Summary of key outcomes:

The construction of the Port Botany Expansion would consist of three main components:

- construction of the new terminal and associated port infrastructure;
- progressive development of terminal facilities for the operation of the new terminal; and
- provision of public recreation facilities including improved access, upgraded beach and park areas, a new boat ramp and car park and habitat enhancement works in Penrhyn Estuary to retain the area as an ecological habitat.

8.1 Introduction

Development of the Port Botany Expansion has three distinct elements:

- construction of the new terminal, shipping berth and associated port infrastructure;
- progressive development of terminal facilities for the operation of the new terminal; and
- enhancement of public space areas, public facilities and Penrhyn Estuary.

The construction activities and works to create the new terminal and enhance the public recreation facilities and Penrhyn Estuary would be managed by Sydney Ports Corporation and are described in Sections 8.2 to 8.6.

Development of terminal facilities including roads and pavements, installation of container handling equipment, terminal buildings and services reticulation within the new terminal would be the responsibility of the ultimate operator(s). These elements of the construction of the proposed Port Botany Expansion are described in Section 8.7.

The precise nature of the infrastructure to be used for the new terminal would be determined by the ultimate operator(s) of the new terminal. Therefore, there may be a requirement to provide separate detailed design information to PlanningNSW prior to proceeding with the construction of certain elements of the proposal (e.g. buildings). Notwithstanding this, this chapter provides a description of all the construction activities associated with the development of the typical infrastructure required for the operation of a modern container terminal. The general facilities that would be required for the operation of the new terminal are described in **Chapter 6** *Terminal Operations* and the layout of the proposed Port Botany Expansion is shown in **Figure 1.2.**

8.2 Terminal Construction

8.2.1 Construction Works Areas

The construction contractor(s) would require significant working areas to undertake various preparatory activities and to store materials for use in the finished structures. Some of the principle activities that would occur within the works areas include:

- office and administrative functions;
- parking for staff and construction vehicles;
- amenities for the work force;
- workshops and maintenance areas;
- storage and handling of rock for embankment and armouring operations;
- storage and preparation of piles; and
- casting and storage of pre-cast concrete headstocks, beams, decking units and counterfort wall sections.

There are two principal works areas as shown in **Figure 8.1**.

- the new tug berth area (point 1), and;
- the area at the western end of Brotherson Dock North (point 2).

Tug Berth Works Area

The new tug berth area would be utilised as a rock handling and loading area for the rock embankment material. This would be one of the earliest operations and would continue for approximately 11 months. The area would then be finished for use by the public for boat-launching activities.

Access to the tug berth site would be via Foreshore Road and an intersection would be constructed to facilitate entry and access for construction and future public traffic.

Main Works Area

The main works area would be at the end of Brotherson Dock North as shown on **Figure 8.1**. Access would be via Penrhyn Road and the new access road to the boat ramp to be constructed as part of Patrick Stevedores proposed upgrade. A temporary construction road would be required through the back of the existing boat ramp parking area to allow access to the main works area. Additional car and trailer parking would be provided to compensate for the loss of a portion of the existing parking area. This would be located at the western side of the existing boat ramp car park.

An area of approximately 0.9 ha would be immediately available (Stage 1) with minimal preparation work as shown on **Figure 8.2**. This area would house the initial site offices, staff parking and an amenities building.

The first section of the rock embankment at the northeastern end of the site would be constructed simultaneously with dredging and rock embankment construction at the southeastern end. This would increase the works area to approximately 4.8 ha for Stage 2 as shown in **Figure 8.2**. The Stage 2 area would be completed in time to commence pile storage and preparation work.

The works area could be further expanded for Stage 3 as shown in **Figure 8.2** to accommodate a pre-cast concrete preparation and storage area before these activities reach full production.

8.2.2 Construction of Tug Berths

An early focus of construction activities would be the establishment of the new tug berths and boat ramp at the northern end of the site (refer to **Figure 1.2**). This area would be required for loading rock material onto barges to produce the temporary embankments before major dredging activities can commence. It would also be used to service the dredging activities in the tidal channel at the northern end of the site.

Once the construction road was built to access the main works area at the end of Brotherson Dock North, rock could then be loaded out from this area.

Prior to dredging of the channel adjacent to the tug berths, the existing seagrasses would be removed and transplanted into compensatory habitat as described in **Chapter 19** *Aquatic Ecology*.

Road and water access for recreational boating would be maintained at all times during construction. A new road is to be constructed to the existing boat ramp as part of the current upgrade of the Patrick Stevedores terminal and this road would remain available to the public until an alternative boat launching facility has been provided.

Construction Works Areas **Figure 8.1**

Works Areas

1 Tug Berth Works Area

2 Main Works Area

Main Works Area **Figure 8.2**

Dredging for the tug berths and main terminal berths would restrict water access for pleasure craft, however, a navigable channel to Botany Bay would be maintained at all times during the dredging operation. Markers would be placed to demarcate the channel during construction and notices displayed at the ramp to fully explain access routes for public users. The markers and notices would also indicate the existing exclusion zone adjacent to the Parallel Runway.

The reclaimed area for the boat ramp and tug berths would be supported by a sheet piled wall on the southern side and a rock embankment on the western side. The sheet piling would be driven from the shoreline as embankment material is placed. The sheet piling would be anchored to concrete blocks (deadmen) buried in the embankment material.

Approximately 10,000 m^3 of fill material would be required for the tug berth area and this would be obtained from dredging the tidal channel and northern end of the work area. Alternatively, suitable clean fill material may be brought in by truck. The upper layers would be compacted by roller and sub-base material placed and sealed to provide a working surface during the rock loading stage of construction.

A rock bund wall would be placed at the western end of the berth wall to prevent tug propeller wash from disrupting public boat launching activities.

8.2.3 Dredging and Reclamation

A significant component of the project would involve dredging of the new berths and reclamation of land for port development purposes. Existing seabed contours are shown in **Figure 8.3** and the areas to be dredged and reclaimed for the proposed Port Botany Expansion are shown in **Figure 8.4**. Dredging profile cross sections are shown in **Figure 8.4a** and **Figure 8.4b**. The principal dredging and reclamation activities would include:

- dredging of an access channel to the new berths and removal of high spots adjacent to the ship turning basin to allow ships to manoeuvre and berth at the new terminal;
- reclamation of approximately 57 ha of land for additional container terminal capacity using the dredged material;
- progressive construction of rock embankment walls to contain the outer edges of the reclaimed land; and
- reclamation of approximately 2 ha of land for a new boat ramp and car park with direct access to Foreshore Road.

Dredging and Reclamation Sequence

All dredging, reclamation, berth construction and major infrastructure works would be undertaken in a single construction campaign. This would minimise the high cost of mobilising and demobilising dredging equipment and would limit environmental impacts to a single construction period. Early completion of the entire reclamation would be required to allow for consolidation of the reclamation to occur prior to development activities being undertaken such as pavement construction, installation of services and drainage works.

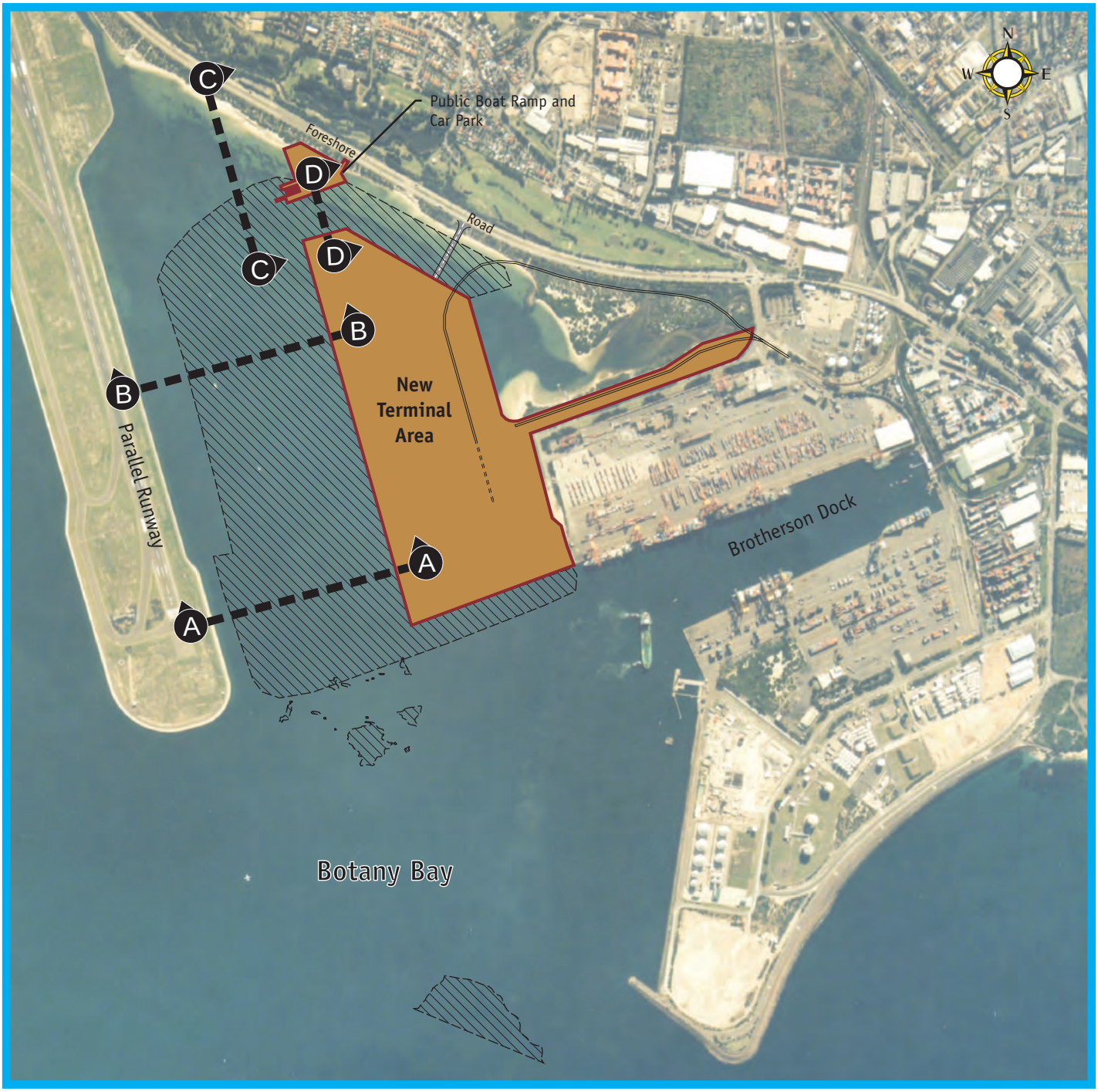
0 500m

Existing Seabed Contours **Figure 8.3**

20.0 Seabed Contour and Level (LAT)

Minor Seabed Contour at 2.5m intervals (LAT)

