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ANNEX

3 PROJECT DESCRIPTION

3.1 THE PROJECT

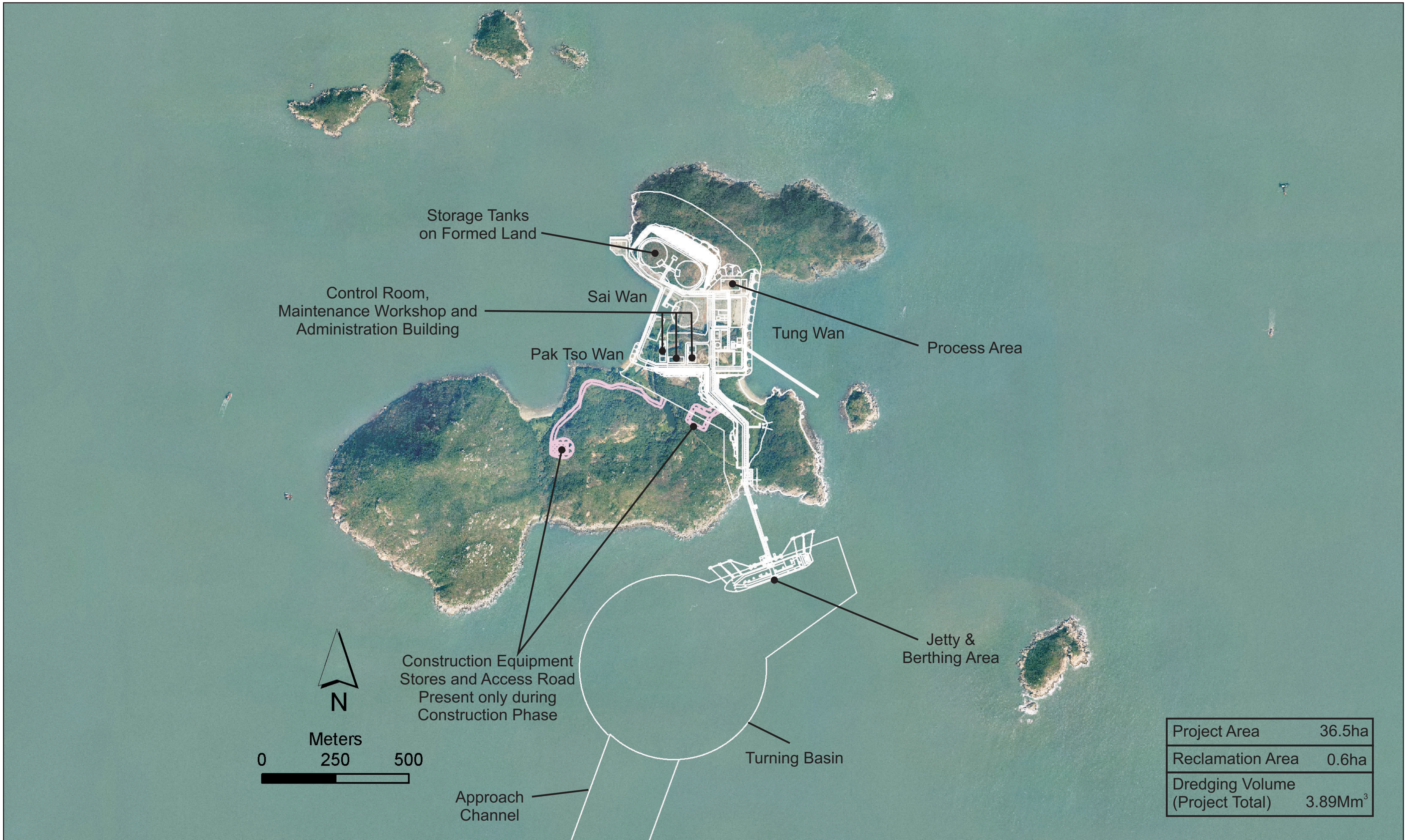
The Project is classified as a Designated Project under the *Environmental Impact Assessment Ordinance (Cap.499) (EIAO).* The works that are the subject of the EIA Study include the construction and operation phases of the Project. The key components of the Project include the following:

- 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*);
- Installation of a submarine gas pipeline connecting the proposed LNG terminal at the South Soko Island and the Black Point Power Station (item *H.2 of Part I of Schedule 2 of EIAO*);
- Dredging operation for the installation of a submarine power cable connecting Shek Pik with the proposed LNG terminal at South Soko which is less than 500 m from the nearest boundary of an existing Site of Cultural Heritage (item *C.12(a) of Part I of Schedule 2 of EIAO*); and,
- Potential dredging operation for the installation of a submarine water main connecting Shek Pik with the proposed LNG terminal at South Soko which is less than 500 m from the nearest boundary of an existing Site of Cultural Heritage (item *C.12(a) 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. 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 for the South Soko LNG terminal to be taken forward in this EIA has been described in *Part 2 – Section 2*. On the basis of this selection, the preliminary layout plan is presented in *Figure 3.1*. The key elements of the Project are as follows:



Project Area	36.5ha
Reclamation Area	0.6ha
Dredging Volume (Project Total)	3.89Mm^3

Figure 3.1

Preliminary Indicative Layout for the Proposed South Soko LNG Terminal
(Aerial photograph source: Lands Department)

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Environmental
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- Marine Dredging;
- Land Excavation;
- Land Reclamation;
- LNG Jetty Construction;
- LNG Terminal Facility Construction;
- Submarine Gas Pipeline Installation; and,
- Power Supply and Water Main Installation.

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

3.2.1 Dredging

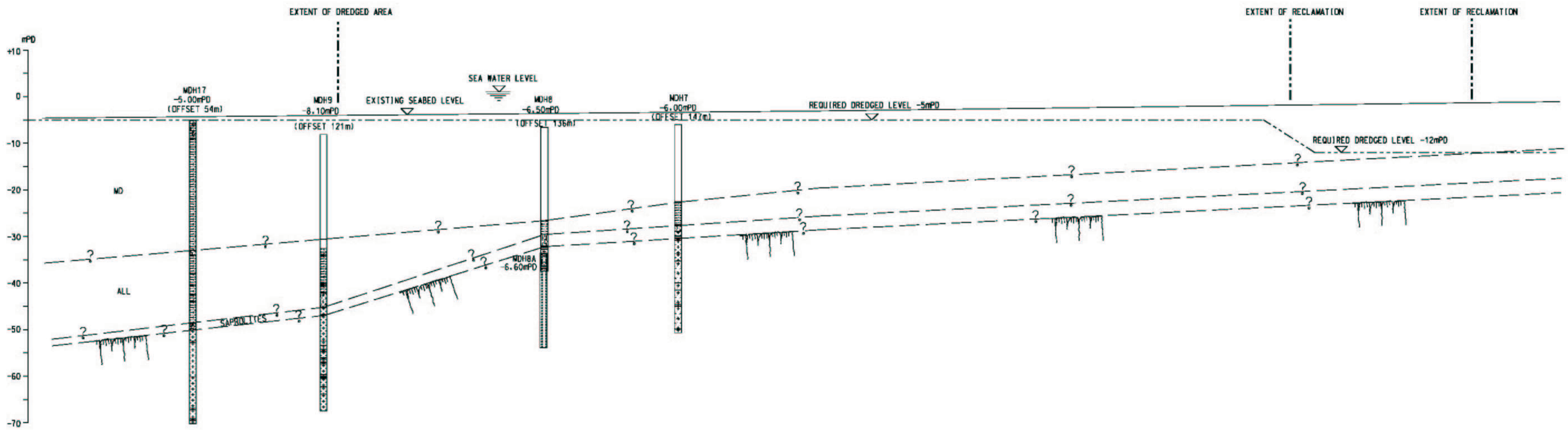
Dredging of marine sediments will be required for the following installations/facilities:

- Approach channel and turning basin;
- Seawall and berthing trench for the reclamation;
- Gas receiving station (adjacent to Black Point Power Station);
- Seawater intake/outfall;
- Power supply and water main; and,
- Submarine gas pipeline.

Dredging requirements for each of the above are discussed below. Dredging requirements for the installation of the submarine gas pipeline and utilities are discussed in *Part 2 – Section 3.3.4*. Information on the extent and depth of the marine sediment dredging requirements for each of the above facilities are shown in *Figures 3.2* to *3.4*.

Approach Channel and Turning Basin

Marine sediments will be required to be dredged to allow safe navigation of the LNG carrier to the South Soko Island terminal. Due to the draft requirements of the LNG carrier, a project seabed dredging level of approximately –15 mPD is required for the approach channel and turning basin (*Figure 3.1*). All dredging will be undertaken within the soft marine deposit layer and side slopes of 1:4 are expected. No excavation of rock or hard material is expected to be required.



SECTION 1

Figure 3.2

South Soko Island Reclamation Area - Section

Environmental Resources Management

ERM

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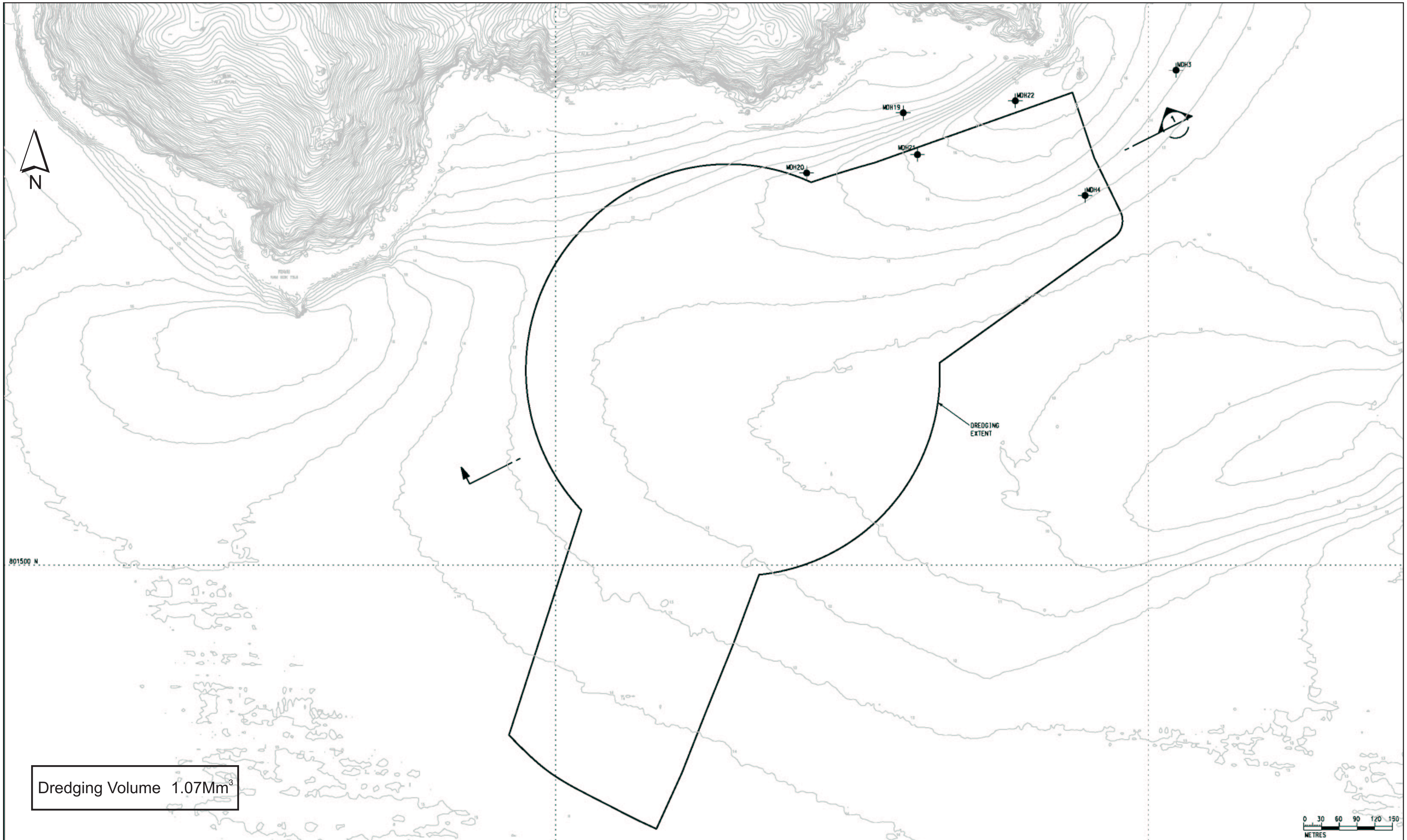

