
Suitability for secondary recreation (e.g. boating)	✓
Suitability for visual (no contact) recreation	✓
Suitability for drinking water supplies	X
Suitability for crop irrigation	X
Suitability for stock watering	✓
Suitability for farm use	✓
Suitability for aquaculture (e.g. red claw, barramundi)	✓
Suitability for human consumers of aquatic food	✓
Suitability for industrial use (including manufacturing plants, power generation)	✓
Protection of cultural and spiritual values	✓

✓ Suitable for the environmental value.

X Not suitable for the environmental value.

8.5.4.1 Hydrological Overview of the Study Areas

The proposed LNG facility is to be located on Curtis Island (China Bay area), within the Boyne-Calliope sub-region of the Fitzroy Basin.

Curtis Island is within the Curtis Coast Region, which consists of Raglan Creek to the north, Colosseum Inlet to the south and the Capricorn Group of islands to the east. The western boundary is defined as the landward edge of the coastal catchments (the Boyne River, Calliope River and part of the Fitzroy River catchment) within the Gladstone Regional Council local government area. The Curtis Island Basin has a total catchment area of 576 km².

Curtis Island is 45 km long and a maximum of 14 km wide (ANRA, 2007). The major drainage feature on Curtis Island is Graham Creek, located north of the study area. The creek channels a significant portion of surface water runoff from the southern half of Curtis Island into The Narrows. Graham Creek, however, is not part of the study area catchment.

Water features within the LNG facility site catchment (Figure 8.5.1) consist of drainage features which only contain water during and immediately after rainfall events. During flood events, runoff is predicted to contain high sediment loads, as flows erode the upper catchment alluvials. The relatively short drainage features discharge into the intertidal flats of China Bay. Saltpan and mangrove communities are present along the sheltered intertidal zones to the south and west of the site.

8.5.4.2 Climatic Data

Rainfall and evaporation data were obtained from the Bureau of Meteorology (BOM). As no site data was available, rainfall and evaporation data for gauges adjacent to the study area were subsequently reviewed.

Rainfall averages suggest a distinct wet and dry season, with the wet season generally extending from October to April, and the dry season from May to September.

Mean daily pan evaporation is greatest in December and January with the lowest pan evaporation levels occurring in June/July.

Refer to Section 8.2 for a more detailed description of climate.

8.5.4.3 Stream Flows

Neither the Gladstone Regional Council nor the Department of Natural Resources and Water (DNRW) hold stream flow records for Curtis Island.

8.5.4.4 Soils and Geology

The terrain in the LNG facility study area and along the perimeter road includes gentle to moderately inclined foot-slopes and undulating valley plains and alluvial drainage-ways, which are fringed along the coastline by supra-tidal estuarine/marine flats and tidal mangrove flats.

Refer to Section 8.3 for a more detailed description of soils, geology and landform.

8.5.4.5 Existing Flood Characteristics

The proposed LNG facility catchment is approximately 3.8 $km^{2.}$ The catchment stretches from the hills to the east at approximately 124 m AHD in elevation, to the flat salt marsh of the China Bay coast. At higher elevations the site is densely vegetated bushland, whilst at lower elevations the vegetation generally becomes sparser.

Within the site catchment all drainage features are ephemeral in nature and have small catchments. To assess flooding within the site a hydrological/hydraulic assessment was undertaken. The flood flow estimates were undertaken for a range of probable flood events using the Rational Method (Weeks 1991).

To approximate the flood depths at each drainage feature, a basic hydraulic assessment has been undertaken using industry accepted software (HEC-RAS v3). In both, major (100 year ARI) and minor (2 year ARI) flood events, out of channel bank flooding is predicted to occur.

