7. PROJECT DESCRIPTION: LOGISTICS

This chapter provides an update on the anticipated management of logistics for personnel, equipment and materials logistics for the Arrow LNG Plant during the early works, construction and operation phases. It updates project information presented in Chapter 6, Project Description: LNG Plant, Chapter 27, Social and Chapter 28, Traffic and Transport of the Arrow LNG Plant Environmental Impact Statement (EIS) (Coffey, 2012) with refined information on workforce accommodation and transportation, and materials transportation developed in front-end engineering design (FEED).

Accommodation and logistics service providers were consulted by the FEED team, and a high-level desktop assessment undertaken, to identify services and equipment that may be available in the Gladstone region during early works and construction. Further investigations will be undertaken to refine estimates of materials quantities and to investigate transportation alternatives prior to commencing early works. Final estimates will be contained in various construction management plans including:

- Project Logistics Plan.
- Traffic Management Plan.
- A Marine Activity Management Plan (incorporating a Port of Gladstone shipping activity strategy and management plan).

Operations estimates have been derived from the experience of Royal Dutch Shell plc, part-owner of Arrow Energy, which has constructed and operates similar LNG plants in other countries around the world.

7.1 Construction

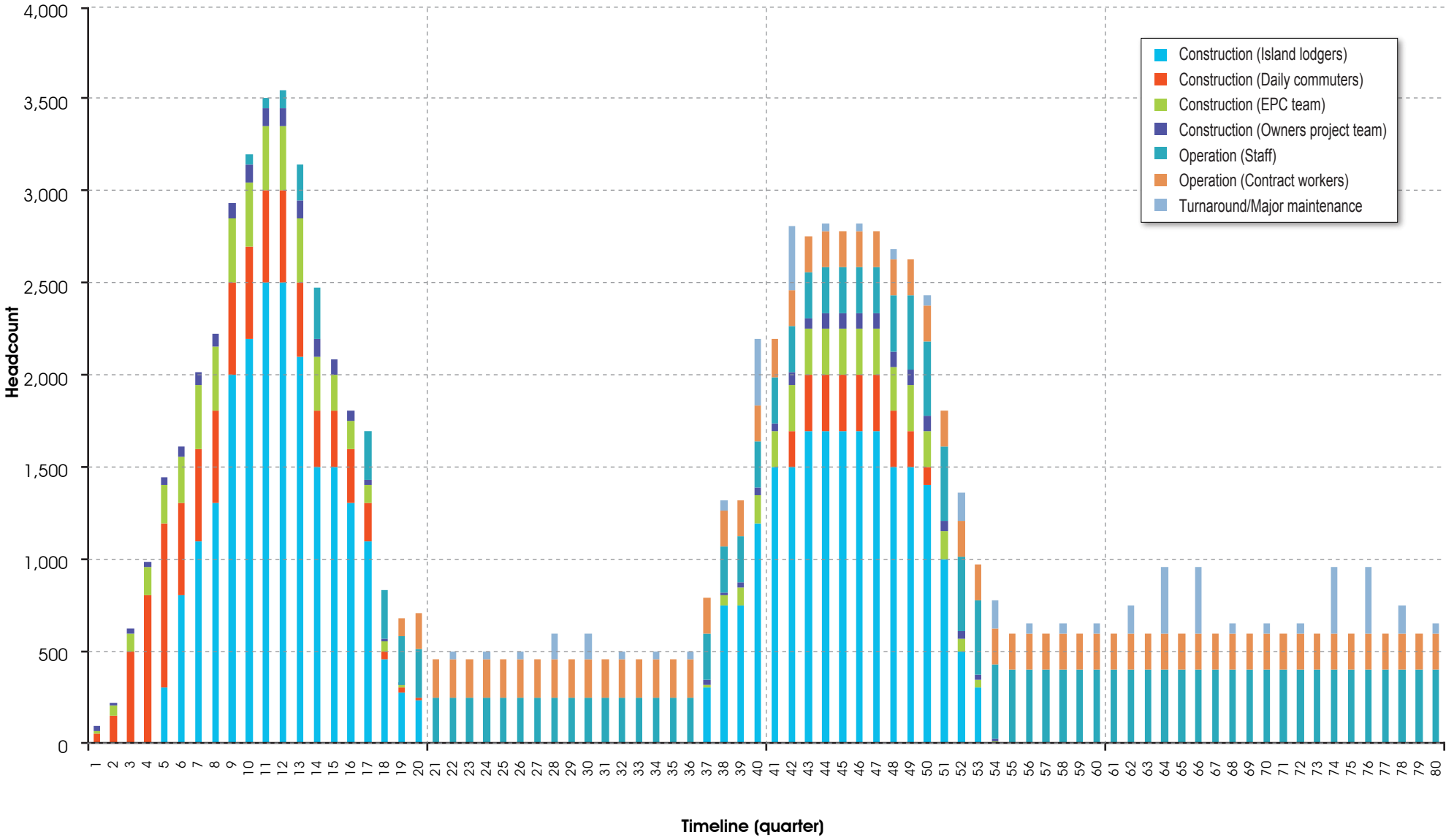
This section provides an update of the personnel and materials logistics during early works and construction.

7.1.1 Personnel

The estimated peak construction workforce for the LNG plant, tunnel, feed gas pipeline, and dredging has not changed from that described in the EIS. However, as shown in Figure 7.1, the ramp up to peak workforce numbers is slower reflecting the more detailed understanding of the early works program. Personnel logistics, including peak workforce demographics and anticipated road, air and marine transportation requirements are discussed below.

Peak Workforce

The peak workforce required for construction remains unchanged from the EIS. It is estimated at around 3,500 persons, consisting of 3,000 construction workers, 350 engineering, procurement and construction (EPC) contractor management personnel, and 150 Arrow Energy employees. In addition, up to 100 persons will be required to construct the tunnel, 75 persons to install the feed gas pipeline, and 20 to 40 people for dredging activities.



KEY:
EPC Engineering, procurement, construction

Source: Arrow Energy

coffey environments

Date: 26.09.2012

File Name: 7033 _16_F07.01_FT

Arrow Energy

Arrow LNG Plant

arrow energy go further

Arrow LNG Plant Manpower Loading at Site

Figure No: 7.1

The EIS presented the results of an analysis of the workforce mix for major projects in the Gladstone region, along with the forecast workforce requirements for the other LNG developments. The analysis indicated that between 5% and 20% of the 3,000 construction workers could be sourced from the local community. Locally-sourced workers were defined as persons living within 50 km of the City of Gladstone. Local content is expected to be higher during early works when local subcontractors are expected to be able to provide the required civil construction and trades skills. The timing of completion of the other LNG projects and the overall development climate in Australia at the time the project commences will influence the ultimate make-up of the workforce. Similarly, training initiatives offered by other LNG proponents prior to the commencement of the Arrow LNG Plant may increase the local labour pool.

As stated in the EIS, Chapter 26, Social Impact Assessment, it is estimated 5% of EPC contractor management staff and 10% of Arrow Energy staff could be sourced from Gladstone. Table 7.1 (Table 26.7 of the EIS) provides an estimate of local and non-local workers employed during peak construction.

