13 LNG COMPONENT CONSTRUCTION

13.1 RESPONSE TO SUBMISSIONS ON DRAFT EIS

Submissions relating to the Queensland Curtis LNG (QCLNG) Project's LNG Component Construction (and in particular draft environmental impact statement (EIS) *Volume 2, Chapter 13: LNG Component Operations*), as described in the draft EIS, are summarised in *Table 2.13.1* below.

Table 2.13.1 Response to Submissions on Draft EIS: LNG Component Construction

Issue Raised	QCLNG Response	Relevant Submission(s)
Additional engineering design and description of construction methodology to assist with impact assessment was requested for a range of LNG Facility structures, including: • The Materials Offloading Facility (MOF). • The LNG jetty. • The potential bridge from the Gladstone mainland to Curtis Island via Laird Point and Friend Point.	Detailed engineering of the MOF and Jetty is ongoing. While the layout of these structures remains essentially unchanged from the draft EIS, further detail as to construction methodology is provided in *Section 13.3.2* below. However, some detail requested (such as drawing showing staging of design) will not be completed until further into detailed design. A bridge from Gladstone to Curtis Island is not proposed for the QCLNG Project and forms no part of planning for construction, operation or decommissioning of the LNG Facility.	32, 37
Submissions were made regarding transport and logistics for construction, specifically: • Requesting further detail as to quantity of aggregate and other bulk materials required for construction, and transportation to the LNG Facility site. • Requesting further detail on transportation of personnel to and from the site, shift start and finish times for workers, associated parking issues for worker transport, and consideration by QGC of use of buses to transport workers. • Suggestion that the Project include construction of a multi-storey carpark for construction workers. • Request for liaison on transport logistics with appropriate transport regulators and Gladstone Regional Council during both construction and operations.	Logistics associated with construction of the LNG Facility have been refined subsequent to preparation of the draft EIS, with an updated summary description provided in this Chapter and detailed description and impact assessment provided in *Volume 5, Chapter 14* of this supplementary EIS. Transport of materials and equipment, including bulk materials and aggregate, is described in *Section 13.3.5*. An amended description of the logistics plan for transport of the construction workforce, reflecting refined workforce numbers and shift roster assumptions, is provided in *Section 13.3.5*. This logistics plan incorporates a bussing strategy for non-local employees, as well as car parking split between Auckland	21, 27, 29

Issue Raised	QCLNG Response	Relevant Submission(s)
	Point and an off-site location. A multi-storey carpark is not proposed as sufficient parking is available on the sites selected. QGC will continue to liaise with the Gladstone Regional Council and appropriate transport regulators with regard to logistics planning and proposed management and mitigation measures for identified impacts in the lead-up to the start of construction.	
The draft EIS described accommodation of non-local craft construction personnel in a purpose-built construction camp (capacity up to 1,200 personnel, dependant upon the degree to which local labour can be utilised) to be built within the LNG Facility footprint on Curtis Island (refer *Volume 2, Chapter 13, Section 13.2* and *Section 13.6* of the draft EIS for further description). Submissions expressed concerns regarding potential social and economic impacts of a camp on Curtis Island instead of the mainland, concerns that a construction camp ensures that Gladstone continues to be a fly-in/fly-out (FIFO) town with limited local economic benefit, and requested further detail and justification of a camp on Curtis Island.	A construction camp on Curtis Island within the bounds of the LNG Facility footprint remains the preferred option for the Project for a range of social, environmental and economic reasons. A detailed justification of siting a construction camp on the island instead of the mainland is provided in *Section 13.3.4* of this chapter. Amended workforce and shift roster data resulting in amendments to the proposed size of the construction camp and worker accommodation generally is addressed in *Sections 13.3.3, 13.3.4* and *Volume 2, Chapter 6* of this supplementary EIS.	6, 29, 32
Submissions were made relating to solid waste management for LNG Facility construction, stating that the only suitable site for general waste disposal within the area of the Gladstone Regional Council is the Benaraby Landfill, and that general waste generated be transported to the Benaraby Landfill by the Project and not to local transfer stations.	General construction waste will be disposed of at the Gladstone Regional Council's Benaraby Landfill Facility. Further detail on waste management, including options for recycling, are provided in *Volume 5, Chapter 17* of this supplementary EIS.	29
Mulching is a preferred option for green waste generated on the LNG Facility site.	Cleared timber and vegetation will be mulched on the LNG Facility (a small volume of timber may be transported to the mainland for local use as appropriate). Mulch will be used on the LNG Facility site as sediment and erosion control during construction, with excess mulch blended with excess site cut (soil/rock) and placed in disposal Area A within the LNG Facility boundary (refer *Figure 2.13.1*).	29

Issue Raised	QCLNG Response	Relevant Submission(s)
The draft EIS described management of sewage on the LNG Facility site during construction by operation of a secondary sewage treatment plant on the site, with liquid effluent discharged into Gladstone Harbour and treatment plant solids removed from site for disposal at existing facilities in the Gladstone region. Submissions were made requesting: • greater emphasis on sewage effluent reduction and reuse on site • tertiary treatment for sewage effluent before any discharge from the site • additional assessment of potential impacts arising from site effluent discharges, including cumulative impacts associated with discharges from other potential projects on Curtis Island.	As the Project proceeds through detailed design, further consideration will be given to options for management of sewage effluent other than discharge, including reuse on site. A range of potential options are under consideration, including: • moisture conditioning of backfill, truck wash, dust control around the site; and/or • irrigation within the LNG Facility site. For discharged waters, QGC is investigating treatment of sewage effluent to a standard meeting the definition of tertiary treated sewage specified by sub regulation 135(3) of *The Great Barrier Reef Marine Park Regulations 1983 (Statutory Rules 1983 No. 262 as amended)* before discharge from the LNG Facility site. However, this is subject to ongoing assessment of treatment technologies. Further assessment of potential impacts arising from discharge of treated sewage and RO brines, including discussion of the need for cumulative assessment of impacts to address discharges from other potential projects on Curtis Islands, is provided in *Volume 5, Chapter 8* of this supplementary EIS.	29, 32

13.2 AMENDMENT TO DESCRIPTION OF PROJECT ELEMENTS

In general, construction of the LNG Facility will be undertaken as outlined in the draft EIS. A summary of amendments/modifications to the LNG Component Construction description, made subsequent to the draft EIS as a result on ongoing refinement of Project design and construction planning, is provided in *Table 2.13.2* below. Further detail is provided in *Section 13.3*.

Legend

- Proposed QCLNG Site Boundary
- Indicative Wet Lease Area
- QCLNG Footprint Plant Layout
- Proposed Export Pipeline
- Spoil Disposal Area

Source Note:
Aerial Photo - Department of Infrastructure and Planning for QCLNG Project

Projection: UTM MGA Zone 56 Datum: GDA 94

0 100 200 400 m

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QUEENSLAND CURTIS LNG
A BG Group business

Project: Queensland Curtis LNG Project

Client: QGC - A BG Group business

Title: Revised LNG Facility Site Layout Showing Spoil Disposal Areas

ERM
Environmental Resources Management Australia Pty Ltd

Drawn	KP	sEIS Volume 2	Figure S2.13.1
Approved	RS	File No:	0086165b_SUP_GIS001_S2.13.1
Date	19.01.10	Revision	0

Disclaimer:
Maps and Figures contained in this Report may be based on Third Party Data, may not to be to scale and are intended as Guides only.
ERM does not warrant the accuracy of any such Maps and Figures.

Table 2.13.2 Amendments to Project Elements

Project Element	Draft EIS description	Section of Draft EIS	Supplementary EIS description	Factors Affected by Change	Section Describing Assessment of Change
Construction Timeframe, Staging and Method	For the purpose of description, construction activities have been divided into five stages: • Stage 1: Site Preparation • Stage 2: Civil Work, Foundations and Structures • Stage 3: Mechanical and Electrical Installation and Testing • Stage 4: Systems Strength and Integrity Testing • Stage 5: Energisation and Introduction of Hydrocarbons.	*Vol 2, Ch 13 Section 13.1.1*	For the purpose of description in this sEIS, construction activities have been divided into five stages: • Stage 1: Site Preparation • Stage 2: Civil Work, Foundations and Structures • Stage 3: Module, Mechanical and Electrical Installation and Testing • Stage 4: Systems Strength and Integrity Testing • Stage 5: Energisation and Introduction of Hydrocarbons.	• No significant change in impact	
Pre-assembled Modules	Pre-assembled modules include the following, although these may vary with further refinement of design: • refrigeration gas compressors • cold boxes • cryogenic pipe rack • jetty trestles • LNG tank water falls • gas turbine generators • boil-off gas (BoG) compressors • pre-assembled Vessels V1201 and V1202 Column units.	*Vol 2, Ch 13 Section 13.1.1*	Off-site pre-assembled modules include the following, although these may vary with further refinement of design: • cryogenic pipe racks • propane condenser racks • equipment modules (cold boxes, gas turbine generators, and other pre-assembled process units) • pipe racks • pipe rack cassettes • jetty trestles. Additional detail on the modularisation strategy is provided in *Section 13.3.1*.	• Traffic	*Vol 5, Ch 14*

