4. PROJECT DESCRIPTION: LNG PLANT

Arrow CSG (Australia) Pty Ltd (Arrow Energy) has undertaken the front-end engineering design (FEED) for the Arrow LNG Plant. FEED and other investigations have resulted in changes to the description of the LNG plant and ancillary infrastructure presented in the Arrow LNG Plant Environmental Impact Statement (EIS) (Coffey Environments, 2012) submitted to the Queensland Government on 16 December 2011. This chapter describes the variations and the rationale behind the changes to the project description of the LNG plant and ancillary infrastructure. Workforce accommodation and logistics are discussed in Chapter 7, Project Description: Logistics.

4.1 Overview of Changes

A summary of project description changes associated with the LNG plant and ancillary infrastructure is provided in Table 4.1 and discussed in more detail in the following sections.

Table 4.1 Overview of project description changes: LNG plant and ancillary infrastructure

Component	Arrow LNG Plant EIS	Supplementary Report to EIS
LNG plant layout	• Wastewater treatment facilities and power generation facilities located to the east side of the LNG trains. • Wildlife corridor preserved.	• Wastewater treatment facilities remain located to the east, but power generation facilities have been relocated to the west side of the LNG trains. • Drawings produced for FEED show the design of the LNG plant facilities encroaching on the wildlife corridor (EIS commitment C17.04). Measures will be taken to ensure the wildlife corridor minimum width is maintained.
LNG plant power	• Base case – mechanical drive. • Option 1 – mechanical/electrical configuration A. • Option 2 – mechanical/electrical configuration B. • Option 3 – all electrical.	• All mechanical (also known as power island mode). • Mechanical/electrical (also known as partial auxiliary import power mode).
Construction and auxiliary power	• Base case/Option 1 – diesel generators. • Option 2 – 132-kV cable under Port Curtis. • Option 3 – 275-kV cable under Port Curtis.	• Base case/Option 1 – Two 132-kV cables will connect the LNG plant to the Gladstone North Substation for construction and auxiliary power supply. • Option 2 – diesel generators.
LNG plant flare	Four-train operation: • Two cold dry flares. • One warm wet flare. • One LNG storage and loading flare. • One operational flare. • One emergency flare.	Four-train operation: • Two cold dry flares. • One warm wet flare. • One LNG storage and loading flare. • One emergency flare. The operational flare is no longer proposed.

Table 4.1 Overview of project description changes: LNG plant and ancillary infrastructure (cont'd)

Component	Arrow LNG Plant EIS	Supplementary Report to EIS
MOF and integrated personnel jetty	Three options proposed: • Boatshed Point (preferred site). • Hamilton Point South. • GLNG MOF at Hamilton Point. The Boatshed Point MOF comprised a single pier for modules; lift-on, lift-off (LOLO) cargo; and roll-on, roll-off (RORO) cargo; and a personnel jetty with two berths. Minor dredging was required to construct the MOF.	The Hamilton Point South option has been discontinued. The GLNG MOF at Hamilton Point is still being considered. Key features of the redesigned Boatshed Point MOF are: • The pier has been extended approximately 70 m to the west to cater for larger module transport vessels and to reduce the footprint of the MOF encroaching on the south and east faces of Boatshed Point headland. Module transport vessels and other RORO vessels share a berth, with a separate berth for LOLO vessels. • The passenger jetty and transfer facility has been moved from the east side to the north side of the facility to allow better segregation of personnel and construction traffic. A berth pocket for the fast passenger ferries and RoPax ferries will be dredged to the north of the pier. • An additional linkspan berth for barges has been provided to the east of the pier. • The structure has been changed from a piled concrete deck to a sheet-piled earth-filled structure. • Reclamation to the north of the MOF will provide for staging facilities and laydown areas. • A swing basin will be established in the main access channel immediately west of the pier to allow the large module transport vessels to manoeuvre. • Minor dredging will be required to establish an access channel to the MOF.
Mainland launch site	• Launch site 1 (preferred site). • Launch site 4N.	• Launch site 1 area increased from 13 ha to 52 ha for the construction phase, allowing for increased laydown areas on the mainland. The operational footprint will be significantly smaller than the construction footprint. • Launch site 4N is still viable but dependent on the progress of the Western Basin Dredging and Disposal Project spoil disposal and stabilisation in the Western Basin Reclamation Area.

Table 4.1 Overview of project description changes: LNG plant and ancillary infrastructure (cont'd)

Component	Arrow LNG Plant EIS	Supplementary Report to EIS
Pioneer mainland launch site	Not defined at the time of writing the EIS.	*Passengers, equipment and materials:* • Mission Landing and other landing facilities, Gladstone Marina. • Auckland Point/Barney Point. *Bulk materials:* • Fishermans Landing.
Curtis Island pioneer landing facilities	Not defined at the time of writing the EIS.	• GLNG pioneer MOF. • Gladstone Area Water Board (GAWB) ramp on Hamilton Point South. • Boatshed Point (southwest of headland, with ramp lying in the footprint of the permanent MOF).
Staging areas	Not defined at the time of writing the EIS.	Two options are being considered: • TWAF 7. • Red Rover Road.
Water supply	• Desalination plant to treat seawater. • Mains water supply (GAWB pipeline) referenced as an option undergoing feasibility.	• Mains water supply (GAWB pipeline, preferred option). • Desalination plant to treat seawater.
Wastewater treatment system	• Controlled discharge facility. • Onsite effluent treatment plant	• Gladstone Regional Council (GRC) category B sewer main (preferred option). • Controlled discharge facility. • Onsite effluent treatment plant.
Sewage treatment system	• Onsite effluent treatment plant.	• GRC category A sewer main (preferred option). • Onsite effluent treatment plant.
Surface water drainage system	• Diversion channels east and west around the LNG plant bench. • Integration of diversion channels in toe drains that will intercept runoff from LNG plant bench batters.	• Diversion channel west of the LNG plant bench and construction of a retarding basin. • Diversion channel east of the LNG plant bench. • Six sediment ponds to capture runoff from disturbed and undisturbed areas.
Construction cut and fill	• Cut: 4,700,000 m^3. • Fill: 4,200,000 m^3.	• Cut: 5,820,000 m^3. • Fill: 3,140,000 m^3.

Table 4.1 Overview of project description changes: LNG plant and ancillary infrastructure (cont'd)

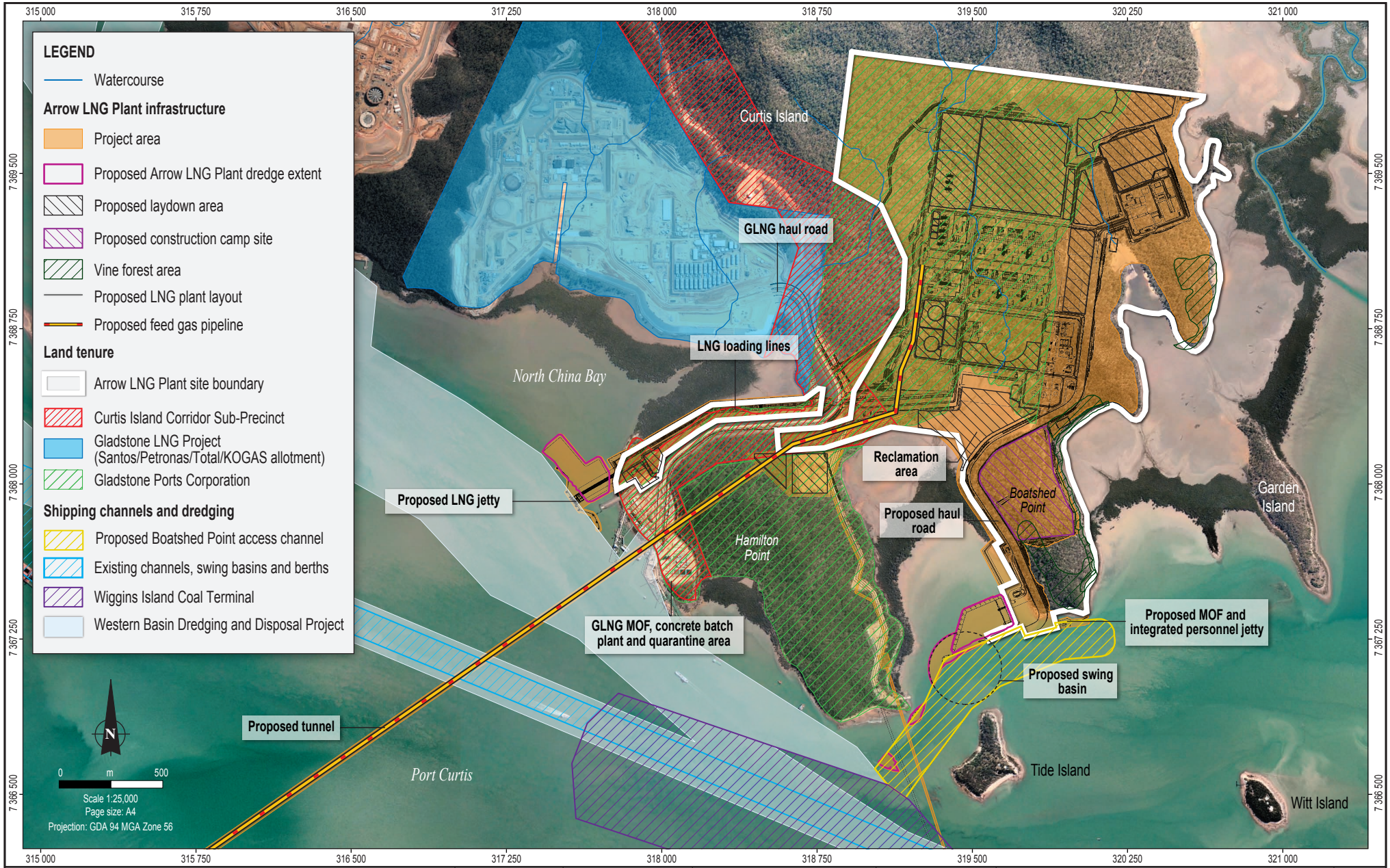
Component	Arrow LNG Plant EIS	Supplementary Report to EIS
Curtis Island land reclamation	• Hamilton Point – reclamation required for LNG loading lines formation and revetment (sea) wall.	• Expansion of Hamilton Point reclamation area due to as-built extent and location of GLNG haul road and realignment of the LNG loading lines. • Eastern part of the intertidal area between Boatshed Point and Hamilton Point reclaimed using excess cut material. During construction, the site will serve as a laydown area. During operations, the site will form part of the radiation exclusion zone for the flare and potentially as a wetland complex for surface water discharge from adjacent sediment basins.