Figure 3.3

South Soko Island Approach Channel & Turning Basin - Plan

Environmental Resources Management

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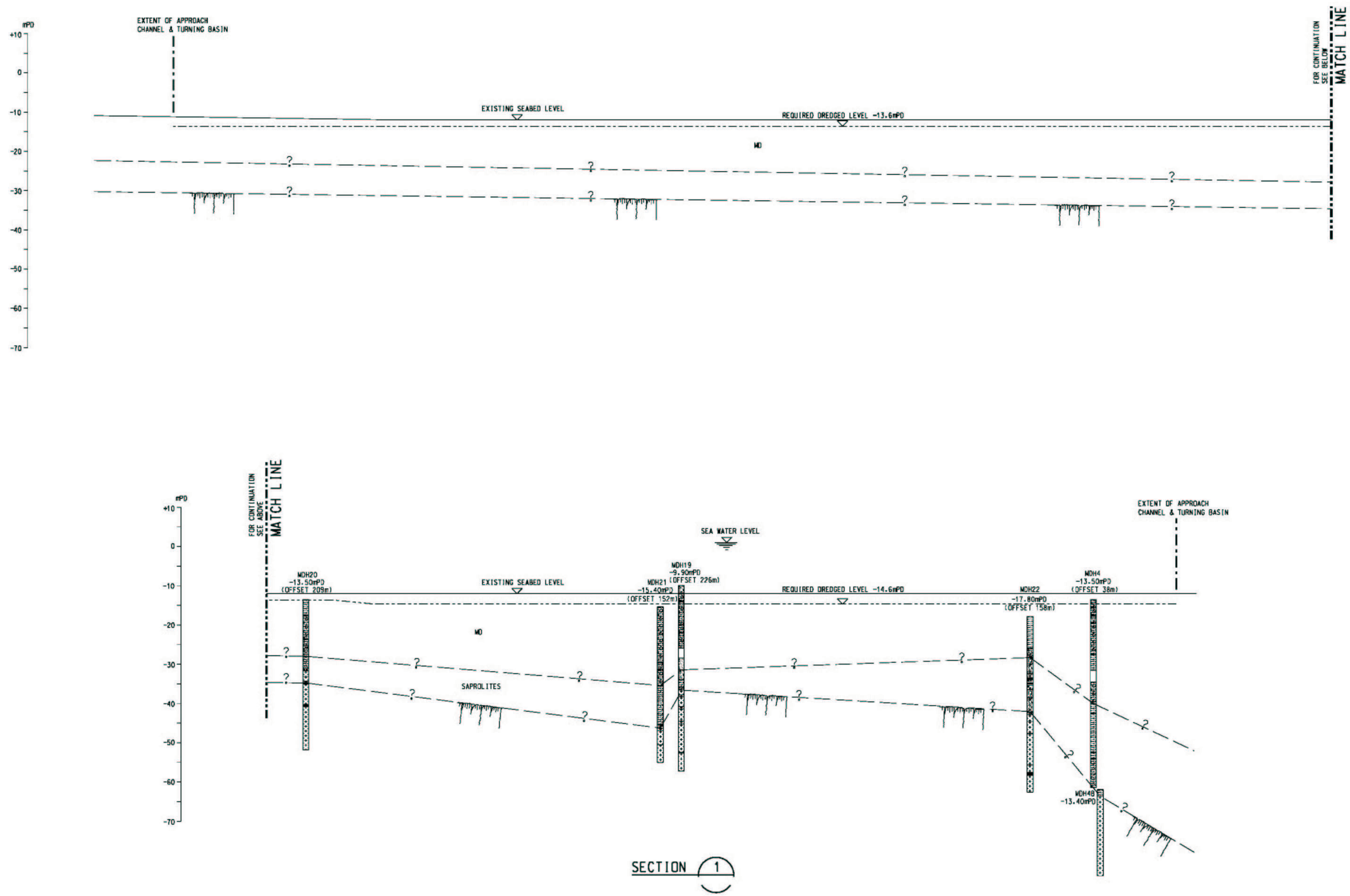

Figure 3.4

South Soko Island Approach Channel & Turning Basin - Section

Environmental Resources Management

ERM

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DATE: 04/08/2006

Approximately 0.37 Mm^3 of sediments will be required to be dredged for the approach channel. The turning basin will require approximately 0.7 Mm^3 of sediment to be dredged. The detailed breakdown of the dredging and volumes is presented in *Table 3.2*. It should be noted that these volumes have been based on preliminary design and may be subject to change following detailed design.

Seawall and Reclamation

Approximately 0.6 hectares (ha) of land will be reclaimed to the west of the formed facility platform area. The reclamation will be formed to provide seawalls for future marine vessel berths and as the platform area for the proposed future third LNG storage tank. Seawall upgrade will be required along the western edge of the site.

Permanent seawalls will be constructed around the seaward boundary of the reclamation to protect it from wave and tidal action. These will comprise predominately sloping seawalls although vertical seawalls will be constructed where marine access is required to the site or where spatial constraints exist. The sloping seawall option will result in a larger volume of dredged sediment. However, in terms of hydrodynamic effects, the sloping seawall is preferred as it is able to dissipate wave energies more efficiently than a vertical seawall and hence reduces wave reflections, particularly close to areas where marine berthing is required. The preliminary layout of the proposed seawalls together with typical sections are shown in *Figure 3.5*.

On the west side of the site, vertical seawall is planned along the northern end to provide a necessary berthing area for construction barges. On the east side, sloping seawalls will be adopted. The seawall modification works will occupy a total seabed area of 1.1 ha. The total length of the modified seawalls (including sloping and vertical seawalls) to be built along the eastern and western berths is approximately 0.6 km.

Dredging will be undertaken to remove the soft material beneath the seawall to ensure that these structures are stable and able to be built as soon as practical. Approximately 0.10 Mm^3 of soft marine sediments will be dredged for the construction of the seawalls. A small amount of rock trimming may be required to provide a level platform for seawall construction, which may be undertaken using a hydraulic breaker.

The seawalls and reclamations will be formed using rockfill and general fill sourced from the on-land excavation works and therefore no imported sand fill is required for the South Soko Island site.

Seawater Intake/Outfall

The design of the seawater intake and outfall for the South Soko terminal is described in *Part 2 – Section 3.3.3*. Dredging of marine sediments will be required to bury the intake pipe to a safe depth. The majority of dredging

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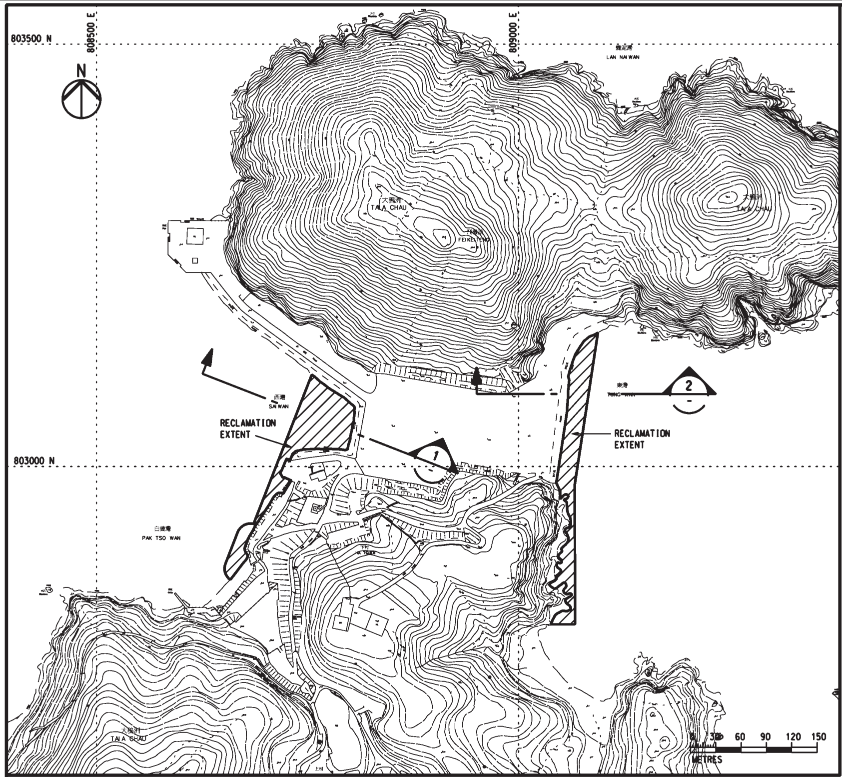

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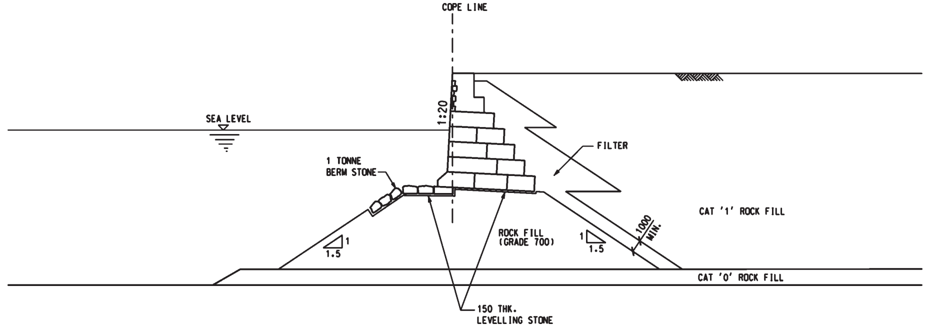

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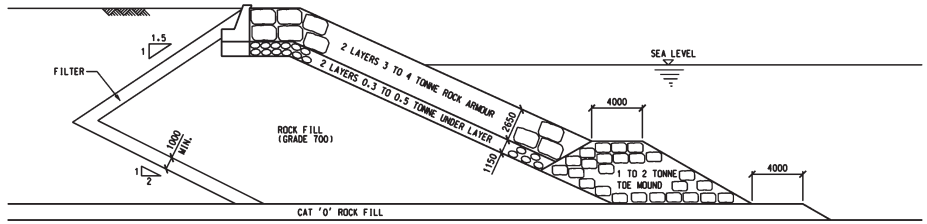

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Figure 3.5

Marine Works Near South Soko Island

Environmental Resources Management

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will be undertaken in soft marine sediments. An approximate quantity of 30,000 m^3 will be required to be removed. An additional 4,500 m^3 of rock will also require to be dredged.

Power Supply and Water Main

The design of the power supply and water main are described in *Part 2 – Section 3.3.5*. Dredging and jetting of marine sediments will be required to bury both utilities to a safe depth. The majority of dredging will be undertaken in soft marine sediments with an approximate quantity of 0.22 Mm^3 required to be removed.

Submarine Gas Pipeline

The design of the submarine gas pipeline is described in *Part 2 – Section 3.3.4*. Dredging and jetting of marine sediments will be required to bury the gas pipeline to a safe depth. The majority of dredging will be undertaken in soft marine sediments with an approximate quantity of 2.06 Mm^3 required to be removed.

3.2.2 *Land Excavation*

Combined excavation of approximately 560,000 m^3 of soft material (i.e., soil) will be required to be excavated on the north and south slopes, respectively, on either side of the existing platform on South Soko Island. An additional volume of approximately 1.80 Mm^3 of hard material (i.e., rock) will also be required to be excavated on each slope, respectively. The excavated areas and the existing platform area from the earlier demolished Detention Centre (approximately 5 ha) will be used to house the LNG storage tanks and associated facilities.

