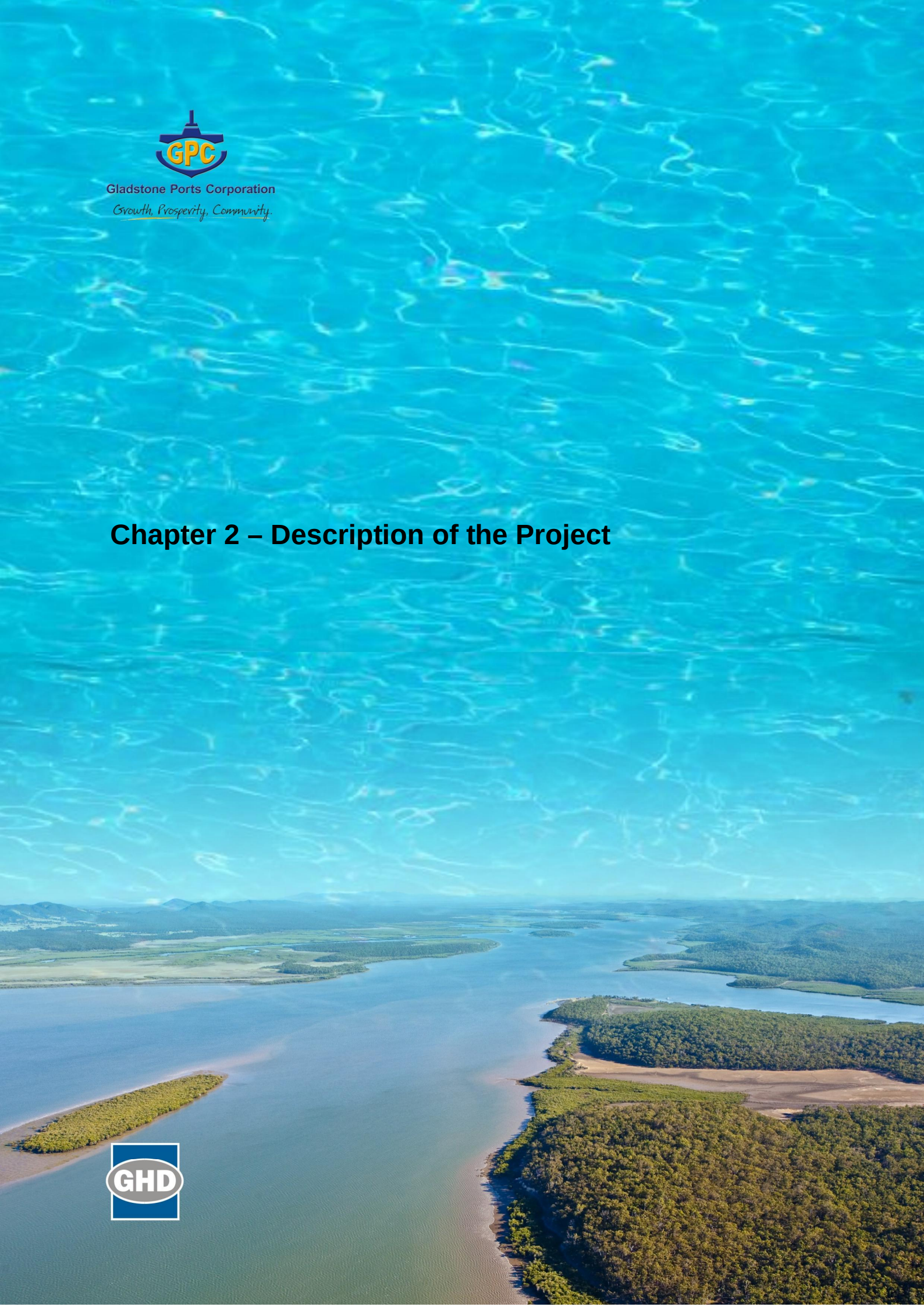
Gladstone Ports Corporation

Growth, Prosperity, Community.

Chapter 2 – Description of the Project



2. Description of the Project

Overview

This chapter of the EIS has been prepared to address Section 2 - Description of the Project in the ToR for the Project (Appendix A). This chapter provides a description of the Project through its lifetime (including construction) and includes a description of the location of the Project as well as the design, construction, infrastructure and waste management aspects of the Project. Where further detail and impact assessment is provided in later sections of the EIS, this is indicated. The Project locality definitions are outlined in Section 1.3.

2.1 Overview of Project

2.1.1 Key Project Components

Approval for dredging and dredged material disposal is sought to support the progressive development of the harbour through provision of access to port facilities, which will be a key component of the import and export chain and will assist in developing industries, specifically the developing Liquefied Natural Gas (LNG) industry, to be located within the Gladstone region. In line with the Draft Master Plan, two areas of development are required for the long-term strategic development of the Port and are the subject of this EIS:

- The inner harbour dredging associated with deepening and widening of existing channels and swing basins, and the creation of new channels, swing basins and berth pockets (Figure 1.2); and
- The disposal of dredged material in the Western Basin Reclamation Area, which is adjacent to the existing Fisherman's Landing Reclamation and the proposed Fisherman's Landing Northern Expansion (Figure 1.3).

Specifically, this EIS addresses the following activities:

- Construction of the outer bund wall of the Reclamation Area from bluestone material sourced from the GPC owned quarry (Section 2.3.4);
- Capital and maintenance dredging from the nominated dredging footprint (Section 2.3.3);
- Placement of dredged material into the Reclamation Area, including management of decant waters (Section 2.3.5); and
- Final capping, surface stabilisation and stormwater management upon completion of the reclamation (Section 2.4.3).

With respect to dredging, the following is included:

- Access channels, swing basins and shipping berths; and
- Marine offload facilities on Curtis Island.

The Project components and location are shown in Figure 2-1.

As per section 1.4 of the ToR, this Project does not address dredging associated with the LNG pipelines. This is being addressed by the LNG proponents in association with the State Government.

By encompassing all of the dredging and dredged material disposal that is envisaged to enable the development of industries in the Port of Gladstone, the Western Basin Dredging and Disposal Project seeks to provide a cumulative impact assessment of these activities, to a greater extent than would be possible should each individual development attempt this assessment independently.

Dredging Stages

Table 2-1 summarises the maximum proposed dredging stages for the Western Basin Dredging and Disposal Project (should each project proceed). These are shown on Figure 2-1. Each Dredging Stage is required to either support various LNG proponents (Stages 1A, 1B and 2) or future import or export facilities for as yet unidentified proponents and/or GPC (Stages 3 and 4). The current EIS addresses all dredging stages and overall footprint of development to provide a cumulative assessment of potential impacts.

Table 2-1 Dredging Stages for the Western Basin Dredging and Disposal Project

Dredging Stage	Description	Volume
Stage 1A	North China Bay LNG Precinct	16 million m^3
Stage 1B	Fisherman's Landing LNG	6.1 million m^{3*}
Stage 2	Laird Point	4.5 million m^3
Stage 3	Fisherman's Landing Development	5.5 million m^3
Stage 4	Hamilton Point	3.9 million m^3
	Total	**36 million m^3**

*part of this dredging may be undertaken by the proponent under a separate approvals process

Western Basin Reclamation Area

Material dredged during the Project is proposed to be placed into a bunded Reclamation Area (Figure 2-1). The proposed Western Basin Reclamation Area is 10 km north of Gladstone City immediately adjacent to the existing Fisherman's Landing Reclamation and proposed Fisherman's Landing Northern Expansion, which is the subject of a separate EIS. The construction of the Western Basin Reclamation Area requires the construction of a bund wall, followed by progressive infilling with dredged material and stabilisation of the surface. The volume available in the Reclamation Area is summarised in Table 2-2. This volume makes allowance for a substantial volume of maintenance dredging material over the life of the Project. A further detailed discussion of the Reclamation Area is provided in Table 2-3.

Table 2-2 Summary of Fisherman's Landing and Western Basin Reclamation Areas

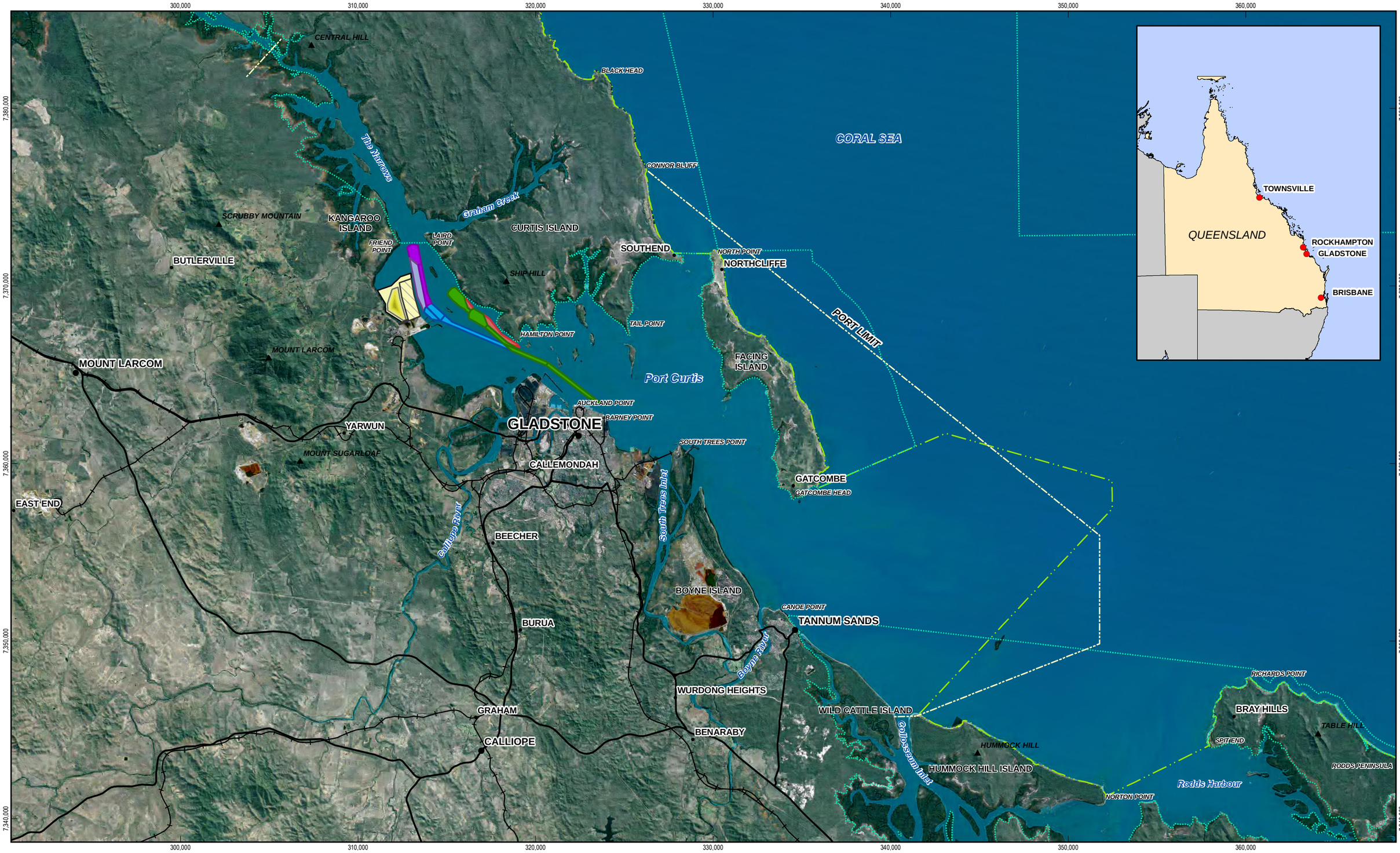
Reclamation Area	Footprint	Volume
Fisherman's Landing Northern Expansion (separate EIS)	173.5 ha	10 million m^3
Western Basin Reclamation Area	235 ha	45 million m^3
Total	**408.5 ha**	**55 million m^3**

Activities Not Considered in this EIS

The GPC owned quarry from which the bund construction materials will be sourced is located within the Gladstone State Development Area. Materials from this quarry will also be used to service other GPC construction projects in the short and long term. Therefore, the quarry is undergoing a separate development approval process to allow development of the quarry to be undertaken prior to the commencement of GPC projects requiring these materials. A Planning Report, including an Site Based Management Plan, was prepared in support of the development application. Studies conducted as part of this report included noise and vibration modelling, terrestrial flora and fauna surveys, cultural heritage assessment and visual impact assessment. The report outlines the potential impacts and mitigation measures to be implemented for the environmental management of potential issues such as surface water runoff, dust, sediment and erosion control, noise and fuel storage. An additional study undertaken as part of the application process included a traffic impact assessment for haulage of rock to GPC sites in Gladstone.

Approval of the Environmentally Relevant Activities to be conducted at the quarry was received in August 2009, with the Department of Environment and Resource Management (DERM) being the assessment manager for that application. The Material Change of Use (MCU) application for the quarry was submitted to DIP under the GSDA Development Scheme in May 2009 and approval, including the relevant conditions, is expected by December 2009. Surrounding landholders such as Transpacific Industrial Solutions, Queensland Energy Resources Limited and Cement Australia as well as the advice agencies including Gladstone Regional Council (GRC), Department of Transport and Main Roads (DTMR), Department of Employment, Economic Development and Innovation (DEEDI) and DERM were provided with copies of the application and supporting information.

For this Project, the bluestone materials will be hauled from the quarry to the Reclamation Area using trucks, which will travel on either an on-road or off-road haul route, depending on the required bund wall construction rate. The haul routes are undergoing a separate options assessment and approvals process to allow them to be developed prior to the receipt of approvals for the construction of the bund wall (GHD 2009a). Should a low construction rate be adopted, the road route will undergo approval through GRC and should the high construction rate be adopted, the off road haul route will undergo MCU and operational works approvals through both the GSDA planning scheme and Calliope Shire Council Planning Scheme as relevant.



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0 2 4 6 8 10

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 56

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LEGEND

- Town or Locality
- Major Road
- Railway
- Port Limit
- Western Basin Reclamation Area
- Fisherman's Landing Northern Expansion
- Coastal Marine Park Boundary (State)
- Great Barrier Reef Marine Park Boundary (Commonwealth)

Proposed Dredging Stages

- Stage 1A - North China Bay LNG Precinct
- Stage 1B - Fisherman's Landing LNG
- Stage 2 - Laird Point LNG
- Stage 3 - Fisherman's Landing
- Stage 4 - Hamilton Point

Port of Gladstone
Western Basin Dredging and Disposal Project

Job Number	42-15386
Revision	A
Date	30 Aug 2009

Western Basin Dredging and Disposal Project Location with Project Components

Figure 2-1

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Table 2-3 Components of Port of Gladstone Western Basin Strategic Dredging and Disposal Project

Project Component	Description	Volume/Capacity of Dredged Material	Trigger	Potential Timing
DREDGING				
Stage 1A North China Bay LNG Precinct	The DIP has identified the development of a LNG precinct on the western side of Curtis Island. This precinct could allow for the development of up to four LNG plants, each of four train configuration. Each plant is anticipated to have an annual throughput of 12 – 15 Mtpa. Two LNG proponents are currently investigating sites on Curtis Island in the North China Bay area for the development of LNG plants for the processing and export of coal seam gas. The proponents and projects are the Santos/Petronas Gladstone LNG (GLNG) project and the Queensland Gas Corporation (a BG Group company) Queensland Curtis LNG (QCLNG) project. LNG Carriers under consideration have dimensions of up to draft 12.5m, length 300m, and beam 50m. The LNG industry is seeking to have capability of handling the vessels during the full tidal range such that there is no constraint on either arrival or departure. It is anticipated that channel depths of 13.0 m and swing basins/berth pockets of 13.0 m depth will be required. The initial development allows for one berth for each proponent. The dredging components of the GLNG and QCLNG projects have also been referred under the EPBC Act and are required to be addressed by the Terms of Reference for the GLNG and QCLNG projects also. The EISs for these projects have been prepared and placed on public display for agency and stakeholder comment in Q3/Q4 2009.	16.0 million m^3	Commitment by LNG proponents	Late 2010
Stage 1B Fisherman's Landing LNG	One smaller LNG proponent is investigating the development of an LNG plant at the existing Fisherman's Landing Facility. Gladstone LNG Ltd (LNG Ltd) is proposed to have an annual throughput of three million tonnes. Exports will be undertaken through Fisherman's Landing No.5 Berth. The Targinie Channel requires widening and the swing basin needs to be extended beyond the existing approved channel configuration to cater for the ultimate development and the associated larger LNG carriers. The proponent is investigating the options for utilising smaller LNG carriers in the early stages of development and the first two stages of dredging are being assessed in a separate development approval and in the Fisherman's Landing Northern Expansion EIS. This EIS considers the ultimate development from a channel width of 180 – 200 m and swing basin width from 550 – 650 m.	6.1 million m^{3**}	Commitment by LNG proponent	Late 2010
Stage 2 Laird Point	Australia Pacific LNG (APLNG), an Origin/ConocoPhillips joint venture, is investigating the potential to develop a 16 mtpa LNG facility at a site adjacent to Laird Point. The marine facility requires the extension of the Targinie Channel with a width of 200 m and depth of 13.0 m. In the event that this development precedes the expansion of the Fisherman's Landing facilities (Stage 3), it will be necessary to undertake the dredging of the existing Targinie Channel as part of this stage.	4.5 million m^3	Commitment by LNG proponent	2012
Stage 3 Fisherman's Landing	The existing reclamation at Fisherman's Landing allows the development of five berths. Four of these berths are already constructed or are currently under construction. The fifth berth is limited in size, due to it location between Berth 2 and Berth 4 (Rio Tinto and Cement Australia). The Fisherman's Landing Northern Expansion reclamation currently being investigated is capable of supporting a further six berths. Large scale industrial facilities, similar to Rio Tinto Alcan Yarwun and Gladstone Pacific Nickel, would typically require two berths for their ultimate development. The facilities at Fisherman's Landing are those most likely to support development in the GSDA. An area in excess of 28,000 ha has been declared for long-term industrial development on the mainland. It is therefore planned to construct a line of berths somewhere between Fisherman's Landing and Friend Point.	5.5 million m^3	Further industrial development in the GSDA requiring import and export wharves and potentially stockpile and storage areas. The berth pockets and swing basin area would be constructed progressively as proponents require them.	Various – as required over time