4.2 LNG Plant Layout

The layout of the LNG plant (Figure 4.1) remains substantially unchanged from the layout presented in the EIS. Design optimisation has resulted in changes to the location of ancillary infrastructure (Figure 4.2). Most notably, the power generation facilities have been relocated from the eastern side of the plant to the western side of the plant adjacent to the gas inlet station. The refrigerant storage tanks have been relocated from the western side of the plant to a utilities area on the eastern side of the plant. The utilities area accommodates the refrigerant storage tanks and the sites for the water and effluent treatment plants, if required and constructed.

The relocation of power generation facilities and refrigerant storage tanks was driven, in part, by the proposed connection to the electricity grid and installation of a propane import pipeline. Connection to the electricity grid is discussed in Section 4.3. A propane import pipeline will be installed from the Boatshed Point MOF along the haul road to the propane storage tank located in the utilities area. The pipeline will be used for the first fill of the propane storage tank/s from a bulk carrier, after which it will be purged with inert gas and rendered safe. If top-up of the propane storage tank is required during operation, the pipeline will be reactivated, with reuse dependent on the volume required to top up the storage tank.

The layout of the proposed administration, workshops and amenities buildings complex has been modified and reoriented. Drawings produced in FEED show the complex and several sediment control dams encroaching on the wildlife corridor that extends along the east coast of Boatshed Point and connects the semi-evergreen vine thicket on the point with the Curtis Island Environmental Management Precinct of the Gladstone State Development Area (see Figure F051). Consistent with commitment C17.04 of the EIS, measures will be taken to address this encroachment to maintain Arrow Energy's commitment to maintain the wildlife corridor.



Source:
Place names and roads from DME. Watercourses from Alluvium
Study area, proposed auxiliary facilities, marine infrastructure and vine forest areas from Arrow Energy.
Western Basin Dredging Master Plan and Disposal Project from Gladstone Ports Corporation.
Study area and proposed feed gas pipeline from Coffey Environments.
Imagery from Nearmap (captured 7 August 2012).

coffey environments

Date: 10.12.2012
MXD: 7033CB_16_GIS001_v1_11
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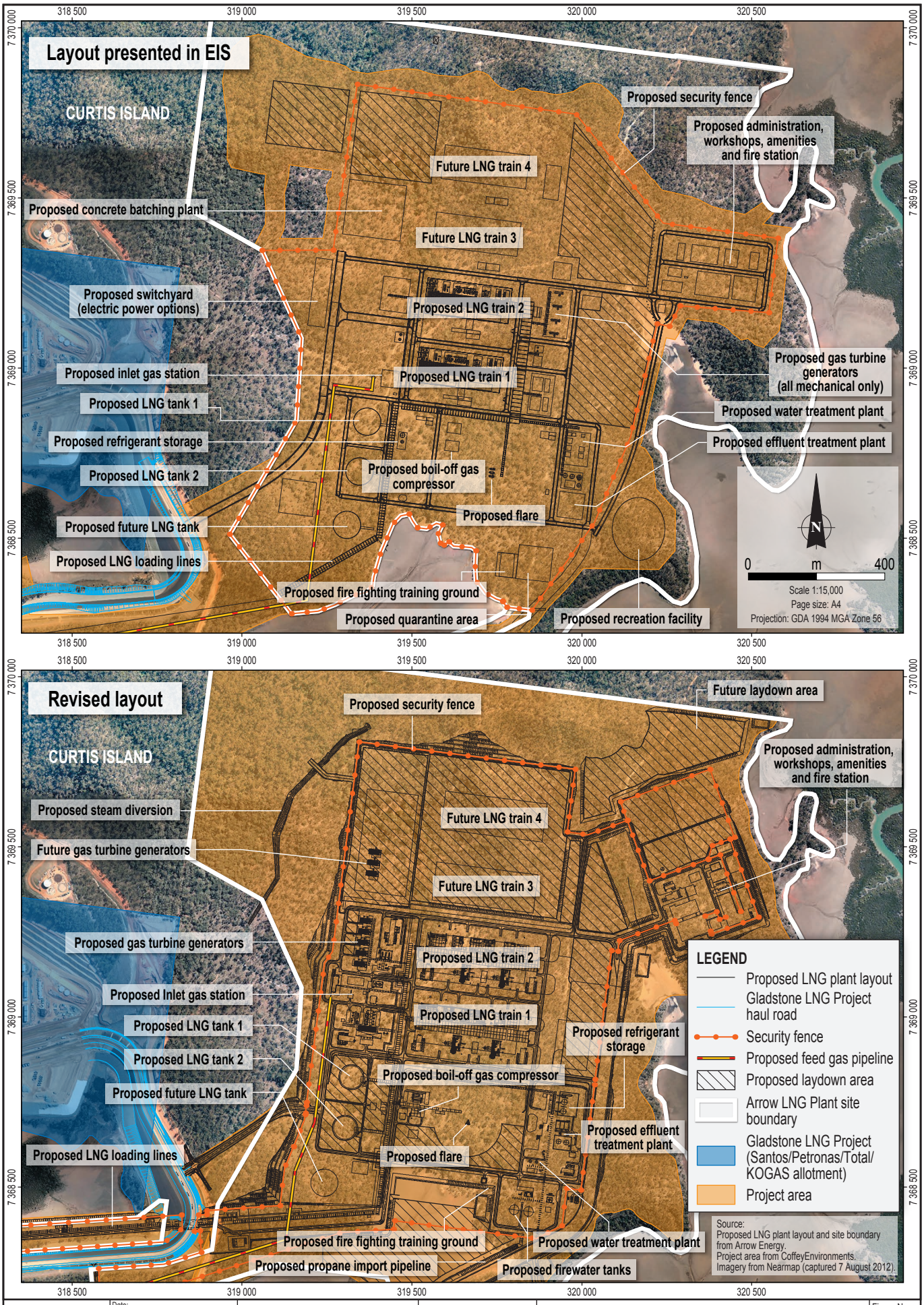
Arrow Energy

Arrow LNG Plant

arrow energy go further

LNG plant and ancillary infrastructure

Figure No: 4.1



coffey environments	Date: 10.12.2012 MXD: 7033CC_16_GIS023_v1_2 File Name: 7033_16_F04.02_GIS_HB	Arrow Energy Arrow LNG Plant	arrow energy go further	LNG plant layout	Figure No: 4.2

The location of the LNG jetty at the northwestern corner of Hamilton Point in the southern part of North China Bay has not changed. Land-based, marine-based and a combination of land- and marine-based construction methods are still under investigation. The ultimate construction method will be determined by the EPC contractor. The dredge footprint has been revised to reflect marine-based construction of the LNG jetty, as this represents the worst case with respect to dredging and potential impacts (Figure 4.3).

