CONTENTS

ANNEX

3 PROJECT DESCRIPTION

3.1 THE PROJECT

The Project is classified as a Designated Project under the *Environmental Impact Assessment Ordinance (Cap.499) (EIAO).* The works that are the subject of the EIA Study include the construction and operation phases of the Project. The key components of the Project include the following:

- Storage, transfer and trans-shipment of liquefied natural gas with a storage capacity of not less than 200 tonnes (item *L.2 of Part I of Schedule 2 of EIAO*);
- Dredging operation for the approach channel and turning basin that exceeds 500,000 m^3 (item *C.12 of Part I of Schedule 2 of EIAO*); and,
- Reclamation works (including associated dredging works) of more than 5 ha in size (item *C.1 of Part I of Schedule 2 of EIAO*).

3.2 PROJECT DESIGN

The proposed Project involves the construction of a LNG receiving terminal together with its related developments and supporting infrastructure (*Figure 3.1*). The information presented in this section is taken from the preliminary design and will be subject to further study at the detailed engineering design stage.

The preferred scenario/alternative to be taken forward in this EIA has been described in *Part 3 – Section 2*. This has been identified as the Base Case Layout (Option 1). On the basis of this selection, the preliminary layout plan is presented in *Figure 3.1*. Shown on the drawing is the third tanks which will be constructed in the expansion case. A laydown area is also included for construction of all three tanks. An on-site construction facility area has been included in the layout for storage of construction equipment and later for maintenance equipment. The key elements of the Project are as follows:

- Marine Dredging;
- Land Excavation;
- Land Reclamation;
- LNG Jetty Construction; and,
- LNG Terminal Facility Construction.

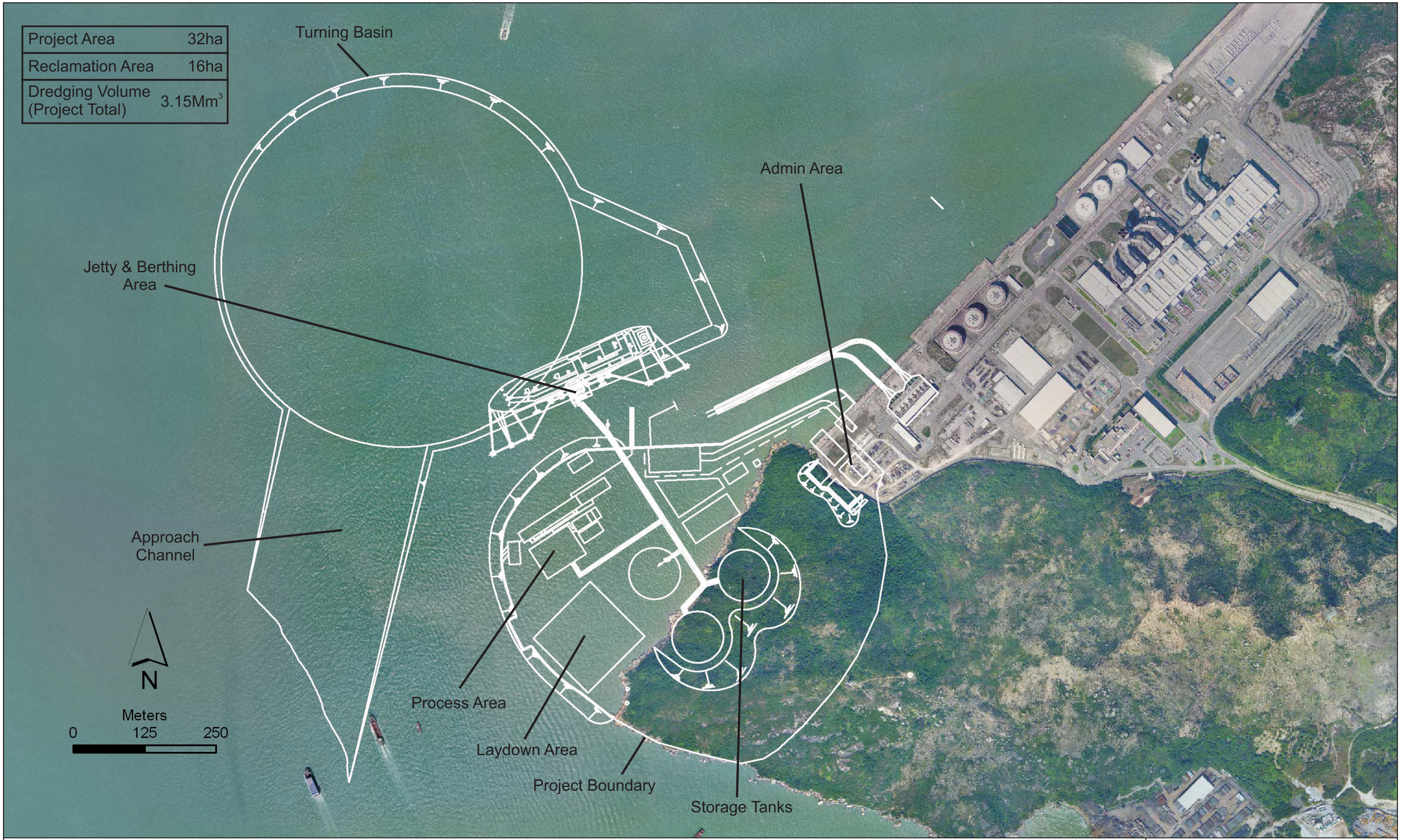

Figure 3.1

Layout for the Proposed Black Point LNG Terminal
(Aerial photograph source: Lands Department)

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A general summary of each of these key elements is presented in turn below followed by a description of the key construction and operational activities in *Sections 3.3* and *3.4*.

3.2.1 *Dredging*

Dredging of marine sediments will be required for the following installations/facilities:

- Approach channel and Turning basin;
- Seawall for reclamation; and,
- Seawater intake/outfall.

Dredging requirements for each of the above are discussed below. Representative geological cross sections showing the extent and depth of the marine sediment dredging requirements for each of the above facilities are shown in *Figure 3.2*.

Approach Channel and Turning Basin

Marine sediments will be required to be dredged to allow safe navigation of the LNG carrier to the Black Point Terminal. Due to the required draft of the LNG carrier a project seabed dredging level of approximately -15 mPD is required for the approach route from the pilot embarkation at the anticipated boarding station south of Ngan Chau, through the Ma Wan Channel, along the Urmston Road to the delineated channel approaching Black Point. Due to the water depth west of Lantau Island, safe transit of the LNG carrier to Black Point is restricted to the East Lamma Channel and Western Fairway. The approach channel and turning basin for the carrier are presented in *Figure 3.1*. All dredging will be undertaken within the soft marine deposit layer and slopes of around 1:4 are expected. No excavation of rock or hard material will be required. Approximately 0.71 Mm^3 of sediments will be required to be dredged for the approach channel. The turning basin will require approximately 1.78 Mm^3 of sediment to be dredged. The estimated breakdown of the dredging and volumes is presented in *Table 3.4*.

Seawall and Reclamation

Approximately 16 hectares (ha) of land will be reclaimed to the south of the Black Point Power Station in order to provide sufficient space for the terminal facilities. The Partially Dredged Method of reclamation has been adopted for the Black Point site as discussed in *Section 2.2.1*.

The use of ground improvement techniques including vertical drains and surcharging have been considered in order to accelerate the dissipation of pore water pressures and hence consolidation settlements.