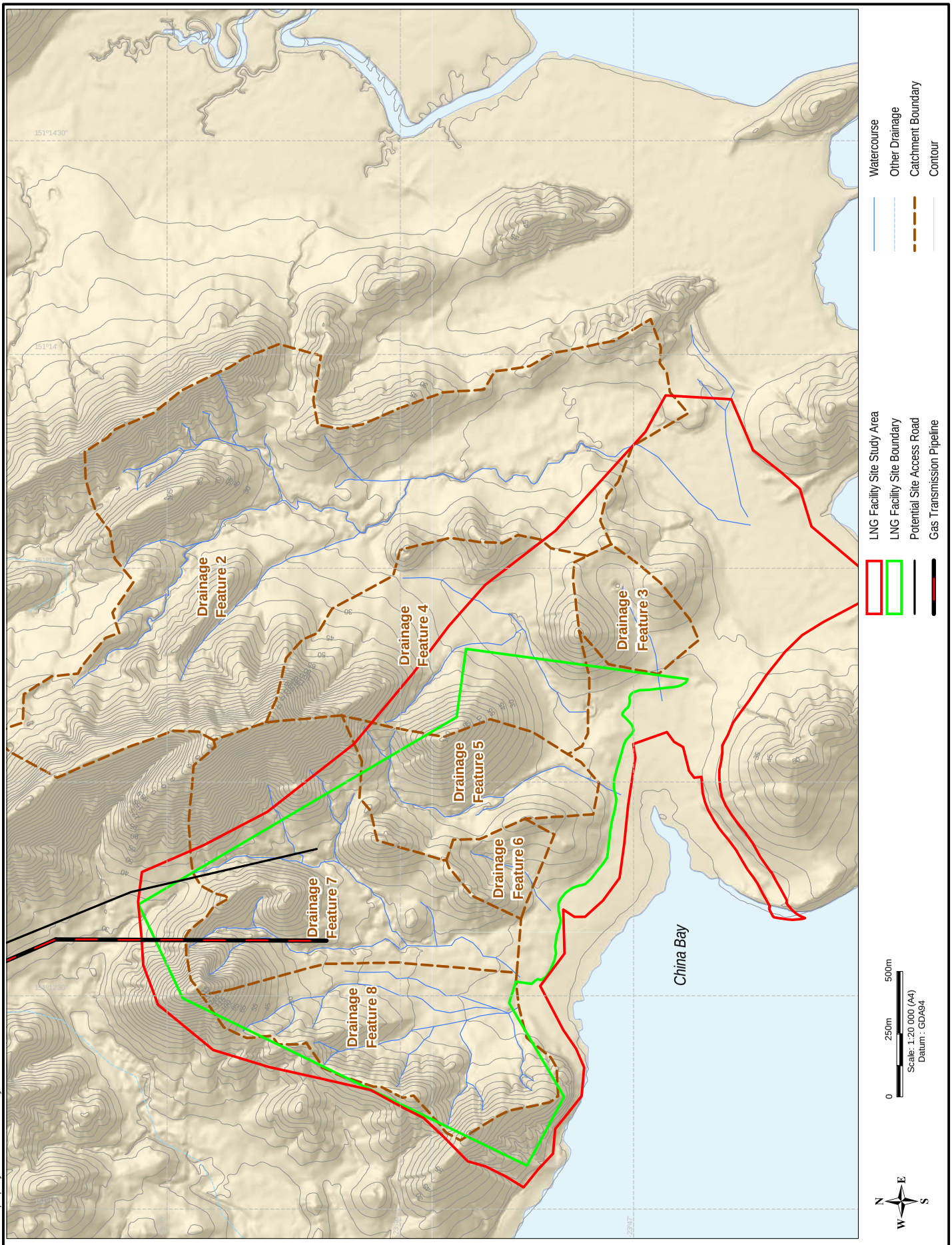
For further detail of the hydrologic and hydraulic analysis and results refer to Appendix O3.

8.5.4.6 Existing Water Quality

The surface water channels within the study area would generally be classified as drainage features. Furthermore, no recognised watercourses are anticipated to be impacted by the project. No existing water quality data was available for the identified drainage features or any watercourse on Curtis Island. Observations during the site assessment, undertaken in May 2008, indicated drainage features at the site were ephemeral and are dry outside of rain events. The visual assessment also suggested that both minor and major flows will carry sediment and organic matter such as leaf litter.