Outline of New Terminal Area

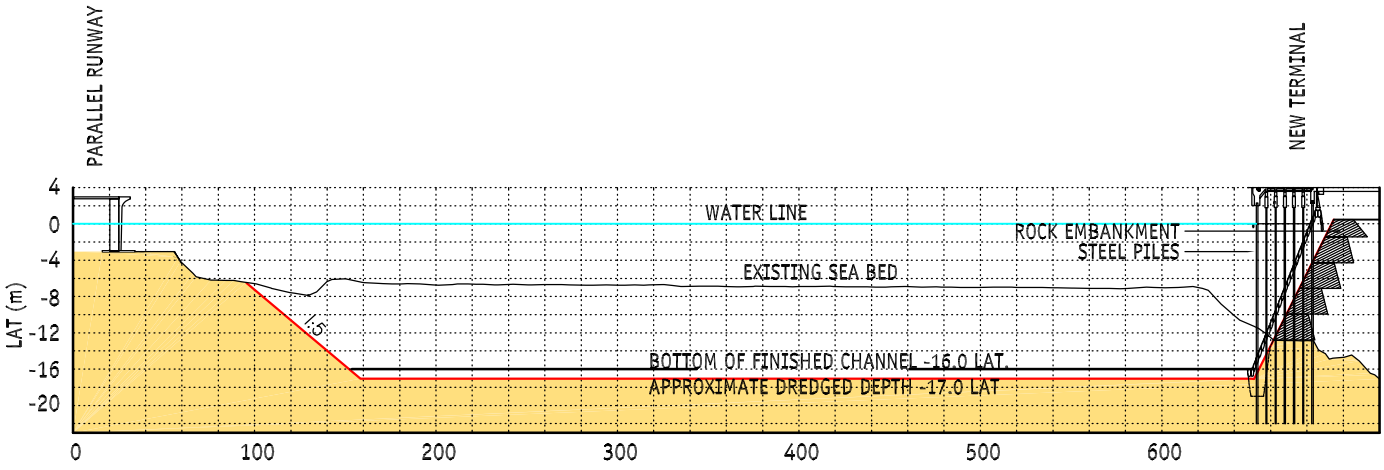


Dredging Plan **Figure 8.4**

Area to be Dredged

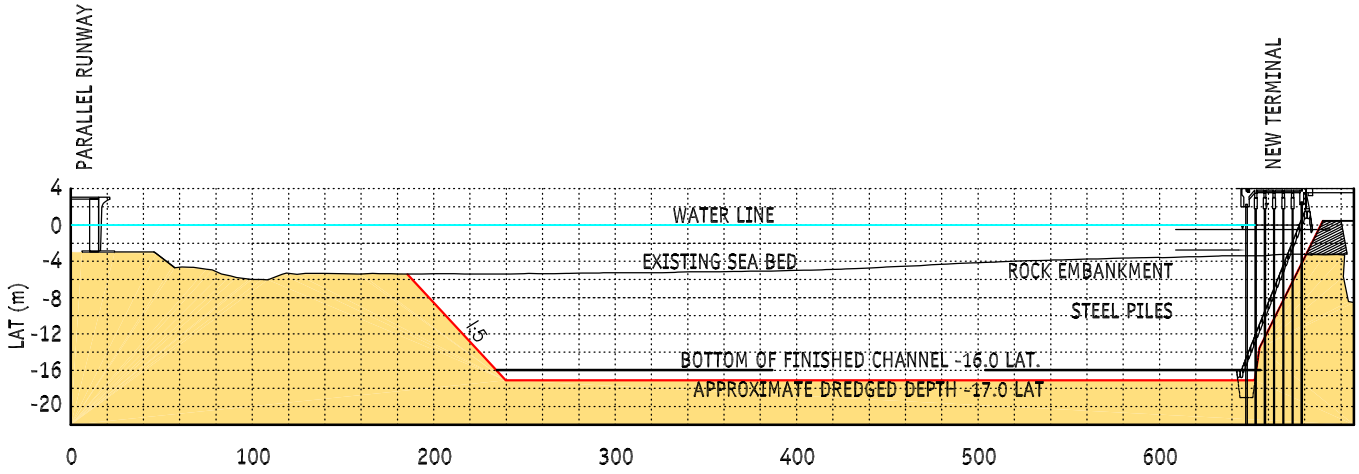
Area to be Reclaimed

A Cross Sections (see Fig 8.4a and Fig 8.4b)



SECTION A

SCALE 1 Horizontal : 5 Vertical

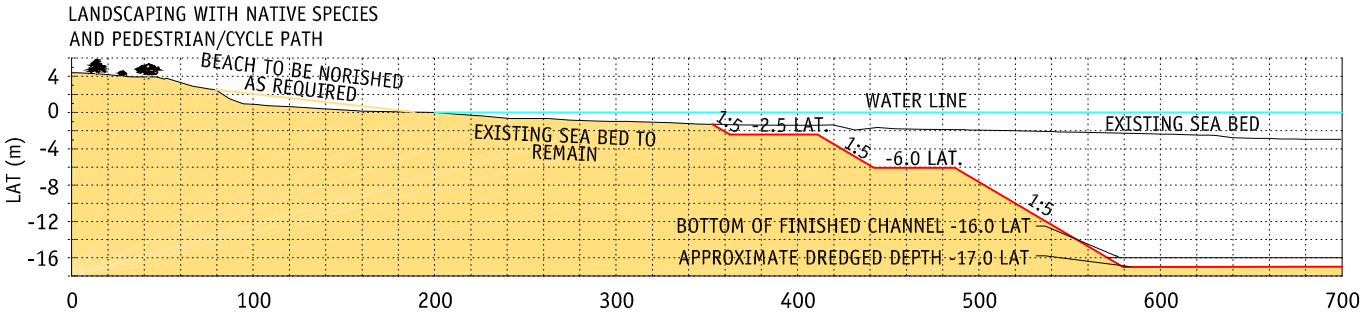


SECTION B

SCALE 1 Horizontal : 5 Vertical

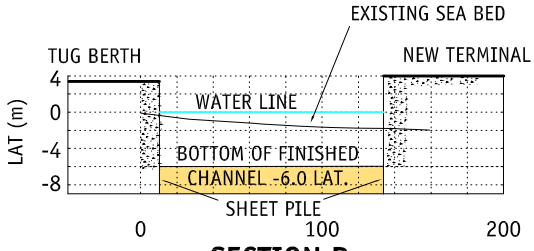
Indicative Cross - Sections with Vertical Exaggeration

Dredging Sections **Figure 8.4a**



SECTION C

SCALE 1 Horizontal : 5 Vertical



SECTION D

SCALE 1 Horizontal : 5 Vertical

Indicative Cross - Sections with Vertical Exaggeration

Dredging Sections **Figure 8.4b**

The sequence of dredging and reclamation would be as follows:

1. progressive dredging of the shipping berth footprint along the south and west perimeter of the new terminal boundary to provide a finished depth of at least –16 m LAT;
2. concurrent placing of the first rock embankment of the multi-terraced embankment along the edge of the berth footprint;
3. concurrent filling behind the first rock embankment;
4. placement of the second rock embankment; and;
5. filling behind the second rock embankment.

This sequence would be repeated until the embankment has reached the full height of approximately +3.5 m LAT as shown in **Figure 8.5** and **Figure 8.6**.

Dredging Methods

The dredging work would be carried out using hydraulic dredging methods. This method is based on pumping seabed material using water as the transport medium. The material to be dredged would be generally fine to medium grained sands, and would be in close proximity to the area to be reclaimed. A cutter suction dredge with a pump line to the reclamation area would be most suitable for this activity.

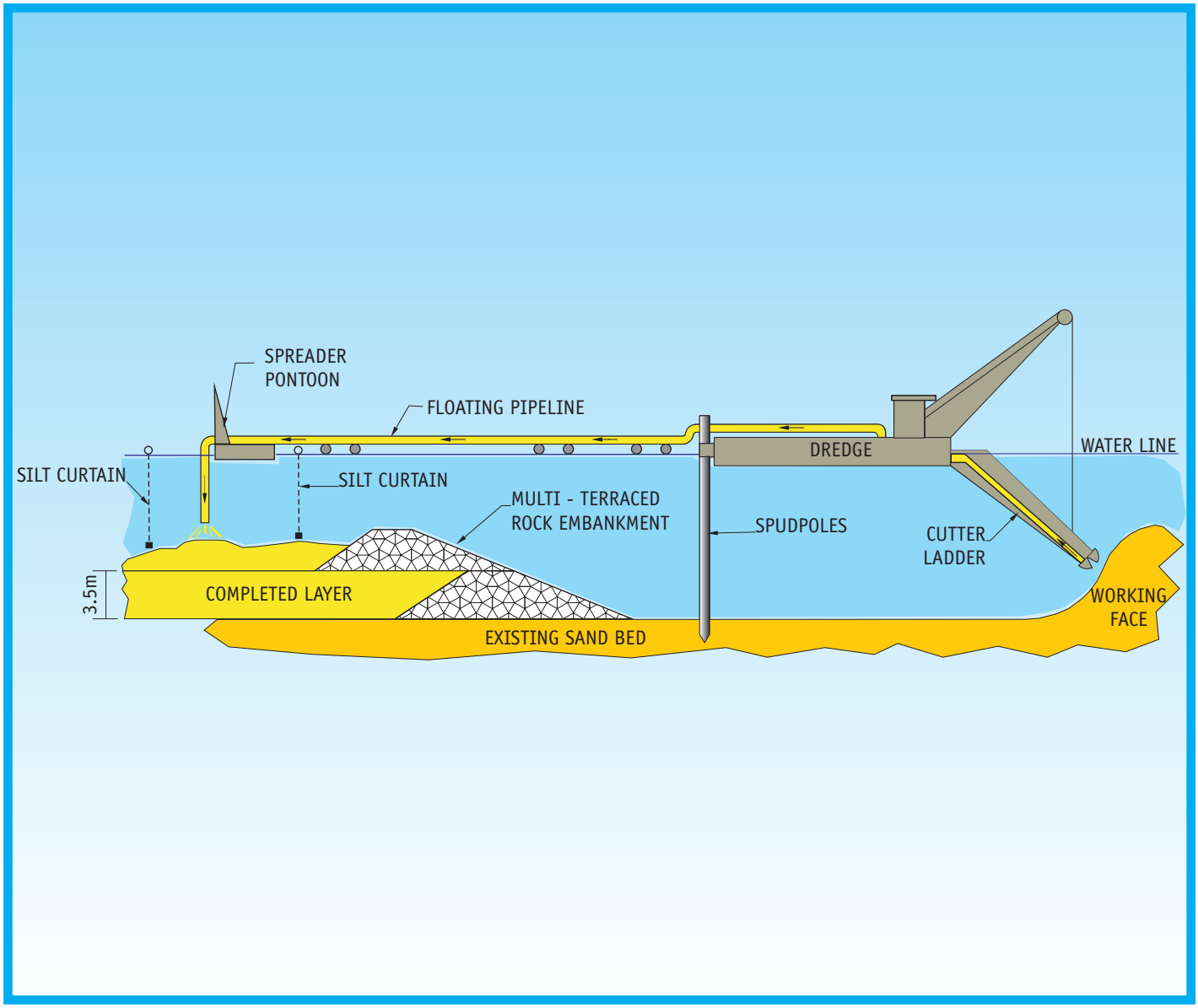
Cutter suction dredges use a large revolving cutter head to break up the sand matrix and can dredge a wide variety of material strengths. Placing of the dredged material is normally undertaken by pumping material in the form of slurry through a discharge pipeline to the reclamation area. Usually, pumping distances are less than 2 km due to repair costs associated with wear, although fine to medium sands can be pumped distances in excess of 10 km. The dredged material for this project would be transported directly to the reclamation placement point by means of a floating pipeline.

A spreader pontoon would be moored above the deposition point and the delivery pipeline traversed along the pontoon to obtain an even deposition without segregation of the finer material. It is envisaged that fill would be built up in layers of approximately 3.5 m in height as shown in **Figure 8.5**.

Several high spots currently exist in the ship turning area to the south of the main dredge area as shown in **Figure 8.4**. It would be necessary to remove these navigation hazards as shipping traffic increases in these areas and ships become larger. Dredging of these minor obstructions would be conducted as part of the contract for the berth and reclamation area to avoid having to remobilise dredging equipment at a later date.

