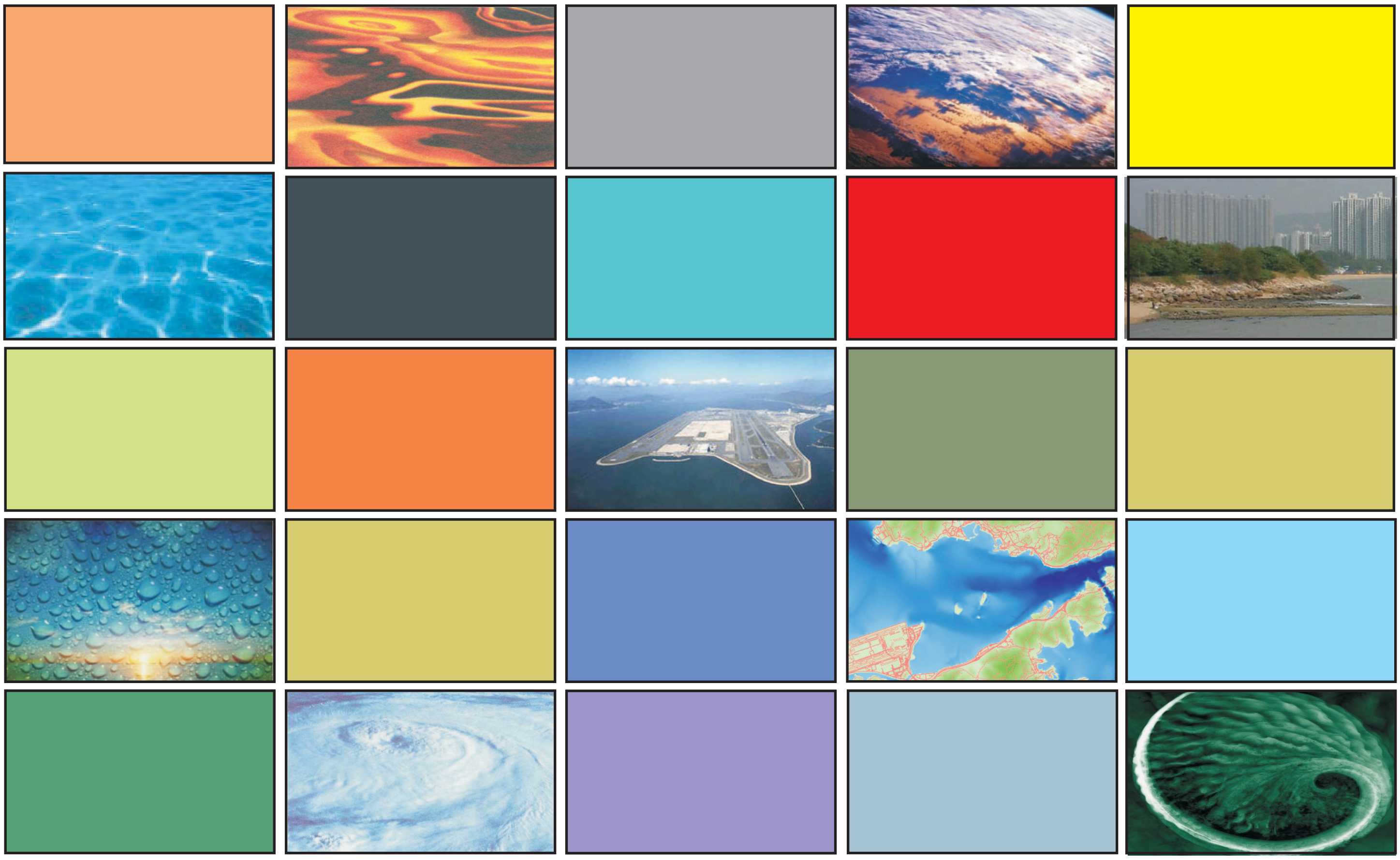
PROJECT PROFILE
工程項目簡介



Proposed 132kV Submarine Cable Route for Airport "A" to Castle Peak Power Station Cable Circuit

擬敷設132千伏青山發電站至機場'A'變電站電纜線路之海底電纜分段

中華電力
CLP Power

18th July 2006
二零零六 七月十八日

Environmental Resources Management
21/F Lincoln House
Taikoo Place 979 King's Road
Island East Hong Kong
Telephone 2271 3000
Facsimile 2723 5660
www.erm.com

香港環境資源管理顧問有限公司
香港英皇道九七九號太古坊
林肯大廈二十一樓
電話：二二七一 三零零零
圖文傳真：二二七三 五六六零
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18 July 2006
二零零六年七月十八日

Reference 0046048
檔案編號

For and on behalf of
代表
Environmental Resources Management
香港環境資源管理顧問有限公司

Approved by: Dr Robin Kennish
批核: 簡樂文

Signed: Robin Kennish
簽署

Position: Director
職位： 總監

Date: 18 July 2006
日期： 二零零六年七月十八日

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1 BASIC INFORMATION

1.1 PROJECT TITLE

Proposed 132kV Submarine Cable Route for Airport "A" to Castle Peak Power Station Cable Circuit.

1.2 PURPOSE AND NATURE OF THE PROJECT

CLP Power (CLPP) intends to install a 132 kV submarine cable circuit to connect Castle Peak Power Station and Hong Kong International Airport in order to meet the electricity load growth at the Hong Kong International Airport.

Owing to various constraints (eg mud pits and existing submarine utilities), viable submarine cable route between Tuen Mun and the Airport are limited. The proposed route is located in between and parallel with the existing CLP 132 kV submarine cable circuit and the Hutchison Global Crossing Ltd. (HGC) Optical Fibre Submarine Cable System (*Figure 1.1*).

At the Tuen Mun side, CLPP proposes to land the cable to the west of the boundary of Butterfly Beach and the HGC submarine cable. At the Airport, it is proposed to make use of the existing provisions inside existing cable ducts underneath the seawall at the north of the Airport Platform.

This Project Profile includes an assessment of the potential environmental impacts associated with the installation of the submarine cable circuit. The assessment has been based on information compiled by the Project Proponent (CLPP) describing the expected construction activities. Once installed, the cable circuit will not result in any impact to the environment during operation.

1.3 NAME OF PROJECT PROPONENT

CLP Power
Engineering Projects Department
6/F Shamshuipo Centre
215 Fuk Wa Street
Kowloon

Phone: 2678 6524
Fax: 2678 6819

1.4 *LOCATION AND SCALE OF PROJECT*

1.4.1 *Location*

The cable landing sites will be located to the west of Butterfly Beach, Tuen Mun and at the northern part of the platform of Hong Kong International Airport (see *Figure 1.1*). The proposed cable route will start from Tuen Mun and extend southward crossing Urmston Road to the Airport.

1.4.2 *History of the Site*

The landfall at Tuen Mun is located to the west of the boundary of Butterfly Beach. There are two existing submarine cables located parallel to the proposed cable route. At Tuen Mun, similar submarine cable landing points at approximately 100 m east and approximately 150 m west were constructed by HGC in 2002 and CLPP in 2003 respectively. At the Airport, the proposed cable circuit will be landed through existing cable ducts installed by CLPP in the 90's underneath the seawall at the north of the Airport. The seabed in the general vicinity of the proposed 132kV submarine cable within the Urmston Road up to the landing site has been disturbed from historical sand dredging and mud disposal activities.

1.4.3 *Scale of the Project*

The Project involves the installation of 132kV cable circuit, with an intended burial depth of up to 5 m (near the landing points a depth of less than 5 m protection cover will be adopted due to seabed geotechnical constraints). The total length of the cable is approximately 6.2 km.

The cable laying process will only require minor works within the marine environment which will not adversely affect water quality or the marine ecology of the area. Only small scale construction works are required on land at Tuen Mun for connecting the submarine cables with land cables (underground).

1.5 *CABLE ROUTE SELECTION PROCESS*

1.5.1 *Selecting the Land Site*

The selection of landing site was based on the following considerations (*Figure 1.2*).

- Avoiding the seawater intakes as far as practically possible.
- Avoiding the bathing beach as far as practically possible.
- Avoiding locations with conservation interest as far as practicable.
- Selecting technically feasible areas (ie soft muds and using the existing cable duct at the Airport) to minimise the construction difficulties.

1.5.2 Marine Route Planning Considerations

There are some existing physical and environmental constraints to the 132kV cable route, which have confined the alignment of the cable (*Figure 1.2*). The following constraints have been taken into consideration:

- Minimising crossing or encroaching on the existing submarine cables or other submarine utilities situated within Urmston Road, thereby ensuring that cable laying operations do not cause any disturbance to the existing seabed utilities.
- Avoiding the location of the mud disposal sites and sand deposits.
- Avoiding any structures of the deployed artificial reefs.
- Avoiding shallow sediment areas to meet the optimal 5 m burial depth requirement.

In addition to the avoidance of the aforementioned constraints, the following considerations have also been taken into account.

- For simultaneous cable burial/laying operation, sharp bending of cable alignment has been avoided and the cable route maintained as straight as possible.
- To provide the shortest interface with the seawalls (as perpendicular as far as possible).
- Select the shortest cable alignment to minimise the potential for adverse impacts to the environment and marine traffic.

1.6 DESIGNATED PROJECTS TO BE COVERED BY THE PROJECT PROFILE

The project is classified as a Designated Project under the *Technical Memorandum on Environmental Impact Assessment Process (TM EIAO)*:

Schedule 2 (Part I), C.12 – A dredging operation which ---

(a) is less than 500 m from the nearest boundary of an existing or planned –
(vi) bathing beach

1.7 NAME AND TELEPHONE NUMBER OF CONTACT PERSON

Environmental Resources Management (ERM) has been appointed by CLPP to undertake the environmental permitting for this Project.

All queries regarding the project can be addressed to:

CLP Power
Engineering Projects Department
6/F Shamshuipo Centre
215 Fuk Wa Street
Kowloon

Phone: 2678 6524
Fax: 2678 6819

Attn: Mr Thomas WK Lau – Senior Circuit Project Engineer

2 OUTLINE OF PLANNING AND IMPLEMENTATION PROGRAMME

2.1 PROJECT PLANNING AND IMPLEMENTATION

The Project will be constructed through the following activities:

- ***Shore-end Cable Laying* -** At the shore end near Tuen Mun, the cable will be laid within a pre-dredged trench to a burial depth not more than 5 m deep and backfilled. The work would be undertaken mainly by a single grab dredger typically using a 11 m^3 grab. Should any bed rocks be encountered, rock breaking will be involved. The marine mud at the Airport landfall will be extracted by grab following the (methods as described above) and / or suction dredging followed by backfilling with the excavated materials. During the suction dredging operation, an approx. 22 inch diameter rigid steel pipe will be extended from the dredger to the designated location such that the marine mud at that location will be sucked up then delivered into the hopper barge, which will be berthed beside the dredger for marine mud collection. The cable segment (cable size of approximately 150 mm in diameter) will be laid ashore (via a floated shore-end operation) from a construction barge holding position at a distance of around 100 m from the seawall. The cable end will be fed by divers into the existing cable duct entrance at the base of the seawall then hauled by hand or using a small winch, as appropriate. The cable will then be anchored to an existing fitting at the seabed duct entrance and positioned on the seabed by divers before the seaward end of cable laying commences. The dredging rate is not expected to exceed 1,500 m^3 per day for either the grab dredger or suction pipe. The total volume of dredged materials is expected to be no more than a total of 50,000 m^3 at the landing points.

- ***Cable Laying Methodology* -** The majority of the proposed 132kV submarine cable will be installed by simultaneously laying and burying the cable using a water jetting burial machine. The machine liquefies the seabed sediments through the use of water jets which allow the cable to be laid into the seabed to the desired burial depth.

  It is expected that the cables will be laid for the majority of the cable length to a burial depth of approximately 5 m below the surrounding seabed. In areas where a shallower burial depth is required, the cables will require a protective cover, such as a concrete slab and / or split cast iron tube.

All nearshore and onshore construction works are expected to be undertaken during normal working hours (7am – 7pm). If evening or night-time works are later found to be necessary, a construction noise permit (CNP) will be applied for.

2.2 *PROJECT PROGRAMME*

The 132kV cable is scheduled to be installed and landed at Tuen Mun and the Airport landing sites during mid 2007. The expected construction schedule is as follows:

Landing Site Preparation and Cable Landing (at Tuen Mun and the Airport)	approximately 8 weeks
Cable Laying	approximately 4 weeks
Post Lay Protection	approximately 6 weeks

3 *MAJOR ELEMENTS OF THE SURROUNDING ENVIRONMENT*

The various major elements of the area surrounding the cable alignment are shown in *Figure 1.2*.

3.1 LAND & SEA ACTIVITIES

3.1.1 Landing Sites

Tuen Mun

The landing site is situated on the western part of the gazetted Butterfly Beach in Tuen Mun.

Hong Kong International Airport

The landing site is situated at the north-eastern side of the Airport and the near shore areas are designated as Restricted Areas.

3.1.2 Shipping Lanes and Fairways

There is a major shipping route which the proposed cable route passes through, known as the Urmston Road.

3.1.3 Submarine Cables, Pipelines and Outfalls

There are numerous submarine utilities located to the east and west of the proposed cable route. The proposed route is located in between and parallel with the existing CLP 132 kV submarine cable circuit and the HGC Optical Fibre Submarine Cable System.

3.1.4 Gazetted and Existing Marine Facilities

To the east of the proposed cable route is the Tuen Mun Anchorage, uncontaminated mud disposal sites and sand deposits. To the west are the contaminated mud disposal sites. Around half of the proposed cable route is located within the gazetted sand dredging and mud disposal areas. The seabed within these gazetted areas are presumed to be disturbed to a certain extent. The proposed cable route at the southern end is located close to the artificial reef complex (80 m) but the route confirmed that it would not physically affect any structures of this complex.

3.2 SITES OF SPECIAL SCIENTIFIC INTEREST (SSSIs)

The closest Sites of Special Scientific Interest (SSSI) are Castle Peak SSSI and Tsing Shan Tsuen SSSI which are located over 1.7 km north of the Tuen Mun landing site, and the San Tau SSSI, Tai Ho stream and Pok To Yan & Por Kai Shan SSSI are located over 4 km south of the Airport landing site. The Lung Kwu Chau, Tree Island & Sha Chau SSSI is located more than 6.5 km from the proposed Tuen Mun to the Airport cable route. Apart from the San Tau and Lung Kwu Chau, Tree Island & Sha Chau SSSIs, all of the above mentioned SSSIs are located on land and therefore they are not expected to be affected due to the project.

3.3 *SITES OF CULTURAL HERITAGE*

No declared / deemed monuments, graded or recorded heritage resources are located in the vicinity of the proposed cable route or in the surrounding areas of both of the landing sites.

3.4 *GAZETTED BATHING BEACHES*

There is a gazetted bathing beach, the Butterfly Beach which is approximately 370 m from the landing point of the proposed 132kV submarine cable.

3.5 *MARINE PARK OR MARINE RESERVES*

The Sha Chau and Lung Kwu Chau Marine Park is located approximately 5.5 km from the closest part of the proposed cable route.

3.6 *FISH CULTURE ZONES*

The closest Fish Culture Zone (FCZ) is Ma Wan FCZ which is situated over 9 km from the proposed cable route.

3.7 *SEAWATER INTAKE POINT*

There are six seawater intakes in the vicinity of the proposed cable route. These are, Airport intakes, Castle Power Station intake, Tuen Mun Area 38 intake, Shiu Wing Steel Mill intake and Tuen Mun WSD intake. The closest seawater intake to the cable route is the Airport intake (north), which is approximately 270 m from the closest segment of the cable route.

4 POSSIBLE IMPACTS ON THE ENVIRONMENT

4.1 SUMMARY OF POTENTIAL ENVIRONMENTAL IMPACTS

The construction impacts associated with the proposed 132kV submarine cable are summarized in *Table 4.1* and are described in further detail in the following *Sections*. There are no environmental impacts that are expected to occur during the operation of the submarine cable system.

Table 4.1 Potential Sources of Environmental Impacts (Construction)

Potential Impact	
• Dust	✗
• Noise	✓
• Liquid Effluents, Discharges, or Contaminated Runoff	✗
• Generation of Waste or By-products	✓
• Disruption of Water Movement or Bottom Sediment	✓
• Unsightly Visual Appearance	✗
• Cultural & Heritage	✗
• Ecological Impacts:	
- Terrestrial	✗
- Marine	✓
- Fisheries	✓
• Gaseous Emissions	✗
• Odour	✗
• Night-time Operations	✗
• Traffic Generation	✗
• Manufacturing, Storage, Use, Handling, Transport, or Disposal of Dangerous Goods	✗
• Hazardous Materials or Wastes	✗
• Risk of Accidents Which Result in Pollution or Hazard	✗
• Disposal of Spoil Material, Including Potentially Contaminated Materials	✓

Notes: ✓ = Potential to result in impacts

✗ = Not expected to result in impacts

The environmental sensitive receivers in the vicinity of the cables are shown in *Figure 1.2*.

4.2 NOISE

Noise Sensitive Receivers are not close to the Project works sites and the land based works are expected to be small in scale, in the order of minor public utility works. Thus noise generated during construction of the cable landing sites and associated manholes are not expected to result in impacts to sensitive receivers. The nearest Noise Sensitive Receiver (NSR) is Melody Garden which is located over 850 m from the closest cable segment.

During the cable laying process, only minimal noise will be generated from the barge and cable laying equipment. This is considered to be similar to that of existing marine traffic in the area and will not impact Noise Sensitive Receivers. On this basis, no direct or indirect adverse noise impacts will result from this Project.

4.3 *WATER QUALITY*

4.3.1 *Land-Based Activities*

The potential for impacts to water quality during the land based activities, involving cable installation and construction of the manholes, primarily relate to surface water run-off. However, the following measures will be incorporated into the land based construction activities to prevent any adverse impacts to water quality.

- stockpiles of materials will be covered with tarpaulin or similar fabric to minimise runoff during the rainy season;
- care will be taken during the cable landing and construction to avoid any spillage of materials to the adjacent marine waters and to ensure that spoil materials are not discharged into adjacent waters; and
- all construction waste will be handled and disposed of in accordance with the *Waste Disposal Ordinance*.

The above measures will be sufficient to prevent adverse impacts to water quality during the shore based construction activities. Therefore, there are no predicted adverse impacts (either direct or indirect) to water quality from the shore based construction activities.

4.3.2 *Marine-Based Activities*

The marine based construction activities involve burying the cables below the existing sea bed. The cables will be buried up to 5 m below the existing seabed by simultaneously laying and burying the cable using a water jetting burial machine. The burial depth less than 3 m is necessary to provide protection to the cables. The machine liquefies the seabed sediments through the use of water jets which allow the cable to be laid into the seabed to the desired burial depth. The cables are expected to be installed over an approximate 4 week period. The maximum speed during cable laying will be approximately 1 km day^{-1}.

Cable laying will result in the formation of an area of relatively concentrated suspended sediment around the cable burial machine, which will remain close to the seabed and settle out quickly. The sediment disturbed during cable laying will remain in suspension for a very short period of time, and hence the potential for the release of any contaminants from seabed sediments and exertion of an oxygen demand on the receiving waters will be limited and is not expected to cause adverse impacts to water quality.

Analysis of the potential transport of fine sediments suspended in the water column was undertaken and it was determined that the maximum distance of transport for the suspended sediments would be approximately 206 m (see *Annex A*).

During cable installation at the shore ends, suspended solids will be released into the water column during dredging works and, to a much lesser extent, during backfilling. Analysis of the potential transport of sediment predicts that with the implementation of silt curtains, elevated concentrations in excess of 10 mg L^{-1} will only occur within 200 m and 70 m of the dredging operation at the shore ends of Tuen Mun and the Airport respectively. Given the short construction programme it is clear that impacts to water quality associated with the dredging work at the shore ends will be of short duration and of low severity.

No long term disruption to bottom sediment will occur and no disruptions to water movement will result from this Project. No adverse impacts to water quality are predicted to occur during or after the marine works. Water quality monitoring will be undertaken to verify the predictions concerning sediment plume dispersion during dredging at the landing sites.

4.4 WASTE MANAGEMENT

During the cable landing work, no waste material will be generated at the sites, other than general construction waste materials, which will be handled and disposed of in accordance with the *Waste Disposal Ordinance*.

The cable circuit will be laid under the seabed by a combination of jetting (along the seaward section) and dredging (at landing sites only). Only dredging will generate marine sediments which require disposal and it is estimated that approximately 50,000 m^3 of these materials will need to be dredged at the landing sites. The EPD data show that the sediment of the study area are not classed as contaminated (discussed in *Annex A*). In order to confirm and provide an indication of the quality of the sediment and the volumes of different types of sediment to be dredged, marine sediment sampling and testing will be undertaken by the Project Proponent prior to the commencement of the dredging activities. The sediment sampling programme (including the sampling stations, the chemical analysis suite and the biological testing programmes) will be developed based on the guidelines described in *ETWBTC 34/2002*. After carrying out the sampling and testing, a *Sediment Quality Report* (SQR) will be prepared for EPD approval as required under the *Dumping at Sea Ordinance*. The SQR will include the sampling details, the chemical testing results, quality control records, proposed classification and delineation of sediment according to the requirements of the Appendix A of *ETWBTC 34/2002*. The final disposal site will be determined by the Marine Fill Committee and a dumping licence will be applied from EPD prior to the commencement of the dredging works. With the implementation of the above mentioned procedures, no adverse waste impacts (either direct or indirect) will be generated from cable installation works and construction of the cable manholes.

4.5 *DISRUPTION OF WATER MOVEMENT OR BOTTOM SEDIMENT*

There will be no disruption of water movement and only minor disruption of bottom sediment during construction of the cable. There will be no disturbance during operation of the cable.

4.6 *LANDSCAPE AND VISUAL*

Since the cable conduits will be underground and the submarine cables are buried in the seabed, no visual obstructions or inconveniences to the public are expected to occur.

4.7 *TERRESTRIAL ECOLOGY*

The cable landing sites are situated on beaches which hold no important terrestrial ecological resources. Low terrestrial ecological impacts are expected due to the generally low ecological value of the habitats affected, the absence of flora or fauna of conservation significance, and the small scale of the proposed development. No impacts to terrestrial ecology will arise from this Project.

4.8 *MARINE ECOLOGY*

A review of the baseline marine ecological conditions of the north Lantau waters in the vicinity of the proposed submarine cable alignment and landing point have been undertaken. All of the identified ecological sensitive receivers were located at least 4 km from the proposed cable route (*Figure 1.2*). The predicted elevations of suspended sediment from the dredging works at Tuen Mun and the Airport and cable laying across to Urmston Road are not predicted to exceed the WQO (*Section 4.3.2*). The cable laying and dredging works are unlikely to affect the ecological resources due to the relative remoteness of the sensitive receivers from the proposed cable route and no predicted adverse impact to water quality or habitat loss.

It is emphasised that there are no predicted impacts to the Chinese White Dolphin, *Sousa chinensis* (*Annex B*). Impacts to the dolphins as a result of elevations of SS concentrations are generally associated with the potential influence on prey and, therefore, affect the animals indirectly. As impacts to fisheries resources are not expected to occur (discussed below), it is thus expected that unacceptable impacts to marine mammals arising from elevated SS levels will not occur. As discussed in *Annex A*, the EPD data show that the sediment of the study area are not classed as contaminated (no exceedance of Lower Chemical Exceedance Level), release of dissolved contaminants due to the dredging and jetting impact on the dolphins would not be expected to occur. In addition, increases in slow moving vessel traffic for the cable installation would be expected to pose a low / no risk of vessel collision on marine mammals. The vessels involved in the work do not generate significant amounts of underwater noise within the range that marine mammals are sensitive to. Consequently, underwater noise during the dredging and jetting works is not expected to adversely impact any dolphins that may be present in the vicinity of the works.