Project Element	Draft EIS description	Section of Draft EIS	Supplementary EIS description	Factors Affected by Change	Section Describing Assessment of Change
Source of Bulk Materials	It is anticipated that rock-fill material (for MOF construction) may be sourced from within the LNG Facility boundary.	*Vol 2, Ch 13 Section 13.1.2.1*	Bulk materials (including select fill, aggregate, armour rock and concrete sand) for LNG Facility construction will largely be sourced from existing quarries on the mainland, and transported to the LNG Facility site by barge. Tonnages required and discussion of transportation are provided in *Section 13.3.5.2*.	• Traffic	*Vol 5, Ch 14*
Stage 1: Site Preparation – Early Site Access	Site preparation will include the following works on the LNG Facility site: • establishment of an initial beachhead to allow mobilisation of personnel and equipment to site early in the Project and in advance of MOF construction. This will initially take the form of a pioneer dock located approximately 600 m south of the proposed LNG jetty location, with a primary purpose allowing early and unencumbered access to the site, including for further detailed site investigation before the start of construction. This pioneer dock may be expanded (subject to ongoing engineering investigation and detailed design) into a more expansive 'rock dock', which will be used during Stages 1, 2 and 3 of construction for importation of bulk aggregate to the site. Preliminary design indicates that the rock dock will be a sheet-piled, earth-filled structure. The pioneer dock will be located and designed to avoid the need for dredging as much as practicable.	*Vol 2, Ch 13 Section 13.1.2*	Early site access will take the form of a Construction Dock to be located along the western coastline of Curtis Island close to the southern boundary of the LNG Facility site (refer to *Volume 2, Chapter 9, Figure 2.9.1* for location). Further detail on layout and construction methodology of the construction dock is provided in *Section 13.3.2.3*.	• Marine Ecology (mangroves) • Coastal Environment (hydro-dynamics)	*Vol 5, Ch 8* *Vol 5, Ch 11*

Project Element	Draft EIS description	Section of Draft EIS	Supplementary EIS description	Factors Affected by Change	Section Describing Assessment of Change
Management of Cleared Timber	Preliminary planning for management of vegetation cleared from the site involves the following: • Leaves, branches and small timber will be mulched or chipped on site and, where appropriate, used for site stabilisation and erosion control. The site will be progressively rehabilitated, and mulch will be used for progressive landscaping/replanting (where appropriate). Any excess mulch will be placed in the spoil disposal areas. • Merchantable timber may be made available to the local community where there is a feasible volumetric request. • Timber which is unsuitable for milling, or which exceeds the local capacity for timber use, will be disposed of at the municipal waste disposal facility as green waste for mulching. Additional options for management and disposal continue to be assessed. These options (…) include the following: • clearing, grubbing and shredding of timber and co-disposal with site strip material in the spoil disposal areas • clearing, grubbing and possibly controlled burning of felled timber on site followed by disposal of the ash mixed in the soil stockpile and disposal areas on site • combination of moving merchantable timber back to Gladstone on an on-demand basis, combined with burning, mulching and shredding of the balance of the materials.	*Vol 2, Ch 13 Section 13.1.2.4*	In general, site vegetation will be managed as follows: • All vegetation will be processed by mobile mulching machines. Approximately 150,000 m^3 of mulch is expected to be generated. • Mulched material will be used on site, where appropriate, for site stabilisation and erosion control. • Excess mulched material will be blended with excess site cut (soil/rock) and placed in disposal Area A within the LNG Facility boundary (refer *Figure 2.13.1*). The need for methane venting and seepage collection for this disposal area continue to be assessed.	• Traffic	*Vol 5, Ch 14*
Bench Heights	*Figure 2.13.1*	*Vol 2, Ch 13, Figure 2.13.1*	Changes in LNG Facility layout (refer *Volume 2, Chapter 9* of this supplementary EIS) include revised bench heights for bulk earthworks. The key changes in bench height is the LNG Trains, which are now anticipated to be at a relative level of 13.75 m (Australian Height Datum). Other changes in bench heights across the LNG Facility site are described in *Volume 5*, *Chapter 16* of this supplementary EIS.	• Noise • Visual	*Vol 5, Ch 13* *Vol 5, Ch 16*

<table>
<tr><th>Project Element</th><th>Draft EIS description</th><th>Section of Draft EIS</th><th>Supplementary EIS description</th><th>Factors Affected by Change</th><th>Section Describing Assessment of Change</th></tr>
<tr><td>Site Strip Material</td><td>Approximately 1,000,000 m^3 of root mat, topsoil and other site strip material will be placed in designated disposal sites on Curtis Island within the LNG Facility boundary.</td><td>Vol 2, Ch 13 Section 13.1.2</td><td>Approximately 600,000 m^3 excess cut material, plus 170,000 m^3 site strip material will be placed in designated disposal sites on Curtis Island within the LNG Facility boundary (refer Figure 2.13.1).</td><td>• No significant change in impact</td><td></td></tr>
<tr><td>Tonnage and Transport of Bulk Materials</td><td>An indicative summary of cement, sand, aggregate and other bulk earth and rock materials required for all stages of construction is provided below, although these are likely to vary subject to ongoing geotechnical investigation and refinement of detailed Facility design.
<table>
<tr><th></th><th>Material</th><th>Tonnes</th></tr>
<tr><td rowspan="3">Materials for concrete batching</td><td>Cement</td><td>42,000</td></tr>
<tr><td>Sand</td><td>110,000</td></tr>
<tr><td>Aggregate</td><td>160,000</td></tr>
<tr><td rowspan="4">Other bulk materials and aggregate requirements</td><td>Final Grading</td><td>60,000</td></tr>
<tr><td>Temporary Gravel for pads and sheeting</td><td>20,000</td></tr>
<tr><td>Road Sub base</td><td>20,000</td></tr>
<tr><td>MOF and scour protection</td><td>450,000</td></tr>
</table>
Aggregates and other bulk materials may be transported to Curtis Island by barge to minimise transit of these materials through Gladstone City.</td><td>Vol 2, Ch 13 Section 13.1.3.2</td><td>Total tonnage of bulk materials used on the LNG Facility site (transported from the mainland) is estimated at 1.71 million tonnes (MT). An additional 160,000 tonnes is estimated to be required for construction at Auckland Point, for a total of approximately 1.87 MT used.

Bulk materials transported to Curtis Island will be transported to the RG Tanna aggregate dock (or Fishermans Landing for first six months of construction) in 40 t loads. Movement of bulk materials on the mainland is anticipated to be undertaken on an 18 hour per day basis, although 24 hour per day movement may be required for limited periods and will be undertaken on a notification basis.

A detailed breakdown of tonnage required for LNG Facility construction, by type and construction month, is provided in Section 13.3.5.2.</td><td>• Traffic</td><td>Vol 5, Ch 14</td></tr>
</table>

Project Element	Draft EIS description	Section of Draft EIS	Supplementary EIS description	Factors Affected by Change	Section Describing Assessment of Change
Construction Workforce Numbers	Peak numbers for direct and indirect craft personnel for the two-train facility are approximately 1,200, with up to a further 300 craft personnel supporting indirect work (…) With the planned craft manpower peaks, approximately 200 construction supervisors will be engaged at peak in direction of the craft workforce for a total peak construction workforce (craft and field non-manual personnel) of approximately 1,500 personnel (plus additional craft supporting indirect work and other QGC supervisory and personnel).	*Vol 2, Ch 13 Section 13.2*	Total numbers of construction workers will be dependent upon the availability of local labour. However, assuming minimal constraints on availability of local labour, the peak total site population will be approximately 3,000 persons, with an additional 330 non-local personnel off shift for a total workforce of approximately 3,300. This total includes all local and non-local craft personnel, subcontractors employed on the LNG Facility site, as well as EPC non-manual staff and BG/QGC non-manual personnel. Further detail on construction workforce numbers is provided in *Section 13.3.3*.	• Social and Economic • Traffic	*Vol 8* *Vol 5, Ch 14*
Construction Shifts	In general, shifts will commence no earlier than 6 am and be complete no later than 6 pm. Minimal night-time works are anticipated, although night works may be required for short periods (indicatively three to four weeks) for slipforming tanks and for other uninterruptible activities or where schedule adjustment is required (e.g. due to adverse weather).	*Vol 2, Ch 13 Section 13.2*	Normal working hours on the LNG Facility site during construction will be 6:30 am - 5 pm or 7 am - 5:30 pm. These times may vary due to stage of construction, activity being undertaken, and schedule issues. In particular, works are planned to be 24 hours per day during the Site Preparation stage of construction, and in particular during site clearing works (for approximately three months). Works may be undertaken on a 24 hour per day basis sporadically at other times throughout the construction schedule when uninterruptible activities are being undertaken or where schedule adjustment is required. Movement of bulk materials on the mainland is anticipated to be undertaken on an 18 hour per day basis, although 24 hour per day movement may be required for limited periods. This will occur over several months, and will require activity both at the loading area at RG Tanna, Auckland Point, and on the LNG Facility site.	• Traffic • Noise	*Vol 5, Ch 14* *Vol 5, Ch 13*
Construction	Construction works are planned to operate on a 9/90 schedule (with nine days/90 hours a fortnight, broken down	*Vol 2, Ch 13*	Indicative construction shift rosters as follows:	• Social	*Vol 8*

Project Element	Draft EIS description	Section of Draft EIS	Supplementary EIS description	Factors Affected by Change	Section Describing Assessment of Change
Shift Roster	as five working days on, two days off, four working days, three days off), commencing Monday. Weekends will only be worked where site activities require continuity or to make up schedule slippage.	*Section 13.7*	• non-local craft personnel: six days per week (Monday to Saturday). One in five weeks off-shift (20% of non-local craft off-shift for a week at any given time) • local craft personnel: nominal five days per week (Monday to Friday) although opportunity for work on Saturday will be available at times. Annual leave provision • non-local field non-manual personnel (residing in Gladstone or surrounds): six days per week (Monday to Saturday). Annual leave provision • local field non-manual personnel: nominal five days per week (Monday to Friday) although opportunity for work on Saturday will be available at times. Annual leave provision.	• Traffic	*Vol 5, Ch 14*
Construction Labour Force Accommodation	For non-local personnel, a temporary construction camp on the Curtis Island site is planned. It is expected that up to 400 personnel will use this facility. However, due to the possibility that a lower percentage of local labour may be available than anticipated, the camp is to be indicatively sized for up to 1,200 personnel, primarily to house non-local craft and non-local supervision personnel from month 12 onwards. The camp will be located within the footprint of the LNG Facility.	*Vol 2, Ch 13 Section 13.6*	Approximately 1,700 non-local craft and other non-local personnel will be accommodated in the purpose-built temporary construction camp to be located on Curtis Island (within the LNG Facility site boundary). If the local labour market is significantly constrained, the construction camp may need to accommodate up to approximately 2,000 personnel. Further detail on workforce accommodation is included in *Section 13.3.4* as well as *Volume 8* of this supplementary EIS.	• Social • Traffic	*Vol 8* *Vol 5, Ch 14*