Relevant water quality objectives for the study area were identified from Queensland water quality guidelines (QWQG, 2006) to support and protect different environmental values for waters in the Curtis Island Basin. Salinity guidelines were obtained from Appendix G of the QWQG (2006). These water quality objectives should be used as a guide to what the ambient water quality should be. The receiving environment is Port Curtis.

Further details of the QWQG and there relevance to the Curtis Island site is provided in Appendix O3.



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Client: LNG / URS	Project: GLADSTONE LNG PROJECT ENVIRONMENTAL IMPACT STATEMENT	Title: **CATCHMENT BOUNDARIES CURTIS ISLAND**
Drawn: RG/CA	Approved: JB	Date: 26-02-2009
Job No: **4262 6220**	File No: 42626220-g-897b.wor	Figure: **8.5.1**
		Rev: B **A4**

8.5.5 Potential Impacts and Mitigation Measures

The potential risks associated with the proposed LNG facility, commissioning, operations, decommissioning and potential bridge construction activities have been identified. Management plans and monitoring programs have been proposed to reduce impacts to the surrounding environment to an acceptable level.

It is proposed to implement a water quality monitoring program to assess impacts and the effectiveness of mitigation measures to water quality. Sampling will be conducted on a regular and "as needed" basis (for instance after storms) to ensure that the peaks events are monitored. The testing parameters will include nitrogen phosphorus, turbidity, pH and electric conductivity.

Potential impacts to the surface water environment have been addressed in Appendix O3.

8.5.5.1 Construction Phase

Earthmoving Activities and Works Adjacent to/within Drainage Lines

Potential Impacts

The movement of sediment and potential erosion may be exacerbated from the construction of the LNG facility, potential bridge abutments and vehicle crossings of drainage features.

Mitigation Measures

These impacts will be minimised using erosion and sediment control techniques.

Contaminant Mobilisation and Pollution

Potential Impacts

There is potential for contaminant mobilisation on site through the use of fuels and chemicals including diesel and other petroleum-based fuels and lubricants.

Mitigation Measures

These potential impacts will be mitigated by establishing spill and refuelling standards and practices. Waste management measures will be included in the EMP to manage litter and other construction waste as well as the treatment of sewage.

Dewatering of Excavations and Discharge to Surface Drainage Lines

Potential Impacts

Groundwater monitoring across the LNG facility study area (refer to Section 8.6) indicated higher background levels of dissolved metals in both near-surface and deeper aquifers.

Mitigation Measures

Should these groundwaters be exposed during site excavation works, any site dewatering activities will be subject to appropriate management controls before discharge to grade is considered.

Accommodation

Potential Impacts

During construction a workforce accommodation facility will be established. Stormwater from the accommodation facility and parking areas will pass through a gross pollutant trap and first flush pond to remove any entrained contamination. Excess runoff above the 'first flush' volume will by-pass the pond and discharge directly into the stormwater outlet system. The volume of dilution provided by rainfall events above this volume is considered to provide a manageable reduction in the risk of harmful substances.

Mitigation Measures

All stormwater pipes and open drainage channels will all be designed in accordance with best-practice engineering principles.

Sewage from the accommodation facility will be treated to a secondary standard at an on-site package sewage treatment plant. Relevant approvals for the plant will be obtained by Santos in conjunction with the facility's development approvals. Treated effluent will be loaded into tankers and barged to the mainland for disposal at an existing wastewater treatment plant. Santos will discuss this proposal with the Gladstone Regional Council.

Flooding

Potential Impacts

A risk to water quality is posed by out-of-bank/flash flood rainfall events, during construction. This is discussed in Appendix O3.

Mitigation Measures

Where construction activities are required to be undertaken during wet season, appropriate management/mitigation measures will be implemented to minimise flooding risks.