Despite the above, as a safeguard, a dolphin exclusion zone within a radius of 250 m from the cable laying vessel should be implemented during the construction phase. An exclusion zone of 250 m radius should be scanned around the work area for at least 30 minutes prior to the start of cable laying. If cetaceans are observed in the exclusion zone, cable installation works should be delayed until they have left the area. When dolphins are spotted within the exclusion zone, construction works will cease and will not resume until the observer confirms that the zone has been continuously clear of dolphins for a period of 30 minutes.

The implementation of good construction practices and a code of practice for dolphins should be checked as part of the environmental monitoring and audit procedures to evaluate whether there have been any effects on the animals during the construction period. No other ecology-specific measures are considered necessary.

4.9 FISHERIES

A review of the existing information on the fisheries resources and fishing operations surrounding the cable route has identified the area as a Spawning Ground of Commercial Fisheries Resources and supporting a fishery of medium ranking in terms of fisheries production.

The majority of the catches reported by fishermen operating in the waters are low value bottom dwelling crustaceans or small fast growing pelagic species of low commercial value. The closest Fish Culture Zone (FCZ) lies about 9 km from the proposed cable route, namely at Ma Wan and is too remote to be affected by the project (*Figure 1.2*). The Fishing Zones have, in general, been ranked as medium in comparison to other Fishing Zones in Hong Kong waters, in terms of fisheries production on a per hectare basis. There are no AFCD gazetted Fish Culture Zones within the vicinity of the proposed route.

Due to the proposed method of cable deployment and installation, no unacceptable impacts have been predicted to occur to fisheries resources or fishing operations. Any potential disturbances to the seabed will be minimal, localised and of a short duration. Information indicates that sediment dispersed by the cable laying will be of low concentration and localised in nature and is therefore not expected to result in any unacceptable impacts to water quality and subsequently fisheries resources or fishing operations.

No specific mitigation measures have been recommended as no impacts have been identified.

4.10 *CULTURAL HERITAGE*

No known heritage sites are identified to be impacted by the proposed cable alignment. No impacts to archaeological deposits are expected to arise due to the minimal amount of work required and the levels of existing disturbance in this area. The proposed cable alignment is small in scale and only creates minor disturbance to the terrain. Only small scale manhole construction would be undertaken at the beaches and will only involve excavation of shallow trenches. Therefore no impacts are expected to result to archaeological deposits.

An assessment of the potential marine archaeological resources of the project area was conducted based on a review of historical records, UK Wrecks database and the results of hydrographic and geophysical surveys of the proposed cable route corridor (*Annex C*). Although three seabed anomalies (sonar contacts) were found in the new cable corridor, two have been characterised as artificial reefs (10 & 40m east of the centre line), the third as debris (50m west of the centre line) and they are not expected to have any historical or archaeological significance.

The boomer survey however revealed 31 sub seabed anomalies and their character is unknown at this stage. All, many or some could be natural features or dumped materials. The surface of the seabed is characterised by a general distribution of debris and dumped materials which given the movement of sediments could now be below the seabed. It is recommended that further geophysical work be carried out to better interpret these 31 sub seabed anomalies before the cable installation works (refer to *Annex C*).

4.11 *OTHERS*

Gaseous Emissions: Only a small quantity of gaseous emissions (SO_2 and NO_x) from diesel-powered equipment would be generated during construction of the cable landing sites. These emissions will not impact Air Sensitive Receivers.

Odour: No odour impacts are expected to occur as a result of this Project.

Traffic Generation: Only minimal traffic is expected to be generated as a result of the Project and this will not generate significant noise or gaseous emissions.

Dangerous Goods: No dangerous goods will be involved in this Project.

Night-time Operations: It is expected that all cable laying and burial work will be performed within the inshore area during normal working hours. If works are proposed during the evening or night-time hours, a Construction Noise Permit will be applied for at the time.

Hazardous Materials or Wastes: No hazardous materials or wastes will be generated by this Project.

Risk of Accidents Resulting in Pollution or Hazard: No pollution or hazard generating accidents will result from this Project. The submarine cables use stable silicon optical fibres protected with multi-layers of corrosion resistant polyethylene and galvanized steel wires and are designed for a normal working life-time of more than 25 years in sea water. Therefore no pollution or hazard generation accidents are expected during either the construction or operation phase of the submarine cable.

Disposal of Spoil or Contaminated Material: The marine sediment quality will be determined and reported in a *Sediment Quality Report* and the final disposal site will be determined by the Marine Fill Committee. A dumping licence will be applied from EPD prior to the commencement of the dredging works. Background data from EPD indicates that the sediments that are required to be excavated are not contaminated.

5 PROTECTION MEASURES AND ANY FURTHER IMPLICATIONS

5.1 POSSIBLE SEVERITY, DISTRIBUTION AND DURATION OF ENVIRONMENTAL EFFECTS

The marine installation works for the submarine cable system are expected to take approximately 170 days. The residual environmental impacts of the works activities are predicted to be localised to the immediate vicinity of the cable alignment and of low severity and, hence are considered to be acceptable.

No environmental impacts are predicted during the operation of the submarine cable system.

5.2 CUMULATIVE IMPACTS

There are a number of concurrent projects within areas in the vicinity of the proposed cable route during the laying of the submarine cables. These projects include disposal of contaminated mud at the east of Sha Chau and Airport east, Permanent Aviation Fuel Facility (PAFF). The sediment disturbed during cable laying will remain close to the sea bed, and is predicted to remain in suspension for a very short period of time. Any sediment was predicted to settle onto the sea bed within 206 m of the cable route. Because of the small scale impact from the cable installation no cumulative impacts are predicted to occur with other concurrent projects.

5.3 FURTHER IMPLICATIONS

The geotechnical environment of the proposed landing points have been confirmed to be suitable for submarine cable landing by electronic surveys.

The methods used for burying the submarine cable system, as described above, have been used around the world for more than one century and are widely accepted to have no impact on the surrounding environment. The working period is very short and no waste or contaminant disposal issues or excessive noise will be generated by such an operation.

6 *ENVIRONMENTAL MONITORING & AUDIT*

Aside from the requirements to conduct water quality monitoring at the landing sites during dredging and dolphin monitoring during cable installation (as presented in *Annex D*), no other environmental monitoring and audit measures have been recommended as being necessary for this Project.

7 USE OF PREVIOUSLY APPROVED EIA REPORTS

In conducting this assessment ERM has made reference to similar projects that have received Environmental Permits, including:

- *Submarine Cable Landing Installation at Tuen Mun for HGC Optical Fibre Submarine Cable System Between Tuen Mun and Chek Lap Kok, Hutchison Global Crossing Limited.* The Project Profile for this study was submitted to EPD on 25 September 2001 (AEP-106/2001). The study concluded that there would be no adverse long term or cumulative effects/impacts to the environment and the Environmental Permit granted on 24 October 2001 (EP-106/2001). The Environmental Permit was then superseded by EP-106/2001/A. The alignment of the HGC cable system is located next to the proposed submarine cable circuit and the proposed methodology for the cable installation for this proposed project will be similar to the HGC cable system.

- *132kV Submarine Cable Installation for Wong Chuk Hang - Chung Hom Kok 132kV Circuits, Hongkong Electric Co Ltd (HEC).* The Project Profile for this study was submitted to EPD on 26 March 2002 (AEP-132/2002). The study concluded that there would be no adverse long term or cumulative effects/impacts to the environment and the Environmental Permit granted on 16 April 2002 (EP-132/2002). The proposed methodology for the cable installation for this proposed project will be similar to the HEC submarine cable circuits.

- FLAG *North Asian Loop*. The Project Profile for this Study was submitted to EPD in March 2001 (AEP-099/2001). The Study concluded that there would be no adverse long term or cumulative effects/impacts on the environment and the Environmental Permit was granted on 18 June 2001 (EP-099/2001)

- *New T&T Hong Kong Limited: Domestic Cable Route, New T&T*. The Project Profile for this Study was submitted to EPD in December 2000 (AEP-086/2000). The Study concluded that there would be no adverse long term or cumulative effects/impacts on the environment and the Environmental Permit was granted on 16 February 2001 (EP-086/2001).

- *C2C Cable Network – Hong Kong Section: Chung Hom Kok, GB21 (Hong Kong Limited).* The Project Profile for this Study was submitted to EPD in December 2000 (AEP-087/2000). The Study concluded that there would be no adverse long term or cumulative effects/impacts on the environment and the Environmental permit was granted on 16 February 2001 (EP-087/2001).

- *East Asian Crossing (EAC) Cable System (TKO), Asia Global Crossing.* The Project Profile for this Study was submitted to EPD on 11 August 2000

(AEP-081/2000). The study concluded that there would be no adverse long term or cumulative effects/impacts on the environment and the Environmental Permit was granted on 4 October 2000 (EP-081/2000).

- *East Asian Crossing (EAC) Cable System, Asia Global Crossing.* The Project Profile for this Study was submitted to EPD on 21 June 2000 (AEP-079/2000). The study concluded that there would be no adverse long term or cumulative effects/impacts on the environment and the Environmental Permit was granted on 6 September 2000 (EP-079/2000).

- *Submarine Cable Landing Installation in Tong Fuk Lantau for Asia Pacific Cable Network 2 (APCN 2) Fibre Optic Submarine Cable System, EGS.* The Project Profile for this study was submitted to the EPD in May 2000. The study concluded that there would be no adverse long term or cumulative effects/impacts to the environment and the Environmental Permit was issued on 26 July 2000 (EP-069/2000).

- *Telecommunication Installation at Lot 591SA in DD 328, Tong Fuk, South Lantau Coast and the Associated Cable Landing Work in Tong Fuk, South Lantau for the North Asia Cable (NAC) Fibre Optic Submarine Cable System.* The Project Profile for this study was submitted to the ePD in March 2000 (AEP-064/2000). The study concluded that there would be no adverse long term or cumulative effects/impacts to the environment and the Environmental Permit was granted in June 2000 (EP-064/2000).

- *Cable Landing Work in Deep Water Bay for SEA-ME-WE 3 Fibre Optic Submarine Cable System, Hong Kong Telecom.* The Project Profile for this study was submitted to the EPD in May 1998 (AEP-001/1998). The study concluded that there would be no adverse long term or cumulative effects/impacts to the environment. The Environmental Permit was granted July 1998 (EP-001/1998).

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附件 ***A*** *水質*
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1　　基本資料

1.1　　工程項目名稱

擬敷設 132 千伏青山發電站至機場'A'變電站電纜線路之海底電纜分段

1.2　　工程項目的目的和性質

中華電力有限公司（以下簡稱「中電」）建議敷設一套 132 kV 的海底電纜系統，從青山發電廠連接至香港國際機場，以便配合香港國際機場日益增長的電力需求。

由於有各種限制（如泥坑和現有海底公共設施），屯門至機場之間可以鋪設海底電纜的路線非常有限。建議的電纜鋪設路線位於中電現有的 132 kV 海底電纜和和記環球電訊有限公司（以下簡稱「和記環球電訊」）的海底光纖電纜系統之間，並與兩者保持平行（*圖 1.1*）。

中電建議的屯門登岸地點位於蝴蝶灣泳灘邊界及和記環球電設現有海底電纜以西。至於機場方面的登岸地點，則建議利用機場平台北面海堤下的現有電纜導槽。

本工程項目簡介包括這項海底電纜敷設工程對環境可能造成的影響評估。這項評估是基於工程項目倡議者就預計的施工活動所整理的資料而作出。這套電纜系統在裝設完成後，電纜的運作不會對環境造成任何影響。

1.3　　工程項目倡議人名稱

九龍
福華街 215 號
深水埗中心六樓
中華電力有限公司工程項目部

電話： 2678 6524
傳真： 2678 6819

1.4　　工程項目的地點及規模

1.4.1　　位置

電纜的登岸點會位於屯門蝴蝶灣泳灘以西，及香港國際機場的北部（見*圖 1.1*）。建議的電纜路線從屯門開始，向南橫過龍鼓水道直至機場。

1.4.2 工地簡史

在屯門方面的登岸位置設在蝴蝶灣泳灘邊界以西。建議的電纜路線將會與兩條現有的海底電纜平行伸延。現時屯門有兩個相若的海底電纜登岸點，位於建議登岸點東面約 100 米和西面約 150 米，分別由和記環球電訊於 2002 年和中電於 2003 年建造。至於機場方面，建議電纜會透過中電於九十年代於機場北面海堤下建造的現有電纜導槽登岸。擬議橫過龍鼓水道的一段 132kV 海底電纜鋪設路線附近的海床，曾受挖沙和卸泥活動滋擾。

1.4.3 工程項目規模

本工程項目將會敷設一組 132kV 的電纜，預計掩埋深度最深至 5 米（靠近登岸點的一段因爲受到海床限制，保護層的覆蓋會少於 5 米）。電纜的總長度約爲 6.2 公里。

電纜鋪設工程只需在海洋環境中進行少量工程，並不會對該區的水質或海洋生態造成不良影響。把海底電纜連接至陸地電纜（地底）亦只需在屯門進行小規模的建造工程。

1.5 電纜鋪設路線篩選過程

1.5.1 篩選登岸地點

登岸地點是按照下列準則作出篩選（*圖 1.2*）。

- 盡量避開海水進水口。
- 盡量避開泳灘。
- 盡量避開具保育價值的地點。
- 選擇技術上可行的地區（即有軟泥的地區，以及利用機場現有的纜槽），藉此減低建造難度。

1.5.2 海底路線之規劃考慮

建議中 132kV 電纜的鋪設路線受到一些現存的地理及環境限制，因而局限了可選擇的路向。在選擇鋪設路線時，已盡可能迴避下列各項限制：

- 盡量減少橫過或貼近龍鼓水道內的現有海底電纜或其他海底公共設施，以確保電纜鋪設工作不會干擾現有海底設施。
- 迴避卸泥區和海沙沉積區。
- 迴避人工魚礁的所有結構。

- 迴避沉積層淺薄的地區，以便達到規劃所要求的 5 米最佳掩埋深度。

除了迴避上述各項限制外，亦考慮了下列準則：

- 爲了能夠同時進行電纜掩埋／鋪設工作，電纜的延伸路向需避免出現急彎，並盡可能令鋪設路線保持筆直。
- 盡量縮小電纜與海堤的交接面（盡量令電纜垂直地通過海堤）。
- 選擇最短的電纜鋪設路線，務求盡量減少電纜對環境和海運交通可能造成的不良影響。

1.6 *工程項目簡介內所包括的指定工程項目*

根據*《環境影響評估程序技術備忘錄》*（以下簡稱「環評技術備忘錄」）的規定，這個工程項目屬於符合下列條文的指定工程項目：

附表 2（第 I 部份）之 C.12 項－挖泥作業

(a) *距離一個現有或計劃中的(vi)泳灘的最近界線少於 500 米。*
(vi) 泳灘

1.7 *聯絡人姓名及電話號碼*

香港環境資源管理顧問有限公司受中電委託，負責爲這個工程項目申領環境許可證的事宜。

有關是項工程的查詢，可與下列人士聯絡：

九龍
福華街 215 號
深水埗中心六樓
中華電力有限公司
工程項目部

電話：2678 6524
傳真：2678 6819

聯絡人：劉永強先生 – 高級線路項目工程師

2 計劃大綱及計劃的執行

2.1 工程之規劃及實施

這個項目會進行下列工程：

- *岸端電纜鋪設工程*－靠近屯門岸邊的電纜會鋪設於預先挖成，深度不超過 5 米的纜槽內，再加以回填。這項工程主要由一個單抓斗挖泥機，以典型的 11 立方米的抓斗進行。若遇到任何基岩，便會進行鑿石工程。在機場登岸點的海泥會以抓斗（方法如上）及／或吸管挖走，然後以挖出的物料回填。在進行吸管挖泥工程時，會以一條直徑 22 吋的鋼質硬管，從挖泥船伸展至指定位置把海泥吸起，並輸送至停泊於挖泥船旁的泥艙船上收集。這段電纜（直徑約爲 150 毫米）會由一艘停舶於距離海堤約 100 米處的建築躉船進行鋪設（於近岸水面操作）。電纜的末端會在潛水員引導下，進入位於海堤地基處的現有纜槽入口，再以人手或絞盤拖曳。然後，電纜會與海床纜槽入口的固定裝置連接，並由潛水員安放於海床上後，才開始朝離岸方向鋪設電纜。預計無論是抓斗式或吸管式挖泥船的挖泥速度都不會超過每日 1,500 立方米。據估計，在兩個登岸點所挖出的物料總體積不會超過 50,000 立方米。

- *電纜鋪設方法*－建議的 132kV 海底電纜主要以水力噴注式掩埋機同時進行鋪設和掩埋。掩埋機所噴出的水柱會把海床上的沉積物沖開，讓電纜可以被安放在海床上所需要的掩埋深度下。

  預計該電纜大部份都會被掩埋在海床下約 5 米的深度。在掩埋深度較淺（3 米）的地區，需要爲電纜加上覆蓋保護層，例如混凝土板及／或對開的鐵管。

預計所有近岸和岸上的建造工程都會在正常工作時間（早上七時至晚上七時）內進行。假若日後需要在黃昏或晚間施工，工程倡議者會申請建造噪音許可證。

2.2 工程計劃

這組 132kV 電纜預算會在 2007 年中安裝完成，並在屯門和機場登岸。預計施工時間表如下：

登岸地點準備工程及電纜登岸工程 （於屯門及機場）	約 8 星期
電纜安裝工程	約 4 星期
電纜安裝後保護工程	約 6 星期

3 周圍環境的主要要素

電纜沿線地區的主要要素均展示於*圖 1.2*。

3.1 陸上及海底工程

3.1.1 登岸地點

屯門

登岸地點位於屯門蝴蝶灣的已刊憲泳灘西面。

香港國際機場

登岸地點位於機場東北面，附近的海岸均屬禁區。

3.1.2 海運航線及航道

建議中的電纜裝設路線會穿越一條主要航道，即龍鼓水道。

3.1.3 海底電纜、管道及渠口

建議中的電纜裝設路線的東面和西面都有多項海底公共設施。建議中的電纜鋪設路線位於中電現有的 132 kV 海底電纜及和記環球電訊有限公司的海底光纖電纜系統之間，並與兩者保持平行。

3.1.4 已刊憲及現有的海事設施

在建議中的電纜鋪設路線東面是屯門危險品碇泊處、未受污染淤泥卸置區和海沙沉積區；西面則是已受污染淤泥卸置地點。建議中的電纜鋪設路線中約有一半位於已刊憲的挖沙區和卸泥區。預料這些地區的海床已經受到一定程度滋擾。建議電纜鋪設路線的南端靠近一組人工魚礁（80 米），但該路線肯定不會對人工魚礁的結構造成實質影響。

3.2 具特殊科學價值地點

最接近的具特殊科學價值地點是位於屯門登岸地點北面超過 1.7 公里的青山具特殊科學價值地點和青山村具特殊科學價值地點，以及位於機場登岸地點以南超過 4 公里的石散頭具特殊科學價值地點、大蠔涌、薄刀屻和婆髻山具特殊科學價值地點。龍鼓洲、白洲及沙洲具特殊科學價值地點距離屯門至機場的建議鋪設電纜路線超過 6.5 公里。除了石散頭具特殊科學價值地點和龍鼓洲、白洲及沙洲具特殊科學價值地點外，上述各個具特殊科學價值地點均位於陸上，因此預計不會受到是項工程影響。

3.3 *文物古蹟遺址*

無論在建議中的電纜鋪設路線或兩個登岸地點附近地區，都沒有任何已公布或將公布的古蹟，或任何已被評級或已作記錄的文物。

3.4 *已刊憲之泳灘*

在建議中的 132kV 海底電纜登岸地點附近只有蝴蝶灣一個已刊憲的泳灘，它距離登岸點約 370 米。

3.5 *海岸公園或海岸保護區*

沙洲及龍鼓洲海岸公園距離建議中的電纜鋪設路線最近的部份約 5 公里。

3.6 *魚類養殖區*

最近的魚類養殖區是馬灣，距離建議中的電纜鋪設路線超過 9 公里。

3.7 *海水進水口*

建議中的電纜鋪設路線附近有六個海水進水口，包括：機場進水口、青山發電廠進水口、屯門 38 區進水口、紹榮鋼鐵廠進水口及屯門水務署進水口。最接近電纜走廊的海水進水口是機場進水口（北），與電纜走廊最短的距離約爲 270 米。

4 *對環境可能造成的影響*

4.1 *潛在環境影響摘要*

建議鋪設的 132kV 海底電纜在施工時可能造成的影響均羅列於*表 4.1*，並會在下文詳細闡述。這條海底電纜在運作期間不會對環境造成任何影響。

表 4.1 *環境影響之可能來源（施工階段）*

潛在影響	
• 塵埃	×
• 噪音	✓
• 污水、排水或受污染之徑流	×
• 產生廢物或副產品	✓
• 水流或海底沉積物受干擾	✓
• 不悅目之外貌	×
• 古蹟文物	×
• 生態影響：	
- 陸上	×
- 海洋	✓
- 漁業	✓
• 廢氣排放	×
• 氣味	×
• 夜間操作	×
• 新增交通	×
• 危險物品之製造、存放、使用、處理、運輸或棄置	×
• 有害物料或廢物	×
• 導致污染或危險之意外	×
• 廢料（包括可能已受污染之物料）之棄置	✓
附註：　✓ = 可能造成影響，　× = 預計不會造成影響	

圖 1.2 所示，是這條電纜附近對環境敏感的地點。

4.2 噪音

噪音敏感受體並不接近工程地點，而且預期陸上工程的規模細小，只會進行小型的公共設施工程。因此，預計在建造電纜登岸地點和相關沙井時所產生的噪音，將不會影響噪音敏感受體。最接近的噪音敏感受體是美樂花園，與電纜最接近的距離超過 850 米。

在鋪設電纜期間，只有躉船和電纜鋪設器材會產生輕微噪音。這些噪音與區內的現有海上交通相若，因此不會影響噪音敏感受體。有鑑於此，這項工程不會造成直接或間接的不良噪音影響。

4.3 水質

4.3.1 陸上工程

對水質可能造成的影響主要是透過進行陸上工程時產生的地面徑流造成，這些工程包括裝設電纜和建造沙井等陸上工程。然而，下列措施會被納入各項陸地建造工程中，以防止對水質造成不良影響。

- 物料堆會以帆布或相近的織物覆蓋，藉以減少雨季時所產生的徑流。
- 在進行電纜登岸和建造工程時將會特別小心，以免物料溢進附近海水中，並確保不會把廢料排入附近海域；及
- 所有建造廢物的處理和棄置，都會按照*《廢物處置條例》*的規定。

上述措施將足以防止岸上的施工活動對水質造成的不良影響。因此，預計岸上的施工活動將不會對水質造成不良影響（無論是直接或間接影響）。

4.3.2 海底工程

海底的施工活動包括把電纜掩埋於現有海床下。海底電纜會以水力噴注式掩埋機進行鋪設，並同時掩埋於現有海床下 5 米深的地方。掩埋深度不足 3 米的電纜需要加上保護層。掩埋機所噴出的水柱會把海床上的沉積物沖開，讓電纜可以被掩埋在海床下所需要的深度。預計安裝電纜需時約 28 天。鋪設電纜的最高速度約爲每日 1 公里。

電纜鋪設工程會在電纜掩埋機四周形成一個懸浮沉積物濃度較高的區域。這些懸浮沉積物會貼近海床，並會迅速降回海床上。在鋪設電纜時受到滋擾的沉積物只會在一段很短的時間內呈懸浮狀態，因此，海床釋出受污染物質和令附近海水的需氧量增加的可能性很有限，所以預計水質不會受到不良影響。