Project Element	Draft EIS description	Section of Draft EIS	Supplementary EIS description	Factors Affected by Change	Section Describing Assessment of Change
Transport: Personnel	At peak construction (approximately month 35 with up to 1,500 total personnel) it is assumed that: • approximately 1,100 personnel (craft and field non-manual (FNM)) will depart the Curtis Island site daily and return to Gladstone and surrounds via Auckland Point • at major shift end, approximately 95 per cent of the construction workforce (1,450 persons) will depart the Curtis Island site via Auckland Point.	*Vol 2, Ch 13 Section 13.7.1*	At peak construction: • on Monday to Friday of each week, approximately 1,600 personnel (local craft and field non-manual) will make the return journey from Gladstone to the Curtis Island site via Auckland Point • on specific weekday and weekend afternoons, a smaller (and variable) number of local craft and field non-manual personnel will make the return journey from Gladstone to Curtis Island • on Saturday afternoon, in addition to local craft and field non-manual personnel returning to Gladstone, some of the personnel accommodated in the camp will transit to the mainland via Auckland Point to commence their leave period. Further detail on personnel transport is provided in *Section 13.3.5*.	• Traffic	*Vol 5, Ch 14*
Transport: Heavy Vehicles	Heavy vehicles through Gladstone via Auckland Point: • aggregate to be sourced outside Gladstone and arrive site via ship (sourced from location within 1.5 days sailing time – source not yet defined) • cement may be supplied from Gladstone via Auckland Point to batch plant on site – approximately one truck per day at peak • removal of waste off site – approximately one truck per day • fuel storage on site – delivery approximately one 20 t fuel tanker to site via Auckland Point per day at peak • approximately one refrigerated container food and dry goods to site via Auckland Point per day at peak • for first year of construction, water to be brought to site – approximately one 20 t tanker to site via Auckland Point per day at peak • other general consumables • some occasional mobilisation/demobilisation of plant and delivery of equipment to site.	*Vol 2, Ch 13 Section 13.7.2*	Refer to *Section 13.3.5.2* for details of heavy vehicle movements in the Gladstone region, which supercedes the description provided in the draft EIS.	• Noise • Traffic	*Vol 5, Ch 13* *Vol 5, Ch 14*

Project Element	Draft EIS description	Section of Draft EIS	Supplementary EIS description	Factors Affected by Change	Section Describing Assessment of Change
Water Supply: Moisture Conditioning on Backfill	For the bulk earthworks undertaken in Stage 1 of construction, the materials (on site) that are most suitable for reuse as fill will require (…) at peak, approximately 900 m^3 to 1,000 m^3 of water per day for moisture conditioning. Water supply for moisture conditioning – desalination of sea water using reverse osmosis (RO) utilising floating barge moored near the shoreline of the LNG Facility, with a minimum of two or three days storage requirement on board and with a reverse osmosis unit rated between 60 m^3 and 90 m^3 per hour, running on a 10-hour basis. Power generation for the RO would come from the site generation capacity, with power cables suspended to the moored barge, to avoid the requirement for refuelling over water and make use of the Project's fuel supply chain.	*Vol 2, Ch 13 Section 13.9.1*	The peak water requirements for moisture conditioning of backfill are estimated at 2,000 m^3 per day. To produce this quantity of fresh water, a desalination/reverse osmosis (RO) plant will be installed close to the Construction Dock and operated on a seven day-24 hours basis, in conjunction with barging of water from Gladstone mainland (for first six months of construction only). A storage pond lined with clay will be constructed with a water loading station. Additional discussion on water supply is provided in *Section 13.3.6* below.	• Marine Ecology (RO brine discharge)	*Vol 5, Ch 8*
General Water Supply and Management	Early in the construction schedule (for no longer than the first year), there will be relatively few personnel on the Curtis Island site. During this early period, fresh water will be brought to the site on barges or ferries, contained in road tankers and ISO containers. A stormwater filtration plant, combined with dosing, natural flocculation, pressure filters and sedimentation through the retention pond, will be provided to treat the impounded stormwater that will be recycled for use. Desalination of sea water using RO will be used as a second source of water, with RO plants moved from barge-mounted operation to on-shore operation when bulk earthworks on site are complete. RO will form a source of make-up water for periods where rainfall does not provide sufficient supply. Estimated potable and service water demand during the construction phase of the LNG Component is provided below (excluding water required for conditioning of backfill):	*Vol 2, Ch 13 Section 13.9*	Indicative volumes of water anticipated to be required for LNG Facility construction are described in *Section 13.3.6* below. Potable water use on site will be higher due to the increase in the construction workforce.	• Marine Ecology (RO brine discharge)	*Vol 5, Ch 8*

Project Element	Draft EIS description	Section of Draft EIS	Supplementary EIS description	Factors Affected by Change	Section Describing Assessment of Change
	Water Demand / **Total** / **Peak Rate** Hydrotest water[1] — 100,000 m^3 — - LNG plant concrete work[2] — 40,000 m^3 — - Site preparation/dust control — 6,000 m^3 — - Potable water[3] — 40,000 m^3 — - Water used for "flushing" — 4,000 m^3 — - Feed water (sea water)[3] — - — 1-60 m^3/hr Potable water demand[3] — - — 1-30 m^3/hr **Note 1:** Based on largest tank and reusing water to test other tanks and piping **Note 2:** Based on 0.214 m^3 water per m^3 of concrete **Note 3:** Based on peak manpower loading of 1,500 people over a construction duration of 55 months with potable water demand of 300 litres per person per day. Does not include hydrotest water, which is anticipated to be produced from impounded stormwater runoff and made-up with desalinated seawater.				
Fuel	Diesel will be stored on site in bunded above-ground, double-containment. Total capacity will be approximately 2,000 m3 with storage compliant with API 650 (American Petroleum Institute standard for Welded Steel Tanks for Oil Storage) and AS-1940 (Australian Standard for the Storage and Handling of Flammable and Combustible Liquids). Diesel delivered to Curtis Island during construction of Trains one and two will be approximately 50,000 tonnes (approximately 60,000 m3) Diesel will be sourced from a recognised supplier of petrochemical products, and transported in approved road transportation equipment that is driven onto barges/ferries equipped with spill containment and clean-up equipment)	*Vol 2 Ch 13 Section 13.3.2, 13.7.2*	Diesel will be stored on site in bunded above-ground, double-containment tanks. Total capacity will be approximately 972 m^3 based on using a total of ten 97,200 litre storage tanks. Storage will be compliant with API 650 (American Petroleum Institute standard for Welded Steel Tanks for Oil Storage) and AS-1940 (Australian Standard for the Storage and Handling of Flammable and Combustible Liquids). Total diesel delivered to Curtis Island during construction of Trains one and two will be approximately 74,000 tonnes (approximately 88,000 m^3). Diesel will be transported via 750 m^3 capacity bunker barge from the Gladstone diesel bunkering facilities.	• Traffic	*Vol 5, Ch 14*
Construction Camp Wastes	The following waste streams will be generated predominantly from the camp and camp operations (total over all stages of construction).	*Vol 2, Ch 13 Section 13.11*	Domestic wastes generated on the site will be a function of the size of the camp, which in turn is dependent upon constraints on the availability of local labour.	• Traffic • Waste	*Vol 5, Ch 14* *Vol 17*

Project Element	Draft EIS description	Section of Draft EIS	Supplementary EIS description	Factors Affected by Change	Section Describing Assessment of Change

Waste Stream	Indicative Amount
Sewage	240,000 m³
Sewage treatment plant solids	650 m³
Food waste	350 t
Domestic waste	520 t
Paper	180 t
Plastics	60 t
Glass	30 t
Metals	40 t
Other	205 t

Waste Stream	Indicative Amount (total for construction period)
Sewage	
Sewage	560,500 m³
Sewage treatment plant solids	1,495 m³
Domestic wastes	
Paper	400 t
Food waste	800 t
Plastics	125 t
Glass	60 t
Metals	90 t
Other	450 t

Further discussion on waste management is provided in *Volume 5, Chapter 17.*

Project Element	Draft EIS description	Section of Draft EIS	Supplementary EIS description	Factors Affected by Change	Section Describing Assessment of Change
Sewage Treatment	A secondary sewage treatment plant will be operated on site, with liquid effluent discharged into Gladstone Harbour and treatment plant solids removed from site for disposal at existing facilities in the Gladstone region.	*Vol 2, Ch 13 Section 13.11*	As the Project proceeds through detailed design, further consideration will be given to options for management of sewage effluent other than discharge, including reuse on site. A range of potential options are under consideration including moisture conditioning of backfill, truck wash, dust control around the site; and/or irrigation within the boundary of the LNG Facility site. For discharged waters, QGC is investigating treatment of sewage effluent to a standard meeting the definition of tertiary treated sewage specified by sub regulation 135(3) of *The Great Barrier Reef Marine Park Regulations 1983 (Statutory Rules 1983 No. 262 as amended)* prior to discharge from the LNG Facility site. However, this is subject to ongoing assessment of treatment technologies. Assessment of potential impacts on marine biota arising from discharge of treated sewage and RO brines is provided in *Volume 5, Chapter 8* of this Supplementary EIS. The assessment is based on assumed discharge of treated effluent (no reuse or irrigation, to provide a conservative assessment), with a peak discharge rate of approximately 7.5 litres per second (based on peak construction camp population from approximately month 27 to month 30 of construction, with effluent discharge as a constant stream 24 hours per day during this period).	• Marine Ecology (treated effluent discharge)	*Vol 5, Ch 8*
Electricity/ Energy	Power requirements on the Curtis Island site during LNG Facility construction will be met through use of diesel-powered generators. While power requirements (and consequently diesel consumption) will vary subject to the construction phase, it is estimated that peak construction power requirements will be in the order of 15 MVA for approximately 18 months.	*Vol 2, Ch 13 Section 13.8*	The Project is considering use of bi-fuel generators for construction, using a blend of up to 75/25 natural gas and diesel fuel. This would enable generators to operate using CSG ramp gas, subject to availability on site. Assuming early availability of gas, this is anticipated to reduce the total volume of diesel consumed during construction.	• Traffic (diesel transport)	*Vol 5, Ch 14*

13.3 DETAILED DESCRIPTION

13.3.1 Modularisation

The draft EIS (*Volume 2, Chapter 13, Section 13.1.1*) describes the overall construction philosophy for the LNG Component as employing a level of pre-assembly of key modules (assembly outside Australia and import to site as a completed module), in order to overcome labour constraints where specific skills are not available in the Australian labour market or where modules are proprietary vendor modules that cannot be sourced in Australia.