Bridge

Potential Impacts

There is potential for contaminate mobilisation (fuels and chemicals including diesel and other petroleum-based fuels and lubricants) from construction vehicles travelling over the potential bridge.

Mitigation Measures

The movement of these contaminants to each end of the bridge will be subject to appropriate management controls before discharge to grade or to the marine environment is considered. Appropriate drainage controls will be incorporated into the bridge design.

8.5.5.2 Operational Phase

The LNG process is essentially a dry process that produces only minor quantities of wastewater. Figure 8.5.2 summarises the sources and fate of liquid wastes and stormwater runoff from the facility site.

The waste water streams in the LNG facility will be managed to minimise environmental risks and impacts on receiving waters. The following are key management strategies in achieving this objective:

- Treating potentially contaminated water;
- Minimisation of the potential for contaminants to be mobilised in off-site runoff; and

- Directing naturally occurring runoff around the site and away from process or utility areas.

To implement these strategies, the site will be divided into the following surface water management catchments:

- Process areas;
- Maintenance, support facilities, and utility areas;
- Oily water drainage areas (amine, hot oil and slug catcher area drains); and
- Undisturbed/ non-process areas.

The facility will also have an on-site sewage treatment plant.

Process Areas

Potential Impacts

Process areas will be built on bunded concrete slabs. The bunded areas will each have a sump to collect stormwater. Stormwater collected in the bund sumps and utility water from cleaning operations or testing of fire fighting equipment will pass through a skimmer with the skimmed water/oil being routed to a corrugated plate interceptor (CPI) oil/water separator unit for removal of oil and grease and suspended solids.

Mitigation Measures

The skimmer underflow will flow to a “first flush” retention pond. The “first flush” pond will be designed to retain the first 10 mm of runoff from its catchment. Excess runoff above the “first flush” volume will by-pass the initial stormwater storage and discharge directly to the stormwater outlet system. The volume of dilution provided by rainfall events above this volume is considered sufficient to provide a manageable reduction in the risk of harmful substances. The first flush pond will be emptied regularly. This water will be tested and if suitable will be discharged to the stormwater outlet system. Otherwise (off-spec) it will be sent to the contaminated water tank for transport to an approved off-site treatment and disposal facility.

Stormwater pipes and open drainage channels will all be designed in accordance with best-practice engineering principles.