經分析後確定，懸浮沉積物可能出現的漂移的最遠距離約爲 206 米（見*附件 A*）。

在裝設岸端電纜而進行挖泥工程時，會把懸浮固體釋放至水中；而在回填時亦會如此，但數量則會較少。對沉積物可能漂移情況所進行的分析顯示，在裝設擋泥圍幕後，只有在屯門和機場兩個岸端挖泥地點 200 米至 70 米範圍內的沉積物濃度會超過每公升 10 毫克。由於施工期較短，岸端挖泥工程只會對水質造成短暫和輕微的影響。

這項工程不會對海底沉積物造成長遠干擾，亦不會干擾水流。預計在海底工程進行期間或之後，都不會對水質造成不良影響。工程倡議者會進行水質監察，以便對登岸地點挖泥工程所產生的沉積物卷流的擴散情況預測加以驗證。

4.4 *廢物管理*

電纜登岸工程除了會產生一般建造廢物外，不會在工地產生其他廢物。工程所產生的一般建造廢物會按照*《廢物處置條例》*的規定加以處理和棄置。

海堤下的電纜鋪設會結合水力噴注法（沿海堤的一段使用）和挖泥法（只在登岸地點使用）。只有挖泥工程會產生需要棄置的海洋沉積物，而估計在兩個登岸地點共需挖走的沉積物約爲 50,000 立方米。根據環保署的資料，研究區內的沉積物並非已受污染的類別（於*附件 A* 探討）。爲了證實和顯示沉積物的質量，以及需要挖掘的不同種類沉積物的數量，工程項目倡議者會在展開挖泥工程前，對海洋沉積物抽取樣本並加以化驗。工程項目倡議者會根據環境運輸及工務局技術通告 34/2002 號所闡述的指引，擬訂沉積物樣本收集計劃（包括樣本收集站、化學分析的內容和生物化驗計劃）。在進行樣本收集和化驗後，會按照「海上傾倒物料條例」的規定，草擬一份「沉積物質量報告」，並提交予環保署批准。這份沉積物質量報告會包括收集樣本的詳情、化學檢驗結果、品質控制記錄，以及按照「環境運輸及工務局技術通告 34/2002 號」*附件 A* 的要求來建議沉積物的類別和描述。最終的棄置地點會由海洋填料委員會決定。在進行挖泥工程前，亦會向環保署申請一份傾倒執照。在實施上述程序後，電纜鋪設工程和電纜沙井建造工程將不會產生不良的廢物影響（無論是直接或間接影響）。

4.5 *水流或海底沉積物之干擾*

無論在電纜的安裝或使用階段，此工程都不會干擾水流或海底沉積物。然而，在使用噴注器鋪設 132kV 海底電纜時，海底沉積物會被暫時沖開。不過，在電纜鋪設工作完成後，這些沉積物會自然地重新沉積。

4.6 景觀及視覺影響

由於電纜管道將會埋於地底，而海底電纜則會埋於海床下，因此預計不會造成任何視覺上的障礙，或對公眾構成不便。

4.7 陸地生態

兩個電纜登岸地點均位於沒有任何重要陸地生態資源的海灘上。由於受影響的生境一般都只具有偏低的生態價值，而且當地沒有具保育價值的植物或動物，再加上這個建議發展項目規模細小，因此預計陸地生態只會受到偏低的影響。這項工程不會影響陸上生態。

4.8 海洋生態

顧問對建議海底電纜鋪設路線附近的北大嶼山海域和電纜登岸點，都進行了基線海洋生態情況檢討。所有已知的生態環境敏感受體均距離建議電纜鋪設路線最少 4 公里（*圖 1.2*）。根據預測，在屯門和機場進行的挖泥工程，以及橫過龍鼓水道的電纜鋪設工程所造成的懸浮沉積物的增加，均不會超過水質指標（參閱*第 4.3.2 節*）。由於對水質敏感的受體遠離建議電纜鋪設路線，而且根據預測，水質不會受到不良影響，亦不會有生境受損，因此，電纜鋪設工程和挖泥工程都不會影響生態資源。

應予強調的是，預計這項工程不會影響中華白海豚（*Sousa chinensis*）（見*附件 B*）。懸浮固體濃度增加對海豚的影響通常都是因爲海豚的獵物受到影響而造成，因此對海豚而言屬間接影響。由於漁業資源預計不會受到影響（於下文探討），因此，海洋哺乳類動物亦不會因爲懸浮固體濃度增加而受到不可接受的影響。一如*附件 A* 所述，環保署的資料顯示研究區內的沉積物並非已受污染的種類（沒有超過最低化學超標水平），因此預計，海豚不會因爲挖泥和噴注工程釋出已溶解污染物而受到影響。此外，由於鋪設電纜的工程船隻移動緩慢，預計這類船隻碰撞海洋哺乳類動物的風險屬偏低或不存在。這項工程所使用的船隻都不會顯著地產生海洋哺乳類動物所敏感的水底噪音。因此，預計挖泥工程和噴注工程所產生的水底噪音都不會對工程地區附近的海豚造成不良影響。

縱然如此，仍應於施工階段內，把電纜鋪設船隻四周 250 米的範圍劃爲海豚禁入區以作預防。在開始進行電纜鋪設前，應該在該區內搜尋最少 30 分鐘。若在區內發現海豚，便應延遲進行電纜鋪設工程，直至牠們離開該區爲止。若在施工時於區內發現海豚，便會停止施工，直至觀察員確定區內持續 30 分鐘沒有再發現海豚爲止。

應該對良好施工方法和保護海豚守則的實施情況加以核查，作爲環境監察與審核程序的其中一環，藉以評估這些動物在施工期間是否受到任何影響。除此之外，無需進行其他生態影響緩解措施。

4.9 漁業

根據現有的漁業資源和電纜鋪設路線附近捕漁作業的資料，這一地區是商業漁業資源的繁殖場，其產量屬中等。

據在該水域作業的漁民報稱，該處大部份漁獲都屬低價值的底棲甲殼類動物，或只具低商業價值的細小而生長迅速的品種。最近的魚類養殖區是馬灣，距離建議電纜鋪設路線超過 9 公里。由於距離較遠，不會受這項工程影響（*圖 1.2*）。若與香港其捕漁區比較，這個捕漁區的每公頃漁獲量只屬中等。建議海底電纜鋪設路線附近沒有漁農自然護理署的已刊憲魚類養殖區。

鑑於建議採用的電纜佈置及安裝方法，預計漁業資源和捕漁作業都不會受到不可接受的影響。這項工程對海床可能造成的任何滋擾，都只會是輕微、局部和短暫的。資料顯示，由電纜鋪設工程所漂散的沉積物濃度會偏低，並屬局部性質，因此預計不會對水質造成任何不可接受的影響，故此亦不會影響漁業資源和捕漁作業。

由於沒有發現任何影響，因此無需建議實施特定緩解措施。

4.10 古蹟文物

建議電纜鋪設路線不會影響任何已知的古蹟文物遺址。由於是項工程規模很小，而且這區亦曾受干擾，因此預計是項工程不會影響考古遺蹟。建議敷設的電纜規模細小，只會對地形造成輕微影響。將會在沙灘上進行的沙井建造，規模亦屬細小，而且只需挖掘很淺的槽溝。因此，預計不會對考古遺蹟造成影響。

顧問根據歷史記錄、英國的遺蹟數據庫，以及建議中的電纜鋪設路線走廊的水文和地質調查結果，對工程地區的海洋考古資源潛力進行了評估。雖然在新電纜走廊內的海床發現三個異常位置（聲納接觸點），但其中兩個已被界定為人工魚礁（中心線以東 10 米及 40 米），而第三個則屬碎屑（中心線以西 50 米），預計都沒有任何歷史或考古價值。

然而，水文及地質調查卻在海床下發現 31 個異常位置，而現階段亦未能確定它們的性質。當中全部，或有很多，或只有部份是天然物質或被傾倒的物貨。海床表面通常都有不少碎物和被傾倒的物質。根據沉積物的移動情況，這些碎物和被傾倒的物質可能已被覆蓋在海床下。建議在進行電纜鋪設工程前，先進行深入的地質探討，務求解釋該 31 個異常地方（*參考附件 C*）：

4.11 其他

廢氣排放：在建造電纜登岸地點時，只有柴油發動的設備產生小量廢氣（二氧化硫和氧化氮）。這些廢氣不會影響對空氣質素敏感的受體。

氣味：預計是項工程不會造成氣味影響。

新增交通：預計是項工程只會產生極小量交通，因此不會產生顯著的噪音或廢氣。

危險物品：是項工程不會涉及任何危險物品。

夜間操作：預計所有電纜鋪設和掩埋工作都會在正常工作時段內，在近岸地區進行。若需要在黃昏或晚間施工，工程倡議者會申請建造噪音許可證。

有害物料或廢物：是項工程不會產生任何有害物料或廢物。

導致污染或危險之意外：　這項工程不會造成任何可導致污染或危險的意外。海底電纜是採用穩定的硅質光學纖維製成，並以多層抗腐蝕的聚乙烯和鍍鋅鋼線加以保護，設計上可以在海水中正常使用超過 25 年。因此預計，這條海底電纜無論在施工或運作階段，都不會造成可導致污染或危險的意外。

廢料或受污染物料之棄置：工程倡議者會確定海洋沉積物的質量，並在「沉積物質量報告」中匯報，然後由海洋填料委員會決定最終棄置地點。工程倡議者會在進行挖泥工程前向環保署申請傾倒物料執照。根據環保署的背景資料，需要挖出的沉積物未受污染。

5 保護措施及其他有關事項

5.1 環境影響的可能嚴重程度、分布及持續時間

預計海底電纜的海底鋪設工程需時約 170 天。這些工程可能產生的剩餘影響只會局限在電纜沿線的近鄰區域，其嚴重程度亦屬偏低，因此會在可接受範圍內。

預計該海底電纜系統在運作時，不會對環境造成影響。

5.2 累積影響

在海底電纜鋪設期間，有多項其他工程在建議電纜鋪設路線附近同期進行。這些工程包括在沙洲以東，以及在機場東面的永久飛機燃料設施卸置已受污染淤泥。在鋪設電纜時受干擾的沉積物會留在貼近海床的地方，而且預計只會於極短時間內保持懸浮狀態。預計所有沉積物都會在距離電纜沿線 206 米的範圍內沉回海床。因爲電纜只會引致輕微影響，是項工程不會與其他同期進行的工程造成累積影響。

5.3 其他事項

以電子儀器進行的土力勘察結果證實，建議登岸點的土力環境適宜海底電纜登岸。

上文所闡述的海底電纜系統掩埋方法，已經在世界各地使用超過一個世紀，並被廣泛認爲不會影響附近環境。這項工作需時很短，而且不會產生需要處置的廢物或污染物，亦沒有超過標準的噪音。

6　環境監察與審核

除了需要在挖泥時於電纜登岸地點進行水質監察，以及在鋪設電纜時監察海豚外（見*附件 D* 的闡述），是項工程無需實施其他環境監察與審核措施。

7 已獲通過之環境影響評估報告之使用

近期在香港特區內進行的類似工程有下列各項：

- *和記環球電訊有限公司於屯門與赤鱲角之和記海底電纜系統屯門登岸設施光纜鋪設工程*。該項計劃的工程項目簡介於 2001 年 9 月 25 日提交環保署 (AEP-106/2001)，其研究結果指出，該項計劃並不會對環境造成長遠或累積性的不良影響。該項計劃已於 2001 年 10 月 24 日取得環境許可證 (EP-106/2001)。其後，該許可證由 EP-106/2001/A 取代。該個和記環球電訊電纜系統位於擬議鋪設的海底電纜旁，其鋪設方法與是項工程的擬用方法相似。

- *香港電燈有限公司（以下簡稱「港燈」）之黃竹坑 – 舂坎角 132kV 電路之 132kV 海底電纜鋪設工程*。該項計劃的工程項目簡介於 2002 年 3 月 26 日提交環保署 (AEP-132/2002)，其研究結果指出，該項計劃並不會對環境造成長遠或累積性的不良影響。該項計劃已於 2002 年 4 月 16 日取得環境許可證 (EP-132/2002)。是項計劃擬用的電纜鋪設方法與港燈海底電纜所用的方法相似。

- *FLAG 北亞光纖電纜系統*。該項計劃的工程簡介於 2001 年 3 月提交環境保護署（AEP-099/2001），其研究結果指出，該項計劃並不對環境造成長遠或累積性的不良效果／影響。該項計劃已於 2001 年 6 月 18 日取得環境許可證（EP-099/2001）。

- *新電訊之香港新電訊有限公司：本地通訊電纜*。該項計劃的工程簡介於 2000 年 12 月提交環境保護署（AEP-086/2000），其研究結果指出，該項計劃並不會對環境造成長遠或累積性的不良效果／影響。該項計劃已於 2001 年 2 月 16 日取得環境許可證（EP-086/2001）。

- *GB21（香港有限公司）之 C2C 電纜網絡 – 香港段：舂坎角*。該項計劃的工程簡介於 2000 年 12 月提交環境保護（AEP-087/2000），其研究結果指出，該項計劃並不會對環境造成長遠或累積性的不良效果／影響。該項計劃已於 2001 年 2 月 16 日取得環境許可證（EP-87/2001）。

- *Ease Asian Crossing (EAC)之東亞通訊電纜系統（TKO 段）*。該項計劃的工程簡介於 2000 年 8 月 11 日提交環境保護署（AEP-081/2000），其研究結果指出，該項計劃並不會對環境造成長遠或累積性的不良影響。該項計劃已於 2000 年 10 月 4 日取得環境許可證（EP-081/2000）。

- *East Asian Crossing (EAC)之東亞通訊電纜系統*。該項計劃的工程簡介於 2000 年 6 月 21 日提交環境保護署（AEP-079/2000），其研究結果指出，該項計劃並不會對環境產生長遠或累積性的不良影響。該項計劃已於 2000 年 9 月 6 日取得環境許可證（AEP-079/2000）。

- *EGS 之亞太通訊電纜網二號海底光纖電纜系統於大嶼山塘福之海底訊電纜登岸設施工程*。該項計劃的工程簡介於 2000 年 5 月提交環境保護署，其研究結果指出，該項計劃並不會對環境產生長遠或累積性的不良影響。該項計劃已於 2000 年 7 月 26 日取得環境許可證（EP-069/2000）。

- *位於大嶼山南岸塘福第 328 號約第 591SA 地段之北亞海底光纖通訊電纜系統遠程通訊設施及相關之電纜登岸工程*。該項計劃的工程簡介於 2000 年 3 月提交環境保護署（AEP-064/2000），其研究結果指出，該項計劃並不會對環境產生長遠或累積性的不良影響。該項計劃已於 2000 年 6 月取得環境許可證（EP-064/2000）。

- *香港電訊公司之 SEA-ME-WE3 海底光纖電纜系統深水灣登岸工程*。該項計劃的工程簡介於 1998 年 5 月提交環境保護署（AEP-001/1998），其研究結果指出，該項計劃並不會對環境產生長遠或累積性的不良影響。該項計劃已於 1998 年 7 月取得環境許可證（EP-001/1998）。

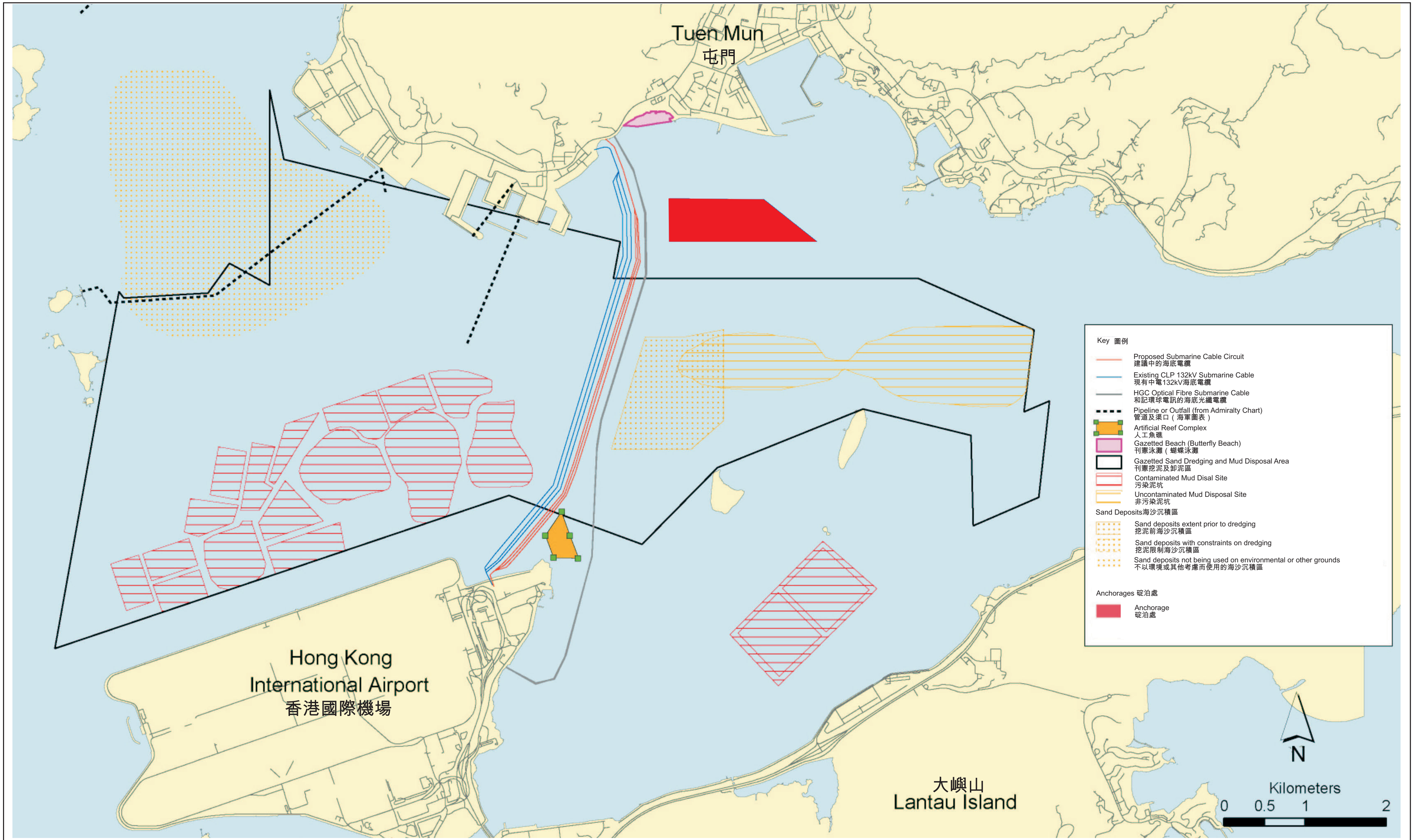

Figure 1.1
圖1.1

Alignment of the Proposed 132kV Submarine Cable Route for Airport "A" to Castle Peak Power Station Cable Circuit
擬敷設132千伏青山發電站至機場'A'變電站電纜線路之海底電纜分段

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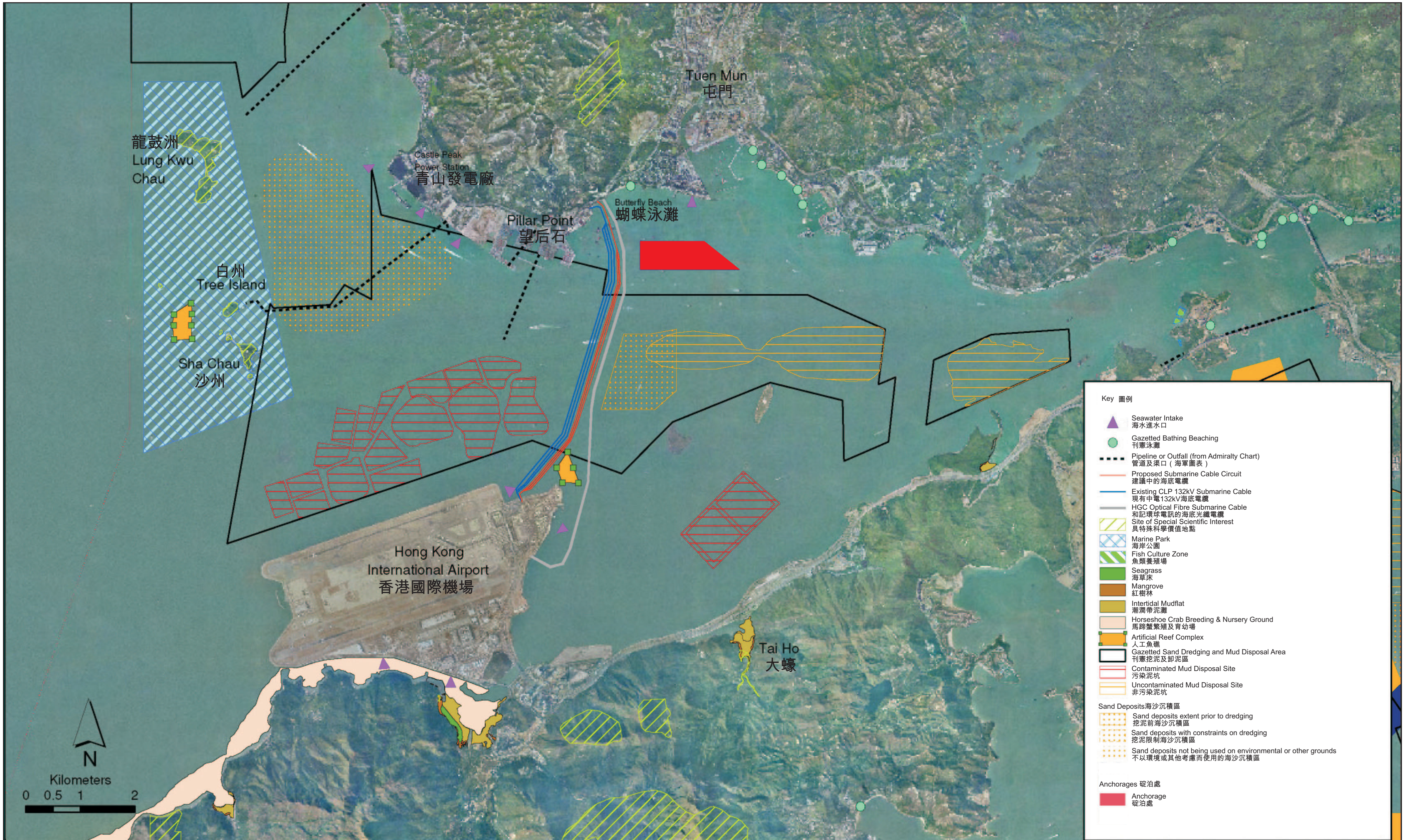

Figure 1.2
圖1.2

Environmental Constraints to the Routing of a Proposed 132kV Submarine Cable Route for Airport "A" to Castle Peak Power Station Cable Circuit
擬敷設132千伏青山發電站至機場'A'變電站電纜線路之海底電纜分段之選址環境限制

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Environmental
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Annex A
附錄A

Water Quality
水質

CONTENTS

A1 INTRODUCTION

This *Annex* presents an evaluation of the potential water quality impacts associated with the construction and operation of the 132kV submarine cable system. The cable will pass from Tuen Mun to the Airport. Mitigation measures are outlined where potential adverse impacts are identified.

A2 RELEVANT LEGISLATION AND ASSESSMENT CRITERIA

The following pieces of legislation and associated guidance or non-statuary guidelines are applicable to the evaluation of water quality impacts associated with the construction and operation of the proposed submarine cable system.

- *Water Pollution Control Ordinance (WPCO)*;
- *Environmental Impact Assessment Ordinance (Cap. 499. S.16)* and the *Technical Memorandum on EIA Process (EIAO-TM), Annexes 6* and *14*;
- *Technical Memorandum for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters (TM- ICW)*;
- Water Supplies Department (WSD) water quality criteria for seawater intakes; and
- Practice Note for Professional Persons, *Construction Site Drainage* (ProPECC PN1/94).