3.2.3 *Land Reclamation*

Approximately 0.6 ha will be reclaimed within Sai Wan of South Soko Island for the construction of the LNG terminal. No fill material will need to be imported for construction as reclamation will be undertaken using fill generated from the excavation works. The works will involve construction of about 0.6 km of vertical and sloping seawalls. The reclamation area on the west side will be used initially for the temporary housing of the concrete batching plant during construction and later for the future third tank. Approximately 2 Mm^3 of material will be used for construction of the South Soko Island terminal, which will be completely sourced from the material excavated from the site.

3.2.4 *LNG Jetty*

The construction of an approximately 240 m long trestle leading to the jetty structures and unloading arms will be required for the South Soko terminal (*Figure 3.1*). The primary use of the jetty will be to unload LNG from the LNG carriers.

3.2.5 LNG Terminal Facilities

Once the land has been formed the construction of LNG terminal infrastructure and facilities will include LNG Storage Tanks (capacity of up to 180,000 m^3 with approximate dimensions of up to 90 m external diameter and up to 64 m (70 mPD) height to the top of the dome of the tank), 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 and Living Quarters.

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 entire contents of an LNG carrier (each carrier has a maximum capacity of 215,000m^3) 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. This EIA Report will assess the worst case scenario which comprises three tanks.

3.2.6 Submarine Gas Pipeline

Construction of a submarine natural gas pipeline of approximately 38 km in length connecting the proposed LNG receiving terminal at South Soko Island and the Black Point Power Station will be required to deliver the re-gasified natural gas to fuel the power generation plant at Black Point. Approximately 1.30 Mm^3 of rock fill material shall be required to protect the pipeline from anchor drop or drag.

3.2.7 Power Supply and Water Main

Power and water supplies are required for the routine operation of the LNG terminal. These utilities will be provided through installation of a combination of on land and submarine power cable and water main from Shek Pik which is located on the southern coast of Lantau Island. The need for the water main connection will be confirmed during later design following a condition survey of the existing decommissioned watermain.

3.3 LNG TERMINAL CONSTRUCTION

3.3.1 General Construction Sequence

To accommodate the necessary infrastructure of the LNG terminal at South Soko Island, a total area of approximately 36.5 ha of land is needed. Some of the land (approximately 15-16 ha) will remain physically unaltered as the land

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

will be outside of the footprint of the terminal infrastructure or works areas but within the terminal boundary fence. The land will include the area previously used for the demolished Detention Centre. This area is currently flat land, however, the remains of previous building raft foundations and concrete surfacing will need to be removed. The remaining land will be formed through excavation of the hillsides and limited reclamation adjacent to the demolished Detention Centre. As the nearshore marine approach to the site is shallow, dredging will need to be carried out to provide sufficient water depth for the access of marine working barges mobilising heavy machinery to the site. 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 at the detailed design stage.

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

2. Site access will be made to the site from the berthing points. Floating pontoons will be used where the water depth is insufficient to allow berthing of construction vessels.

3. The on-land site works will commence with the clearance of vegetation on the existing slope prior to slope cutting works.

4. The removal of soft materials on the surface of slopes will continue shortly afterwards. In conjunction with these works, temporary haul roads will be constructed on both the southern and northern faces, which will allow heavy machinery to be mobilised and transported to the crown of the cut slope.

5. Additional excavations and access cutting will be formed at the south of South Soko Island to site the explosive magazines away from the blasting areas.

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

7. Blasting works would be carried out until the final formation level is reached.

8. Once approval is obtained to undertake marine works, dredging will be undertaken at the western side of the island to provide marine access to the site as well as on the eastern side for seawall upgrade.

9. Dredged material would be removed to approved disposal/storage sites by barge.

10. Excavated rock material will be initially removed from site for stockpiling and reused as practical fill material for the rock bedding of submarine gas pipeline, water supply line and electricity cables and within the

reclamation 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 site or quarry for use elsewhere in Hong Kong.

11. 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.

12. 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.

13. Marine dredging will be carried out for the installation of the utilities as well as the submarine pipeline leading to the power plant at Black Point.

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 approximately +6 mPD for the LNG tanks and approximately +12 mPD for process facilities. This will involve blasting, followed by grading with earth movers, to ensure a suitable construction surface. As the excavation quantities will exceed the requirements for seawall and reclamation fill requirements, a substantial part of generated spoil (soil and rock) will be required to be exported offsite.

The initial phase of site formation, including site clearance and excavation of vegetation, topsoil and top fragmented layers of rock, will be excavated by machine. The remaining excavation will be conducted by drilling and blasting. The fragmented rock will be used for the reclamation of the seawall core, secondary and primary armour layers, road embankments and can be crushed for use as road base, sub base, selected fill and blinding for buildings. Excess rock will be disposed of off-site in accordance with relevant regulations. A primary rock crusher is expected to be required to aid in processing the excavated material to facilitate onsite reuse or export off site.

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,

   d. Power Supply and Water Main.

Each of these proposed works are discussed below.

Formation of Access Roads

The existing slopes at South Soko 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 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 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. It could be expected that the slope cutting works may be carried out on the southern slopes and the northern slopes simultaneously.

As South Soko Island is relatively remote, a 24 hour day and 7 days per week working schedule is proposed. The *Noise Impact Assessment* (*Part 2 – Section 5* of this EIA Report) has examined the effects of these works and should be referred to for further details.

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 as 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.

At South Soko Island a relatively small proportion of the soil and rock material will be used within the reclamation and therefore most of the material will need to be exported off site. As there is no land access to the island, the material will need to be transported by barge.

Soft material and blasted rock will be used as practical within the reclamations and seawalls. The excess soft material will be disposed off in a public fill bank, whereas, excess blasted rock will be barged to a designated stockpile site or quarry for processing and subsequent use elsewhere in Hong Kong. Waste management is discussed in *Part 2 – Section 7* of this EIA Report.

Seawall and Reclamation Construction

The rock fill and general fill material will likely be brought in to the site by split-bottom or derrick barges. These barges have been widely used in reclamation works throughout Hong Kong. The rock filling or public filling will continue to be undertaken by derrick barges through end tipping, after the 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 fill materials may be obtained from the stockpile of fill material excavated from the land formation works.

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.

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 been 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 to a minimum.

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

As the blasting works progress, the exposed finished rock surfaces will be mapped and appropriate slope protective measures designed and incorporated as soon as practical. 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 an appropriate de-silting process. 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 2 – 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 cryogenic LNG Tanks with space for a third tank for future expansion, nominal size of 90m diameter by 49m high to the top of the dome and capacity each of up to 180,000 cubic metres will be constructed. Alternative tank sizes may be considered by CAPCO, however the capacity of the tanks will be similar. The potential size of these tanks could be 64 m high with a smaller diameter. In order to assess the worst case scenario, a total tank height of 70m PD (64m tank + 6m) is shown in the photomontages detailed in *Part 2 - Section 11* for the landscape and visual assessment.

The full containment system of LNG storage tanks has been selected for this project. Typical full containment LNG storage tanks are composed of a 9% nickel steel inner tank, 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 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 2 – Section 6* of this EIA Report). Potential impacts of hydrotesting activities on marine ecology and fisheries are assessed in *Part 2 – Section 9* and *Part 2 – 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 LNG Tank structures and the associated processing units. To secure the supply of concrete for the construction at South Soko Island 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 2 – 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. As South Soko Island is a remote site and the shipment of the explosives to site on a daily basis is neither convenient nor practical, it is, therefore, recommended that a temporary magazine and explosive storage be constructed on site to store the detonators and emulsion explosive.

Two appropriate locations are suggested for the magazine and explosive store on the south east and south west of the site, respectively, as shown in *Figure 3.1*. The existing berth within the north western area of the site will need to be equipped with a temporary berth or floating pontoon with unloading facilities for the explosives to comply with the regulatory requirements.

Mines Division have been consulted on the implementation and erection of an explosives store at South Soko Island. 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 3.1*).

Table 3.1 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)	~36.5
	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

Power Supply and Water Main

The power supply and water main will launch from Lantau Island to South Soko Island. The on land portion of the power supply will be connected to the existing grid near Shek Pik. It is proposed that the on land portion of the water main be buried following the alignment of Shek Pik Reservoir Road, connecting to a new header tank to be constructed adjacent to the existing Correctional Services Department Storage Tank near Shek Pik Reservoir. Water will be provided from the reservoir.

(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^{0}C.

Due to the location of the header tank, the water main will pass through the Lantau South Country Park. The potential for impacts to occur as a result of installation of the water main are discussed in the *Terrestrial Ecology Assessment* (*Part 2 – Section 8* of this EIA Report).

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. It should be noted that 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.

Seawall and Reclamation Construction

The first two 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 outside of the cut slopes on either existing or reclaimed land. To reduce potential for water quality impacts to occur during the construction stage, reclamation works will only commence following the installation of seawalls.

The reclamation at Sai Wan will be formed using a partially dredged method. 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 would be expected to be carried out by grab dredgers and are discussed further in the *Water Quality Impact Assessment* (*Part 2 – Section 6* of this EIA Report).

A permanent seawall comprises 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 one 240 m long trestle leading to the jetty structures and unloading arms will be undertaken to the South East of South Soko Island. The jetty and associated facilities will typically consist of an unloading platform, a trestle, walkways, four breasting dolphins, and six mooring dolphins. The jetty will be capable of accommodating LNG carriers 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. 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 3.6*.

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 3.7* whereas the conceptual plan and elevation of the mooring and breasting dolphin is shown on *Figure 3.8*.

Piling for the Jetty

In order to resist the horizontal loading generated by the berthing and mooring 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).