Modules will be assembled in a module yard outside Australia and shipped to Curtis Island in as complete a form as possible. Modules will either be loaded on self-propelled module transporters (SPMTs) and then on to flat-deck heavy cargo roll-on/roll-off self-propelled ships, or crane lifted and loaded on to flat-top barges pulled by tugs.

13.3.1.1 Quarantine Requirements for Modules

Australian Quarantine Inspection Services (AQIS) requirements will be implemented in the module yard before shipment, including any wash down and cleaning of assembled modules immediately before shipment (as required).

Table 2.13.3 below provides an overview of pre-assembled modules proposed for the Project, superseding that in the draft EIS. The modules described in *Table 2.13.3* were developed and optimised during the latest design phase of the Project.

Table 2.13.3 Indicative Major Modules for Construction

Module Description	Quantity	Weight Range (Te)
Cryogenic Pipe Racks	6	1,500 - 2,000
Propane Condenser Racks	8	1,300 - 1,500
Equipment Modules	4	350 - 1,650
Pipe Racks	13	300 - 600
Pipe Rack Cassettes	20	70 - 400
Jetty Trestles	19	60 - 100

13.3.2 Construction Methodology Description

Additional detail is provided below as to the construction methodology of the MOF, LNG Product Jetty and the Construction Dock on the LNG Facility site, as an enhancement to the description provided in the draft EIS.

It should be noted that dredging will be required for construction of and access to the LNG Facility. However, in contrast to the draft EIS, the scope of dredging activities proposed by the Project are:

- pipeline crossing of The Narrows and Targinie and Humpy creeks
- Construction Dock and associated access channel
- MOF and MOF access channel.

The swing basin, shipping channel and reclamation are no longer in the scope of works for the QCLNG Project EIS. Dredging for construction of the swing basin and channel will be undertaken by Gladstone Ports Corporation (GPC), as described in GPC's Western Basin Dredging and Disposal EIS. Further discussion of dredging works to be undertaken, including volumes and management and placement of dredged material, are described in *Volume 2, Chapter 10* and *Chapter 14*, and *Volume 6*, of this supplementary EIS. Assessment of impacts associated with Project dredging works, and associated management and mitigation measures, are described in *Volume 5, Chapter 8* and *Volume 6* of this supplementary EIS.

13.3.2.1 Materials Offloading Facility

The indicative layout of the Materials Offloading Facility (MOF) is shown in *Volume 2, Chapter 13, Figure 2.13.3* of the draft EIS. Refinement of this design is ongoing and is subject to change, and a detailed methodology for construction of the MOF will be developed during the Engineering, Procurement and Construction (EPC) phase of the Project, but, in general, construction will be undertaken using a combination of rock interior core, piled walls and armour rock.

Rock for the MOF construction will be sourced from existing quarries in or around the Gladstone region. Further discussion of volumes of bulk fill materials required, as well as transport requirements, is provided in *Section 13.3.5.2* below. Traffic impacts associated with transport of bulk materials are assessed in *Volume 5, Chapter 14* of this supplementary EIS.

MOF construction will be undertaken in coordination with associated dredging. Once initial dredging is completed, driving and pile transportation barges will be mobilised to the site. Placement of the various rock core materials will start before completion of pile-driving activities, with rock placement progressing westwards from landward to the pile wall.

Once the pile-driving and core backfilling are substantially completed, installation of the exterior amour rock will start. Rock installation will be worked from an onshore work face and augmented with marine barge work fronts.

Drainage for tidal water from within the structure core will be installed before the final installation of the specified final top course road base materials.

Acid sulfate soils will be managed in accordance with the Project Acid Sulfate Soils (ASS) management framework (refer *Appendix 2.2*) and a detailed site-specific ASSMP (Acid Sulfate Soils Management Plan) to be developed under this management framework.

A discussion of the impacts on mangroves arising from construction of the MOF, as well as other marine infrastructure, is provided in *Volume 5, Chapter 8*.

13.3.2.2 LNG Jetty

The construction of the permanent marine facility (LNG jetty) for the export of LNG cargo will start along with the civil and concrete installation program. As noted in the draft EIS, the marine elements of the jetty will be an open trestle design, and construction (and operations) will be undertaken in accordance with applicable industry standards as referenced in *Table 2.13.4* below.

Table 2.13.4 Industry Standards Applicable to Construction of Marine Facilities

Organisation	Applicable Standard/Guidelines
International Maritime Organisation (IMO)	International Convention for the Prevention of Pollution from Ships (MARPOL). Latest edition with amendments and MEPC resolutions International Ship and Port Facility Security (ISPS) Code and SOLAS Amendments 2002, 2003 Edition
British Standards Institution	British Standard Code of Practice for Marine Structures (BS 6349) – Parts 1-6 Installation and Equipment for Liquefied Natural Gas – Design of Onshore Installations (BS EN:1473)
Society of International Gas Tankers and Terminal Operators Ltd (SIGTTO)	Site Selection and Design for LNG Ports and Jetties, Information Paper No. 14. Guidelines for Ship to Shore Access for Gas Carriers. LNG Operations in Port Areas.

Organisation	Applicable Standard/Guidelines
Oil Companies International Marine Forum (OCIMF)	International Safety Guide for Oil Tankers and Terminals (ISGOTT) (with International Chamber of Shipping and International Association of Ports and Harbours) Prediction of Wind Loads on Large Liquefied Gas Carriers (with SIGTTO) Prediction of Wind and Current Loads on Very Large Crude Carriers (VLCCs) Mooring Equipment Guidelines. Guidelines and Recommendations for the Safe Mooring of Large Ships at Piers and Sea Islands Safety Guide for Terminal Handling Ships Carrying Liquefied Gases in Bulk
Permanent International Association of Navigation Congresses (PIANC)	Guidelines for the Design of Fender Systems Joint PIANC-IAPH Report on Approach Channels, A Guide for Design (*Vols 1 and 2*) Beneficial Uses of Dredged Material – A Practical Guide
National Fire Protection Association (NFPA)	NFPA 59A, Production, Storage and Handling of Liquefied Natural Gas (LNG) NFPA 307, Construction and Fire Protection of Marine Terminals, Piers, and Wharves

A detailed methodology for the construction of the jetty has yet to be finalised, but, in general, construction will be undertaken as follows.

The LNG pipe rack approach for jetty construction will be carried out by 'Over the Top' construction methods, while the loading platform and dolphins will be constructed concurrently using floating plant.

The pipe rack construction will be undertaken using a crane travelling on a rail/bogey system, which will drive piles and install headstocks, followed by a travelling gantry system, which will install and deck girders, parapets, module pipe bridges and other follow-up works.

The loading platform and dolphin construction will be undertaken by barge-mounted pile-driving plant and piling frame. It is envisaged that the approach pipe rack jetty, loading platform and dolphins will be constructed at the same time.

Mangroves

As the LNG Jetty 'Over the Top' construction method is initiated, temporary roadways and piling crane pads will be required for the first two jetty pile structures. This will be the only on grade construction that will result in direct impact on mangrove areas working from the land.

Due to long-term maintenance, and to ensure no encroachment the operating LNG pipe rack, mangroves and other vegetation will be removed in a corridor approximately 10 m either side of the jetty approach structure. The jetty approach structure is approximately 15 m wide, resulting in removal of mangroves and vegetation in a corridor approximately 35 m wide and 70 m long. This vegetation would be removed working with large swampy excavators from the land side through the tidal area. Outside the construction and operation zone of influence, care will be exercised to not disturb the adjacent mangrove areas.

A discussion of the impacts on mangroves arising from construction of the jetty and other marine infrastructure is provided in *Volume 5, Chapter 8*.

LNG Jetty Construction Completion

As the heavy civil and heavy rigging construction activities of the LNG Jetty near completion, the marine terminal building, jetty diesel generator and water treatment skid systems and shelters will be installed. After all heavy structures, including the LNG ship fender system, are set, miscellaneous steel catwalks to the mooring and breasting dolphin structures will be installed, followed by pipe installations, wire pulling, pipe testing, loading arm hydraulic tubing and instrumentation installations.

Finalised security fencing and gates at the head of the jetty, fire protection systems, jetty ladder ways, cathodic protection systems, permanent signage, permanent lighting, mooring tensioners or capstans, marine terminal building heating, ventilation and airconditioning (HVAC) systems, marine terminal building ship-to-shore communication and plant site communication systems, sea water intake piping, sea water filtration package, treated water discharge piping, CCTVs, LNG ship positioning system, marine navigation aids, tool shelter, and various marine safety devices will be installed on the LNG Jetty facility before it goes into operation.

Throughout jetty construction, acid sulfate soils will be managed in accordance with the Project Acid Sulfate Soils (ASS) management framework (refer *Appendix 2.2*) and a detailed site-specific ASSMP (Acid Sulfate Soils Management Plan) to be developed under this management framework.