A2.1 WPCO

The *WPCO* is the primary legislation for the control of water pollution and water quality in Hong Kong. Under the *WPCO* Hong Kong waters are divided into 10 Water Control Zones (WCZs). Each WCZ has a designated set of statutory Water Quality Objectives (WQO). The route for the proposed submarine cable system passes through the North Western WCZ, which was first appointed on 1 April 1992. A summary of the WQOs for the North Western WCZ are presented in *Table A1*, and are applicable as evaluation criteria for assessing the compliance of any discharges during the construction and operation phases of the proposed 132kV submarine cable system.

Table A1 *Summary of Water Quality Objectives for the North Western WCZ*

Parameter	North Western WCZ
Temperature	Not to exceed 2°C due to waste discharge
pH	To be in the range 6.5-8.5, change due to waste discharge not to exceed 0.2
Suspended Solids (SS)	Not exceeding 30% of the natural ambient level
Dissolved Oxygen (DO)	
• Bottom	Not less than 2 mg L^{-1} for 90% samples
• Depth-averaged	Not less than 4 mg L^{-1} for 90% samples
Nutrients (measured as inorganic nitrogen)	Not to exceed 0.3 mg L^{-1} (annual mean depth-averaged)
Unionised Ammonia	Not to exceed 0.021 mg L^{-1} (annual mean)
Chlorophyll-*a*	No criteria established
Toxicants	Toxicants are not to be present at levels producing a significant toxic effect

A2.2 *EIAO - TM*

Annexes 6 and *14* of the *EIAO-TM* provide general guidelines and criteria to be used in assessing water quality impacts. The *EIAO-TM* recognises that, in the application of the above water quality criteria, it may not be possible to achieve the WQO at the point of discharge as there are areas which are subjected to greater impacts (which are termed by the EPD as the **mixing zones**) where the initial dilution of an input of pollutants takes place. The definition of this area is determined on a case-by-case basis. In general, the criteria for acceptance of the initial dilution area are that it must not impair the integrity of the water body as a whole and must not damage the ecosystem.

A2.3 *TM- ICW*

All discharges during both the construction and operation phases of the proposed submarine cable system are required to comply with the *TM - ICW* issued under *Section 21* of the *WPCO*, which defines acceptable discharge limits to different receiving waters. Under the *TM - ICW* effluents discharged into the drainage and sewerage systems, inshore and coastal waters of the WCZs are subject to pollutant concentration standards for particular volumes of discharge. These are defined by EPD and specified in licence conditions for any new discharge within a WCZ.

A2.4 *SEAWATER INTAKES*

Water Supplies Department (WSD) have their specific standards and these are presented in *Table A2*. With respect to Suspended Solids (SS), Biological Oxygen Demand (BOD_5) and *Escherichia coli* (*E. coli*). The SS concentration for the WSD intake should not be more than 10 mg L^{-1} (with an upper tolerance level of 20 mg L^{-1})

Table A2 Water Quality Criteria for Seawater to be used by WSD for Flushing Water Intakes

Parameter	**WSD Flushing Target Limit**
Colour (HU)	<20
Secchi Disc Depth (m)	-
Salinity (ppt)	-
pH	-
Turbidity (NTU)	<10
Threshold Odour Number	<100
Ammoniacal Nitrogen (mg L^{-1})	<1
Total Nitrogen (mg L^{-1})	-
Total Phosphate (mg L^{-1})	-
Suspended Solids (mg L^{-1})	<10 (20 – upper threshold)
Dissolved Oxygen (mg L^{-1})	>2
Dissolved Oxygen (% saturation)	-
Biochemical Oxygen Demand (mg L^{-1})	<10
Synthetic Detergents (mg L^{-1})	<5
Chlorophyll-a (μg L^{-1})	-
E. coli (cfu 100 mL^{-1})	<20,000

With regard to the Airport Authority Hong Kong (AAHK), there is no water quality criteria specified for their seawater intakes. For the assessment purpose, the WQOs will be used as the criteria for the intakes. Among the WQOs, the sole relevant criterion is SS concentration near sea bottom which is based on the recent published EPD routine monitoring data (1998-2004) [(1)] at Station NM3. The ambient level has been derived as the average annual 90th percentile SS concentrations, i.e. 28.9 mg L^{-1} (at bottom) and thus the allowable elevation was calculated as **8.7 mg L^{-1}**.

Note that AAHK's intake may be able to suffer a higher elevation of SS and the WQO which is the most stringent criterion has been adopted in this study in order to consider the most conservative case. Prior to the dredging works, confirmation with AAHK regarding the criterion is recommended.

A2.5 ProPECC PN 1/94

Apart from the above statutory requirements, the Practice Note for Professional Persons, *Construction Site Drainage* (*ProPECC PN 1/94*), issued by EPD in 1994, also provides useful guidelines on water pollution associated with construction activities.

(1) EPD (2005). Marine Water Quality for Hong Kong in 2004.

A3 DESCRIPTION OF THE ENVIRONMENT

A3.1 HYDRODYNAMICS

In general, the main ebb tide currents flow southeast along the Urmston Road, with a subsidiary flow bifurcating northwest of Chek Lap Kok to flow south down the west coast of Lantau, and southeast around the east of Chek Lap Kok Island. Flood tides show the reverse pattern.

During the dry season the influence of the Pearl River is at its least because of reduced flows, resulting in typically well-mixed coastal waters. In contrast during the summer (wet) season, the flow of the Pearl River increases and the coastal waters become highly stratified as the large influx of freshwater water overlies the denser, more saline oceanic waters near the sea bed.

Currents in the area are generally strongest on dry season spring tides. The strength of the currents has been measured in three studies. The first found moderate to low velocities (generally less than 0.4 m s^{-1}) predominated by velocities rising to 1.0 - 1.5 m s^{-1} during spring tides [(1)]. The second study, which looked only at spring tides, recorded a maximum of 0.6 m s^{-1} [(2)]. In the *EIA of the Contaminated Mud Pits IV* [(3)], the study found current velocities, to the north of the Airport, were up to 1.1 m s^{-1} on spring tides and up to 0.7 m s^{-1} on neap tides.

A3.2 WATER QUALITY

The proposed route for the submarine cable system passes through the North Western WCZ. There are two EPD routine water quality monitoring stations in the vicinity of the cable route. Water quality data for these stations, which were collected between 1998 and 2004 [(4)] and are the most up to date published data, are summarised in *Table A3.* The locations of the stations are shown in *Figure A1*.

(1) CES & BCL (1994). East Sha Chau Monitoring Programme, Final Report (November 1992 - December 1993).

(2) Hydraulics and Water Research (Asia) Ltd (1993). Disposal of Contaminated Mud at East Sha Chau: An Assessment of the Stability of Dumped Spoil and Capping Layers.

(3) ERM – Hong Kong Ltd (1997). EIA for Disposal of Contaminated Mud in the East Sha Chau Marine Borrow Pit. EIA Report. For the Civil Engineering Department, HKSAR Government.

(4) EPD (2005). Marine Water Quality in Hong Kong in 2004.

Table A3 EPD Routine Water Quality Monitoring Data for the North Western WCZ for Stations along the Cable Route

WQ Parameter	NM2 Pearl Island	NM3 Pillar Point
Temperature (°C)	23.6 (15.6 - 29.7)	23.5 (15.6 - 29.7)
Salinity	28.6 (9.4 - 33.5)	29.0 (11.1 - 33.6)
pH	8.0 (7.3 - 8.5)	8.0 (6.4 - 8.4)
Dissolved Oxygen – Depth-averaged (mg L^{-1})	5.9 (2.7 - 9.2)	5.8 (2.2 - 8.8)
Dissolved Oxygen - Bottom (mg L^{-1})	5.8 (2.7 - 8.4)	5.6 (2.2 - 8.6)
BOD_5(mg L^{-1})	0.7 (0.05 - 3.5)	0.7 (0.05 - 2.6)
Suspended Solids (mg L^{-1})	7.9 (1.1 - 47)	10.3 (1.2 - 71)
Total Inorganic Nitrogen (mg/L)	0.43 (0.05 - 1.37)	0.43 (0.02 - 1.43)
Unionised Ammonia (mg L^{-1})	0.005 (0.001 - 0.022)	0.005 (0.001 - 0.025)
Chlorophyll-a (microgram L^{-1})	2.8 (0.1 - 23)	2.5 (0.1 - 25)
Escherichia coli (cfu 100mL^{-1})	368 (5 – 8,100)	495 (0.5 – 180,000)

Notes:

a) Except as specified, data presented are depth-averaged.
b) All units are mg L^{-1}, unless stated.
c) Data presented are annual arithmetic means except for *E. coli* which are geometric means.
d) Data enclosed in brackets indicate the range.
e) Shaded cells indicate non-compliance with the WQOs.

The data show that compliance with the WQOs for dissolved oxygen (depth-averaged and bottom). The data for chlorophyll-*a* show a wide variation between the maximum and minimum values, which indicate that at certain times of the year algal growth may be significant. The SS and *E. coli* concentrations also lie inside a wide range and the maximum values reach up to 71 mg L^{-1} and 180,000 cfu 100mL^{-1} respectively at Station NM3. Note that the SS levels at NM3 have already exceeded the lower limit of 10 mg L^{-1} of WSD flushing water intakes. There is also an increasing trend for total inorganic nitrogen at both stations over the past 7 years.

A3.3 SEDIMENT QUALITY

There are two EPD routine sediment quality monitoring stations, i.e. NS2 and NS3, in the vicinity of the cable route. Sediment quality data for these stations are available for 1998-2004 (1) and are summarised in *Table A4*. The location of the sediment quality monitoring stations are shown on *Figure A1*.

(1) EPD (2005). Marine Water Quality for Hong Kong in 2004.

Table A4 ***EPD Routine Sediment Quality Monitoring Data in the Vicinity of the Cable Route***

Parameter	NS2	NS3
COD (mg kg^{-1})	14,214 (10,000 – 17,000)	15,314 (8,400 – 19,000)
TKN (mg kg^{-1})	303.6 (220 - 370)	294.3 (120 - 440)
Cadmium (mg kg^{-1})	0.06 (0.05 - 0.1)	0.08 (0.05 - 0.3)
Chromium (mg kg^{-1})	33.5 (25 - 43)	31.6 (16 - 41)
Copper (mg kg^{-1})	34.3 (27 - 50)	32.6 (17 - 47)
Mercury (mg kg^{-1})	0.09 (0.06 - 0.16)	0.12 (0.06 - 0.19)
Nickel (mg kg^{-1})	19.4 (15 - 27)	19.0 (10 - 25)
Lead (mg kg^{-1})	39.2 (32 - 55)	38.5 (20 - 54)
Zinc (mg kg^{-1})	97.4 (73 - 130)	90.9 (48 - 120)
Arsenic (mg kg^{-1})	10.5 (7.5 - 14)	11.1 (6.3 - 14)
PAHs (μg kg^{-1})	132 (86.5 - 267)	162 (90.5 - 379)
PCBs (μg kg^{-1})	4.8 (2.5 - 15)	6.2 (2.5 - 15)

Notes:

a) Data presented are arithmetic mean; ranges are enclosed in brackets.

b) Results are based on laboratory analysis of bulk samples, which are collected twice per year from each sampling location.

c) All parameters are reported on a dry weight basis, unless otherwise stated.

The above data show that the sediment would not be classed as contaminated, based on the existing sediment classification guidelines (ETWBTC 3y / 2002).

A3.4 ***WATER QUALITY SENSITIVE RECEIVERS***

Water quality sensitive receivers (WSRs) in the vicinity of the cable route and landing sites have been identified under the broad designations of gazetted bathing beaches, water intakes, fisheries and areas of ecological interest. The identified WSRs in these two categories, shown on *Figure A2*, are summarised as follows.

- **Gazetted Bathing Beaches**: Butterfly Beach; other Tuen Mun Beaches including Castle Peak Beach; Kadoorie Beach, Cafeteria New Beach and Golden Beach;

- **Fisheries:** Artificial Reefs; Spawning Ground of Commercial Fisheries Species;

- **Seawater Intakes**: Intakes at the Airport; Castle Power Station Intake; Tuen Mun Area 38 Intake; Shiu Wing Steel Mill Intake; Tuen Mun WSD Intake; and

- **Sites of Ecological Interest:** Chinese White Dolphin habitat at East of Sha Chau / Lung Kwu Chau (including the Marine Park) and the Brothers; Seagrass at San Tau and Tai Ho Bay.

The distances between the cable alignment and the identified representative sensitive receivers are summarised in *Table A5*.

Table A5 Closest Approach of the Proposed Cable Alignment to Sensitive Receivers

ID	Water Quality Sensitive Receivers	Approximate Distance to Proposed Cable Route (m)
A1	Artificial Reef at Airport	80
B1	Butterfly Beach	370
B2	Tuen Mun Beaches	1,700
S1	Seawater intake at Airport (north)	270
S2	Seawater intake at Airport (east)	750
S3	Seawater intake for Tuen Mun WSD	1,700
S4	Seawater intake at Area 38	2,400
S5	Seawater intake for Shiu Wing Steel Mill	3,000
S6	Seawater intake for Castle Peak Power Station	3,800
F1	Fish Culture Zone at Ma Wan	9,000
D1	Indo-Pacific humpback dolphin habitat at East of Sha Chau / Lung Kwu Chau (Marine Park)	5,500
B1	Seagrass at San Tau	4,000

It should be noted that the actual distances from sensitive receivers may be greater than those presented in *Table A5*, depending on the deployed position of the cable within the works area.

A5 WATER QUALITY IMPACT ASSESSMENT

The potential water quality impacts associated with the construction and operation of the proposed 132kV submarine cable system are described below.

A5.1 CONSTRUCTION PHASE

A5.1.1 Cable Laying Works

With regard to the segment of the cable to be buried using a cable burial machine, the Contractor responsible for the cable installation has provided information on the construction methods.

The approach detailed below has been utilised to calculate the transportation of sediment in suspension in the following project profiles for which Environmental Permits have been issued:

- *Hongkong Electric Co Ltd 132kV Submarine Cable Installation for Wong Chuk Hang - Chung Hom Kok 132kV Circuits* (AEP132 / 2002). Environmental Permit granted on 16 April 2002 (EP-132 / 2002)

- *FLAG North Asian Loop* (AEP 052/2001). Environmental Permit granted on 18 June 2001 (EP-099/2001).
- *New T&T Hong Kong Limited: Domestic Cable Route, New T&T* (AEP-086/2000). Environmental Permit granted on 16 February 2001 (EP-086/2000).
- *C2C Cable Network - Hong Kong Section: Chung Hom Kok, GB21(Hong Kong Limited)* (AEP-087/2000). Environmental Permit granted on 16 February 2000 (EP-087/2000).
- *East Asian Crossing (EAC) Cable System (TKO), Asia Global Crossing* (AEP-081/2000). Environmental Permit granted on 4 October 2000 (EP-081/2000).
- *East Asian Crossing (EAC) Cable System, Asia Global Crossing* (AEP-079/2000). Environmental Permit granted on 6 September 2000 (EP-079/2000).
- *Submarine Cable Landing Installation in Tong Fuk Lantau for Asia Pacific Cable Network 2 (APCN 2) Fibre Optic Submarine Cable System, EGS.* Environmental Permit granted on 26 July 2000 (EP-069/2000).
- *Telecommunication Installation at Lot 591SA in DD 328, Tong Fuk, South Lantau Coast and the Associated Cable Landing Work in Tong Fuk, South Lantau for the North Asia Cable (NAC) Fibre Optic Submarine Cable System* (AEP-064/2000). Environmental Permit granted in June 2000 (EP-064/2000).
- *11kV Cable Circuits from Tai Mong Tsai to Kiu Tsui, CLP Power.* Gazetted under Foreshore Seabed (Reclamation) Ordinance in 2004.
- *Black Point to Shekou Submarine Cable System, for CLP Power.* Gazetted under Foreshore Seabed (Reclamation) Ordinance in 2005.

Along the majority of the cable corridor laying of the cable will be undertaken using a jet plough deployed from a lay barge. The jet plough utilises water injection jets to fluidise the seabed sediments, which enables the plough to safely and accurately insert the cable to the required burial depth. The majority of the trench is filled by the sediment disturbed during laying, with the remainder through natural sedimentation. During the cable laying process the seabed sediments will be disturbed and a small percentage will be lost to suspension in the lower part of the water column in the immediate vicinity of the jet plough. This small amount of suspended sediment will be advected away from the cable corridor by tidal currents.

Due to the shallow water depth at the shore approach the cable burial will be undertaken by excavation of a trench using a grab dredger or a suction pipe from a dredger, followed by backfilling with the excavated materials. The material to be excavated at the landing sites is fine material and the quantity will be small (up to 50,000 m^3). During dredging a portion of the fine sediments will be lost to suspension to the surrounding marine waters.

Calculation of Sediment Transport

The rate of sediment lost to suspension is calculated as follows:

Release rate = cross-sectional area of disturbed sediment x speed of cable laying machine x sediment dry density x percentage loss

depth of disturbance = 5 m (burial depth of cable)

width of disturbance = 2 m for each cable (width of disturbance at seabed)

maximum cross sectional area = 5 m^2 for each cable (v-shaped trench formed by jet plough)

loss rate = 20% (majority of sediment not disturbed)

speed of machine = 0.022 m s^{-1} (80 m $hour^{-1}$)

in-situ dry density = 600 kg m^{-3} (typical of Hong Kong sediment)

Release Rate = 13.2 kg s^{-1}

During cable laying, the seabed sediment will be released at the bottom of the water column which will result in high localised suspended sediment concentrations and high settling velocities. This is because at high concentrations within a much localised area suspended sediment will tend to form large aggregations of sediment particles (the process of flocculation) which have a higher settling velocity than the individual sediment particles.

It is expected that the suspended sediments will remain within 1 m of the seabed, which is independent of the water depth. Although the current velocities at the seabed are lower than those near the water surface, due to such effects as bottom friction. For the purposes of the assessment it is assumed that the current velocity is 1.5 m s^{-1}, which is an upper bound estimate of surface current velocities in the vicinity of the cable works area and extremely conservative. It is expected that the sediment will initially spread to a maximum of 6 m along the centre-line of the cable alignment, which represents the longitudinal dimension of the jet plough. The suspended solids will tend to form around the cable laying works, however, the potential impacts have been addressed using a conservative assumption that a cross-current carries the sediment towards the sensitive receivers.

Based on the above, and given the worse case scenario that the sediment initially mixes evenly over the lower 1 m of the water column and over the initial length of spread of the sediment, the initial concentration of the suspended sediment is as follows:

Initial Concentration = release rate / (current speed x height of sediment x width of sediment)

release rate = 13.2 kg s^{-1}

current velocity = 1.5 m s^{-1}

height of sediment = 1 m

width of sediment = 6 m

Initial Concentration = 1.47 kg m^{-3}

The settling velocity for the suspended sediment has been calculated by the following relationship, which was derived during the WAHMO (Water Quality and Hydraulic Model) studies and successfully applied to a number of assessments in order to determine the behaviour of sediment disturbed during dredging works in Hong Kong.

Settling velocity = 0.01 x (suspended sediment concentration)

suspended sediment concentration = 1.47 kg m^{-3}

Settling Velocity = 0.0147 m s^{-1} = 14.7 mm s^{-1}

However, as the sediment progressively settles onto the seabed, suspended sediment concentrations will gradually reduce. In order to account for the gradually reducing concentrations the above settling velocity is halved, which gives a value of **7.3 mm s^{-1}**. This is the same approach as was adopted in the EIA for the gas pipeline serving the Lamma Power Station Extension (1).

The time taken for the sediment to settle onto the seabed will thus be the maximum height of the sediment divided by the average settling velocity.

Settling Time = 1 m / 0.0073 m s^{-1} = **137 s**

The distance travelled by the sediment will thus be the settling time multiplied by the current velocity.

Distance Travelled = 137 s x 1.5 m s^{-1} = **205.5 m**

The above calculation indicates that the sediments disturbed during laying of the cable will settle onto the sea bed within approximately **206 m** of the cable alignment.

A5.1.2 Dredging Works at Shore Ends

Due to the shallow water depth, cable burial will be undertaken by excavation of a trench using a closed grab dredger at the shore end of Tuen Mun. At the

(1) ERM - Hong Kong, Ltd (1998) EIA for a 1,800MW Gas-fired Power Station for Lamma Extension. For The Hongkong Electric Co Ltd.

shore end of the Airport, two alternatives have been considered, i.e., grab dredging versus suction method. The cable within the trench will be placed by divers, backfilling with clean sand over the cable once it is in place.

For predicting the near field behaviour of sediments disturbed during the dredging operations, a similar approach has been taken which was applied to the *Design of Reclamation and Edge Structures for Container Terminals 10 and 11* (1) and in the assessment of the Penny's Bay reclamations (2). This approach uses a simple model to calculate the depth averaged suspended sediment concentrations along the centreline of a plume by solving the advection-diffusion equation for a continuous line source (3). This model is considered appropriate for the calculation of suspended sediment concentrations from the dredging for the cable trenches because the equation is based on a continuous line source of sediment, which is a reasonable approximation of the loss of sediment to suspension during dredging.

The formula is as follows.

$$C(x) = q / (D * x * \omega * \sqrt{\pi})$$

where: $C(x)$ = concentration at distance x from the source

q = sediment loss rate

D = water depth

X = distance from source

ω = diffusion velocity

The use of the above equation is limited to situations where the value of γ, as defined by the following equation, is small and where ω / u is also small.

$$\gamma = Wt / D$$

where W = settling velocity of suspended sediment

t = time

D = water depth

(1) Maunsell Consultants Asia Ltd (1995). Lantau Port Development Stage 1. Design of Reclamation and Edge Structures for Container Terminals 10 and 11 and Back-up Areas. Environmental Impact Assessment. Final Report.

(2) ERM (2000). Environmental Impact Assessment for Construction of an International Theme Park at Penny's Bay of North Lantau and Its Essential Associated Infrastructure.

(3) R E Wilson. A Model for the Estimation of the Concentrations and Spatial Extent of Suspended Sediment Plumes. Estuarine and Marine Coastal Science (1979), Vol 9, pp 65-78.

Settling Velocity (W)

In the modelling of sediment plumes from the construction of the WDII reclamations [(1)] the settling velocity for the fines was assumed to be **0.0001 ms^{-1}** and is considered appropriate for the fines portion of the dredging material lost to suspension.

Time (t)

The value for "t" is taken to be half of the tidal period, which may be taken to be the time between the ebb and flood phases of the tidal cycle. In Hong Kong, this is greatest for the ebb phase of a spring tide where the time from high water to low water can be up to **8 hours**.

Water Depth (D)

The substrata consist of bare rocks, rubbles and sand in the shallow water region (<-3mCD) and become muddy in the deeper region (-5mCD). Thus, the representative water depth along the direction of dispersion of the sediments suspended during the dredging works is approximately **5 m**.

Diffusion Velocity (ω)

The value for diffusion velocity is taken to be **0.01 m s^{-1}**, which is the same as that which was used in the previous study for the near field assessment of sediment plumes from the installation of Hong Kong Electric's 132kV cable in Deep Water Bay and from the reclamations associated with the developments at Penny's Bay [(2)]. The diffusion velocity represents reductions in the centre-line concentrations due to lateral spreading.

Hence, the value of γ is calculated to be 0.58, which is considered to be small. The current speed in the vicinity of the cable alignment has conservatively been assumed to reach as high as 1.5 m s^{-1}, which means that the value of ω / u is calculated to be 0.007, which is considered to be small. Therefore, the use of the above equation is considered valid.