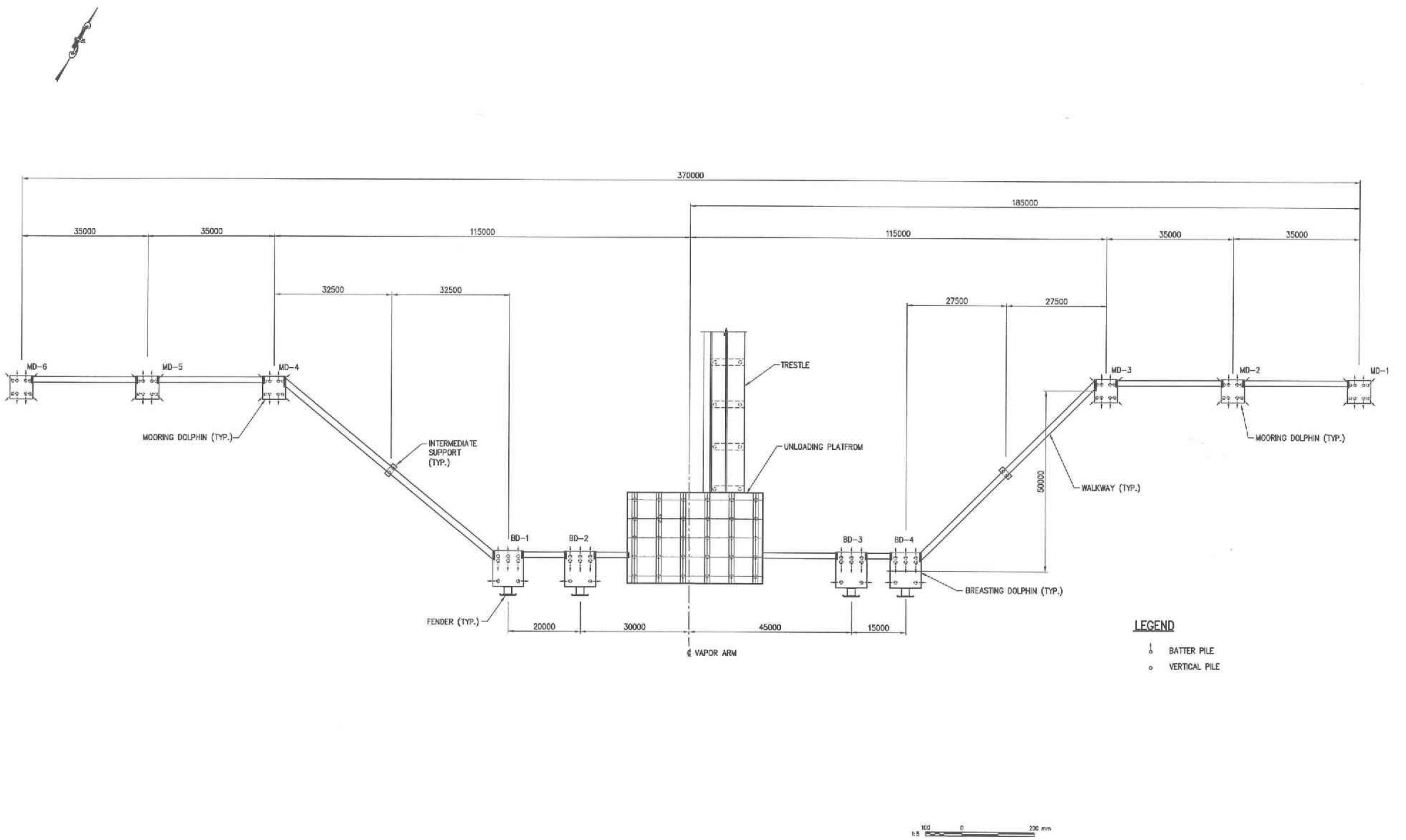

Figure 3.6

Conceptual Plan of the LNG Jetty at South Soko Terminal

Note : Design to be defined in detail design

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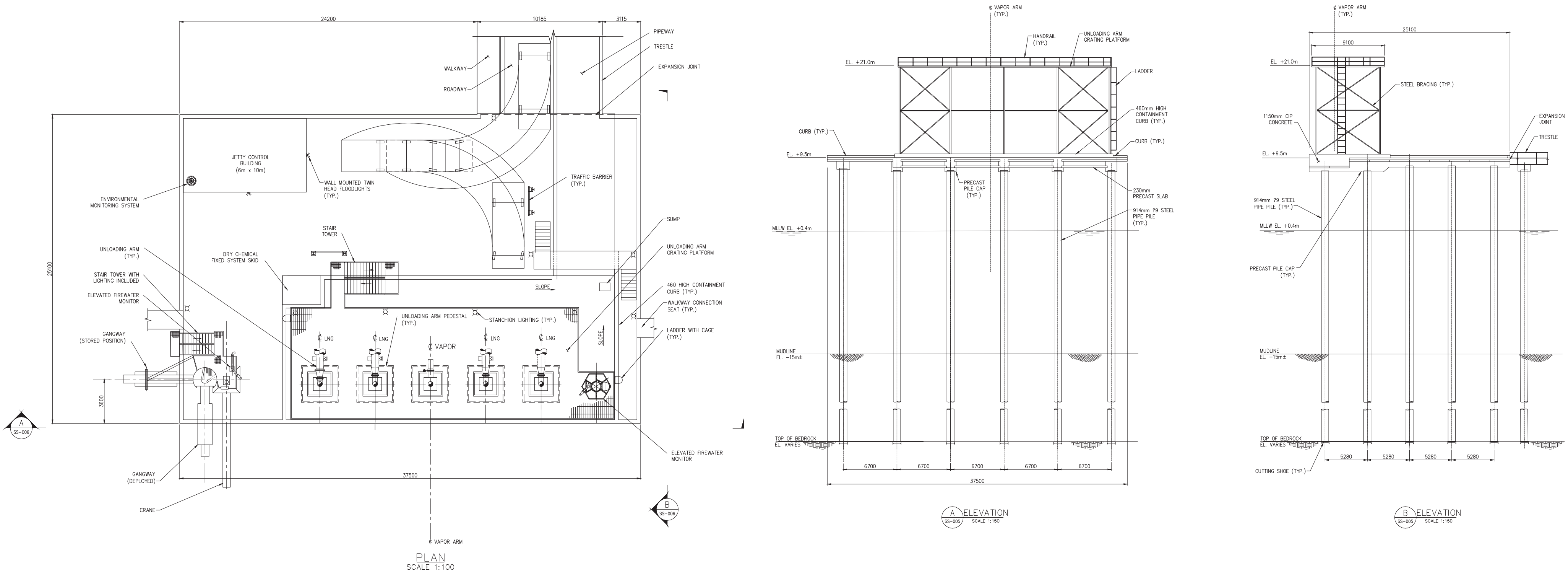

Figure 3.7

Conceptual Plan of the Unloading Platform for the LNG Jetty at South Soko Terminal

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

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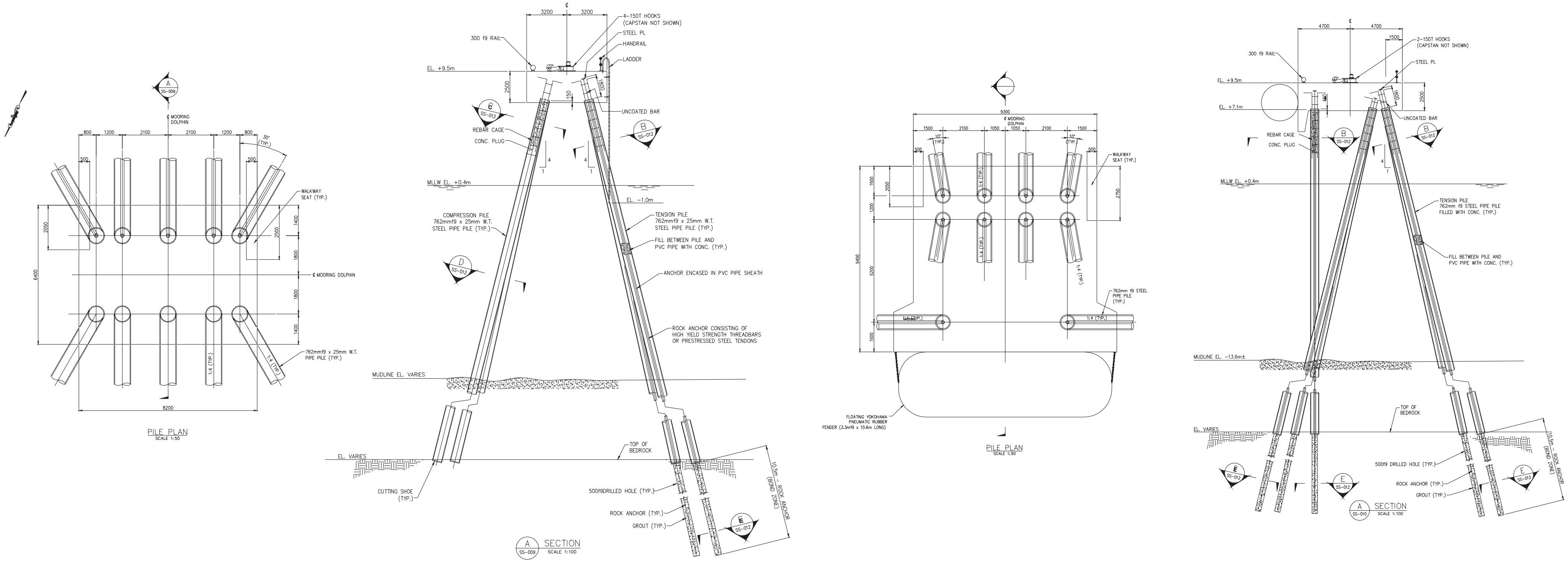

Figure 3.8

Conceptual Plan of the Mooring Breasting Dolphin for the LNG Jetty at South Soko Terminal

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

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Bored Piles

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.

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 and 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. Consistent with standard Hong Kong practice, the marine percussive pile driving will be conducted during the day time for a maximum of 12 hours.

Standard practice in Hong Kong also 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 involve 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 noise 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 3.16*.

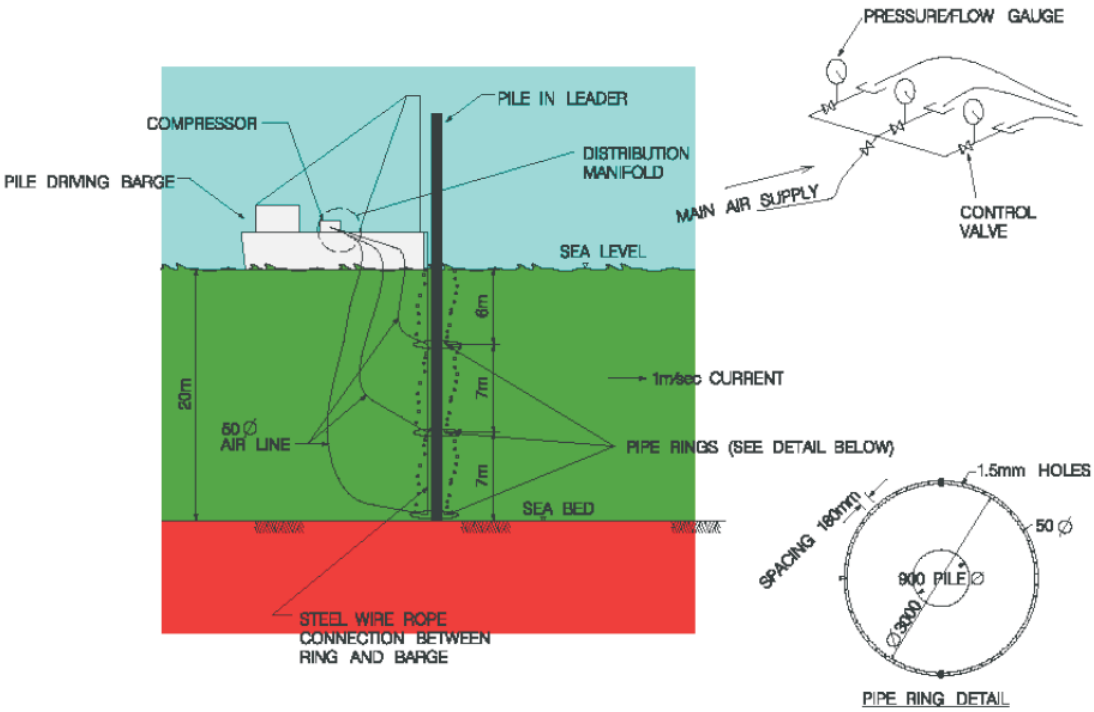
Potential impacts of underwater sounds are discussed in the *Marine Ecological Assessment* (*Part 2 – Section 9* of this EIA Report).

Associated Facilities

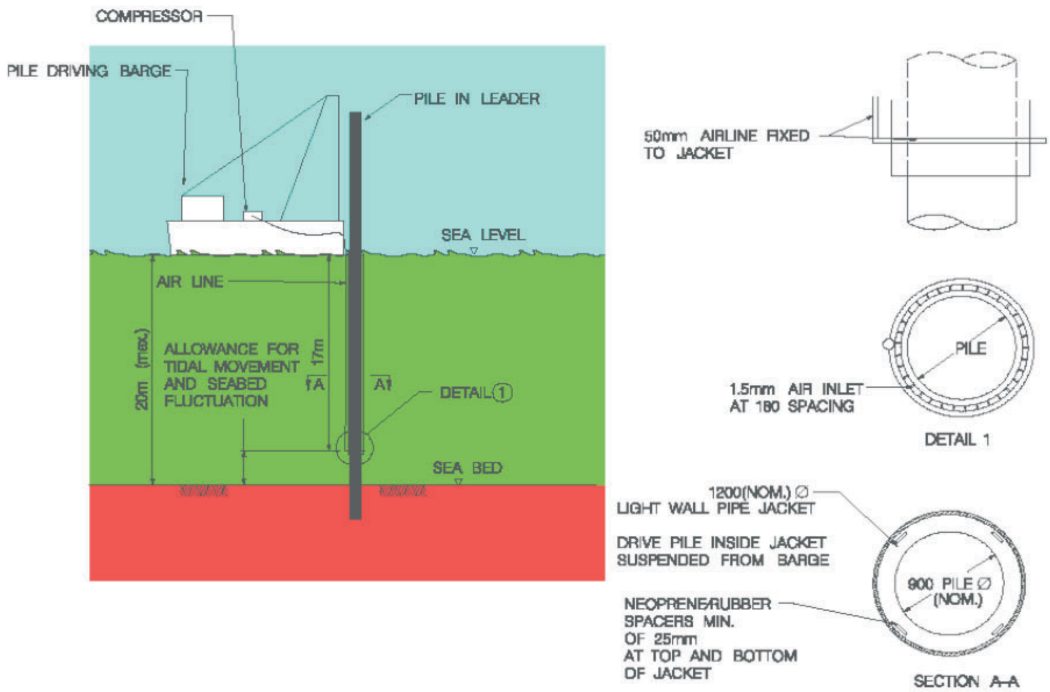
Service Berth

A service berth shall be provided for delivery of the construction plant and materials, removal of waste and for transporting workers to and from the site during the construction stage. The service berth will also allow for the transportation of fresh water in advance of the installation and commissioning of the water main to South Soko Island.