Project Component	Description	Volume/Capacity of Dredged Material	Trigger	Potential Timing
Stage 4 Hamilton Point	Natural deep water occurs adjacent to Hamilton Point. This area is capable of being developed for Cape-sized vessels. Further, it presents the one remaining area in the port for land-backed wharves to be developed. With respect to trade opportunities, these wharf facilities present an ideal opportunity to service break bulk and containerised trades. The steel industry could also benefit from this development as the importation of iron ore and other bulk products can be accommodated in Cape-sized vessels. Exports of blooms, billets, ingots and coils are best accommodated with the land backing allowing for ready transfer of product from shore-side to ship. For the container industry, the ready access from vessel to yard is important with full land backing being critical. A total of five berths can be developed at this site with minimal dredging. Also included in Stage 4 are the second berths for each of the proponents in North China Bay.	3.9 million m^3	Bulk / break bulk and container industries requiring land backed wharves. The berth pockets and swing basin area would be constructed progressively as proponents require them.	Various – as required over time
	TOTAL WESTERN BASIN	**36.0 million m^3**		
DISPOSAL				
Fisherman's Landing Northern Expansion	**Current Proposed Fisherman's Landing Northern Expansion Reclamation** The EIS process is being undertaken for the reclamation of the Fisherman's Landing Northern Expansion, adjacent to the existing reclamation at Fisherman's Landing (Figure 2-1). The reclamation was a non-controlled action under the Commonwealth EPBC Act and a Significant Project under the Queensland *State Development and Public Works Organisation Act 1971*. The reclamation is required to provide for the development of additional berths to service future industry. The original proposal allowed for an additional six berths to be developed in the long term. The reclamation will also provide a location for the disposal of dredged material. The EIS process addresses the Fisherman's Landing Northern Expansion reclamation approval and the widening of the Targinie Channel and Fisherman's Landing Swing Basin. It does not cover additional berth development beyond that previously approved (five berths) for the existing reclamation.	10 million m^3	Dredging in the inner harbour. There are no current disposal sites available with the overall capacity to accept material from all of the Western Basin dredging areas, should all of the developments proceed.	Mid 2010
Western Basin Reclamation Area	**Western Basin Reclamation Area** A total potential capital and maintenance dredged volume of 55.0 million m^3 is required to allow for dredging all basins and channels in the Project Area should all projects ultimately proceed. Subject to the timeframe over which this dredging is undertaken, allowance in the storage capacity is also required for the initial bulking of the material during the dredging operation and adequate retention time to allow for water quality to be controlled. Given these constraints, the option for a single Western Basin reclamation is under consideration. This reclamation would be adjacent to the Fisherman's Landing Northern Expansion reclamation that is currently undergoing an EIS under the SDPWO Act. The Reclamation Area as shown in Figure 2-1 has the capability of storing 55 million m^3 (to allow for bulking and decant of capital material and future maintenance dredging material) and is suitable for the overall development of the Western Basin, thereby avoiding the need to consider reclamation at sites on Curtis Island or Kangaroo Island/Friend Point.	55 million m^3 This volume includes the proposed Fisherman's Landing Northern Expansion	Dredging in the inner harbour. There are no current disposal sites available with the overall capacity to accept material from the Project Area should all of the developments proceed.	Late 2010

* LWD = Low Water Datum

** part of this dredging may be undertaken by the proponent under a separate approvals process

2.1.2 Cost and Timing of the Project

The construction of the bund wall for the Western Basin Reclamation Area is anticipated to commence immediately upon receipt of Project approvals in 2010. The construction of the bund wall is likely to be completed within 12 months of commencement.

The capital dredging of the Western Basin will occur in stages and the rate of development will be controlled by the demands of industry locating in the Gladstone region requiring access to port facilities. Operational works approvals will be sought for each Project stage as they are required. Table 2-4 provides an overview of the current likely timing of the stages of the Project as presented in Figure 2-1.

Table 2-4 Project Timing

Project Stage*	Potential Length and Timing of Dredging
Stage 1A – North China Bay Industry Precinct	Late 2010 – 2012 (2 years)
Stage 1B – Fisherman's Landing LNG	Late 2010 – 2012 (dredged concurrently with Stage 1A)
Stage 2 – Laird Point	2014 (follows after Stage 1A and 1B)
Stage 3 – Fisherman's Landing Development	To be determined (will be staged over a number of years)
Stage 4 – Hamilton Point	To be determined (will be staged over a number of years)

The capital cost of construction of the reclamation has been estimated at $343 million over 40 years. The cost of the capital dredging has been estimated at $656 million.

2.1.3 Key Environmental Design Features

Key environmental design features of the dredging, dredged material disposal and construction of the Reclamation Area include:

- Minimisation of the footprint of the Reclamation area by creating a mound of material on the landward side of the reclamation;
- Lining of the inner face of the bund wall of the Reclamation Area with geotextile fabric to reduce the migration of fines through the bund wall;
- Use of internal cells and adjustable weir boxes within the reclamation to allow retention of dredge tailwaters to allow settling of suspended solids;
- Removal of fine material (< 20 mm) from the rock used to build the bund wall to reduce the generation of turbid plumes during placement of rock in the water;
- Extensive use of cutter suction dredgers and direct pumping of dredged material into the Reclamation Area, which results in much lower turbid plume generation;
- Use of turtle excluding devices on trailer hopper suction dredgers to reduce the likelihood of capture of marine turtles;

- Progressive installation of stormwater management measures on the final reclamation surface as it is completed;
- At the completion of filling of the reclamation, retention of a large stormwater pond in the north west corner to manage stormwater water quality off the final surface. This may also provide some habitat value for migratory birds in the future; and
- Progressive capping and revegetation of the reclamation surface to manage stormwater quality and dust.

2.1.4 Employment Benefits

Up to 350 people will be employed at any one time for the construction phase of the Project, with additional employment arising from indirect opportunities such as service industries and hospitality (Chapter 13). The largest workforce will be associated with the dredging operations, which will occur after the Reclamation Area bund construction is complete.

The majority of the dredging operations workforce will be sourced externally with locally sourced employees required for bund construction (either GPC employees or a contractor).

The annual economic impact of the Western Basin Dredging and Disposal Project has been calculated for the period from 2010 to 2019 (Chapter 15). Economic impacts are anticipated to be most significant in 2013 and are expected to include 1,822 full-time equivalent positions, including 1,460 indirect full-time equivalent positions.

2.2 Location

The Western Basin is situated in the Port of Gladstone (the Port), 10 km north of Gladstone. Gladstone is located on the eastern seaboard of Australia, approximately 525 km north of Brisbane and 100 km south of Rockhampton, on the Capricorn Coast of Central Queensland (Figure 2-1).

The Port of Gladstone is located within Port Curtis, which is bounded to the east by Facing Island, the north by the southern end of Curtis Island and the west and south by the mainland. The main entrance to Port Curtis (or the harbour), is in the south east, with the North Channel providing limited access between the northern end of Facing Island and south eastern tip of Curtis Island. The Narrows is located at the northern end of the harbour and is the waterbody that separates Curtis Island from the mainland.

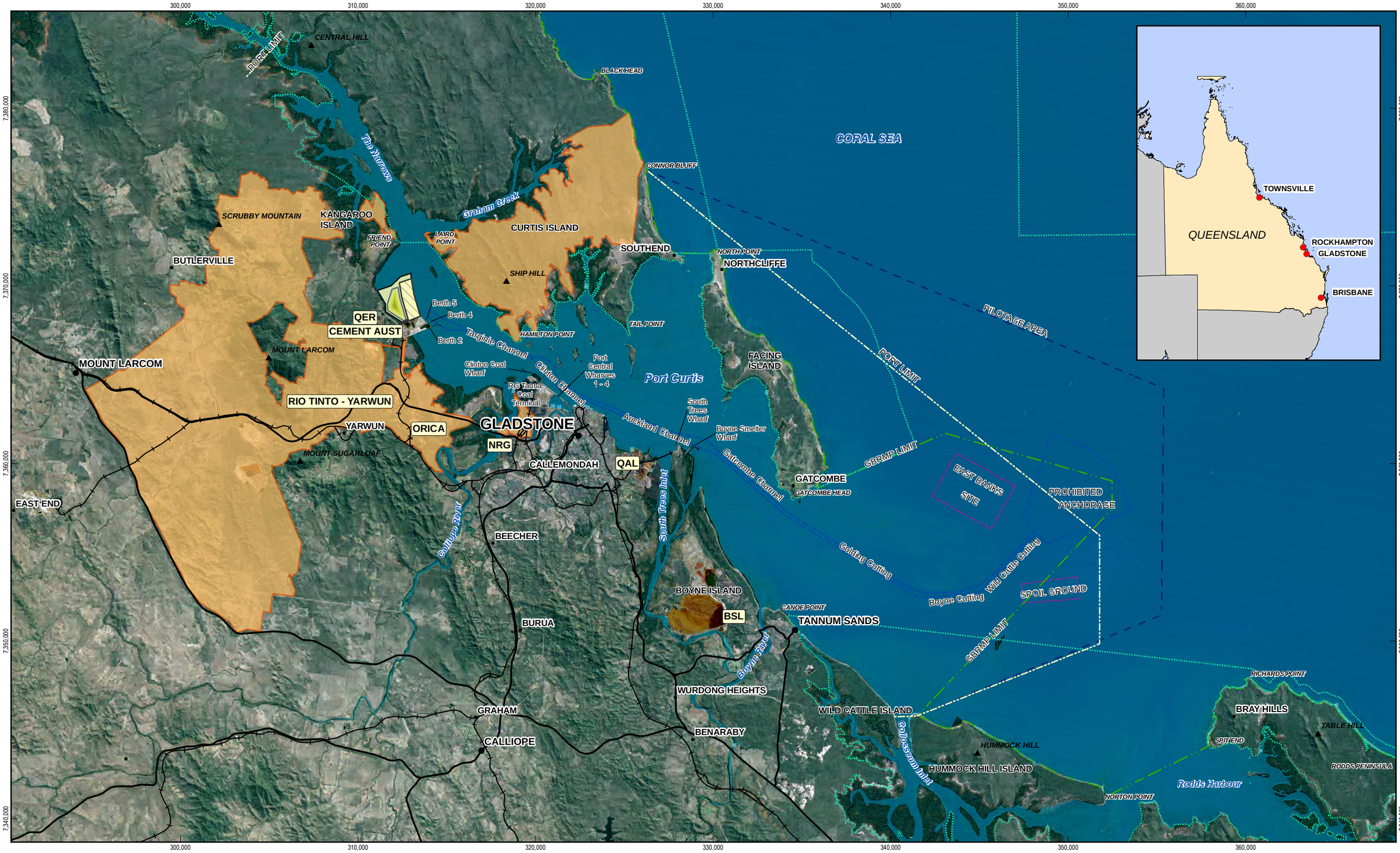
The site of the proposed Western Basin Dredging and Disposal Project falls within the Curtis Coast Coastal Management District, is currently below high water mark within the Port Limits, and is unallocated State land under the administration of DERM. Because the land is below high water mark and has not been reclaimed or tenure designated, there is no cadastral property description available. The site is within the boundaries of the Gladstone Regional Council (GRC).

It is GPC's intention to gain ownership over the land, once reclaimed, and apply for the area to be designated Strategic Port Land. While the proposed reclamation is not included in the Gladstone State Development Area (GSDA), it is connected to the GSDA via the Materials Transportation Services Corridor (MTSC), which is itself part of the GSDA.

2.2.1 Regional Context

The Port of Gladstone consists of six major port facilities; Boyne Smelter Wharf, South Trees Wharf, Barney Point Terminal, Auckland Point Terminal (Port Central), RG Tanna Coal Terminal and Fisherman's Landing (Figure 2-2). Coal from numerous Central Queensland coal mines is exported from RG Tanna Coal Terminal and Barney Point Terminal. South Trees Wharf provides for bauxite and caustic import and alumina export for Queensland Alumina Limited (QAL) and Boyne Smelter Wharf provides for aluminium export for Boyne Smelter. Port Central (Auckland Point Wharves) provides for the export of bulk cargo such as magnetite, calcite, petroleum products, grain and containers (GPC 2008b). The East Banks Sea Disposal Site is located to the north of the entrance to the main shipping channel (Figure 2-2). This site is GPC's approved ocean disposal site for disposal of maintenance dredging material.

The Port is wholly contained within the Great Barrier Reef World Heritage Area (GBRWHA) and partly contained within the Great Barrier Reef Marine Park (GBRMP), to the east of Facing Island in the outer harbour (Figure 2-2). The Project Area, however, is outside the GBRMP. While it forms part of the GBRWHA and is adjacent to other protected areas, it has been an operating port since 1914. Mangroves are established along parts of the coastline within the Project Area and extensive seagrass beds are located within the Port Limits and surrounding areas.



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0 2 4 6 8 10

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 56

N

LEGEND

- Town or Locality
- Major Road
- Railway
- Port Limit
- Disposal Site
- Port Channels
- Pilotage Area
- Coastal Marine Park Boundary (State)
- Great Barrier Reef Marine Park Boundary (Commonwealth)
- Western Basin Reclamation Area
- Fisherman's Landing Northern Expansion
- Gladstone State Development Area

Port of Gladstone
Western Basin Dredging and Disposal Project

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Port of Gladstone Facilities

Figure 2-2

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2.2.2 Local Context

Land access to the Fisherman's Landing site is via Landing Road, which runs off Gladstone – Mt Larcom Road, the major northern access road to Gladstone.

The proposed Reclamation Area and facilities are located adjacent to the GSDA. Immediately adjacent to the proposed Western Basin Reclamation Area is the current Fisherman's Landing port facility, which includes a multi-user Bulk Liquids Wharf (Berth 5), Cement Australia's cement and clinker wharf (Berth 3) and the Rio Tinto Alcan Yarwun Refinery wharf (Berths 1 and 2). Orica Australia's bulk liquid ammonia tank is on this site and caustic storage facilities for the Rio Tinto Alcan Yarwun Refinery and Orica are also located at the facility.

There are various industrial developments in the immediate proximity of the proposed expansion to the existing Fisherman's Landing Reclamation, including (Figure 2-2):

- Cement Australia;
- Rio Tinto Alcan Yarwun Alumina Refinery;
- Orica Australia;
- Transpacific Industrial Solutions (based at the former Ticor Chemical Manufacturing site); and
- Queensland Energy Resources Stuart Shale Oil Plant (who have leasehold land directly to the north of the Project site and overlapping with the proposed development site).

Other land uses in close proximity to the Fisherman's Landing site include State Forestry, based in Targinie State Forest. The local land area formally accommodated various rural land uses, including beef cattle grazing and horticulture, however many of the former landholders have since relocated.

Figure 2-3 shows coastal vegetation in the foreground of the site, with Mt Larcom and surrounding ranges in the background. The industrial facilities are Cement Australia to the left and Queensland Energy Resources Limited (QER) to the right. Figure 2-4 shows a panoramic view of the existing Fisherman's Landing port facilities, including the Reclamation Area and ammonia storage tank (far right), Cement Australia, and the facilities associated with QER (far right). The view of the proposed Western Basin Reclamation Area from Mt Larcom is shown in Figure 2-5. This view also encompasses Dredging Stages 2, 3 and 4, with the northern parts of Stages 1A and 1B also in this area.

Figure 2-3 The coastline in the Immediate Vicinity of the Proposed Western Basin Reclamation Area

Figure 2-4 Panoramic View of the Existing Fisherman's Landing Port Facilities

Figure 2-5 View towards Curtis Island, Fisherman's Landing and the proposed Western Basin Reclamation Area (to the left of the existing reclamation) from Mt Larcom. The QER site is in the foreground

2.3 Construction

2.3.1 Proposed Pre-construction Activities

Infrastructure for Construction

Quarry

The GPC owned quarry from which the bund construction materials will be sourced is located within the GSDA at the end of Guerassimoff Road (Figure 2-6). Materials from this quarry will also be used to service other GPC construction projects in the short and long term. Therefore, the quarry is undergoing a separate development approval process to allow development of the quarry to be undertaken prior to the commencement of GPC projects requiring these materials.

Haul Routes

For this Project, the bluestone materials will be hauled from the quarry to the Reclamation Area using trucks, which will travel on either an on-road or off-road haul route, depending on the required bund wall construction rate (Figure 2-6). The haul routes are undergoing a separate options assessment and approvals process to allow them to be developed prior to the receipt of approvals for the construction of the bund wall (GHD 2009a).

LEGEND

- Preferred Haul Route (HR3) (Off-road)
- Preferred Road Route 3 (RR3) (On-road) RR1 Loaded & RR2 Unloaded
- Quarry Lot Boundary
- Materials Transportation Services Corridor
- Western Basin Reclamation Area
- Fishermans Landing Northern Expansion
- Cadastre

1:25,000 (at A4)

0 100 200 300 400 500

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

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Port of Gladstone
Western Basin Dredging and Disposal Project

Location of GPC Quarry and Preferred Haul Route and Road Route

Job Number	42-15386
Revision	A
Date	01 Sept 2009

Figure 2-6

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Access to existing Fisherman's Landing Reclamation

The addition of a 70 m wide strip on the northern wall of the existing Fisherman's Landing Reclamation has been proposed in the Fisherman's Landing Northern Expansion EIS. This widening will allow for continued access to the barge landing facility at the north-eastern corner of the existing Reclamation during construction of both the Fisherman's Landing Northern Expansion and the Western Basin Reclamation Area. This barge landing facility is currently used for both import of construction materials for the Rio Tinto Yarwun Alumina Refinery Stage 2 Expansion and may also be used for transport of construction equipment and materials for the LNG industry on Curtis Island.

There is no requirement for up-grade, relocation, realignment or deviation of other infrastructure as part of the construction phase of the Western Basin Dredging and Disposal Project. Temporary infrastructure will be provided at the existing Fisherman's Landing Reclamation during the bund construction and dredging phases of the Project as detailed in Section 2.4.

Extent of Vegetation Clearing

There is no vegetation clearing required for the pre-construction phase of the Project. Marine and terrestrial vegetation impacts for the construction phase are discussed in detail in Chapter 9.

Any vegetation clearing required for the off road haul route construction will be addressed in the separate approvals process for the haul route.