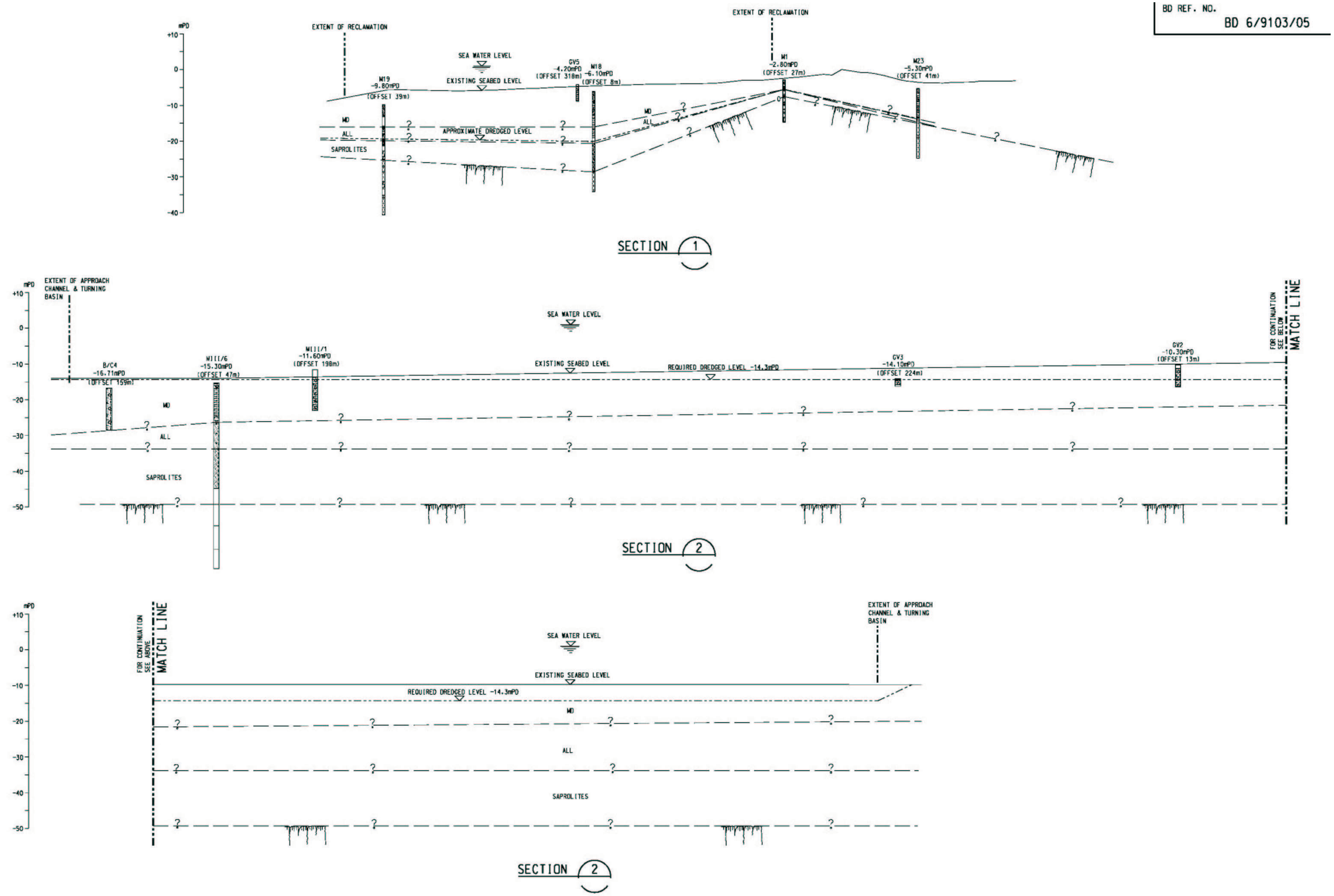

Figure 3.2

Black Point Reclamation Approach channel & Turning Basin - Section

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The preferred layout option for the Black Point Site involves approximately a 700 m length of sloping seawall and a 400m length of vertical seawall. An existing cooling water intake from Black Point Power Station runs along the north-eastern shoreline of the proposed reclamation. The cooling water intake culvert is presumed to be supported on a rock base above the seabed. In order to reduce the disturbance to the cooling water intake culverts, vertical seawall structures are adopted adjacent to the intake culverts to maintain a clearance of 50 m from the seawall dredging works.

To reduce the hydrodynamic effects on the locality, the sloping revetment type seawall is adopted along the remaining length of the reclamation boundary as it will dissipate the wave energy more efficiently than a vertical seawall and hence reduce wave reflection back towards the jetty structures. Also the sloping seawall has a more natural appearance and is therefore more aesthetically attractive. Typical sections through the proposed seawalls are shown in *Figure 3.3*.

Dredging will be undertaken to remove the soft material beneath the seawalls to ensure that these structures are stable. Approximately 0.63 Mm^3 of soft marine sediments will be dredged under the seawalls. A small amount of rock trimming may also be required to provide a level platform for seawall construction, which may be undertaken using a hydraulic breaker.

Approximately 0.785 Mm^3 of rock shall be required beneath the seawalls which shall be largely sourced from the on-land excavation works. The remaining excavated rock material and soft soil material from the land works shall be used within the reclamation. The remaining reclamation volume will be filled with approximately 1.56 Mm^3 of marine sand fill and 0.54 Mm^3 of public fill.

The quality of marine sand fill to be used for the reclamation including the fines content is detailed in *Tables 3.1* and *3.2.*

Table 3.1 ***Particle Size Distribution of Sand Fill***

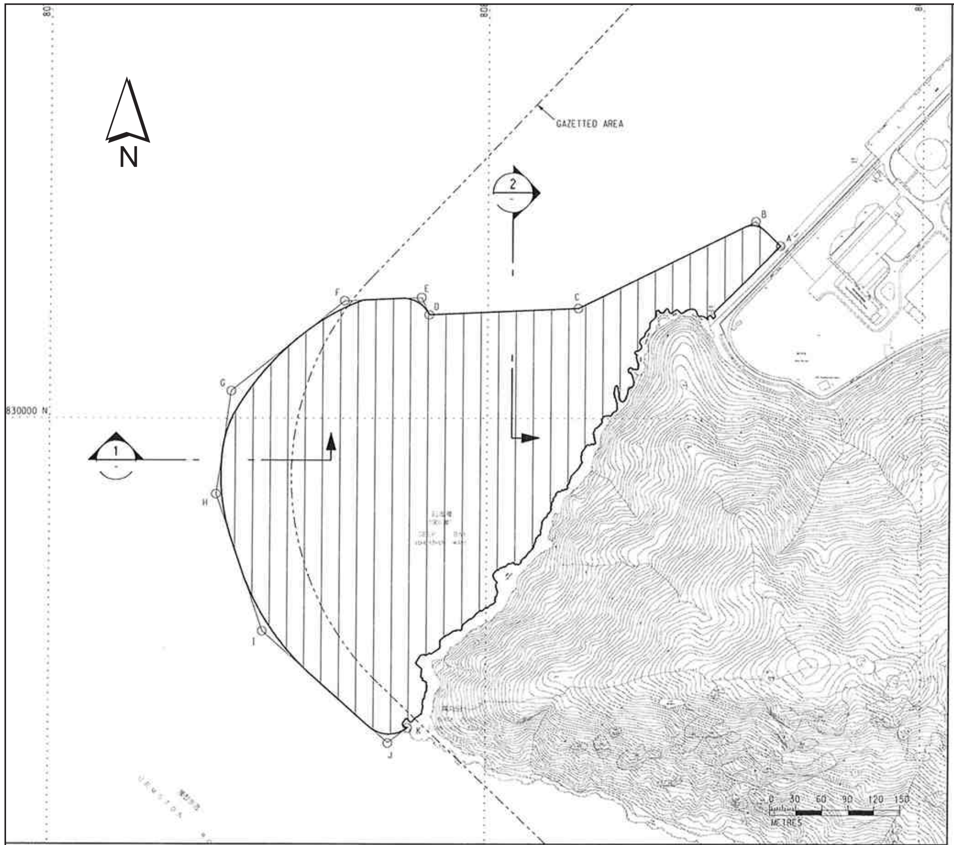
Type of Fill Material	**Percentage by Mass Passing (%)**		
	BS test sieve size		
	75mm	**20mm**	**63mm**
Underwater fill material (Type 1)	100	-	0-30
Underwater fill material (Type 2)	100	-	0-25

Table 3.2 ***Geotechnical Parameters of Sand Fill***

	Bulk Density (kN/m^3)	**Friction Angle (^{o})**	**Cohesion (kN/m^2)**
Underwater fill	19	30	0

3.2.2 *Seawater Intake/Outfall*

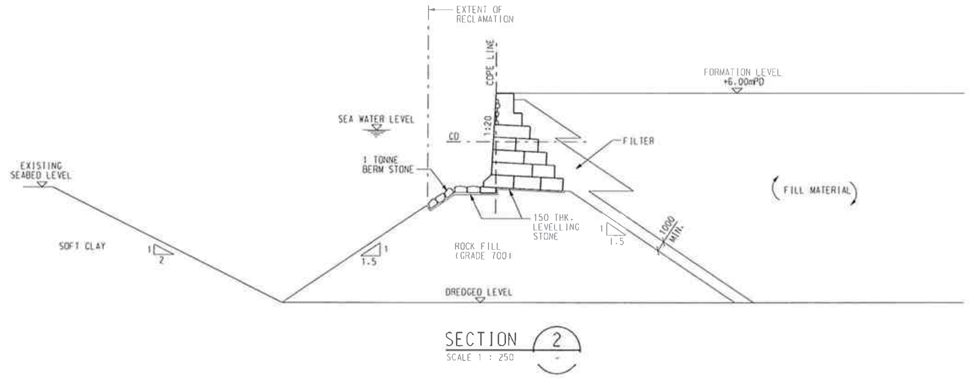
The design of the seawater intake and outfall for the Black Point terminal is described in *Part 3 – Section 3.3.3*. Dredging of marine sediments will be required to bury the intake pipe to a safe depth. All dredging will be



PLAN
SCALE 1:3000

RECLAMATION SETTING-OUT CO-ORDINATES

POINT	EASTING	NORTHING
A	808335.890	830197.757
B	808307.477	830225.611
C	808103.871	830126.087
D	807933.285	830118.629
E	807924.560	830138.267
F	807836.605	830134.422
G	807707.231	830031.304
H	807690.441	829912.893
I	807744.105	829755.665
J	807889.186	829627.242
K	807911.296	829644.379