The LNG loading lines have been relocated from the southern side of the GLNG haul road to the northern side of the haul road (see Figure 4.3). The revised alignment improves separation of the LNG loading lines and the GLNG haul road, with the LNG plant access road to the LNG jetty being located between the LNG loading lines and the GLNG haul road and thus reducing the exposure to a single crossing point.

The inclusion of sediment control dams and a retarding basin on the proposed diversion in the northwestern corner of the site have reduced the land available for laydown, spoil disposal and topsoil storage. To accommodate the required laydown area and topsoil storage, it is expected that the entire allotment may need to be developed, increasing the area of disturbance reported in the EIS (459.6 ha) to 533.7 ha. A requirement to reclaim land for development of laydown areas and creation of safety exclusion zones is discussed in Section 4.12.

4.3 LNG Plant Power and Diesel Consumption

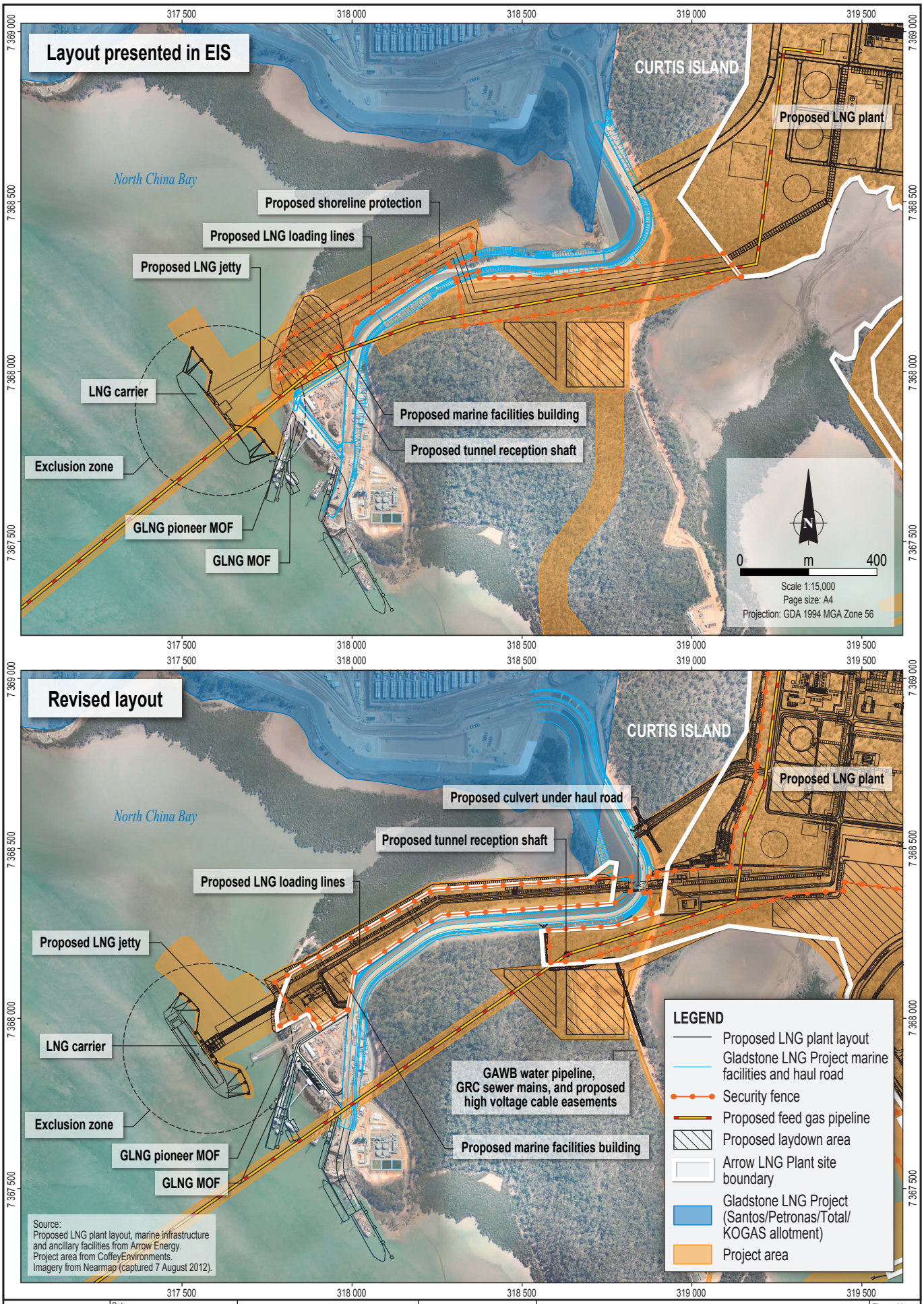
Revised power supply options to the LNG plant for construction and operation and further information on diesel consumption and storage are provided below.

4.3.1 Power Supply Options

Three power options for the LNG plant were assessed in the EIS: all mechanical drive, mechanical/electrical, and all electrical. Two configurations (options A and B) were investigated for the mechanical/electrical option. FEED has resulted in the all electrical option being discontinued and the all mechanical drive (also known as power island mode) being retained in the event the preferred mechanical/electrical option is not taken forward. No configuration changes have been made to the all mechanical power option described in the EIS.

The mechanical and electrical option investigated during FEED is a variation on the configurations (options A and B) presented in the EIS. This option, which is also known as partial auxiliary import power mode, will provide power during the latter stages of construction and replace two gas turbines during operation.

Under this option, two 132-kV feeders will supply power to the LNG plant site from Gladstone North Substation on the mainland. The circuits will supply up to 80 MVA of installed power. The capacity of the circuits has been determined by the worst-case scenario, which involves one gas turbine generator tripping out while another gas turbine generator is undergoing maintenance. Under this scenario, the power import could be as much as 45 MW to meet the power demand at full capacity LNG production. During the first 16 months of construction, diesel engine generators will be installed on site to supply 5 MW for construction activities. On completion of installation of the high-voltage electricity circuits from the mainland, construction power will be imported from the Queensland electricity grid.



coffey environments	Date: 10.12.2012 MXD: 7033CC_16_GIS024_v1_1 File Name: 7033_16_F04.03_GIS_HB	Arrow Energy Arrow LNG Plant	arrow energy go further	Infrastructure corridor and LNG jetty	Figure No: 4.3

It is expected to take 14 months to establish the connection from commencement of construction. The permanent electrical connection will provide power to the construction camp and the bulk of the temporary facilities. Major electrical users, such as the construction camp and main temporary offices, will be switched over to mains power following connection. Smaller, isolated users will continue to receive power from diesel generators. Electrical power for commissioning will be provided by the electrical connection. Power use on site prior to commissioning is expected to peak at approximately 13 MVA.

The underground feeder cables will originate from the Ergon Gladstone North Substation and will be laid on an alignment along the Gladstone–Mt Larcom Road and then follow an alignment along the recently installed GAWB water pipeline and GRC sewer mains towards the RG Tanna Coal Terminal. The two high-voltage feeders (cables) to Curtis Island will be laid in ducts installed by horizontal directional drilling (HDD) under Port Curtis from the mainland at RG Tanna Coal Terminal to Hamilton Point on Curtis Island. The ducts will be approximately 450 mm in diameter and up to 2.25 km long. They will be approximately 40 m below the seabed at the deepest (midway) point and will be laid west of the recently installed GAWB water pipeline and GRC sewer mains. After surfacing on Curtis Island, the cables will be laid in an easement adjacent to the alignment of the water pipeline and sewer main to the LNG plant site (see Figure 4.1). The cables will terminate at the substation that will be constructed on the LNG plant site adjacent to the power generation facility.

The ducts will be installed by pulling and/or pushing steel casing through HDD holes with a nominal diameter of 760 mm. A stringing area will be required to weld casing sections together to form pipe strings. This area will be located at the RG Tanna Coal Terminal. Approximately 8,300 m^3 of waste material is expected to be produced during the HDD work under Port Curtis, which, if found to contain acid sulfate soils, will be treated and disposed of in accordance with State Planning Policy SPP2/02, Planning and Managing the Development of Acid Sulfate Soils 2002 (LGP/NRM, 2002).

Single-core cables will be used on the mainland and Curtis Island with lengths joined and protected at cable jointing pits. The cables will be installed in a trench dug by an excavator. Where installed under railway lines (possibly the Gladstone Power Station rail loop), the cables will be laid in ducts installed using such techniques as horizontal boring or pipe jacking.