Sediment Loss Rate (q)

The loss rate of fine sediment to suspension is calculated based on the rate and method of working. The trench dredging will be undertaken by a closed grab dredger working at a maximum rate of 1,500 m^3 day^{-1} at Tuen Mun shore approach over a 10-hour working day, whereas at a maximum rate of 650 m^3 day^{-1} and 1,600 m^3 day^{-1} for grab and suction pipe dredging respectively over a 16-hour working day at Airport shore approach. In a study assessing the impacts of dredging areas of Kellett Bank for mooring buoys [(3)] it was determined that a representative loss rate for grab dredgers working in areas

(1) Maunsell Consultants Asia Ltd (2001). Wan Chai Development Phase II. Comprehensive Feasibility Study. Environmental Impact Assessment Study. EIA Report.

(2) ERM (2000). *Ibid*.

(3) ERM (1997). Dredging an Area of Kellett Bank for Si Government Mooring Buoys. Environmental Impact Assessment.

without significant debris would be 17 kg m^{-3} dredged. This value, however, was determined for dredgers working in muddy sediments where the fines content may be over 80%. The loss rate from the grab dredging operations is thus **0.71 kg s^{-1}** and **0.19 kg s^{-1}** for Tuen Mun and the Airport shore approach respectively.

For suction dredgers, the loss rate should be lower that that for grab dredger. In consideration of similar mechanism with trailer dredger, it is assumed that the rate of loss for suction dredgers is the same as that of a trailer dredger, i.e. 7 kg m^{-3} (1) (2). It is also assumed that no overflow is permitted and the suction pipe is well-sealed. Hence, the loss rate from the suction dredging operations is **0.19 kg s^{-1}**.

Concentration at Distance x from the Source (C(x))

The results of the assessment applying the above described equation are shown below in *Table A6*.

Table A6 Predicted Suspended Sediment Elevations due to Dredging at Shore Ends

Distance from Source	**Tuen Mun (Grab Dredging)**	**Airport (Grab Dredging)**	**Airport (Suction Method)**
	Concentration (mg L^{-1})	**Concentration (mg L^{-1})**	**Concentration (mg L^{-1})**
10	799	217	219
100	80	22	22
200	40	11	11
500	16	4	4
1000	8	2	2
2000	4	1	1
3000	3	1	1

CLP has proposed to deploy silt curtains around the dredgers in order to minimise the quantities of sediment transported beyond the dredging operation. In the EIA for the WDII reclamations [3] it was identified that deployment of silt curtains would reduce the dispersion of suspended solids by a factor of 4. The SS concentrations resulting from deployment of a silt curtain are shown below in *Table A7*. The SS concentrations against distance from the source are presented in *Figures A3, A4* and *A5*.

Table A7 Predicted Suspended Sediment Elevations due to Dredging at Shore Ends following the Deployment of Silt Curtains

Distance from Source	**Tuen Mun (Grab Dredging)**	**Airport (Grab Dredging)**	**Airport (Suction Method)**
	Concentration (mg L^{-1})	**Concentration (mg L^{-1})**	**Concentration (mg L^{-1})**

(1) Kirby, R and Land J M (1991). The impact of Dredging - A comparison of Natural and Man-Made Disturbances to Cohesive Sedimentary Regimes. Proceedings CEDA - PINC Conference (incorporation CEDA Dredging Days), November 1991, Amsterdam. Central Dredging Association, the Netherlands.

(2) Environment Canada (1994). Environmental Impacts of Dredging and Sediment Disposal. Les Consultants Jaques Beraube Inc for the Technology Development Section, Environmental Protection Branch, Environment Canada, Quebec and Ontario Branch.

(3) Maunsell Consultants Asia Ltd (2001). *Op cit*.

Distance from Source	Tuen Mun (Grab Dredging)	Airport (Grab Dredging)	Airport (Suction Method)
	Concentration (mg L^{-1})	Concentration (mg L^{-1})	Concentration (mg L^{-1})
10	200	54	55
100	20	5	5
200	10	3	3
500	4	1	1
1000	2	1	1
2000	1	0	0
3000	1	0	0

Figure A3 ***Predicted Suspended Sediment Elevations due to Dredging at Shore End of Tuen Mun***

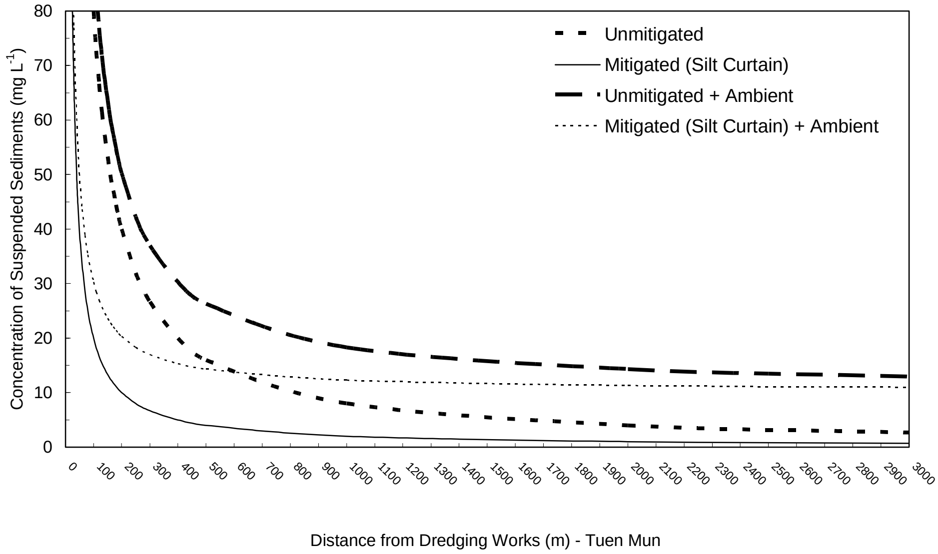


Figure A4　　*Predicted Suspended Sediment Elevations due to Dredging at Shore End of the Airport using Grab Dredging*

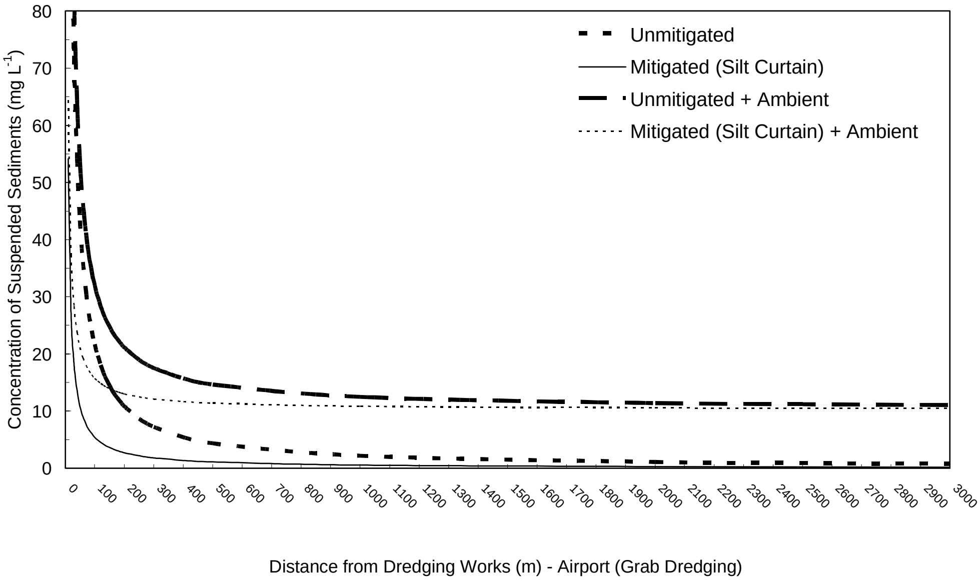
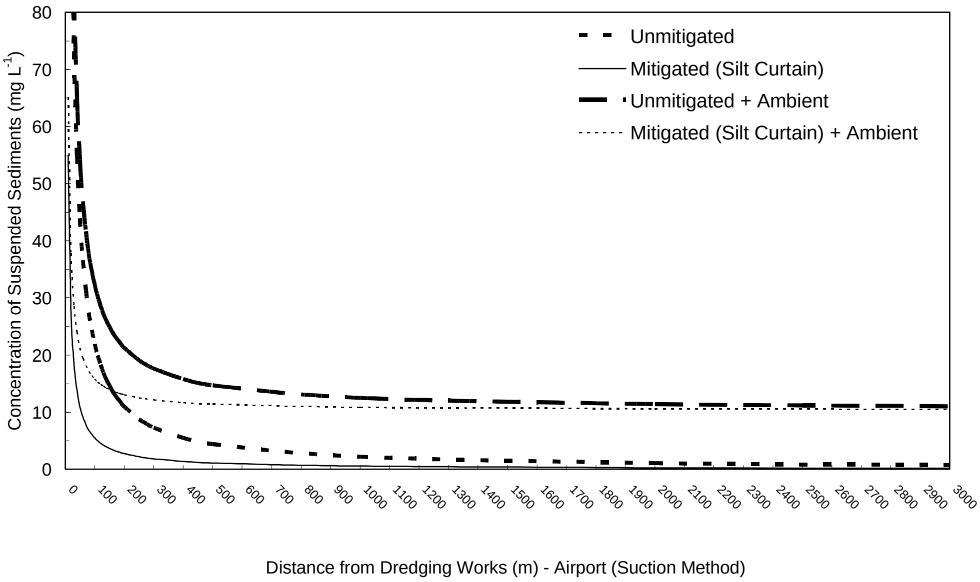


Figure A5　　*Predicted Suspended Sediment Elevations due to Dredging at Shore End of the Airport using Suction Method*



Based on the results presented above, SS elevations due to the dredging operations are localised. No exceedances are anticipated at the nearby sensitive receivers, especially the WSD flushing water intake and the Airport seawater intake.

With the adoption of silt curtains, concentrations (with ambient) in excess of the WSD intake criterion (<20 mg L^{-1}) only occur within 200 m the shore end at Tuen Mun, whereas elevations in excess of the Airport intake criterion (<8.7 mg L^{-1}) only occur within 70 m the shore end at the Airport.

A5.2 POTENTIAL IMPACT IDENTIFICATION

Impacts to marine water quality of the Project, either direct or indirect, have been identified and listed as follows:

A5.2.1 Increase in Suspended Solids (SS)

Cable laying will result in the formation of an area of high suspended sediment concentrations around the cable burial machine, which will remain close to the seabed and settle out quickly. Analysis of the potential transport of fine sediments suspended in the water column was undertaken and it was determined that the maximum distance of transport for the suspended sediments would be 206 m which is considered to be small and away from sensitive receivers. The sediment disturbed during cable laying will remain in suspension for a very short period of time in a local region and is not expected to cause adverse impacts to water quality.

During cable installation at the shore ends suspended solids will be released into the water column during dredging works and, to a much lesser extent, during backfilling. Analysis of the potential transport and concentrations predict that with the implementation of silt curtains, elevated concentrations in excess of 10 mg L^{-1} will only occur within 200 m and 100 m of the dredging operation at the shore ends of Tuen Mun and the Airport respectively. Impacts to the water quality associated with the dredging work will be of short duration and of low concentration.

Most of the WSRs are located at least 1,700 m away from the sources, except the Butterfly Beach, i.e. B1 (*Table A5*), and the seawater intakes of the Airport, i.e. S1 & S2 (*Table A5*). Based on the results, it is thus expected that the elevation of SS would not cause unacceptable impacts to those remote WSRs. For B1 (370 m away from Tuen Mun landing point), the results show that the SS elevations at B1, due to grab dredging, have been predicted to 6 mg L^{-1} In addition, the results (*Table A*7) show that suction dredging at the Airport would cause SS elevation of 4 mg L^{-1} at the distance of 200 m from the source when silt curtains are applied as one of the mitigation measures. It is predicted that unacceptable exceedances in SS at S1 (260 m away from the Airport landing point) would be unlikely to occur. Hence, the short duration-SS elevation due to suction dredging is unlikely to cause unacceptable impacts to the intake.

A5.3 MITIGATION MEASURES DURING CABLE LAYING

During cable laying the following will be undertaken.

- Although the sediment loss during both grab dredging and suction dredging is expected to be quite small, the Contractor will be employing a silt curtain around the dredgers to reduce the dispersion of sediments from the landing points.

- Closed grab dredgers shall be used to avoid dispersion of suspended solids into the sea.

- The maximum dredging rate at Tuen Mun shore approach should be limited to 1,500 m^3 day^{-1} for working 10 hours per day, i.e., 150 m^3 hr^{-1}.

- The maximum dredging rates of grab dredgers and suction method, whichever to be deployed by the contractor, at the Airport shore approach should be limited to 650 m^3 day^{-1} and 1,600 m^3 day^{-1} for working 16 hours per day, i.e., 41 m^3 hr^{-1} and 100 m^3 hr^{-1}.

- All barges used for the transport of dredged materials shall be fitted with tight bottom seals in order to prevent leakage of material during loading and transport.

- All barges should be filled to a level, which ensures that material does not spill over during loading and transport to the disposal site and that adequate freeboard is maintained to ensure that the decks are not washed by wave action.

- The forward speed of the jetting machine should be limited to a maximum of 80 m hr^{-1} and 24 hours operation.

In addition to the above, the Contractor will be undertaking water quality monitoring to verify the predictions concerning sediment plume dispersion during dredging at the landing sites.

A5.4 OPERATIONAL PHASE

It should be noted that as a result of cable laying using the cable burial machine, no long-term disruption of bottom sediment will occur and no disruptions to water movement will result from this project. No adverse impacts to water quality will occur during or after the marine works. The operation of the cable will not result in any pollutant emissions into the surrounding waters. Although there will be small scale temporary displacement of bottom sediment during the laying of the cables using the cable burial machine, once the cable is installed, the bottom sediment will naturally resettle.

No mitigation measures for the cable system during the operational phase are considered necessary as no impacts are predicted.

A6 SUMMARY AND CONCLUSIONS

A review and assessment of sediment dispersion impacts associated with dredging works at the approach to shore ends, i.e. Tuen Mun and the Airport, and cable laying works along the proposed cable alignment have been undertaken.

Water quality sensitive receivers have been identified and most of them are located at the distance at least 1,700 m from the proposed cable route. The calculation of sediment transport from the construction works indicates that the sediments disturbed during laying of the cable will settle onto the sea bed within approximately 206 m of the cable alignment. It is not expected that any exceedances will occur at the nearby sensitive receivers. Silt curtains have been demonstrated as effective in reducing the extent of sediment dispersion and will be used for the Project at the shore ends. Due to the remoteness of most water quality sensitive receivers from the cable laying and dredging works and the short duration of working period, they are unlikely to be affected by adverse changes in water quality.

目錄

A1　　引言

本附件旨在闡述在安裝和使用 132kV 海底電纜系統時可能產生的水質影響評估。該電纜會從屯門連接至機場。本附件亦對可能會出現的不良影響提出相應的緩解措施。

A2　　相關法例及評估準則

下列法例及相關指引或一般標準及指引，適用於評估在安裝和使用擬議海底電纜系統時可能產生的水質影響。

- *《水污染管制條例》*；
- *《環境影響評估條例（499 章 16 條）》*及*《環境影響評估程序技術備忘錄》*（以下簡稱「環評技術備忘錄」）*之附件 6* 及 *14*；
- *《技術備忘錄：排入去水渠及污水渠系統、內陸及海岸水域的污水標準》*（以下簡稱「廢水排放技術備忘錄」）；
- 水務署海水進水口的水質標準；及
- 專業人士專業守則之*《建築工地的排水渠》*（專業人士環保事務諮詢委員會專業守則 PN1/94）

A2.1　　水污染管制條例

*《水污染管制條例》*是香港在控制水污染和水質方面的主要法例。根據該條例，香港的水域分爲十個水質管制區，每區各有一套法定的水質指標。擬議敷設的海底電纜系統將會穿越於 1992 年 4 月 1 日設立的西北部水質管制區。這個水質管制區的水質指標羅列於*表 A1*。這些指標會成爲評估準則，用以評估擬議裝設的海底電纜系統在施工和運作階段時所排放的廢水是否符合規定。

表 A1　　西北水質管制區水質指標摘要

參數	西北水質管制區
溫度	由廢水排放所造成的溫度改變不應超過攝氏 2.0 度
酸鹼值	應介乎 6.5-8.5，由廢水排放所造成的改變不應超過 0.2 單位
懸浮固體	不應超過天然背景水平的 30%
溶解氧	
• 水底	在 90%的樣本中不應少於每公升 2 毫克
• 不同深度的平均值	在 90%的樣本中不應少於每公升 4 毫克
養份（按無機氮量度）	不應超過每公升 0.3 毫克（不同深度平均值的年平均值）
非離子化氨	不應超過每公升 0.021 毫克（年平均值）
葉綠素－α	未有確立標準
大腸桿菌	按年的幾何平均數不應超過每 100 毫升 610 個
有毒物質	有毒物質的含量不應高至足以產生顯著中毒效果

A2.2　　環境影響評估條例之技術備忘錄

*《環評技術備忘錄》*附件 *6* 及 *14* 提供了評估水質影響的一般指引和準則。*《環評技術備忘錄》*允許，在排放點應用上述各項水質標準時，未必能夠達到規定的水質指標，因為這些水域會受到較大影響（環保署稱之為**混合區**），廢水中的污染物正是在這些水域開始被初步稀釋。這些地區均按當地具體情況而劃定。一般而言，混合區的界定，不可損害有關水體的整體性，亦不可破壞其生態系統。

A2.3　　廢水排放技術備忘錄

擬議海底電纜系統在施工和運作階段所排放的廢水都必須符合根據*《水污染管制條例》第 21 條* 而頒佈的*《廢水排放技術備忘錄》*內的規定。該份備忘錄列明了不同水體可以接受的廢水排放限制。根據這份技術備忘錄的規定，所有排放入排水系統、污水系統，以及各個水質管制區的近岸及岸邊水域內的廢水，其特定體積內的污染物濃度必須符合指定標準。這些標準是當有新的廢水來源需要排放入某一個水質管制區時，由環境保護署負責制定，並註明於有關的發牌條件上。

A2.4　　海水進水口

水務署有一套特定標準，均羅列於*表 A2*；其中包括懸浮固體、五天生化需氧量和大腸桿菌。水務署海水進水口的懸浮固體濃度不應超過每公升 10 毫克（超額水平上限為每公升 20 毫克）。

表 A2　　水務署對沖廁用水進水口所採用的海水水質標準

參數	水務署沖廁用水目標限額
顏色（HU）	<20
透明度板深度（米）	-
鹽度 (ppt)	-
酸鹼值	-
混濁度（NTU）	<10
氣味閾限值	<100
氨氮（mg L^{-1}）	<1
氮總量（mg L^{-1}）	-
磷總量（mg L^{-1}）	-
懸浮固體（mg L^{-1}）	<10 (20 – 上閾限)
溶解氧（mg L^{-1}）	>2
溶解氧（飽和度%）	-
生化需氧量（mg L^{-1}）	<10
合成清潔劑（mg L^{-1}）	<5
葉綠素-*a* (gL^{-1})	-
大腸桿菌 (cfu 100m L^{-1})	<20,000

根據香港機場管理局，本港現時沒有特別為其海水進水口而設的質素準則。因此本評估會採用水質管制區的水質指標作標準。基於環保署近期發表的慣常監察數據(1998-2004)中有關 nm3 站的資料 (1)，在眾多水質指標中只有水底的懸浮固體濃度和本評估有關。懸浮固體濃度的周遭水平已被定為全年平均的第 90 個百一分段值，即 28.9 mg L^{-1}，而可提高的濃度值為 8.7 mg L^{-1}。

應予注意的是，香港機場管理局的海水進水口可能可以承受較高的懸浮固體濃度，而本報告已採用水質管制區的水質指標，亦即目前最嚴厲的標準來作最壞情況預測的考慮。建議應在進行挖泥工程之前取得機場管理局對有關的標準作出進一步釐清。

A2.5　　專業人士環保事務諮詢委員會專業守則 1/94

除了上述法定要求外，環保署於 1994 年所頒佈的專業人員守則 – *《建築工地的排水渠》*（專業人士環保事務諮詢委員會專業守則 1/94 號）亦對建造工作所造成的水質污染，闡述了一些有用的指引。

(1)　環保署（2005）。　2004 年香港海水水質報告。

A3 環境說明

A3.1 流體力學

一般而言，退潮時的潮水是沿著龍鼓水道向東南方流動；另有一股支流在赤鱲角西北面，向南沿著大嶼山西岸流動，以及向東南繞到赤鱲角島的東面。潮漲時的潮水則呈反向流動。

在旱季時，珠江的水量減少，其影響亦是最低，因此一般形成鹹淡水混合的沿岸水域。相反地，在夏季（雨季）時，珠江流量增加，大量淡水浮在海床附近較鹹和密度較高的海水之上，令沿岸水域出現顯著的分層情況。

區內的海潮一般都是在旱季的大潮時最強。海潮的強度曾在三項研究中量度過。第一次研究量度得中等至徧低的速度（一般少於每秒 0.4 米），而以大潮時每秒 1.0-1.5 米的速度爲主 [(1)]。第二次研究只探討大潮時的情況，記錄到的最高速度爲每秒 0.6 米[(2)]。在《IV 號污泥坑環評研究》[(3)] 中發現，機場北面的潮水速度在大潮時可達每秒 1.1 米，而在小潮時則達每秒 0.7 米。

A3.2 水質

海底電纜系統的擬議路線會經過西北水質管制區。電纜走廊附近有兩個環保署的定期水質監察站。這兩個監察站從 1998 年至 2004 年間所收集到的水質數據 [(4)]（是最新公佈的數據），均羅列於*表 A3*。兩個監察站的位置則展示於*圖 A1*。

(1) CES & BCL (1994).。 東沙洲監察計劃最後報告（1992 年 11 月 - 1993 年 12 月）。

(2) Hydraulics and Water Research (Asia) Ltd (1993)。 東沙洲的污泥卸置：已卸廢物和覆蓋層的穩定性評估。

(3) 香港環境資源管理顧問有限公司(1997)。於東沙洲海上取土坑卸置污泥的環境影響評估。環評報告。爲香港特區政府土木工程署進行。

(4) 環保署（2005）。2004 年香港海水水質報告。

表 A3　　電纜沿線之環保署西北水質管制區定期水質監察站之水質監察數據

水質參數	NM2 龍珠島	NM3 望后石
溫度（℃）	23.6 (15.6 - 29.7)	23.5 (15.6 - 29.7)
鹽度	28.6 (9.4 - 33.5)	29.0 (11.1 - 33.6)
酸鹼值	8.0 (7.3 - 8.5)	8.0 (6.4 - 8.4)
溶解氧－深度平均 (mg L^{-1})	5.9 (2.7 - 9.2)	5.8 (2.2 - 8.8)
溶解氧－水底（mg L^{-1}）	5.8 (2.7 - 8.4)	5.6 (2.2 - 8.6)
五天生化需氧量（mg L^{-1}）	0.7 (0.05 - 3.5)	0.7 (0.05 - 2.6)
懸浮固體（mg L^{-1}）	7.9 (1.1 - 47)	10.3 (1.2 - 71)
無機氮總量 (mg L^{-1})	0.43 (0.05 - 1.37)	0.43 (0.02 - 1.43)
非離子化氨氮 (mg L^{-1})	0.005 (0.001 - 0.022)	0.005 (0.001 - 0.025)
葉綠素-*a*（μg L^{-1}）	2.8 (0.1 - 23)	2.5 (0.1 - 25)
大腸桿菌（cfu 100mL^{-1}）	368 (5 － 8,100)	495 (0.5 － 180,000)