Table 7.1 Estimate of local and non-local workers in the peak construction workforce

Worker Type	Non-Local (No.)	Local (No.)	Local (%)
LNG construction workforce	2,400 to 2,850	150 to 600	5% to 20%
Engineering, procurement and construction (EPC)	332	18	5%
Arrow Energy	135	15	10%
Feed gas pipeline, tunnel and dredging	215	0	0%
Total	**3,082 to 3,532**	**183 to 633**	**4.9% to 17%**

Source: Table reproduced without change from Table 26.7 (Coffey, 2012).

The ratio of non-local to local labour remains unchanged as the current tight labour market indicates the estimate of 5% local content is the most appropriate assumption for the workforce mix. The exception is the assumption that 10% of Arrow Energy employees could be sourced locally. This reflects Arrow Energy's preference to employ locally. These assumptions result in an estimated peak non-local workforce of 3,318 workers, as presented in the EIS. Assuming the tunnel construction, pipeline construction and dredging workers are not local this brings the estimated maximum non-local workforce to 3,533 workers.

Table 7.2 (Table 26.8 of the EIS) gives the indicative skills base for the LNG plant construction workforce which remains unchanged.

Table 7.2 Indicative skills base for LNG plant construction workforce

Occupation Type	Total Workforce (%)
Civil engineering – tanks	15%
Civil engineering – marine	10%
Other civil works (early works, buildings, underground, site preparation)	30%
Mechanical	20%
Electrical and instrumentation	9%
Painting and insulation	6%
Management/others	10%

Source: Table reproduced without change from Table 26.8 (Coffey, 2012).

Shift and Accommodation Arrangements

The majority of non-local workers will be engaged on a single status, fly-in, fly-out (FIFO) basis consistent with current practice in the oil and gas industry. The non-local workers' contracted pick-up and set-down location will be a capital city or other major city nearest their place of residence in Australia or overseas. Drive-in, drive-out (DIDO) workers may also be engaged from locations in central Queensland.

Employment contracts will stipulate that while on site, the workers will live in the construction camp on Curtis Island or a mainland temporary workers accommodation facility or third party accommodation facility (workers camp) or company facilitated accommodation. The accommodation requirements and proposed arrangements for the early works and construction phases are set out below.

Early Works Workforce Accommodation

The non-local workforce will steadily increase to approximately 800 persons (650 FIFO/DIDO construction positions and 150 management and supervisory positions) in the month prior to the first construction camp beds becoming available on Curtis Island. A range of accommodation will be used to house workers during the early works phase which is expected to last for 12 months. Third-party accommodation facilities and company facilitated accommodation are the preferred options.

Examples of third party workers camps that may be available include the MAC Services Group and the Maroon Group's accommodation facilities at Calliope and Calliope River Road respectively, and the proposed Fleetwood camp near Gladstone Airport. Single-status FIFO and DIDO workers will be preferentially accommodated in such facilities.

EPC contractor management staff and Arrow Energy employees engaged on family status will relocate to Gladstone and be accommodated in purchased or rented houses. Single status contractors and employees will be accommodated in company facilitated accommodation including, but not limited to, rented apartments and shared houses.

The SIMP Action Plan: Housing and Accommodation contained in Attachment 4, Social Impact Management Plan Update provides details on the housing and accommodation strategy which will reflect market conditions and housing and rental accommodation availability nearer to the commencement of construction.

Construction Workforce Accommodation

A construction camp catering for up to 2,500 people at Boatshed Point on Curtis Island remains the preferred option for FIFO and DIDO workforce accommodation during construction. At peak construction, a further 500 to 600 workers for the LNG plant, tunnel, pipeline and dredging will need to be accommodated.

While third-party accommodation facilities may be utilised to address the peak demand for accommodation, the distance and travel times from the facilities to the mainland launch site may make these options less attractive. Consequently, options for temporary worker accommodation facilities (TWAF) on the mainland have been retained and are being further investigated.

TWAF 8 at the corner of Forest Road and Targinie Road remains an option, as legislative constraints negate the use of TWAF 7, the former Gladstone Power Station No 7 ashpond, for

accommodation facilities. A further option has been identified in proximity to the mainland launch site. The site on Red Rover Road south of the Gladstone Power Station has capacity to provide accommodation, staging, carparking and laydown facilities.

Table 7.3 sets out likely shift and accommodation arrangements for the early works and construction workforces.

Table 7.3 Likely construction working hours, rosters, personnel and accommodation options

Construction Workforce	Working Hours	Roster	Number of Workers (Peak)	Preferred Accommodation Option
LNG plant workforce (including EPC contractor staff and Arrow Energy employees)	Typically 6.00 a.m. to 6.00 p.m. However, there may be requirements for night work when modules arrive, during concrete pours and for other construction activities.	• Local workforce: Monday to Saturday. • Three-on, one-week off roster for FIFO and DIDO workers from Australia and New Zealand. • Twelve week-on, two-week off roster for FIFO workers from overseas countries other than New Zealand.	3,318	**Single status:** *Early works* • Third-party mainland accommodation camp • Company-facilitated accommodation* *Peak construction* • Curtis Island construction camp (2,500 persons) • Red Rover Road (overflow) • Company-facilitated accommodation* • TWAF 8 (overflow) **Family status:** *All construction phases* • Company-facilitated accommodation*
Feed gas pipeline workforce	6.00 a.m. to 6.00 p.m.	28 days on and 9 days off shift rotation, or 21 days on and 7 days off shift rotation.	75	Third-party mainland accommodation camp, TWAF or company-facilitated accommodation
Tunnel workforce	Two 12-hour shifts	Three shift crews working 7 days on, 4 days off shift rotations.	100	Third-party mainland accommodation camp, TWAF or company-facilitated accommodation

Table 7.3 Likely construction working hours, rosters, personnel and accommodation options (cont'd)

Construction Workforce	Working Hours	Roster	Number of Workers (Peak)	Preferred Accommodation Option
Dredging workforce	Two 12-hour shifts	Land based staff will work as per the LNG plant workforce. Depending on the volume of material to be dredged crew may live on board working in a three shift arrangement of 7 days on, 4 days off shift rotation.	20-40	Third-party mainland accommodation camp, TWAF or company-facilitated accommodation or dredge vessel
Gladstone office	8.00 a.m. to 5.00 p.m.	Monday to Friday (and Saturday as required).	15	Assumed to be residents of Gladstone who live in a family home.

* Arrow Energy's estimates indicate that based on the current (September, 2012) availability of housing, up to 130 houses may be required to accommodate its employees and EPC contractor management personnel.

Air Transportation Requirements

FIFO workers will be flown in and out of Gladstone Airport. Table 7.4 shows the assumed number of personnel air movements through Gladstone Airport, which peak at 522 movements per week. This is a reduction on the estimate of 800 movements per week presented in the EIS (see section 28.4.3). The majority of personnel are expected to fly to Brisbane or Sydney airports, then on to their final destinations in Australia or overseas.

Table 7.4 Assumed personnel air movements – return flights per week

Source	Early Works	Construction Ramp-up	Construction Peak	Construction Ramp-down
Queensland FIFO (3:1 roster)	60	190	200	60
Other Australia / New Zealand (3:1 roster)	12	50	250	12
Overseas (12: 2 roster)	8	15	72	8
TOTAL	**80**	**255**	**522**	**80**

Chartered flights or a mix of chartered flights and block-booked regular passenger services may be used during peak construction to augment regular passenger services between Brisbane and Gladstone. Any movements through Rockhampton Airport are expected to be limited.