Single lengths of three-core cable will be used for the marine crossing, as jointing is not possible in the ducts installed by HDD. It is likely that the single length of cable will be delivered to the mainland HDD site by barge. Rollers installed on a temporary bridge on the mainland would support the cable as it is pulled through the ducts by a pulling machine located at Hamilton Point.

4.3.2 Diesel Consumption and Storage

Diesel consumption and storage was not discussed in the EIS. Diesel consumption will be the same for the first 14 to 18 months of construction regardless of the power configuration adopted for the LNG plant. Diesel for power generation and onsite vehicles will gradually increase to 22 m^3/day, resulting in an estimated total consumption of 2,200 m^3 for that period.

From the sixteenth month to the end of construction, the total diesel consumption under the all mechanical power option will be 410,000 m^3, peaking at 42 m^3/day. Peak consumption is expected to last 30 to 36 months, with generation of 13 MW of power (predominantly for the

construction camp) comprising the majority of consumption. Diesel will be stored in two 400-m^3 storage facilities, each comprising two 200-m^3 aboveground tanks.

Diesel consumption from the sixteenth month to the end of construction will fall dramatically under the mechanical/electrical power option, as mains power will replace the majority of diesel generation, except at remote sites. Diesel consumption for this period is estimated at 1,000 m^3. One 150-m^3 aboveground diesel storage tank will required for this period.

4.4 LNG Plant Flare

The flare configuration for four-train operation presented in the EIS comprised two cold dry flares, one warm wet flare, one LNG storage and loading flare, one operational flare, and an emergency flare.

The purpose of the operational flare was to dispose of releases during start-up of the LNG plant and periodically after dry-docking of LNG ships loading cargoes from the LNG storage tanks. FEED has determined that the operational flare is not required, as there will be no continuous flaring of releases. Scheduled routine maintenance of the LNG plant will generally be conducted while the plant is operational and without the need for flaring. Flaring will be triggered by unscheduled plant upsets occurring as a result of equipment malfunction and/or process upset (excursion outside the normal operating envelope and/or an emergency, such as a gas leak). Scheduled shutdowns will still require flaring of LNG train and process unit inventory.

Up to 20 plant upsets are anticipated each year during operations, with four of these upsets assumed to result in flaring. Under plant upset conditions, the affected part of the plant will be automatically or manually isolated, minimising the amount of inventory that needs to be flared to approximately 20% of the inventory of the affected LNG train. Flaring under upset conditions is estimated to continue for up to 2 hours.

The flare stack described in the EIS is a steel lattice structure standing between 100 and 130 m high, although nominally 110 m, comprising five flares and one spare flare. The flare stack design resulting from FEED is a 115-m-high steel lattice structure housing four flares and one spare flare. Although increased in height, the overall elevation of the flare is the same, as the elevation of the bench on which the flare will be located has been lowered by around 5 m.

4.5 MOF and Integrated Personnel Jetty

The materials offloading facility (MOF) will service the construction, operations and maintenance, and decommissioning phases of the project on Curtis Island. The MOF will receive construction materials and supplies necessary for the construction and operation of the LNG plant. The MOF will allow RORO and LOLO vessels to dock and offload preassembled modules, equipment, supplies and construction materials. The personnel jetty will receive fast passenger ferries and a link span will receive RoPax ferries for transfers to and from the mainland of workers and vehicles respectively. A haul road to transport overdimensional loads (including modules) and heavy and light vehicles will connect the MOF and personnel jetty with the LNG plant and construction camp.

The size of modules was revised during FEED, and it is now proposed to construct the LNG plant using larger 4,500-tonne modules rather than the 2,500-tonne modules contemplated in the basis of design presented in the EIS. This has necessitated redesign of the MOF to incorporate a larger

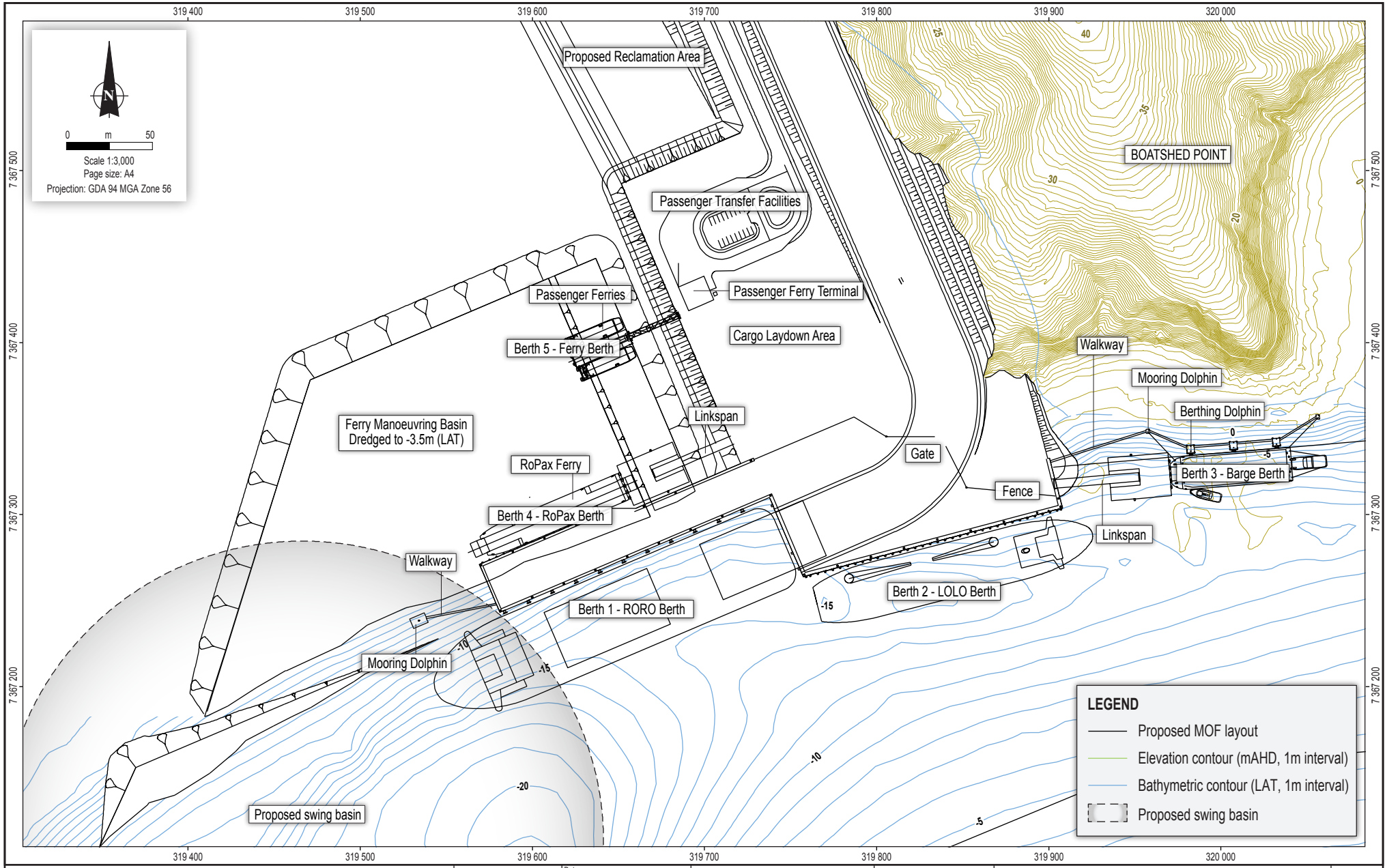
pier to accommodate larger module transport vessels. The redesign of the MOF conflicted with the siting of the personnel jetty terminal, in turn leading to further modifications to the MOF and integrated personnel jetty design. Consequently, the key changes arising from FEED, as shown in Figure 4.4, are:

- The pier has been extended approximately 70 m to the west to cater for larger module transport vessels. Module transport and other RORO vessels share a berth (Berth 1), with a separate berth (Berth 2) for LOLO vessels.
- A linkspan berth (Berth 3) for barges has been provided at the east end of the pier.
- The passenger jetty and transfer facility has been moved from the east side to the north side of the pier. A berth pocket for RoPax ferries (Berth 4) and fast passenger ferries (Berth 5) will be dredged to the north of the pier. Berth 4 will be a linkspan berth.
- The structure has been changed from a piled concrete deck to a sheet-piled earth-filled structure.
- Reclamation immediately to the north of the MOF will provide for staging facilities and laydown areas.
- A swing basin will be established immediately west of the MOF in the access channel to enable module transport vessels to safely manoeuvre.
- Minor dredging to remove two high points will be required to establish an access channel to the MOF.