13.3.2.3 Construction Dock

The draft EIS (refer *Volume 2, Chapter 13, Section 13.1.2*) described establishment of an initial beachhead to allow mobilisation of personnel and equipment to site early in the Project and in advance of MOF construction, with the primary purpose being to allow early and unencumbered access to the site including for further detailed site investigation before the start of construction. This ‘pioneer dock’ could subsequently be expanded into a more expansive ‘rock dock’, which will be used during Stages 1, 2 and 3 of construction for importation of bulk aggregate to the site.

Further logistics planning and design has resulted in the pioneer dock and rock dock described in the draft EIS being replaced with a single construction dock, which forms the dual purpose of allowing early site access as well as providing for importation of bulk aggregate to the site.

The location of the construction dock is near the southern boundary of the LNG Facility site (refer to *Volume 2, Chapter 9, Figure 2.9.1* of this supplementary EIS). Detailed design of this structure is ongoing, but in general it will be undertaken using sheet piling with backfill using a free draining granular material. Overall, sequencing of construction for the Construction Dock will include:

- dredging (and associated disposal) to allow access
- installing sheet piling, using a combination of onshore and offshore pile-driving equipment. Ongoing geotechnical investigations will determine the need for pre-drilling piles
- backfilling the cofferdam with free-draining material
- concrete caps and ramps, which will be constructed on trafficked areas. Roll on-roll off ramps will be paved with reinforced concrete slabs
- a floating dock (for docking of personnel ferries), and the installation of mooring/fender piles, gangways, signage, navigation aids and lighting.

An indicative layout of the Construction Dock is provided in *Figure 2.13.2*, although this layout is subject to ongoing development and design and may vary before construction.

A discussion of the impacts on mangroves arising from construction of the Construction Dock, Jetty and MOF, as well as other Project infrastructure, is provided in *Volume 5, Chapter 8*.

Legend

- Proposed QCLNG Site Boundary
- Indicative Wet Lease Area
- QCLNG Footprint Plant Layout

Source Note:
Aerial Photo - Department of Infrastructure and Planning for QCLNG Project
Plant Layout - Bechtel SK-00-00001-00B

Projection: UTM MGA Zone 56 Datum: GDA 94

0 10 20 40 60 m

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QUEENSLAND CURTIS LNG
A BG Group business

ERM
Environmental Resources Management Australia Pty Ltd

Project	Queensland Curtis LNG Project
Client	QGC - A BG Group business
Title	Indicative Layout of LNG Facility Construction Dock

Drawn	KP	sEIS Volume 2	Figure S2.13.2
Approved	RS	File No:	0086165b_SUP_GIS003_S2.13.2
Date	19.01.10	Revision	0

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13.3.3 Construction Workforce

A summary description of the construction workforce, including shift roster and accommodation, is provided below in *Section 13.3.3, Section 13.3.4*, and *Section 13.3.4.1*. The description provided in this section supersedes the description of construction workforce provided in the draft EIS, and forms the basis for the updated assessment of social, infrastructure and other impacts provided in *Volumes 5* and *8* of this supplementary EIS.

A detailed discussion of the construction workforce is provided in *Volume 2, Chapter 6* of this supplementary EIS, with additional discussion and assessment of resultant social impacts provided in *Volume 8, Chapter 6*.

13.3.3.1 Workforce Numbers

Construction labour will be made up of craft personnel involved with direct and indirect work activities. These personnel will be employed by the EPC contractor and through selected specialty subcontractors for specific identified work scopes (such as LNG storage tanks, marine facilities, site preparation). However, the entire workforce will be under the day-to-day direction of the EPC contractor. Additional oversight will be provided by QGC non-manual staff.

Direct activities are those where craft personnel are engaged with the installation and testing of permanent plant facilities, such as pipe fitters, concrete finishers, steel erectors and millwrights. Indirect activities are those where the craft personnel are involved in supporting services required to facilitate a construction operation, such as temporary works, clean-up, housekeeping, equipment maintenance, welfare facility maintenance, warehousing and materials storage.

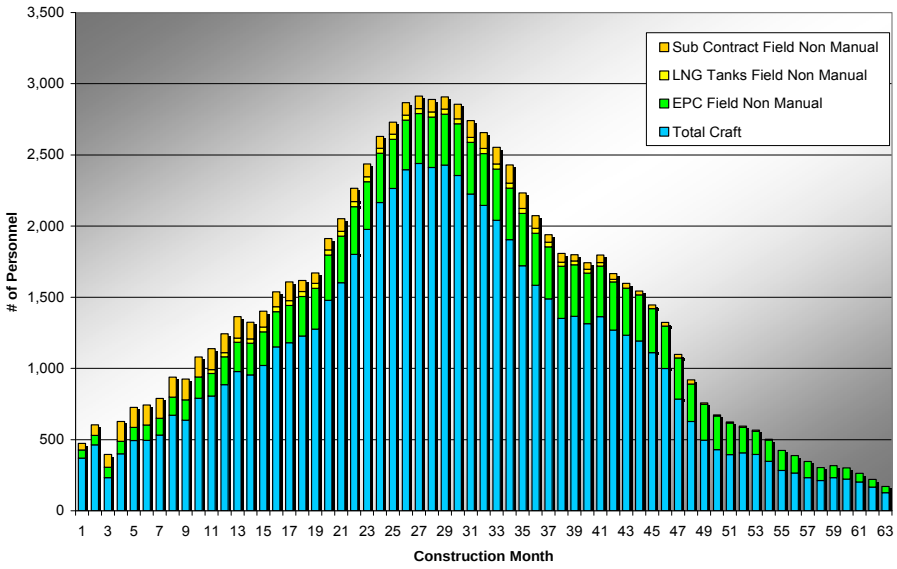
Total numbers of construction workers will depend on the availability of local labour (refer *Section 13.3.4* below). However, assuming minimal constraints on local labour, the peak total site population will be approximately 3,000 persons, with an additional 330 non-local personnel off shift for a total workforce of approximately 3,330. This total includes all local and non-local craft personnel, subcontractors employed on the LNG Facility site, as well as EPC non-manual workers and QGC non-manual personnel.

The peak numbers are for construction of the initial two-train facility (with construction of Train 1 and Train 2 overlapping).

A breakdown of the workforce over the construction phase is depicted in *Figure 2.13.3* below, with a breakdown by direct-hire trade provided in *Figure 2.13.4*. This histogram is based on relatively ready availability of local labour, and will change subject to constraints on the local labour market. Refer to *Volume 2, Chapter 6* and *Volume 8, Chapter 6* of this supplementary EIS for

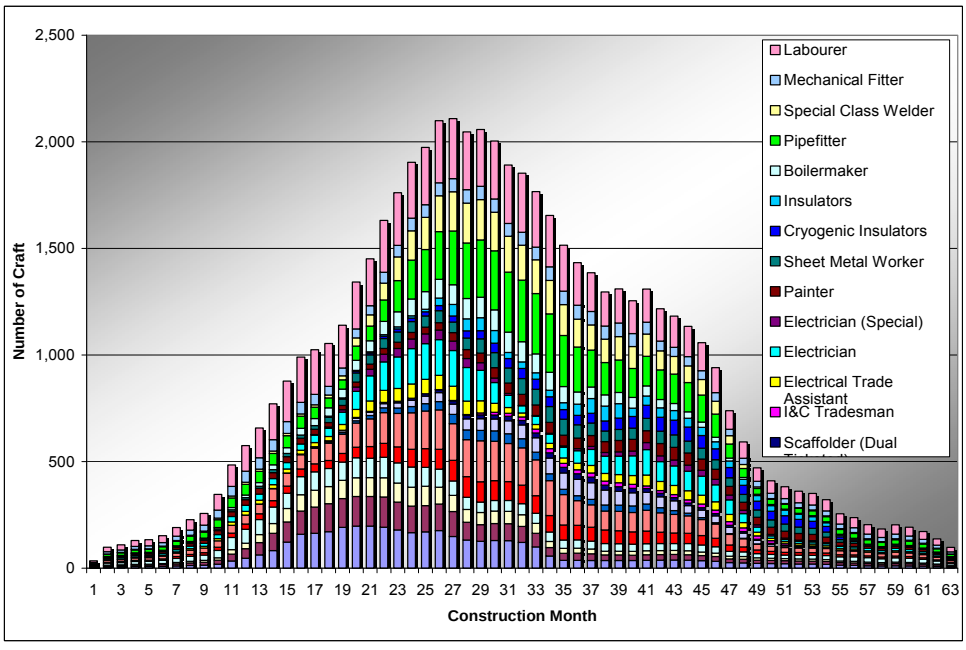
further discussion of the impacts on total workforce of labour constraints, as well as discussion of the resulting change in social impact as a result.

Figure 2.13.3 Total Site Population



Note: Figure excludes off-shift personnel and BG/QGC field non-manual personnel.

Figure 2.13.4 Direct Hire Workforce by Trade (including LNG Tanks)



13.3.3.2 Workforce Shift Roster

Various shift rosters will be in place for the construction workforce, with different rosters applying to local craft personnel, non-local craft personnel and

field non-manual personnel. While there may be some variation subject to a range of employment factors, for the purposes of this supplementary EIS the indicative shift rosters will be as summarised in *Table 2.13.5* below. These indicative shift rosters form the basis of the amended traffic impact assessment provided in *Volume 5, Chapter 14* of this supplementary EIS.

These shift rosters are predicated on accommodation of non-local craft personnel, and some subcontractor non-local personnel, in a camp on Curtis Island within the LNG Facility site. Refer to *Section 13.3.4.1* for further discussion of workforce accommodation.

Normal working hours on the LNG Facility site during construction will be 6:30 am - 5 pm or 7 am - 5:30pm, although these times may vary due to stage of construction, activity being undertaken, and schedule issues. In particular, works are planned to be 24 hours per day during the Site Preparation stage of construction, and in particular during site clearing works. Works may be undertaken on a 24 hour per day basis sporadically at other times throughout the construction schedule when uninterruptible activities are being undertaken or where schedule adjustment is required.