Travel for rest and recuperation may be allowed on three days per week e.g., Tuesday, Wednesday and Thursday. This will lead to a peak of approximately 175 departures and arrivals per day on regular passenger services, either as a single flight or via several different flights throughout the day.

Marine Transportation Requirements

Daily personnel movements between Gladstone and Curtis Island have been estimated based on the workforce assumptions set out in Table 7.1 and the availability of the Curtis Island construction camp after 12 months of construction. Assumed movements are shown in Table 7.5.

Table 7.5 Assumed personnel requirements – return trip to Curtis Island per day

Source	Early Works	Pre-Camp Peak	Construction Ramp-up	Peak Construction	Construction Ramp-down
Rest and recuperation changeover (FIFO/DIDO)	36	60	98	191	36
Mainland resident	1,000	1,500	800	1,000	500
TOTAL	**1,036**	**1,560***	**898**	**1,191**	**536**

* Numbers peak in the month prior to beds at the construction camp becoming available (assumed worst case).

It is assumed that personnel transport between the mainland and Curtis Island will be by fast passenger ferries with approximately 250-person capacity. However, smaller ferries of around 150-person capacity are assumed to operate during early works while the mainland launch site at Gladstone and the materials offloading facility (MOF) on Curtis Island are developed. Prior to mainland launch site and MOF construction, temporary facilities will be established at Hamilton Point or Boatshed Point on Curtis Island, with ferries operating out of Gladstone Marina or possibly Auckland Point/Barney Point. At peak, ferry movements are expected to reach eight return (16 one-way) trips per day.

Table 7.6 describes how personnel may be transferred to and from Curtis Island. Table 7.7 provides an indicative ferry timetable based on 45-minute round-trips with two fast passenger ferries operating. It assumes that ferries will return to the mainland launch site rather than waiting at Curtis Island during the day. The exception is the morning service for FIFO/DIDO workers going off roster and leaving the island to go on rest and recreation (i.e., one week or two week break). In this instance, one of the ferries will stay at the island to make that trip.

Table 7.6 Assumed personnel movements – transfer methods

Purpose of Travel	Transfer Method
Day shift work on Curtis Island (transfer personnel accommodated on the mainland)	Transfer of up to 1,000 persons working split shifts so that 50% of personnel start and finish work one hour earlier than the other 500 workers. Utilise two ferries each undertaking two trips (start and end of each shift) to transport 500 personnel in each trip.
Rest and recuperation changeover (FIFO/DIDO)	Personnel will depart on an empty return ferry journey during morning or evening peak; or utilise a dedicated ferry trip during non-peak.
General ferrying	Use small water taxis (<15 m in length) for general ferrying during the day.
Medivac	Use suitably equipped small vessel that will be available at all times.

Table 7.7 Indicative ferry timetable (two shift start times)

Trip No.	Ferry Name	Departure	No. People	Purpose
1	Ferry 1	5.30 a.m. from mainland	250	Daily commute
2	Ferry 2	5.35 a.m. from mainland	250	Daily commute
3	Ferry 1	6.30 a.m. from mainland	250	Daily commute
4	Ferry 2	6.35 a.m. from mainland	250	Daily commute
5	Ferry 1	7.30 a.m. from Curtis Island	191	Rest and recuperation
6	Ferry 1	1.00 p.m. from mainland	191	Rest and recuperation
7	Ferry 1	4.30 p.m. from Curtis Island	250	Daily commute
8	Ferry 2	4.35 p.m. from Curtis Island	250	Daily commute
9	Ferry 1	5.30 p.m. from Curtis Island	250	Daily commute
10	Ferry 2	5.35 p.m. from Curtis Island	250	Daily commute

Road Transportation Requirements

The mainland launch site was proposed as the centralised car and bus parking area for transfer of personnel to and from Curtis Island. Forecast congestion at intersections along Port Curtis Way has prompted a review of personnel transport on the mainland, and has resulted in alternative arrangements for early works and construction.

Early Works

During early works, all local and DIDO workers transferring to and from Curtis Island will be transported to the mainland pioneer launch sites in busses from car parks to be established at TWAF 7 and/or Red Rover Road or other approved locations (such as private carparks). Workers residing in company facilitated accommodation such as third party accommodation camps will all be bussed to and from that location to the pioneer mainland launch site. The exception will be local workers employed on tunnel construction who will drive to car parking to be provided at the mainland tunnel launch site. FIFO workers will be transferred from Gladstone Airport to their accommodation in busses, and in busses from their accommodation to the mainland pioneer launch sites. A fleet of 55-seat busses will be used to transport the workers. Non-local employees residing in Gladstone will be picked up at their residence and transported to the mainland pioneer launch site in 20-seat busses.

Construction

Similar arrangements will apply during construction. The majority of local and DIDO workers will continue to use car parks at TWAF 7 and/or Red Rover Road or other approved locations from where they will be transported to the mainland launch site in 55-seat busses. Any workers residing in company-facilitated accommodation such as third party accommodation camps will be bussed to and from that location to the pioneer mainland launch site. Non-local resident employees will typically be picked up at their residence and transported to the mainland launch site in 20-seat busses. FIFO workers will be transported from Gladstone Airport to the mainland launch site in 55-seat busses. Local tunnel construction workers will continue to drive to, and park at, the mainland tunnel launch site.

Based on workforce assumptions set out in Table 7.1, the estimated number of local, DIDO and FIFO workers making return road trips per day is detailed in Table 7.8.

Table 7.8 Estimated number of construction personnel making return road trips per day

Source	Early Works	Construction Ramp-up	Peak Construction	Construction Ramp-down
Local personnel to mainland launch site	500	700	500	500
Mainland workers camp to mainland launch site	450	100	250	0
Non local Gladstone residential employees to mainland launch site	50	200	250	100
DIDO	9	13	17	9
FIFO to Gladstone Airport	27	85	174	27

Tables 7.9 and 7.10 are derived from Tables 5.1 and 5.3 of Appendix 13 (Supplementary Report: Traffic and Transport Impact Assessment) to the SREIS.

Table 7.9 Estimated peak daily road trips during early works

Travel Route	Description	Persons	Trips Generated	Car Occupancy and Bus Capacity
Gladstone to car park[1]	Local	300	200 car movements	1.5 persons per car
Car park to pioneer launch site	Local	300	6 bus movements	55 seat bus
Third party camp to Gladstone Airport	FIFO	174	4 bus movements	55 seat bus
Gladstone to mainland tunnel launch site	Local	36	25 car movements	1.5 persons per car
Bruce Highway to third party camp (e.g., Calliope)	DIDO	9	9 car movements	1 person per car
Third party camp (e.g., Calliope) to pioneer launch site	Non-local	50	13 bus movements	55 seat bus
Third party camp (e.g., Calliope) to pioneer launch site	FIFO/DIDO	650		
Car park to mainland launch site (for construction of facility)	Mix	100	2 bus movements	55 seat bus

1. Car park will be established at either TWAF 7, or off Red Rover Road, or another approved location. Table derived from Table 5.1 of Appendix 13 (Supplementary Report: Traffic and Transport Impact Assessment) to the SREIS.