Bund Area Constructions

The following is noted with respect to pre-construction activities for the Reclamation Area, addressing items outlined in Section 2.3 of the ToR for the Project:

- There are no land acquisitions required for the Western Basin Reclamation Area as the area is currently unallocated State land that is under the high water mark in Port Curtis;
- The separate approvals process being undertaken for the off-road haul route will seek the required agreements for temporary access to the various land parcels traversed by the haul route;
- The traffic and transport impacts associated with the proposed off-road and on-road haul routes for the construction of the Western Basin Reclamation Area are being assessed as part of the separate approvals process. These impacts are also discussed in Chapter 11 of this EIS;
- Temporary infrastructure will be provided at the existing Fisherman's Landing Reclamation to support the bund construction and dredging phases of the Project, as detailed in Section 2.4; and
- The bund construction materials consist of various size classes of bluestone sourced from a GPC owned quarry located in the GSDA. Characteristics of the bund construction materials are discussed in Section 2.3.4.

Potential Disruption to Flows of Waterways during Construction

Only one structure will be placed in a waterway to aid construction. This will be a temporary, at-grade crossing from the end of the off-road haul route, through the intertidal zone, to allow construction of the third 'front' of the bund wall (Section 2.3.2 and Plan 1, Figure 2-8). This at-grade crossing will be designed to minimise disturbance to mangroves and water flows and will be removed once bund

construction is completed. The crossing will be constructed using rock materials from the GPC owned quarry.

Potential Disruptions to Harbour Traffic from Dredging and Dredged Material Disposal

A detailed discussion of the potential impacts of the Project on harbour traffic is provided in Chapter 11.

The Port of Gladstone is Queensland's largest multi-commodity port, housing the world's fourth largest coal export terminal. Each year more than 1,400 commercial vessels visit the Port of Gladstone. The bulk of shipping movements are at the RG Tanna Coal Terminal, at the southern end of the Stage 1A dredging area. The QAL and Boyne Smelter wharves are outside the Project Area. Alumina, bulk liquids and cement exports and bauxite and caustic imports occur at the existing Fisherman's Landing berths, but shipping volumes are not high in this area.

The dredging contracts for this Project will include conditions regarding the way in which the dredging operation is to be conducted to minimise impacts to shipping movements within the Port. The dredging and shipping movements will be managed by Maritime Safety Queensland.

The proposed Project Area is located in an area that is currently used for various commercial and recreational activities, including fishing. Non-fishing boating activity includes smaller vessels and yachts that use the adjacent channel to access in and out of The Narrows. It is likely that the dredging activities will result in some interruptions to commercial and recreational fishing and boating. These impacts will be minimised through the use of Notices to Mariners to keep the public informed of restrictions and sections of the pipelines from the cutter suction dredgers to the Reclamation Area will be submerged to allow traffic to pass.

2.3.2 General Construction Phase Activities

This section provides an overview of the Project's construction phase, including staging of the dredging and reclamation activities and timeframes. Sections 2.3.3, 2.3.4 and 2.3.5 discuss the dredging and reclamation design and construction methods.

Development Scenarios

Based on the likely requirements of the various proponents for activities requiring port facilities, three scenarios were developed for the five dredging stages. These are described in Table 2-5 and illustrated in Figure 2-7. Grouping of the dredging stages that are likely to be undertaken concurrently into single scenarios allows for a worst case assessment of environmental impacts.

The Western Basin Reclamation Area bund wall will be fully constructed prior to the commencement of dredging. It is likely that Stages 1A and 1B will be dredged concurrently, followed by Stage 2, with Stages 3 and 4 being dredged progressively over time as new proponents require access to the port. For the purposes of hydrodynamic modelling and impact assessment, Scenario 3 was assessed as the ultimate or fully developed case. As it is already approved and will potentially commence in 2010, the Wiggins Island Coal Terminal dredging has been included as part of the base case (existing conditions) for this Project.

Table 2-5 Dredging and Reclamation Development Scenarios

Scenario	Dredging	Reclamation
Base Case	Existing Channels Wiggins Island Coal Terminal	Existing Fisherman's Landing reclamation
Scenario 1	Stage 1A Stage 1B	Western Basin Reclamation Area bund wall fully constructed
Scenario 2	Stage 2	Western Basin Reclamation Area bund wall fully constructed
Scenario 3 (ultimate / fully developed case)	Stages 3 and 4	Western Basin Reclamation Area bund wall fully constructed

Dredging Stages

Table 2-6 and Figure 2-7 present the likely staging and timing for the proposed dredging outlined in the previous section.

Table 2-6 Indicative Timing for Each Dredging Scenario and Stage

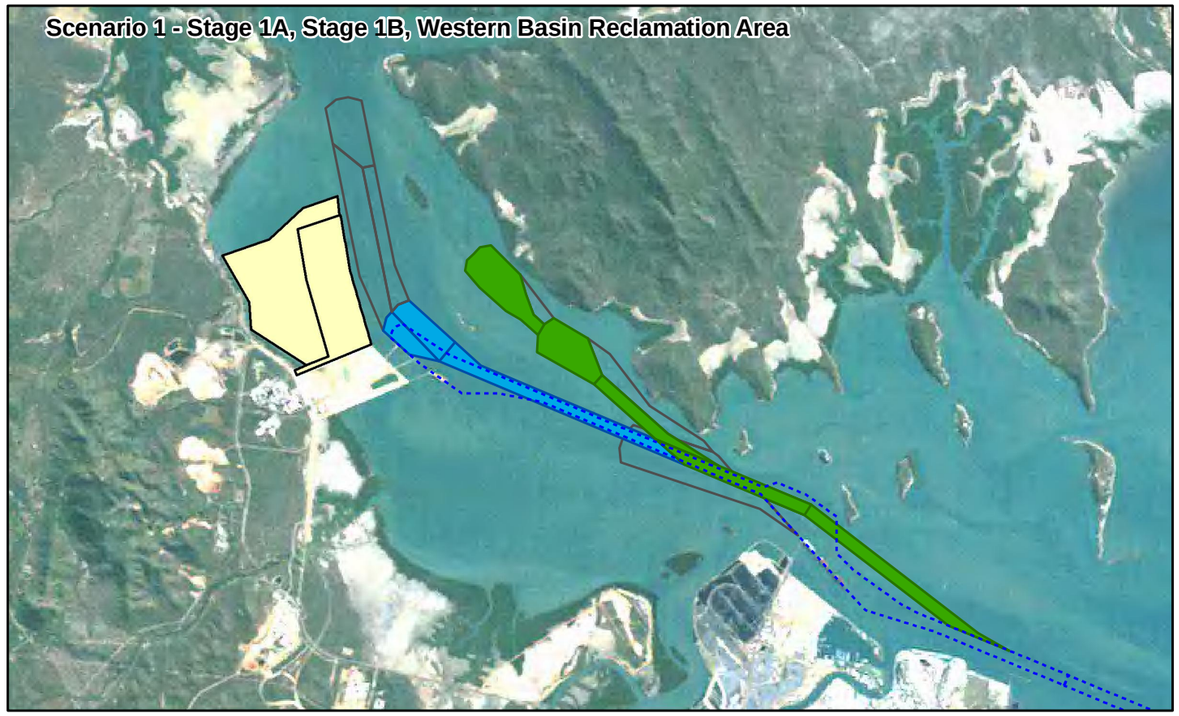
Scenario	Stage	Dredge Area	Start Date	Completion Date
1	Stage 1A	QGC Marine Offload Facility (MOF)	Early 2010	Early 2010
		Santos MOF	Early 2010	Early 2010
		Curtis Channel & Clinton By-Pass	Late 2010	Late 2012
		Curtis Channel Swing Basin		
2	Stage 1B	Targinie Channel	Late 2012	Early 2014
		Fisherman's Landing Swing Basin		
	Stage 2	Laird Point Channel		
		Laird Point Swing Basin		
3	Stage 3	Fisherman's Landing	Will be dredged in stages as required by future proponents	
	Stage 4	Hamilton Point	Will be dredged in stages as required by future proponents	

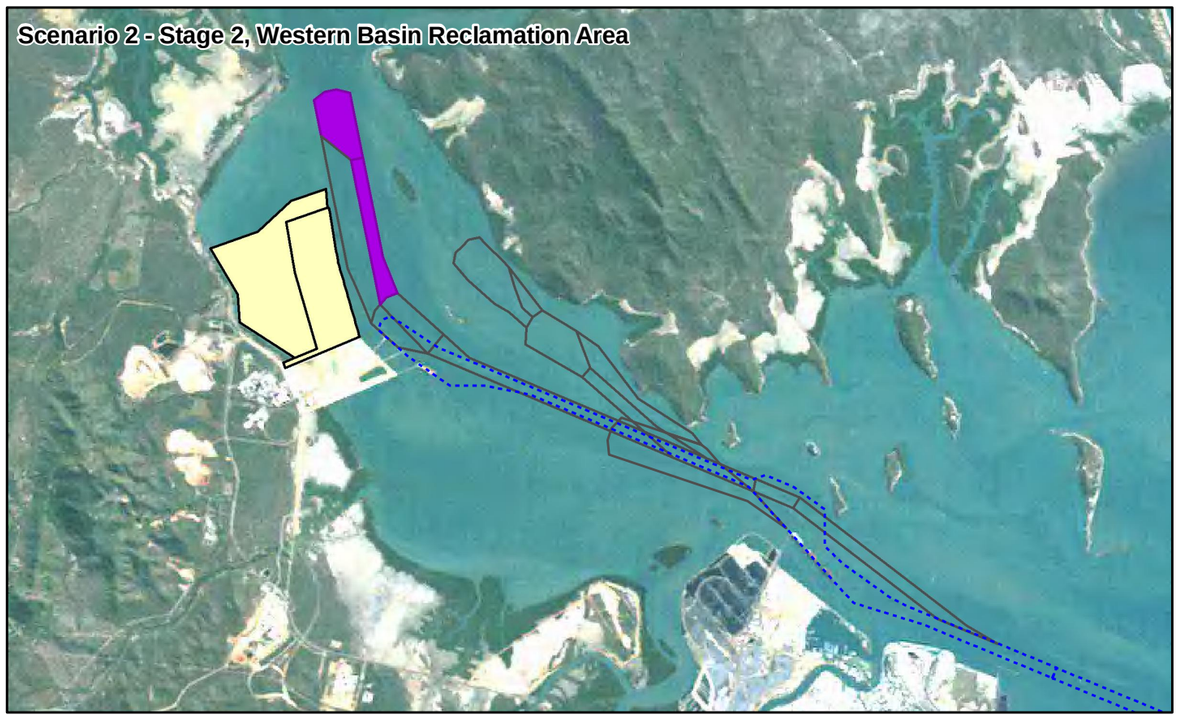
Reclamation Staging

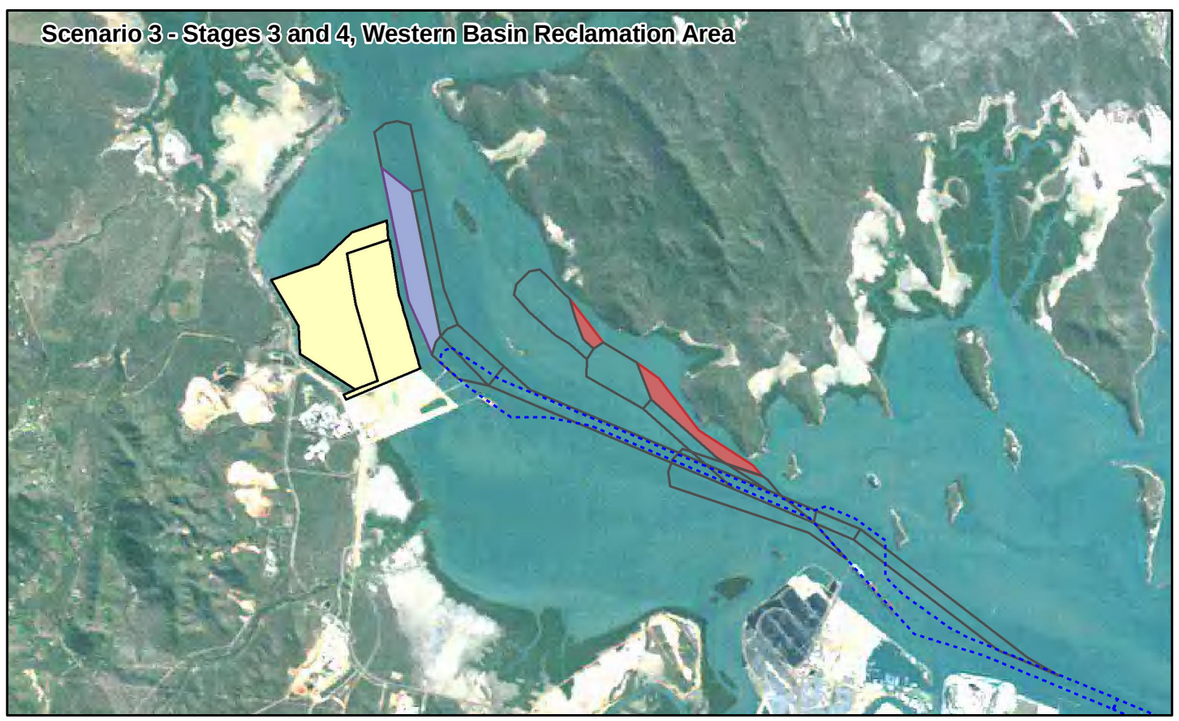
The Western Basin Reclamation Area bund wall will be fully constructed prior to the commencement of dredging. Should the Fisherman's Landing Northern Expansion reclamation be approved under a separate EIS process that is currently being undertaken, construction of a portion of that reclamation may be undertaken prior to the approval and commencement of the Western Basin Reclamation Area.

The Fisherman's Landing Northern Expansion reclamation will therefore have the potential to contain early works material from one or more of the LNG facilities proposed for Curtis Island and the Western Basin Reclamation can later be constructed around this initial portion of the Fisherman's Landing Northern Expansion.

To enable the construction of the complete bund wall in one year, it is proposed to construct the Western Basin Reclamation Area bund walls from three 'fronts'. Two of these fronts start from the existing Fisherman's Landing reclamation, and a third starts from part way along the western bund wall (Plan 1, Figure 2-8). The third 'front' will be from the end of the off-road haul route to a portion of the western bund wall as shown on Plan 1, Figure 2-8, with an at-grade crossing of what will be the intertidal channel constructed to enable this access. The at-grade crossing will need to be designed to minimise disruption to water flows during tidal movements and will be removed upon completion of the bund wall construction.







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Kilometres

Map Projection: Universal Transverse Mercator
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Grid: Map Grid of Australia 1994, Zone 56

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LEGEND

- Western Basin Reclamation Area
- Existing Channels, Swing Basins and Berths
- Wiggins Island Coal Terminal (Approved)
- Stage 1A - North China Bay LNG
- Stage 1B - Fisherman's Landing LNG
- Stage 2 - Laird Point LNG
- Stage 3 - Fisherman's Landing
- Stage 4 - Hamilton Point