Movement of bulk materials on the mainland is anticipated to be undertaken on an 18 hour per day basis, although 24 hour per day movement may be required for limited periods and will be undertaken on a notification basis. Bulk material movement will be undertaken over several months, and will require activity both at the loading area at RG Tanna wharf and on the LNG Facility site.

Table 2.13.5 Workforce Shift Rosters

Construction Personnel	Shift
Non-local craft	Six days per week (Monday to Saturday). One in five weeks off-shift (i.e., 20% of non-local craft off-shift for a week at any given time).
Local craft	Nominal five days per week (Monday to Friday) although opportunity for work on Saturday will be available at times. Annual leave provision.
Non-local field non-manual	Six days per week (Monday to Saturday). Annual leave provision.
Local field non-manual	Nominal five days per week (Monday to Friday) although opportunity for work on Saturday will be available at times. Annual leave provision.

13.3.4 Workforce Source and Accommodation

As far as practical, the construction workforce for the LNG Component will be sourced from the Gladstone region. Additional personnel that cannot be sourced from the Gladstone region will be sourced from elsewhere within Australia or internationally.

Assumptions about local and non-local personnel, and proposed accommodation options, are outlined below. A more detailed breakdown and

discussion of accommodation options and impacts on Gladstone region housing are provided in *Volume 2, Chapter 2* and *Volume 8* of this supplementary EIS. It should be noted that the assumptions below may be subject to significant variation due to local labour market conditions, and will depend in large part on whether other major construction projects are under way concurrent with QCLNG Project construction works.

Early in the construction schedule (approximately the first 11 to 12 months), all construction workers will be accommodated on the mainland in the Gladstone region. Further detail is provided in *Volume 2, Chapter 2* and *Volume 8* of this supplementary EIS.

A construction camp will be built within the LNG Facility boundary on Curtis Island, with the camp available for partial accommodation of construction workers approximately eight months after the start of construction. The camp will be developed with a phased approach to allow for occupancy while camp construction is ongoing. At the peak of construction (approximately construction month 30), it is intended that the construction workforce (at peak) will be housed as follows:

- Approximately 1,350 local craft, local subcontractors, and local field non-manual personnel will live at their current residences in Gladstone City or surrounding region and commute to Curtis Island daily from Auckland Point, subject to local labour market availability.
- Approximately 250 non-local field non-manual personnel will be accommodated in Gladstone City or the surrounding region, and commute to Curtis Island daily from Auckland Point.
- Approximately 1,700 non-local craft and other non-local personnel will be accommodated in the purpose-built construction camp on Curtis Island at peak construction (note that this includes non-local personnel who are off-shift). If the local labour market is significantly constrained, the construction camp may need to accommodate approximately 2,000 personnel.

Further discussion about the construction camp on Curtis Island is provided in *Section 13.3.4.1* below. Details of personnel transport to and from site are provided in *Section 13.3.5* and in *Volume 5, Chapter 14* of this supplementary EIS. An assessment of impacts of the construction workforce on housing and other social infrastructure in the Gladstone area is provided in *Volume 8*.

13.3.4.1 Curtis Island Construction Camp

The draft EIS (refer *Volume 2, Chapter 13*) provided a summary of accommodation options considered before selection of a camp on Curtis Island (within the boundary of the LNG Facility site) as the preferred option for construction workforce accommodation. Subsequent to submission of the draft EIS, the Department of Infrastructure and Planning has requested further justification for the establishment of temporary construction workforce

accommodation facilities on Curtis Island. The justification was to clearly demonstrate the impacts of other accommodation options involving a mainland presence, in conjunction with, or as an alternative to, the proposed Curtis Island Construction Camp.

To that end, QGC has undertaken an assessment using a number of criteria covering the social, environmental and economic aspects of temporary workforce accommodation, comparing the following two options:

- **Option 1**: Construction workforce accommodation on both mainland (for initial construction stage and Export Pipeline construction) and Curtis Island (as described in the draft EIS and updated in *Section 13.3.4* above)
- **Option 2**: Construction workforce accommodation all on mainland.

The full assessment report comparing these options is included as *Appendix 2.4* to this supplementary EIS[1]. In summary, this assessment reviewed these two options against the criteria outline in *Table 2.13.6* below.

Table 2.13.6 Workforce Accommodation Options: Assessment Criteria

Criteria	To be considered
Economic benefits to local community	Local business, goods and services
Traffic impacts on mainland	Transporting mainland workforce and materials to and from port
Boat traffic on the harbour	Transporting workforce and materials to and from Curtis Island
Cost to industry	Costs related to transporting workforce, relative accommodation numbers, remuneration
Local Government and community perception	
Potential land-use conflicts	Compatibility with LNG development and associated infrastructure on Curtis Island and other relevant land uses on the mainland
Industry delivery risk	Schedule and construction efficiency
Environmental impact	Air, water, land, flora and fauna, and climate change
Social and cultural impact	On workers as well as local community
Opportunities for shared infrastructure	Shared construction and operation of infrastructure for use by other LNG proponents or other industries
Community legacies	Facilities remaining after construction which may be of use to local community
Health and safety issues	Workforce in the vicinity of a major hazard facility and separation distances

The assessment also outlined the experience of BG, QGC and the LNG Facility EPC contractor in constructing and developing a number of LNG facilities around the world, and in particular practical experience in managing non-local workers housed in communities, in construction camps and on islands, and camps on gas and oil platforms. The recreational and other facilities available to the workforce in a camp on the island have also been considered in the assessment.

1 QGC, 2009. Curtis Island Workforce Accommodation: Queensland Curtis LNG

A qualitative assessment of the differences between the two options against all the criteria listed in *Table 2.13.6*, indicated that Option 1 was comparable to or more positive than Option 2 for all criteria, with the sole exception of the "Local Government and community perception" criterion.

The main differentiating points between the two options were:

- Social and housing impacts – There will be a significant reduction in social and housing pressures for the option of accommodating a major component of the workforce on Curtis Island.
- Project delivery risk – Planning and approval requirements and transportation issues for workforce accommodation solely on the mainland and the associated schedule impacts would severely compromise Project delivery.
- Cost to industry – There would be a major cost implication for the project for solely mainland accommodation due to:
  - Increased working day hours
  - Daily transportation of thousands of workers
  - Housing and managing a fleet of buses and additional ferries.

Overall, QGC strongly believes that using mainland camps for the first year of construction for the LNG Facility and for up to 18 months for the Pipeline in the Gladstone area, coupled with accommodating the LNG non-local manual workforce on Curtis Island, will provide the optimum solution for the community and the Project.

13.3.5 Transport Requirements and Infrastructure

In general, transportation of personnel, materials and equipment for the construction phase of the Project will be undertaken via a staging area on the mainland at Auckland Point. However, materials and equipment brought in by ship from outside the Gladstone region will be taken directly to the LNG Facility site without offloading in Gladstone. Bulk materials sourced in the Gladstone region (select fill, armour rock, base and sub-base material and other aggregates, and sand for concrete) will be transported via an aggregate dock to be constructed at RG Tanna Coal Terminal (except for approximately the first six months of construction, when a facility at Fishermans Landing may be used). Details of traffic flows during the construction period, and detailed assessment on impacts, are provided in *Volume 5, Chapter 14*.

An indicative layout of the Auckland Point staging area is provided in *Figure 2.13.5*, and the indicative layout of the Auckland Point marine facilities shown in *Figure 2.13.6*, being an update of the layout shown in *Volume 2, Chapter 13, Figure 2.13.3* of the draft EIS.

Legend

- Plant and Trans-shipment of Personnel Holding Areas (11.5 Ha)
- Pipe Laydown Areas (11.0 Ha)
- Common Access Areas (2.2 Ha)
- Rail Loadout Holding Areas (2.3 Ha)
- Marine Facility Location

Source Note:
Aerial Photo - Department of Infrastructure and Planning for QCLNG Project

Projection: UTM MGA Zone 56 Datum: GDA 94

0 50 100 200 m

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QUEENSLAND CURTIS LNG A BG Group business	Project: Queensland Curtis LNG Project		Title: Indicative Layout Auckland Point Staging Area
	Client: QGC - A BG Group business		
ERM Environmental Resources Management Australia Pty Ltd	Drawn: KP	sEIS Volume 2 Figure S2.13.5	Disclaimer: Maps and Figures contained in this Report may be based on Third Party Data, may not to be to scale and are intended as Guides only. ERM does not warrant the accuracy of any such Maps and Figures.
	Approved: RS	File No: 0086165b_SUP_GIS004_S2.13.5	
	Date: 19.01.10	Revision: 0	

Source Note:

Aerial Photo - Department of Infrastructure and Planning for QCLNG Project
Auckland Point Marine facility - bechtel KO-1T00-00009-00B