Table 7.10 Estimated peak daily road trips during peak construction

Origin	Description	Persons	Trips Generated	Car Occupancy & Bus Capacity
Gladstone to car park	Local	500	334 car movements	1.5 persons per car
Car park to mainland launch site	Local	500	10 bus movements	55 seat bus
Mainland launch site to Gladstone Airport	FIFO	174	4 bus movements	55 seat bus
Gladstone to mainland tunnel launch site	Local	36	25 car movements	1.5 persons per car
Bruce Highway to car park	DIDO	17	17 car movements	1 persons per car
Third party camp (e.g., Calliope) to mainland launch site	Non local	500	10 bus movements	55 seat bus

Source: Derived from Table 5.1 of Appendix 13 (Traffic and Transport) to the supplementary report to the EIS.

On Curtis Island, an estimated fleet of 14 55-seat buses will be required to transport up to 1,500 personnel arriving at the MOF – over three half-hourly intervals – to the LNG plant site. An estimated fleet of 17 55-seat buses will be required to transport up to 2,500 personnel between the construction camp and the LNG plant site.

7.1.2 Materials

Materials transport will be optimised following the development of the shipping schedule for the project. The shipping schedule will take into account materials dimensions and weight, and ports of export and import. Indicative types, volumes and methods of transporting construction materials and associated procedures are discussed in the following sections.

Quarantine Requirements

The Australian Quarantine and Inspection Service (AQIS) manage quarantine controls at Australia's borders to minimise the risk of exotic pests and diseases entering the country. The shipment of project goods and materials to Australia will meet the applicable quarantine standards.

AQIS facilities will be used for materials and equipment received as general cargo at Gladstone, Brisbane and other ports within Australia. Modules, major equipment and associated general cargo will also be received at the MOF. An approved quarantine facility will be established on Curtis Island and systems established to ensure quarantine requirements are met prior to the shipment and receipt of goods.

The quarantine facility will feature:

- Standing areas for modules, containers and equipment waiting inspection and washdown.
- An inspection stand – meeting AQIS requirements – for examining the undersides of fully-laden containers.
- A wash bay for washing and chemical disinfection of maximum size modules, containers and major equipment shipped directly to the site.
- A fumigation facility for treating 40-foot containers and storing chemicals.
- General facilities including fencing, signage, lighting and a segregation area for quarantined materials.

Three-days notice of impending deliveries is required and will be provided to aid the timely scheduling of inspections by locally based AQIS inspectors.

All equipment and vehicles being transferred to the island will need to comply with the weed and pathogen management procedures to be developed.

Staging (Marshalling) Areas

The preferred logistics solution is to ship materials and equipment directly to the MOF thereby reducing the need for double handling. Materials and equipment arriving at Port of Gladstone or other Australian ports will be transported to staging areas for storage and dispatch to Curtis Island. Staging facilities will be preferentially provided at the mainland launch site, as well as at TWAF7 and/or Red Rover Road or other approved location if they are developed for that purpose.

Materials and equipment processed through staging areas will be shipped to Curtis Island using RoPax or RORO ferries and dumb barges.

Quantities of Construction Materials

Estimated quantities of construction materials and equipment required in the various phases of construction are provided in Table 7.11.

Table 7.11 Estimated quantities of construction materials

Construction Phase	Materials	Volume (FT)*
Mobilisation		Minimal
Early works	• Aggregate • Construction equipment • Materials for temporary facilities	50,000
Site preparation	• Aggregate • Equipment and materials (stick-build)	200,000
Civil works and underground infrastructure	• Aggregate • Equipment and materials (stick-build)	500,000
Module installation and hook-up	• Modules	300,000
Commissioning	• Commissioning materials and chemicals	100,000

*FT denotes freight equivalent tonnes.

Estimated quantities of materials required to construct the LNG plant and ancillary infrastructure are provided in Table 7.12. Table 7.13 lists the equipment required to construct the plant and ancillary infrastructure assuming modular construction.

Table 7.12 Estimated quantities of bulk and unitised materials

Type of Material	Volume
Bulk Materials	
Concrete aggregate/ marine rock (1.6 t/m^3/ 2t/m^3)[1]	441,600 t
Sand for backfill (120,000 m^3 at 1.6 t/m^3)[1]	192,000 t
Cement for concrete (60,000 t)	60,000 t
Sand for concrete (75,000 m^3 at 1.6 t/m^3)[1]	120,000 t
Fill for mainland launch site (153,000 m^3 at 1.6 t/m^3)[2]	245,000 t
Unitised Materials	**Quantity**
Pipe (feed gas pipeline)	800 12 m lengths (i.e., 9.6 km)
Piles (incl. sheet piles)	2,000 piles
Cable (early works)	300 drums
Underground piping	900 bundles
Camp modules	1,144 (3 m by 12 m)
Building modules	1,200 (3 m by 12 m)
Cryogenic tank material	10,000 t (15 t/load)
Structural steelwork	2,500 t (10 t/load)
Aboveground piping	500 t (10 t/load)

Table 7.12 Estimated quantities of bulk and unitised materials (cont'd)

Unitised Materials	Quantity
Electrical cable	4,000 drums
Instrument cable	1,000 drums
Other tank materials	5,000 t (15 t/load)
Other bulk materials	1000 trailer loads (200 t)
Consumable and other materials	10 trailers/day

Source: Derived from Table 5.6 of Appendix 13, Traffic and Transport.

1. Assumes 130,000 m^3 of concrete works, with concrete aggregate, sand and marine rock imported to Curtis Island via the mainland launch site from quarries in the Gladstone area.
2. Assumes all fill for the mainland launch site is imported from quarries in the Gladstone area. Site preparation on Curtis Island will result in 5.8 million m^3 cut and 3.1 million m^3 fill with suitable cut material being used for structural and general fill, and road base.
3. Assumes pipe supplied in 12 m lengths.

Table 7.13 Estimated quantity of construction equipment

Construction Equipment	Number of Units	Construction Equipment	Number of Units
Transportation (trailer/truck)	100 to 180	Piling machine	10
Crawler crane (250 t to 1,200 t)	20	Dump truck	12
Crane (general purpose 10 t to 250 t)	70	Light vehicle (utility vehicle/rigid)	20
Forklift	50	Welding machine	460
Excavator/back-hoe	20	Manlift (scissor lift/boom lift)	100
Bulldozer	13	Compressor	75
Grader	23	Generator	65
Scraper	21	Compactor	9
Front-end loader	20	Water cart	19
Roller	12	Concrete mixer truck	8
Crushing and screening plant	2	Concrete batcher (100 m^3)	2

Source: Derived from Table 5.6 of Appendix 13, Traffic and Transport.