SECTION 2
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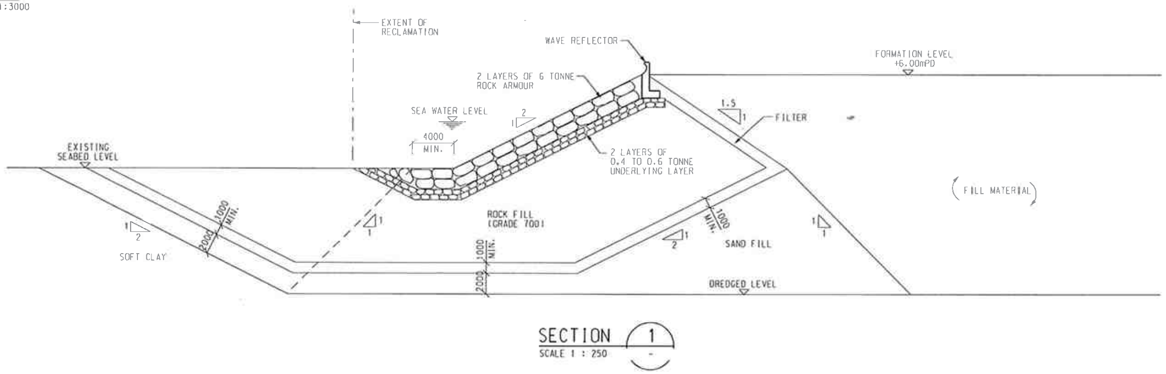

SECTION 1
SCALE 1 : 250

Figure 3.3

Black Point Reclamation Area and Sections

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undertaken in soft marine sediments for which an approximate quantity of 34,500 m^3 will be required to be removed.

3.2.3 *Land Excavation*

Excavation of around approximately 220,000 m^3 of soft material (i.e., soil) will be required to be excavated from the Black Point headland. An additional quantity of approximately 770,000 m^3 of hard material (i.e., rock) will also be required to be removed.

3.2.4 *Land Reclamation*

Reclamation of about 16 ha of land extending from the Black Point headland will be made using marine sand fill and fill generated through excavation works. Approximately 320,000 m^3 of public fill material will need to be imported to supplement the existing 220,000 of m^3 of available soft material for construction of the Black Point terminal. The works will involve construction of about 1.1 km of vertical and sloping seawall. The reclamation area will be primarily for the LNG terminal process area and other associated facilities such as the lay down area and administration buildings.

3.2.5 *LNG Jetty*

Construction of a 100 m long trestle leading to the jetty structures and unloading arms will be required to the northwest of the reclamation site (*Figure 3.1*). The primary use of the jetty will be to unload LNG from the LNG carriers.

3.2.6 *LNG Terminal Facilities*

Once the land has been formed the construction of LNG terminal infrastructures and facilities will include LNG Storage Tanks (capacity of 160,000 to 180,000 m^3 with approximate dimensions of 90 m external diameter by 49 to 64 m height to the top of the dome of the tank, ie +70mPD), Low Pressure and High Pressure pumping systems, Vaporization (Re-gasification) Area, Vents (low pressure and high pressure), Process Area, Maintenance Workshop, Administration Building, Guard House, Utility Area, Control Room.

Terminal storage capacity is determined by a number of factors including gas usage patterns, peak demand, demand growth, distance from LNG sources, and ship size. Tanks are sized to allow offtake of the contents of an LNG carrier and to provide such additional storage capacity to allow for uninterrupted gas supply in the event of shipment delays due to storms, etc. and to accommodate seasonal demand patterns. Based on simulations[1], the terminal will initially require two tanks, each with capacity up to 180,000m^3, with a potential third tank to meet future expansion

[1] Hong Kong LNG Terminal Project Shipping Simulation for Terminal Tank Sizing, CAPCO internal study.

3.3 LNG TERMINAL CONSTRUCTION

3.3.1 General Construction Sequence

To accommodate the necessary infrastructures of the LNG terminal at Black Point, a total area of approximately 32 ha of land is required. Not all of this land will, however, be physically altered. The majority of the land will be formed through and balanced cut and fill reclamation. This will necessitate excavation of the Black Point headland which will also provide screening for the LNG tanks. As the marine approach to the site is shallow, floating pontoons will be initially used to reach the deeper water to provide initial access for marine vessels. Dredging will be carried out as soon as practical to obtain closer shore access once approval to undertake marine dredging is attained. Heavy machinery will be mobilised to site either via barge or road access using the temporary haul roads formed on land as necessary. The conceptual construction sequence is presented below. It should be noted that this sequence has been based on preliminary design and will be subject to further study during the detailed design stage.

1. Barging points will be set up at the waterfront with sufficient water depth to allow berthing of barges.

2. The on-land site works will commence with the removal of the scrub and vegetation on the existing slope prior to slope cutting works.

3. The removal of the soft materials on the surface of slopes will continue shortly afterwards. In conjunction with these works, a temporary haul road will be constructed which will allow heavy machinery to be mobilised and transported to the crown of the cut slope.

4. Immediately upon completion of the haul roads, drilling rigs will be mobilised to the crown of the proposed slope for the sinking of holes for blasting operation.

5. Blasting works would be carried out continuously on a daily basis until the final formation level is reached.

6. Once approval is obtained to undertake marine works, dredging will be undertaken for the seawalls and reclamation in parallel with the blasting works.

7. Dredged material will be removed to approved disposal/storage sites by barges.

8. Rock material excavated from the site will be reused as to the extent practical for the foundation of seawalls assuming their quality and properties meet the requirements of the core material for seawall construction. Excess material will be barged away to an appropriate approved stockpile or quarry for use elsewhere in Hong Kong. The relative timing of the land excavation and marine dredging works will

determine whether temporary storage of the excavated rock and fill material is required off-site.

9. A sand blanket layer followed by rock fill and soft soil materials, of suitable size and grading from the blasting and excavation works, will be deposited into reclamation works until the required formation level is reached.

10. Two batching plants will be erected on site as early as possible to provide the necessary steady supply of concrete for the superstructure works and the proposed slope protection measures.

A more detailed description of the construction activities is presented below.

3.3.2 *Land Based Works*

The site will require levelling, preparation and excavation for the landside works to a level of approximately +6 mPD, which should largely comprise rock excavation. This will involve blasting followed by grading with earthmovers to ensure a suitable construction surface. Approximately 95% of the excavated material will be suitable for use within the reclamation. However, due to uncertainties between the relative timing of the land excavation works and the marine reclamation works it may be necessary to temporarily store and process the excavated material off-site. The remaining 5% is assumed to be topsoil, which is unsuitable for reclamation purposes and will be used for landscaping on the site to the extent practical.

In general, the land-based works would be expected as follows:

1. Formation of access haul roads
2. Slope cutting works
3. Seawall and reclamation works
4. Slope protection works
5. Drainage works
6. LNG Tank Construction
7. Construction of Associated Facilities
    a. Batching Plants
    b. Magazine Storage
    c. Operating Facilities

Each of these proposed works are discussed below.

Formation of Access Roads

The existing slopes at Black Point are estimated to be inclined at between an average of 45 ~ 50° which is too steep to permit direct access to construction plant. As slope cutting work are required to commence from the upper levels of the existing terrain working progressively downwards good road access will be required. A temporary haul road is, therefore, necessary to be constructed to facilitate the mobilization of construction plant to the initial excavation areas. The haulage road will also be used for mobilization and transportation of drilling rigs, excavators, explosives and protective cages etc which will be essential for the slope cutting works. The road will also be used to transport excavated materials from the site to the barging points for disposal off site or directly onto the reclamation area. If necessary, soft material may need to be temporarily stock piled at the site depending on the rate of excavation and permitting process. It is expected that the slope cutting works may be carried out on the southern and northern slopes simultaneously.

Slope Cutting Works

The site formation works will be carried out from several berms formed at pre-determined levels to accommodate the necessary drainage works and landscaping works. The berms are typically provided at 10 m vertical intervals and will likely be used to provide a temporary working platform for the drilling and blasting works.

Construction plant will be mobilized on site to undertake the excavation works including bulldozers, excavators, wheel loaders trucks etc.

The majority of material excavated from Black Point shall be used within the reclamation. However, due to the relative timing of the excavation and reclamation works and the limited space available on site it may be necessary to temporarily store the excavated material at a designated stockpile site. Black Point is located on a headland with limited road access. Marine-based transportation mode such as barges for the disposal or removal of the excavated materials is, therefore, recommended. For this purpose barging points will need to be set up on site. Waste management is discussed in *Part 3 – Section 7* of this EIA Report.

Seawall and Reclamation Construction

It is assumed that no marine borrow area would be allocated by the government within Hong Kong waters and therefore the sand fill material will need to be sourced by the contractor. It is considered that the sand material can be readily sourced from the suppliers within the Pearl River Delta area, which has provided a steady supply of sand material over the last few decades. However, it is recognised that this source is not certain due to recent overseas supply restrictions imposed by the Chinese Government. The effect of these recent developments is being investigated at this time.