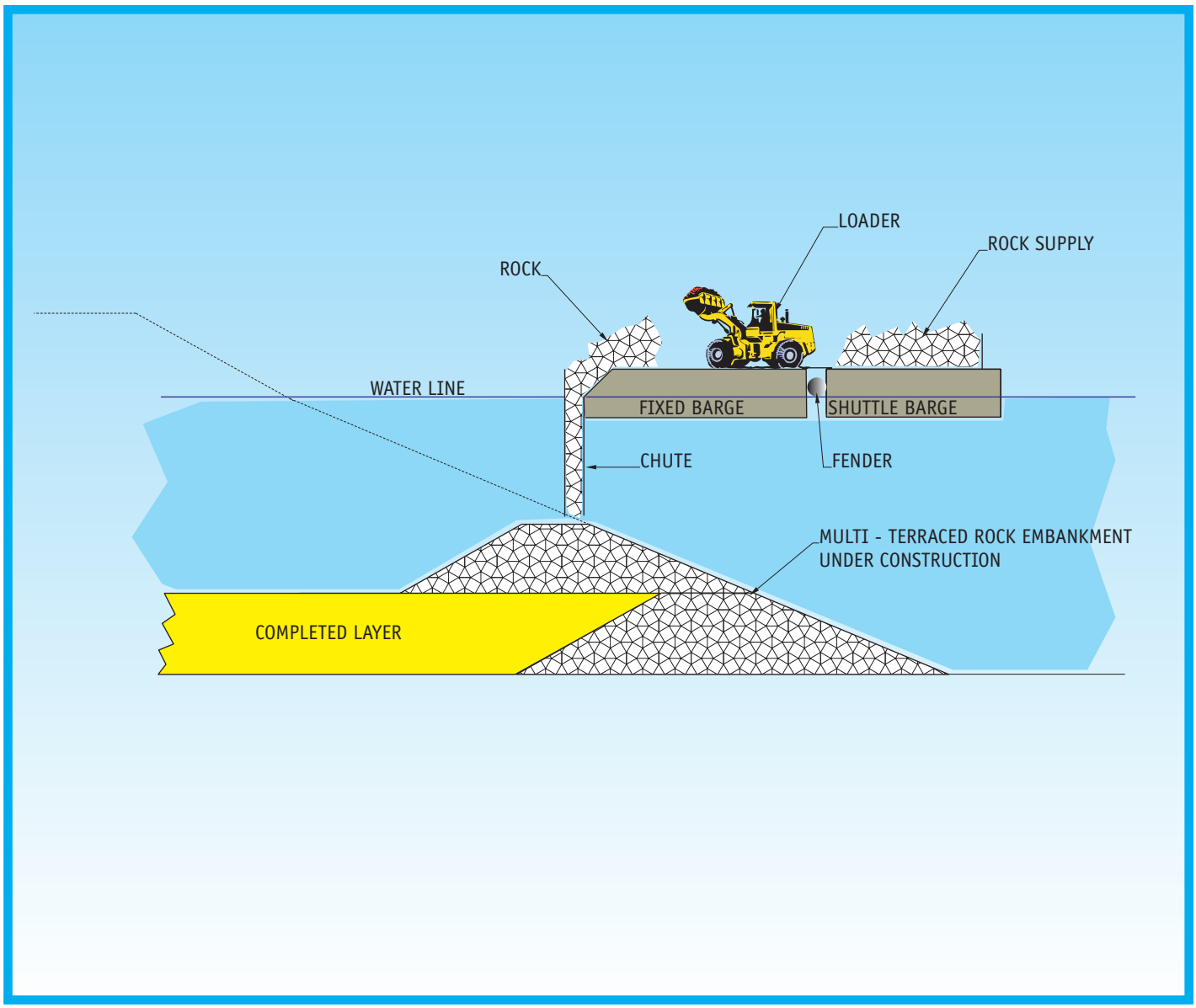
It is expected that approximately 220,000 m^3 of material would need to be removed from these areas. The cutter suction dredging method would be used. Where possible, dredged material would be pumped directly to the reclamation area, however, pumping may not prove practical for the most distant locations, in which case, the dredged material would be loaded into barges for transportation to the reclamation site.

The site of the proposed dredging and reclamation works is protected from adverse wave impacts by the existing developments and, as such, adverse wave impacts would be unlikely to affect the progress of work. The exception to this is the dredging of the high spots in the existing navigation channel which is located at a more exposed position. If environmental conditions exceed the allowable operational environmental limits of the particular equipment, all works in the affected area would cease.



Dredged Sand Reclamation

Dredging Sequence **Figure 8.5**



Dredged Sand Reclamation

Construction of Multi-Terraced Embankment

Figure 8.6

Considerable experience has been gained in mounting dredging operations in Botany Bay and it is expected that the programmed production rate of approximately 175,000 m^3 per week can be confidently achieved. The dredging operation would be undertaken on a 24 hours a day, 7 days a week basis for a period of 12 to 15 months.

Fill Requirements

Reclamation for the new terminal would be constructed to a level of approximately +3.5 m LAT. The estimated fill requirement for the reclamation would be 7.5 million m^3 of sand fill and 175,000 m^3 of rock embankment material.

Initial geotechnical information indicates that dredging of the areas shown in **Figure 8.4** should provide sufficient suitable sand to complete the reclamation. Suitable material for the reclamation may, however, be sourced from other infrastructure projects around Sydney (e.g. tunnelling projects) on an "opportunistic basis" at the time of construction. Any offsite material used in the reclamation would be Virgin Excavated Natural Material (VENM) or "clean fill".

Geotechnical investigations and experience with Brotherson Dock and the Parallel Runway (**Appendix M**) have verified that the proposed site for the new terminal is geotechnically suitable for its intended use as a container terminal.

These studies have shown that the soil strata at the site consists predominantly of sand to about -22 m LAT with stiff clays layers below this level. Peat lenses have also been encountered within the area. The underlying rock level is typically very deep and irregular. The proposed dredging would be contained within the dense sand layer and the piles used in construction of the wharf structure, would bear on the stiff clay layer.

A small proportion of the dredged material would consist of fine marine silt and muds which may not meet the required criterion for terminal reclamation and may therefore be unsuitable. This material could be used for the creation of new intertidal flats in Penrhyn Estuary.

Containment of Fill

There are a number of methods that could be employed to contain the dredged material. The method ultimately selected would be determined through a competitive tendering process and would be governed by circumstances prevailing at the time. These circumstances would include:

- results from further geotechnical investigations;
- detailed design development;
- type and availability of dredges and other floating plant at the time of construction;
- availability and cost of suitable rock material;
- evaluation of environmental impacts of alternative methodologies; and
- construction contractor's existing plant and preferred working methods.

The preferred construction technique for the containment of fill would involve a multi-terraced embankment made of rock as shown in **Figure 8.5**. An advantage of this method is that the foundation conditions are not

as critical as for some other methods. It also has the advantage of not requiring as much dredged material for filling, although this may be offset to some degree by the cost of the rock and piling works. It also has the significant environmental advantage of creating rocky reef habitat for marine organisms and fish.

The multi-terraced embankment method described here is well proven and considered to be entirely feasible and achievable within the environmental, social and other project constraints. During the detailed design and tender process any altered environmental impact as a result of alternate designs would need to be identified and additional approvals sought from the relevant authorities, if required.

For this method, approximately 175,000 m^3 of rock would be placed under water to form the multi-terraced embankment. The rock would be delivered by truck to the tug berth site (refer to **Figure 1.2**), where a temporary barge loading ramp and pontoon would be constructed. An alternative rock loading point at the western end of the Brotherson Dock North may also be utilised if necessary.

The rock fill required for the embankments shown in **Figure 8.6** would be sound and reasonably well graded quarry-run sandstone material or similar.

The rock material would be required over an estimated 12-month period. Assuming a 12-hour day and a 6-day working week, deliveries would occur at the tug berth site approximately every 10 minutes.

The rock would be moved onto the barge using a rubber tyred loader and transported to the marine working face. Several barges would form a shuttle operation to take rock from the loading pontoon to the placement point along the perimeter of the reclamation.

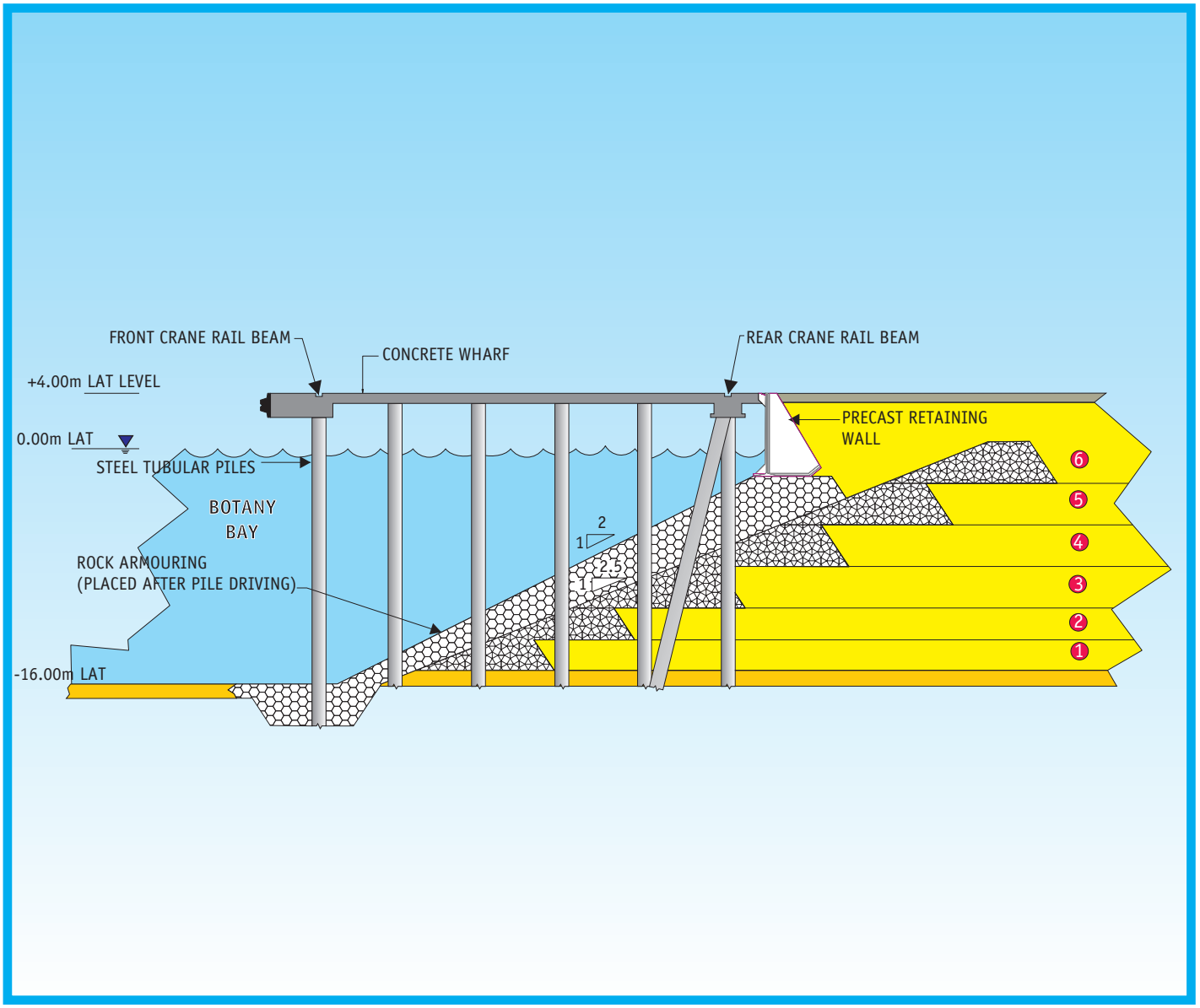
A larger, flat-topped barge would be accurately positioned and moored above the portion of the multi-terraced embankment which is being constructed. The barge would be fitted with a telescopic chute to direct the rock to the construction point on the sea bed. Rock would be transferred from the shuttle barges to the placement barge and chute by a small loader as shown in **Figure 8.7**. Preliminary investigations indicate that stability of the rock embankment would require it to be placed at a slope of 2.5 horizontal to 1 vertical.

The rock embankment along Penrhyn Estuary on the northern and eastern side of the site would either be tipped direct from trucks or placed from barges. The rock embankment would be trimmed and shaped by backhoe.

Exposed embankment material placed on the edges of the reclaimed area would be sized to prevent damage to the reclamation from wave action during the construction period.

8.2.4 Compaction and Preloading of Reclamation

Preliminary geotechnical investigations indicate that there may need to be some compaction of reclamation material within a strip approximately 20 m wide behind the embankment wall. Compaction, if required would be undertaken utilising vibro-compaction techniques as the fill material is placed in this zone. Vibro-compaction involves the use of probes inserted into the reclamation which vibrate and increase the level of compaction of the reclaimed material. The technique relies on the vibration of the inserted probes and does not involve percussive hammering such as that associated with typical piling activities for wharf construction.