4.6 Mainland Launch Site

A mainland launch site is required to provide for the storage, loading and unloading of aggregate and materials and for the transfer of materials, aggregate, vehicles, plant and equipment, and personnel to and from Curtis Island. The EIS presented two options for the launch site: launch site 1 situated on the former Gladstone Power Station ash ponds adjacent to the RG Tanna Coal Terminal and Calliope River (preferred) and launch site 4N at the northern end of the as-yet-to-be completed Western Basin Reclamation Area. Launch site 1 remains Arrow Energy's preferred mainland launch site. Launch site 4N remains an option; however, is not preferred for reasons set out in Chapter 3, Assessment of Alternatives.

The EIS stated that the mainland launch facility would require approximately 16 ha of land during construction, reducing to 4 ha of land during operations. The land requirements have been revised to approximately 53 ha for launch site 1 (mainland launch site) during construction and 5 ha during operations. The additional land at the mainland launch site will be required for laydown areas during construction. Access to the mainland launch site will be from the Gladstone–Mt Larcom Road via one of the three possible routes described in Chapter 3, Assessment of Alternatives. Carparking at the mainland launch site has been reduced, as forecast congestion at roundabouts on the Gladstone–Mt Larcom Road makes it prudent to develop a staging area from which a proportion of workers would be bussed to and from the mainland launch facility.



Source:
Proposed MOF layout from Arrow Energy.
Elevation contours from DEHP.
Bathymetric contours derived from Coffey Geotechnical supplied bathymetry survey points.

coffey environments

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Arrow Energy

Arrow LNG Plant

arrow energy go further

Revised MOF layout

Figure No: 4.4

Marine infrastructure at the mainland launch site has been revised to incorporate a barge berth, a LOLO berth, a RoPax berth and a passenger ferry berth, as shown in Figure 4.5. The RoPax and passenger ferry berths will be permanent facilities that will service the LNG plant during operations. Detailed bathymetry indicates less dredging may be required to establish the access channel to the marine facilities; however, for assessment purposes, a worst-case dredge volume of 900,000 m^3 has been assumed and remains unchanged from the EIS.

It was indicated in the EIS that marine facilities such as boat ramps in the Calliope River may be temporarily unavailable to local boating and fishing users at certain times throughout construction of launch site 1. Restriction of vessel movement (including speed and wash limitation) will be required in the vicinity of dredges that are moving due to safety considerations. Such restrictions may temporarily affect river usage. Whilst dredges are stationary but operating there will be speed and wash restrictions in the Calliope river adjacent to launch site 1. Public access to an unnamed boat ramp located immediately adjacent to launch site 1 will be permanently restricted as launch site 1 is developed. Access to this boat ramp has been restricted for some time due to the nearby haul road. Arrow Energy will notify the public in advance of any closures and limitations will be advised through 'notices to mariners'. Information on planned closures and limitations will be provided in accordance with MSQ requirements and in a timely manner that ensures potentially affected stakeholders are informed. Details of specific notification requirements will be set out in the marine activity management plan that will be developed prior to construction commencing. There is no expectation that the Calliope River boat ramp (near the NRG plant) will be closed at any time. It is however anticipated that dredging will result in an increased impact to this ramp during the lowest of low tides. This is discussed in Chapter 14.

4.7 Pioneer Facilities

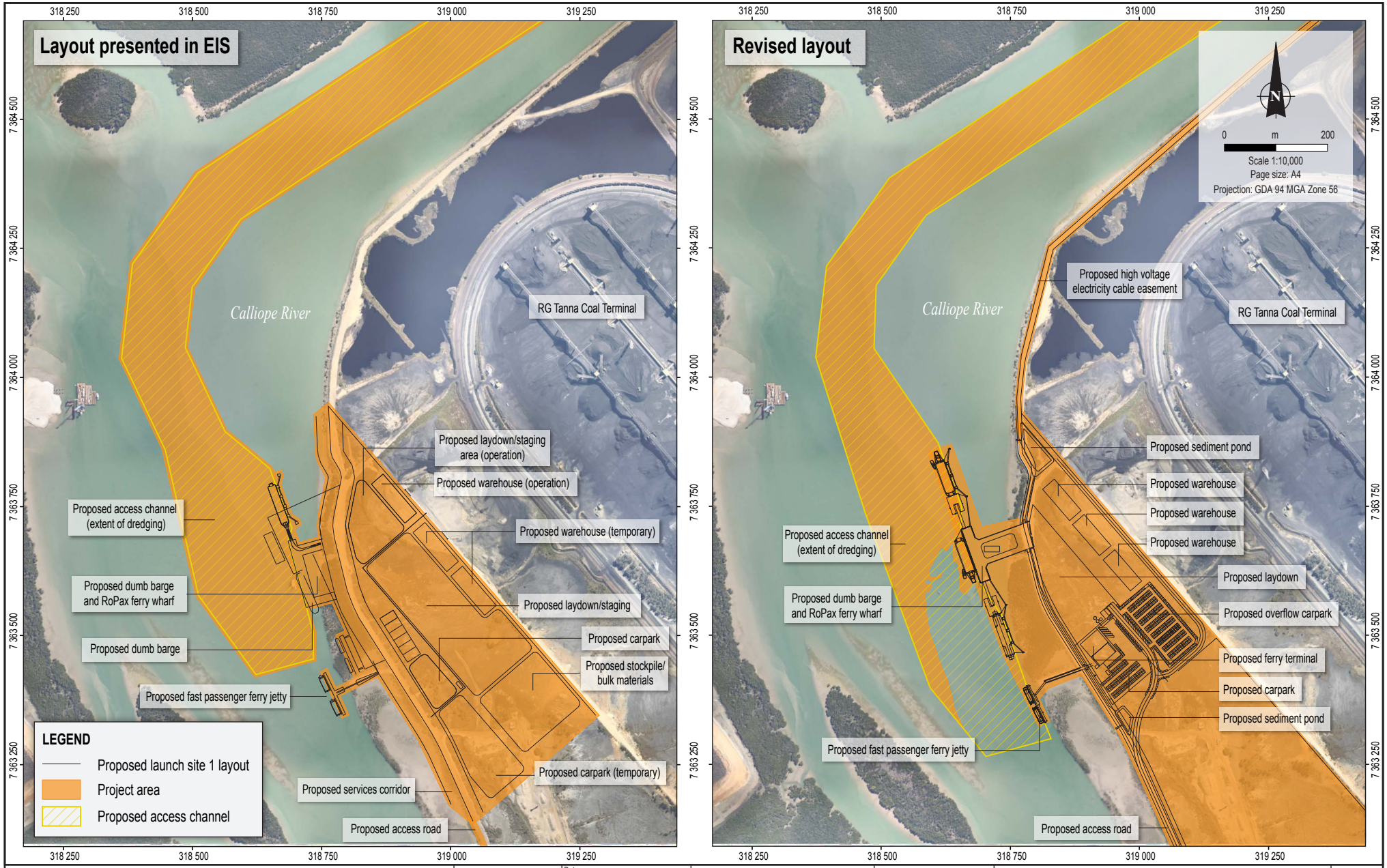
Early works comprises the establishment of pioneer facilities on the mainland and Curtis Island to enable construction of the LNG plant and ancillary infrastructure. Pioneer facilities include:

- Pioneer mainland launch sites for transfer of materials, earthmoving and civil construction equipment, and personnel to and from Curtis Island.
- Pioneer landing sites on Curtis Island to ship personnel, material and equipment to the island.
- Pioneer camp on Curtis Island.

Details about establishment of the pioneer camp on Curtis Island remain unchanged and are as described in the EIS. Investigations subsequent to publication of the EIS have resulted in more information on options being investigated for the pioneer mainland launch facilities and the pioneer landing sites on Curtis Island. The options being considered are discussed in the following sections.

4.7.1 Pioneer Mainland Launch Sites

Separate pioneer mainland launch sites are being considered for personnel, materials and equipment and for bulk materials transport to and from Curtis Island.



Source:
Proposed launch site 1 layout and access channel from Arrow Energy.
Project area from CoffeyEnvironments.
Imagery from Nearmap (captured 7 August 2012).

coffey environments

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File Name: 7033_16_F04.05_GIS_VS

Arrow Energy

Arrow LNG Plant

arrow energy go further

Launch site 1 general arrangement

Figure No: 4.5

Personnel, Equipment and Materials

The potential for the use of Mission Landing and other landing facilities at Gladstone Marina as initial pioneer mainland launch sites is being investigated, as the existing facilities have served this purpose for the other LNG projects. Located off Bryan Jordan Drive and along Alf O'Rourke Drive, the landings have been and will continue to be used to transfer personnel, materials and equipment to and from the island using RORO vessels. Once a permanent mainland launch site is constructed it is anticipated that there will be no ongoing need for the use of the pioneer launch sites.