附註：

a)　除了特別註明之處外，表內所有數據均為深度平均值。

b)　除了特別註明之處外，表內所有單位均為毫克／公升

c)　表內數據均為年度算術平均值，只有大腸桿菌採用幾何平均值。

d)　括號內的數字表示變化範圍。

e)　灰色格子代表該數值未能符合水質指標。

上述數據顯示，該區的溶解氧（深度平均值和海底數值）均符合水質指標。葉綠素-*a* 的最高值和最低值之間有很大差距，顯示海藻的生長在一年中的某些時間會特別顯著。懸浮固體和大腸桿菌的濃度變化幅度很大，其中在監察站 NM3 的最高值分別為 71 mg L^{-1}和 180,000 cfu 100mL^{-1}。應予注意的是，NM3 的懸浮固體水平已經超出水務署沖廁用水進水口的目標限額的下限 10 mg L^{-1}。過去七年間，兩個監察站所記錄到的無機氮總量亦呈上升趨勢。

A3.3　　沉積物質素

電纜走廊附近有兩個環保署的定期沉積物質素監察站，即 NS2 和 NS3。這兩個監察站在 1998-2004 年期間的沉積物質素數據 (1)，均羅列於*表 A4*。監察站的位置則展示於*圖 A1*。

(1)　環保署（2005）。2004 年香港海水水質報告。

表 A4　　　　電纜沿線之環保署定期沉積物質素監察數據

參數	NS2	NS3
化學需氧量（mg kg^{-1}）	14,214 (10,000 – 17,000)	15,314 (8,400 – 19,000)
克氏氮總量 (mg kg^{-1})	303.6 (220 - 370)	294.3 (120 - 440)
鎘（mg kg^{-1}）	0.06 (0.05 - 0.1)	0.08 (0.05 - 0.3)
鉻（mg kg^{-1}）	33.5 (25 - 43)	31.6 (16 - 41)
銅（mg kg^{-1}）	34.3 (27 - 50)	32.6 (17 - 47)
汞（mg kg^{-1}）	0.09 (0.06 - 0.16)	0.12 (0.06 - 0.19)
鎳（mg kg^{-1}）	19.4 (15 - 27)	19.0 (10 - 25)
鉛（mg kg^{-1}）	39.2 (32 - 55)	38.5 (20 - 54)
鋅（mg kg^{-1}）	97.4 (73 - 130)	90.9 (48 - 120)
砷（mg kg^{-1}）	10.5 (7.5 - 14)	11.1 (6.3 - 14)
多環芳烴 (µg kg^{-1})	132 (86.5 - 267)	162 (90.5 - 379)
多氯聯苯（µg kg^{-1}）	4.8 (2.5 - 15)	6.2 (2.5 - 15)

附註：

a) 表內的數據均是算術平均值；括號內的數字是變化範圍。

b) 各項數據，是每年在各個取樣地點收集兩次樣本，然後在實驗室中進行化驗分析的結果。

c) 所有參數均以乾重量為單位，另有註明者除外。

根據現有和未來的沉積物分類指引，上述數據顯示沉積物不屬已受污染的類別。

A3.4　　　　水質敏感受體

在電纜沿線和登岸地點附近所識別的水質敏感受體，分別屬於已刊憲的泳灘、海水進水口、漁業資源和具生態價值的地區。這些水質敏感受體均展示於*圖 A2*，並摘述如下。

- **已刊憲泳灘**：蝴蝶灣；其他屯門泳灘，包括青山灣、嘉道理灣、新咖啡灣和黃金泳灘；

- **漁業資源**：人工魚礁、商業魚類產卵場；

- **海水進水口**：機場進水口；青山發電廠進水口；屯門 38 區進水口；紹榮鋼鐵廠進水口；屯門水務署進水口；及

- **具生態價值地點：**位於沙洲／龍鼓洲東面和磨刀島的中華白海豚生境；散頭及大蠔灣的海草。

表 A5 羅列了電纜走廊和敏感受體之間的距離。

表 A5　擬議電纜沿線與敏感受體間之最短距離

辨認號	敏感受體	與擬議電纜鋪設路線大約的距離（米）
A1	位於機場的人工魚礁	80
B1	蝴蝶灣泳灘	370
B2	屯門泳灘	1,700
S1	機場海水進水口（北）	270
S2	機場海水進水口（東）	750
S3	屯門水務署海水進水口	1,700
S4	第 38 區海水進水口	2,400
S5	紹榮鋼鐵廠海水進水口	3,000
S6	青山發電廠海水進水口	3,800
F1	馬灣魚類養殖場	9,000
D1	沙洲／龍鼓洲東面之中華白海豚生境	6,000
B1	散頭之海草	4,000

應予注意的是，這些敏感受體與電纜走廊之間的真正距離，可能會超過*表 A5* 所羅列的數值，視乎電纜在工程區內的安放位置而定。

A4　水質影響評估

擬議鋪設的 132kV 海底電纜系統在施工和運作階段可能產生的水質影響將於下文闡述。

A4.1　施工階段

A4.1.1　電纜鋪設工程

有關以電纜掩埋機進行掩埋的一段電纜，負責鋪設工程的承建商將會提供施工方法的資料。

下列各個工程項目簡介均採用下文所詳述的方法計算懸浮沉積物的漂移情況，並已經獲發環境許可證。

- *香港電燈有限公司之黃竹坑 － 春坎角 132kV 電路之 132kV 海底電纜鋪設工程*（AEP-132/2002）。於 2002 年 4 月 16 日獲發環境許可證。
- *FLAG 北亞環迴電路*（AEP 052/2001）。於 2001 年 6 月 18 日獲發環境許可證（EP-099/2001）。

- *新電訊之香港新電訊有限公司：本地通訊電纜* (AEP-086/2000)。於2001年2月16日獲發環境許可證（EP-086/2000）。

- *GB21（香港有限公司）之 C2C 電纜網絡－香港段：舂坎角*（AEP-087/2000）於2000年2月16日獲發環境許可證（EP-087/2000）。

- *Asia Global Crossing 之東亞通訊電纜系統（將軍澳段）*（AEP-081/2000）。於2000年10月4日獲發環境許可證（EP-081/2000）。

- *Asia Global Crossing 之東亞通訊電纜系統*（AEP-079/2000）。於2000年9月6日獲發環境許可證（EP-079/2000）。

- *EGS 之亞太通訊電纜網二號海底光纖電纜系統於大嶼山塘福之海底通訊電纜登岸設施工程*。於2000年7月26日獲發環境許可證（EP-069/2000）。

- *位於大嶼山南岸塘福第328號約第591SA地段之北亞海底光纖通訊電纜系統遠程通訊設施及相關之電纜登岸工程*（AEP-064/2000）。於2000年6月獲發環境許可證（EP-064/2000）。

- *中華電力有限公司從大網仔至橋咀之 11kV 電纜*。按照*《前濱及海床（填海工程）條例》*的規定，於2004年於憲報刊登。

- *中華電力有限公司之爛角咀至蛇口海底電纜系統*。按照*《前濱及海床（填海工程）條例》*的規定，於2005年於憲報刊登。

在電纜走廊沿線的大部份電纜敷設工作，將由一艘鋪纜躉船上的水力噴注工具進行。該噴注工具利用水力噴注技術沖開海床上的沉積物，讓電纜安全和準確地沉入特定的掩埋深度。纜槽大部份是由鋪設電纜時所揚起的沉積物填平，餘下的部份便靠自然沉積填平。在鋪設電纜的過程中，海床上的沉積物會被沖起，其中小部分會懸浮於噴注工具四週的海水中。這些數量不多的懸浮沉積物，會被潮水沖離電纜走廊。

由於電纜靠岸區的水位很淺，因此，電纜掩埋工程會以抓斗式挖泥機或從挖泥船伸出吸管來挖掘纜槽，然後以挖出的物料回填。需要在登岸地點挖掘的大都是較幼細的物料，而且需要挖掘的數量亦很少（最多為50,000立方米）。在進行挖掘工程時，部份幼細的沉積物會懸浮於四週的水中。

沉積物漂流情況計算

沉積物進入懸浮狀態的速率，可以用下列公式計算：

<u>釋放率</u> = 受干擾沉積物之橫截面面積 X 電纜敷設機器之速度 X 沉積物之乾密度 X 流失百份比

<u>受干擾區之深度</u> = 5米（電纜之掩埋深度）

受干擾區之闊度　　=　每條電纜 2 米（受干擾區於海床之闊度）

橫截面最大面積　　=　每條電纜 5 平方米（由水力噴注器所形成的鍥形槽）

流失率　　=　20%（大部分沉積物均未受干擾）

機器速度　　=　每秒 0.022 米（每小時 80 米）

原地乾密度　　=　每立方米 600 公斤（香港海床沉積物之常見密度）

釋放率　　=　每秒 13.2 公斤

在鋪設電纜時，海床上的沉積物會被釋出至水體的底部，從而令局部範圍內的懸浮沉積物濃度增高，同時亦會令沉積速度加快。這是因爲在一個局部地區內的高濃度懸浮沉積物會凝聚成較大的顆粒，即所謂絮凝過程，而凝聚後的較大顆粒會比原先的顆粒沉積得更快。

預計無論水深多少，懸浮沉積物都會保持在海床附近 1 米的範圍。雖然貼近海床的水流速度，會因爲海床的磨擦力而比海面的水流速度低，但在評估時仍以電纜走廊的海面水流速度估計值的上限，即每秒 1.5 米這個極爲保守的數值作爲計算的依據。預計沉積物在一開始時，會沿著電纜走廊的中軸擴散至最多 6 米的距離。這個距離亦正是噴注工具的長度。在一般情況下，懸浮固體多會在電纜鋪設工程的四周形成，但爲了評估潛在的影響，顧問採用了一個保守的假設，即有一股側向的水流，將沉積物沖向那些對沉積物敏感的地點。

根據上述各項假設，並再假設出現最壞的情況，令沉積物均勻地混和在水體最底的 1 米和最初的擴散距離所形成的範圍內。這樣，懸浮沉積物的最初濃度可以用下列公式計算出：

最初濃度　= 釋放率 ÷（水流速度 X 沉積物高度 X 沉積物闊度）

釋放率　= 每秒 13.2 公斤

水流速度　= 每秒 1.5 米

沉積物高度　= 1 米

沉積物闊度　= 6 米

最初濃度　= 每立方米 1.47 公斤

至於沉積速度，可以運用“水質及水力模型”研究中所得出的關係公式加以計算。該公式曾被成功地應用於多項評估研究之中，用以確定多項本地挖泥工程所揚起的沉積物的擴散情況。該公式如下：

<u>沉積速度</u> = 0.01 x (懸浮沉積物濃度)

<u>懸浮沉積物濃度</u> = 1.47 kg m^{-3}

沉積速度= 0.0147 m s^{-1} = 14.7 mm s^{-1}

不過，當沉積物重新沉積回海床時，其濃度會逐漸降低。爲了反映這項因素，需將上述沉積速度減半，變成每秒 7.3 毫米。這個方法與南丫島發電廠擴建部份的輸氣管工程的環境影響評估中所用方法一樣(1)。

這樣，懸浮沉積物重新沉積回海床所需要的時間，便等於沉積物的最大高度除以平均沉積速度。

沉積時間 = 1 m /0.0073 m s^{-1} = 137 s

至於沉積物的漂流距離，則等於沉積時間乘以水流速度。

漂流距離 = 137 s x 1.5 m s^{-1} = 205.5 m

上述計算結果顯示，鋪設電纜所揚起的沉積物，會在電纜沿線的 206 米範圍內重新沉回海床。

A4.1.2 岸端挖泥工程

由於電纜靠岸區的水位很淺，因此，在屯門岸端的電纜掩埋工程會以抓斗式挖泥機來挖掘纜槽。而在機場岸端，抓斗式挖泥法和吸管法兩種方法都已考慮採用。纜槽內的電纜將會由潛水員安放，再以清潔的海沙回填。

爲了預測在挖泥時近處被揚起的沉積物的變化情況，顧問採用了在“十號及十一號貨櫃碼頭之填海及邊緣結構設計”(2)以及竹篙灣填海評估 (3)中所使用的相近方法。這個方法運用一個簡單的數學模型來計算沿著一股卷流中軸線的懸浮沉積物深度平均濃度。方法是求取一條連續線來源的漂移－擴散公式 (4)的解。這個數學模型很適合用作計算挖掘纜槽所產生的懸浮沉積物濃度，因爲這條公式是基於沉積物來自一條連續的線性的來源，與抓斗挖泥時沉積物被揚起成爲懸浮沉積物的情況相似。

該公式如下：

$$C(x) = q/(D*x*\omega*\sqrt{\pi})$$

(1) 香港環境資源管理顧問有限公司 (1998) 爲香港電燈有限公司進行之《南丫島發電廠擴建部份之1,800MW 燃氣發電廠之環境影響評估》。

(2) 茂盛（亞洲）工程顧問有限公司 (1995). 爲大嶼山港口發展第一期進行之《十號及十一號貨櫃碼頭及後勤區之填海及邊緣結構設計環境影響評估最後報告》。

(3) 香港環境資源管理顧問有限公司 (2000). 《於北大嶼山竹篙灣興建一個國際主題公園及其相關之必要基礎設施之環境影響評估》。

(4) Wilson R E (1979) “估計懸浮沉積物卷流之濃度及空間伸延之模型”河口及海岸科學。卷九頁 65-78。

其中： C(x) = 與來源的距離爲 x 時之濃度

q = 沉積物流失率

D = 水深

x = 與來源之距離

ω = 擴散速度

上述公式只能應用於當由下列公式所求得的 γ 值很小，而且ω/u 的值亦很小的情況下。

$\gamma = Wt/D$

其中： W = 懸浮沉積物的沉積速度

t = 時間

D = 水深

沉積速度（W）

在模擬灣仔第二期發展計劃填海工程[1]中的挖泥工程所引起的沉積物卷流時，幼細沉積物的沉積速度被假定爲每秒 0.0001 米。這個數值亦適用於這次研究的被挖物料中被揚起的幼細部份。

時間（t）

"t"的數值被設定爲潮水週期的一半，亦即潮汐週期中低潮與高潮之間的時間。在香港，春潮期間的低潮間距爲最大。從潮漲至潮退可達八個小時。

水深（D）

淺水區（<-3mCD）的基底由岩石、毛石和沙粒粗成，而在深水區（-5mCD）則主要是泥濘。因此，在進行挖泥工程時懸浮沉積物擴散方向的具代表性水深是約 5 米。

擴散速度（ω）

至於擴散速度，則採用了香港電燈公司的深水灣 132kV 電纜鋪設工程，以及竹篙灣發展項目的填海工程中用作評估近距離沉積物卷流所採用的數值，即每秒 0.01 米[2]。擴散速度代表中線濃度因爲橫向分散而減少的幅度。

(1) 茂盛（亞洲）工程顧問有限公司 (2001)。《灣仔發展第二期綜合可行性研究環境影響評估研究》環境影響評估報告。.

(2) 香港環境資源管理顧問有限公司 (2000)。同上

根據這些資料而計算得的 γ 數值爲 0.58，屬於細小。在電纜沿線附近的水流速度的保守估計值爲每秒 1.5 米。換言之，ω/u 的值等於 0.007，亦屬細小。因此，上述公式可以有效地使用。

沉積物流失率（q）

幼細沉積物被揚起成爲懸浮狀的速度，是根據工作的速度和方法來計算。在屯門岸端進行的挖掘纜槽工作，將會使用一部抓斗式挖泥機進行，以每日 1,500 立方米的最高速度工作 10 小時。而在機場岸端，則將會使用一部抓斗式挖泥機或吸管式挖泥機進行，分別以以每日 675 立方米或 1,600 立方米的最高速度工作 16 小時。根據一份就奇力灘設置繫泊浮筒而進行挖泥工程的環影響評估結果(1)，抓斗式挖泥機在沒有顯著碎屑的區域工作時，具代表性的沉積物流失率是每挖泥一立方米流失 17 公斤。然而，這個數值是來自抓斗式挖泥機在多泥的沉積物上工作。這種沉積物的幼細部份可達 80%。因此，在屯門岸端，抓斗式挖泥工程所造成的沉積物流失率應是每秒 0.71 公斤，在機場岸端則是每秒 0.19 公斤。

吸管式挖泥機所導致的流失率應比抓斗式挖泥機較低。鑑於吸管式挖泥機的運作原理與拖曳式挖泥機相似，因此假定兩者所造成的流失率相同，即每挖掘一立方米流失 7 公斤 (2) (3)。若假設不允許有溢出情況發生，而且吸管亦加上密封，吸管式挖泥工程的流失率便是每秒 0.19 公斤。

與來源的距離爲 x 時之濃度（C(x)）

表 A6 展示了運用上述公式而計算出的評估結果。

表 A6　　預計於岸端挖泥而造成的懸浮沉積物濃度

與來源距離	屯門（抓斗式挖泥）	機場（抓斗式挖泥）	機場（吸管式挖泥）
	濃度（$mg\ L^{-1}$）	濃度（$mg\ L^{-1}$）	濃度（$mg\ L^{-1}$）
10	799	217	219
100	80	22	22
200	40	11	11
500	16	4	4
1000	8	2	2
2000	4	1	1
3000	3	1	1

(1) 香港環境資源管理顧問有限公司 (1997)。爲興建六個政府繫泊浮筒而於奇力灘其中一區進行挖泥工程之環境影響評估。

(2) Kirby, R and Land J M (1991)。挖泥的影響－比較人天然及人工挖泥對黏性沉積層的干擾。 1991 年 11 月於亞姆斯特丹舉行之 CEDA - PINC 研討會記錄（連同 CEDA 挖掘日）。荷蘭中央挖泥學會。

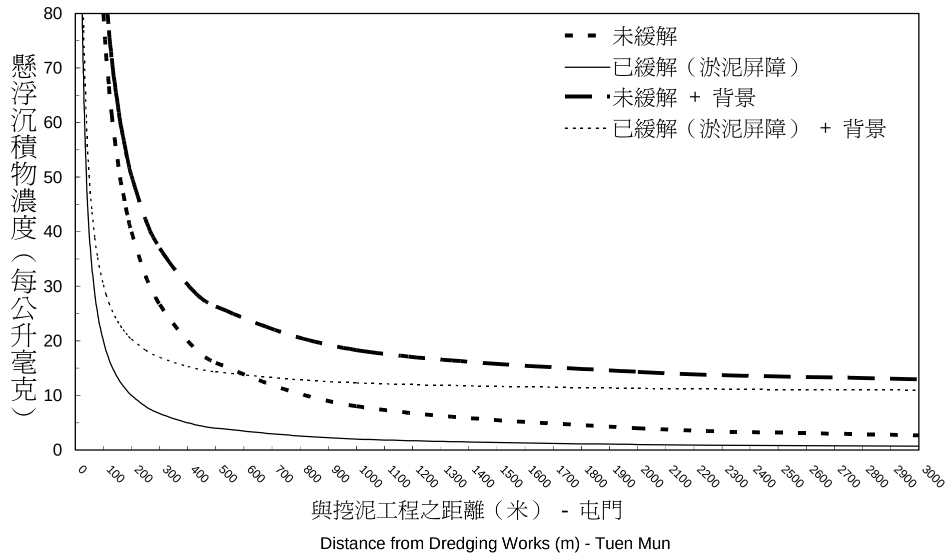
(3) Environment Canada (1994). Les Consultants Jaques Beraube Inc 爲加拿大魁北克及安大略省環境局環境保護署技術發展處進行的「挖泥及卸置沉積物的環境影響」研究。

中電已建議在挖泥機四周設置淤泥屏障，務求盡量減少沉積物漂離工程區的數量。根據灣仔發展計劃第二期填海工程的環境影響評估結果[(1)]，設置淤泥屏障可以減少懸浮固體的擴散速度達四倍之多。*表 A7* 展示設置淤泥屏障後的懸浮固體濃度。*圖 A3*、*A4* 和 *A5* 則展示離開來源不同距離時的懸浮固體濃度變化。

表 A7　　預計於岸端挖泥而造成的懸浮沉積物濃度（已設淤泥屏障）

與來源距離	屯門（抓斗式挖泥）濃度（mg L^{-1}）	機場（抓斗式挖泥）濃度（mg L^{-1}）	機場（吸管式挖泥）濃度（mg L^{-1}）
10	200	54	55
100	20	5	5
200	10	3	3
500	4	1	1
1000	2	1	1
2000	1	0	0
3000	1	0	0

圖 A3　　預計於屯門岸端挖泥而增加之懸浮沉積物濃度



(1)　茂盛（亞洲）工程顧問有限公司 (2001)。同上。

圖 A4　　　預計於機場岸端使用抓斗式挖泥而增加之懸浮沉積物濃度

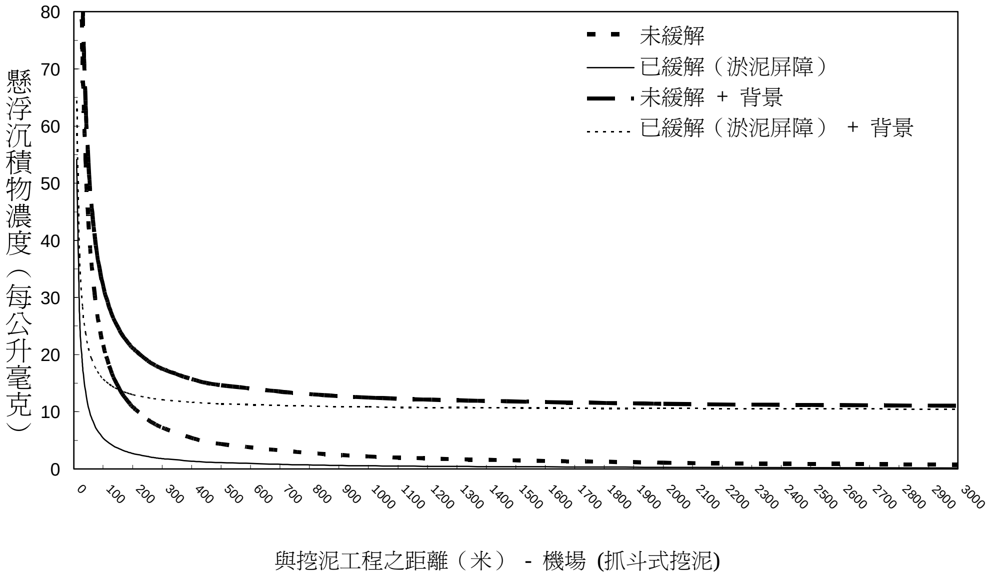
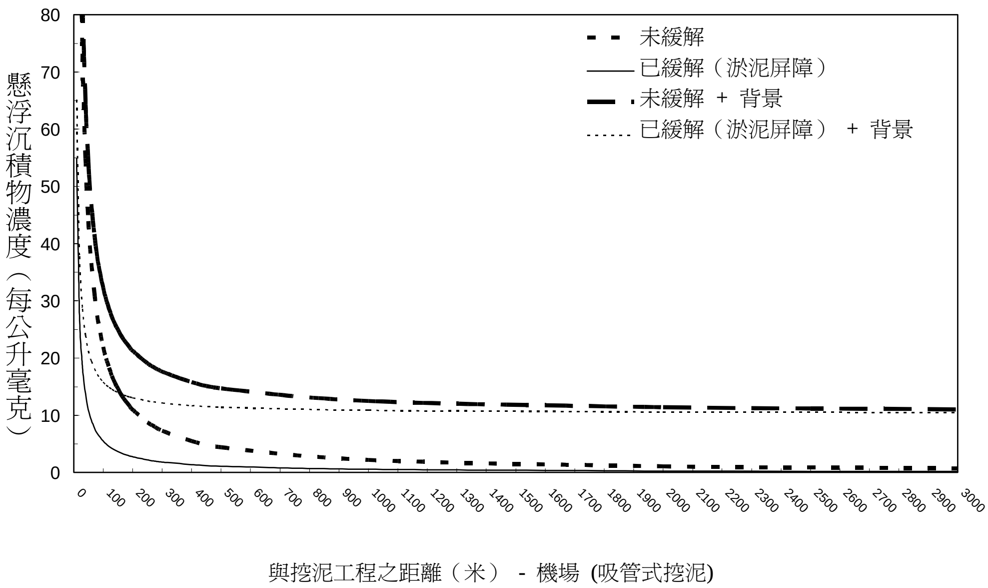