Projection: UTM MGA Zone 56 Datum: GDA 94

0 25 50 100 m

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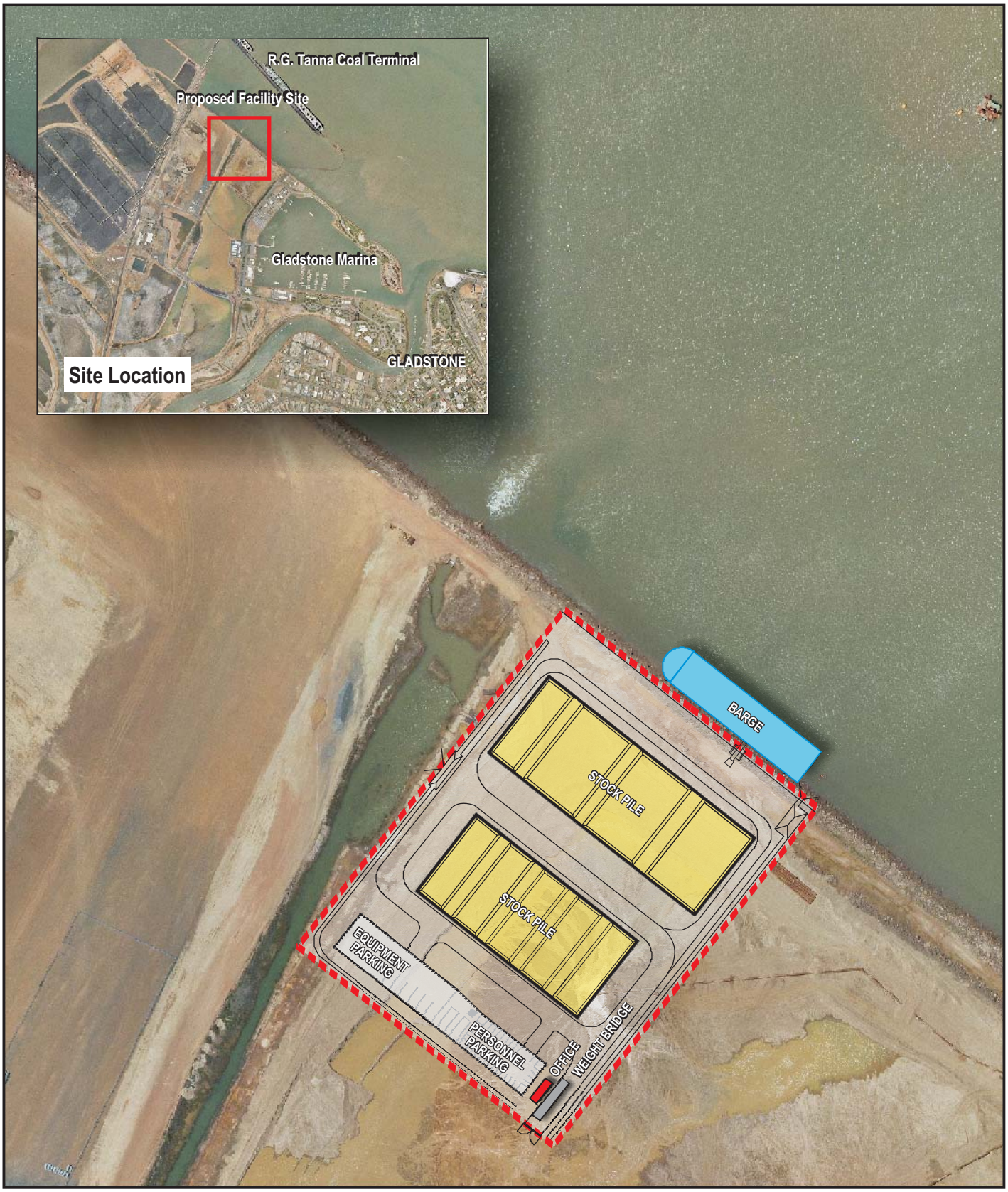
QUEENSLAND CURTIS LNG A BG Group business	Project: Queensland Curtis LNG Project		Title: Auckland Point Marine Facilities Layout
	Client: QGC - A BG Group business		
ERM Environmental Resources Management Australia Pty Ltd	Drawn: JB	sEIS Volume 2 Figure S2.13.6	Disclaimer: Maps and Figures contained in this Report may be based on Third Party Data, may not to be to scale and are intended as Guides only. ERM does not warrant he accuracy of any such Maps and Figures.
	Approved: RS	File No: 0086165b_SUP_CDR001_S2.13.6	
	Date: 19.01.10	Revision: 0	



Legend

Proposed Facility Site Boundary

Source Note:

Aerial Photo - Department of Infrastructure and Planning for QCLNG Project
Operations Terminal Facility - Bechtel C0K-0000-00038_00A

Projection: UTM MGA Zone 56 Datum: GDA 94

0 25 50 100 m

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QUEENSLAND CURTIS LNG A BG Group business	Project: Queensland Curtis LNG Project		Title: R.G. Tanna Bulk Materials Marine Facilities Layout
	Client: QGC - A BG Group business		
ERM Environmental Resources Management Australia Pty Ltd	Drawn: JB	sEIS Volume 2 Figure S2.13.7	Disclaimer: Maps and Figures contained in this Report may be based on Third Party Data, may not to be to scale and are intended as Guides only. ERM does not warrant he accuracy of any such Maps and Figures.
	Approved: RS	File No: 0086165b_SUP_CDR001_S2.13.7	
	Date: 19.01.10	Revision: 0	

13.3.5.1 Personnel

As outlined in the draft EIS, personnel transportation will be undertaken using water taxis (approximate capacity 170 persons, for fast transit of small numbers of personnel) and larger ferries capable of carrying approximately 400 persons.

Given the proposed split of personnel accommodation between the construction camp on Curtis Island and the mainland, the numbers of personnel travelling daily will depend on:

- the stage of construction
- the number of workers sourced from the local Gladstone area
- the day of the week (with fewer local personnel travelling to site on Saturday, but non-local personnel potentially coming off Curtis island for their day off or to start their week off-shift).

At peak construction, and assuming a relatively unconstrained local labour market, it is assumed that:

- On Monday to Friday of each week, approximately 1,600 personnel (local craft and field non-manual) will make the return journey from Gladstone to the Curtis Island site, transiting via Auckland Point. Local workers will travel between Auckland Point and their residences in their private vehicles, with parking on site at Auckland Point.
- On Saturday, a smaller (and variable) number of local craft and field non-manual personnel will make the return journey from Gladstone to Curtis Island.
- On Saturday afternoon, in addition to local craft and field non-manual personnel returning to Gladstone, some of the personnel accommodated in the camp will transit to the mainland via Auckland Point.
- On various afternoons throughout the week, in addition to local craft and field non-manual personnel returning to Gladstone, some of the personnel accommodated in the camp will transit to the mainland via Auckland Point as the start of their week off-shift (20% of the total non-local craft workforce).

Buses will be provided at Auckland Point for transport of non-local personnel. Non-local personnel with personal vehicles will be provided with parking on the mainland at a long-term car parking facility to be constructed on Gladstone Port Corporation (GPC) land on Alf O'Rourke drive. Further details of bussing and parking for non-local personnel are provided in *Volume 5, Chapter 14* of this supplementary EIS.

Given these personnel movements, the peak requirements for ferry transit of personnel are estimated in *Table 2.13.7*. It should be noted that additional transits may be required during the day or evening on an as-needs basis.

Table 2.13.7 Indicative Peak Personnel Ferry Transits

Days	Ferry Loads[1]		
	Morning (start shift)[2]	Daytime	Evening (end shift)[2]
Monday - Friday	4	As required	4
Saturday	3	As required	5
Sunday		As required	

1 Total number of ferry transits of Gladstone Harbour will be higher, due to the requirement for return journeys and transit to daytime/nighttime anchorage location.

2 Numbers are for peak of construction workforce, assuming unconstrained local labour.

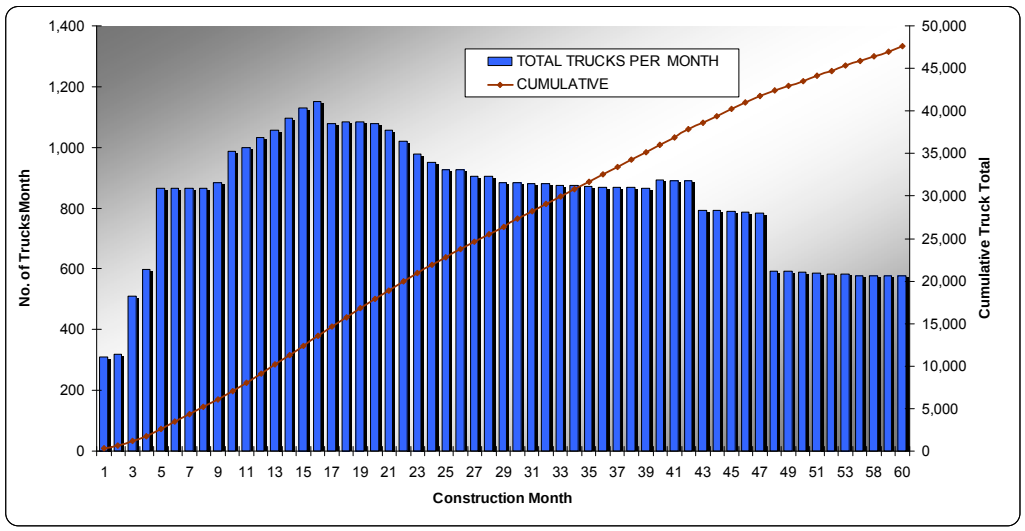
13.3.5.2 Materials and Equipment – Transit Through Gladstone

As noted in the draft EIS, equipment and materials for the Project will be sourced worldwide, with Project cargo (LNG Facility) shipped into Gladstone to be unloaded directly at the LNG Facility without being transferred via the Gladstone mainland.

However, a range of site plant, equipment and materials (including consumables for both construction activities and the construction camp and workforce) will be sourced from the Gladstone region and/or transported through Gladstone to the LNG Facility site. This will be transported to the site on trucks via barge or ferry, staging from Auckland Point. Wastes from the site (refer *Volume 5, Chapter 17* for further detail on Wastes) will also be transported to the mainland via the Auckland Point staging area.

An indicative breakdown of truck movement through Auckland Point, by construction month, is provided in *Figure 2.13.8*. In summary, this indicates peak truck numbers through Auckland Point of approximately 1,150 trucks per month are anticipated, or 40 trucks per day (assuming truck movements are undertaken six days per week). Trucks carrying plant, equipment and consumables for the LNG Facility site will be loaded on barges/ferries for transit to Curtis Island at Auckland Point. It is assumed that trucks will transit Auckland Point in non-peak daylight and evening periods, although some nighttime movement may be necessary.