Proposed Wharf Design **Figure 8.7**

1 Stage of Works

Dredged Sand Reclamation

Rock Armouring

Rock Embankment

Existing Sand Bed

Studies undertaken to date have indicated that long term settlements of up to 250 mm could occur due to consolidation of underlying material. The long term effects can be mitigated by inducing greater settlement during the construction period before the final structures are placed on the reclamation. One method of achieving higher early settlement is to preload areas where the highest settlements are expected. This would be achieved by overfilling these areas for up to a year to accelerate the initial settlement. Excess material would then be progressively removed for deposition in the more stable areas of the reclamation.

Preloading of the reclamation may be supplemented with other methods to reduce the long term settlement. These methods may include the provision of rock columns along the outer edge of the reclamation area. These columns would reinforce the soft soil layers and provide a shorter drainage path so that consolidation occurs more rapidly.

8.2.5 Sediment Control

Turbidity has not proved to be a problem during the construction phase of large dredging projects undertaken in Australia in recent years with the implementation of appropriate mitigation measures (e.g. silt curtains). Examples of large dredging projects include Sydney Airport Parallel Runway, Sydney Harbour Tunnel and Brotherson Dock.

Construction of the Parallel Runway employed a silt curtain approximately 5 km in length to control turbidity in Botany Bay. For the proposed Port Botany Expansion, a smaller curtain at the deposition point would be sufficient to contain the finer material. Turbidity control for the Port Botany Expansion would be a less significant problem than for the Parallel Runway for the following reasons:

- the proposed filling technique would discharge the dredged material underwater at sea bed level (**Figure 8.5**);
- the reclamation area is within an embayment with low tidal currents which would limit dispersal of any plume; and
- the reclamation would be contained within multi-terraced embankment rock berms.

Reclamation for the Parallel Runway established three zones for turbidity monitoring:

- Zone 1 (the outer most zone) – limit for normal dry weather conditions of 20 mg/l;
- Zone 2 (the middle zone) – limit of 50 mg/l outside the silt curtain; and
- Zone 3 (the inner most zone) - no limit because it was the turbidity containment area.

Sydney Ports Corporation would comply with similar limits:

- inside the silt curtain and around the discharge point no limit because it would be the turbidity containment area;
- 50 mg/l outside the silt curtain; and
- 20 mg/l beyond 500 m from the silt curtain.

The final surface of the new reclaimed area would be profiled and stabilised for dust and sediment control using a temporary bitumous coating sprayed over the surface. The surface would be graded to form

retention basins and earthen bunds would be constructed around the perimeter of the reclamation surface to avoid sediment entering the Bay.

Further information on sediment control measures is provided in **Chapter 16** *Hydrology and Water Quality.*

8.2.6 Port Navigation Channel

It would be necessary to delineate navigation channels for the various types of vessel which use this part of Botany Bay during construction and operation of the new terminal. These areas include:

- a commercial shipping channel;
- a channel for recreational vessels: and
- an exclusion zone adjacent to the Parallel Runway

Temporary buoys or timber piles would be positioned in the area between the construction zone and the Parallel Runway to mark the channel to be used by recreational vessels during the dredging and reclamation. Explanation of the routes would be provided in notices displayed at the existing and new boat ramp as required. Permanent channel markers for recreational vessels would be installed once dredging is complete and the new boat ramp is operational.

Permanent channel navigation markers would be installed within the project area to mark the route to be followed by commercial ships entering and leaving the new terminal. The positioning of these markers would take account of the exclusion zone applicable to shipping operating adjacent to the Parallel Runway and the recreational vessel channel.

The existing port navigation channel to Port Botany does not require dredging as part of this project and it is expected that significant maintenance dredging would not be required for the navigation channel and berthing basin for the new terminal once construction was complete.

8.3 Wharf Construction

Development of the new terminal would create an approximately 1,850 m of additional wharf face. This would involve an extension of the existing northern wharf face of about 550 m at Brotherson Dock North and a 1,300 m length of wharf face parallel to the Parallel Runway (refer to **Figure 1.2**).

The wharf structure would be required to perform a number of functions. These include:

- to provide an operational platform at the interface between vessels and the container terminal handling areas;
- to absorb ship berthing forces;
- to provide a facility for mooring vessels; and
- to provide support to vertical live loads such as container cranes and vehicles.

A pre-cast and in-situ concrete wharf decking would be constructed, supported on steel piles. The piles would also support the front and rear crane rails to withstand the heavy loads imposed in these locations and to reduce settlement of these key elements.

A rock armouring layer would be placed against the multi-terraced rock embankment after the piles have been driven, but before the superstructure is installed. The rock armouring layer would be used to support pre-cast concrete retaining wall units which would allow the final fill material to be placed and would provide erosion protection and additional stability for the reclamation. The proposed wharf design is shown in **Figure 8.7**.

8.3.1 Pile Driving

Approximately 3,300 steel hollow-section piles, 750 mm in diameter with 19 mm wall thickness, would be required to support the berth structure and container crane rails. It is anticipated that the piles would be manufactured in 12 m lengths and transported by road to the works construction area at the western end of Brotherson Dock. It is anticipated that about six truck deliveries per working day over a 20-month period would be required to deliver the piles.

The actual length of driven pile would depend on subsurface conditions. The pile sections would be welded on site into 24 and 36 m lengths, loaded onto barges and delivered to the pile driving pontoons and gantries. The average finished length of each pile is expected to be 48 m.

The proposed piling methodology would not infringe the Obstacle Limitation Surface (OLS) required for airport operations at Sydney Airport.

The steel piles would be protected against corrosion with a hard, durable coating. The coated surface would extend from the top of the pile to below the sea bed level. It may also be desirable to jacket the pile within the tidal zone to provide additional corrosion protection, although this work could be postponed until corrosion levels have been assessed over a number of years.

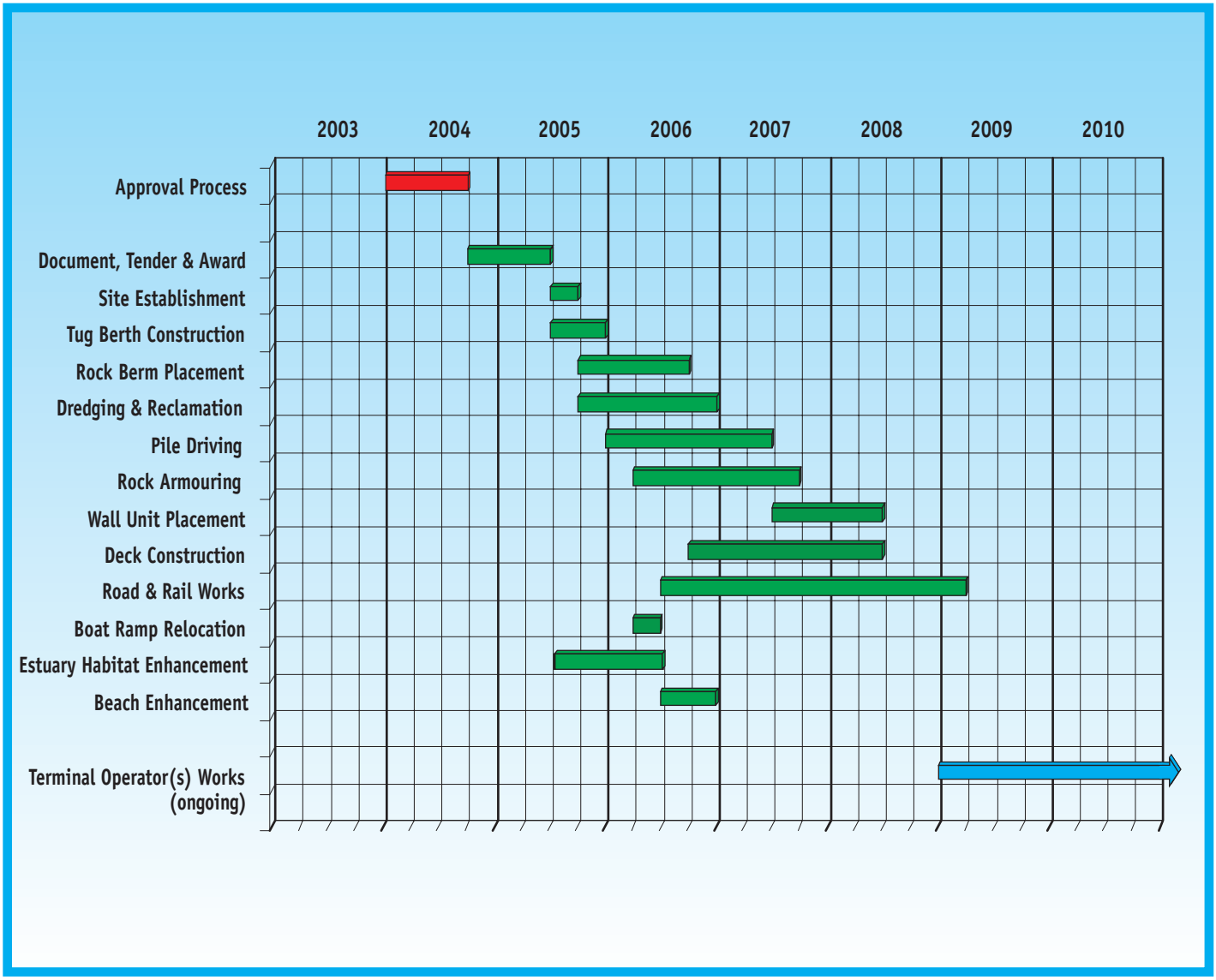
An impressed current or sacrificial anode system could also be installed to provide additional corrosion protection. Protection requirements would be ascertained during development of the detailed design.

The draft construction programme shown in **Figure 8.8** has assumed that two piling pontoons would be employed, each driving at least three piles a day working on a 10-hour day, six days a week. The total duration of the pile driving operation would be approximately 20 months.

An alternative construction method would be to drive the initial piles from floating plant then install a gantry platform on these piles. Subsequent pile rows would then be driven from the gantry. A similar production rate could be expected utilising this method.

8.3.2 Rock Armouring

A selected, hard rock armouring berm would be placed against the multi-terraced embankment after pile driving is completed for a section of the work. The armouring berm would serve to increase the long term stability of the embankment, provide protection against wave action and to support the pre-cast retaining wall at the back of the berth.



Indicative Construction Programme **Figure 8.8**

The rock used for the armouring berm would need to be highly durable and it is envisaged that an igneous rock, with maximum size of approximately 750 kg and a minimum of fine material would be required. Preliminary investigations indicate that long term stability of the armouring berm would require it to be placed at a slope of 2 horizontal to 1 vertical.

Approximately 200,000 m^3 of hard rock material would be required for the rock armouring berm in addition to the 175,000 m^3 of sandstone (or similar) required for the multi-terraced embankment. Transportation of this material may be by barge, although truck transport would also be a possibility depending on the source of the rock.

If truck transport of the rock is utilised, a supply rate of approximately 40 trucks per working day for approximately 20 months would be required to meet the program requirements.

Accurate placing of the rock armouring is required to avoid overrun obstructing the berthing area and to protect the piles from damage while placing. It is therefore anticipated that placing would be by one or more floating cranes with rock grabs.

The rock armouring would be anchored in a 2 m deep toe trench at the foot of the armouring berm and a 1 m layer of rock or concrete scour mat would extend partway under the ship mooring area to provide scour protection from propeller wash.

8.3.3 Concrete Works

Substructure and Deck

The substructure and decking would consist of pre-cast concrete units arranged in a system similar to that shown in **Figure 8.9**. The piles would be capped with starter bars protruding and pre-cast beams and decking units placed using mobile cranes.

The beam and decking units would be cast in the works area at the western end of Brotherson Dock North, although they could be cast at a remote site and brought in by truck or barge. Approximately 30,000 m^3 of concrete would be required for the pre-cast units over the planned construction period.