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 be also provided adjacent to the berth such that the



Schematic of a Canadian Bubble Jacket



Schematic of a Fixed Bubble Jacket

Figure 3.16

Schematic of Bubble Jacket Techniques (Indicative)

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materials/equipments could be offloaded for inspection and be delivered to the work site using trucks.

Berths will be located at the western side of the proposed site for loading/unloading activities. As these berths would not be available until at a later stage of the construction floating pontoons will need to be set up on site to facilitate the transportation of plant, equipment and materials to site.

Barging Points

Specially designed barging points will be used for the unloading of spoil material into the hopper of a barge.

To accommodate the throughput rate of the blasting works it is estimated that at least two barging points will be required. It is recommended that one barging point shall be erected at either end of the proposed site, i.e. one on the eastern end and the other on the western end. This arrangement has the advantage that at least one berth can be in operation at all times regardless of wave direction.

Floating Pontoons

Due to the potential delay in the provision of a permanent service berth, a floating pontoon may be used 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 Tung Wan via submarine intake. The intake will extend approximately 300 m from the pumphouse to the offshore intake heads (*Figures 3.9* and *3.10*). It is proposed that a typical box culvert design be employed and the intake structure comprises of a precast concrete tower ballasted with mass concrete. The tower would be connected to the seawater pumphouse by submarine pipelines. The foundation will likely comprise a rockfill base placed directly over the rockhead level following dredging by grab dredgers to remove a thin layer of marine deposits beneath. The intake from the tower would be placed at an approximate depth of approximately –3 mPD. A cross-sectional drawing of the conceptual intake is presented in *Figure 3.10.*

The returned seawater leaving the ORV's will be discharged to the sea through an open channel following a similar alignment to the cryogenic pipes to the LNG Jetty (*Figure 3.9*). To allow a gravitational controlled flow, the channel will be designed with a longitudinal gradient to the shore. A pipe approximately 50 m long will discharge the cooled seawater through spargers into the surrounding waters. The spargers will lie on the seabed at a depth of approximately 10 metres. The outfall will be buried to a depth of -1.5 mPD with rock armour protection. Dredging works will be undertaken using grab

Figure 3.9

Indicative Layout for the Cooled Water Intake and Outfall
(Aerial photograph source: Lands Department)

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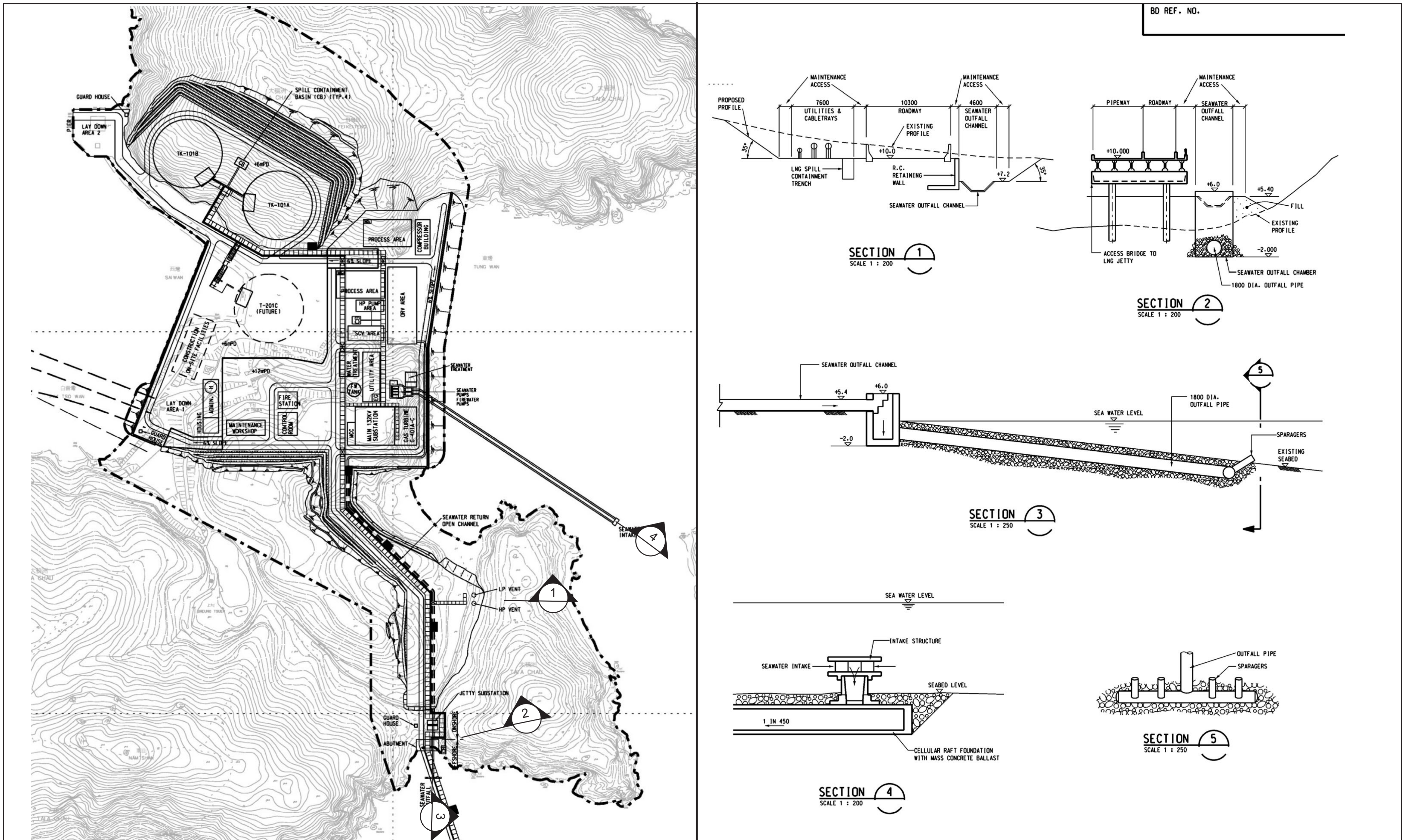

Figure 3.10

Preliminary Designs of Intake and Outfall Structures

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dredgers. A cross-sectional drawing of the conceptual outfall is presented in *Figure 3.10*.

3.3.4 *Gas Pipeline Installation*

A submarine gas pipeline of approximately 30" diameter will be necessary to supply natural gas to the Gas Receiving Station (GRS) at the Black Point Power Station (BPPS) (*Figure 3.11*). The pipeline would have a design life of 50 years and would be situated either below land or below the seabed to a depth that would be dependent on the conditions and location of the area to be traversed. The preliminary construction methodology for the pipeline is presented below covering both the onshore and submarine works, and shall be finalized at the detailed engineering design stage.

Onshore Section of Pipeline

The land-based construction works associated with the Project would include laying the pipeline through an open trench followed by direct burial. The pipeline would, typically, be buried at about 1 m below ground level within a trench approximately 1 m wide. An open cut method of construction would be used. The onshore pipeline would be coated with a protective coating and provided with cathodic protection.

Submarine Section of Pipeline

The marine-based burial depth would typically be 3 m below the existing seabed level to the top of the pipe.

Typical cross sections of the trench designs that may be used for the submarine pipeline are shown in *Figure 3.12*. For marine areas that are considered to pose a threat to the integrity of the pipeline system through anchor drop/drag, protective measures would be required and may include rock armouring. The submarine pipeline would be coated externally with an asphalt enamel coat and wrap and, would have an outer layer of steel reinforced concrete weight coating.

In summary, there are four types of protection proposed for the pipeline, as follows:

- 3 m burial with natural backfill with 1 m Armour Rock Protection and 2 m natural backfill (Type 1B);
- 3 m burial with 3 m Armour Rock Protection (Type 2A);
- 1.5 m burial with 1.5 m Armour Rock Protection (Type 2B);
- 3 m burial with 3 m Armour Rock Protection (Types 3A and 3B).

Trench Type 1 (*Figure 3.12*) is designed to protect against trawling activities and small anchors. This protection is applied generally throughout the route selection. Trench Types 2A and 2B (*Figure 3.12*) are designed for Type 1B hazards (i.e., trawling and small anchors), with additional protection against dropped objects and small (2 MT) anchors within the landfall approaches of South Soko and Black Point. Protection measures will also prevent damage to the pipeline through any potential future dredging works.

Trench Types 3A and 3B (*Figure 3.12*) provide maximum protection to the pipeline. It is designed to protect against both Type 1B and Type 2 hazards, with additional protection against accidental anchor drop (15 to 20 MT anchors) and drag by seagoing vessels. This protection is provided at the location where the pipeline crosses high intensity shipping areas (Urmston Road and Adamasta Channel).

Pipelaying

The laybarge method is the most common form of pipeline installation. It is a process whereby individual pipe lengths (usually 40 ft) are systematically welded on the laybarge. In the pipelay operation, the laybarge winches itself forward after welding is completed. In relative terms, the pipes, after welding, continue along a ramp for the checking of welds and to the field joint coating station. The pipes then leave the barge and typically, go over a curved ramp known as a stinger before going into a suspended span in the water prior to touching down on the seabed. The curvature of the pipeline in the suspended span is controlled by tension, applied through a tracked or wheeled tensioner system after the welding stations.

Potential impacts associated with the pipelaying activities are discussed in the *Water Quality Impact Assessment* and *Waste Management* (*Part 2 – Sections 6* and *7* of this EIA Report).

Dredging

The proposed pipeline design requires a burial depth of at least 3m. For submarine utility installations, dredging involves the removal of marine sediments from the seabed to form the trench, into which the pipeline is laid. Many dredging techniques, such as grab, trailing suction hopper and cutter suction dredging are available and chosen depending on the prevailing environmental conditions (e.g. shear strength of marine deposits). Dredging can be a comparatively fast way to construct a pipeline trench and is necessary in areas where extra pipeline protection is required (e.g. rock armour protection). The selection of installation method and sequencing activities for the gas pipeline have been discussed in *Section 2.2.5* and depicted in *Figure 3.11*.

The *Water Quality Impact Assessment* (*Part 2 – Section 6* of this EIA Report) has examined the effects of the dredging of the gas pipeline on water quality and should be referred to for further details.