Assuming that sand may be sourced from these areas then the sand fill material will be brought in to the site by self-propelled pelican barges.

Pelican barges have been widely used in reclamation works as its application would not be limited by water depth. With the aid of a conveyor belt installed at the front of the vessel, the sand material could be deposited up to a level of +6 mPD. In this regard, the only issue is to maintain a marine access throughout the construction period through good sequence planning such that the pelican barges can deposit the sand fill material at the designated deposition area. In this manner double handling of deposited fill material using land-based trucks would also be kept at a minimum.

The rock filling or public filling will be undertaken by derrick barges through end tipping, after the sand fill has reached a level of +2.5 mPD and treated with vibro-compaction. The fill materials will be placed by truck and compacted by bulldozer in layer increments of 300 mm thickness or less. The public fill materials can be obtained from the existing fill banks located at Tuen Mun Area 38 although transportation of materials will be the Contractor's responsibility. It could also be obtained from the public filling barging points at different locations around Hong Kong although the quality of the fill is difficult to control.

The ground improvement techniques for the placed fill materials include vibro-compaction. Vibro-compaction is the most commonly used ground improvement method applied in drained reclamations to densify the fill material to reduce long-term creep settlement. It is carried out by controlled penetration and retraction of a vibrating poker (vibroflot) within the fill layer.

The vibration is applied at a high frequency and with the assistance of a water jet or compressed air. Using this method the inter-granular forces between the soil particles are temporary nullified and liquefaction occurs, allowing the particles to be rearranged into a denser matrix. The degree of compaction is controlled by the energy input and spacing of the compaction points, typically at between 2.5 m and 4 m.

This ground improvement technique is effective in densifying the ground at the lower levels although it is less effective within the surface few metres and therefore a traditional roller compaction method is normally employed for these layers. In addition, trial compaction shall be performed to determine the optimal values of spacing and depth before full-scale implementation.

Slope Protection Measures

After the blasting works progress, the exposed rock surfaces will be mapped and appropriate slope protective measures designed and incorporated. The drilling rigs at the site will be used to install stabilisation measures, which will likely comprise of dowels and anchors.

Drainage System

Appropriate drainage systems shall be installed after the slope cutting works are completed in conjunction with appropriate de-silting processes. During the construction stage, a temporary surface channel shall be constructed along the perimeter of the site such that any surface run off will be collected and treated before discharging into the sea.

The temporary drainage system during the construction phase shall be formulated by the Contractor to be compatible with his method of works and construction programme. The temporary drainage shall follow EPD's *Practice Note ProPecc PN 1/94*.

Appropriate mitigation measures to prevent impacts to water quality are discussed in the *Water Quality Impact Assessment* (*Part 3 – Section 6* of this EIA Report).

LNG Tank Construction

The construction of the LNG tanks is one of the key elements of the works. At the initial operation stage, two tanks shall be available for operation, with a third tank for future expansion. The 180,000m^3 tanks have an external diameter of about 90 m with an overall height up to 64 m (ie +70mPD) although there could be some variations in the final detailed design. This EIA Report will assess the worst case scenario which comprises three tanks.

The full containment system of LNG tanks has been selected for this project. Typical LNG storage tanks are a full containment design and are composed of a 9% nickel steel inner tank container, which is surrounded by an insulator. An external concrete outer tank will be constructed around the outermost surface to protect the insulator and the 9% nickel steel container. The full containment tank is capable of containing the LNG liquid and performing controlled venting of the vapour from any LNG leakage.

After the external reinforced concrete tank wall has been completed, the roof is then air raised. The 9% nickel steel tank will be constructed within the concrete tank. Steel plates will be welded on site within the outer tank. A temporary platform will be erected within the concrete tank to facilitate the steel work construction, lifting and installation process.

Following construction the tanks will be hydrotested for integrity. The assessment of any potential impacts associated with hydrotesting activities are discussed in the *Water Quality Impact Assessment* (*Part 3 – Section 6* of this EIA Report). Potential impacts of hydrotesting activities on marine ecology and fisheries are assessed in *Part 3 – Section 9* and *Part 3 – Section 10* respectively.

Construction of Associated Facilities

Batching Plant

A continuous and undisturbed supply of concrete will be required for the construction of the critical structural elements and in particular the external concrete walls for the large LNG Tank structures and the associated processing units. To secure the supply of concrete for construction two batching plants will be erected on site. The plants would be expected to be of a relatively small size and will likely be located near the waterfront with a dedicated berth for the import and storage of sand, cement and aggregates.

Potential air quality impacts associated with the batching plant are discussed in *Part 3 – Section 4* of this EIA Report.

Magazine Storage

The use of explosives for blasting is essential in the large-scale site preparation works. The explosive will be classified as *Category 1 Dangerous Goods*.

For safety and security reasons, stringent control on the storage and usage of explosives will be employed. Various requirements on the implementation of such a facility have been provided and are summarised below.

- Max 1,000 kg of explosive,
- Brick and earth bund,
- 400 m from densely populated areas (based upon a 1,000 kg store),
- 45 m away from (440v) to 75 m away from (1KV) electric cables,
- Approval of Police Commissioner,
- Secure facilities,
- Lightning conductor,
- Non ferrous hinges on doors,
- Fence offset 6 m and at least 2.5 m high and secure,
- Guard, guardhouse, watchdog and telephone,
- Flood lighting,
- Fire fighting equipment,
- Level ground,
- Notices and Warning Signs and other minor conditions.

The above requirements will be incorporated during the detailed design stage.

Operating Facilities

Following the completion of the land works the formed site will be handed over for permanent facilities construction. The facilities portion of the work will include installation of the following:

a. Jetty including unloading arms,

b. Process Area,

c. Two full containment cryogenic LNG Tanks (capacity of up to 180,000 m^3 each) with a third tank for future expansion,

d. Low Pressure and High Pressure pumping systems,

e. Vaporization (Re-gasification) Area,

f. Vents (low pressure and high pressure),

g. Maintenance Workshop,

h. Administration Building,

i. Guard House,

j. Utility Area,

k. Control Room.

The basic features of the above are discussed in *Part 1 – Section 3*.

The LNG terminal will be designed and operated according to the *European Standard EN 1473 – Installation and Equipment for Liquefied Natural Gas - Design of Onshore Installations* [(1)]. The tanks will be designed and constructed to BS 7777 [(2)] standard. Other design parameters are shown in the Basis of Design (*Table 3.3*).

Table 3.3 Project Design Features

Key Parameter	Preliminary Design Value / Codes
LNG Carrier Capacity (m^3)	125,000 to 215,000
Maximum Number of LNG Storage Tanks	3
LNG Tank Size (m^3)	160,000 - 180,000
Land Requirement (Ha)	~32
	Major Design Codes
Terminal	EN1473
LNG Tanks	BS 7777 – 2 – 1993
LNG Carriers	IGC/OCIMF/SIGTTO/Class
Gas Pipeline to BPPS	ASME B31.8, IGE/TD/1, DNV 81

(1) The European Standard EN 1473 – Installation and Equipment for Liquefied Natural Gas – Design of Onshore Installations

(2) BS 7777 -2 - 1993. Flat-bottomed, vertical, cylindrical storage tanks for low temperature service. Specification for the design and construction of single, double and full containment metal tanks for the storage of liquefied gas at temperatures down to -165°C.

3.3.3 *Marine Works*

Marine works associated with the LNG Terminal will be divided into the following works:

- Seawall and Reclamation,
- LNG Jetty,
- Seawater Intake/Outfall.

A description of the works associated with each of the above key construction activities are presented below. The information presented in this section will be further studied at the detailed engineering design stage.

Seawall and Reclamation Construction

To ensure stability, the LNG tanks are to be constructed within the base formation of the cut slopes and founded on rock. Associated plant facilities will, therefore, need to be located on the reclamation land. To reduce potential for water quality impacts to occur during the construction stage, reclamation work will commence following the installation of seawalls.

Reclamation extending from the Black Point headland will be formed using partially dredged methods of reclamation. Reclamation activities for the project will include the construction of a seawall, which will involve:

- Dredging of sediments in the area where the seawall will be located. A small amount of rock trimming may be required to provide a level platform for seawall construction;
- Placement of excavated rock and fill material and concreting works to construct the seawall;
- Infill of the area behind the seawall with excavated rock and fill materials to create the formed site;
- Surcharge of the filled site to assist settlement; and
- Removal of surcharge material and completion of formed site.

Dredging in the seawall area may be carried out using either Trailing Suction Hopper Dredgers (TSHDs) or grab dredgers or a combination of both. Dredging plant is discussed further in the *Water Quality Impact Assessment* (*Part 3 – Section 6* of this EIA Report).

A permanent seawall and vertical block-work will be constructed around the seaward boundary of the reclamation to protect the reclamation site from wave and tidal action.