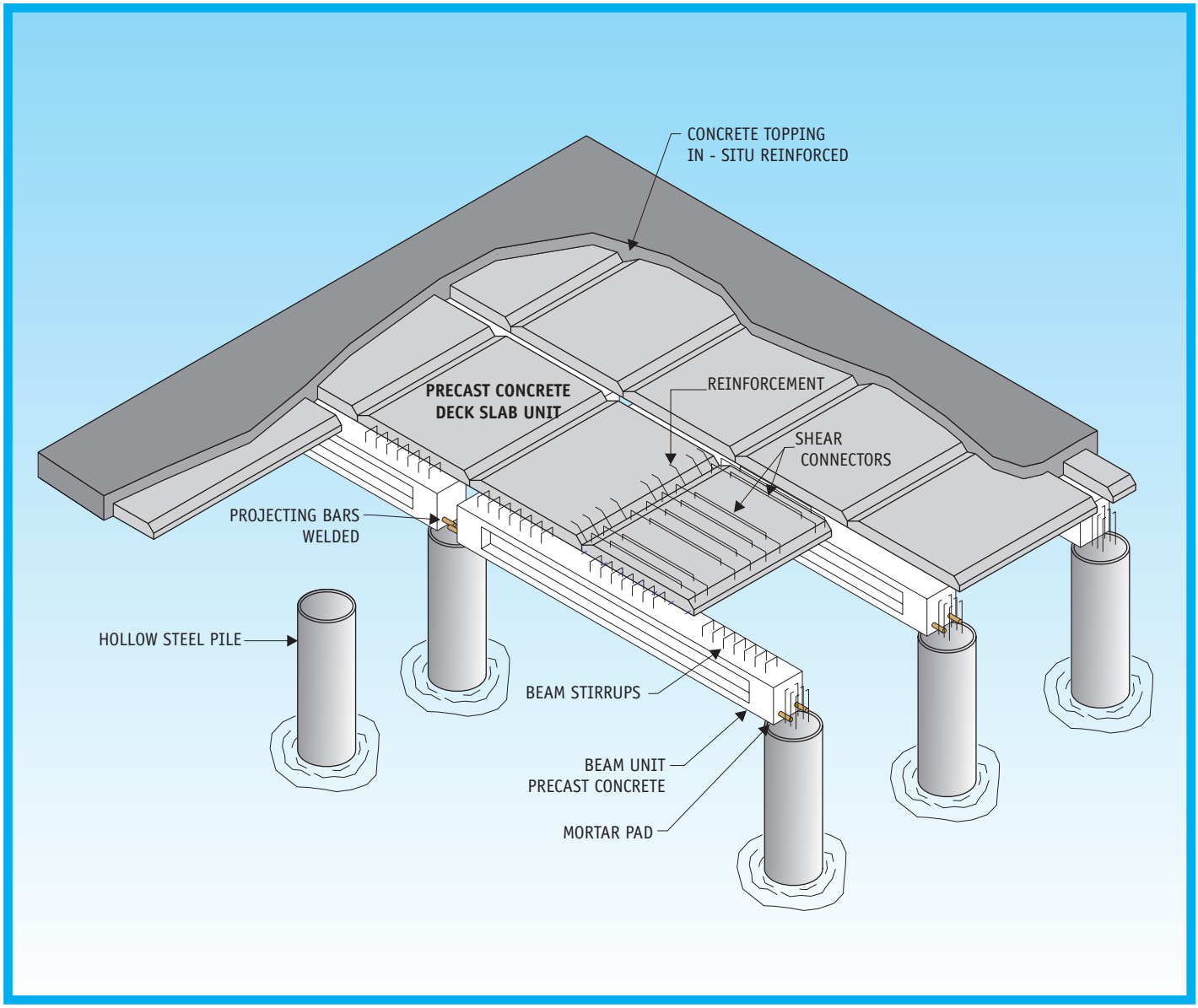
An in-situ concrete fender beam would then be cast and an in-situ deck wearing surface poured. Approximately 35,000 m^3 of concrete would be required for these in-situ works.

Pre-Cast Retaining Wall

The top of the rock armouring berm would be finished approximately 1 m below low water level. This level has been selected to remove habitat for vermin.

The top of the armouring berm would be levelled by screeding or backhoe to receive pre-cast concrete retaining wall units. Each pre-cast wall unit would be 5 m high and approximately 4.5 m long, the final length to be determined by handling considerations. The weight of each unit would be about 30 tonnes.

The units would probably be cast in the works area at the western end of Brotherson Dock North, although they could be cast at a remote site and brought in by barge or truck. Total production of the 411 units required is expected to take approximately 22 months and would require production of approximately 5,000 m^3 of concrete.



Substructure and Decking **Figure 8.9**

The wall units would be transported by truck on the new decking slab and lowered on to the prepared foundation by crane.

Concrete Production

A total of approximately 70,000 m^3 of concrete would be required for the works described above. A temporary concrete batching plant would be built in the main works area near the end of Brotherson Dock North as shown on **Figure 8.2**. Deliveries of materials for the concrete batching plant would equate to an average of approximately two trucks per hour working on a six day week, 10 hours per day basis for approximately 23 months.

8.4 Port Infrastructure

Additional port infrastructure would need to be constructed to complete the new terminal in readiness for leasing to a terminal operator(s). Some of these infrastructure works include (refer to **Figure 1.2**):

- provision of the signal-controlled road junction on Foreshore Road and an entrance bridge across the channel separating the existing shoreline from the new terminal;
- construction of the Inter-Terminal Access Road joining the new terminal with to the existing port area for internal vehicle movements;
- provision of rail access to the new terminal area by means of an extension to the existing Botany Freight Rail Line. The new line would run parallel to Foreshore Road and would involve construction of a rail bridge and culverts;
- construction of a road bridge over the rail line at the eastern end of Penrhyn Road;
- wharf fixtures including fendering systems, mooring systems and crane rail support beams; and
- utility services for the new terminal area including electricity, water supply and sewerage connections to the boundary of the new terminal.

8.4.1 Road Access

Two new access points would be required from Foreshore Road. One of the access points is required for the new boat ramp area and the other would be the primary access to the new terminal, which would be via a road bridge connecting to Foreshore Road as shown in **Figure 1.2**.

Principal features of the Foreshore Road access points would include:

- traffic signal control of the new terminal access to Foreshore Road, which would include a right turn bay and left turn slip lane for vehicles entering the terminal (refer to **Figure 21.4**); and
- access to the public recreation area and boat ramp via a seagull type intersection on Foreshore Road which would include a right turn bay and left turn lane for entering vehicles and a right turn acceleration/merge lane, left turn acceleration/merge lane for exiting vehicles (refer to **Figure 21.5**).

An early requirement for the construction phase would be installation of the seagull type intersection from Foreshore Road to the new boat ramp area. This would be required for trucks transporting material required

for construction of the tug berths and traffic bringing rock embankment material for loading onto barges moored at the tug berths. Construction of the intersection would involve standard road work procedures which would cause some minor disruption to traffic using Foreshore Road. A Construction Traffic Management Plan would be implemented with RTA's concurrence for the duration of the works.

Installation of traffic signals at the main terminal access point would also involve some minor disruption to traffic as would construction of the right hand turn lane.

Construction of the acceleration/merge lanes would not involve major interference with traffic, however speed restrictions would need to be applied on Foreshore Road while construction is being undertaken.

In addition to the main road access, there would be an Inter-Terminal Access Road running east-west parallel to the existing Penrhyn Road. This would link the new and existing terminals internally thus avoiding inter-terminal traffic unnecessarily using Foreshore Road.

The Inter-Terminal Access Road would pass through the back of the parking area of the existing boat ramp and therefore construction would not be undertaken until the new boat ramp was opened to the public or additional parking provided at the western side of the existing boat ramp. Construction work would involve some excavation and placing of rock for road foundations. An asphaltic concrete surface would then be placed and compacted. These operations would not add significantly to construction traffic on the southern side of Penrhyn Estuary.

8.4.2 Road Bridge

A 16.4 m wide road bridge with two lanes each way would be constructed to link the new berth with Foreshore Road as shown in **Figure 8.10**. The bridge span would be approximately 150 m long and would be of pre-cast concrete construction supported on approximately six rows of piles. Four of the pile rows would be driven from a barge after the channel has been dredged with the abutment piles being driven from shore.

The superstructure and decking work would be undertaken from the new terminal end of the bridge to minimise disruption to traffic on Foreshore Road. The pre-cast units would be brought by truck to the terminal end of the bridge where they would be lifted on to the headstocks. Decking units would be positioned on the beams and finishing work undertaken. The finishing works would include erection of noise barriers at the southern end of the bridge.

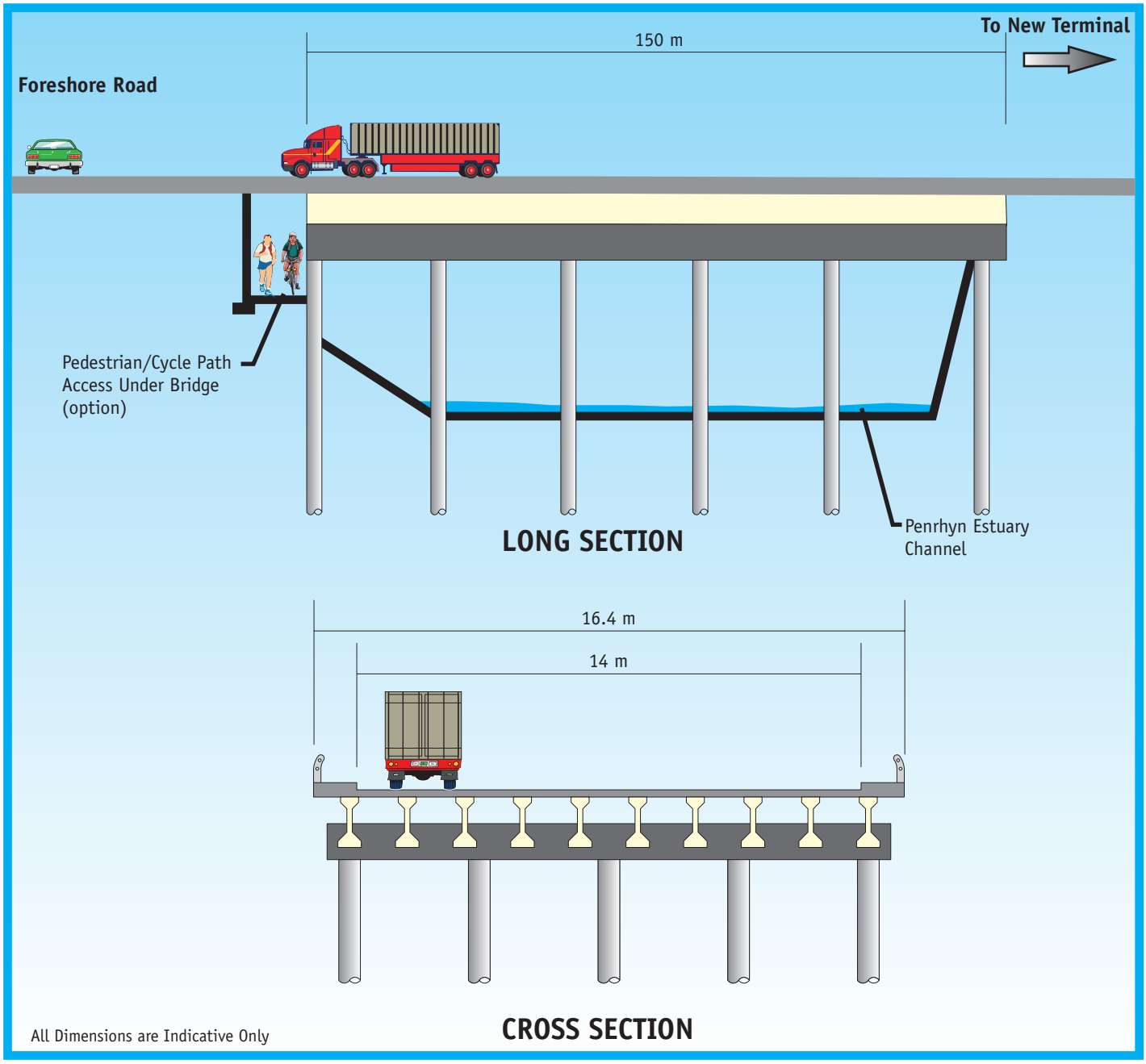
8.4.3 Rail Access

Five new rail sidings are to be constructed as part of development works for the new terminal.