Port of Gladstone
Western Basin Dredging and Disposal Project

Dredging Scenarios 1, 2 and 3

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Revision	A
Date	14 Sep 2009

Figure 2-7

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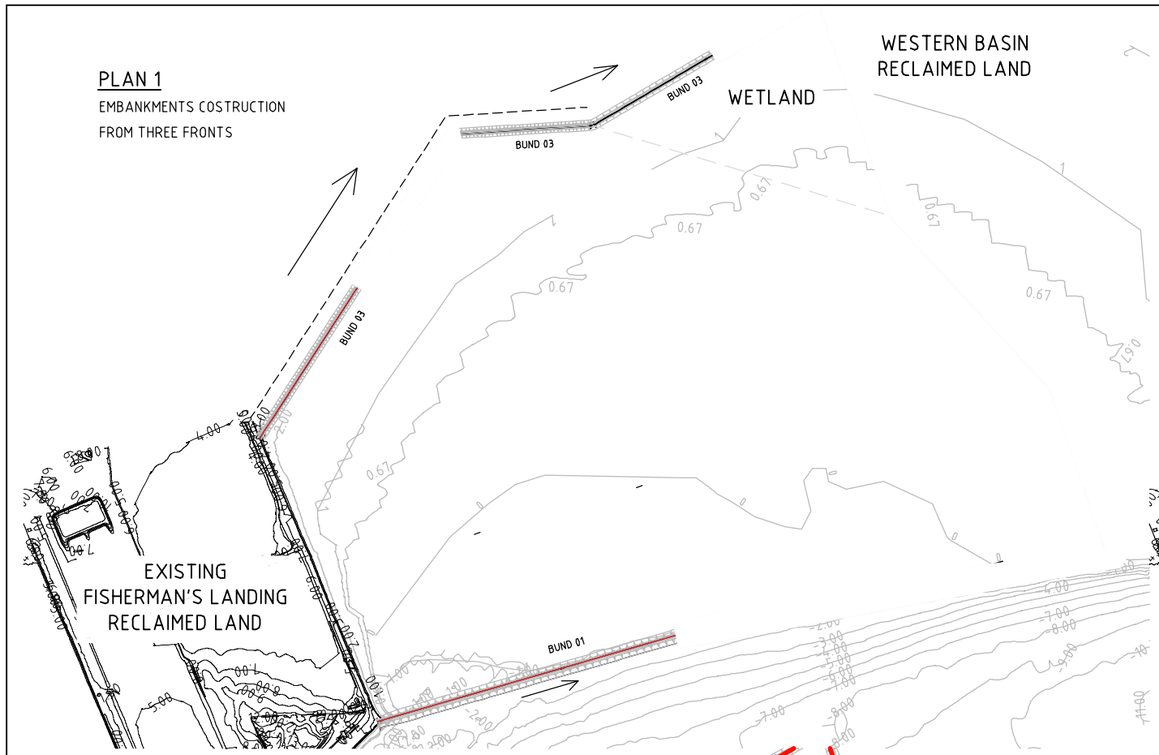
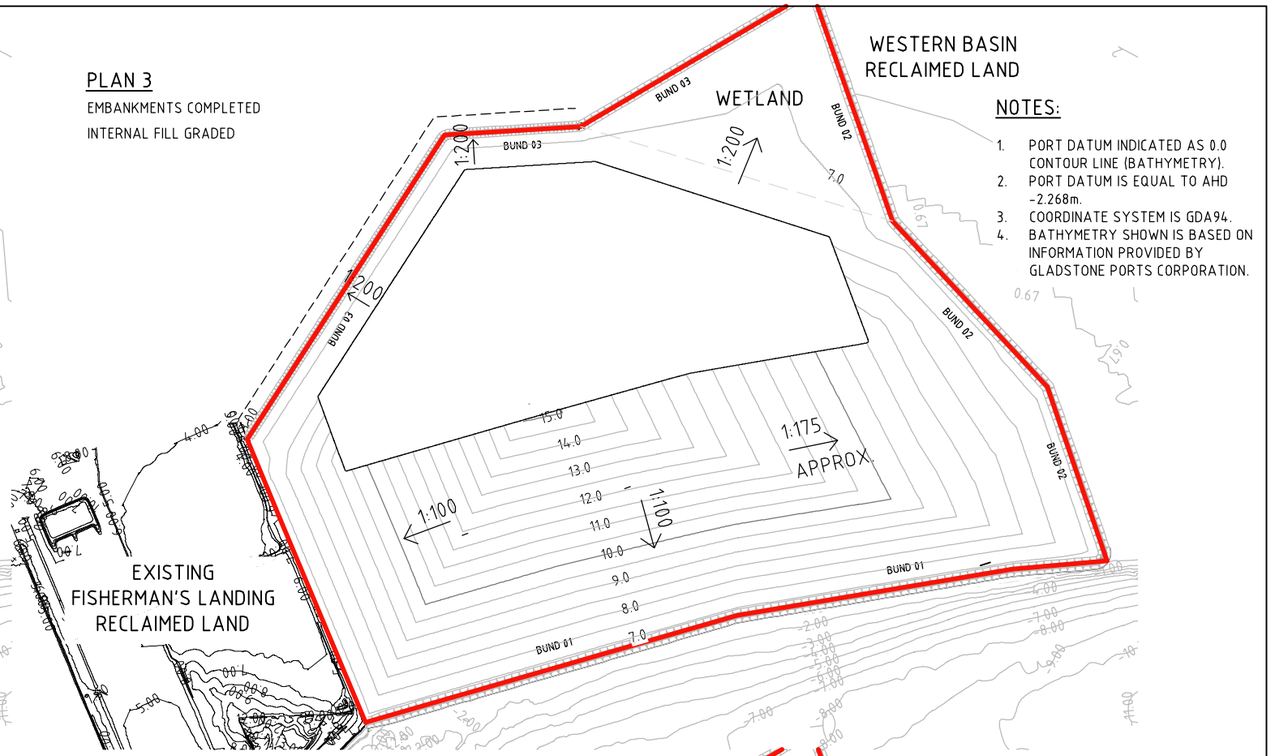
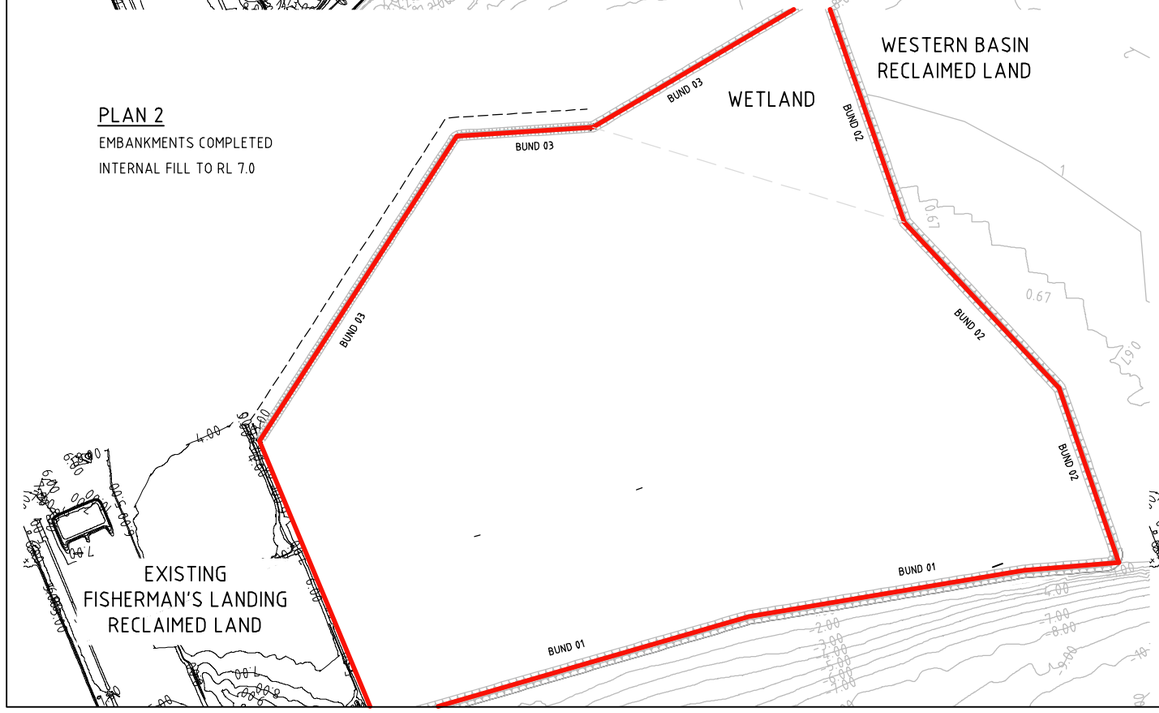
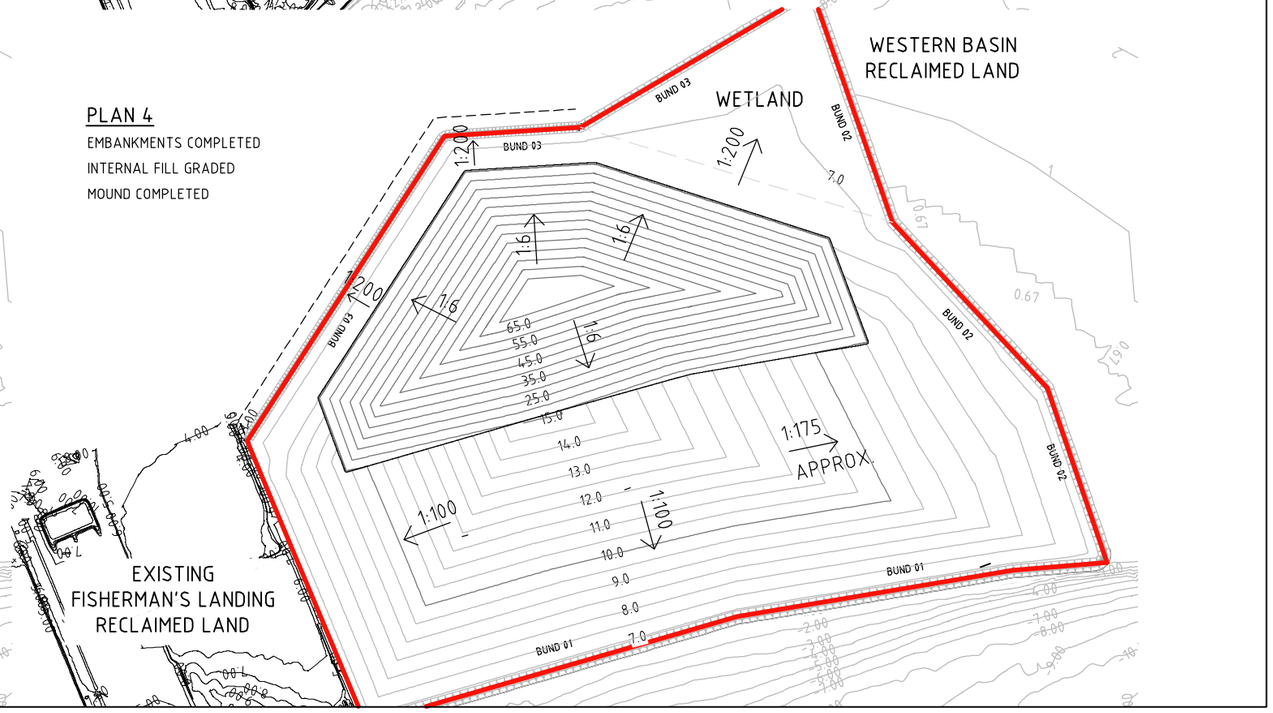




NOTES:

1. PORT DATUM INDICATED AS 0.0 CONTOUR LINE (BATHYMETRY).
2. PORT DATUM IS EQUAL TO AHD -2.268m.
3. COORDINATE SYSTEM IS GDA94.
4. BATHYMETRY SHOWN IS BASED ON INFORMATION PROVIDED BY GLADSTONE PORTS CORPORATION.





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SCALE 1:20,000 AT ORIGINAL SIZE

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 56

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LEGEND

Port of Gladstone
Western Basin Dredging and Disposal Project

Job Number 42-15386
Revision A
Date October 2009

Reclamation Construction Staging Plan

Figure 2-8

G:\42\15386\CADD\DRAWINGS\WESTERN BASIN\42-15386-28-FIG2-8.DWG

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2.3.3 Proposed Dredging Methods

In accordance with Section 2.3 of the ToR, this section describes the methods proposed for the dredging of the new berth pockets, swing basins and channels. This information is drawn from a report entitled the Dredging Works Description for the Western Basin Dredging and Disposal Project (GHD 2009b).

Definition of Terms and Dredging Sub-Areas

For the purposes of specifying the appropriate dredging equipment for the proposed works, the dredging stages were divided into the following sub-areas:

- Clinton Bypass Wedge (Stage 1A)
- Clinton Bypass Channel (Stage 1A)
- Curtis Channel – North (Stage 1A)
- Curtis Channel – Middle (Stage 1A)
- Curtis Channel – South (Stage 1A)
- Targinie Channel (Stage 1B)
- Fisherman's Landing Swing Basin (Stage 1B)
- Laird Point (Stage 2)
- Fisherman's Landing (Stage 3)
- Hamilton Point (Stage 4).

In the description of dredging works, it is essential that the reference depths are clearly defined. Within this document the following definitions have been adopted (Figure 2-9):

Channel Toeline Width	The width at the base of the channel, not taking into account the batter slopes.
Design Depth	The depth above which no material is to remain at the completion of the works. Pilots and Harbours Masters often refer to this as the "Declared Depth".
Approved Depth	The average depth of the bed at the completion of the works. This depth is below the "Design Depth". As such, it makes provision for tolerance on the finished profile of the bed and some allowance to accommodate siltation between maintenance dredging campaigns. The "Approved Depth" for the proposed works is 300 mm below the "Design Depth".

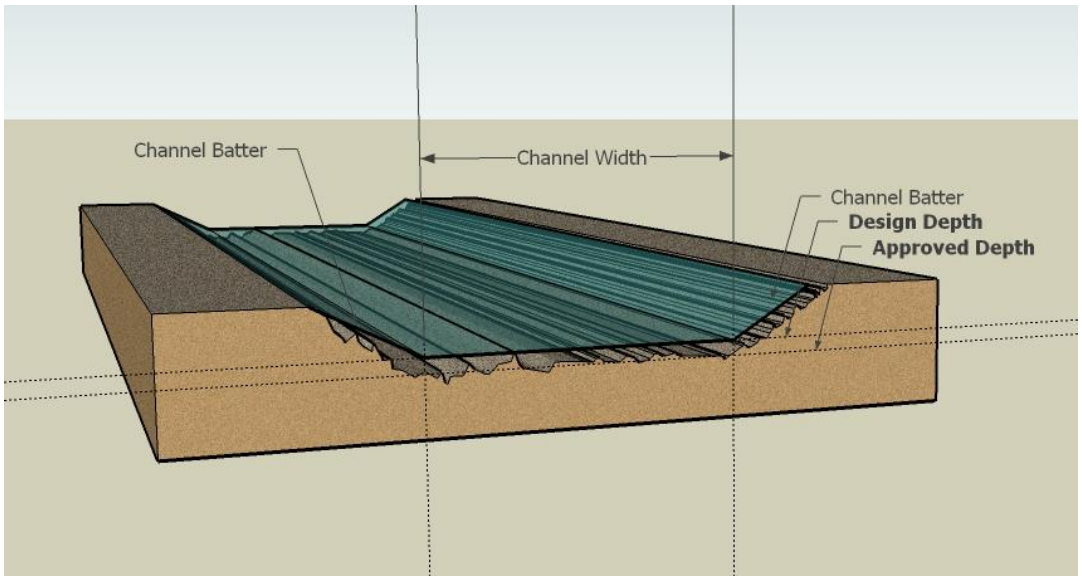


Figure 2-9 Illustration of Relationship between Approved Depth and Design Depth

Design of Dredged Areas

Design parameters are provided in Table 2-7 with key considerations as follows:

- The LNG industry does not wish their ships to be limited to departing only on certain stages of the tide, therefore the swing basin and berth pocket are the same depth. Stages 3 and 4 however, are likely to cater for various product types and ship sizes and may have berth pockets deeper than the swing basins;
- Table 2-7 shows design depths. These are the depths that will be officially declared by the Harbour Master for the channels and swing basins. The volume calculations include an allowance for 0.3 m of over-dredging (caters for dredging tolerance and over-dredging to allow for siltation). Therefore, an approved depth of maximum -18.0 m LAT (lowest astronomical tide) would be applied; and
- The datum is LAT. Therefore, the numbers represent the depth of water available in each area at the lowest astronomical tide.

Table 2-7 Design of Dredged Areas for each Dredging Stage

Scenario	Stage	Dredge Area	Design Depth	Approved Depth	Channel Toeline Width	Batter Slope V:H	Volume million $m^{3\#}$
1	Stage 1A	QGC MOF	-7.8 m LAT	-7.8 m LAT		1:3	0.2
		Santos MOF	TBC***	TBC		1:3	0.1
		Curtis Channel & Clinton By-Pass	-13 m LAT	-13.3 m LAT	200 m	1:3	16.0**
		Curtis Channel Swing Basin	-13 m LAT	-13.3 m LAT	600 m	1:3	
2	Stage 1B	Targinie Channel	-13 m LAT	-13.3 m LAT	200 m	1:3	4.6
		Fisherman's Landing Swing Basin	-13 m LAT	-13.3 m LAT	650 m	1:3	
	Stage 2	Laird Point Channel	-13 m LAT	-13.3 m LAT	200 m	1:3	4.5
		Laird Point Swing Basin	-13 m LAT	-13.3 m LAT	650 m	1:3	
3	Stage 3*	Fisherman's Landing	-13 m LAT	-13.3 m LAT	450 m	1:3	5.5
	Stage 4*	Hamilton Point	Up to -16.0 m LAT		Varied	1:3	3.9

Volume calculations are based on Approved Depths

* Stages 3 and 4 will be dredged as and when new berths are required

** Approximately 3,000,000 m^3 of Stage 1A might be dredged prior to the dates proposed to give access to the Marine Offloading Facility for QGC

*** to be confirmed with final design

Types of Dredgers

Table 2-8 details the particulars of the dredgers proposed for this Project.

Table 2-8 Details of the Proposed Dredger Types

Dredge Type	Total Installed Power (kW)	Hopper Capacity (m^3)	Discharge Pipe (mm)	Bucket Capacity (m^3)
Large TSHD	21,500	10,000	-	-
Medium TSHD	6,500	4,750	-	-
Large CSD	16,100	-	900	-
Medium CSD	5,340	-	750	-
Backhoe	1,985	-	N/A	6

For each of the dredger types outlined in Table 2-8, the operational characteristics and environmental considerations are summarised in the following sections.

Trailing Suction Hopper Dredger

Trailing suction hopper dredgers (TSHDs) are self-propelled ships (Figure 2-10).

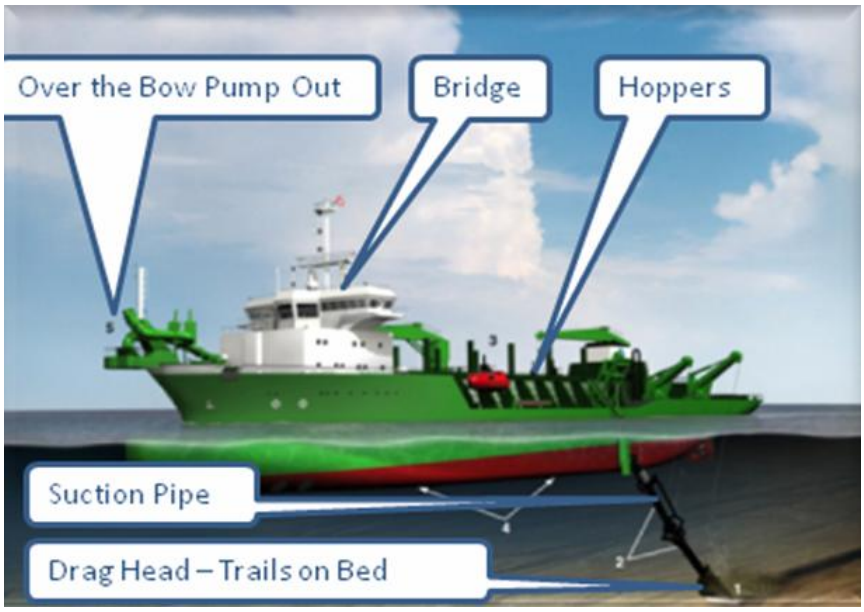


Figure 2-10 Key Operational Components of a Trailing Suction Hopper Dredger

TSHDs are equipped with either single or twin (one on each side) trailing suction pipes or drag arms. Dredging is undertaken while the dredger is sailing along pre-planned tracks with the drag arms lowered to the sea bed. Material is lifted through the trailing pipes by one or more pumps and discharged into a hopper within the hull of the dredger. The fact that the drag heads are essentially on the sea bed and they ingest the material raised into suspension, means that there are minimal turbid plumes created at the drag heads. On completion of loading, the dredger sails to the site where the dredged material is

discharged. For placement of the material into a bunded Reclamation Area, the discharge can occur by either:

- Pumping ashore; or
- Bottom dumping in close proximity to the Reclamation Area and use of a suction dredger to pick up the material and pump it into the reclamation.

TSHDs are not very effective with hard materials such as the stiffer clays, but can dredge rock which has been loosened by a cutter dredger or blasted and fractured.

The amount of material pumped into the hopper on any one load is maximised by overflowing the hopper during dredging operations. The overflow from the hoppers typically comprises of water and fines. There are substantial advantages in overflowing the hoppers, because the dredging operation efficiency increases with increasing load. Other advantages are:

- The time period through which the dredging operations will impact the environment is minimised; and
- The fuel consumed (and greenhouse gases emitted and costs) are minimised.

Conversely, if the turbid water resulting from the overflow is likely to impact sensitive receptors, management of the dredger overflow to reduce it to acceptable levels can be considered. However, as operation in non-overflow mode substantially reduces the efficiency of the dredging operation, there are the corresponding disbenefits in the increased length of dredging campaign and associated impacts and increased fuel consumption (greenhouse gases emitted and costs).