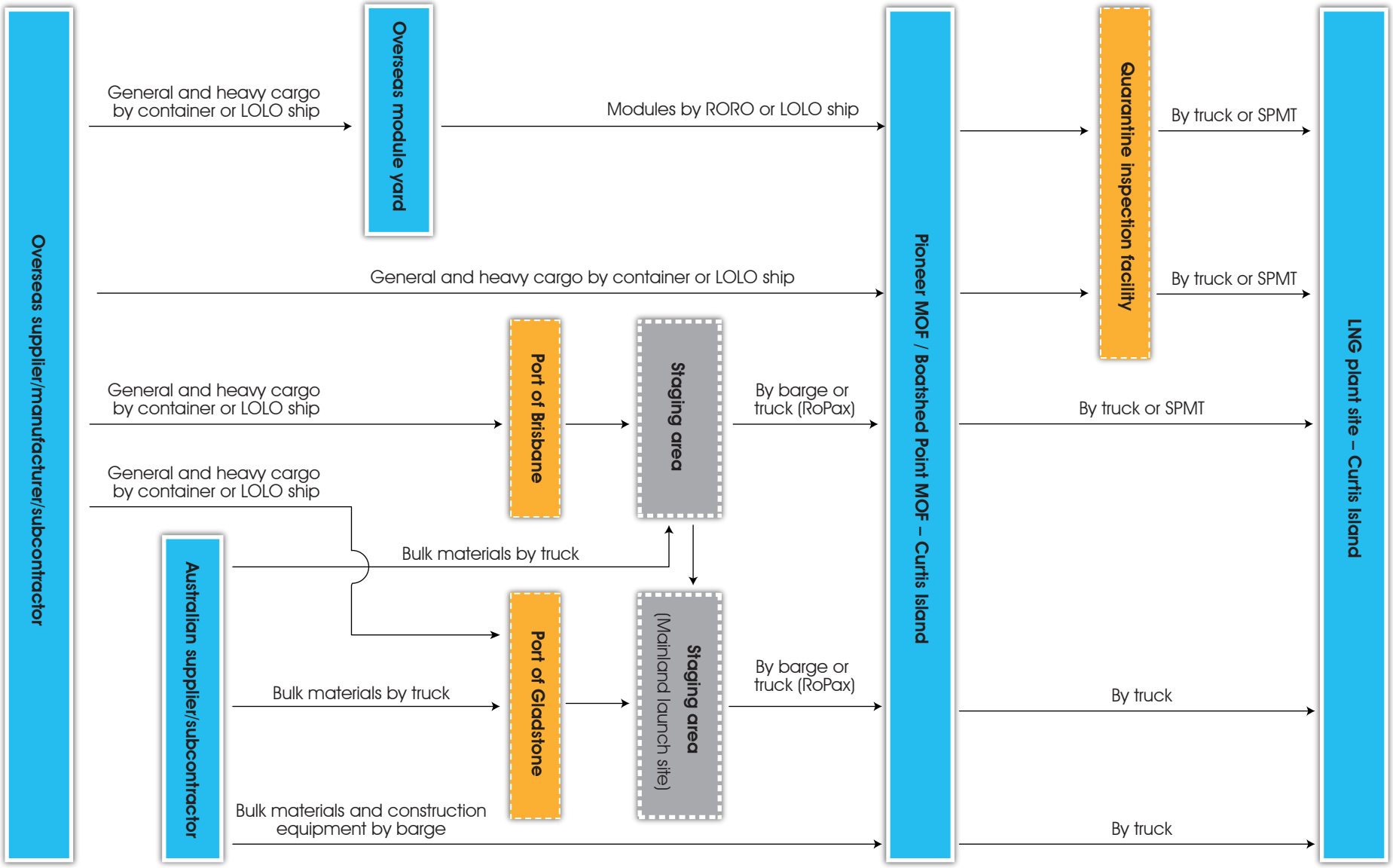
An indicative overall cargo flow diagram, showing the main cargo types and their means of transport to Curtis Island, is shown in Figure 7.2. Further information on cargo types is provided below.

Modules

The majority of modules will be fabricated at various sites in Asia from where they will be shipped to the MOF on Curtis Island. Modules with a weight in excess of 700 tonnes will be transported by a flat-deck open-stern type RORO vessel. Modules with a weight of less than 700 tonnes will typically be transported on LOLO heavy-lift vessels, however some may be transported by RORO. The vessels may also collect other heavy equipment, break-bulk or unitised cargo en route to Gladstone. Self-propelled modular transporters will be used to transport modules from the MOF to the quarantine facility and on to the LNG plant site.

General Cargo and Containers

Likely arrangements for receiving general cargo and containers and transporting these to Curtis Island are described in Table 7.14.



KEY

SPMT Self-propelled modular transporter
RORO Roll-on, roll-off
LOLO Lift-on, lift-off
MOF Materials offloading facility

coffey environments

Date: 03.12.2012
File Name: 7033_16_F07.02_FT

Arrow Energy
Arrow LNG Plant

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Indicative overall cargo flow (excluding air shipment)

Figure No: **7.2**

Table 7.14 Shipment type, port of entry and handling arrangements

Shipment Type and Entry Port	Handling
General cargo shipped as break bulk designated to the Port of Gladstone	• Discharged at port by ship's crane. • Customs clearance and AQIS inspection at the Port of Gladstone. • Cargo delivered and sorted at the Gladstone staging area (mainland launch site). • Cargo loaded onto trucks and transferred by RoPax or RORO ferry from the mainland launch site[1] to the MOF[2].
General cargo shipped as break bulk designated to the Port of Brisbane	• Discharged at port by ship's crane. • Customs clearance and AQIS inspection at the Port of Brisbane. • Cargo loaded for transport to Gladstone by: – Road to the mainland launch site and then RoPax or RORO ferry to the MOF. – Rail to the Gladstone, then truck to the mainland launch site and RoPax ferry to the MOF. – Marine barge to Port of Gladstone with cargo loaded onto trucks and ferried (RoPax or RORO) from the mainland launch site to the MOF[2]. – Marine barge direct to the MOF.
Container designated to the Port of Brisbane	The majority of container deliveries will arrive through the Port of Brisbane. This will involve: • Customs clearance and AQIS inspection at the Port of Brisbane. • Containers delivered by rail and sorted at the Gladstone staging area (mainland launch site). • Containers loaded onto trucks and transferred by RoPax or RORO ferry from the mainland launch site to the MOF.
Container designated to the Port of Gladstone	Multi-modal vessels will deliver containers to the Port of Gladstone. This will involve: • Customs clearance and AQIS inspection at the Port of Gladstone. • Delivery of containers by road to the Gladstone staging area (mainland launch site). • Containers loaded onto trucks and transferred by RoPax or RORO ferry from the mainland launch site to the MOF.

1. Prior to the MOF becoming available, RoPax ferries will use the GLNG pioneer MOF or the ramp established by GAWB at the southern end of Hamilton Point, or a ramp at Boatshed Point.
2. Prior to the mainland launch site becoming available to receive materials, RoPax ferries will depart from Mission Landing at Gladstone Marina, Auckland Point/Barney Point, and the bulk materials launch site at Fishermans Landing.

Bulk Materials

Subject to further investigation, aggregate is expected to be sourced from quarries local to Gladstone e.g., Yarwun Quarries, Unimin Quarry and Earth Commodities Gladstone. Sand and cement may be sourced from local facilities e.g., Boral Tannum Sands and Cement Australia. Bulk materials will be transported in trucks with 40 t tipper trailers each carrying a 32 t payload, or in 3,500 deadweight tonnage (DWT) dumb barges.

Trucks will be transported to the island on RoPax or RORO ferries or on 3,500 DWT dumb barges each capable of carrying 20 trucks, a total payload of 640 t. Bulk transfer using dumb barges would involve loading the barges from stockpiles at the pioneer mainland bulk materials launch site during early works, and the mainland launch site during construction. Each barge is able to carry a 2,000 t payload.

Heavy Equipment

A LOLO heavy-lift ship will transport a limited amount of non-modularised heavy equipment directly to Curtis Island (most heavy equipment will be integrated within the modules). Ship cranes will unload the equipment to the MOF where it will be transported to the LNG plant site by truck or self-propelled modular transporters.