Three of the rail sidings would be created by extending the existing Botany Freight Rail Line around the edges of Penrhyn Estuary and into the new terminal (refer to **Figure 1.2**). Two rail sidings would also be created parallel to Penrhyn Road (refer to **Figure 1.2**).

The principal features to be constructed include the following:

- a major rail bridge crossing the tidal channel to Penrhyn Estuary;
- two minor rail bridges or culverts crossing over Springvale and Floodvale Drains;



Road Bridge **Figure 8.10**

- rail maintenance access points;
- security fencing; and
- signalling, signage and lighting.

The rail track would generally be constructed at grade. This would require excavation of surface material and replacing it with suitable foundation material which can be compacted to form a solid base for the rail lines. The material is predominantly sand and where possible, it would be reused either in creating the public recreation areas or in the embankment for the new terminal.

Construction of the rail embankment along Foreshore Road would result in some additional truck movements in this area. It is expected that there would be approximately four truck movements per hour over a 4-month period. This level of activity would also be expected in constructing the rail embankment parallel to Penrhyn Road

High quality, free draining rock ballast would then be placed on the foundation. The rail ballast would be brought in by truck and levelled by backhoe. This work would be concurrent with foundation construction. Placing and levelling of the sleepers and rails is a specialised operation and would probably be undertaken by RIC utilising rail mounted equipment.

Construction of the rail services would include provision of vehicular access points for maintenance of the rail line. These would be constructed as part of the preliminary excavation and compaction works and would not significantly increase the construction traffic. Security fencing would be erected beside the rail lines with gates provided to allow entry for maintenance.

A disruption to the existing service on the rail line into Patrick Stevedores terminal is anticipated during the installation of the new rail track. The installation could be undertaken within a 12-hour period during the night to minimise operational impact.

8.4.4 Rail Bridge Construction

A new rail bridge would be constructed over the channel created between Foreshore Beach and the new terminal. Construction would be similar to that for the road bridge in that supporting piles would be driven from a barge after the channel has been dredged with the abutment piles being driven from shore.

The bridge superstructure would consist of steel or pre-cast concrete beams brought to site by truck and lifted into position.

In addition, two smaller bridges or culverts would need to be constructed across Springvale and Floodvale Drains. These bridges would take three to six months to construct and would involve preparation of footings and placing of pre-fabricated beams and rail support units. It is expected that these operations would be concurrent with rail embankment preparation along Foreshore Road and would only marginally increase construction traffic during this period.

8.4.5 Noise Barriers

A 4 m high acoustic barrier would be constructed along the eastern and northern edges of the new terminal. Design of the barrier would be undertaken during the detailed design phase, however, it is envisaged that its

construction would require either concrete footings or posts driven into the ground. Construction would take approximately three months and would involve either a small excavator or light pile driver working for about half this time.

There would also be a small number of truck movements over a 2-month period to bring pre-fabricated wall panels to the site. These panels would be lifted into position by mobile crane.

8.4.6 Grade Separation

Construction of a grade-separated crossing for road transport over the new and existing rail tracks would be required to have efficient train and truck movements to and from the port in the future as both train and truck movements increase. This crossing would cater for road traffic to and from the existing Brotherson Dock area and inter-terminal traffic as well as trains into and out of the port. **Figure 8.11** shows the proposed grade separation works.

The work would require construction of three road bridges and four ramps (A, B, C and D) as shown on **Figure 8.11** together with an elevated intersection. Bridge 1 would have a double span, while bridges 2 and 3 would be single spans.

Construction would proceed in a number of stages to maintain full traffic flow through the area at all times.

The first stage of construction would consist of a temporary road diversion system around the works areas. This would be followed by construction of earth embankments to form ramps A, B, C and D. The elevated turning area between bridges 1 and 2 would also be constructed at this stage. Fill material would be brought to the site by truck and spread in layers and compacted. The sides of the embankment would be supported by pre-cast concrete panels anchored within the embankment material.

Concurrent with ramp embankment placement, work would commence on construction of the centre supports of bridge 1. Upon completion of the ramps, steel or pre-cast concrete beams would be lifted into position by crane to form the superstructure of bridges 1 and 2. Decking and bridge furniture would then be installed.

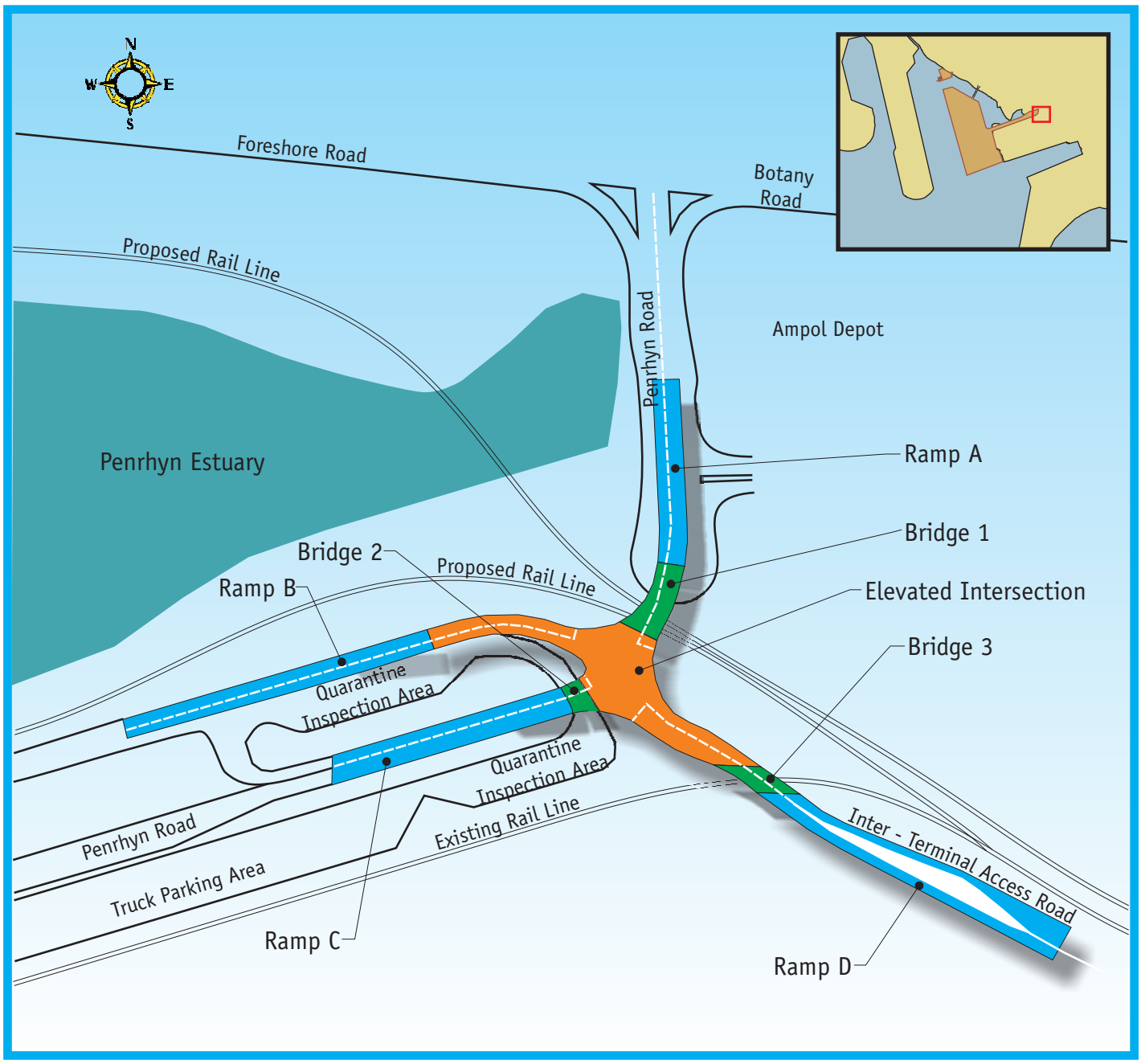
Further road diversion work would then be undertaken and the section between the elevated turning area and bridge 3 would be constructed. Bridge 3 beams would then be lifted into place and decking installed.

It is expected that this work would take approximately twelve to eighteen months to complete and would result in a considerable number of trucks and construction plant entering and leaving the site. The roads would be kept open at all times, however, short duration delays to port traffic would be expected throughout this period.

8.4.7 Provision of Services

Basic services would be provided to the boundary of the new terminal area. The terminal operator(s), when appointed, would be responsible for extending these services to suit their layout of facilities within the terminal area.

The services would be generally buried and construction or extension of these services would involve trenching and backfilling operations. Where practical, standard trenching techniques would be employed.



Road Over Rail Grade Separation, Penrhyn Road

Figure 8.11

It is likely that the construction contractor would undertake extension of services to the site boundary at an early stage to provide utilities during the construction phase. This work would occur over a three to 6-month period utilising two or three backhoes and a small number of truck movements per day.

Water Supply

An existing 450 mm diameter water main runs along Penrhyn Road and this main would be sufficient to provide water to the new facilities, details are contained in **Chapter 33** *Water and Wastewater***.** It is proposed to construct a ring-main system with a new buried water main in a services corridor beside Foreshore Road.

Excavation would be by backhoe with the majority of material retained beside the trench for backfilling after the pipe has been laid. Excavation would be in sand so it is unlikely that a significant amount of bedding material would need to be brought to the site. Pipes would be delivered via Foreshore Road and strung along the trench for laying by backhoe or mobile crane. The trenching, pipe laying and backfilling operations would be kept as close together as practical to minimise the risk of trench collapse. Very little construction traffic would be generated by this operation.

The water main would cross the channel to the new terminal in an exposed pipe hung beside the new road bridge. The main would then continue in a trench across the new terminal area and down Penrhyn Road to reconnect with the existing system. This main would provide water for domestic, fire fighting and ship supply purposes. The water main would also be extended to the amenities and fish cleaning facility at the new boat ramp area and to the tug berths.

Wastewater Services

A sewer pumping station (SPS-570) exists in the eastern end of Penrhyn Road and this facility would have capacity for the operation of the new terminal.

There is insufficient grade for a gravity line, so a new 100 mm diameter rising main and two small sewerage pumping stations would be installed to service the new facilities. The sewer main would be located within a services easement along Penrhyn Road and along the eastern and northern boundaries of the new terminal, with a branch attached under the new road bridge extending to the amenities at the new boat ramp area and tug berths. The small pumping stations would most likely be installed beneath the deck in the northern part of the new terminal and at the new boat ramp. It is likely that construction of the sewerage services would be concurrent with extension of the other services along Penrhyn Road and would not therefore add significantly to construction traffic.

Further details of wastewater services are provided in **Chapter 33** *Water and Wastewater*.

Stormwater

Design and installation of the permanent stormwater system would be carried out by the terminal operator, however, interim arrangements would be required during the construction phase. The system would be constructed progressively as sections of the terminal reclamation are completed.

Runoff from the completed reclamation would be channelled to settling ponds to retain sediment prior to release into the Bay. Separate, bunded areas would be provided around the workshop and fuel storage areas.

A stormwater drainage system would be installed along Penrhyn Road as part of the road construction works. Discharge from the system would be channelled along bioremediation swales into sumps to treat stormwater before being discharged into Penrhyn Estuary.

Similar stormwater systems would be installed in the tug berth area and along the new rail line parallel to Foreshore Road.

Electrical Services

A 33 kV power supply currently exists at the eastern end of Penrhyn Road. This supply would be extended by buried line in the services corridor along Penrhyn Road. The supply would terminate at the eastern boundary of the new terminal. Extension of this service would be concurrent with the other services along Penrhyn Road.

Further details are provided in **Chapter 35** *Energy*.