圖 A5　　　預計於機場岸端使用吸管式挖泥而增加之懸浮沉積物濃度



根據上述結果，挖泥工作只會令局部地方的懸浮固體增加。預期附近的敏感受體不會有超標，特別是在水務署沖廁用水進水口和機場進水口。

在採用淤泥屏障後，只有位於距離屯門岸端 200 米的懸浮固體濃度才會超過水務署進水口的水質標準(每公升不超 20 毫克)，而只有位於距離機場岸端 70 米的懸浮固體濃度才會超過機場海水進水口的水質標準(每公升不超過 8.7 毫克)。

A4.2 潛在影響

下文所述，是這項工程對海水水質的已知可能影響（不論是直接或間接影響）。

A4.2.1 懸浮固體增加

鋪設電纜會令電纜掩埋機四周形成一個懸浮沉積物濃度偏高的範圍。這些高濃度的懸浮沉積物會一直貼近海床，並會迅速重新沉積。顧問對水體中的幼細懸浮沉積物的漂流情況進行了分析，並確定最遠的漂流距離爲 206 米，屬於短距離。鋪設電纜所揚起的沉積物亦會在一段很短的時間內保持懸浮狀態，並會逗留在一個局部範圍內。因此預計，電纜鋪設工程不會對水質造成不良影響。

在鋪設岸端的電纜時，挖泥工程會使懸浮固體揚起至水中，而在回填時亦會如此，但程度較輕。從懸浮沉積物漂流和濃度的預測可以看到，在裝設淤泥屏障後，只有距離屯門和機場岸端 100 米的地方的懸浮固體的濃度才會超過每公升 10 毫克。因此，挖泥工程可能對水質造成的影響只屬短暫，懸浮沉積物的濃度亦屬偏低。

除了蝴蝶灣泳灘（即 B1）（*表 A5*）和機場的海水進水口（即 *S1* 和 *S2*）（*表 A5*）之外，其他敏感受體和污染來源的距離最少有 1,700 米。基於上述結果，預計懸浮固體的增加不會對這些遙遠的敏感受體造成不可接受的影響。在 B1 方面（距離屯門登岸點 370 米），預測抓斗式挖泥會令懸浮固體濃度增加至每公升 6 毫克。此外，*表 A7* 所羅列的結果顯示，在使用淤泥屏障作爲緩解措施後，機場的吸管式挖泥工程會在距離挖泥點 200 米的地方，令懸浮固體濃度每公升增加 4 毫克。根據預測，S1（距離機場登岸點 260 米）的懸浮固體濃度不會出現不可接受的超標情況。因此，吸管式挖泥工程所引致的懸浮沉積物增加只屬短暫，不會對海水進水口造成不可接受的影響。

A4.3 電纜鋪設工程之緩解措施

在鋪設電纜時，將會實施下列措施。

- 雖然抓斗式和吸管式挖泥方法都只會造成小量沉積物流失，承建商仍會在挖泥機四周裝設淤泥屏障，以便減少沉積物從登岸點向外擴散。
- 必須使用閉合抓斗式挖泥機，以免懸浮固體擴散至海中。
- 應限制在屯門岸端的最大挖泥速率爲以每日 1,500 立方米的速度工作 10 小時。
- 不論承建採用那一種挖泥方法，應限制在機場岸端的最大挖泥速率。使用抓斗式挖泥機的最大挖泥速率爲以每日 650 立方米的速度工作 16

小時，而使用吸管式挖泥機的最大挖泥速率則爲以每日 1600 立方米的速度工作 16 小時，即分別是每小時 41 立方米和 100 立方米。

- 運送被挖出物料的躉船都必須把船底密封，以免在裝貨和運送途中有物料滲漏。
- 所有躉船都只應裝載至一個特定水平，以確保物料不會在裝船和運送途中溢出，並應保持一定高度的乾舷，以確保海浪不會沖上甲板。
- 水力噴注機的最高前進速度應限制在每小時 80 米，以及每天 24 小時運作。

除了上述措施外，承建商亦會進行水質監察，以便對登岸地點挖泥工程所造成的沉積物卷流的擴散情況預測進行驗證。

A4.4 運作階段

應予注意的是，使用電纜掩埋機鋪設電纜不會對海底的沉積物做成長遠的干擾；而且，是項工程亦不會干擾水流。在進行上述各種海洋工程時，以及在工程完成後，都不會對水質造成不良影響。電纜在運作時不會排放任何污染物至附近海域。雖然在使用電纜掩埋機鋪設電纜時會令小量海底沉積物短暫轉移，但在電纜鋪設完成後，海底沉積物便會自然重新沉積。

因此，在電纜系統的運作階段無需實施任何緩解措施。

A5 摘要和結論

顧問對屯門和機場兩個電纜靠岸區的挖泥工程，以及海底電纜鋪設工程可能造成的沉積物擴散影響，進行了檢討和評估。

敏感受體亦已被識別出，其中大部份都距離擬議電纜鋪設路線最少 1,700 米。有關沉積物由施工地點向外漂流的計算結果顯示，預期在敏感受體附近的位置不會有任何超標。裝設淤泥屏障已被證實爲可以有效地縮小沉積物的擴散範圍。大部份敏感受體都遠離進行電纜鋪設工程和挖泥工程的地點，而且工程爲時短暫，因此不會受到水質惡化的影響。

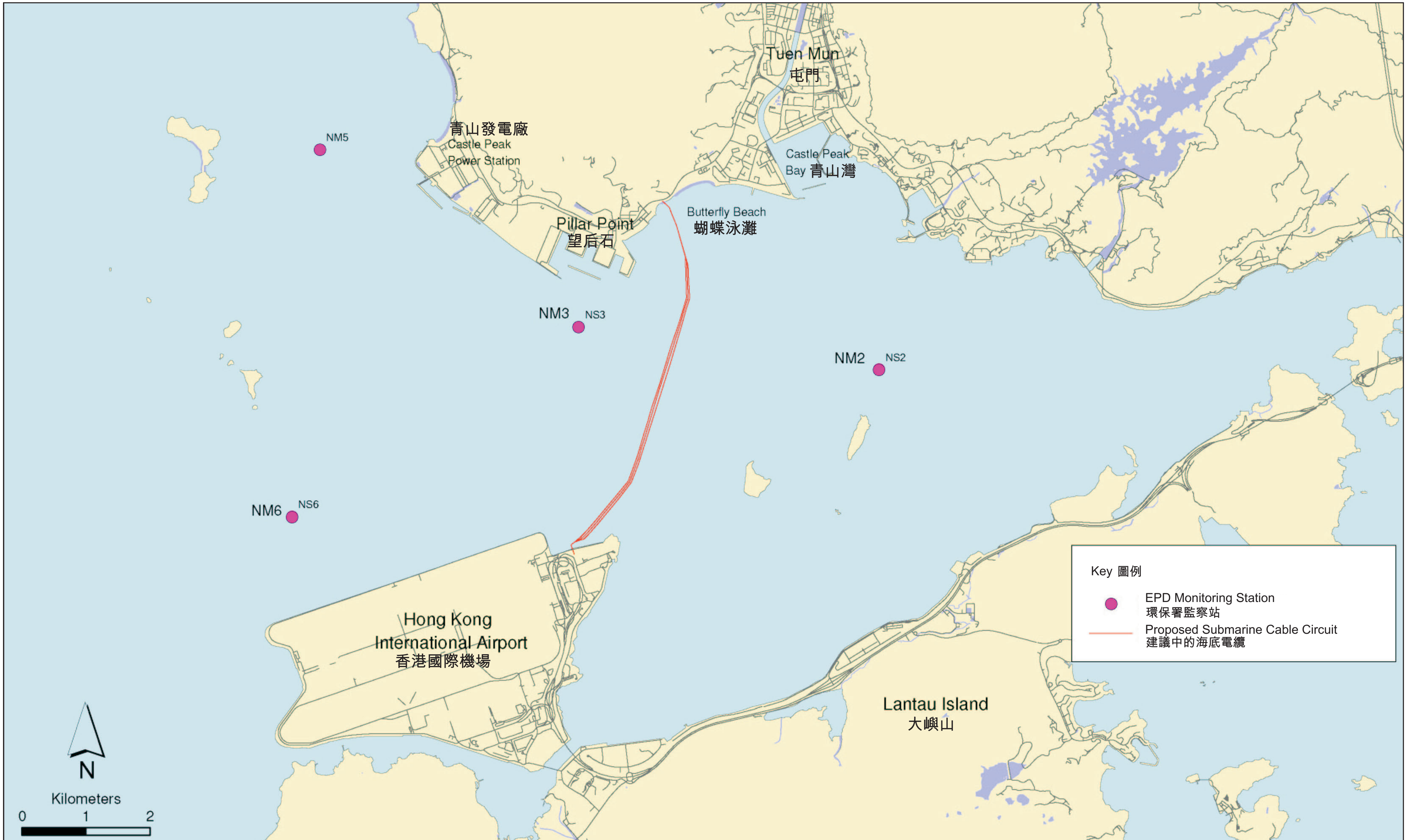


Figure A1
圖A1

Location of Routine Water Quality and Sediment Quality Monitoring Stations
定期水質監察站和沉積物質素監察站位置

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DATE: 11/07/2006

Environmental
Resources
Management

ERM

Figure A2
圖A2

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Location of Water Quality Sensitive Receivers
水質敏感受體位置

Environmental
Resources
Management

ERM

Annex B
附錄B

Marine Ecology
海洋生境

CONTENTS

B1 INTRODUCTION

This *Annex* presents the baseline conditions of ecological resources in the vicinity of the proposed submarine cable circuit from Tuen Mun to Airport. Results of the assessment of the potential ecological impacts from the construction and operation of the cable system are presented. Measures required to mitigate identified adverse impacts are recommended, where appropriate.

B2 RELEVANT LEGISLATION AND GUIDELINES

The criteria for evaluating marine ecological are laid out in the *EIAO TM*. *Annex 16* of the *EIAO TM* sets out the general approach and methodology for the assessment of marine ecological impacts arising from a project or proposal, to allow a complete and objective identification, prediction and evaluation. *Annex 8* of the *EIAO TM* recommends the criteria that can be used for evaluating such impacts.

Other legislation which applies to marine ecology includes: *The Wild Animals Protection Ordinance (Cap. 170) 1980*, which protects all cetaceans.

B3 MARINE ECOLOGICAL RESOURCES BASELINE CONDITIONS

B3.1 ECOLOGICAL SENSITIVE RECEIVERS

There are a number of ecological sensitive receivers located within north Lantau waters but away from the proposed 132 kV submarine cable route and landing points at Tuen Mun and the Airport (*Figure 1.2*).

B3.2 SITE OF SPECIAL SCIENTIFIC INTEREST

The San Tau Beach Site of Special Scientific Interest (SSSI), which provides a nursery ground for horseshoe crabs in Hong Kong and has associated mangroves, mudflat and seagrass beds, is the nearest SSSI from the proposed cable circuit in the marine environment. The SSSI is located approximately 4 km from the proposed submarine cable alignment.

B3.3 MARINE PARK

There are currently three designated Marine Parks in Hong Kong waters and one Marine Reserve. The Sha Chau and Lung Kwu Chau Marine Park, is located within the study area (see *Figure 1.2*). Covering an area of approximately 1,200 ha, the Marine Park encloses the Lung Kwu Chau, Tree Island and Sha Chau SSSI, which was designated for ornithological interest. The Marine Park is located approximately 5.5 km from the proposed submarine cable alignment.

B3.3.1 Intertidal Mudflats and Horseshoe Crab Habitats

Intertidal mudflats are classified as areas of fine-grained sediment (ie silt or fines) which lie between the high and low tide marks which are not covered by seagrasses, mangroves or typical wetland vegetation and are generally fed with freshwater streams. Also considered to be habitats of ecological importance, mudflats provide key breeding grounds for a variety of species, and act as food sources for both fisheries resources and resident and wintering birds in Hong Kong.

Horseshoe crabs are an ancient and taxonomically isolated group (class Merostomata, sub-class Xiphosura) related to spiders, ticks and mites. Three species occur in HKSAR waters: *Tachypleus tridentatus*, *T. gigas* and *Carcinoscorpius rotundicauda*. These represent all species known from the South China Sea, and three of the four species known world-wide. The intertidal mudflat habitats, located within Tung Chung Bay and Tai Ho Bay have been identified as a breeding ground for horseshoe crabs (*Tachypleus tridentatus* and *Carcinoscorpius rotundicauda*) (1). The intertidal mudflats, as well as the horseshoe crab nursery grounds, are located at least 4 km from the proposed submarine cable alignment and landing point at the Airport.

B3.3.2 Mangrove

Mangroves provide food, shelter and breeding grounds for a range of organisms including various pelagic and coastal fisheries, and birds (2). Two main mangrove stands are present within the study area located at Tung Chung Bay and Tai Ho Bay. Within Tung Chung Bay, there are two separate stands, namely Tung Chung Bay itself and San Tau Beach. The mangroves are located at least 4 km from the proposed submarine cable alignment and landing point at the Airport.

B3.3.3 Seagrass Beds

Seagrass beds occur in shallow, sheltered or subtidal areas and are recognised as areas of high biological productivity. They provide high value habitat as feeding and nursery ground for a range of marine species (3). Within Hong Kong, seagrass beds have been recorded with a very low distribution, occupying less than 0.1% of the total land area. Seagrass beds were recorded in San Tau, Tung Chung Bay and Tai Ho Bay. The seagrass beds are located at least 4 km from the proposed submarine cable alignment and landing point at the Airport.

B3.3.4 Marine Mammals

A total of 16 (and possibly up to 18) species of marine mammals, or cetaceans, have been recorded in Hong Kong waters (4). The Chinese White Dolphin, *Sousa chinensis,* and the Finless Porpoise, *Neophocaena phocaenoides,* are the

(1) Chiu HMC and Morton B (1999) The distribution of horseshoe crabs (*Tachyopleus tridentatus* and *Carcinoscorpius rotundicauda*) in Hong Kong. Asian Marine Biology. 16, 185-196.

(2) Tam NFY and Wong YS (1997) Ecological Study on Mangrove Stands in Hong Kong: Volume 1. University Press, Hong Kong.

(3) Lee SY (1997) Annual cycle of biomass of a threatened population of the intertidal seagrass *Zostera japonica*. Marine Biology 129: 183 - 193.

(4) Jefferson, pers comm.

only two species of marine mammals regularly sighted in Hong Kong waters [1] [2].

Studies on the distribution, abundance, habitat use, and life history of humpback dolphins within Hong Kong have been undertaken since 1995 [3] [4] [5]. The results of these ongoing studies indicated in 2004 that approximately 1,300 individual dolphins are estimated to utilise the waters of the Pearl River Estuary. Of these individual dolphins, approximately 360 are thought to include waters within Hong Kong as part of their range.

Historically, marine mammal data have been presented in terms of sightings [6]. Recent analysis adopted in the marine mammals monitoring study [7] has allowed data to be standardised to reflect numbers of sightings in terms of survey effort. Such data are considered to be closer to a direct indication of abundance and habitat usage than raw observational data. In order to utilise the most up-to-date data, yet still allow comparison with previous studies to be made, both types of data will be discussed.

Abundance of humpback dolphins in Hong Kong waters is highest in the north and west Lantau areas (*Figure B1*). North Lantau and West Lantau are considered to be the major habitats for humpback dolphins in Hong Kong waters where individuals of humpback dolphins have been consistently sighted throughout the year.

(1) Parsons C, Mary L. Felly and Lindsay J. Porter. 1995. An Annotated Checklist of Cetaceans recorded from Hong Kong's Terrestrial Waters. The Swire Institute of Marine Science, The University of Hong Kong, Cape d' Aguilar, Shek O, Hong Kong.

(2) Jefferson T.A. 2000. Conservation Biology of the Finless Porpoise (*Neophocaena phocaenoides*) in Hong Kong waters: Final Report. Ocean Park Conservation Foundation Ocean Park Aberdeen, Hong Kong.

(3) Jefferson T.A. 2000. Population Biology of the Indo-Pacific Humpback dolphin in Hong Kong waters. *Wildlife Monographs 144*:1-65.

(4) Jefferson T.A., S.K. Hung, L. Law, M. Torey and N. Tregenza.2002. Distribution and Abundance of Finless Porpoise in Hong Kong and Adjacent Waters of China. *The Raffles Bulletin of Zoology 2002 Supplement No. 10*: 43-55.

(5) Jefferson T.A. and S.K. Hung. 2004. A review of the status of the Indo-Pacific humpback dolphin in Chinese waters. *Aquatic Mammals (Special Issue) 30*: 149-158.

(6) AFCD. 2004. Monitoring of Chinese White Dolphins (*Sousa chinensis*) in Hong Kong waters – Data collection, Final Report (1 April 2003 to 31 March 2004), prepared by Hong Kong Cetacean Research Project

(7) AFCD. 2004. *op. cit.*

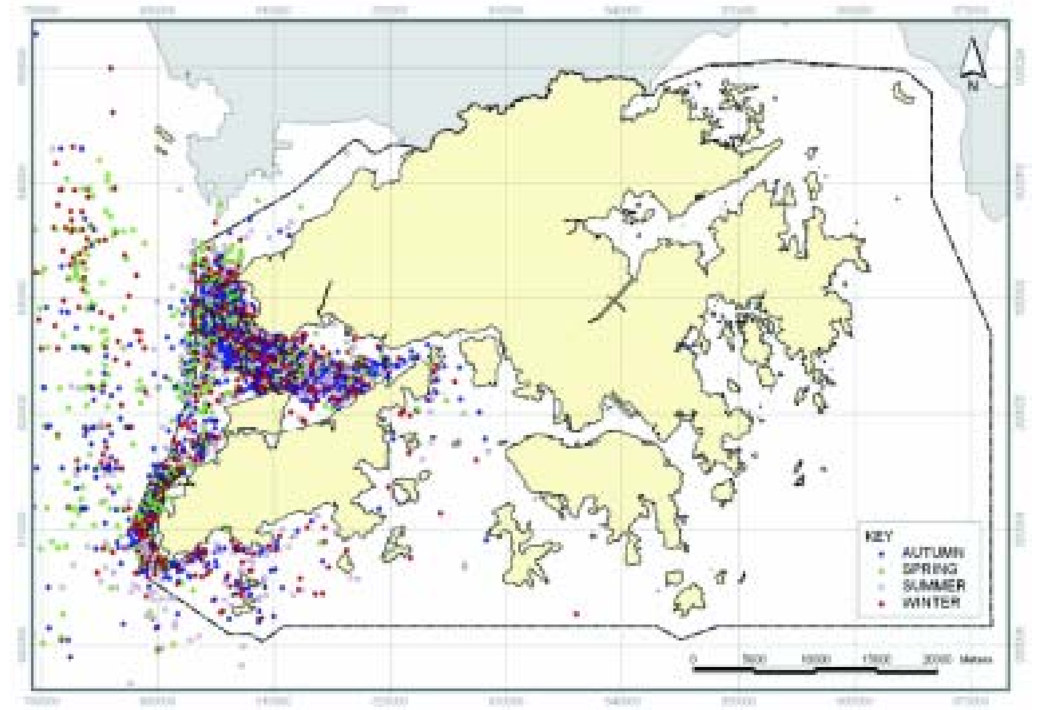

Figure B1. Seasonal Distribution of the Chinese White Dolphin, *Sousa chinensis*, in Hong Kong waters. Data Collected between 1995 and 2004 (AFCD 2004)

Humpback dolphins exhibit a seasonal shifting in abundance and density and thus a seasonal variation of abundance in different locations (*Figure B2*). The variation is thought to be due to the increased input of freshwater from the discharge of the Pearl River Estuary and the subsequent movements of estuarine prey species (1) (2) (3) .

(1) Jefferson T.A. 2000. Population Biology of the Indo-Pacific Humpback dolphin in Hong Kong waters. *Wildlife Monographs 144*:1-65.

(2) Jefferson T.A. and S.K. Hung. 2004. A review of the status of the Indo-Pacific humpback dolphin in Chinese waters. *Aquatic Mammals (Special Issue) 30*: 149-158.

(3) Barros, N.B., T.A. Jefferson, and E.C.M. Parsons. 2004. Feeding habits of Indo-Pacific humpback dolphins (*Sousa chinensis*) stranded in Hong Kong. *Aquatic Mammals (Special Issue) 30*: 179-188.

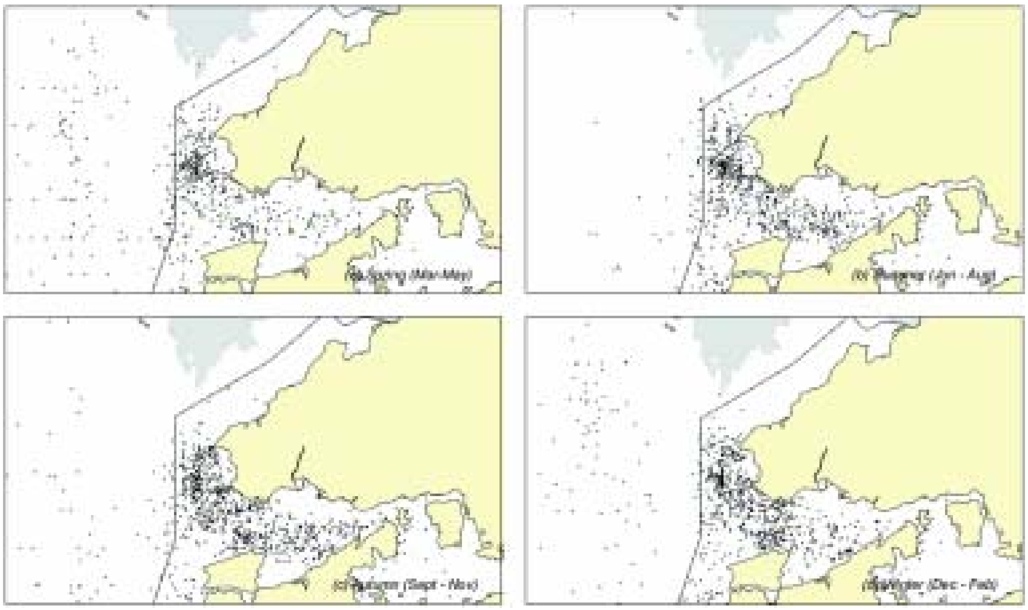

Figure B2. Seasonal Distribution of the Chinese White Dolphin, *Sousa chinensis*, in Hong Kong waters. Data Collected between 1995 and 2004 (AFCD 2004)

Recently published information indicates that the abundance of dolphins in Hong Kong ranges from 78 in spring to 217 in winter (1). Present estimates for the Pearl River Estuary population range from 731 in summer to 1,504 in winter (2).

The recent studies on marine mammals in Hong Kong have attempted to conduct quantitative analysis of habitat use (3). Sighting densities have been calculated in terms of number of on-effort sightings per km^2, with the survey area mapped using a 1 km by 1 km grid. These data are presented as Sightings Per Survey Effort (SPSE) values. The average SPSE per grid in West Lantau (most of the grids has SPSE value >20) is the highest (15.55) compared with the average in Northwest Lantau of 5.30. The grids around the proposed cable circuit have SPSE values ranging between 0 – 17. The results indicate that the area around the route has relatively low density for dolphins, and the nearest high density area is along the east coast of Lung Kwu Chau (6 km away).

In contrast to humpback dolphins, studies on the finless porpoise indicate that the majority of sightings have been recorded in the southern and eastern waters of Hong Kong. No sightings have been recorded in the waters surrounding the proposed submarine cable route (4).