Armour Rock Placement

Rock armour is necessary to achieve adequate protection against anchor drop and drag. The vessel will manoeuvre to the designated area where the rocks

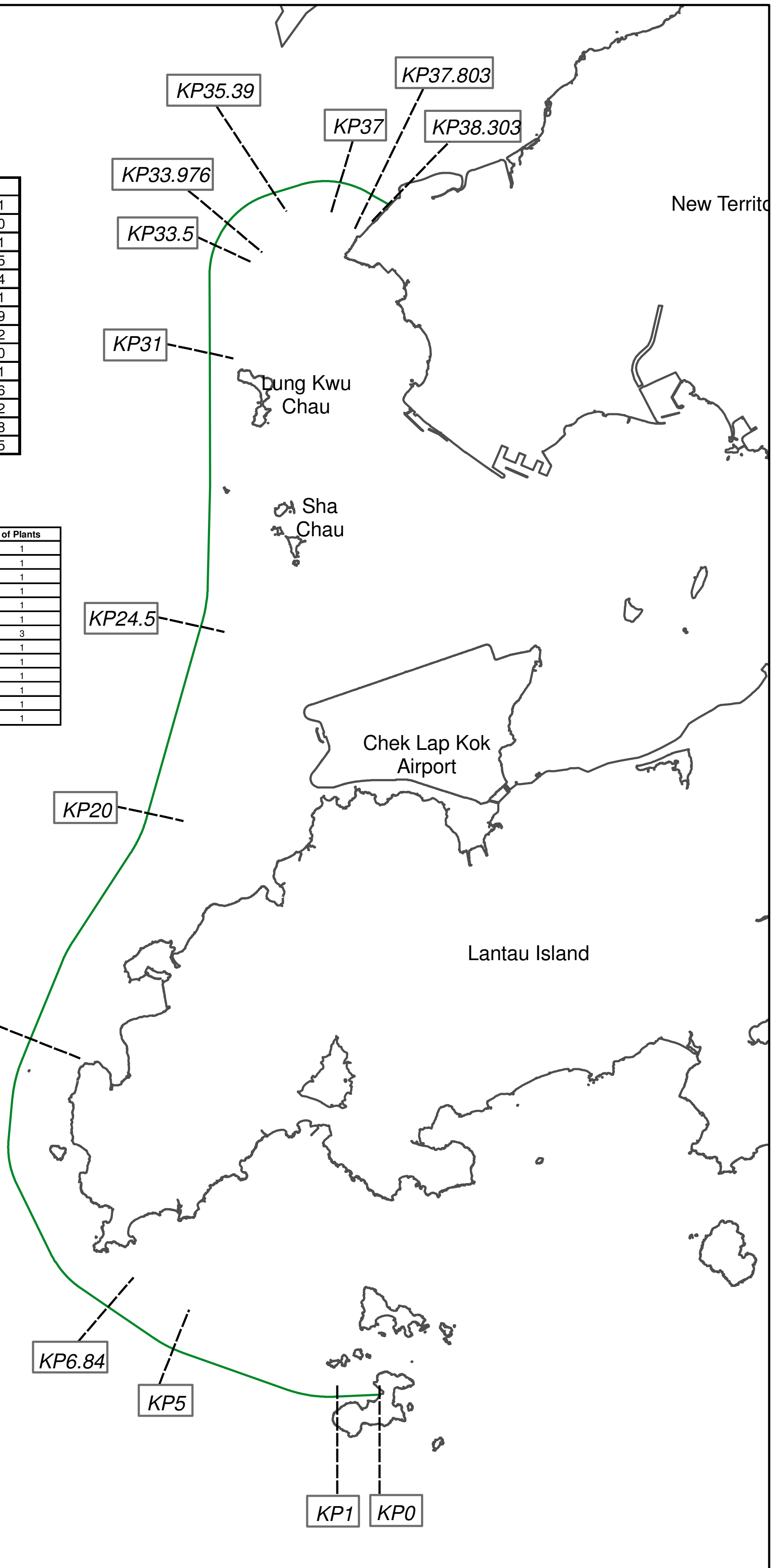
KEY

Gas Pipeline

Distance Point	Easting	Northing
KP0	808726.9977	802997.01011
KP1	807727.9242	802953.97430
KP5	803911.5167	804063.85511
KP6.84	802366.6748	805058.82235
KP14	800558.6637	811325.19124
KP20	803307.7451	816625.93301
KP24.5	804528.1988	820957.27149
KP31	804746.8102	827438.17932
KP33.5	804870.8264	829922.45140
KP33.976	805090.6327	830343.39191
KP35.39	806219.719	831145.91776
KP37	807788.6034	831403.29772
KP37.803	808532.0085	831113.16768
KP38.303	808942.7082	830874.20005

* Refer to Figure 3.12 for the details of the cross-section of each trench.

Zone				Trench Type	Plant Type	No. of Plants
KP	0	-	1	2A	Grab Dredger	1
KP	1	-	5	1B	TSHD	1
KP	5	-	6.84	3B	TSHD	1
KP	6.84	-	14	3A	TSHD	1
KP	14	-	20	3B	TSHD	1
KP	20		24.5	1B	TSHD	1
KP	24.5	-	31	1B	Grab Dredger	3
KP	31	-	33.5	1B	Grab Dredger	1
KP	33.5	-	33.976	3B	Grab Dredger	1
KP	33.976	-	35.39	3A	Grab Dredger	1
KP	35.39	-	37	3B	Grab Dredger	1
KP	37	-	37.803	1B	Grab Dredger	1
KP	37.803	-	38.303	2B	Grab Dredger	1



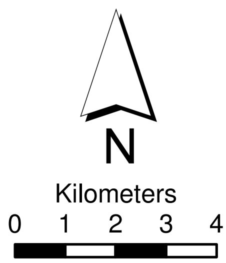


FIGURE 3.11

Pipeline Route

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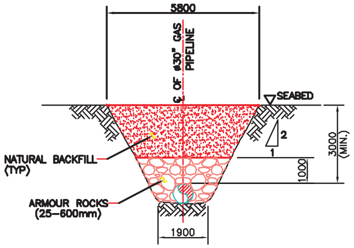
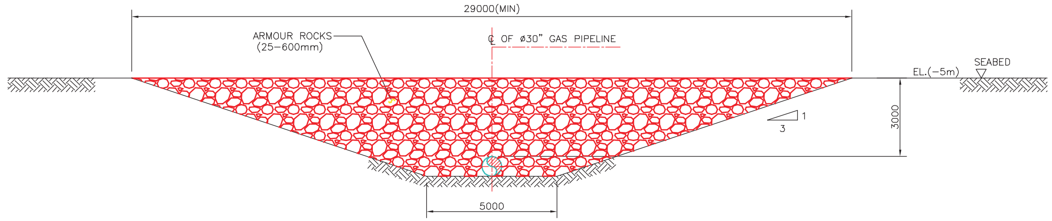


TYPE 1B - PRE-TRENCH BY GRAB DREDGING WITH ARMOUR ROCKS BACKFILL

SCALE 1:100



TYPE 2A - PRE-TRENCH WITH ARMOUR ROCK BACKFILL (SSI SHORE APPROACH)

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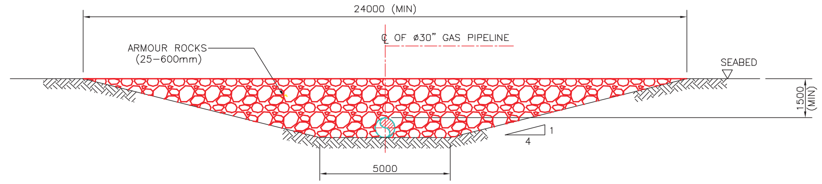
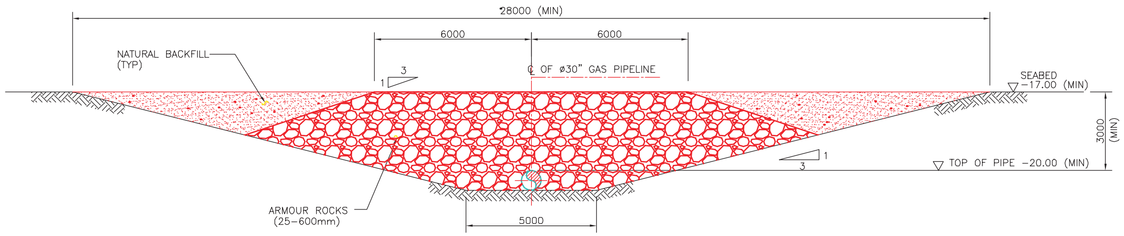


TYPE 2B - PRE-TRENCH WITH ARMOUR ROCK BACKFILL (BPPS SHORE APPROACH)

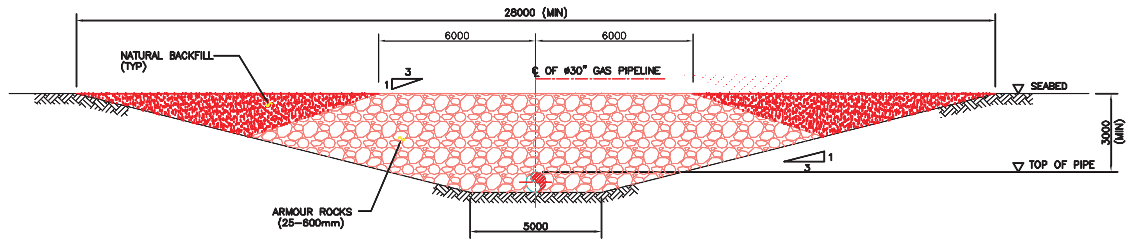
SCALE 1:100



TYPE 3A - PRE-TRENCH WITH ARMOUR ROCK BACKFILL

SCALE 1:100

NOTE: TOP OF ARMOUR ROCK PROTECTION LEVEL NEED TO BE DREDGED TO MIN. –17.0m C.D.



TYPE 3B - PRE-TRENCH WITH ARMOUR ROCK BACKFILL

SCALE 1:100

Figure 3.12

Preliminary Pipeline Design Information

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will be placed on top of the pipeline and this can be done down a tremie pipe. A barge will transport rocks from a quarry or South Soko to the material storage barge.

Rock dumping is based on the use of typical Hong Kong Derrick Lighters (1,800 – 3,000T) configured to place rocks using grabs (as experienced on Towngas project.) These units have the capability to place 2,400/3,600 T/day of graded rock. It is possible that the Contractor may elect to utilize specialized side-dump equipment for some of the deeper water areas (e.g. Type 3A and 3B). It is also likely that the Contractor will manipulate the numbers of units working in any area depending on the equipment available at any time and on its actual progress vs. planned.

Similar to the dredging works, noise generated by armour rock placement is not expected to acoustically interfere significantly with dolphins or porpoises. As the armour rocks will be placed directly on top of the pipe which located at the bottom of the dredged trench, it is not expected to pose a collision risk to dolphins or porpoises. Armour rock placement is not expected to cause adverse impacts to water quality as the material has a low fines content. Any fines present will be inert and will settle to the seabed soon after dumping has finished. The backfill material, including any fines, will be placed directly on top of the pipe and therefore the affects on water quality, marine ecology and fisheries will be minor. A geophysical survey will be conducted following completion of the placement of armour rock to verify that the protection is either flush with or below the surrounding seabed level so that the rocks do not present a hazard to fishing operations.

It should be noted that many similar pipelines have been installed or permitted in Hong Kong with similar post construction protection using armour rock including HEC Shenzhen to Lamma pipeline, AAHK PAFF pipeline and Towngas Shenzhen to Tai Po pipeline, in which some of the pipeline sections pass through marine mammal habitats, ie South Lamma, Po Toi and the Sha Chau Lung Kwu Chau Marine Park. Consequently, placement of rock armour on the gas pipeline is not expected to cause impacts to marine mammals.

Gas Receiving Station

The pipeline from South Soko Island to the BPPS will terminate at a Gas Receiving Station (GRS) located at the existing GRS for the Yacheng Pipeline (*Figure 3.11*). Facilities associated with the GRS are not complex and the site area requirements usually are small, generally comprising:

- Emergency Shutdown valve;
- PIG receiver, with associated service piping;
- Station inlet header;
- Inlet filter-separators (duty and standby runs);

- Metering runs (duty and standby runs);
- Pipeline gas heaters (duty and standby runs);
- Pressure control runs (duty and standby runs);
- Station export header, check valve and ESD/isolation valve.

Piping and equipment will generally be skid-mounted (size permitting) and placed on prepared concrete footings. Larger piping and equipment assemblies will be delivered to site as discreet subassemblies and assembled on-site. Sensitive instrumentation will be housed in air-conditioned instrument enclosures that are commonly prefabricated portable buildings.

Gas will be received via the offshore pipeline and the first major piece of equipment in the station will be an Emergency Shutdown (ESD) valve, which can be closed by means of the station ESD system in the event of an emergency, isolating the station from the source of gas.

Downstream of the ESD valve will be the station inlet header that will distribute the gas to inlet filter units. Parallel to the inlet filters oriented in-line with the incoming pipeline will be a pig receiver, enabling the running of cleaning and inspection pigs in the pipeline.