Alternative sites are the existing, or proposed facilities at Auckland Point/Barney Point subject to agreement being reached with the operator. Existing facilities include the Auckland Point general cargo wharves and facilities established for other LNG projects. Auckland Point/Barney Point pioneer mainland launch sites would be accessed from Hanson Road and Port Access Road.

Bulk Materials

A pioneer bulk materials launch site could be established at Fishermans Landing on land adjacent to Australia Pacific LNG's mainland launch site. The launch site would encompass laydown areas, warehouses, carparking and wharves and would be constructed on reclaimed land north of the bulk liquids terminal. Stabilisation works have already been undertaken at the site, leaving only civil works being required to establish the facility.

Wharves would be constructed north of the bulk liquids berth to facilitate provide for materials transport and possibly personnel transfer to and from Curtis Island. Access to the pioneer bulk materials launch site would be via Landing Road.

The suitability of other potential locations in the area for the pioneer bulk materials launch site will continue to be investigated.

4.7.2 Pioneer Landing Sites

Access to Curtis Island for early works will require use of an existing facility or construction of a temporary facility until the MOF is established. Three options are being investigated for pioneer landing facilities. They are the GLNG pioneer MOF on Hamilton Point, the GAWB ramp on the southern end of Hamilton Point and a ramp to be constructed by Arrow Energy at the southwest corner of Boatshed Point. Access to the existing facilities and the associated haul and access roads is dependent on negotiations with the operators of those facilities

The GLNG pioneer MOF is located adjacent to the proposed Arrow Energy LNG jetty and GLNG's MOF, batching plant and quarantine facility (see Figure 4.3). The GLNG pioneer MOF would be used for 12 to 18 months until the Boatshed Point MOF is constructed and in operation. The impacts of construction and operation of GLNG's MOF and the haul road were assessed as part of the GLNG Project and were therefore not assessed in the Arrow LNG Plant EIS.

In the event that either the GLNG pioneer MOF or GAWB ramp is not available, a pioneer MOF would be constructed at Boatshed Point off the southwest point of the headland. The MOF would comprise a barge-landing ramp constructed of crushed rock and guide poles driven into the seabed. The rock would be laid on the seabed using an excavator operating from a barge. The excavator would form the ramp, which would extend to approximately 1 m below LAT. The ramp

would be contained within the final footprint of the permanent MOF and ultimately be incorporated into the final MOF structure.

4.8 Staging Areas

Forecast congestion on Port Curtis Way, particularly at its intersection with Blain Drive and Red Rover Road, has prompted the investigation of staging areas to reduce the traffic entering and leaving the preferred mainland launch site on Calliope River (launch site 1). Two sites have been identified and are under consideration.

4.8.1 TWAF 7

TWAF 7, the former Gladstone Power Station ash pond off Blain Drive, was identified and assessed as a possible temporary accommodation workers facility and laydown site. Legislation constrains the use of the site for an accommodation facility. Its proximity to launch site 1 makes it a suitable site for a staging and laydown area. Staging facilities would comprise car and bus parking, personnel transfer facilities, warehouses and laydown areas. Development of TWAF 7 was assessed in the EIS. Traffic impacts associated with the changed use of the site have been assessed in the supplementary report to the EIS (Chapter 20, Traffic and Transport).

4.8.2 Red Rover Road

Arrow Energy has identified a site on Red Rover Road, west of Gladstone Power Station, as suitable for a staging and laydown area for the early works phase of construction and as a backup facility for the mainland launch site (see Figure 1.1). The facility would accommodate car and bus parking, warehouses, laydown areas and potentially a temporary accommodation facility. Establishment of the facility would enable personnel transfers to the mainland launch site and the bulk materials launch site, which would reduce the need for or amount of parking at Gladstone Marina or the bulk materials launch site. Vegetation clearing, earthworks, and civil works, including site drainage and turning lanes on Red Rover Road, would be required to develop the site. Site water supply and wastewater services will be provided by connection to existing utilities or by package water and wastewater treatment plants installed on site.

4.9 Water Supply

Water of varying quality is required for use in the LNG plant. The EIS discussed the use of a desalination plant to treat seawater drawn from Port Curtis. The EIS also referred to the supply of mains water to Curtis Island via a pipeline installed by GAWB as an option undergoing feasibility.

The GAWB water supply pipeline option has since progressed beyond feasibility and is now Arrow Energy's preferred water supply option. Construction of the pipeline has commenced, and it will be operational when required for construction and operation of the LNG plant. In the event that mains water becomes unavailable or restricted (e.g., in a time of drought), Arrow Energy will retain the option to develop a desalination plant to ensure the plant is self-sufficient. Consequently, a desalination plant remains a water supply option for the proposed LNG plant.

Figure 4.6 shows the updated conceptual water management for water supply during operation. It shows the changes resulting from connection to the GAWB pipeline in contrast to the arrangement shown in Figure 6.8 of the EIS, which assumes water supply from a desalination (reverse osmosis) plant.

4.10 Wastewater and Sewage Treatment

The LNG plant and ancillary infrastructure will generate various kinds of wastewater, including clear water (from roof and clean-surface runoff and neutralised demineralisation plant waste), accidentally contaminated water (from equipment washdown, used fire-fighting water, and cooling water system blowdown), continuously contaminated water (from the slops oil tanks, wastewater sumps, collection sumps, and gas turbine wash sumps) and sewage. An effluent treatment plant and a controlled discharge facility were the proposed means of disposing of wastewater presented in the EIS.

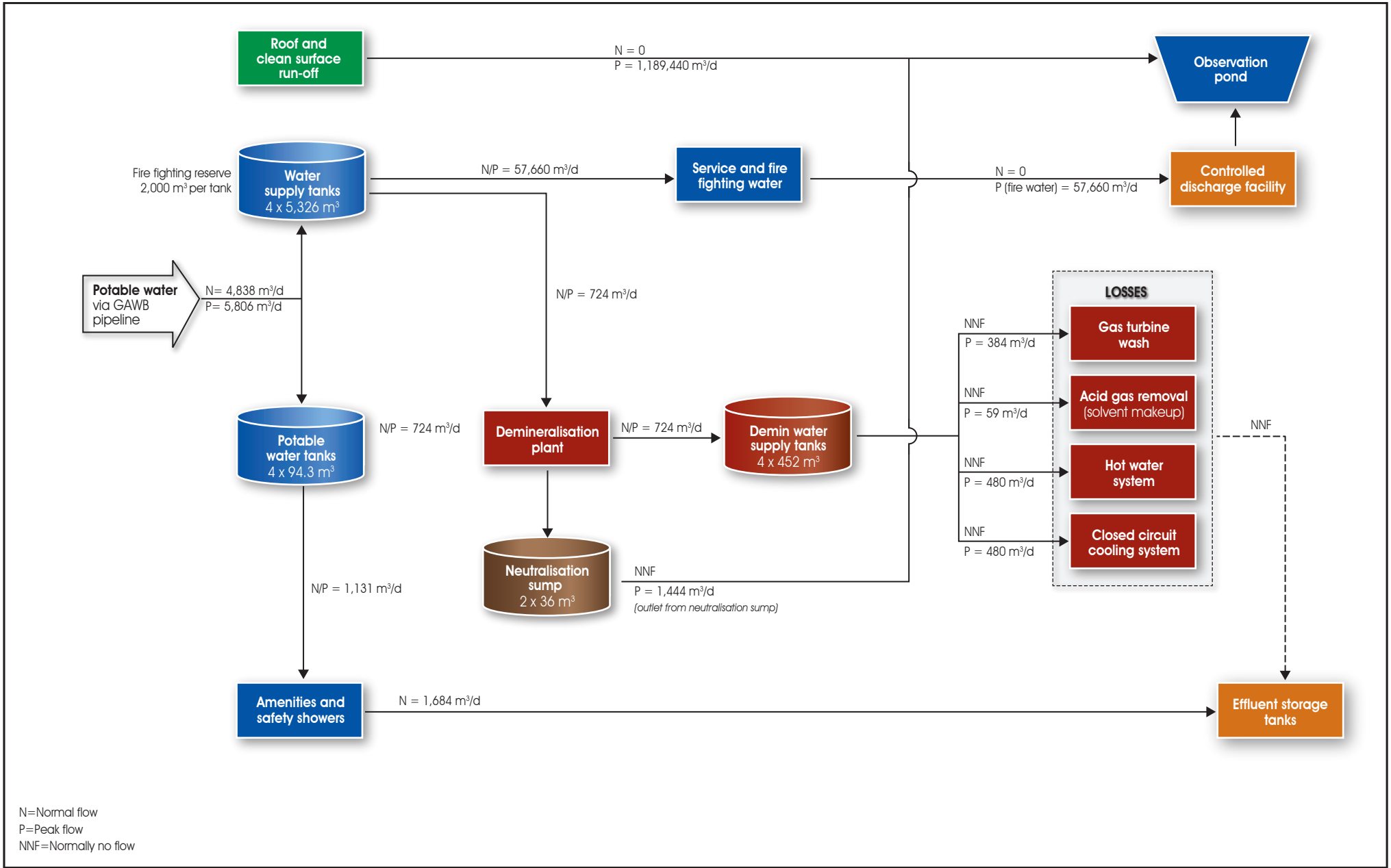
Gladstone Regional Council (GRC) has installed two sewer mains under Port Curtis to service the LNG plants on Curtis Island. The pipelines have been installed by HDD from RG Tanna Coal Terminal to Hamilton Point and can accept both category A (sewer) and category B (trade waste) waste water. The sewer mains are expected to have a capacity of 864 m^3 per day, which will be sufficient to meet peak construction demands for both the LNG plant and construction camp. As a consequence, FEED considered disposal of effluent via the sewer mains in lieu of an effluent treatment facility. Figure 4.7 shows the updated conceptual water management system for effluent treatment and disposal using the GRC sewer mains.