8.5 Public Recreation Areas

The following works would be undertaken to create the public recreation facilities and the ecological enhancement of Penrhyn Estuary described in **Chapter 7** *Public Recreation and Ecological Plan*.

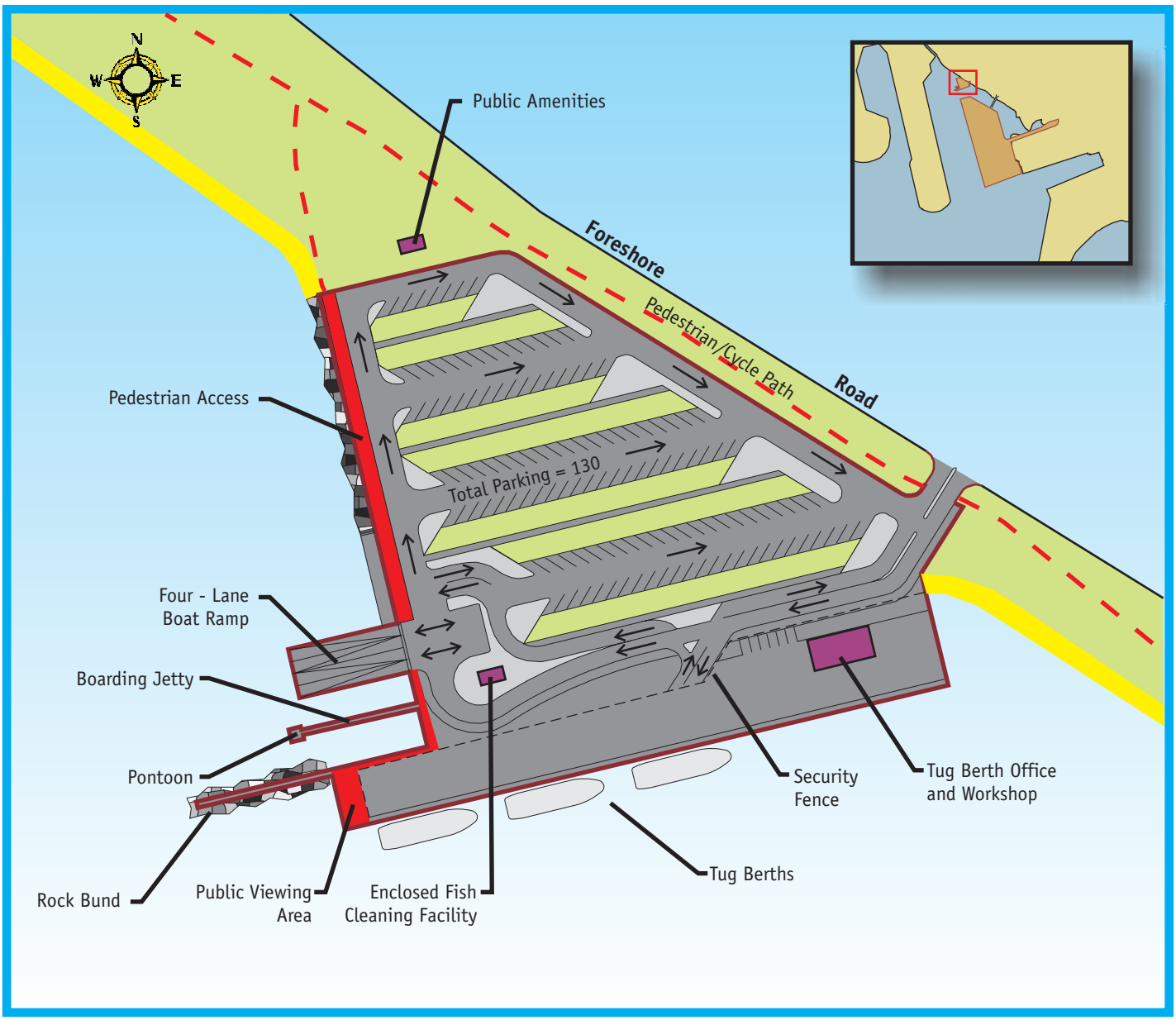
8.5.1 Boat Ramp

Upon completion of the rock loading operation, the area would be landscaped and asphalted to provide public boat launching facilities as shown in **Figure 8.12.** These public facilities would include:

- parking for approximately 130 cars and boat trailers;
- amenities building;
- a four-lane boat launching ramp;
- a jetty and pontoon for temporary mooring while trailers are parked and passengers board; and
- an enclosed fish cleaning facility.

A rock embankment wall would have been constructed on the western side of the area during construction of the tug berths. The rock would be tipped from trucks and levelled by backhoe. A concrete, four-lane boat ramp would be constructed within the rock embankment.

Piles would be driven adjacent to the boat ramp to support a timber jetty and pontoon to facilitate loading and unloading of passengers and to allow boats to be temporarily moored while trailers are moved to and from the ramp. An area at the eastern end of the tug berths would be fenced and an office constructed as an administrative office for managing the tug boat service and as a waiting area for crews.



Boat Ramp Area **Figure 8.12**

8.5.2 Beach Enhancement

The beach on the western side of the tug berth area would be enhanced as part of the project development work. Sand from the dredging operation would be used to nourish the existing beach and to provide the landscaped park area at the western end. The sand would be brought to the beach area by truck and spread by use of a rubber-tyred loader. The existing concrete stormwater pipes would be extended across the beach as part of the rejuvenation works.

The outlet of the Mill Stream would be extended slightly by construction of a new rock bund (refer to **Figure 7.1a**). Rock would be brought to the site by truck and placed by backhoe as an extension of the existing concrete channel wall. Sand from the dredging operation would be brought to the site by truck where it would be distributed by loader and levelled. About 10 to 15 truck deliveries per day would be expected for this operation over a 6-month period.

Top soil would be spread over the fill material and the area landscaped to create the park area (refer to **Figure 7.1a**).

8.5.3 Pedestrian/Cycle Path and Boardwalks

A new pedestrian and cycle path would be constructed parallel to Foreshore Road between the Mill Stream and Penrhyn Road (refer to **Figure 7.1a, 7.1b** and **7.1c**). The path would run in the landscaped strip between Foreshore Road and the new beach/rail line. An underpass would be provided for pedestrians and bicycles beneath the new road and rail bridges.

The area for the cycle path would be cleared and a layer of crushed rock placed and compacted to form a sub-base. Asphaltic concrete would then be brought to the site by truck, placed and compacted by small roller or plate compactor.

A boardwalk would also be provided at the western end of Penrhyn Estuary. The boardwalk would be supported on piles driven from shore to provide public access to the edge of the enhanced estuary. A viewing platform would be constructed at the end of the boardwalk to allow observation of wildlife within Penrhyn Estuary.

8.5.4 Pedestrian Footbridge

Access to the new beach and public domain areas would be facilitated by construction of a footbridge over Foreshore Road (refer to **Figure 7.1a**). The bridge would be located approximately at the mid point of the beach, west of the new tug berths. The pedestrian bridge, with disabled access, would connect residential areas and Sir Joseph Banks Park to the enhanced beach area and new cycle and pedestrian path.

Concrete foundations and piers would be constructed adjacent to Foreshore Road and prefabricated beams lifted in to position by crane. There would be some disruption to traffic on Foreshore Road while the lifting operation is being undertaken. This disruption would be mitigated by scheduling beam lifting operations to low traffic periods which would necessitate some out of hours working.

8.5.5 Penrhyn Estuary

It is proposed to construct new intertidal, saltmarsh and seagrass areas within Penrhyn Estuary to greatly expand the habitat available to birds and native wildlife (refer to **Figure 7.2**). This work would need to be undertaken with great sensitivity to avoid undue disruption of the existing habitat. It is therefore proposed to concentrate works at the western end of Penrhyn Estuary and retain much of the existing habitat at the eastern end.

It is further proposed that work in this area commence at the earliest opportunity during the construction campaign and be predominantly undertaken during the winter months when migratory birds are not present. Fencing of this area would also be erected early in the construction campaign to restrict public access to sensitive shorebird habitats.

Material for the new intertidal and saltmarsh areas would be obtained from the large sand dune on the northern side of Penrhyn Estuary. This material would be supplemented, where necessary, by material obtained during the dredging operations.

The dune material would be loaded into trucks and tipped along the area where the intertidal flats are to be created. It would then be pushed out into the water by swamp dozer working opportunistically during low tide periods. Recent experience in creating similar areas in Brisbane indicates that material can be placed to the low water level and allowed to settle thus achieving the desired bird wading environment.

Top soil material would be spread over the areas to encourage stabilisation and microbe growth. This topping material may be supplemented by sea bed sediment layers stockpiled during the dredging operation. It is expected that the stockpiled material would be located adjacent to the main works area at the western end of Brotherson Dock North.

The remains of the former Government pier would be preserved as part of the development of the enhanced Estuary. The pier would be fenced off during the construction period.

The works within Penrhyn Estuary would be staged as described in **Chapter 20** *Terrestrial Ecology* to provide an opportunity to monitor the use of the area by migratory shorebirds during the construction period. The first stage would involve the creation of only a portion of the proposed intertidal shorebird habitat to provide additional roosting habitat for shorebirds during construction. The remainder of the proposed habitat enhancement works would be completed following a shorebird monitoring program to be undertaken during the construction period and consultation with relevant government authorities.

8.6 Construction of Terminal Facilities

The terminal operator(s) would need to undertake various construction activities after the basic wharf construction has been completed. The elements to be constructed would include:

- internal reticulation of services;
- installation of cranes and container handling equipment;
- buildings; and
- roads and pavements.

8.6.1 Internal Services

Power, water and wastewater services would have been brought to the boundary of the site during the main wharf construction process as described earlier. These services would be extended throughout the site by the terminal operator(s). The services would be primarily buried and installation would therefore involve conventional trenching and backfilling operations.

A stormwater drainage system would be constructed whereby surface runoff is channelled into inlet pits which would drain to a series of box culverts. The first flush would drain from each box culvert line into a series of first flush retention trenches at the eastern and northern boundary of the new terminal as detailed in **Chapter 16** *Hydrology and Water Quality*.

Construction of these facilities would involve some excavation of the reclamation material, forming and pouring of concrete, installation of precast concrete culvert sections and reinstatement works. Excavation would be by backhoe and loader with excess material removed by truck. Pre-cast units would be delivered on trucks and installed by mobile crane. In-situ concrete would be supplied by agitator truck and pumped into the forms.

It is expected that these trenching, installation and construction activities would continue over a six to 12-month period.

8.6.2 Installation of Cranes and Handling Equipment

The terminal operator would be responsible for installing the main crane rails on the previously prepared concrete beams. Additional rails would be required for Rail Mounted Gantries within the site and some minor pile driving may be required as part of this operation.

The quay and mobile container handling equipment would be delivered to site in purpose-built ships in a fully assembled state. The quay cranes would then be installed on their rails on the wharf. The cranes would remain below the OLS at all times during the installation process.

Rail Mounted Gantries would be brought to the site by ship in a semi-assembled state and would be erected at the rail sidings using mobile cranes.

8.6.3 Building Construction

A number of buildings would be required by the terminal operator and these would include a two to three storey administration and operation centre, workshop, gatehouse, substation and minor site buildings. In addition to these buildings on the new terminal, an administration office and workshop would also be required to be constructed for the tug berths located on the new boat ramp reclamation area to the north of the new terminal.

The administration buildings would be constructed on raft or piled foundations which would require some excavation and possibly some pile driving. The building frame would be either concrete or steel columns and beams with masonry walls.

The main equipment maintenance workshop would be constructed with a steel frame and metal cladding. The work would involve some minor excavation, pouring of concrete and erection by mobile crane. The

gatehouse, substation and other minor site buildings (e.g. sewerage pump house) would probably be of masonry construction.

All of these structures would be of a standard form and would probably be built over a 12-month period and would involve truck deliveries of materials at a rate of approximately eight trucks per day.

8.6.4 Roads and Pavements

Internal roads and paved areas would need to be constructed by the terminal operator. It is expected that these would be built progressively over a 6 to 12-month period as other elements are completed.