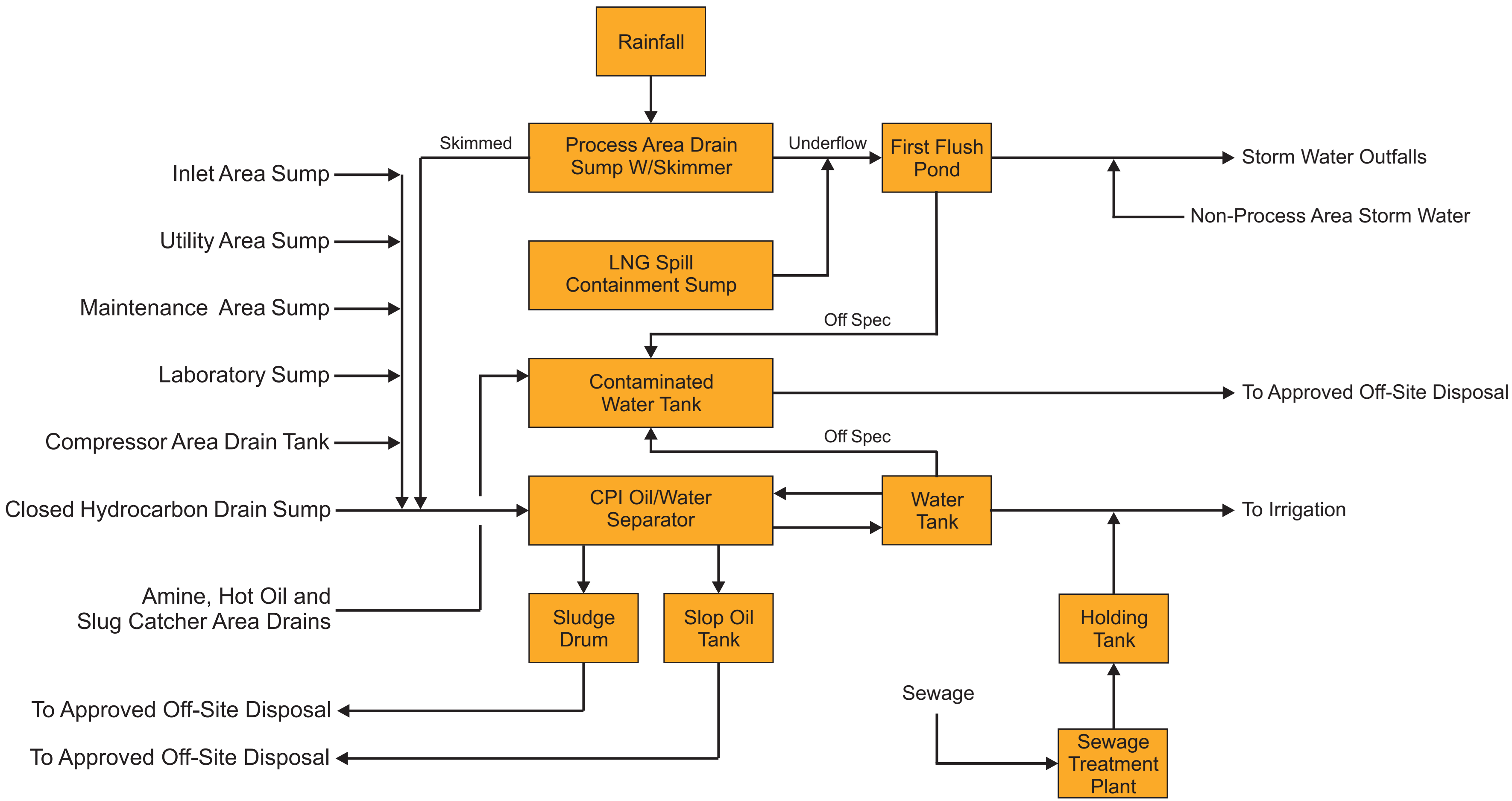
Maintenance, Utility, and General Chemical Storage Areas

Potential Impacts

Utility and support facilities will also be built on concrete slabs. Sump water from these bunded areas will also flow to the CPI for treatment. This will include water from the inlet area sump, utility area sump, maintenance area sump, laboratory sump, compressor area drain tank, and closed hydrocarbon drain sump.

Mitigation Measures

Treated water from the CPI oil/water separator will flow in a water tank. Regular testing will be done to determine the quality of water coming out of the CPI oil/water separator as well as to test the effectiveness of the treatment system. This water will be tested and if suitable quality levels are met, it will be disposed of by irrigation. Otherwise, the contaminated water (off-spec) will be either returned to the CPI for further treatment or sent to the contaminated water tank for transport to an approved off-site treatment and disposal facility. Sludge and slop oil from the CPI oil/water separator will be collected and will also be transported to an approved off-site treatment and disposal facility.



Client

Project
GLADSTONE LNG PROJECT
ENVIRONMENTAL IMPACT STATEMENT

Title
LNG FACILITY
WASTEWATER FLOW CHART

Drawn: LL
Approved: JB
Date: 09-03-2009
Job No.: **4262 6220**
File No. 42626220-g-1018.cdr
Figure: **8.5.2**
Rev. A
A4

Amine, Hot-oil, and Slug Catcher Areas

Contaminated water from amine, hot oil and slug catcher area drains will be pumped to the contaminated water tank pending disposal at an approved off-site treatment and disposal facility.

Undisturbed/ "Clean" Areas

Clean stormwater from non-process areas and undisturbed catchments will be discharged via drains to the surrounding natural drainage system.