The rock filling or public filling will be undertaken by derrick barges and treated with vibro-compaction. Details of the filling activities are reported in *Section 3.3.2*.

LNG Jetty

Construction of a 100 m long trestle leading to the jetty structures and unloading arms will be undertaken to the northeast of the reclamation site. The jetty and associated facilities will typically consist of an unloading platform, walkways, four breasting dolphins, and six mooring dolphins. The jetty will be capable of accommodating an LNG carrier with capacities ranging from 125,000 m^3 up to a class of 215,000 m^3. The main activity at the jetty will be unloading of the LNG carriers to onshore tanks. Unloading arms will be provided to unload the LNG. LNG liquid and vapour pipelines and utility piping and cabling will run to shore along the access trestle. Steel framed walkways connect all dolphins to the unloading platform. The alignment of the jetty is presented in *Figure 3.1* whereas the conceptual layout of the jetty is provided in *Figure 3.4.*

The unloading platform will support four LNG liquid unloading arms, one vapour return arm, an associated cryogenic pipework, and a gangway that provides access to the LNG carrier. The platform will also be provided with firewater monitors, an operator shelter and an environmental (e.g., meteorological) monitoring system. The platform will be sized with sufficient open space to permit a small truck or maintenance crane to make a three point turn. The elevation of the top of the unloading platform is at + 9.5 mPD. The unloading platform will consist of a concrete platform supported by piles. The conceptual plan of the elevation of the unloading platform is shown on *Figure 3.5* whereas the conceptual plan and elevation of the mooring and breasting dolphin is shown on *Figure 3.6*.

Piling for the Jetty

In order to resist the horizontal loading generated by the berthing of LNG carriers, piles have to be designed using either steel or reinforced concrete. There are two basic methods of pile installation including:

- Bored piles; and,
- Percussive piles.

A comparison of these methods is presented in the *Consideration of Alternative Construction Methods* (*Part 2 – Section 2* of this EIA Report).

<u>Bored Piles</u>

In the marine environment high strength bored piles require a steel shell to act as a formwork for casting the reinforced concrete. The shell will need to be advanced by vibratory methods.

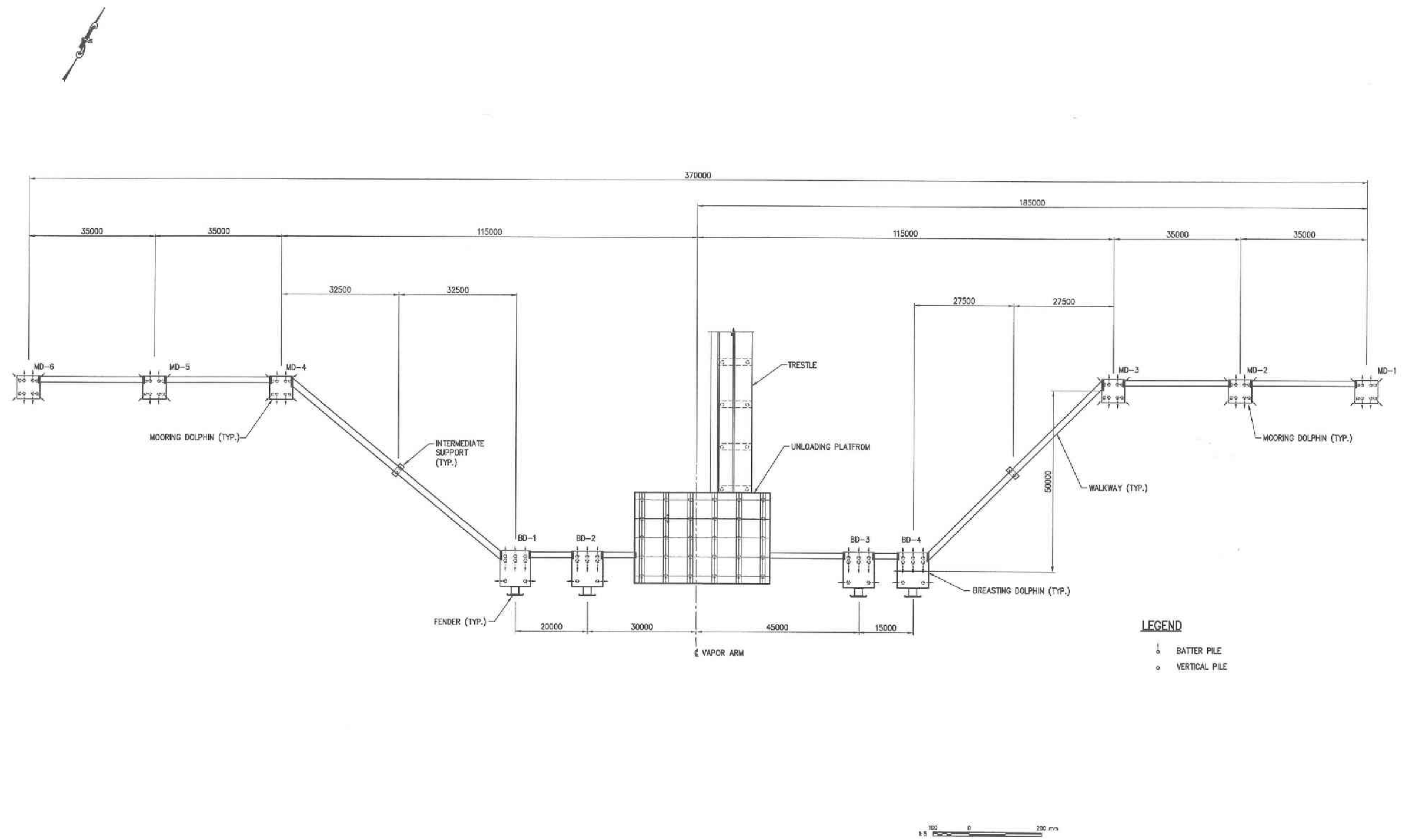

Figure 3.4

Conceptual Plan of the LNG Jetty at Black Point Terminal

Note : Design to be defined in detail design

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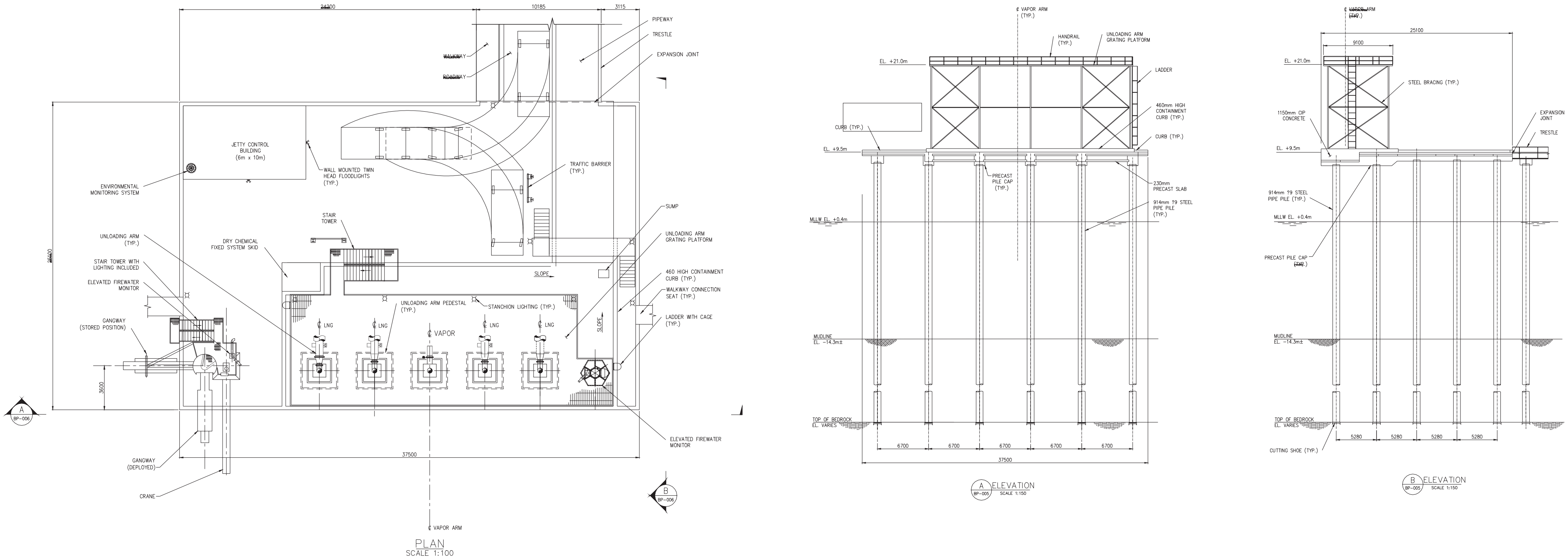

Figure 3.5

Conceptual Plan of the Unloading Platform for the LNG Jetty at Black Point Terminal

Note : 1. Design to be defined in detail design
2. All dimensions are in millimeters unless otherwise noted