Figure 2.13.8 Indicative Breakdown – Total Trucks through Auckland Point, by Construction Month



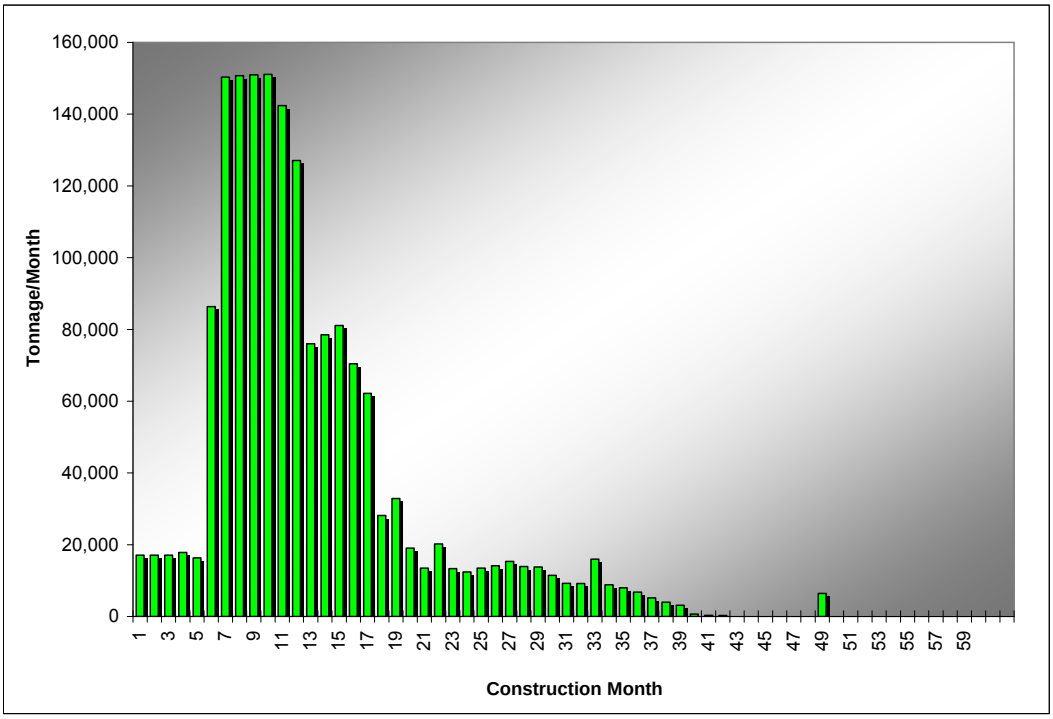
Note: Figure represents indicative truck throughput at Auckland Point, whether for materials sourced in Australia or for material brought in through Brisbane via ocean freight.

In addition to plant, equipment, materials and wastes transported to and from the LNG Facility site via Auckland Point, a range of bulk materials sourced from within the Gladstone region will be required for construction of the LNG Facility. These materials include select fill, base, sub-base, armour rock and concrete sand, and will be sourced from existing quarries within the Gladstone Region.

Bulk materials will be transported to the LNG Facility site via barge loaded at an aggregate dock to be constructed in the vicinity of RG Tanna wharf, at the site of the future operations terminal. For approximately the first six months of construction, while the load-out facility at RG Tanna wharf is being constructed, bulk materials may be loaded on barges at Fishermans Landing for transport to the LNG Facility site. A total of approximately 1.712 MT of bulk materials will be transported to Curtis Island, with an additional 160,000 T for Auckland Point construction.

An indicative breakdown of bulk material tonnage required to be transported to the LNG Facility on Curtis Island is provided in *Figure 2.13.9*. For the assessment of traffic impacts associated with transport of bulk materials, it has been assumed that bulk materials will be transported by truck in 40 T loads. Further detail on bulk material transport (including assumed routes) and an assessment of resultant traffic impacts are included in *Volume 5, Chapter 14* of this supplementary EIS.

Figure 2.13.9 Indicative Breakdown – Bulk Material Tonnage for LNG Facility Construction



Note: Quantities do not include aggregates for the construction of Auckland Point or other facilities on the mainland.

In addition to plant, materials and equipment for the LNG Facility, Auckland Point will be used for importation of materials for the export pipeline. Details are described in *Volumes 3* and *4* of this supplementary EIS, with assessment of impacts on traffic in the Gladstone Region, incorporating impacts from importation of export pipe, addressed in *Volume 5, Chapter 14*.

13.3.6 Water Supply and Management

Given the proposed amendments to personnel numbers outlined above, and ongoing refinement of construction planning and design, estimated volumes of water utilisation during the construction phase have been amended. An indicating water utilisation curve for construction on the LNG Facility site is in *Figure 2.13.10* below. It should be noted that this figure is for utilisation only, and does not take account of potential saving through water reuse or recycling on site.

The bulk of water utilisation early in construction (the first six to nine months) will be for moisture conditioning of backfill. The two peak water utilisation months (months 33 and 39) represent the months where hydrotesting of the first two LNG tanks will be undertaken.

In general, water supply is to be undertaken as follows (subject to finalisation of supply agreements and actual on-site requirements as determined by detailed design):

- **Construction Month 1**: Trucking – transport of water in tanker truck from Gladstone to Curtis Island (for fire protection, vehicle wash down and limited other uses)
- **Construction Months 2 Onwards**: Bunkering – transport of water by barge from Gladstone to Curtis Island moored at the construction dock – (to fill on-site pond and tanks for use of backfilling, fire protection, dust control, concrete, vehicle wash down and other site uses)
- **Construction Months 6 to 10**: Rental Reverse Osmosis – desalination of sea water on Curtis Island using trailer-mounted RO Treatment plants – (to fill on-site ponds and tanks for use of backfilling, fire protection, dust control, concrete, vehicle wash down and other site uses)
- **Construction Month 10 onwards**: Construction RO – desalination of seawater on Curtis Island using modularized RO Treatment plants – (to provide potable water to camp and to fill on-site pond and tanks for use of backfilling, fire protection, dust control, hydrotesting, LNG tank hydrotesting, concrete, vehicle wash down and other site uses).

As described in the draft EIS, where suitable volume and quality of make-up water is appropriate, a stormwater filtration plant, combined with dosing, natural flocculation, pressure filters and sedimentation through the retention pond, will be used to treat the impounded stormwater for use on site to partially offset requirements for barging and RO.

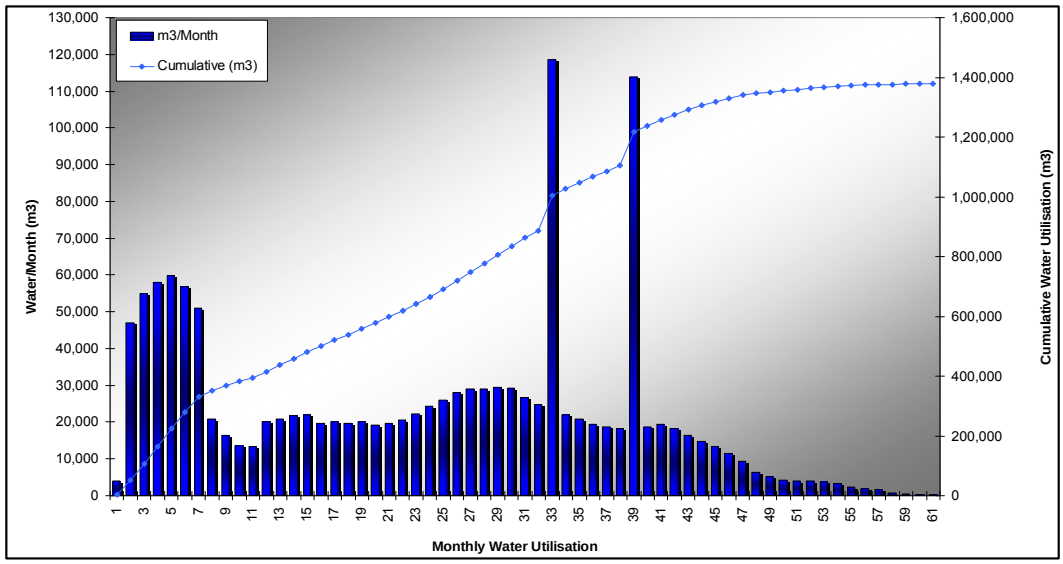
Detailed design of the RO plant is ongoing. In general, key elements of the RO process resulting in discharges to the marine environment include:

- RO Intake Screen, incorporating measures to control bio-fouling of the desalination system inlet screen and piping. This will include chlorine as sodium hypochlorite solution added to the intake structure, as well as periodic (approximately every 5-minute) bursts of air to dislodge marine life from the seawater intake screens. Most of the chlorine will be drawn into the desalination system
- Feedwater Inlet Basket Strainer, to capture marine particles that make it past the intake screens. A constant flow of chlorinated seawater will return captured particles to the marine environment
- Feedwater filter backwash, including two dual media (sand and anthracite) pressure filters capture the finer marine particles. Seawater backwash will be performed when the solids in the seawater accumulate in the filter. Seawater solids are returned by backwash back to the sea, with backwash rate and concentration dependent upon the turbidity in the seawater but indicatively on backwash of approximately 50 cubic metres/day. This chlorinated backwash flow will be discharge via the RO brine outfall pipeline and will therefore undergo significant dilution before discharge

- Reverse Osmosis Brine, being chlorine free reject returned to the sea through a subsea outfall pipeline. The RO brine is concentrated seawater at a concentration of approximately 60,000 mg/l total dissolved solids (TDS) (subject to final RO plant design). RO brines will be blended with wastewater (including treated sewage effluent) discharges from the LNG Facility site, which will reduce the concentration of the TDS in the discharge stream.

Potential impacts on marine biota arising from discharge of RO brines from the site are assessed in *Volume 5, Chapter 8* of this supplementary EIS.

Figure 2.13.10 Indicative Water Utilisation Curve for Curtis Island (Construction)



Note: Includes potable and non-potable water. Volumes shown are total utilised and do not take into consideration sources of water or potential recycling.