Sewage Treatment

Mitigation Measures

Sewage from the LNG facility will be treated at an on-site sewage treatment plant. Treatment will include primary and secondary treatment followed by chlorination. Plant effluent will be routed to an irrigation system for disposal.

Irrigation Disposal

Potential Impacts

The irrigation area which will dispose of both treated sewage and water of a suitable quality from the water tank will be located and designed to ensure that:

- Sensitive areas are avoided;
- Soil erosion and soil structure damage is avoided;
- There is no surface ponding or runoff of effluent; and
- The quality of groundwater is not adversely affected.

Mitigation Measures

Areas where treated wastewater is discharged to irrigation fields will be fenced and clearly marked with warning notices of the purpose of the area and not to use or drink the water.

Treatment and storage systems will be designed to include alternate measures for wastewater storage and/or disposal, where conditions prevent the absorption of treated water to land (e.g. rain events). This may include wet weather storage or disposal off site. There will be no discharge of treated effluent from wet weather storages to any waters.

Bridge

Potential Impacts

There is potential for contaminate mobilisation (fuels and chemicals including diesel and other petroleum-based fuels and lubricants) from vehicles travelling over the potential bridge.

Mitigation Measures

The movement of these contaminants to each end of the bridge will be subject to appropriate management controls before discharge to grade or to the marine environment is considered. Appropriate drainage capacity will be incorporated into the bridge design.

8.5.5.3 Decommissioning Phase

The removal of equipment and above-ground infrastructure as well as re-contouring of the site may involve the following impacts:

Earth Moving Activities and Works Adjacent to/within Drainage Lines

Potential Impacts

The movement of sediment and potential erosion may be exacerbated from the removal of infrastructure and re-contouring of the site. This may include the infilling of sedimentation ponds.

Mitigation Measures

These impacts will be minimised by using erosion and sediment control techniques similar to those to be used during the construction phase.

Contaminant Mobilisation and Pollution

Potential Impacts

Contaminant mobilisation through the use of fuels and chemicals onsite such as diesel and other petroleum-based fuels and lubricants could enter into drainage lines and receiving waters, altering the physical and chemical quality of the water and waterway. Additionally, exposure of potentially contaminated land may occur during infrastructure removal or the infilling of sedimentation ponds.

Mitigation Measures

These potential impacts will be mitigated as per the decommissioning plan developed in conjunction with the regulatory authorities.

8.5.5.4 Cumulative Impacts

Including the GLNG project there are a number of industrial facilities that are proposed for Curtis Island (as described in Section 1.7). There is limited information available as to the planned development of these proposed projects or the scale and timing of their development. However, a qualitative assessment can be made of the possible cumulative impacts.

Any subsequent proposed project is expected to be situated within a separate watershed catchment to the proposed LNG facility. As there is little or no connection between these watershed catchments, it is expected that limited cumulative impacts will arise.

Further, it is expected that the other projects would include some or all of the proposed mitigation measures in relation to surface water management as described in this section. Utilisation of these mitigation methods is expected to minimise the potential cumulative impacts on the receiving environment.

Table 8.5.2 provides a summary of potential surface water impacts and mitigation measures for the LNG facility.

Table 8.5.2 Potential Surface Water Impacts and Mitigation Measures

Aspect	Potential Impact	Mitigation Measures	Objective
Construction			
Erosion and Sediment Mobilisation.	Sediment from earth moving and stockpiling can enter surface water runoff during rainfall events or blown by wind and discharge to watercourses leading to deleterious effects on water quality and aquatic habitats.	• Undertake monitoring and maintenance programs as required. • Develop, implement and maintain a stormwater management plan following site impact assessment process. This may include: – Erosion control and energy dissipation; – Stormwater controls and upstream treatment; – Stabilisation techniques; – Appropriate scheduling of construction activities during wet season; – Crossings (pipelines and bridges) to be as close as possible right angles to direction of flow; – Stockpiling of topsoil located away from watercourses; – Vehicle wash bays to be located away from watercourses; – Minimise vegetation disturbance; and – Routine inspection. • Identify and avoid other environmentally sensitive areas (e.g. highly erodible soils etc). • Develop and implement a water quality monitoring program during the planning phase, including telemetry and event based grab water samples, to further refine mitigation measures.	Minimise erosion and sediment release.
Pollution.	• Oily waste water (from miscellaneous plant and equipment wash water). • Contaminated runoff from chemical	• All fuel, oil and chemical storage facilities to be bunded. • All industrial waste storage tanks to be bunded.	Ensure contaminants do not enter watercourses.