Black Point Power Station Landfall

The reclamation for the Gas Receiving Station (GRS) will be formed in advance of the pipeline arrival at Black Point Power Station. This will involve the removal of the rock armour from the existing seawalls, using a crane barge with a grab, which will be stored for later use. The soft marine deposits beneath the footprint of the seawall area for the GRS will be subsequently removed using a conventional grab dredger with temporary side slopes of 1:3. Upon removal of the soft marine deposits the new seawalls for the GRS reclamation will be formed using suitable rockfill material which will be placed using a grab to the required profile. Limited sand filling works may be required inside the seawalls as the land reclamation area is small. The stored rock armour will be replaced around the outside of the GRS reclamation to protect the new seawalls.

Upon arrival of the pipeline at Black Point the GRS reclamation will need to be broken out again to allow it to pass though. In order to reduce the amount of demolition and later reinstatement works of the newly formed seawall structure it is proposed that a cofferdam shall be provided for the shore approach works. Initially, the rock armour of the existing GRS platform will be removed across the width of the proposed cofferdam using a crane barge with a grab.

The cofferdam comprising two parallel rows of sheet piles will then be installed using a vibrohammer though the GRS platform. The cofferdam shall be formed perpendicular to the shoreline out to sea to a sufficient distance beyond the existing reclamation area. Any remaining marine deposits within the shore approach cofferdam will be removed using grab dredgers. The grab dredgers will also similarly be used in conjunction with onshore backhoes in the near shore areas to form the required design beach approach profile through the existing GRS reclamation. The excavated rockfill material from the GRS platform will be stored on the barges for later reinstatement works.

Once complete, the pipeline initiation operation will commence by bringing the pipeline to shore through the preformed trench within the cofferdam structure. Following installation of the pipeline the section of seawall within the pipeline trench will be reinstated by backfilling with the stored rockfill material previously removed from the GRS platform. The sheet piles will be subsequently removed and the rock armour reinstated over the front of the seawall and around the pipeline structure.

3.3.5 *Power Supply and Water Main Construction*

Power and water supplies are required for the routine operation of the LNG terminal. These utilities will be provided through installation of a submarine power cable and water main from Lantau Island and are discussed in turn below.

Power Supply

In order to provide reliable power for the construction and operation of the terminal, a land and submarine cable routing of three circuits from Shek Pik to Tai A Chau is proposed. To ensure the security of supply, the circuit spacing of the submarine cable section will be approximately 50 m, whereas, a circuit spacing of 600 mm will be adopted on the land section. The working corridor of the submarine cables is therefore approximately 200 m. The proposed preliminary alignment of the power cables is shown in *Figures 3.13* to *3.15*.

The majority of the submarine cable will be laid by jetting machine. An approximate 200 m long pre-dredged trench will be required at each landing point. For the land and seawall crossings, an approximate 350 mm diameter HDPE pipe will be installed for each cable circuit by open cut method.

Where the burial depth of the submarine cable is less than 5 m, a concrete slab will be used to protect the cable. In case the burial depth of the submarine cable is less than 2 m, split cast iron tubes will be used together with the concrete slab as cable protection.

An on-site gas power generation unit may be used to generate electric power for the LNG terminal. Four gas turbines, with a total capacity of 23 MW, will be provided. For the purpose of this impact assessment study, the four gas turbines have been assumed to be working constantly to estimate potential impacts to air quality as a result of the operation of the LNG terminal.

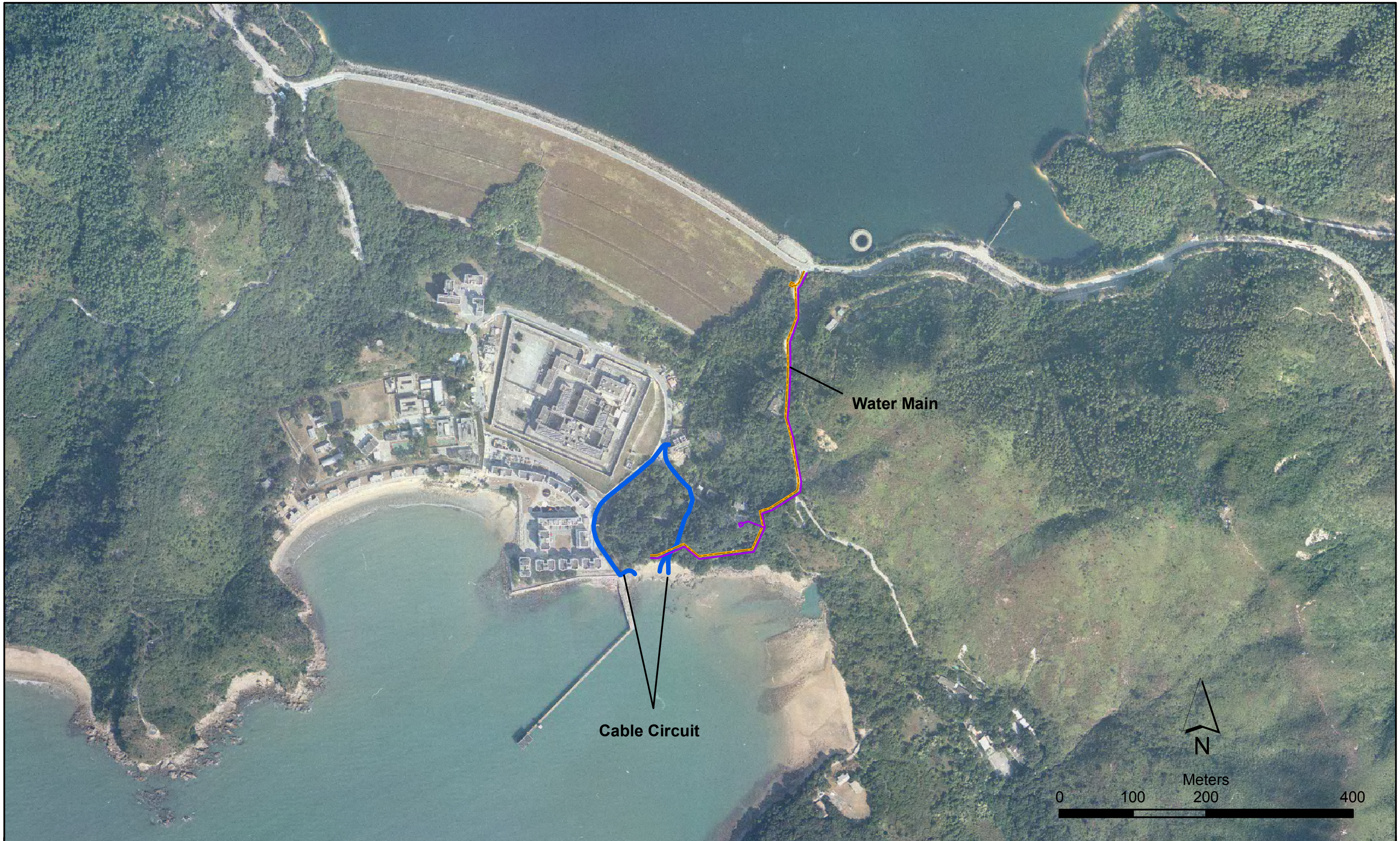

Figure 3.13

Preliminary Indicative Layout of the Proposed Water Main and Cable Circuit at Shek Pik

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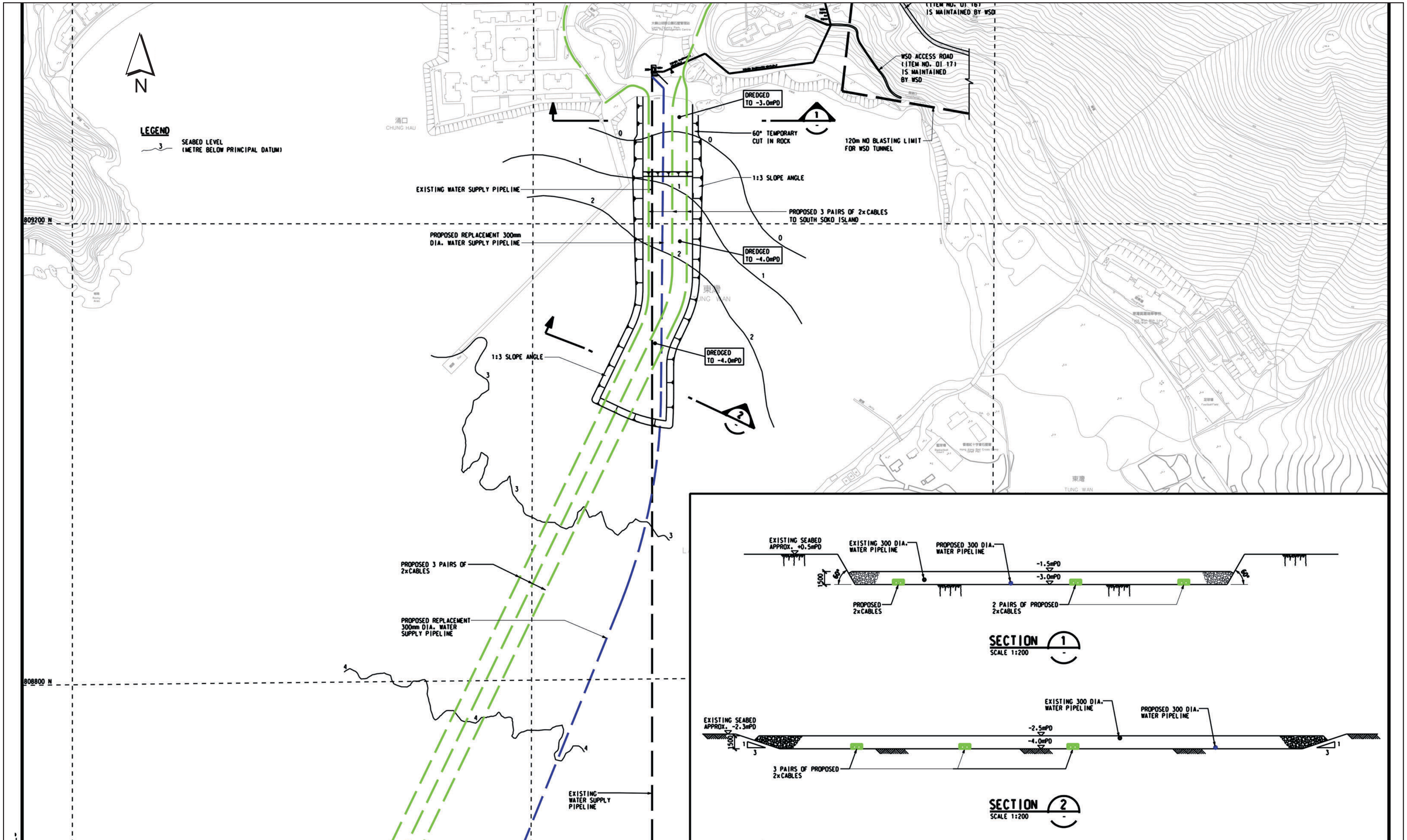

Figure 3.14

Preliminary Design of the Shore Approaches of the Power Supply and Water Main to the South Soko Terminal