TSHDs have the potential to capture marine fauna, in particular turtles that lay on the seabed, into the drag heads as they are unaware of the approaching dredger. Precautions that are commonly adopted include:

- Commencement of pumping is deferred until the drag heads are on the sea bed; and
- Fixing “turtle ticklers” to the drag heads. The turtle ticklers comprise an arrangement of stays and chains which will cause vibrations or touch the turtle to provide a warning to the turtle to move, ahead of the arrival of the drag head.

TSHDs work 24 hours per day / 7 days per week using multiple crews. Crews are typically accommodated on board the dredger. At intervals of approximately two weeks, the dredger will cease operations and berth for a period of ~six hours to facilitate crew changes, bunkering and provisioning.

Cutter Suction Dredger

A cutter suction dredger (CSD) is a stationary hydraulic dredger. Stationary hydraulic dredgers are characterised by the diameter of the discharge pipeline and the mechanical power installed in the dredger. A CSD is shown in Figure 2-11, with the operational components and operational method illustrated in Figure 2-12 and Figure 2-13.

Figure 2-11 Cutter Suction Dredger

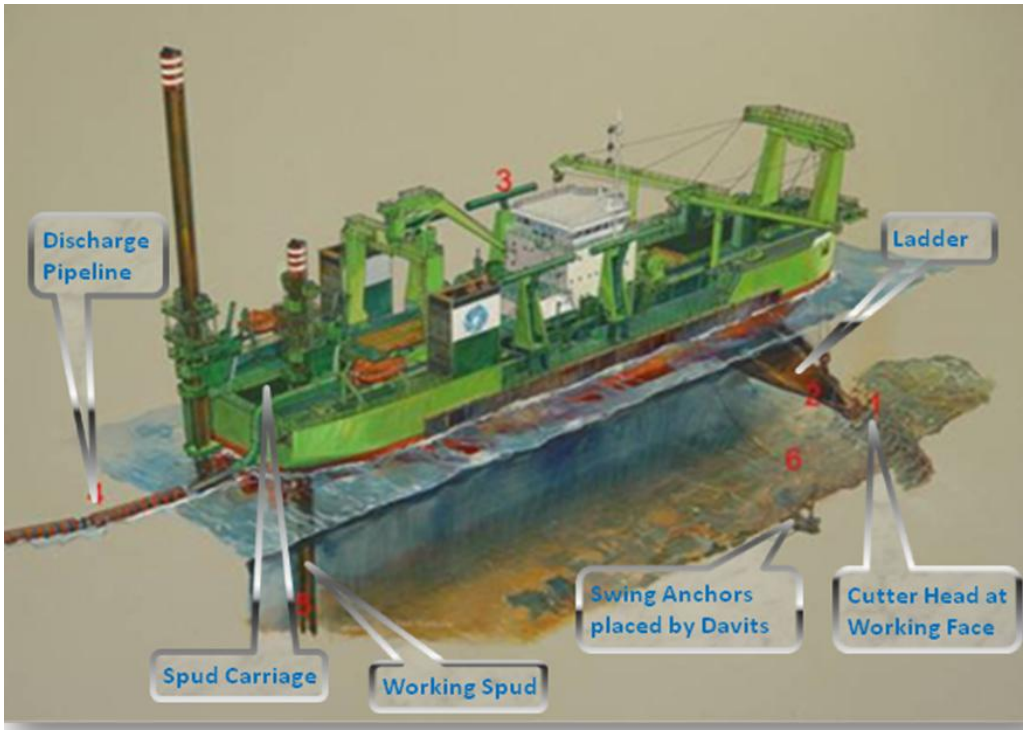


Figure 2-12 Key Operational Components of a Cutter Suction Dredger

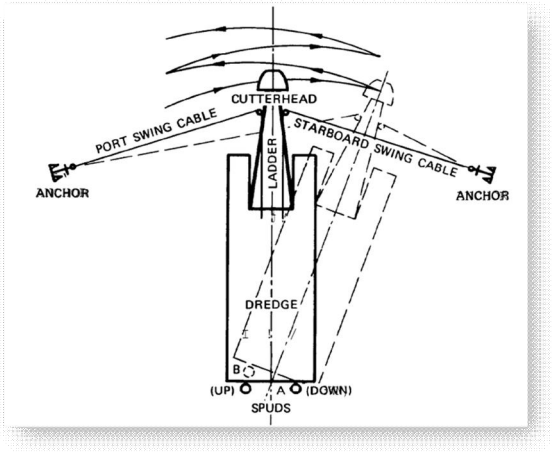


Figure 2-13 Operation of Cutter Suction Dredger

CSDs operate by swinging about a central “working spud” using anchors and winches leading from the lower end of the ladder to anchors. By winching on alternate sides the dredger clears an arc(s) of cut, and then moves forward by pushing against the working spud using a spud carriage.

Medium to larger size dredgers typically work 24 hours per day / 7 days per week using multiple crews. The noise and vibrations of a cutter suction dredger are such that crews can not be accommodated on board and will come ashore at the end of each shift.

The cutter head is an assembly of cutting teeth on a rotary frame. The cutter head “basket” encloses the intake of the suction line. The cutter head rotates around the axis of the suction pipe, enabling the teeth on the cutter head to excavate material from the seabed. The cutting action of the cutter head dislodges the bed material. A mixture of material and water is drawn through the cutter head into the suction line.

While the cutter head will cause some local turbidity, the turbidity will typically be in close proximity to the seabed rather than being released at the surface and falling through the entire water column. Moreover, the vast majority of the material is drawn into the suction line for pumping to the relocation site, resulting in minimal plume generation at the cutter head.

In contrast to TSHDs, the method of operation of the CSD ensures there is ample warning to turtles of the approach of the dredger, as:

- The dredger progresses forward at a very slow rate;
- The action of the cutter engaging the seabed causes substantial vibration; and
- Dredging typically undercuts the seabed and the material slumps into the cuts. Movement of the seabed ahead of the slumping will provide warning to turtles.

The discharge line from the CSD delivers the fluidised material to the disposal/Reclamation Area. Typically, discharge pipelines will be fitted with buoyancy sleeves or installed on pontoons floating aft of the dredger. Site constraints may dictate that it is necessary for sections of the pipeline to be submerged e.g. to allow vessel traffic to pass unimpeded or to protect the pipeline from the influences of waves and currents.

Backhoe Dredger

A backhoe dredger is typically mounted on a floating barge or jack-up platform and the dredged material loaded onto hopper barges for transport and deposition at the relocation site (Figure 2-14). With an appropriate number of hopper barges in support, continuous dredging is maintained.

The main advantage of the backhoe dredger is the ability to dredge a wide range of materials, including those that contain debris or (for large machines) boulders. Difficult materials, such as stiff clays and weak, weathered or fractured rocks, can be dredged by the larger dredgers.

Figure 2-14 Large Backhoe Dredger

Dredging Methodology

Table 2-9 presents a feasible dredging methodology for each of the scenarios detailed in Table 2-5. The size and combination of plant options likely to be suitable to undertake the works have been assessed on the basis of the time constraints associated with completion of each portion of the works for the Project and the information that is currently available regarding the material to be dredged. The likely primary dredge and auxiliary plant to be used are presented.

The global dredging fleet is limited and access to specific size plants at the required project time can not be guaranteed. All proposed works will undergo a tendering process. The available equipment to execute the works will depend on the market at the time of tendering and any performance requirements specified in the project approvals.

Production rates reported in Table 2-8 for each dredger type take into account the type and size of the dredger, foreseen delays (including ship movements), the location of the dredge area, the size and shape of the dredge area, distance to the material relocation area, disposal method, dredging depth and type of material being dredged. It is for this reason that the same type and size dredger may have different production rates for differing areas.

The dredging methodology proposed:

- Confirms that plant is available on the world market to complete the work to the timelines required for the various projects; and
- Provides the basis upon which the environmental impacts were assessed for a range of dredging plant.

Dredging of a “Material Discharge Area” will be required north of the existing Fisherman’s Landing Swing Basin prior to the commencement of the proposed capital dredging if a TSHD is employed. The TSHD will employ either of the following disposal options:

- Bottom dump the material for rehandling using a CSD to pump the material into the Reclamation Area; or
- Pump the material from the hopper directly into the Reclamation Area.

An area with sufficient depth close to the Reclamation Area will be required if the bottom dump methodology is employed. If the pump out option is adopted then the TSHD will require an area clear of shipping movements where it can pump-out the material, which typically takes 1-2 hours. In either case, a suitable Material Discharge Area will need to be developed.

The proposed timing for the dredging of each stage and the anticipated length of the dredging campaign are summarised in Table 2-9. The dredgers are likely to operate on 12 hour shifts and change over at 6 am and 6 pm. At the peak of the dredging operation (Scenario 1), there are likely to be four dredgers in place, being two cutter and two trailer dredgers.

Table 2-9 Dredging Methodology Summary

Scenario	Scenario Start Date	Scenario Completion Date	Likely Dredger Option	Dredge Area	Auxiliary Dredger Option	Dredge Volume ('000,000 m^3)	Estimated Completion Time (months)
1	Late 2010	Late 2012					
			Large TSHD Total Dredging Time 5.3 months to 8.8 months	Clinton Bypass Wedge (Stage 1A)	Backhoe	0.05	0.1 - 0.2
				Clinton Bypass Channel (Stage 1A)	Med TSHD	3.25	3.6 - 6
				Curtis Channel – South (Stage 1A)	Med CSD	1.3	1.6 - 2.6
			Large CSD Total dredging time 15.2 months	Curtis Channel – North (Stage 1A)	Backhoe / Med CSD	5.7	7.6
				Curtis Channel – Middle (Stage 1A)	Med CSD	5.7	7.6
2	Late 2012	Early 2014					
			Large TSHD Total Dredging Time 5.4 months to 9.5 months	Targinie Channel – (Stage 1B)	Med TSHD	2.0	1.8 - 3.3
				Fisherman's Landing Swing Basin – (Stage 1B)	Med TSHD	2.6	3.6 - 6.2
			Large CSD or Large TSHD Total Dredging Time 3.8 months to 7.1 months	Laird Point (Stage 2)	Nil	4.5	3.8 - 7.1
3*	Future Planned Dredging	Future Planned Dredging					
			Large CSD Total Dredging Time 13.1 months	Fisherman's Landing (Stage 3)	Nil	5.5	7.6
				Hamilton Point (Stage 4	Nil	3.9	5.5

* Subject to the demand for this scenario to be completed, a medium sized CSD may also be capable of completing this work.

Marine Offload Facilities Design

The QGC and GLNG projects on Curtis Island are proposing to construct Marine Offload Facilities (MOFs) to provide facilities for the transport of construction materials, equipment and personnel to Curtis Island, as there is no existing road, rail or shipping access to these areas.

A description of these facilities is based on information provided by the proponents, with the general footprint of both facilities shown in Figure 2-15. The sediment and marine flora and fauna characteristics of the dredging footprint for both MOFs have been assessed as part of the overall marine ecological and sediment quality assessments documented in Chapter 9 and Chapter respectively. Water quality impacts during dredging are also discussed in Chapter 7.

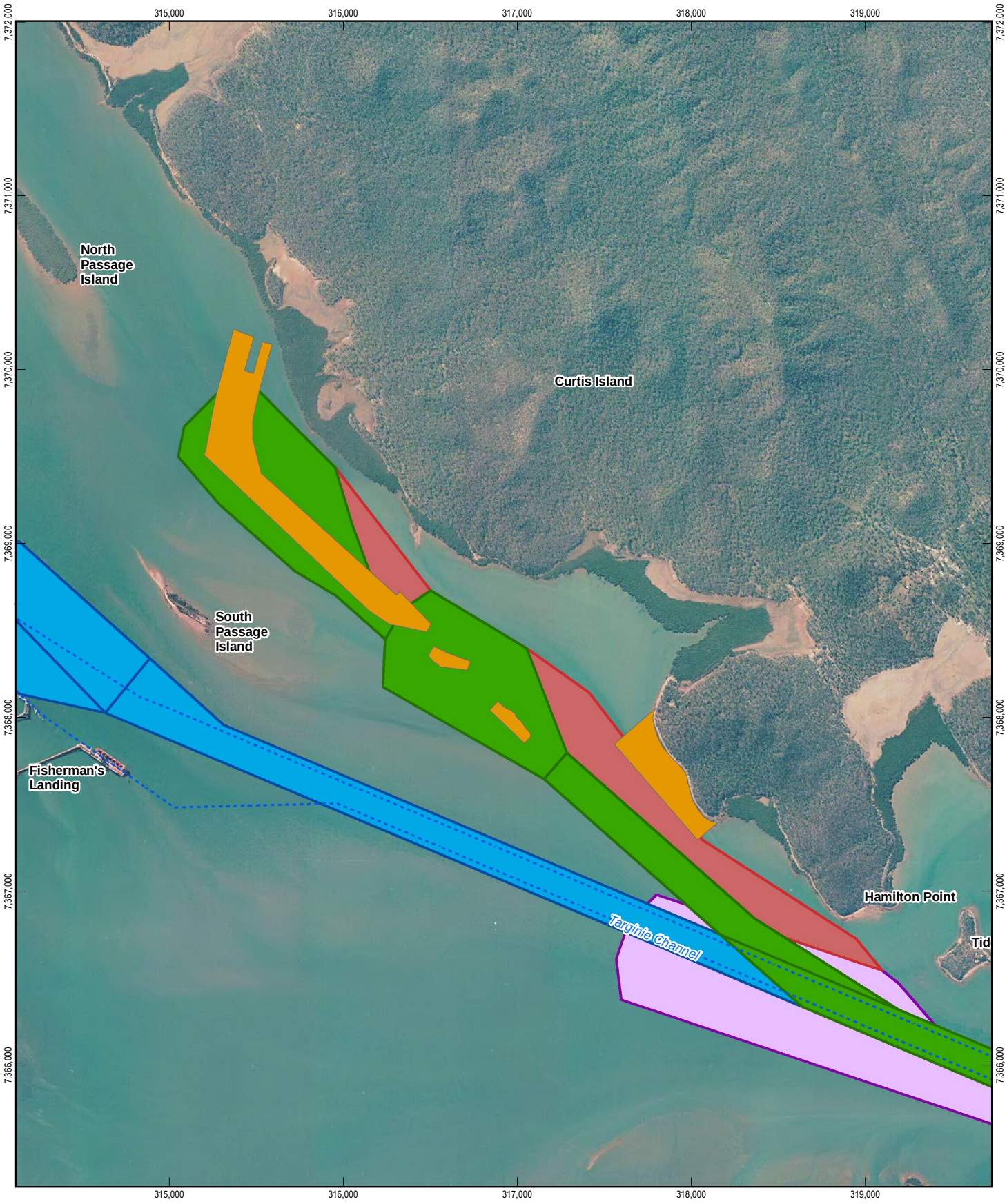
QGC MOF

The QGC MOF as shown on Figure 2-15 and is proposed to be developed in two stages. Stage 1 will require the development of a short channel to a depth of -2.8 m LAT, with a volume of 140,000 m^3 to be removed. Stage 2 requires deepening of the access channel to a depth of -7.8 m LAT and involves removing 3,000,000 m^3 of material. Due to the nature of the bathymetry, Stage 2 requires lengthening of the access channel for some distance to reach the natural -7.8 m LAT contour. Much of this access channel is within the Stage 1A dredging footprint. Therefore should the Stage 1A dredging commence in time, most of the MOF Stage 2 dredging will not be required.

A backhoe dredge would be utilised to conduct Stage 1 of the MOF dredging and a CSD would be used for the MOF Stage 2 dredging.

GLNG MOF

The GLNG MOF design is not finalised, however it will be located within the area indicated on Figure 2-15 and the maximum dredge volume will be 100,000 m^3. The MOF is likely to consist of a breakwater structure and a dredged area to allow barges and ferries to berth and offload. The dredging method cannot be finalised until the design is finalised. If the volume is close to 100,000 m^3, the MOF dredging will be done by the same dredging plant that dredges Stage 1A. If the volume is smaller or if there are depth restrictions for the Stage 1A dredging plant, the dredging is likely to be completed by an excavator, potentially off the MOF structure itself.



LEGEND

- Existing Channels, Swing Basins and Berths
- Proposed Marine Offload Facility

Proposed Dredging Stages

- Stage 1A - North China Bay LNG Precinct
- Stage 1B - Fisherman's Landing LNG
- Stage 4 - Hamilton Point

- Wiggins Island Coal Terminal (Approved)

1:30,000 (at A4)

0 200 400 600 800 1,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

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Port of Gladstone
Western Basin Dredging and Disposal Project

Proposed Marine Offload Facilities, Curtis Island

Job Number 42-15386
Revision A
Date 01 Sep 2009

Figure 2-15

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Maintenance Dredging Methodology

The following factors are considered in the selection of dredging equipment for maintenance dredging:

- Maintenance dredge material is relatively unconsolidated;
- Depth limitations for operation of the dredging plant are generally not of concern;
- Historically, maintenance dredging in Gladstone requires removal of a relatively small volume. However, this volume will potentially increase with the increased trapping efficiency and changed hydrodynamics following the proposed capital dredging;
- Shipping movements; and
- As maintenance dredging is an ongoing requirement, a cost effective option is desirable.

Based on the above points, a TSHD will be the most appropriate dredger to undertake maintenance work. Considering the material will generally be unconsolidated deposits, it is proposed that a medium sized TSHD will be able to complete the works efficiently. It is proposed that material from subsequent maintenance dredging campaigns will be relocated to the Western Basin reclamation.

Dredging Workforce

At the peak of the dredging operation, there could be 4 dredgers in place, being two cutter and two trailer dredges. It is anticipated that when all four dredges are working together, the construction workforce will be approximately 280 people. Of the 280, approximately 55 people will reside on each of the larger TSHD.

Approximately 225 people will commute to the Western Basin reclamation site each day from Gladstone. In addition, daytime personnel movement is anticipated with suppliers of spare parts for the equipment, groceries for the TSHD (e.g., once a week), some of the TSHD personnel visiting town and visitors on-site. Dredge vessel personnel will board the dredgers from a temporary landing on the north east corner of the current Fisherman's Landing reclamation, accessing the site by continuing down Landing Road to the mangroves at the end and following the Services corridor to the southeast, beside the mangroves, to the existing Fisherman's Landing reclamation. At this point, no allowance will be made for transporting personnel to or from Fisherman's Landing (e.g., buses) so it is anticipated private vehicle trips will be undertaken.