Aspect	Potential Impact	Mitigation Measures	Objective
	storage areas. • Potentially contaminated drainage from fuel oil storage areas. • Oil-filled transformer yard areas and general washdown water. Diesel and other petroleum-based fuels and lubricants used by excavation and construction machinery. • Environmental and public health and safety issue.	• Bunds to be inspected regularly for evidence of leakage. • Spills to be reported and immediately contained. • Contaminated soil to be removed and remediated. • Contaminated water (e.g. stormwater in bund) to be treated. • All vehicles, plant and equipment to be checked regularly for integrity of fuel tanks. • Monitoring and maintenance programs to be undertaken as required. • Spill cleanup kits (AS1940 and AS3780) to be located in convenient locations and in all vehicles on site. • Refuelling to occur in bunded areas away from watercourses (> 50 m).	
Improper disposal of all construction wastes.	Litter and other construction waste can be washed into watercourses during rain events and impact receiving waters.	• Develop, implement and maintain waste management plan (Appendix K).	Ensure control of litter and construction wastes appropriately.
Works adjacent to/within drainage lines and watercourses.	Trenching at watercourse crossings and vehicle access crossings can alter flow characteristics.	• Conduct construction activities that will affect existing drainage channels and control measures only after suitable stormwater management infrastructure has been implemented onsite. • Divert watercourse either by low flow diversion or coffer dam with pumping. • Design vehicle crossings adequately for all likely flow conditions, perhaps incorporating under road drainage. • Minimise disturbance by heavy earth moving equipment.	Ensure works adjacent to/within drainage lines and watercourses do not alter flow characteristics.
Flooding.	Possibility of out-of-bank/flash flood rainfall event during construction causing erosion and damage to erosion and sediment control infrastructure.	• Schedule construction activities appropriately during wet season to reduce flooding risk. • Install stormwater management facilities e.g. drainage diversions and bunding. • Facilitate emergency response procedures and flood forecasting.	Manage risk of out-of-bank/flash flooding.

Aspect	Potential Impact	Mitigation Measures	Objective
Lack of water supply.	Inadequate dust suppression, soil compaction and washdown, firewater.	• Develop, implement and maintain a water supply plan.	Ensure an adequate amount of water is available during the construction phase.
Contaminant Mobilisation.	Oxidation of acid sulfate soils (ASS) producing runoff with high acidic levels detrimental to surrounding environment.	• Develop, implement and maintain an ASS Management Plan.	Ensure minimal impacts to watercourses due to ASS.
Dewatering of Excavations and Discharge of Groundwater to Surface Drainage Lines.	Possibility of high concentrations of metals discharging into receiving waters when groundwater is exposed during site excavations.	• Avoid excavations (pile) and generation of soil. • Contain and treat all exposed ground water via Water Treatment Plant (WTP).	Ensure high concentrations of metals do not enter receiving waters.
Commissioning			
Disposal of hydrotest water.	Improper disposal of water used in hydrostatic testing - impact on surrounding environment and receiving waters (water quality and erosion).	• Develop and implement water management procedures in accordance with the waste management plan (Appendix K).	Ensure hydrotest water is disposed of appropriately.
Operation			
Erosion and Sediment Mobilisation.	Permanent structures and minor earth disturbance can result in localised erosion and sediment mobilisation leading to deleterious effects on water quality and aquatic habitats.	• Refer to the construction section above.	Minimise erosion and ensure sediment does not enter watercourses.
Discharges from sediment ponds.	It is proposed to have four sediment ponds onsite. Uncontrolled releases from these ponds could allow process and contaminated stormwater to enter drainage lines and receiving waters.	• Design sediment ponds to contain up to a 10yr ARI. • Control releases from ponds to occur only after the water has been tested and meets license guidelines (which are to be determined).	Limit uncontrolled releases from ponds.
Pollution.	Diesel and other petroleum-based fuels and lubricants used by operational vehicles and machinery entering watercourses.	• Refer to the construction section above.	Ensure contaminants do not enter watercourses.