While disposal of wastewater via the GRC sewerage system is preferred, Arrow Energy will retain the option to develop an effluent treatment plant in the event the sewer mains are unavailable (e.g., they reach capacity). Consequently, an effluent treatment plant remains a wastewater treatment and disposal option for the proposed LNG plant. The conceptual water management for treatment and disposal via an onsite effluent treatment plant is shown in Figure 6.9 of the EIS. Discharges of clear water and treatment effluent to Port Curtis were assessed in the EIS.

4.11 Surface Water Drainage System

A site surface water drainage system will be constructed to reduce the potential during construction and operations for soil erosion and discharge of sediment-laden water to local drainage lines, watercourses and the marine environment.

The surface water drainage system will divert clean surface water runoff away from disturbed areas. The LNG plant will be constructed across several catchments, and this will result in diversion of the system that currently drains the largest catchment through the proposed LNG plant site. The diversion will direct flows to adjacent catchments. The proposed diversion will also intercept flows from tributaries and side gullies.



N=Normal flow
P=Peak flow
NNF=Normally no flow

Source: Coffey Environments and Arrow Energy
Note: Effluent from neutralisation sump is pumped to clean run-off system after confirmation (via sampling) that pH value falls within the range suitable for discharge to Port Curtis

coffey environments

Date: 30.11.2012
File Name: 7033_16_F04.06_VS

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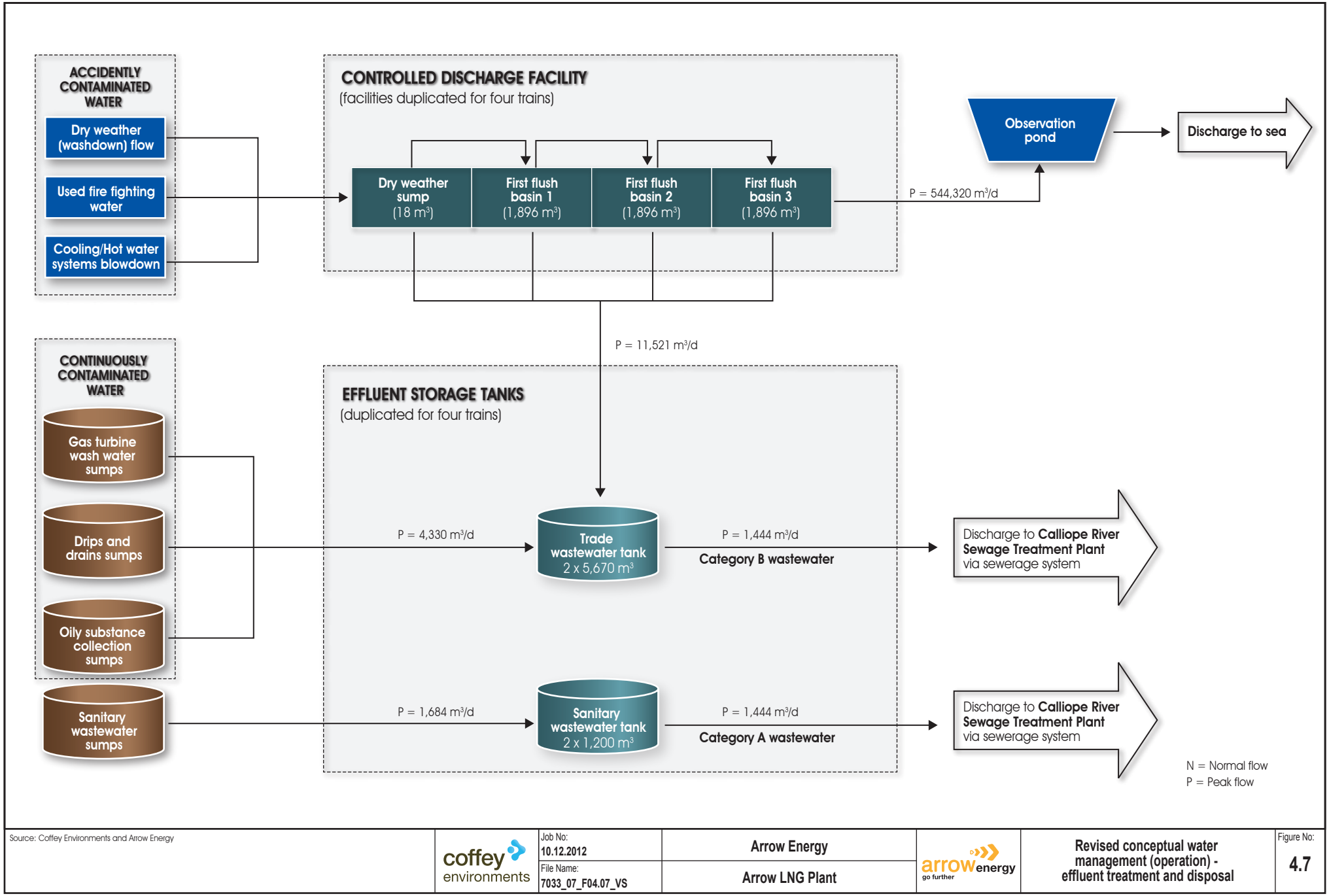
Revised conceptual water management (operation) - water supply and treatment

Figure No: 4.6



Source: Coffey Environments and Arrow Energy

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Arrow LNG Plant

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Revised conceptual water management (operation) - effluent treatment and disposal

Figure No: 4.7

The EIS discussed two options for this diversion (see Figure 13.5 of the EIS), with the preferred option to be determined during FEED:

- The construction of diversion channels west and east around the LNG plant bench. The western diversion channel would discharge to the existing ephemeral watercourse that drains the adjoining catchment and discharges to North China Bay. The eastern diversion channel would discharge to Port Curtis northeast of the LNG plant administration and workshops complex.
- The integration of diversion channels with the toe drains that will intercept runoff from the LNG plant bench batters. The toe drains will extend west and east around the LNG plant bench. The western toe drain will discharge to Port Curtis west of Boatshed Point, and the eastern toe drain will discharge to Port Curtis northeast of the administration and workshops complex, at the same point as the dedicated diversion channel.

FEED has subsequently identified a third, preferred option.

The drainage system would be diverted to the west of the LNG plant bench (trains 3 and 4) to the ephemeral watercourse draining to North China Bay (see Figure 4.1 and the revised layout in Figure 4.2). The diversion would comprise a channel that will be rock armoured to protect against scouring during high-flow conditions. A retarding basin will be constructed on the LNG plant site adjacent to the property boundary to ensure downstream flows do not exceed the channel capacity of the ephemeral watercourse (Figure 4.8).