2.3.4 Proposed Reclamation Area Design and Bund Wall Construction Method

Source of Rock Material

An abandoned quarry situated at Guerassimoff Road, Yarwun, on Lot 71 on RP801113, is being re-established to obtain hard rock quarry materials for use by GPC in this and other projects within the Port. The quarry materials required for bund wall construction include:

Bund armour - This material comprises the larger fractions of quarry materials that may have been separated from the "run of quarry" materials at the quarry. The material is anticipated to be a uniform rock, graded to prescribed engineering specifications.

Bund material - The "run of quarry" material that remains after the armour rock has been removed may also have the smaller particle sizes "scalped". The resulting material to be used for bund construction will have a minimum particle size of 12 mm to assist in the minimisation of the release of fines into the water column and subsequent turbidity generation.

The characteristics of the bund construction materials are described in detail Chapter 5, with a summary provided here. An investigation into the quarry resource was undertaken as part of the quarry design process (GHD 2009e). All rock of resource value in the quarry was categorised as bluestone, which is not expected to result in impacts on water quality when placed in the marine environment. The potential for acid production from the bluestone when it is placed in the marine environment is considered low, however, it will be tested prior to the commencement of construction. A combination of scalped fines and overburden material which consists of residual soils of completely weathered bluestone with little to no organic matter will be used to cap the final reclamation surface (GHD 2009e).

Reclamation Footprint and Design

The layout of the bund wall with respect to the existing Fisherman's Landing reclamation, proposed Fisherman's Landing Northern Expansion and shoreline is shown in Figure 2-16. Cross sections of the eastern (seaward), northern and western (landward) bund walls are provided Figure 2-17. A long section is also provided, illustrating the mound and 40 m wide remnant intertidal channel on the landward side of the Reclamation Area (Figure 2-18).

The Western Basin Reclamation Area will build on the Fisherman's Landing Northern Expansion by extending slightly further north and running west towards the shoreline approximately half way around the Fisherman's Landing embayment. The reclamation will be set back from the foreshore to allow for maintenance of the mangrove communities and to assist with conveying overland flows and stormwater discharges from QER and Cement Australia. The width of this setback may be approximately 40 m.

The footprint of the Reclamation Area provides storage for approximately 29 million m^3 of dredge spoil when filled to RL7 LAT. The total required volume for storage for the dredge spoil is approximately 55 million m^3. To allow the reclamation to accommodate this volume of dredged material without increasing the footprint on the seabed, it is proposed to shape the material into a 50 – 70 m high mound at the back of the reclamation (Figure 2-18). The mound would have a 1:6 grade and may be constructed over time from south to north. An internal bund wall may be required to assist in retaining the material at height, given the high water content of dredged material. This will be investigated at the detailed design stage. It is anticipated the mound will be vegetated with native grasses and trees to assist in stabilising the surface, reducing stormwater runoff and improving visual amenity.

The bund will require approximately 1,800,000 m^3 of quarry material to form the reclamation face. The height of the revetment walls is proposed to be RL 7 m Port Datum, with a crest width of 10 m to allow for construction traffic to turn around and for a roadway around the outer edge of the reclamation, once complete. A 600 m wide strip, sloped at 1% from the back to the front, will be retained along the eastern wall, behind the future wharves, providing an area for lay down and storage. Approximately 200 m will be left between the land area behind the wharves and base of the hill, providing space for a potential future rail loop around the mound and to allow for the management of stormwater drainage. Road and rail access may eventually be provided from the end of Landing Road, with the road heading to the south of the hill to be used for accessing the industrial and wharf areas. The road to the north of the hill may be used by the public to access the boat ramp at the north eastern corner of the reclamation.

During filling of the reclamation, a series of decant ponds will be constructed internal to the outer bund wall to allow for the fine material to settle from the tailwaters. Initially, the final decant pond will be in the north eastern corner of the reclamation, moving to the north western corner as the reclamation is filled over time. The final decant pond will also capture stormwater discharges. Once the reclamation is completed, the final decant pond will be maintained as a wetland with all stormwater discharges directed to this point.

NOTES:

1. PORT DATUM INDICATED AS 0.0 CONTOUR LINE (BATHYMETRY).
2. PORT DATUM IS EQUAL TO AHD -2.268m.
3. COORDINATE SYSTEM IS GDA94.
4. BATHYMETRY SHOWN IS BASED ON INFORMATION PROVIDED BY GLADSTONE PORTS CORPORATION.

ESTIMATED VOLUMES		
ZONE	PLAN AREA (m^2)	VOLUME (m^3)
5.1 (RL 7.0)	3 844 656	38 430 611
5.2 (MOUND)	1 064 212	26 354 711

NOTE:

1. APPROXIMATE LEVELS ASSUMED FOR AREAS OUTSIDE OF SURVEY LIMITS.
2. 5.1 VOLUME EXTRACTED FROM 12d FROM 1.5m BELOW THE EXISTING SEA BED TO RL 7.0 (WITHOUT MOUND).
3. 5.2 VOLUME EXTRACTED FROM 12d, RL 7.0 TO RL 70.

1:20,000 (at A3)

0 200 400 600 800 1000m

SCALE 1:20,000 AT ORIGINAL SIZE

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 56

N

LEGEND

Port of Gladstone
Western Basin Dredging and Disposal Project

Reclamation Area Plan

Job Number	42-15386
Revision	A
Date	October 2009

Figure 2-16

G:\42\15386\CADD\DRAWINGS\WESTERN BASIN\42-15386-28-FIG2-16.DWG

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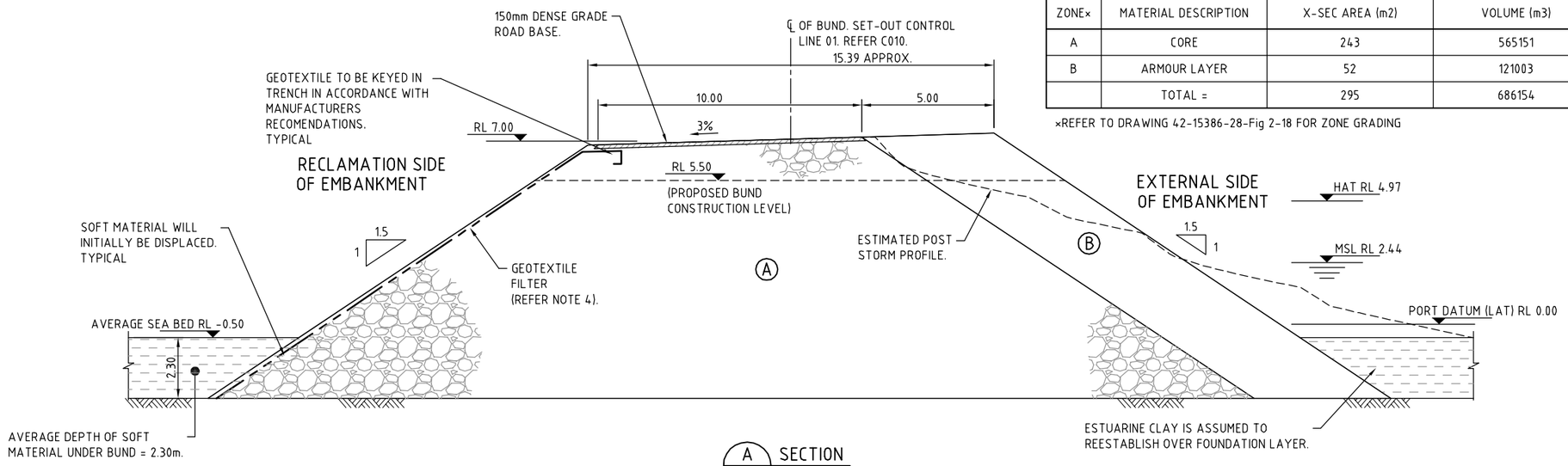
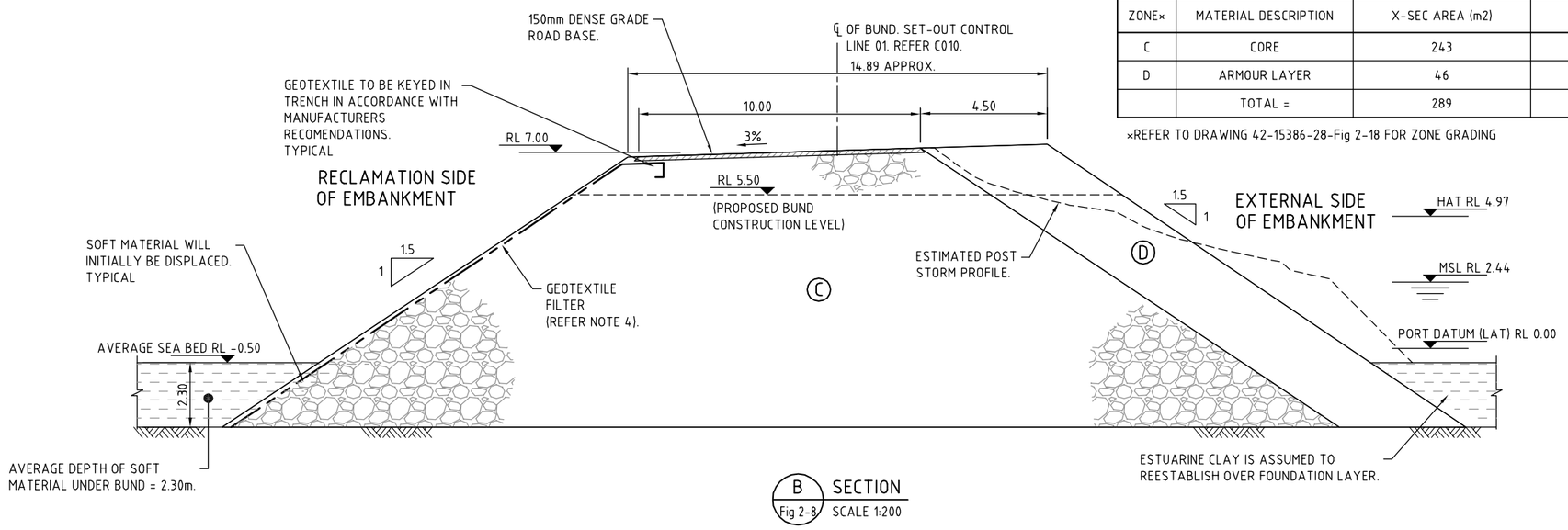


A SECTION
Fig 2-8 SCALE 1:200

DYNAMIC DESIGN - BUND 01
EASTERN EMBANKMENT

BUND 01 - LENGTH = 2187m			
ZONE×	MATERIAL DESCRIPTION	X-SEC AREA (m2)	VOLUME (m3)
A	CORE	243	565151
B	ARMOUR LAYER	52	121003
	TOTAL =	295	686154

×REFER TO DRAWING 42-15386-28-Fig 2-18 FOR ZONE GRADING



B SECTION
Fig 2-8 SCALE 1:200

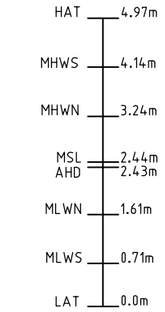
DYNAMIC DESIGN - BUND 02
NORTHERN EMBANKMENT

BUND 02 - LENGTH = 691m			
ZONE×	MATERIAL DESCRIPTION	X-SEC AREA (m2)	VOLUME (m3)
C	CORE	243	373432
D	ARMOUR LAYER	46	70548
	TOTAL =	289	443980

×REFER TO DRAWING 42-15386-28-Fig 2-18 FOR ZONE GRADING

NOTES

1. ALL DIMENSIONS IN METRES
2. ALL REDUCED LEVELS IN METRES RELATIVE TO PORT DATUM.
3. ABBREVIATIONS:
   HAT HIGHEST ASTRONOMICAL TIDE
   MSL MEAN SEA LEVEL
   LAT LOWEST ASTRONOMICAL TIDE
   RL REDUCED LEVEL
4. GEOTEXTILE IS TERRAFIX 1200R (NON WOVEN) OR SIMILAR APPROVED.
5. SEA BED LEVEL AND FOUNDATION LAYER LEVEL VARY.



TIDAL PLANES
FISHERMAN'S LANDING

1:200 (at A3)
0 2 4 6 8 10m
SCALE 1:200 AT ORIGINAL SIZE

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 56

LEGEND

Port of Gladstone
Western Basin Dredging and Disposal Project

Cross Sections of the Eastern, Northern and Western Bund Walls

Job Number	42-15386
Revision	A
Date	October 2009

Figure 2-17

G:\42\15386\CADD\DRAWINGS\WESTERN BASIN\42-15386-28-FIG2-17.DWG

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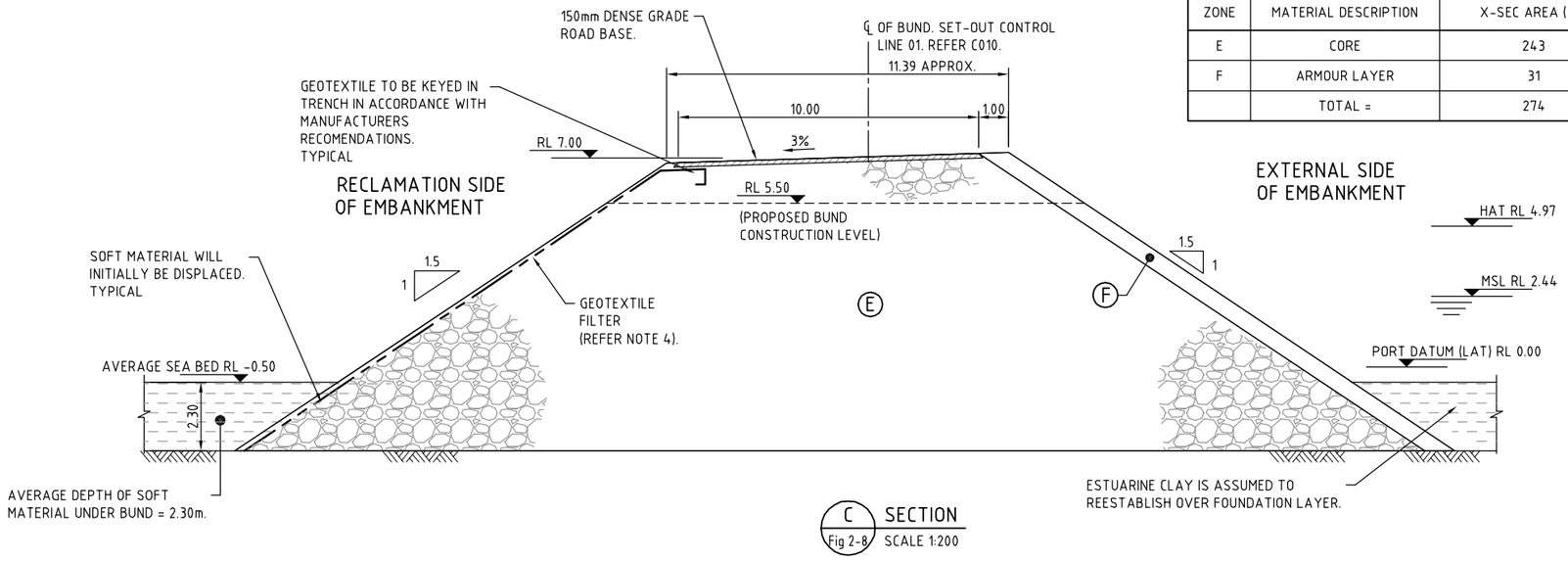
NOTES

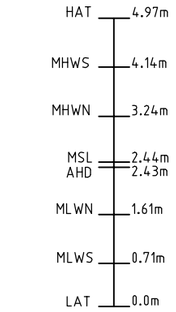
1. ALL DIMENSIONS IN METRES
2. ALL REDUCED LEVELS IN METRES RELATIVE TO PORT DATUM.
3. ABBREVIATIONS:
   HAT HIGHEST ASTRONOMICAL TIDE
   MSL MEAN SEA LEVEL
   LAT LOWEST ASTRONOMICAL TIDE
   RL REDUCED LEVEL
4. GEOTEXTILE IS TERRAFIX 1200R (NON WOVEN) OR SIMILAR APPROVED.

BUND 03 - LENGTH = 2188m			
ZONE	MATERIAL DESCRIPTION	X-SEC AREA (m2)	VOLUME (m3)
E	CORE	243	328165
F	ARMOUR LAYER	31	41309
	TOTAL =	274	369474



C SECTION
Fig 2-8 SCALE 1:200

DYNAMIC DESIGN - BUND 03
WESTERN EMBANKMENT



TIDAL PLANES
FISHERMAN'S LANDING

ZONE GRADING				
ZONE	MATERIAL DESCRIPTION	D15 (mm)	D50 (mm)	D85 (mm)
A	CORE	25	75	155
B	ARMOUR LAYER	175	300	435
C	CORE	20	50	100
D	ARMOUR LAYER	115	200	290
E	CORE	20	50	100
F	ARMOUR LAYER	115	200	290

1:200 (at A3)
0 2 4 6 8 10m
SCALE 1:200 AT ORIGINAL SIZE
Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 56

LEGEND

Port of Gladstone
Western Basin Dredging and Disposal Project
Cross Sections of the Eastern, Northern and Western Bund Walls

Job Number 42-15386
Revision A
Date October 2009
Figure 2-17

G:\42\15386\CADD\DRAWINGS\WESTERN BASIN\42-15386-28-FIG2-18.DWG

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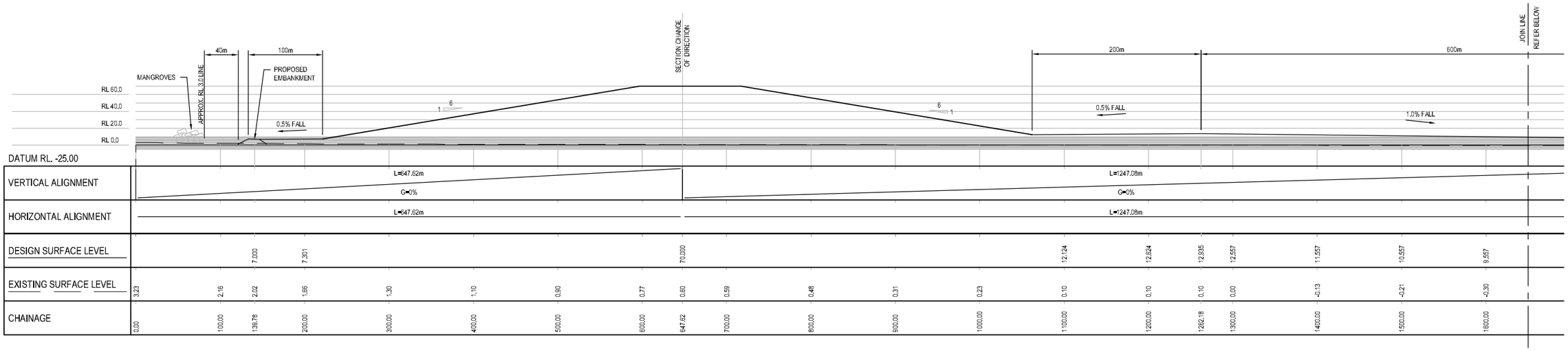
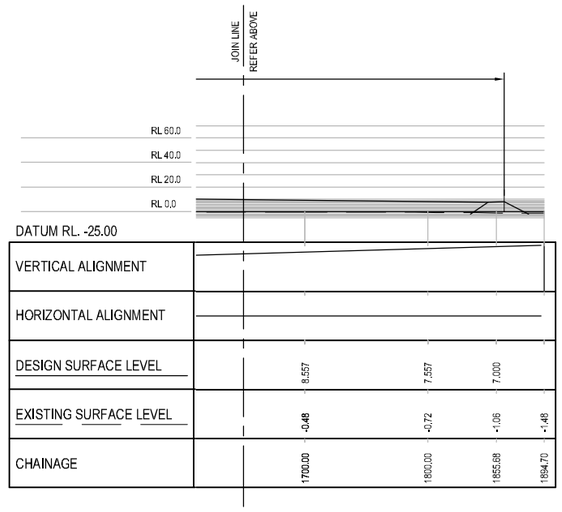


LONGITUDINAL SECTION 1

1 SECTION
Fig 2-18 SCALE 1 : 5000



1:5,000 (at A3)

0 50 100 150 200 250m

SCALE 1:5000 AT ORIGINAL SIZE

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 56

LEGEND

Port of Gladstone
Western Basin Dredging and Disposal Project

Reclamation Long Section, showing Intertidal Channel and Mound

Job Number 42-15386
Revision A
Date October 2009

Figure 2-18

G:\ 42\15386\CADD\DRAWINGS\WESTERN BASIN\42-15386-28-FIG2-19.DWG

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Bund Construction Methodology

The works method description is presented to assist in identifying potential environmental impacts resulting from the works. The methodology reported in the following section relates specifically to the bund “work front”.