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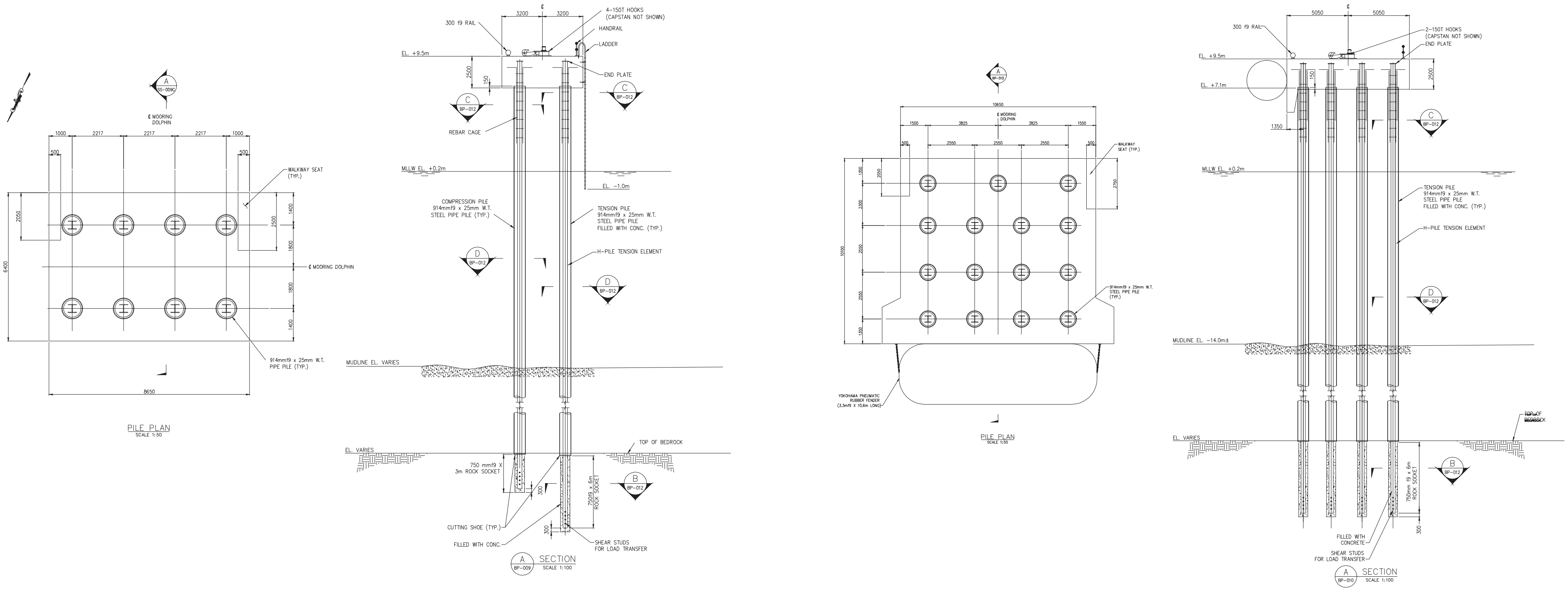

Figure 3.6

Conceptual Plan of the Mooring Breasting Dolphin for the LNG Jetty at Black Point Terminal

Note : 1. Design to be defined in detail design
2. All dimensions are in millimeters unless otherwise noted

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Resources
Management

Percussive Piles

The standard design for heavily loaded oil and gas jetties and also heavily loaded container terminal decks in Hong Kong is percussive piles, comprising steel piles below seabed level that may include cast *in situ* reinforced concrete above seabed level. This is achieved by driving steel tubes down to required design soil resistances then filling the tubes from just below seabed level, allowing for a transition zone, with reinforced concrete.

Standard practice in Hong Kong includes using a bubble curtain/jacket to aid in attenuating underwater sound propagation. Such practice uses air bubbles to reduce noise by reflecting, scattering and absorbing the sound (in the form of underwater pressure pulses) produced by the piling works.

General designs for the bubble curtain include either the operation of a incorporating a steel ring that releases air bubbles either on the seabed or below the surface around the piling barge.

Designs for the bubble jacket involve the release of air bubbles close to the seabed inside a steel jacket fitted with neoprene spacers to prevent the jacket contacting the pile. The bubbles displace water upwards creating an air pocket around the pile that reduces sounds being transmitted to the water outside the steel jacket. The design of the bubble curtain/jacket will depend on the detailed design of the piled structures. Examples of bubble curtain/jacket are shown in *Figure 3.8*.

Potential impacts of underwater sounds are discussed in the *Marine Ecological Assessment* (*Part 3 – Section 9* of this EIA Report).

Associated Facilities

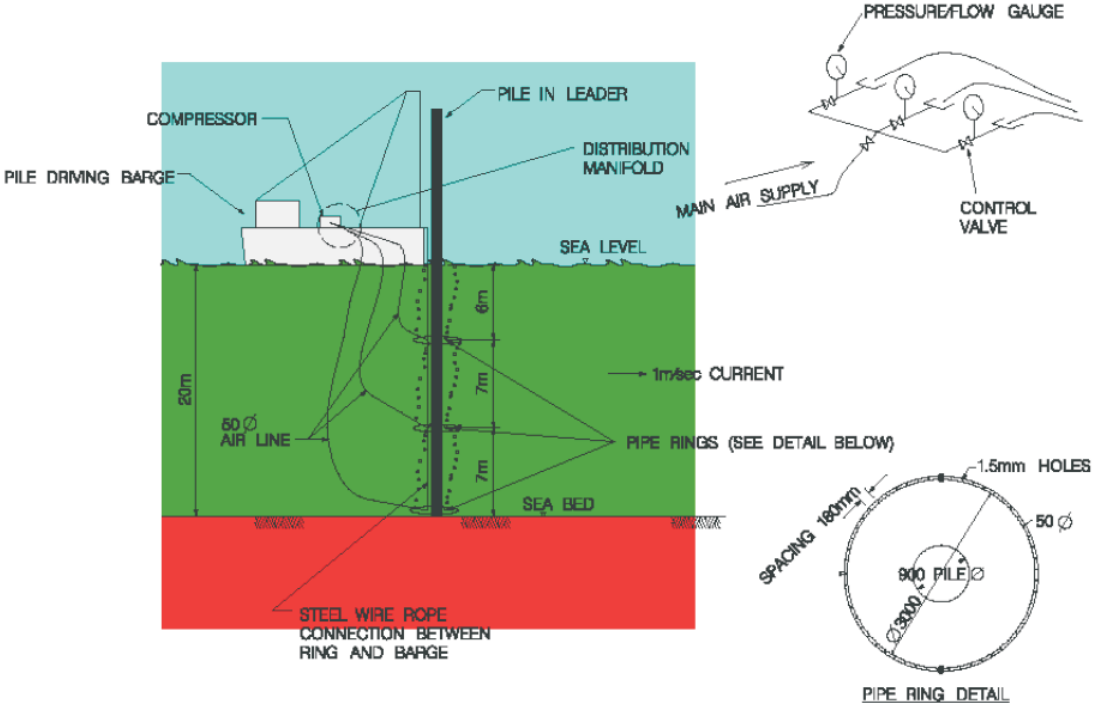
Service Berth

A service berth shall be provided for delivery of the construction plant and materials, fresh water, removal of waste and for transporting workers to and from the site during the construction stage.

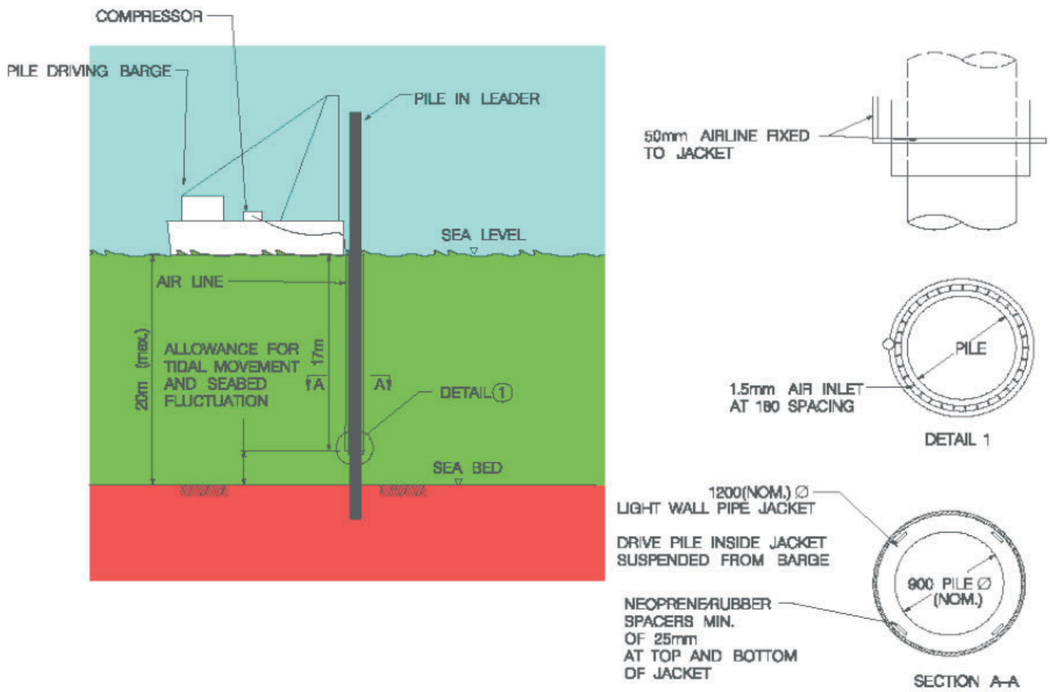
The service berth should be in the form of a simple vertical seawall with sufficient water depth for the berthing of support vessels. Sufficient working area shall also be provided adjacent to the berth such that the materials / equipments could be offloaded for inspection and be delivered to the work site using trucks. As no berth is available at the Black Point site, a temporary berth shall need to be set up to facilitate the mobilization of plant for the initial work phases.