First Fill of LNG Plant

The following deliveries will be made for the first-fill of the LNG plant:

- Propane by tanker ship.
- Ethylene by iso-container.
- Liquid nitrogen by tanker truck.
- Lubricants in drums or iso-cubes.
- ADIP-X solvent and various other chemicals in an iso-container or other approved container.
- LNG for cool down of LNG tanks and loading lines by imported shipment of LNG.

Waste

Sorting of solid waste will occur on-site and/or at the mainland launch site. The waste will be disposed to a licenced landfill. Access to and the capacity of the existing Benaraby landfill (located 20 km south of Gladstone) to receive the waste will be determined in discussions with Gladstone Regional Council. Approximately 20 semi-trailer loads of solid waste are expected per month at peak construction.

Recyclable waste will be segregated and transported to Brisbane or a regional recycling facility by a service provider. Reusable waste, such as scrap steel, will be segregated on site and consolidated at the mainland launch site for sale. Estimated solid, recyclable and regulated waste volumes during construction have not changed from that presented in the EIS.

Mulch (16,000 t) and topsoil (215,000 m^3) will be stockpiled for reuse in rehabilitation of temporary workspaces and LNG plant bench batters and embankments. Excess mulch may be removed to the mainland for reuse or disposal. Some excavated material will be placed on the intertidal mudflat adjacent to the isthmus connecting Boatshed Point to the mainland of Curtis Island where land will be reclaimed for laydown (see Figure 4.1).

Hazardous Materials

Volumes of hazardous materials (regulated wastes) associated with the project are small and will be removed by regulated waste contractors and/or disposed of in accordance with applicable guidelines. Principally, these include:

- Dewatered biosolid sludge from the effluent treatment plant (if constructed).
- Brine from the reverse osmosis facility (if constructed).
- Other regulated wastes including medical wastes, paints and adhesives, batteries, oil-contaminated steel drums, used grease, lubricant and oils.

Hydrostatic test water is not expected to be classified as a regulated waste as it will comprise either water provided by the GAWB pipeline, water from the RO plant (if built), or seawater. The

water will be discharged to Port Curtis following sampling and, if necessary, treatment to ensure it meets relevant water quality standards.

Construction Traffic Movement

The volumes of materials and equipment to be moved from various ports have been revised along with a review of transport options including road, rail and marine transport. The review found that shipping offered the best opportunity for reducing road transport, as transport by rail is constrained by limits on the dimensions of some cargo. Nevertheless, it is expected that rail will be included in the mix of transport options particularly for the transport of bulk materials and general cargo.

The logistics review undertaken for the Arrow LNG Plant has resulted in better estimates of the heavy vehicle movements and shipping activity in the early works period and the ramp up to peak construction. Expected heavy vehicle movements and shipping requirements are discussed in the following sections.

Heavy Vehicle Movements

Figure 7.3 shows the estimated heavy vehicle movements per day for return trips to transport materials and equipment to Gladstone. It shows peak movements occur in month 13 when site preparation overlaps with the ramp up of foundation and structural works, and in peak construction activity between months 21 to 24 when the estimated maximum daily return trips reaches 65. The average movements for the 24 month period are 47 return trips per day.

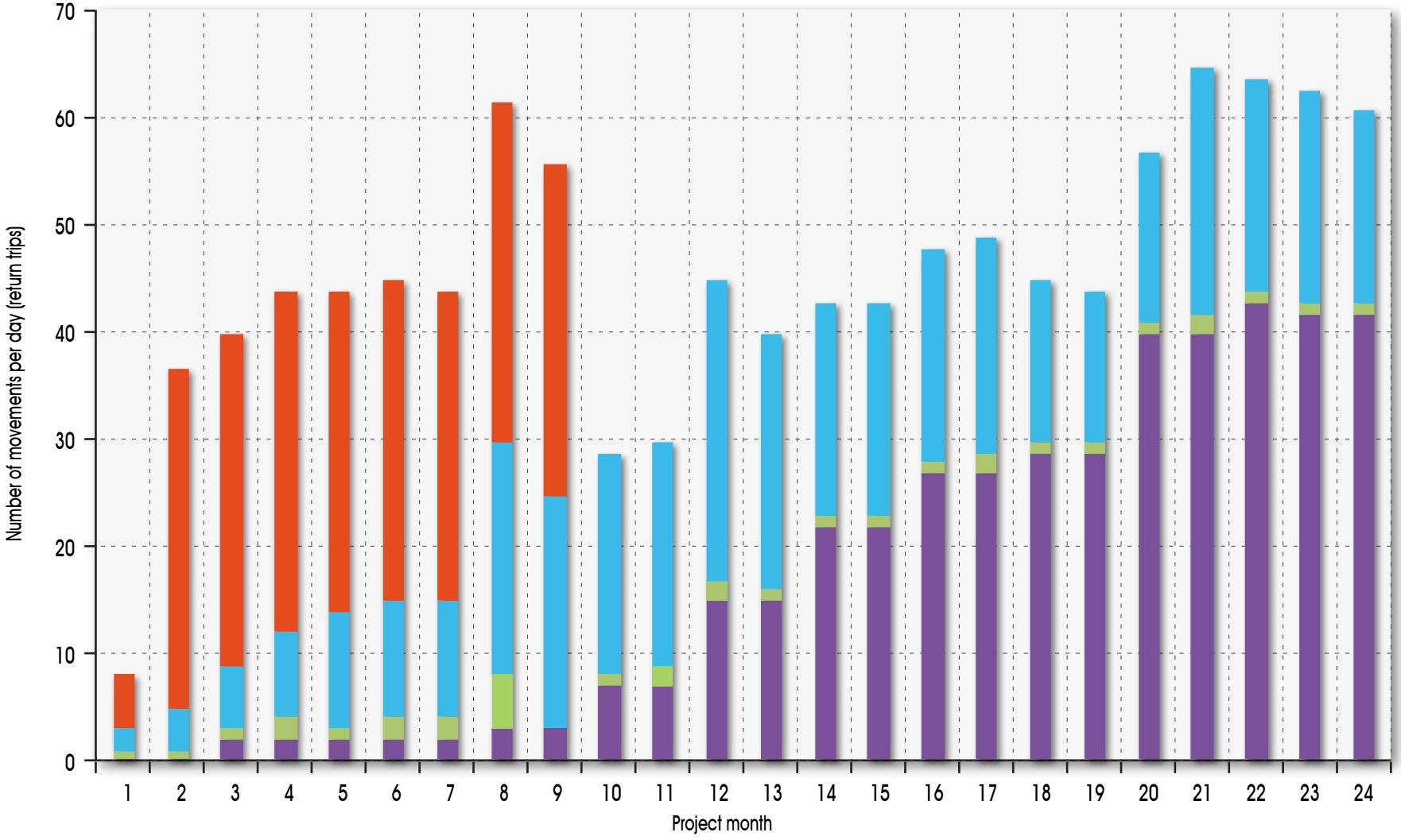
Bulk material transport to Curtis Island from the Gladstone region produces at estimated average of 18 return trips per day over the 24-month period, peaking at 42 movements per day in peak construction. Transport of unitised materials from Brisbane produces an average 17 return trips per day over the 24-month period, peaking at 28 return trips per day in the ramp-up to peak construction. An estimated average of 2 return trips per day peaking to 5 return trips per day is required to transport construction equipment from Brisbane.

Transport of fill material for the mainland launch site produces an estimated average of 28 return trips of heavy vehicles per day over the eight-month duration of the activity.