Construction Sequence

Initial Run of Core Material

Trucks may deliver core material from the quarry directly to the bund work face (Figure 2-19). The initial placement of the bund wall may be to the level of the highest astronomical tide (HAT) – with the crest being 10 m wide. This approach provides a running surface wide enough for construction vehicles above water level. Notwithstanding, there may be instances during the highest tides when the waves lap over the crest of the bund. However, the occurrence of such events can be tolerated within the construction process. The bed comprises soft silts and competent materials which support the bund. The bed layer will be between 1.5 m to 2 m below the mud layer.

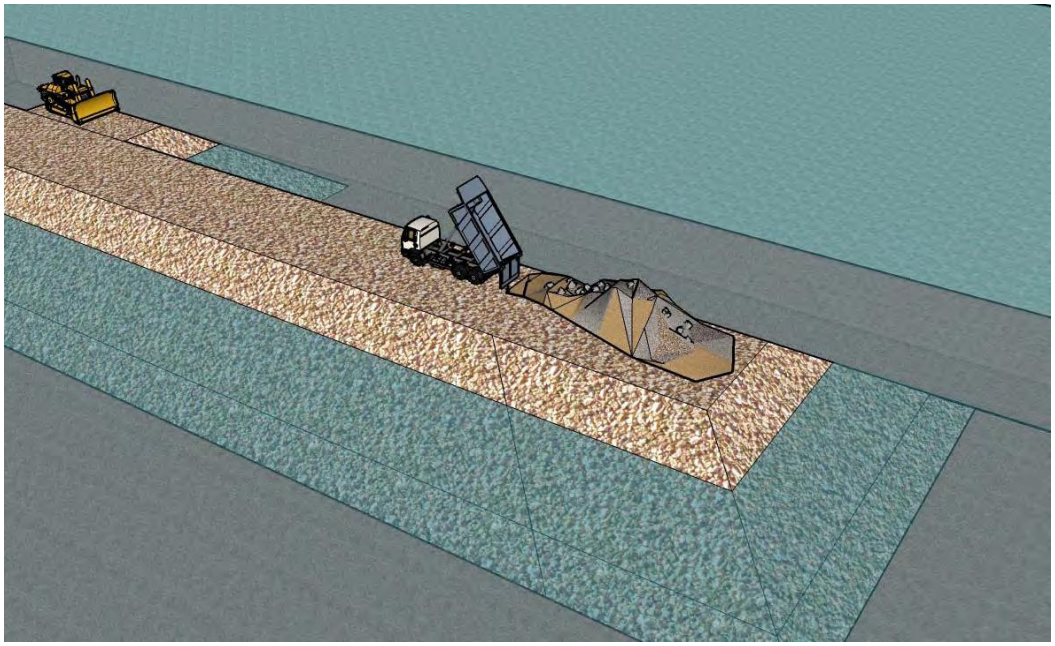

Figure 2-19 Core Construction

Trucks may:

- End tip material onto the bund, with the material being pushed over the face by a bulldozer or end loader; or
- End tip directly over the end of the core.

The core material will sink through the soft bed to settle on the stiff clays underneath. In the process of settling through the soft bed, the soft silts may:

- Become embodied in the matrix of the core material;
- Push out a mud wave ahead of the bund; and

- Push out a mud wave to either side of the bund.

Surveyors will control and guide the progression of the bund wall to the required lines and levels as it extends out into the water. As the bund wall extends some distance from shore, there may be the need to provide turning areas and lay-bys to facilitate the efficient movement of construction plant and equipment.

Placement of Armour Material

The bund core does not have the integrity to withstand substantial wave attack. To protect the core from potential storm (cyclone) conditions that may arise during the course of construction, armour material will be placed along the exposed face of the core material following behind the core work face (Figure 2-20).

A stockpile of armour material will be held at the quarry, sufficient to cover any exposed core if a cyclone were to approach. Contingency planning for a storm will require the placement of the stockpiled armour material to cover exposed faces of the core material.

In a similar manner to which the core material will sink through the in situ silt/mud, the rock armour will sink through the silt/mud, founding on the underlying competent stratum and pushing out a mudwave.

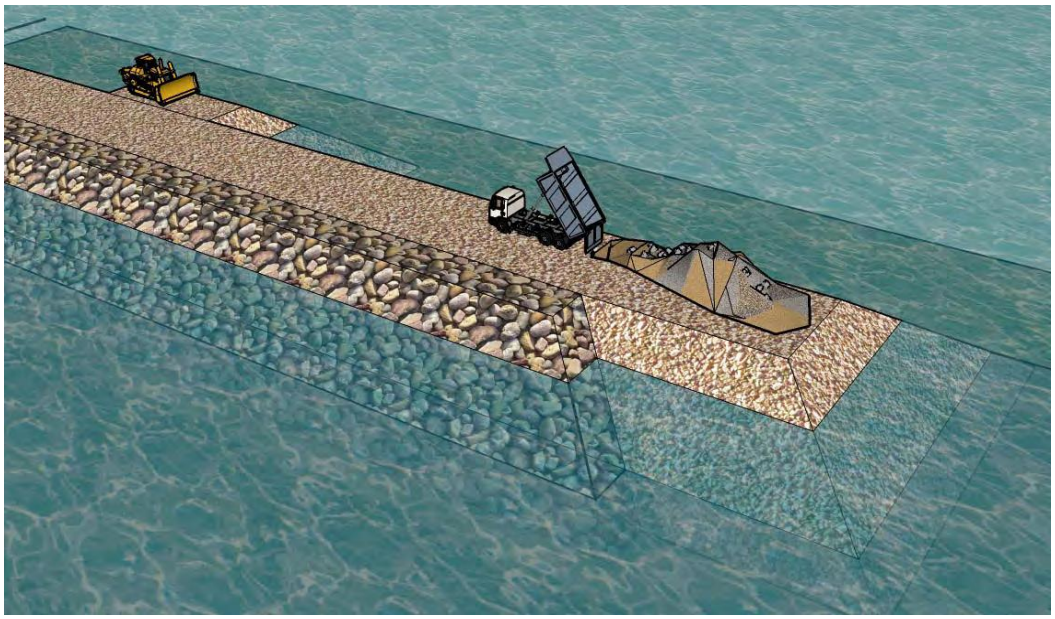

Figure 2-20 Armour Material Placement to Protect the Core

Topping Off

After completion of the bund wall and armouring to the low crest level, the bund will be "topped off" with placement of the remaining core and armour to bring the bunds to final design lines and levels (RL 7m LAT) (Figure 2-21).

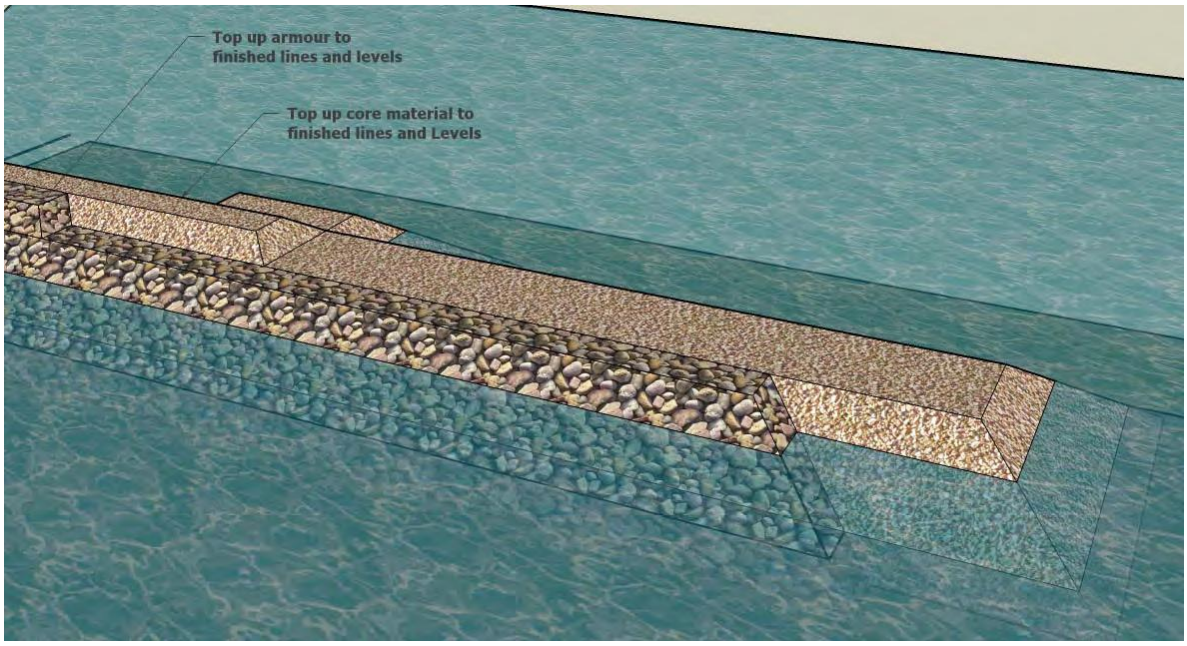

Figure 2-21 Final Top Up of Core and Armour

Geotextile Placement

Geotextile fabric will be placed on the inner face of the bund wall. The purpose of the geotextile material is to minimise migration of fines within the dredged material through the bund wall to the surrounding aquatic environment.

Construction Equipment

Construction equipment required includes trucks (either GPC contractors with body truck with trailer; or CAT 777D, 73 ton capacity, off-highway mining trucks). A small number of excavators or dozers would also be required to aid in the placement of material.

Construction Rate and Timing

The rate at which the bund wall is required to be constructed will depend on the timing and size of the dredging programs that will fill the reclamation. It is likely that the entire bund wall may need to be completed in one construction program, equating to a rate of approximately 1.8 million m^3/year. If the bund is only required to be constructed at a rate that allows for the disposal of maintenance dredging material at approximately 200,000 million m^3/year and minor capital dredging projects, GPC would use their existing fleet of trucks to undertake construction at a rate of approximately 400,000 million m^3/year for a number of years. However, it is most likely that a higher construction rate will be required.

Construction Workforce

The workforce during the construction of the Reclamation Area will be substantially lower than during dredging operations, with a workforce of 30 – 40 people anticipated.

2.3.5 Proposed Dredged Material Disposal Method

The dredged material disposal location proposed for this Project is the Western Basin Reclamation Area. The design and construction method for the Reclamation Area was outlined in Section 2.3.4. A detailed discussion of the potential impacts and mitigation measures for the decant of dredge tailwaters from the Reclamation Area is provided in Section 7.1 and Appendix K, including modelling of turbid plumes and establishment of water quality objectives for the receiving environment. Section 5.5 and Appendix I and Section 7.2 and Appendix L provide a detailed description of the quality of the material to be dredged in terms of acid sulphate soils and sediment chemistry respectively.

This section provides a summary of the way in which dredged material will be placed in the Reclamation Area.

Filling and Decant Management

Once the bund wall is complete, or a section of the bund is complete and enclosed, dredged material will be pumped into the reclamation, typically through a floating discharge line. The dredged material will be transported as slurry by pipeline from the dredger. Material will be allowed to beach adjacent to the bund wall, with excess water decanting towards the northern wall of the reclamation. A single decant point into the receiving environment will be established half way along the outer northern wall of the reclamation.

For past dredging campaigns, these management measures have included the creation of cells internal to the outer bund wall, with the provision of variable height weir boxes between the cells, allowing the rate of discharge to be controlled. These cells will be constructed, installed and maintained so that a freeboard of not less than 0.5 metre is maintained at all times. The cells will operate in series with the waters from the preceding cell entering the next cell via the weirs.

Information regarding the reclamation cells and weir boxes or management measures required will be provided with the development approvals for each individual dredging program. Once the material characteristics, dredge type, volume and flow rates are known for a particular dredging program, calculations will be undertaken to determine the residence time required to achieve the water quality objectives and appropriate management measures installed.

With the material that is typically dredged from the harbour, GPC has been able to meet the water quality objectives set by regulators for previous dredging and reclamation programs, providing confidence that this can continue to be achieved for the Western Basin Dredging and Disposal Project.

In the event that discharge turbidity levels exceed specified limits, the cause of the elevated turbidity will be assessed and an appropriate response determined. This response will include one or more of the following:

- Raise weir levels (final weir and others, if required);
- Switch outlet weirs where more than one is provided between each cell (i.e. eliminate short-circuiting, if this is the cause of elevated turbidity);
- Install internal bund or wave protection measures to reduce re-suspension by wind waves if this is the cause of elevated turbidity;
- Construct additional decant cells;
- Cease discharge from the final cell until water clarity improves; and
- Reduce dredger delivery rate. This would be a last resort if all other measures fail to reduce turbidity to the specified trigger levels in the receiving environment.

Final Surface

Following the completion of filling operations within sections of the Reclamation Area, GPC will undertake surface stabilisation works, which may include capping the final surface with material of an appropriate grade or planting of native grasses suited to coastal locations and installation of stormwater management measures.

A concept design for the stormwater system proposed for the final reclamation surface is discussed in Section 2.4.3.

2.4 Infrastructure Requirements

This section provides descriptions of the infrastructure requirements for the Project in accordance with Section 2.4 of the ToR. Waste generated by the construction phase is also discussed in accordance with Section 3.7 of the ToR as the wastes generated are not significant enough to warrant a separate chapter within the EIS.

Supporting infrastructure that will be established on the existing Fisherman's Landing Reclamation for this Project will be limited to a small site office for 2 – 3 staff during bund construction and a site office, crib facilities and small workshop comprising up to 40 staff during dredging. A small carpark for office and workshop staff will also be established. The location and layout of these facilities will be determined at the commencement of the Project and will take into account ongoing operations and other activities on the existing Fisherman's Landing Reclamation, such as Rio Tinto Stage 2 construction laydown areas. The location in which the site office, workshop and crib facilities are established will be on Strategic Port Land and GPC will establish site security.

2.4.1 Transport

There are two aspects of the Project for which transport is required:

- Commuting of workforce traffic for the bund construction and dredging, and final reclamation surface preparation aspects of the Project; and
- Haulage of construction materials for the Reclamation Area bund wall and final reclamation surface preparation from the GPC owned quarry on Guerassimoff Road.

A detailed discussion of traffic and transport impacts of the Project is provided in Chapter 11.

Materials for the construction of the bund wall for the Reclamation Area will be transported by haul road from the GPC quarry, which is located at Guerassimoff Road, approximately 4 km from Western Basin (Figure 2-6). A separate Haul Route Options Study and approvals process has been undertaken for the on-road and off-road haul routes that are proposed to be used. If GPC trucks are used to haul the rock material, the on road haul route will be used. If a high construction rate is required, off-road mining trucks will be used on the off-road haul route.

Equipment and plant for construction of the reclamation and small volumes of construction waste will be transported on the existing road network, accessing the Western Basin Reclamation Area along Landing Road. The trucks used to haul rock from the quarry to the reclamation will be based at the quarry. No hazardous material will be transported, except for fuel for the reclamation construction traffic, which will be provided at a licensed fuel storage facility at the quarry site.

Workers travelling to the quarry and Reclamation Area during bund wall construction and dredging are expected to travel out of town along the Gladstone – Mt Larcom Road to the quarry site at Guerassimoff

Road and the Reclamation Area as relevant. A small staff carpark will be established at the reclamation site during dredging and bund construction.

There is no requirement for transport of construction materials, equipment or workforce to the Project site by rail or ship, with the exception of the dredging crews, which will be transported on small support vessels from the barge landing at the existing Fisherman's Landing Reclamation to the dredgers.

2.4.2 Water Supply and Storage

GPC will not be providing raw or treated water to the reclamation during the bund construction and infilling phase of the Project. Temporary drinking water supplies will be provided at the temporary site office at a level appropriate to the number of people using the office facilities.

2.4.3 Stormwater Drainage

A concept design for the stormwater system for the final reclamation was prepared (GHD 2009f). A summary of this design is provided in this section.

General Description of Final Reclamation Surface

Given that this Project involves the construction of a bund wall and then reclamation of land in an area that is currently under the high tide mark, there is no requirement to consider stormwater drainage until such land is above sea level. During filling of the reclamation, a dedicated decant point will be established, into which both the tail-waters from the dredged material and any stormwater flows will be directed, after travelling through internal settling ponds.