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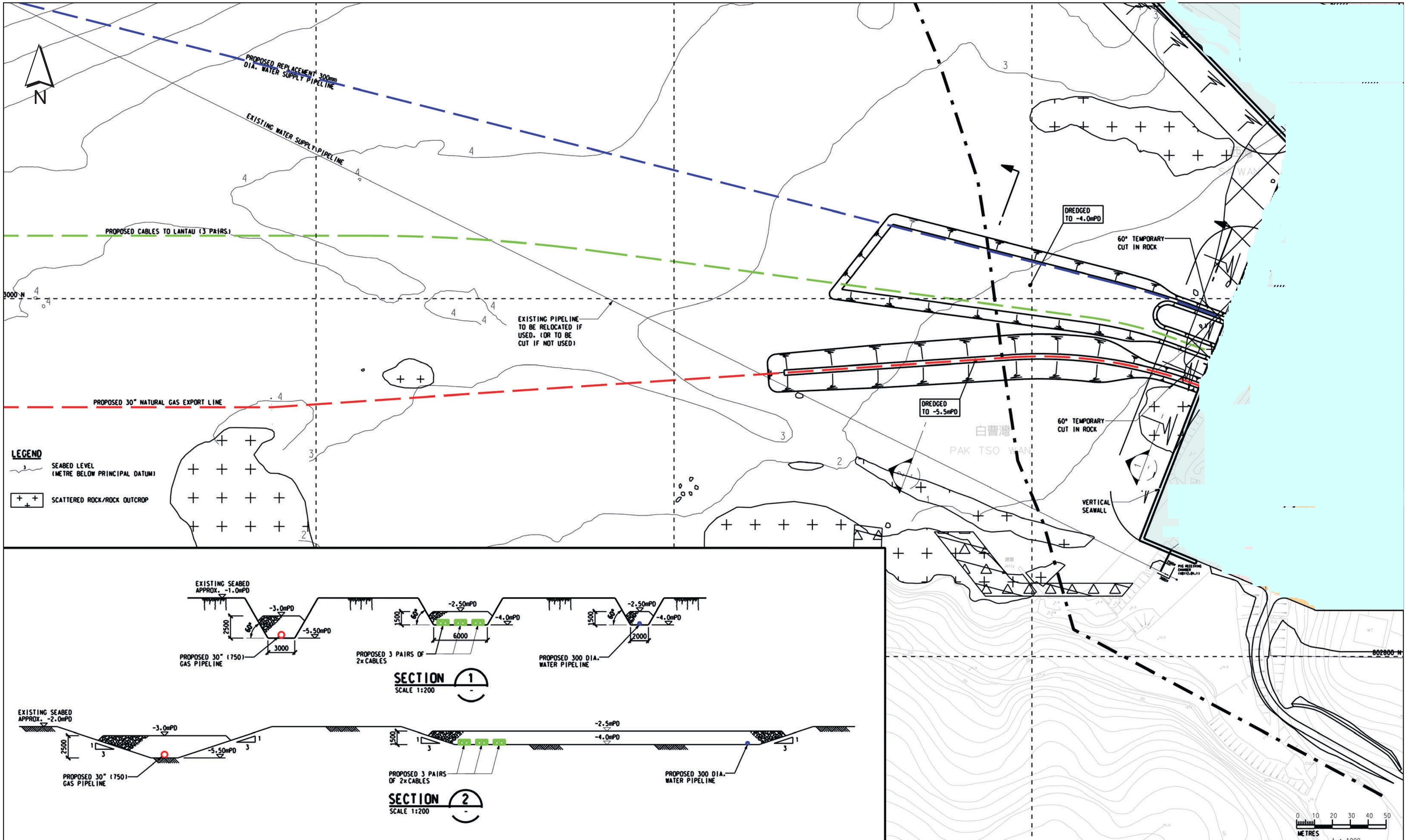

Figure 3.15

Preliminary Design of the Shore Approaches of the Power Supply and Water Main to the South Soko Terminal

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Potential air quality impacts associated with the gas power generation unit are discussed and assessed in *Part 2 – Section 4* of this EIA Report.

Water Main

The proposed submarine watermain is approximately 7.5 km long running from Shek Pik on the south coast of Lantau to the western coast of South Soko Island. The proposed preliminary alignment of the water main is shown in *Figure 3.13* to *3.15*.

Three different types of installation and burial schemes are proposed for the construction and protection of the submarine pipeline at different locations along the alignment as follows:

- **Type 1 -** For post-trenched sections installed using a jetting machine, and where mechanical backfilling is not required.
- **Type 2 -** For pre-pipelay trench sections using any type of dredging equipment, and where mechanical backfilling (with gravels) is required.
- **Type 3 -** For pre-pipelay trench sections using any type of dredging equipment, and where mechanical backfilling (with armour rocks) is required.

Type 2 installation and burial scheme will be adopted for the pipeline sections close to the shore at both Shek Pik and South Soko Island whereas Type 3 installation and burial scheme is to be applied for the pipeline section across the marine sand borrow area and marine navigation channel. Type 1 installation and burial scheme will be adopted for the remaining offshore areas.

Due to the location of the header tank, the water main will pass through a small section of the Lantau South Country Park. The potential for impacts to occur as a result of installation of the water main are discussed in the *Terrestrial Ecology Assessment* (*Part 2 – Section 8* of this EIA Report).

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 the 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 pipeline.

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 submarine pipeline to Black Point. LNG will be pumped from the LNG carrier, through loading arms on the jetty 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 and transported via the gas transportation pipeline to the GRS at Black Point.

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 necessitate the required external safe perimeter zone by distance (buffer zone) sometimes mitigated 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 liquefied natural gas, design of onshore installations and NFPA 59A Standard for the Production, Storage and Handling of Liquefied 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 38.6 ha overall.

3.4.2 *LNG Carrier (LNGC)*

LNG will be transported to the receiving terminal by LNG carriers. The transit of the LNG carrier to South Soko receiving terminal will be from pilot embarkation at South Lamma, west, both outside and in the SAR, then making the turn into the delineated approach channel.

From the pilot embarkation location, four tugboats will follow the LNG carrier in a passive mode along the route to South Soko, available to assist as necessary. Prior to entering the approach channel, four tugboats will be made fast and assist in turning the carrier in the adjacent turning basin. When the manoeuvre is complete, four tugboats will 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. Two tugboats will remain on stand-by in close proximity to the terminal throughout the unloading operation.

At the jetty, the carrier will be connected with the receiving terminal through the unloading arms. 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 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 2 – 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 carrier 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.

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*" (1) has been completed satisfactorily.

In addition, the requirements of the carrier's security plan shall be implemented consistent with the "*International Ship & Port Facility Security Code*" (2) (ISPS).

3.4.4 *Control of LNG Unloading Operations*

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

3.4.5 *Safety Zone*

While an LNG carrier is moored at South Soko, the waters and waterfront facility located within a defined boundary to be constituted as a safety zone to

(1) International Chamber of Shipping Oil Companies, 2006

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

avoid potential collision from passing traffic. The extent of this area is under examination and will depend on the findings of detailed design studies to be conducted under separate permitting exercises outwith of the EIA process.

3.4.6 *Onshore Modes of Operation*

The LNG terminal will operate in 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 LNG vaporisers that discharge the gas into the transportation pipeline.

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.

Waste and Waste Water Treatment

A sewage treatment system shall be provided for the treatment of black and grey water. A sanitary waste system consisting of a collection system and redundant, purpose designed and fabricated packaged sewage treatment unit will be provided. Domestic waste from the administration building and the various terminal control rooms shall be treated by the sewage treatment unit prior to discharge via the seawater outfall. Sewage treatment shall be via chemical or biological treatment methods.

3.5 PROJECT SUMMARY

Table 3.2 presents the summary of the project details. The South Soko Option requires 36.5 ha area, 0.6 ha is required to be reclaimed, 1.1 ha of coastline (both artificial and natural) will be modified to enhance the seawalls and a total dredged volume of 3.89 Mm^3.

Table 3.2 Summary of Project Description

ISSUE	SUMMARY	
Overall Project Area (ha)	36.5 ha	
Land Based Works Areas (ha)	18.5 ha	
Reclamation Areas (ha)	0.6 ha	
Area of Modified Seawalls (ha)	1.1 ha	
Dredging Volumes (Mm^3)	Approach Channel & Turning Basin	= 1.07 Mm^3
	Seawall	= 0.10 Mm^3
	Berthing Trench	= 0.12 Mm^3
	Seawater Intake & Outfall	= 0.03 Mm^3
	Submarine Gas Pipeline	= 2.06 Mm^3
	Water & Power Supply Line	= 0.22 Mm^3
	Gas Receiving Station	= 0.29 Mm^3
	TOTAL	**= 3.89 Mm^3**
Length of Natural Coastline Affected (m)	300 m including 265 m of rocky shore and 35 m of sandy shore	

ISSUE	SUMMARY
Volume of Excavated Construction & Demolition Materials	Soil (Total = 560,000 m^3) Site Formation = 560,000 m^3 Rock (Total = 1,800,000 m^3) Site Formation = 1,800,000 m^3
Volume of Fill Requirements	Soil (Total = 381,000 m^3) Site Formation = 270,000 m^3 Reclamation at South Soko = 20,000 m^3 Reclamation at Gas Receiving Station = 91,000 m^3 Rock (Total = 1,940,000 m^3) Seawall = 150,000 m^3 Seawater Intake & Outfall = 72,000 m^3 Water & Power Supply Line = 180,000 m^3 Submarine Gas Pipeline = 1,310,000 m^3 Gas Receiving Station = 228,000 m^3
Volume of Excavated Construction & Demolition Materials for Disposal	Soil = 179,000 m^3 Rock = 0 m^3
Volume of Imported Fill	Soil = 0 m^3 Rock = 140,000 m^3
Length of Submarine Utilities	Submarine Gas Pipeline = 38.0 km Submarine Water Supply Line = 7.5 km Submarine Power Cable = 8.0 km

3.6 *PROJECT PROGRAMME*

The preliminary construction programme is presented in *Annex 3A*. Site preparation works, including land works and reclamation, are expected to take 18 months. The reclamation works is assumed as a fast track programme 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.

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, tanks, equipment, piping, buildings, and the electrical power and control systems for the process portion of the LNG terminal facilities. The construction works will expect to be completed in time for initial gas delivery in 2011. This gas delivery date 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*).

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.

With the exception of the above, there are presently no committed projects that could have the potential for cumulative impacts to occur with the construction of the South Soko terminal. Discussions with the relevant departments on the construction schedules of the HK-Zhuhai-Macau Bridge, the potential Western Port Development (CT10) and the construction of the Value Added Logistics Park (at Tai Ho)have indicated that these are unlikely to be carried out concurrently with the construction works of the gas pipeline. No other projects are presently planned to be constructed in sufficient proximity to the Project to cause cumulative effects. In light of the above, cumulative impacts are not anticipated.

Annex 3A

Preliminary Construction Programme

Annex 3A - Preliminary Construction Programme

SOUTH SOKO 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
Land Based Works																																																	
Site Preparation Work																																																	
	Site Clearance				Y	Y	Y																																										
	Soil Compaction				Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y																																		
	Blasting and Excavation							Y	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	Y																								
Reclamation																																																	
Dredging					Y	Y																																											
Seawall Construction																																																		
	Placing Seawall Core						Y	Y	Y	Y	Y																																						
	Placing Seawall Rock Armour						Y	Y	Y			Y	Y	Y																																			
Placing Fill									Y	Y	Y																																						
Drainage Works																																																		
	Install of Temporary Work								Y	Y																																							
	Laying of Drainage Pipes								Y	Y																																							
	Backfilling								Y	Y																																							
Main Jetty																																																	
Ground Investigation						Y	Y	Y																																									
Jetties and Access Bridge																																																		
	Steel Piles Construction					Y	Y	Y	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	Y	Y																			
Dredging of Approach Channel and Turning Basin									Y	Y	Y							Y	Y																														
Intake and Outfall Construction											Y	Y	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		
Installation of Water Main & Cable																																																	
Dredging											Y	Y	Y																																				
Water Pipeline Installation														Y	Y	Y																																	
Post Trenching Jetting																Y	Y																																
Backfilling															Y	Y	Y	Y	Y	Y																													
Submarine Cable Installation by Direct Burying (Jetting)																									Y	Y	Y																						
Installation of Submarine Gas Pipeline																																																	
Pipeline Installation by Laybarge/Post Trenching Jetting/Dredging														Y	Y	Y	Y	Y	Y	Y	Y	Y																											
Installation of Gas Receiving Station																																																	
Dredging										Y	Y																																						
Seawall Construction																																																	
	Placing Seawall Core										Y	Y	Y																																				
	Placing Seawall Rock Armour												Y	Y	Y	Y																																	
Placing Fill													Y	Y	Y	Y																																	