Barging Points

Barging points will be used for the unloading of spoil material into the hopper of a barge.



Schematic of a Canadian Bubble Jacket



Schematic of a Fixed Bubble Jacket

Figure 3.8

Schematic of Bubble Jacket Techniques (Indicative)

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Environmental Resources Management

ERM

Floating Pontoons

Due to the potential delay in the provision of a permanent service berth, a floating pontoon is recommended to provide a temporary marine access to the site. A flat top barge with an access bridge connected to a seawall or directly onto the shore would likely be used. An appropriate anchor system will be incorporated to maintain the pier at a fixed position.

Seawater Intake/Outfall

In order to provide water for regasification of LNG, seawater will be extracted from the waters surrounding the reclamation site. In order to draw in the warmest water to the vaporisers for optimum efficiency in the regasification process the seawater intake will be designed to be as high as possible within the water column. For this purpose the intake will be installed through the revetment of the seawall structure (*Figure 3.7*).

The returned seawater leaving the ORV's will be discharged to the sea (*Figure 3.1*) through a box culvert and spargers. The spargers will lie on the seabed at a depth of approximately -7 mPD. The outfall will be buried to an approximate depth of –1.5m below the sea bed with rock armour protection. Dredging works will be undertaken using grab dredgers.

3.4 OPERATION AND MAINTENANCE OF THE LNG TERMINAL FACILITIES

The LNG terminal will serve as a fuel import, storage and supply facility. Operation of the terminal facilities will include the following significant process operations:

- LNG carrier approach, berthing and departure;
- LNG unloading from carriers at LNG jetty and transfer to shore;
- LNG storage in onshore tanks;
- Re-gasification of the LNG to natural gas in LNG vaporisers; and,
- Final send out of natural gas via a short onshore pipeline to the BPPS. The onshore pipeline is expected to be within the boundary of the BPPS.

3.4.1 *LNG Receiving Terminal*

At the receiving terminal, the LNG will be stored at near atmospheric pressure in cryogenic full containment LNG storage tanks and, when required, brought back to a gaseous state prior to being dispatched via an onshore pipeline to Black Point. LNG will be pumped from the LNG carrier through loading arms on the jetty and to the storage tanks onshore via insulated loading lines. In response to the gas demand, LNG will be pumped from the storage tanks to the vaporisers. The resultant natural gas will then be metered, heated and transported to the neighbouring Black Point Power Station.

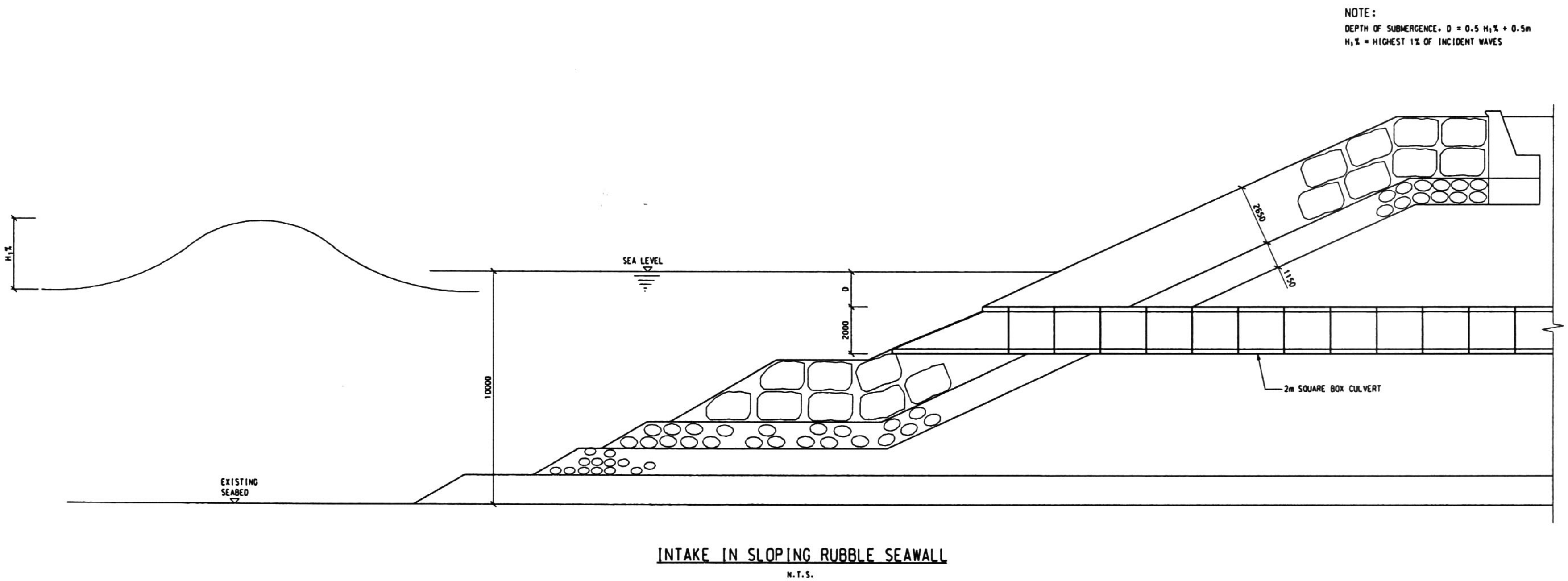

Figure 3.7

Cross-section of Preliminary Design of Cooled Water Intake

Note : Design to be defined in detail design

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Environmental Resources Management

ERM

LNG Terminal Perimeter Fence

As part of the EIA, hydrocarbon hazards have been identified and quantified for this specific project (*Section 13*). The modelling of potential releases for the LNG terminal has given rise to the requirement to create buffer zones based on the category of equipment in particular areas. This has been evaluated so that possible scenarios necesitate the required external safe perimeter zone by distance (buffer zone) sometimes mitgated by fire barriers so that potential accidental releases do not affect populations outside the LNG Plant. The distance to the perimeter is based on potential leak scenarios, the hydrocarbon inventories, and the possible radiation affects from an ignited event. It should be noted that the evaluated events are still low frequency events. British Standard BS EN 1473:1997 installation and equipment for liquified natural gas, design of onshore installations and NFPA 59A Standard for the Production, Storage and Handling of Liquified Natural Gas have been used as a basis. The derived perimeter location has been adjusted to cater for the topography of the land, wind direction and experience from previous site installations worldwide. For safety reasons, members of the public will not be allowed within the confines of this zone. No development will be undertaken inside the zone other than a fence being erected along the buffer zone boundary. This allows for both public safety and security of the facility. The buffer zone increases the total land area required to some 32 ha overall.

3.4.2 LNG Carrier (LNGC)

Two tugboats will accompany the LNG carrier after embarkation of the pilot. Two additional tugs will be available in the vicinity of the Tsing Ma bridge to provide assistance as necessary and remain for the rest of the transit. Before making the turn into the Ma Wan channel, and until clear on a westerly heading, one tugboat will be made fast to the stern of the carrier. For other segments of the transit, tugboats will participate in a passive mode and assist as required.

Prior to a LNG carrier berthing at the Black Point receiving terminal, transit is through the final approach channel into the adjacent turning basin. During the turning manoeuvre, four tugboats will control the carrier. When the manoeuvre is complete, tugboats provide assistance in aligning the carrier for a parallel approach and controlled speed for landing on the jetty fenders. The tugboats will hold the carrier alongside until secured to the mooring dolphins.

At the jetty, the carrier will be connected with the receiving terminal through the unloading arms. Two tugboats will remain on stand-by in close proximity to the terminal throughout the unloading operation. The LNG in the carrier will be unloaded to the storage tanks at a rate of approximately 14,000 m^3 hr^{-1}, using the carrier's own pumps. The discharge of LNG from the carrier takes approximately 18 hours. In addition, approximately 3 hours for mooring, cool down, connecting unloading arms, and cargo measurement, and approximately 3 hours for cargo measurement, arm purging, disconnecting arms, and unmooring.