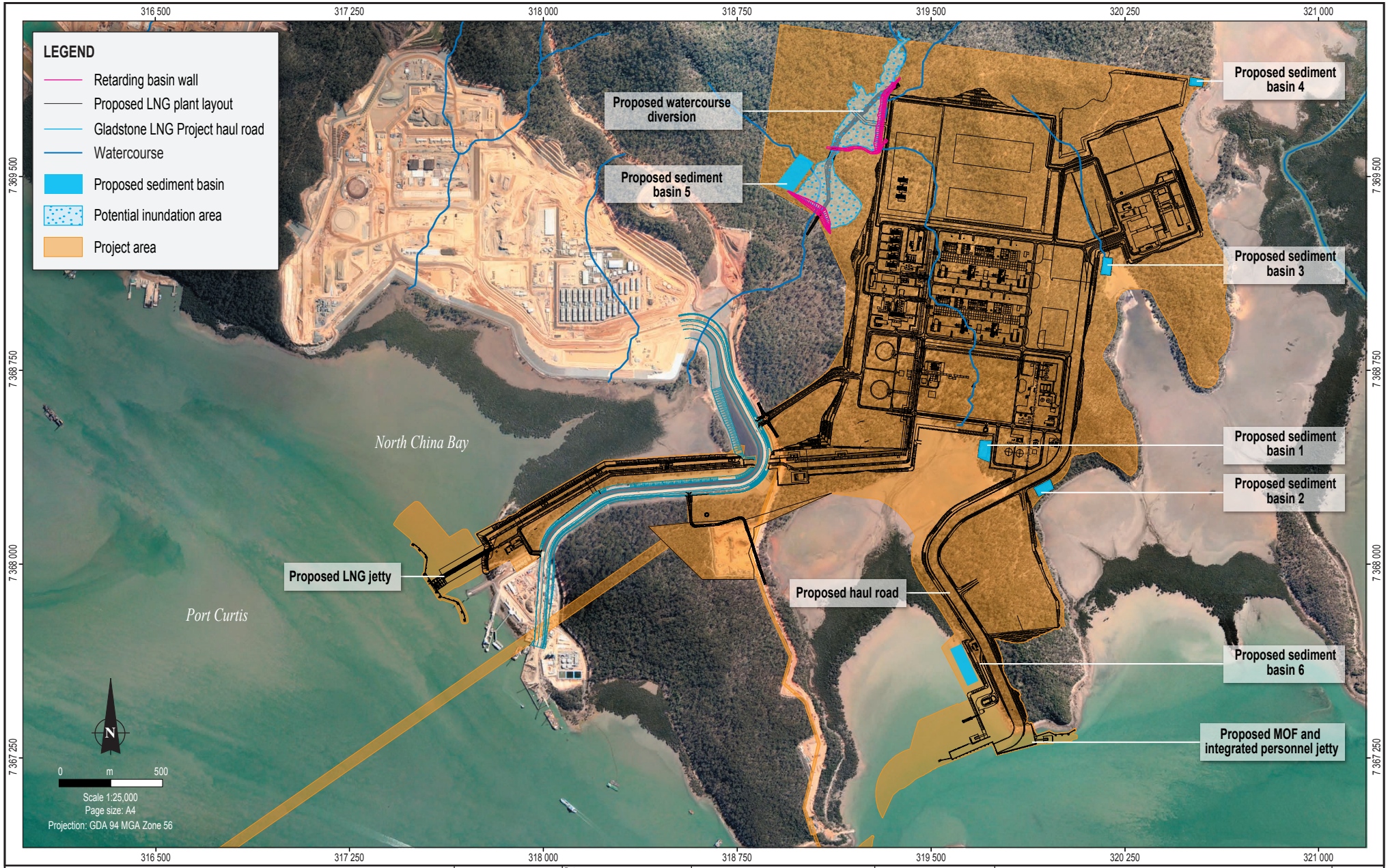
Low-flow pipes installed in the retarding basin wall will pass normal flows up to the maximum bank capacity of the watercourse. Rainfall and stormwater runoff from a 1-in-100-year ARI event will exceed the capacity of the low-flow pipes and back up in the retarding basin, allowing controlled discharge. The low-flow pipes will discharge to a channel that will connect to the ephemeral watercourse. The channel bed and banks will be rock armoured to prevent scouring and erosion in the channel and ephemeral watercourse. The area of inundation at full storage level is approximately 7.4 ha.

While the western diversion is preferred, an option to construct an eastern diversion to be operated in conjunction with the retarding basin is still being considered and will be resolved in detailed design of the LNG plant. An eastern diversion would adopt a similar alignment to the alignment presented in the EIS, with a discharge point to Port Curtis located northeast of the administration and workshops complex of the LNG plant or other suitable location.

Stormwater runoff will be managed via clean and dirty water systems. The clean water system will intercept surface water runoff upstream of the LNG plant bench and batters and direct it to adjacent watercourses or waterbodies or to sediment basins or ponds installed as part of the dirty water system. Surface water runoff from disturbed areas, including the LNG plant bench and batters, will be directed to sediment basins where it will be allowed to settle before discharge to the adjacent watercourse or waterbody.

It is envisioned that six sediment basins (see Figure 4.7) will be constructed to capture runoff from disturbed areas during construction. The location of the basins, the system, and watercourse or waterbody they will discharge to include:

- Sediment basin 1: south of flare; dirty water system accepting runoff from LNG plant bench; discharges to drainage line in intertidal mudflats west of Boatshed Point.



Source:
Watercourses from Alluvium. Project area from Coffey Environments.
Potential inundatio area, proposed LNG Plant layout, auxiliary facilities and marine infrastructure from Arrow Energy.
Imagery from Nearmap (captured 7 August 2012).

coffey environments

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Conceptual erosion and sediment control

Figure No: 4.8

- Sediment basin 2: east of neck of land connecting Boatshed Point to mainland Curtis Island; dirty water system accepting runoff from fire training, quarantine and construction camp benches; discharges to drainage line in intertidal mudflats east of Boatshed Point.
- Sediment basin 3: south of administration and workshops complex; dirty water system accepting runoff from LNG plant bench; discharges to drainage line in adjacent intertidal mudflats.
- Sediment basin 4: northeast of administration and workshops complex; dirty water system accepting runoff from LNG plant bench and clean water system accepting overland flows intercepted upstream of LNG plant bench batters; discharges to drainage line in adjacent intertidal mudflats.
- Sediment basin 5: adjacent to the stream diversion retarding basin; dirty water system accepting runoff from laydown/topsoil stockpile areas and clean water system accepting overland flows intercepted upstream of laydown areas; discharges to stream diversion retarding basin.
- Sediment basin 6: adjacent to MOF; dirty water system accepting runoff from MOF and haul road; discharges to Port Curtis west of Boatshed Point.

The size, location and treatment requirements will be finalised during detailed design to ensure the sediment basins for construction and operation comply with Best Practice Erosion and Sediment Control (IECA, 2008), which will ensure adequate retention time before discharge.

4.12 Construction Cut and Fill and Land Reclamation

Major earthworks (earthmoving and levelling activities) will establish the benches on which the LNG plant, utilities and ancillary infrastructure and the Boatshed Point construction camp will be constructed. The haul road from the MOF and personnel jetty to the LNG plant site, the quarantine inspection area and the formation that will carry the LNG loading lines will also be excavated and formed.

Estimated cut and fill volumes presented in the EIS were 4,700,000 m^3 and 4,200,000 m^3 respectively. FEED has resulted in revised estimates of 5,820,000 m^3 of cut and 3,140,000 m^3 of fill. This is due to the height of benches being reduced and plant layout being optimised.

Cut material will comprise approximately 2,000,000 m^3 of weathered rock and 3,820,000 m^3 of fresh rock. The latter will be used where possible for the production of aggregate for road base and concrete production, which will reduce the overall quantity of aggregate that needs to be imported from the mainland. This supply will be augmented with 100,000 m^3 of concrete aggregate, 75,000 m^3 of sand for concrete, 120,000 m^3 of sand for backfill, and 15,800 m^3 of imported marine rock for shore protection. Where suitable, weathered rock will be used for fill.

Cut includes areas excavated to remove soil that is not suitable for structural fill but may be used for general fill and landscaping. The cut and fill activities will result in approximately 2,500,000 m^3 of surplus material that will be used in preparing laydown areas for construction, landscaping mounds and reclamation of the intertidal mudflats north of Boatshed Point (see Figure 4.1). The reclaimed area will be used as a construction laydown area and a radiation exclusion zone around the flare during operation. The area will be protected by a revetment wall and potentially

used as a wetland complex to further treat surface water discharge from the adjacent sediment basins.

The as-built location of the GLNG haul road and relocation of the LNG loading lines to the north of the haul road has increased the area of land required to be reclaimed to accommodate the loading lines formation. Figure 4.3 shows that the reclamation of the intertidal mudflat will extend from near the LNG jetty along the north side of the haul road to the proposed crossing of the haul road where it turns north to the GLNG LNG plant site.