The distribution of heavy vehicle movements in Gladstone will depend on the destination of the freight. In early works, freight will be delivered to the staging area and from there to the pioneer mainland launch sites, or directly to the pioneer mainland launch sites. During construction, freight will be delivered to the staging area and to the mainland launch site, with most freight being directed to the mainland launch site to avoid double handling. Materials and equipment required to construct the tunnel will be delivered directly to the mainland tunnel launch site.

Marine Movements

An estimate of the container equivalent units of materials and equipment has been made and is presented in Figure 7.4. Figure 7.4 shows the majority of bulk materials being transported to Curtis Island from Gladstone which reflects the likely source of quarry materials and cement, the most significant quantities of materials to be transported during early works and civil construction works. Figure 7.5 shows the indicative movement of bulk materials and equipment in early works and in construction from pioneer mainland launch site and the mainland launch site to the Curtis Island MOF.



Key
MLS Mainland launch site

coffey environments

Date: 03.12.2012

File Name: 7033_16_F07.03_GL

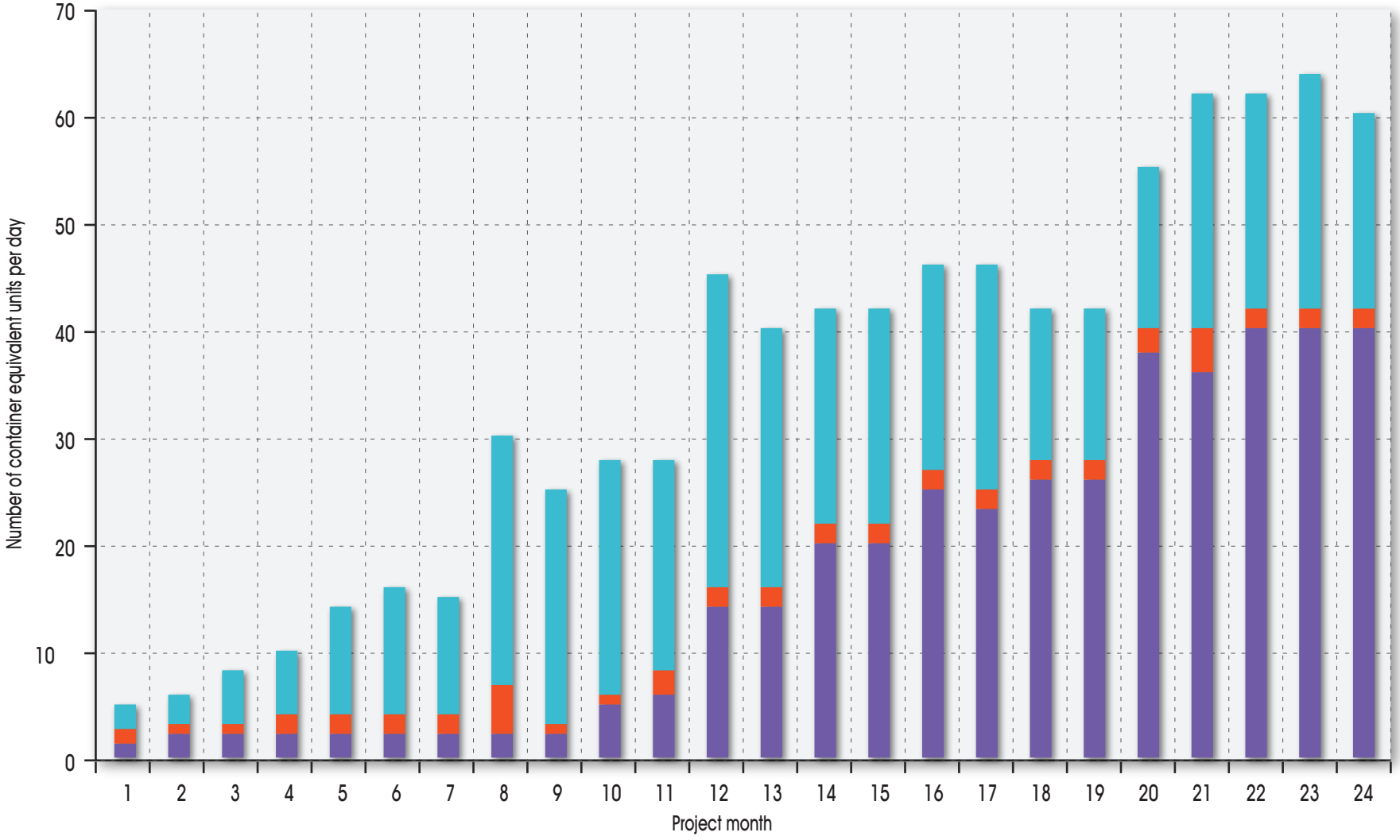
Arrow Energy

Arrow LNG Plant

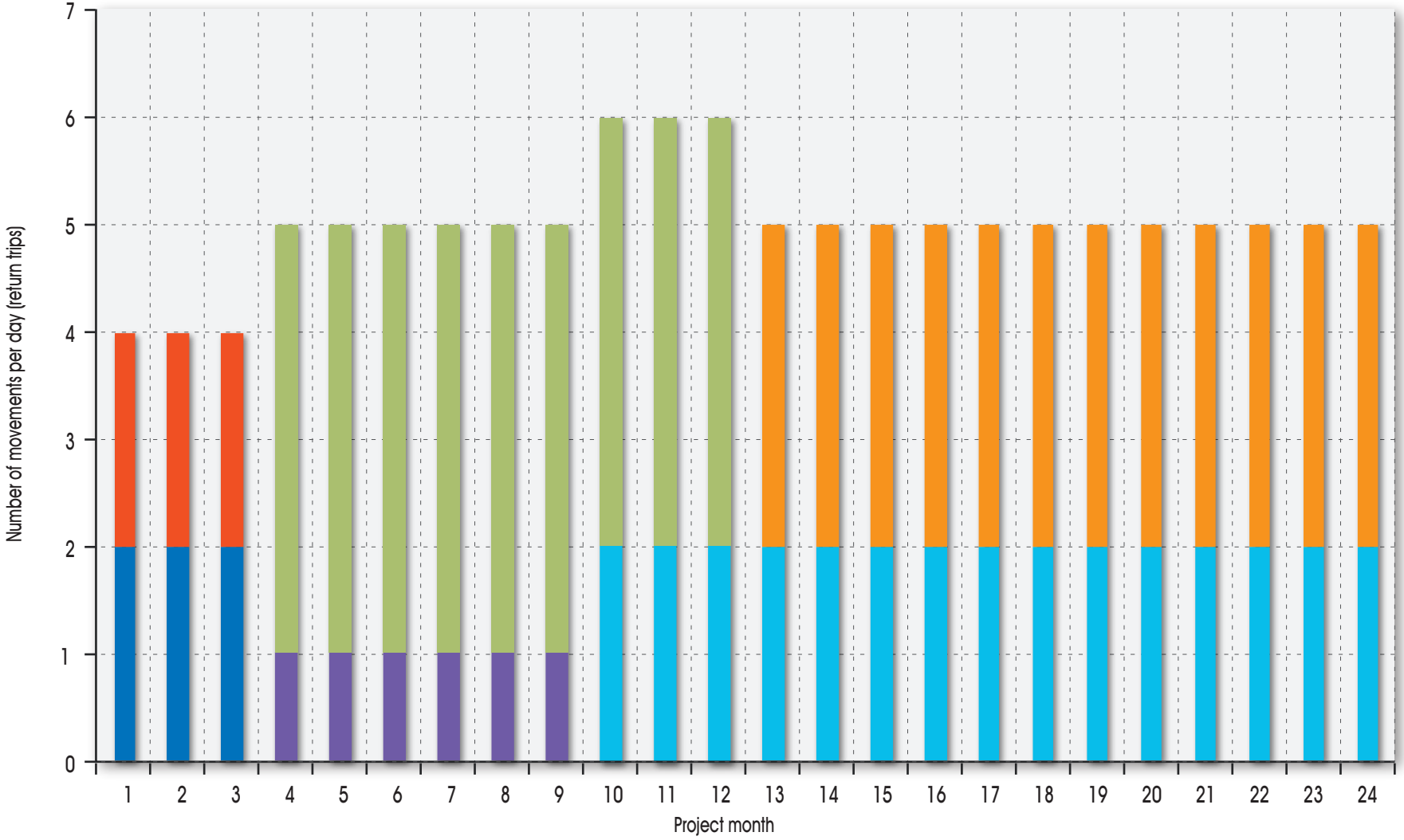
arrow energy go further

Estimated heavy vehicle movements per day - return trips

Figure No: **7.3**



	coffey environments	Date: 28.11.2012	Arrow Energy	arrow energy go further	Estimated shipping volumes per day	Figure No: 7.4
		File Name: 7033_16_F07.04_GL	Arrow LNG Plant			



Key
LCT Landing craft type
MOF Materials offloading facility

coffey environments

Date: 06.12.2012
File Name: 7033_16_F07.05_GL

Arrow Energy
Arrow LNG Plant

arrow energy go further

Indicative marine movements per day - return trips

Figure No: **7.5**

Estimates of other shipping activity presented in the EIS are unchanged. The ultimate distribution of materials and equipment between the various transport modes will be determined in detailed design and finalisation of project logistics.

Arrow Energy will continue to participate in the various forums established by Marine Safety Queensland and Gladstone Ports Corporation to ensure the orderly and efficient operation of the Port of Gladstone.

7.2 Operations

The operating philosophy for the LNG plant is being developed and will, when completed, determine the ultimate requirements for operation and maintenance of the facility. Information provided in the EIS described the workforce, materials (consumable) requirements, waste generation and LNG export. Further information on shift arrangements and transfer of personnel and contractors to Curtis Island is available and detailed in the following sections.

7.2.1 Personnel

The operations workforce presented in the EIS comprised 250 Arrow Energy employees and 200 contractors engaged on routine maintenance for the initial two train development. The EIS reported that Arrow Energy employee numbers would increase to 400 employees for the ultimate four train development bringing the maximum number of operation personnel to 600. Further investigation indicates the number of Arrow Energy employees for the first two-train development will be in the order of 300 employees. This increase does not change the overall operations workforce estimate of 450 persons for the initial development.

Contractors will be used for planned maintenance activities. Table 7.15 details the maintenance activities, duration, interval and workforce requirements.

Table 7.15 Planned maintenance activities

Maintenance Activity	Duration	Interval	Workforce
Gas turbine combustion chamber inspection	5 days	Annually	50