It is envisaged, based on the preliminary terminal throughput, that one LNG carrier will berth at the terminal every five to eight days. In accordance with Study Brief Section 3.2 (vi), the *Landscape and Visual Impact Assessment (Part 3 – Section 11)* will assess the impact of the LNG terminal and the LNG carriers.

During the discharge operation, ballast water will be taken onboard from the surrounding water into the double hull compartments to compensate for cargo discharge. No ballast water will be discharged in Hong Kong waters.

3.4.3 *Control of LNGC Berthing Operations*

The LNG jetty will be designed to accommodate the size and type of LNG carriers that are required to meet the cargo volume requirements. Each LNG carrier will be compared against predetermined acceptance criteria before being approved for the terminal.

In addition, the requirements of the carrier's security plan shall be implemented consistent with the "*International Ship & Port Facility Security Code*" (ISPS) [1] .

Once berthed, staff will complete various safety checks collectively and unloading operations will not commence until the Ship/Shore Safety Checklist included in the '*International Guide for Oil Tankers and Terminals* [2] ' has been completed satisfactorily.

3.4.4 *Control of LNG Unloading Operations*

During cargo discharge the vapour pressure in the LNG carrier cargo tanks will be maintained by returning vapour from the tanks onshore. With this balanced system, under normal circumstances, hydrocarbons will not be released to the atmosphere.

3.4.5 *Safety Zones*

While an LNG carrier is moored at Black Point, the waters and waterfront facility located within a defined boundary will be constituted as a safety zone to avoid potential collision from passing traffic. The dimension of this zone is under review with the objective of providing optimum safety for the moored carrier.

(1) International Maritime Organization (IMO); July 2004

(2) International Chamber of Shipping Oil Companies, 2006

3.4.6 *Onshore Modes of Operation*

The LNG terminal will have two main modes of operation:

- **Unloading Mode** – The unloading mode is the period when an LNG carrier is moored on the jetty and is connected to the onshore storage tank by means of unloading arms. The pumps on the LNG carrier will transfer the LNG in both the unloading and the re-circulation lines to the onshore storage tanks. At the end of unloading, pressurised nitrogen gas will be used to purge the arms of LNG before disconnecting.

- **Holding Mode** – The holding mode is the period when no unloading takes place, while send-out to the transportation gas pipeline continues. The purpose of the holding mode is to allow cryogenic conditions to be maintained in the unloading and circulation system. In order to maintain these conditions LNG will be circulated via the unloading line to the jetty head and back to the onshore storage tanks or the send-out system via the re-circulation line.

During both of these modes of operation, LNG will be pumped out of the onshore storage tanks and boosted to the pressure required by the end user before being routed to the gas transportation pipeline via the LNG vaporisers.

3.4.7 *Drainage System*

Operational Site Drainage

Stationary equipment that could release hydrocarbons and that are not located in a curbed area will be installed on skids containing drain pans. An open drain system will collect spills and rainwater from all equipment skids and other appropriate areas. The drain fluids are collected in an oily water sump and pumped to a CPI-type oily water separator unit for separation. Clean water will flow to the seawater return basin. Oil and hydrocarbon liquids shall be removed and sent to a reclaiming facility. Clean water from the separator will be monitored for oil content before being discharged.

Drainage from open areas that are not subject to hydrocarbon spills will flow to sea via the seawater outfall. Should a hydrocarbon spill in these areas occur from mobile equipment fuel, oil or hydraulic hoses, prompt spill clean up should occur using strategically placed spill clean up supplies.

Engine wastes, such as lube oil, hydraulic fluid and engine coolant shall be transferred to a waste treatment facility for reclaiming or disposal. Solid wastes shall be sent to a proper disposal location.

3.5 PROJECT SUMMARY

Table 3.4 presents the summary of the project site construction details. The Black Point Option requires 32 ha area, half of which will come from reclamation, with 3.15 Mm^3 dredging volume. Approximately 1 Mm^3 of excavation is required on land, all of the excavated materials will be reused for reclamation. In addition, 1.8 Mm^3 soil have to be imported to fill the reclamation area.

Table 3.4 Summary of Site Construction Description

Parameter	- BLACK POINT -
Overall Project Area (ha)	32 ha
Land Based Works Area (ha)	5 ha
Reclamation Area (ha)	16 ha
Site Development Area	21 ha
Dredging Volumes (Mm^3)	Approach Channel & Turning Basin = 2.49 Mm^3 Seawall = 0.63 Mm^3 Berthing Trench & Intake/Outfall = 0.03 Mm^3 **TOTAL = 3.15 Mm^3**
Length of Natural Coastline Affected (m)	600 m
Volume of Excavated Construction & Demolition Materials	Soil (Total = 220,000 m^3) Site Formation = 220,000 m^3 Rock (Total = 770,000 m^3) Site Formation = 770,000 m^3
Volume of Fill Requirements	Soil (Total = 2,100,000 m^3) Reclamation = 2,100,000 m^3 Rock (Total = 785,000 m^3) Seawall = 785,000 m^3
Volume of Excavated Construction & Demolition Materials for Disposal	Soil = 0 m^3 Rock = 0 m^3
Volume of Imported Fill	Soil = 1,880,000 m^3 Rock = 15,000 m^3
Length of Submarine Utilities	N/A

3.6 *PROJECT PROGRAMME*

The preliminary construction programme is presented in *Annex 3A*. Site preparation works, including land works and reclamation, are expected to be about 18 months. The reclamation works is assumed as a fast track in order to meet the startup schedule. Marine works, including dredging for berth box, piling, and superstructure, are expected to be completed in about 36 months. The construction programme emphasises the project's urgency as it would enable the timely replacement of the depleting gas supply from the Yacheng field (off Hainan Island - South China Sea) which is currently forecasted for the next decade (please refer to *Part 1 – Section* 2).

Following the completion of the land works and reclamation and basic infrastructure, the formed site will be handed over for permanent facilities construction. The facilities portion of the work will include installation of the on-site road, permanent drainage, equipment, piping, buildings, and the electrical power and control systems for the process portion of the LNG terminal facilities.

3.7 *CONCURRENT PROJECTS*

There may be the possibility for overlap between construction works associated with the marine works of the proposed Emissions Control Project at the Castle Peak Power Station 'B' Units. However, cumulative impacts are not expected to occur due to the remoteness (> 4 km) between the two project works areas.

There are presently no planned or committed projects that could have the potential for cumulative impacts to occur with the construction of the Black Point terminal. The Animal Carcass Treatment Facilities (ACTF), Sludge Treatment Facilities and Waste-to-energy Facilities (WEF) have been proposed to be constructed at Tsang Tsui (located at least 2 km from Black Point), however, the programme remains uncertain and the separation distance is such that cumulative effects are highly unlikely. Discussions with the relevant departments on the construction schedules of the WENT Landfill, Hong Kong Zhuhai Macau Bridge EIA and Value Added Logistics Park have also indicated that these are unlikely to be carried out concurrently with the construction works for the Black Point LNG terminal.

Water quality cumulative impacts are discussed in *Part 3 - Section 6*.

Annex 3A

Preliminary Construction Programme

Annex 3A - Preliminary Construction Programme

BLACK POINT OPTION

Construction Item	Yr 1												Yr 2												Yr 3												Yr 4													
	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16	M17	M18	M19	M20	M21	M22	M23	M24	M25	M26	M27	M28	M29	M30	M31	M32	M33	M34	M35	M36	M37	M38	M39	M40	M41	M42	M43	M44	M45	M46	M47	M48	M49	M50
Land Based Works																																																		
Site Preparation Work																																																		
Site Clearance				Y	Y	Y	Y																																											
Soil Compaction				Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y																																			
Blasting and Excavation								Y	Y	Y	Y	Y	Y	Y	Y	Y	Y																																	
Slope Stabilization and Drainage Works								Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y																											
Reclamation																																																		
Dredging				Y	Y	Y																																												
Seawall Construction																																																		
Placing Seawall Core						Y	Y																																											
Placing Seawall Rock Armour						Y	Y	Y	Y																																									
Placing Fill								Y	Y	Y	Y	Y	Y	Y	Y	Y																																		
Drainage Works																																																		
Install of Temporary Work								Y	Y	Y	Y	Y	Y																																					
Laying of Drainage Pipes								Y	Y	Y	Y	Y	Y																																					
Backfilling									Y	Y	Y	Y	Y	Y	Y	Y																																		
Main Jetty																																																		
Ground Investigation										Y	Y	Y	Y																																					
Jetties and Access Bridge																																																		
Steel Piles Construction													Y	Y	Y	Y	Y	Y	Y	Y	Y	Y																												
Concrete Caps, Slabs and Foundations																						Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y																
Dredging of Approach Channel and Turning Basin													Y	Y	Y	Y	Y	Y	Y			Y	Y																											
Intake and Outfall Construction																	Y	Y	Y	Y	Y	Y	Y	Y																										
LNG Terminal, Civil, M&E Work																																																		
Terminal Civil, M&E Work																		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y