Aspect	Potential Impact	Mitigation Measures	Objective
Improper disposal of all operational wastes.	Litter and other operational waste can be washed into watercourses during rain events and impact receiving waters.	• Refer to the construction section above.	Ensure contaminants do not enter watercourses.
Flooding.	Possibility of out-of-bank/flash flood rainfall event causing failure of erosion and sediment control infrastructure.	• Refer to the construction section above.	Minimise chances of out-of-bank/flash flooding effecting works.
Decommissioning			
Erosion and Sediment Mobilisation.	Erosion and movement of sediment can potentially have adverse impacts on water quality.	• Implement and maintain a decommissioning environmental strategy. • Apply sediment and erosion control measures.	Minimise erosion and ensure sediment does not enter watercourses.
Pollution.	Diesel and other petroleum-based fuels and lubricants used and machinery entering watercourses.	• Refer to the construction section above.	To ensure contaminants do not enter watercourses.
Improper disposal of all demolition wastes.	Impact to receiving waters.	• Refer to the construction section above.	Ensure contaminants do not enter watercourses.
Works adjacent to/within drainage lines and watercourses.	Infilling on-site surface water bodies or drainage lines can lead to potential loss of water storage and can adversely impact ecological habitats.	• Diversion of drainage features commences (for stable vegetated channels). • Install storm water infrastructure for rehabilitation design. • Minimise number of passes by heavy earth moving equipment. • Develop and implement a monitoring program during and following rehabilitation stage.	Ensure works adjacent to/within drainage lines and watercourses do not alter flow characteristics.
Flooding.	Possibility of out-of-bank/flash flood rainfall event exceeding capacity of the storm water management system resulting in non compliant offsite discharges. Also, risk to construction workers (H&S).	• Refer to the construction section above.	Reduce frequency and volume of off-site discharges, and limit H&S risks to construction workers.
Lack of water supply.	Inadequate dust suppression, soil compaction and washdown, fire water.	• Develop, implement and maintain a water supply strategy and emergency strategy.	Ensure adequate water for decommissioning activities.

Aspect	Potential Impact	Mitigation Measures	Objective
Contaminant Mobilisation.	ASS runoff with high acidic levels detrimental to surrounding environment.	• Develop, implement and maintain an ASS management strategy.	Ensure minimal impacts to watercourses due to ASS.
Incomplete rehabilitation.	Erosion and movement of sediment, potential adverse impact to water quality.	• Develop and implement a decommissioning rehabilitation strategy.	Ensure sediment does not enter watercourses.

8.5.6 Summary of Findings

The key environmental surface water impacts and proposed mitigation measures include the following:

- The clearing of vegetation during the construction phase is likely to result in increased sedimentation mobilisation during rainfall events, consequently impacting the receiving water environment. This will be managed by the implementation of erosion and sediment control measures to manage runoff and reduce sediment mobilisation. The implementation of mitigation measures such as sedimentation ponds and the diversion of undisturbed catchments will be used.
- Contaminants and pollution related either to anthropogenic activities or pre-existing contaminated soils are not only likely to enter receiving waters altering their physical and chemical quality but are also a public health and safety issue. The implementation of procedures and strategies, such as bunded storage areas, will minimise if not prevent any risks of contamination.

The surface water impacts associated with the development of the LNG facility will be appropriately managed by implementing a range of mitigation measures including various construction techniques, operational procedures and planning tools.