Construction would involve levelling work, importation and compaction of sub-base material and the placing and compaction of asphaltic concrete. Truck traffic of about eight arrivals per day would be expected for this operation.

8.7 Construction Implementation

8.7.1 Construction Sequence and Timing

The timing of commencement of construction of the Port Botany Expansion would depend on approval of the DA by the NSW Minister for Infrastructure and Planning and the Commonwealth Minister for the Environment and Heritage. In addition, a number of other approvals and agreements are required from other agencies as specified in **Chapter 9** *Statutory Planning*.

Subject to approval being granted for the project, there would be a period of further design development and documentation, tendering, assessment of submissions and award of the construction contract(s).

Staging and durations of the principal construction activities are summarised in **Figure 8.8**. The lead time to commence operations for the first berth at the new terminal would be approximately seven years. The subsequent roll-out of terminal equipment and capacity by terminal operator(s) would have lead times of no greater than 12 to 18 months for each new berth. The existing facilities at Port Botany would continue operations throughout construction of the new terminal.

8.7.2 Capital Investment

The total capital investment for the proposed Port Botany Expansion (including terminal facilities) has been estimated at $576 million.

8.7.3 Construction Hours

The dredging and reclamation work would be conducted 24 hours a day, seven days a week. Other construction activities would generally be limited to daylight hours (7 am to 6 pm) six days per week with the exception of some rail and road construction activities which could take place at night for a limited period.

Construction activities would not normally be undertaken on Sundays or public holidays, although equipment maintenance and some environmental protection works may be undertaken on these days.

Where the project requires construction work outside these hours, the regulatory authorities and affected stakeholders would be notified.

8.7.4 Construction Equipment

The actual number and types of equipment used would depend on availability and the construction contractor's preferred working method. An indicative list of the major construction equipment to be used, based on the documented methodology is summarised in **Table 8.1**, although alternative equipment may be used if required.

Table 8.1 Major Construction Equipment

PHASE OF WORKS	EQUIPMENT LIST	NUMBER	ACTIVITY
Dredging & Reclamation – construction of embankment (*15 months*)	Trucks	100 / day	Delivery of rock embankment material
	Front End Loader	2	Loading of rock embankment materials onto shuttle barge
	Cutter-suction Dredge Rig	1	Dredging
	Bobcat / Front End Loader	2	Moving rock embankment materials into chute on fixed barges
	Tugs	4	Towing rock transport barges
	Work Boats	2	Servicing dredging operation and general duties
	Barges	4	Rock transport
	Hopper Barges	2	Placing embankment material
Dredging & Reclamation – site trimming and stabilisation (*15 months*)	Dozer	1-2	Level finished (bulk fill) surface
	Water Truck	2	Aid in compaction and also for dust control
	Grader	1	Level finished (bulk fill) surface
	Rollers (Sheepsfoot & Steel Drum)	1-2	Compaction / Completion of finished surface
	Excavator	1-2	Trenching, trimming of embankments and placing temporary armour
Dredging & Reclamation – preloading *(12 months)*	Scraper	6	Profile finished surface
	Water Truck	2	Aid in compaction and also for dust control
	Grader	1	Levelling finished surface
	Dozer / Compactor	1	Level finished surface and compaction
	Roller (Sheepsfoot)	1	Compaction / Completion of finished surface
Wharf Construction (39 months)	Trucks	Up to 60 / day	Delivery of piles and hard rock armouring material
	Piling Rig / Diesel Hammers	2-3	Install steel piles
	Large Crane	1-2	Placement of precast units during wharf construction

PHASE OF WORKS	EQUIPMENT LIST	NUMBER	ACTIVITY
	Dozer	1-2	Moving stockpiled sand to fill behind precast retaining wall
	Grader	1	Level finished infilling area behind retaining wall
	Roller (vibratory)	1-2	Compaction / Completion of finished surface
	Road making equipment – Bitumen Spray Truck Rollers Trucks	1 2 3	Temporary Sealing
	Concrete trucks	20 / day	Construction of wharf, bridges, drainage works, buildings etc
	Barges	3-4	Pile transport and driving
	Mobile Crane	1-2	Moving piles and pile sections for joining
Beach, Recreational Area and Penrhyn Estuary Enhancement (9 months)	Trucks	Up to 30 / day	Delivery of hardrock for revetment and boat ramp, and later for extra beach sand and material as required
	Excavator	1	Placing and forming of rock revetment
	Dozer	1	Landscaping and spreading material for beach and estuary enhancement
	Front End Loader	1	Landscaping and spreading material for beach and estuary enhancement
	Dozer / Compactor	1	Profile finished beach area
Terminal Facilities (24 months)	Trucks	80 / day	Delivery of construction materials
	Heavy Compacting Roller	2	Initial compaction of sub-grade
	Roller (Sheepsfoot)	2	Compaction of sub-grade/base/sub-base materials
	Dozer	2	Grading, profiling and spreading cement
	Asphalt Paving Machine	2	Laying asphalt
	Bitumen Spray Truck	1	Spraying asphalt over surface
	Roller (Steel Drum)	2	Compaction / Completion of finished surface
	Grader	1	Levelling surface
	Water Truck	2	Dust control
	Excavator	1-2	Excavation to install building foundations
	Backhoe	1	Excavation to install services, fencing and lighting
	Crane	1	Erecting lights, building assemblage and terminal equipment
	Concrete Truck	5 / day	Pouring of concrete for building foundations
	Piling Rig / Diesel Hammers	1	Installation of piles
Delivery of Terminal Facilities	Crane Transport Vessel	1	Delivery of fully assembled quay cranes
	Large Trucks	5	Delivery of partially assembled RMG sections
	Mobile Cranes	2 - 3	Erection of RMGs
	Transport Vessel	1	Delivery of Straddle Carriers/RTGs

8.7.5 Refueling

Marine fuel oil required for construction vessels would be provided from existing refueling facilities in Port Botany. Small road tankers would fuel onsite land-based plant and equipment. Onsite storage of fuel for construction equipment would generally not be necessary, except for minor quantities for small equipment like generators. Some earthmoving contractors, however, may require aboveground fuel storage tanks of up to 20,000 L capacity to provide "standby" fuel supply for their equipment.

Storage and handling of fuel would be conducted in accordance with *Australian Standard AS 1940 (1993): The Storage and Handling of Flammable and Combustible Liquids* including the installation of bunding around fuel storage tanks.

8.7.6 Construction Workforce

The average number of employees and contractors onsite during construction would be approximately 60 people. The maximum number of employees and contractors onsite at any one time is expected to be in the order of 160 people. This maximum would occur during periods of intensive construction activity during the second year of construction.

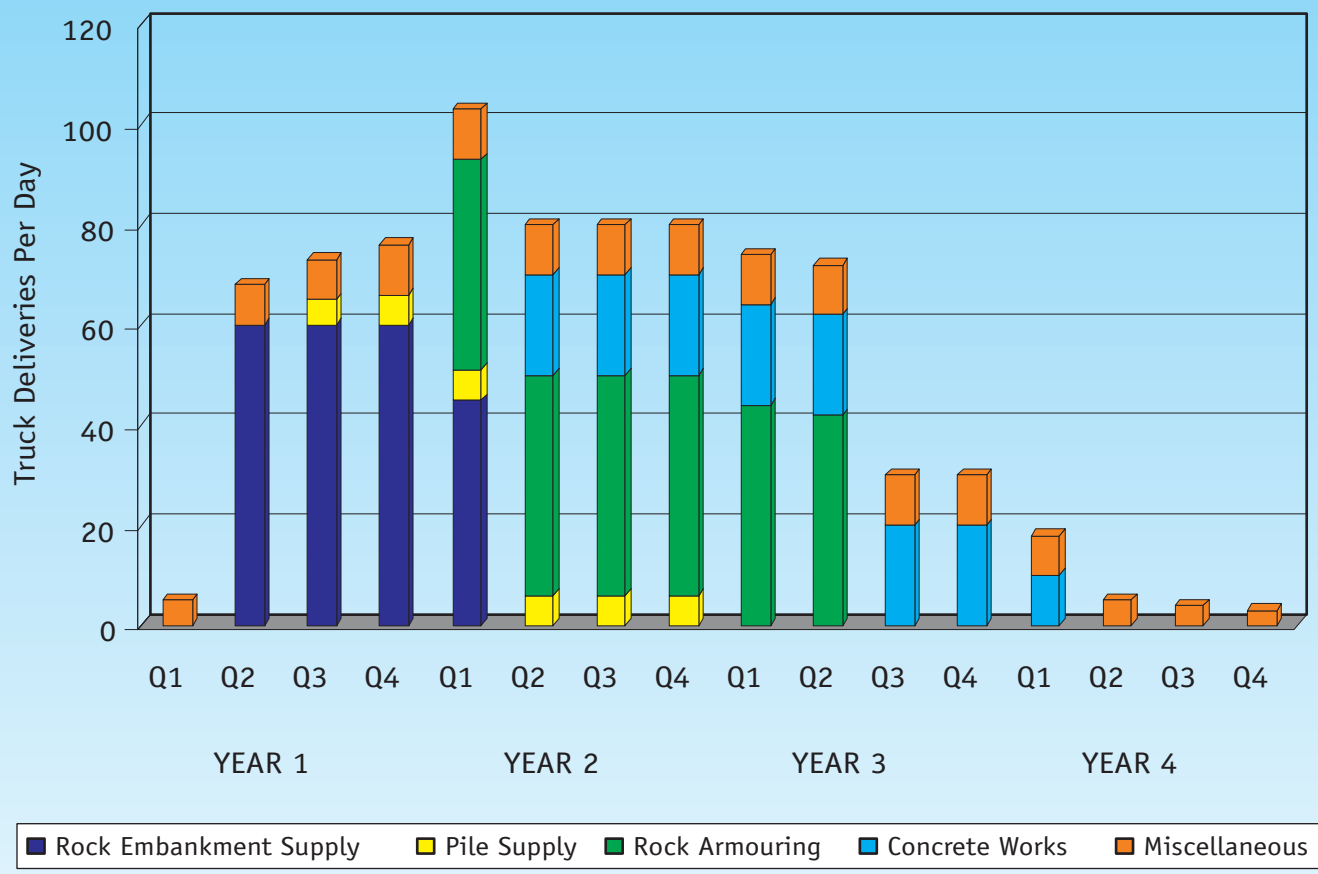
8.7.7 Construction Traffic

Considerable construction traffic would be generated in the first three years of construction of the new terminal. **Figure 8.13** shows the traffic likely to be generated by the main construction operations, but does not include general deliveries or private vehicle traffic. In general, most construction traffic would be generated during the dredging and reclamation and the armouring of the reclamation embankment with rock. These activities would primarily occur during the first two to three years of construction. The maximum number of construction truck deliveries would be approximately 103 per day during the first quarter of the second year of construction.

8.7.8 Environmental Management Plan

A detailed Construction EMP would be prepared for the works to be managed by Sydney Ports Corporation prior to any construction activities being commenced at the site. This plan would include the following sub-plans:

- traffic management;
- erosion and sediment control;
- flora and fauna;
- construction noise impact statements;
- waste management;
- emergency and incident response; and
- stakeholder consultation.



	YEAR 1				YEAR 2				YEAR 3				YEAR 4			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Rock Embankment Supply		60	60	60	45											
Pile Supply			5	6	6	6	6	6								
Rock Armouring					42	44	44	44	44	42						
Concrete Works						20	20	20	20	20	20	20	10			
Miscellaneous	5	8	8	10	10	10	10	10	10	10	10	10	8	5	4	3
Truck Deliveries Per Day	**5**	**68**	**73**	**76**	**103**	**80**	**80**	**80**	**74**	**72**	**30**	**30**	**18**	**5**	**4**	**3**

Traffic Generation During Construction **Figure 8.13**

Detailed work method statements would also be prepared for each phase of the work prior to any construction activities commencing.

Separate Construction EMPs would need to be prepared by the terminal operator(s) prior to construction of terminal facilities.

An outline of the Construction EMP for the works to be managed by Sydney Ports Corporation is provided in **Chapter 38** *Environmental Management and Monitoring*.