Hot gas path inspections on gas turbines	13 days	Three yearly	150
Gas turbine and compressor overhaul	23 days	Six yearly	350

Planned and major maintenance contractor workers will be engaged on a single status FIFO arrangement. It is anticipated third party or company facilitated accommodation facilities would be used to house the workers due to the relatively short duration of the maintenance activities, with regular passenger services being used to fly the maintenance contractors in and out of Gladstone.

7.2.2 Shift Arrangements

Table 7.16 details the latest estimate of operations personnel and likely working hours.

Table 7.16 Likely operations personnel and working hours for two trains

Workforce	No. of Personnel	Working Hours
LNG plant operators (Arrow Energy employees)	80	Plant operators working 2 by 12-hour shifts with shift changes at 6.30 a.m. and 6.30 p.m. Each shift comprises 2 day shifts, 1 day shift for change over with incoming shift, 2 night shifts and 3 days off. This will comprise 20 people on each shift i.e., 4 shifts of 20 personnel = 80 operations staff.
LNG plant security and fire services personnel (Arrow Energy employees)	28	Security and fire fighting personnel working 2 by 12-hour shifts with shift changes at 6.30 a.m. and 6.30 p.m. Each shift will comprise 2 day shifts, 1 day shift for change over with incoming shift, 2 night shifts and 3 days off i.e., 4 shifts of 7 personnel = 28 security and fire fighting staff.
LNG plant day staff (Arrow Energy employees)	140	7.30 a.m. to 3.30 p.m., Monday to Friday.
Gladstone office (Arrow Energy employees)	10	9.00 a.m. to 5.00 p.m., Monday to Friday.
Mainland launch site (Arrow Energy employees)	10	6.30 a.m. to 6.30 p.m., Monday to Friday Shift personnel will cover the operation of the mainland launch site outside these hours.
LNG plant routine maintenance (contractors)	200	7.30 a.m. to 3.30 p.m., Monday to Friday.
Planned maintenance activities (FIFO contractors)	50 to 350	10-hour day (nominally 7.00 a.m. to 5.00 p.m.) 7 days per week for approximately 3 weeks depending on the maintenance activity.

7.2.3 Road and Marine Traffic Movements

Peak personnel movements will occur in the morning and evening when plant operator shifts change and day workers and contractors commence and finish work. Tables 7.17 and 7.18 present indicative vehicle and ferry movements associated with operations. During major maintenance activities personnel numbers will increase up to 800 persons for trains 1 and 2, and up to 950 persons when all four trains are in operation. Movement of between 800 and 950 persons will necessitate a ferry schedule similar to that proposed for construction (see Table 7.7).

Table 7.17 Operation phase personnel movement (excluding maintenance activities)

Time	To Mainland Launch Site			From Mainland Launch Site		
	Personnel	Cars	Buses	Personnel	Cars	Buses
5.00 a.m. to 6.00 a.m.	27 (shift 2)	18				
6.00 a.m. to 7.00 a.m.	340	164	5			
8.00 a.m. to 9.00 a.m.				27 (shift 1)	18 (shift 1)	
4.00 p.m. to 5.00 p.m.				340	164	5
5.00 p.m. to 6.00 p.m.	27 (shift 3)	18 (shift 3)				
7.00 p.m. to 8.00 p.m.				27 (shift 2)	18 (shift 2)	

Table 7.18 Indicative ferry schedule during operations (excluding maintenance activities)

Trip No.	Ferry Name	Departure	No. People	Purpose
1	Ferry 1	6.00 a.m. from mainland	27	Shift operators
2	Ferry 2	6.30 a.m. from mainland	170	Day workers
3	Ferry 1	7.00 a.m. from mainland	170	Day workers
4	Ferry 1	3.00 p.m. from Curtis Island	170	Day workers
5	Ferry 2	3.30 p.m. from Curtis Island	170	Day workers
6	Ferry 1	6.30 p.m. from Curtis Island	27	Shift operators

In addition to passenger transport it is estimated that RoPax ferries will make four return trips to Curtis Island to deliver materials and equipment, and to transport waste and equipment back to the mainland.