The concept design presented here includes the Fisherman's Landing Northern Expansion as this site will be contiguous with the proposed Western Basin Reclamation Area. The total Reclamation Area will be approximately 408 ha in extent and will be contained within rock bunds, with surface profiling as follows:

- An 800 m wide strip of gently sloping land, draining towards the east;
- Gently sloping land to the north-east;
- 100 m wide strip of gently sloping land, draining towards the west;
- Moderately sloping (1:6) mound; and
- An area of land to the north-west, designated for a large stormwater quality improvement device.

All possible future development on the Reclamation Area will be subject to separate assessment(s), as required by the appropriate regulatory authorities.

The details of the conceptual design of a stormwater management system (stormwater drainage system and stormwater treatment measures) are depicted in Figure 2-23. The conceptual design is intended to demonstrate that a functional stormwater management system can be achieved at this site.

When future industries develop on the final reclamation, they will be required to install appropriate stormwater management measures to manage both clean and potentially contaminated stormwater from their sites through the relevant development approvals processes.

Stormwater Drainage System – Concept

The conceptual design of the stormwater drainage system was based on industry norms and standards, with due consideration for possible future land use, staged construction, operation and maintenance, as follows:

- The Reclamation Area will be free draining towards the outer perimeter, with outer slopes generally ranging between 1:100 and 1:200. The mound has a general slope of 1:6;
- The outer perimeter is completely enclosed by channels, draining towards a series of stormwater quality improvement devices;
- The channel configuration takes cognisance of possible future industrial development, to ensure that:
  - The stormwater drainage system is not adversely impacted during possible future development of industrial sites; and
  - The segregation of “clean” and “dirty” water is practicable.
- Contour drains on the mound are at 50 m centres (horizontally), to allow for drainage to be staged as construction of the mound proceeds;
- The majority of the proposed Reclamation Area, including the mound would discharge via a large stormwater quality improvement device into the intertidal zone / remnant bay area to the north-west;
- The remainder of the Reclamation Area discharges via a series of stormwater quality improvement devices at numerous points along the outer perimeter (two in the south-west, discharging into the intertidal channel; two in the north, discharging into the intertidal zone/remnant bay area; and six in the east, discharging into the open waters of Port Curtis); and
- No discharge is proposed along the land-attached southern end, to the existing Fisherman’s Landing Reclamation Area.

Table 2-10 presents the design assumptions used to conceptually size all channels.

Table 2-10 Concept Channel Sizing Design Assumptions

Design Aspect	Design Assumption
Peak discharge	100 year ARI rainfall event
Freeboard allowance	300 mm
Channel slope	1:100 desirable (1:200 minimum)
Channel lining	grass
Maximum permissible channel velocity	2m/s
Lowest permissible invert level	RL 4.97m AHD (equivalent to HAT)

Grass-lined channels have been recommended as these represent a practical compromise between hydraulic efficiency and cost efficacy. Unlined channels would require a substantially larger cross sectional area in order to reduce velocities, thereby minimising erosion.

Stormwater Treatment Measures – Concept

The primary water quality risk associated with the proposed Reclamation Area is the suspended solids content of stormwater runoff. The conceptual design of proposed stormwater treatment measures is based on structural source and treatment control systems, to address soil erosion and sediment control, respectively. The Revised Universal Soil Loss Equation (RUSLE) Method, as presented in BCC (2001) was used to determine probable maximum annual soil loss. International Erosion Control Association (IECA, 2007) was used to select and conceptually design stormwater quality improvement devices.

Soil characteristics were inferred from previous dredging projects in the Port, as follows:

- 5 - 40% sand; and
- 95 - 60% clay and silt.

Given the high clay and silt content, it was assumed that the soil matrix may include a high percentage of dispersive material.

In accordance with IECA (2007), the recommended stormwater treatment measure is a *Type D wet sediment basin*. Type D wet sediment basins are purpose built small dams, designed to collect and settle sediment-laden water (Figure 2-22). They generally perform two main functions:

- Settlement of fine-grained particles (e.g. fine silt and clay) and coarse-grained sediment particles (e.g. sand and coarse silt) from waters retained within the basin following low intensity, high frequency storm events; and
- Settlement of coarse-grained sediment particles from waters passing through the basin following high intensity, low frequency storm events.

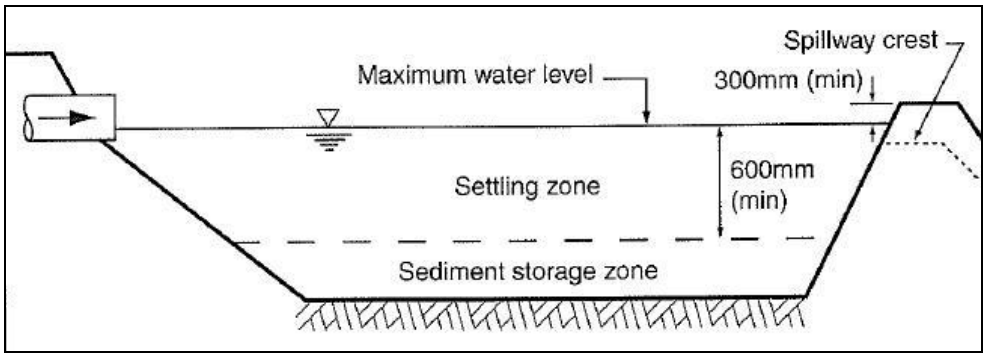

Figure 2-22 Typical Detail of Type D Wet Sediment Basin

Type D wet sediment basins usually consist of a settling pond, a decant system, and a high-flow emergency spillway and are designed to retain sediment-laden water for extended periods, allowing adequate time for the gravitational settlement of fine sediment particles. Operation of these basins may be assisted through the use of chemical flocculants. Ideally, these basins are not drained until a suitable water quality has been obtained within the basin. The proposed Type D wet sediment basin will require decant when the water level reaches the top of the sediment storage zone. This could result in decant after every moderate rainfall event. Given that the proposed Reclamation Area will consist of marine sediments, stormwater runoff is likely to be saline. This will aid in the flocculation of suspended particles. However, it is conceivably possible that chemical flocculation may be required to ensure the water quality objectives are met. The proposed clean-out frequency is approximately 5 years for all sediment basins,

though more frequent inspection would be required.

In accordance with Table B18 of IECA (2008), it is recommended that the discharge limit for the sedimentation pond be 90% of Total Suspended Solids. It is noted that this applies to stormwater runoff from the final reclamation surface, with decant of dredging tailwaters dealt with in Section 2.3.5. This represents an achievable water quality objective, based on current sediment basin design techniques. However, sediment basin design techniques are constantly being refined. Given that the sediment basins will only be constructed in the medium term, after the proposed Reclamation Area has been filled to RL 7.0 m AHD, it is recommended that reference then be made to best practice guidelines for soil erosion and sediment control. To limit soil erosion and loss at source, all exposed surfaces on the proposed Reclamation Area will be appropriately vegetated as soon as is practicable and structural source control systems, such as sediment fences, will be employed to further limit soil erosion.

LEGEND

- Bund
- Catchment Boundaries
- Future Cadastre (indicative only)
- Sediment Basin (Primary)
- Sediment Basin (Secondary)
- Rock Chute
- Drainage Channels
- Flow Direction
- Indicative Grade

1:15,000 (at A4)

0 100 200 300 400 500

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

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Port of Gladstone
Western Basin Dredging and Disposal Project

Concept Stormwater Design for Final Reclamation Surface

Job Number	42-15386
Revision	B
Date	01 Sept 2009

Figure 2-23

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2.4.4 Sewerage

Permanent sewerage services will not be installed to the proposed Western Basin Reclamation Area during the bund construction and infilling phase. Temporary toilet facilities will be provided at the workshop and site office for the duration of construction. A licensed contractor will regularly collect waste from any temporary toilet facilities. No sewerage will be provided to the reclamation as part of this Project. This will be the responsibility of future proponents who develop facilities on the reclamation.

2.4.5 Energy

There is no requirement for the installation of telecommunication infrastructure to the Western Basin Reclamation Area. Wireless communication or temporary telecommunications will be established for any temporary office and workshop facilities that are established during construction.

Generators will be used to provide power to the temporary site office, crib room and workshop facilities.

2.4.6 Waste

The generation of wastes during the construction phase of the Project is expected to be minimal, given that:

- The boundaries of the land reclamation Project are located under the high tide watermark;
- The Project involves the construction of a bund wall using material specifically sourced from a quarry, meaning that there will be no process wastes generated;
- All waste materials relating to on-shore activities of the Project will be limited to personal waste items of a small number of employees and a temporary workshop during dredging only. Temporary office facilities will be present at the reclamation site for both the dredging and reclamation construction. Crib facilities for truck operators will be provided at the quarry during bund construction and temporary crib facilities will be provided at the existing Fisherman's Landing Reclamation during dredging;
- Dredgers do not employ significant workforce numbers or generate large quantities of wastes;
- Waste items related to truck and equipment maintenance will not be generated or stored on-site during bund construction. All truck and equipment maintenance activities that have the potential to generate wastes, such as oil changes, will be undertaken off-site at either the quarry or other GPC facilities. This will avoid the need to manage these wastes in temporary facilities at the Reclamation Area. Should minor oil and fuel spills occur during construction, these will be contained and cleaned up and contaminated materials disposed of in accordance with GPC's standard procedures; and
- A temporary workshop will be established at the existing Fisherman's Landing reclamation during dredging to provide minor marine fabrication and maintenance for the dredgers. Wastes will be appropriately segregated and stored and licensed waste contractors will be contracted to remove wastes on a regular basis. Should minor oil and fuel spills occur during dredging, these will be contained and cleaned up and contaminated materials disposed of in accordance with GPC's standard procedures.

Therefore, wastes generated at the Project site during construction will be limited to a small site office for 2 – 3 staff during bund construction and a site office, crib facilities and small workshop comprising up to 40 staff during dredging.

The bund construction will also increase the wastes associated with crib facilities and vehicle maintenance workshops that are present either at the GPC quarry or other GPC facilities. This increase in waste will be of short duration and the management and disposal of wastes (including recycling) will conform with the GPC policies and procedures, including compliance to the GPC Environmental Management System (EMS).

Solid Waste Disposal

Disposal of the small quantities of office and workshop generated solid waste will be to landfill and other licensed recycling and hazardous waste facilities, as appropriate. Licensed contractors will collect and dispose of wastes from the site office.

The Project involves the reclamation of a water area to form land by the placement of rock to form a bund wall and later, the placement of dredged materials inside the bund to form the landmass. As such, the final bunded Reclamation Area represents a disposal location for solid wastes (dredged material).

Liquid Waste

Water usage for the construction phase of this Project will be minor. Raw water will be used to control dust on the bund walls once they are above high water mark and along the haul routes, as required. It is likely that this water will be sourced from the quarry or a local raw water access point and will not be stored on site. Minor quantities of drinking water will be provided at the temporary office facilities. Temporary toilet facilities will be provided for the duration of the dredging and construction of the Reclamation Area bund wall. A licensed contractor will regularly collect waste from any temporary toilet facilities.

As the Project involves the placement of dredged material into the Western Basin Reclamation Area, decant of tail-waters from infilling of the bund with dredged material and stormwater runoff will be the two forms of wastewater generated. The management of these waters are discussed in previous sections and in Chapters 8 (stormwater) and 9 (decant waters).

2.4.7 Navigational Aids

Maritime Safety Queensland (MSQ) requires navigational aids to be located in the area of dredge operations to ensure safe boating and passage for commercial vessels. Table 2-11 details the number and type of navigational aids that are likely to be removed and installed for this project whilst Table 2-12 provides the specifications of each aid. This is yet to be finalised by MSQ.

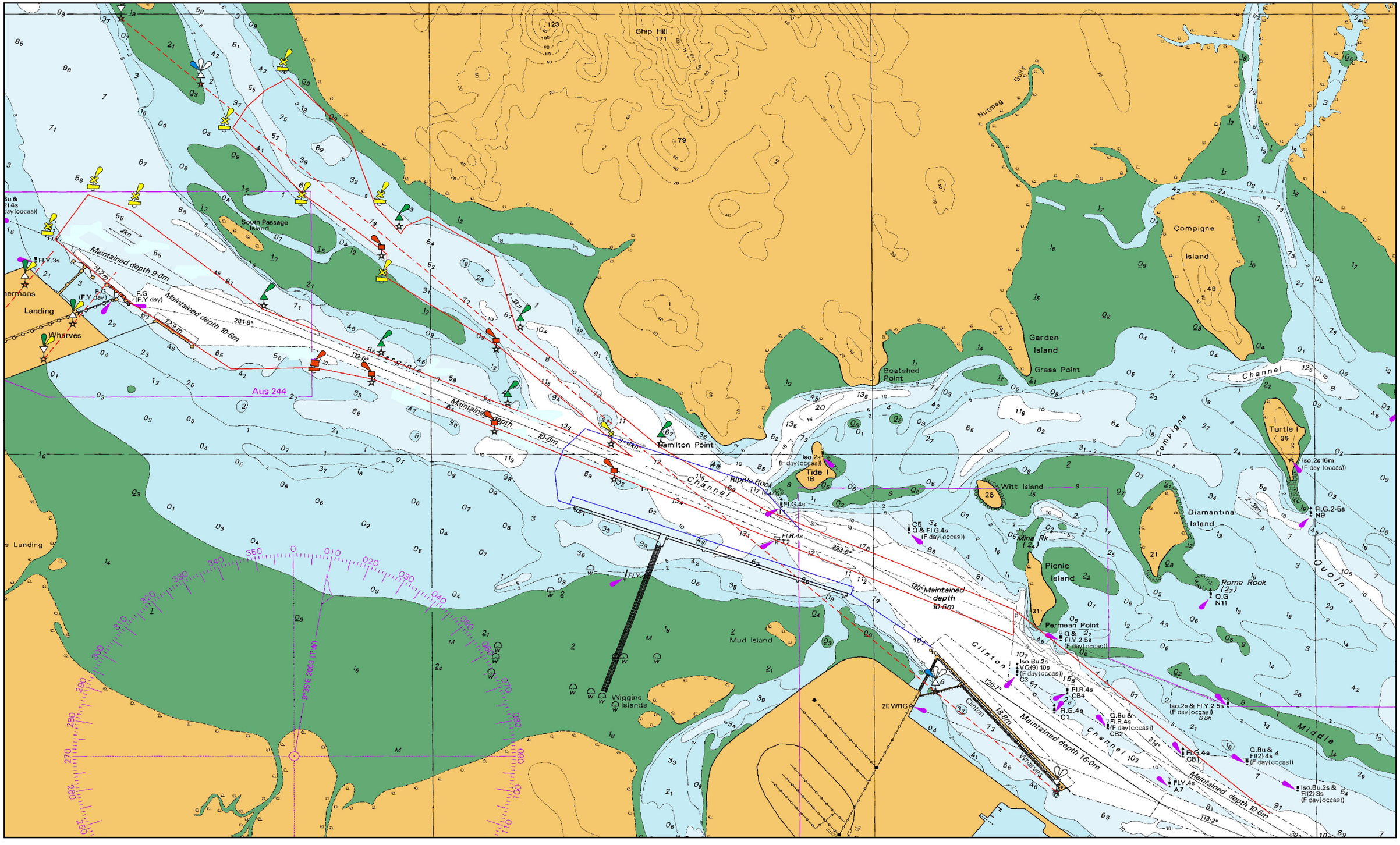
For the purposes of this Project, it is likely that up to 19 new navigational aids will be installed; 9 at the top end of the Stage 1A dredging operations and 10 in the vicinity of Clinton Bypass (in close proximity to the RG Tanna Coal Terminal). Each pile marker is to be pile driven (not to refusal) at an anticipated rate of one per day and to an approximate depth of 6-8 m and each marker buoy positioned using a concrete mass to provide anchorage. Figure 2-24 shows the locations of the additional navigational aids.

Table 2-11 Summary of Current and Proposed Navigational Aids at each Dredge Area

Area	Navigational aids to be Removed	Navigational Aids to be Installed
Clinton Bypass Channel	2 Front Lead Lights – Pile Beacon 2 Rear Lead Lights – Pile Beacon 1 Lateral Marker (Stbd) – Pile Beacon	2 Front Lead Lights – Pile Beacon 2 Rear Lead Lights – Pile Beacon 3 Lateral Marker (Stbd) - Pile Beacon 2 Lateral Marker (Port) – Pile Beacon
Targinie Channel	3 Lateral Marker (Stbd) – Pile Beacon 3 Lateral Marker (Port) – Pile Beacon 1 Lateral Marker (Port) - Buoy	3 Lateral Marker (Stbd) – Pile Beacon 3 Lateral Marker (Port) – Pile Beacon 1 Lateral Marker (Port) – Buoy 1 Special Marker – Pile Beacon
Fisherman's Landing Swing Basin	4 Special Marker - Buoy	3 Special Marker – Buoy 2 Front Lead Lights – Pile Beacon 2 Rear Lead Lights – Pile Beacon
Western Basin	Nil	3 Lateral Marker (Stbd) – Pile Beacon 2 Lateral Marker (Port) – Pile Beacon 5 Special Marker – Buoy 2 Front Lead Lights – Pile Beacon 2 Rear Lead Lights – Pile Beacon

Table 2-12 Summary of Proposed Navigational Aid Specifications

Type of Light	Typical Lights	Colour	Typical Flash Interval	Light Duration
Lead Lights – Clinton Bypass	RL-200	White/Blue	4-sec-Front, 6-sec-Rear	24 hours
Lead Lights – FL Swing Basin	RL-200	Green/Yellow	4-sec-Front, 6-sec-Rear	24 hours
Lead Lights – Western Basin	RL-200	White/Blue	4-sec-Front, 6-sec-Rear	24 hours
Lateral Marker (Stbd) – Pile Beacon	ML-300	Green	2-4 sec	At night only
Lateral Marker (Port) – Pile Beacon	ML-300	Red	2-4 sec	At night only
Lateral Marker (Stbd) – Buoy	ML-155	Green	2-4 sec	At night only
Lateral Marker (Port) – Buoy	ML-155	Red	2-4 sec	At night only
Special Marker – Pile Beacon	ML-300	Yellow	2-4 sec	At night only
Special Marker - Buoy	ML-155	Yellow	2-4 sec	At night only



1:30,000 (at A3)

0 0.25 0.5 0.75 1

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 56

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Port of Gladstone
Western Basin Dredging and Disposal Project

Location and Types of
Proposed Navigational Aids

Job Number	42-15386
Revision	A
Date	05 Oct 2009

Figure 2-24

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