Based on the results of the information available from the long-term studies on marine mammals in the waters of Hong Kong, it appears that of Hong

(1) Jefferson T.A. and S.K. Hung. 2004. A review of the status of the Indo-Pacific humpback dolphin in Chinese waters. *Aquatic Mammals* (Special Issue) 30: 149-158.

(2) AFCD. 2004. Monitoring of Chinese White Dolphins (*Sousa chinensis*) in Hong Kong waters – Data Collection, Final Report (1 April 2003 to 31 March 2004), prepared by Hong Kong Cetacean Research Project..

(3) AFCD. 2004. *ibid*

(4) AFCD. 2004. *ibid.*

Kong's resident cetacean species, only humpback dolphins were recorded within the waters surrounding the proposed submarine cable route.

B3.4 POTENTIALLY AFFECTED AREAS DUE TO THE CABLE INSTALLATION

B3.4.1 *Landing Sites*

The habitat of the proposed landing site at Tuen Mun is identified as a sandy shore. The assemblages present on the shore were of similar composition and abundance to other sandy shores in Hong Kong. The sandy shore will only be temporary affected during the cable installation. If the assemblages are disturbed during the cable laying process it is likely that the fauna can recolonise once the disturbance has ceased.

The habitat of the proposed landing site at the Airport is identified as an artificial seawall. The assemblages present on the shore were of similar composition and abundance to other artificial seawall and sheltered rocky shores in Hong Kong. The artificial seawall at the Airport will not be directly affected and the cable circuit will be fed into the existing cable duct entrance at the base of the seawall. As assemblages are not disturbed during the cable laying process direct impact to marine organisms on the seawall are not predicted to occur.

B3.4.2 *Submarine Cable Alignment – Subtidal Soft Bottom Habitat*

Subtidal soft bottom habitats, as well as supporting infaunal species, commonly support macro-benthic epifauna. These organisms are generally greater than 1 mm in size and live either on or within the surface sediments. As part of the recently completed and most comprehensive benthic study in Hong Kong, there were thirteen sampling stations located within north Lantau waters in which two were very close to the proposed cable alignment [(1)]. The species diversity and abundance of the benthos within north Lantau waters were low in comparison to other areas in Hong Kong and therefore the ecological value of the subtidal soft bottom habitat is considered to be low.

B4 *MARINE ECOLOGICAL IMPACT ASSESSMENT*

Impacts to marine ecological resources arising from the proposed submarine cable may be divided into those due to direct disturbances to habitats / marine organisms and those due to perturbations to water quality parameters through sediment dispersion during dredging and cable laying.

B4.1 DIRECT IMPACTS DURING CONSTRUCTION

No long term direct impacts are expected to occur due to the dredging and cable laying activities. Short term impacts are predicted to occur as a result of the dredging works at Tuen Mun and the Airport.

(1) CityU Professional Services Limited (2002) Consultancy Study on Marine Benthic Communities in Hong Kong. Final Report to Agriculture, Fisheries and Conservation Department.

Soft Substratum Habitats: Short term impacts are predicted to occur as a result of the dredging and cable laying activities, although once these marine works have ceased, marine ecological resources in the affected area are expected to return due to recolonisation of the seabed by benthic fauna. Hence direct impact on the subtidal soft bottom habitats is not anticipated to be a major concern.

Artificial Hard Substratum Habitats: Habitat loss would not be anticipated. Short term impacts are predicted to occur to the intertidal artificial seawall as a result of the shore-end construction activities. Therefore, impacts to the artificial habitats as a result of the proposed construction works are not anticipated to be a major concern.

Marine Mammals: Impacts to marine mammals as a result of the cable installation activities are generally not considered to be adverse. As *Sousa chinensis* is a highly mobile organism, the impacts from the slow moving submarine cable installation vessel and machine are not expected to be high.

B4.2 INDIRECT IMPACTS – DURING CONSTRUCTION

Indirect impacts to marine ecological resources during the construction phase include sediment release associated with the dredging works at the landing sites. Potential impacts to water quality from sediment release are listed below:

- increased concentrations of suspended solids (SS) (further discussed below);
- a resulting decrease in DO concentrations (further to the water quality assessment, insignificant effects will be expected); and,
- an increase in nutrient concentrations in the water column (further to the water quality assessment, insignificant effects will be expected).

Suspended Solids (SS)

Subtidal Soft Benthos: Sessile organisms within the benthos will be susceptible to the effects of increased sediment loads. Effects can be lethal or sub lethal (eg reduction in reproductive potential due to stress incurred by constantly having to flush out the depositing material). The effects of sedimentation on organisms will also depend on other factors, such as an organism's tolerance, growth orientation of sessile organisms and water movement. Infaunal benthic assemblages in Hong Kong are located in soft muds and sands which are frequently disturbed by storms, seabed currents and constant trawling activity which rework the sediments creating high suspended sediments loads in the water column. Benthic invertebrates are, therefore, not likely to be adversely affected by the dredging works with respect to sediment suspension and settlement.

Impacts to benthic assemblages immediately outside of the dredging areas are expected to occur temporarily. The area is expected to be small, as sediment will be deposited within a short distance of the dredging works (*Annex A*). The predicted deposition rates are not likely to impact the natural benthic assemblages in north Lantau waters which are often disturbed by demersal trawling, storms and freshwater runoff from the Pearl River. The organisms present are thus considered to be adapted to seabed disturbances. As the affected areas will be recolonised by fauna typical of the area, the temporary loss of these low ecological value assemblages is deemed acceptable.

Intertidal Habitats: Intertidal habitats within the study area, which may be affected by the dredging works, including the sandy shore and artificial seawall located along the coastlines in the vicinity of the landing sites. No unacceptable impacts will be expected due to the low ecological value of the sandy shore and artificial seawall. No impacts on the ecological sensitive areas, including mangrove, seagrass and intertidal mudflat, as well as the horseshoe crab nursery ground, will be expected as those areas are located at least 4 km from the proposed cable alignment and the dredging areas.

Marine Mammals: Impacts to marine mammals as a result of elevations of SS concentrations are generally associated with the potential influence on prey and, therefore, affect the animals indirectly. As impacts to fisheries resources are not expected to occur (*Section 4.9*), it is thus expected that unacceptable impacts to marine mammals arising from elevated SS levels will not occur. As discussed in *Annex A*, the EPD data show that the sediment of the study area are not classed as contaminated (no exceedance of Lower Chemical Exceedance Level), release of dissolved contaminants due to the dredging and jetting impact on the dolphins would not expect to be anticipated. In addition, increases in slow moving works vessel traffic for the cable installation would not be expected to pose a low risk of vessel collision on marine mammals. Furthermore underwater noise during the dredging and jetting works is not expected to adversely impact any dolphins that may be present in the vicinity of the works.

B4.3 OPERATIONAL IMPACTS

There will be no need to disturb the seabed sediments during operation of the cable. Therefore neither water quality nor marine ecological resources, will be adversely affected.

B5 MITIGATION MEASURES DURING CABLE LAYING

During cable installation the following will be undertaken to minimize potential construction impacts on ecological resources including dolphins.

- Although, the low dredging rates indicate that the sediment loss is expected to be quite small, the Contractor will be employing a silt curtain around the dredger to reduce the dispersion of sediments at Tuen Mun and the Airport landing points;

- All vessel operators working on the Projects construction will be given a briefing, alerting them to the possible presence of dolphins in the area, and the rules for safe vessel operation around cetaceans;

- The vessel operators will be required to use predefined and regular routes, as these will become known to dolphins using these waters;

- The vessel operators will be required to control and manage all effluent from vessels;

- A policy of no dumping of rubbish, food, oil, or chemicals should be strictly enforced. This will also be covered in the contractor briefing;

- Every attempt will be made to minimize the effects of construction of the Projects on the water quality of the area.

- A dolphin exclusion zone within a radius of 250 m from the cable laying vessel will be implemented during the construction phase. An exclusion zone of 250 m radius will be scanned around the work area for at least 30 minutes prior to the start of cable laying. If cetaceans are observed in the exclusion zone, cable installation works will be delayed until they have left the area; and

- When dolphins are spotted within the exclusion zone, construction works will cease and will not resume until the observer confirms that the zone has been continuously clear of dolphins for a period of 30 minutes.

In addition to the above, the Contractor will be undertaking water quality monitoring to verify the predictions concerning sediment plume dispersion during dredging at Tuen Mun, and dolphin monitoring conducted by a qualified team during the submarine cable installation works to evaluate whether there have been any effects on the animals (Annex D).

B6 CONCLUSIONS

A review of the baseline marine ecological conditions of the north Lantau waters in the vicinity of the proposed submarine cable alignment and landing point have been undertaken.

All of the identified fixed location ecological sensitive receivers were located at least 4 km from the proposed cable route. The predicted elevations of suspended sediment from the dredging works at Tuen Mun and the Airport and cable laying across to Urmston Road are not predicted to exceed the WQO at sensitive receivers with implementation of mitigation measures. The cable laying and dredging works are unlikely to affect the ecological resources due to the remoteness of the sensitive receivers from the proposed cable route and no predicted adverse impact to water quality or habitat loss. It is emphasised that there are no predicted impacts to the Chinese White Dolphin, *Sousa chinensis*. The implementation of good construction practices and a code of practice for dolphins should be checked as part of the environmental monitoring and audit procedures to evaluate whether there have been any effects on the animals during the construction period. No other ecology-specific measures are considered necessary.

目錄

B1 *引言*

這份附件旨在闡述擬從屯門至機場的海底電纜走廊四周的生態資源基線情況。附件亦闡述了該套電纜系統在施工和運作階段的潛在生態影響評估結果。此外，亦在適當地方對已知的不良影響建議了緩解措施。

B2 *有關法例和指引*

在「環境影響評估程序技術備忘錄」內，已列出評估海洋生態資源影響的準則。該備忘錄的附件十六闡述了一般的方法，用以評估一項工程或方案對海洋生態可能造成的影響，以便取得完整和客觀的資料、預測和評估。該備忘錄的附件八則建議了在評估這類影響時可以採用的準則。

其他適用於海洋生態的法例包括：*《野生動物保護條例（第 170 章）1980》*。該條例保護了所有鯨目哺乳類動物。

B3 *海洋生態資源基線情況*

B3.1 *生態環境敏感受體*

北大嶼山海域有多個生態環境敏感受體。它們都遠離建議中的 132kV 海底電纜鋪設路線和位於屯門及機場的登岸點（*圖 1.2*）。

B3.2 *具特殊科學價值地點*

石散頭具特殊科學價值地點不單爲香港的馬蹄蟹提供一個育幼場，而且有紅樹林、泥灘和海草床，是距離建議中的電纜最近，且具有海洋環境的具特殊科學價值地點。該地點距離建議中的海底電纜鋪設路線約 4 公里。

B3.3 *海岸公園*

現時香港海域內有三個指定的海岸公園和一個海洋保護區。沙洲及龍鼓洲海岸公園位於研究區內（見*圖 1.2*），佔地約 1,200 公頃，包括龍鼓洲、白洲和沙洲具特殊科學價值地點，主要是因爲其鳥類方面的價值。這個海岸公園距離建議海底電纜鋪設路線約 5.5 公里。

B3.3.1 *潮間泥灘和馬蹄蟹生境*

潮間帶泥灘是位於高潮與低潮標誌之間，由幼細沉積物（即淤泥或幼泥）覆蓋，但沒有海草、紅樹林或其他典型濕地植物覆蓋的地區，通常有淡水河流入。泥灘除了是具生態價值的生境外，亦是多種生物的繁殖場，爲香港各種漁業資源，以及爲棲鳥和候鳥提供食物來源。

馬蹄蟹是一種古老生物，在分類學上屬孤立的族群（肢口綱，劍尾目），與蜘蛛、扁虱和蟎等有關。香港水域內有三個品種：*Tachypleus tridentatus*、*T. gigas* 和 *Carcinoscorpius rotundicauda*。牠們不單是南中國海所有已知的品種，亦是全世界四個已知品種中的三個。這個位於東涌灣和大蠔灣之間的潮間泥灘生境，是已知的馬蹄蟹（*Tachypleus tridentatu* 和 *Carcinoscorpius rotundicauda*）繁殖場 (1)。潮間泥灘和馬蹄蟹育幼場均距離建議中的電纜鋪設路線和機場登岸點最少 4 公里。

B3.3.2 *紅樹林*

紅樹林爲多種生物提供食物、庇蔭和繁殖場，其中包括多種遠洋和近岸的魚類和鳥類 (2)。研究區內有兩個主要的紅樹林，分別位於東涌灣和大蠔灣。東涌灣內有兩個不同的紅樹林，即東涌灣和石散頭灘。這些紅樹林均距離建議中的海底電纜鋪設路線和機場登岸點約 4 公里。

B3.3.3 *海草床*

海草床多在淺水、有蔭蔽或潮間帶地區，具有較高的生物生產力。它們是多種海洋生物的覓食和育幼場，屬高價值的生境 (3)。香港境內只有很少海草床，佔全港總面積不足 0.1%。散頭、東涌灣和大蠔灣均有海草床的記錄。這些海草床均距離建議中的海底電纜鋪設路線和機場登岸點最少 4 公里。

B3.3.4 *海洋哺乳類動物*

香港水域內曾記錄到共 16（可能多至 18）種海洋哺乳類（或鯨類）動物 (4)。然而，經常看見的則只有中華白海豚（*Sousa chinensis*）和江豚（*Neophocaena phocaenoides*）兩種 (5) (6)。

從 1995 年起，香港境內中華白海豚的分布、數目、生境使用情況和生活史等，都是各種研究的對象(7) (8) (9)。在 2004 年，這些持續研究的結果顯

(1) Chiu HMC 和 Morton B (1999)。馬蹄蟹（*Tachyopleus tridentatus* 和 *Carcinoscorpius rotundicauda*）在香港的分布。亞洲海洋生物學, 16, 185-196。

(2) Tam NFY 和 Wong YS (1997)。香港紅樹林生態研究（卷一）。大學出版社，香港。

(3) Lee SY (1997) 一個受威脅的潮間海草 *Zostera japonica* 群落的生物量年度周期。海洋生物學 129: 183 – 193。

(4) Jefferson, pers comm。

(5) Parsons C、Mary L. Felly 和 Lindsay J. Porter. 1995。香港陸地水域鯨類註解清單。 香港石澳鶴咀香港大學太古海洋科學研究所。

(6) Jefferson T.A. 2000。 香港水域江豚（*Neophocaena phocaenoides*）保育生物學最後報告。香港香港仔海洋公園，海洋公園保育基金。

(7) Jefferson T.A. 2000。香港水域內中華白海豚之族群生物學。野生動物專輯 *144*:1-65。

(8) Jefferson T.A.、S.K. Hung、 L. Law、 M. Torey 和 N. Tregenza.2002。 江豚在香港及中國毗鄰海域的分佈和數量。*賴氏動物學報* 2002 年增刊第 10 號，43-55 頁。

(9) Jefferson T.A.和 S.K. Hung. 2004。 中國海域內的中華白海豚狀況檢討。 *水棲哺乳類動物（特刊）第 30 期，149-158 頁。*

示，約有 1,300 隻海豚經常在珠江河口出沒；相信其中約有 360 隻的活動範圍包括香港海域。

在過去，海洋哺乳類動物都是以目擊次數表示 (1)。近期的海洋哺乳類動物監察研究所採用的分析 (2)，則把數據標準化，務求反映調查的目擊次數。一般認爲這種數據比原始觀察數據更能顯示海豚的數量和生境使用情況。爲了能夠運用最新的數據，同時亦能夠與過去的數據互相比較，因此，兩種數據都會加以討論。

香港海域內最多中華白海豚的地方是大嶼山北面和西面（*圖 B1*）。北大嶼山和西大嶼山是中華白海豚在香港水海域內的主要生境，全年都在該區出沒。

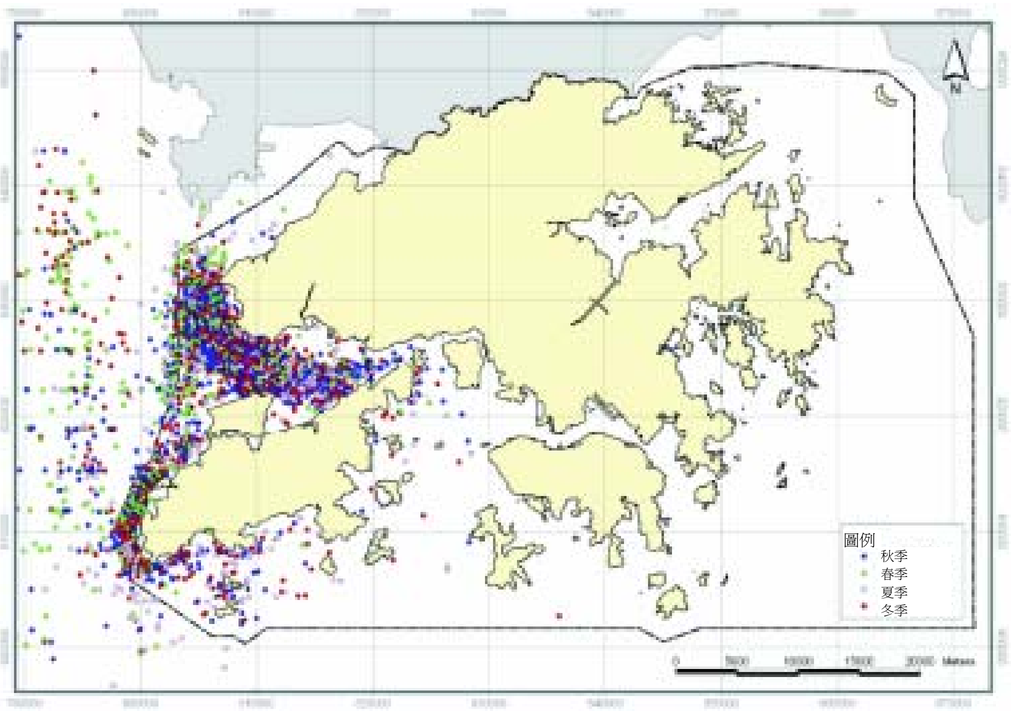

圖 B1　香港海域內的中華白海豚（*Sousa chinensis*）季節性分佈。數據於 1995 至 2004 間收集（漁護署 2004）。

中華白海豚的數量和密度都有季節性轉移的現象，因此，不同地點的數量會隨季節改變（*圖 B2*）。一般相信這種改變是由於珠江河口所排放的淡水增加，因而令河口的海豚獵物增加所造成 (3) (4) (5)。

(1) 漁農自然護理署 2004。香港水域內之中華白海豚（*Sousa chinensis*）監察－數據收集，最後報告（2003 年 4 月 1 日至 2004 年 3 月 31 日）香港鯨類研究計劃編撰。

(2) 漁農自然護理署 2004。同上。

(3) Jefferson T.A. 2000。香港水域內中華白海豚之族群生物學。 野生動物專輯 *144*:1-65。

(4) Jefferson T.A.和 S.K. Hung. 2004。中國海域內的中華白海豚狀況檢討。 *水棲哺乳類動物（特刊）第 30 期，149-158 頁*。

(5) Barros, N.B.、T.A. Jefferson 和 E.C.M. Parsons. 2004。在香港擱淺的中華白海豚（*Sousa chinensis*）的覓食習慣。*水棲哺乳類動物（特刊）第 30 期*，179-188 頁。

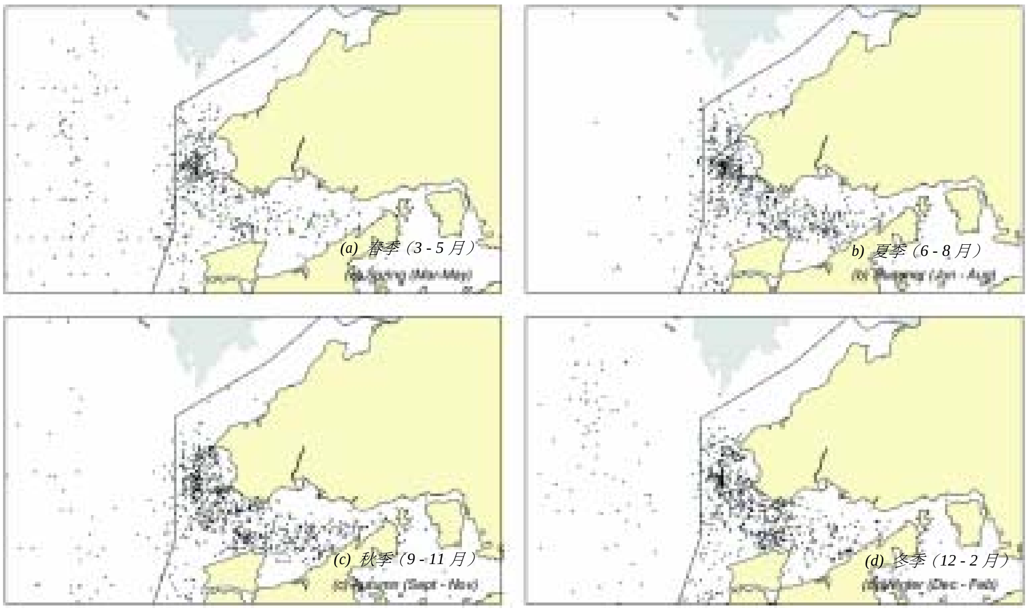

圖 B2. 香港海域內中華白海豚（*Sousa chinensis*）的季節性分佈。數據於 1995 至 2004 間收集（漁護署 2004）。

近期發表的資料顯示，香港境內的海豚數目介乎春季的 78 隻與冬季的 217 隻之間 [(1)]。現時估計珠江口的海豚數目介乎夏季的 731 與冬季的 1,504 之間 [(2)]。

近期有關香港境內海洋哺乳類動物的研究嘗試對生境的使用情況進行定量分析 [(3)]。目擊密度是以每平方公里的正或觀測目擊次數計算，其中需把勘察地區的地圖標上 1 公里乘 1 公里的方格。這些數據是以每次調查目擊次數表示（SPSE）。每方格平均 SPSE 值最高的（15.55）是西大嶼山（大部份方格的 SPSE 值都超過 20），而西北大嶼山的平均值只有 5.30。建議中的電纜走廊四周方格的 SPSE 值介乎 0 - 17，顯示走廊附近的地區只有較低密度的海豚，而最接近的高密度地區是龍鼓洲的東岸（在 6 公里外）。

相反地，有關江豚的研究顯示，大部份目擊都是在香港的南部和東部海域記錄到。建議中的海底電纜鋪設路線四周的海域很少有目擊記錄 [(4)]。

根據對香港海域內的海洋哺乳類動物的長期研究所取得的資料，在經常出沒於香港的鯨類動物當中，只有中華白海豚在建議中的海底電纜鋪設路線四周海域有出沒記錄。

(1) Jefferson T.A.和 S.K. Hung. 2004。中國海域內的中華白海豚狀況檢討。*水棲哺乳類動物（特刊）第 30 期，149-158 頁*。

(2) 漁農自然護理署 2004。 香港水域內之中華白海豚（*Sousa chinensis*）監察－數據收集，最後報告（2003 年 4 月 1 日至 2004 年 3 月 31 日）香港鯨類研究計劃編撰。

(3) 漁農自然護理署 2004。同上。

(4) 漁農自然護理署 2004。同上。

B3.4 *可能受電纜鋪設工程影響的地區*

B3.4.1 *登岸地點*

屯門登岸地點的生境屬於沙質海岸。岸上的生物群落在成份和數量上，都與香港其他沙質海岸相似。沙質海岸只會在鋪設電纜時受到短暫影響。若這些生物群落在電纜鋪設過程中受到影響，亦可能在影響停止後重新聚集該處。

建議中的機場登岸地點的生境屬於人工海堤。岸上的生物群落在成份和數量上，都與香港其他人工海堤和有掩蔽的石質海岸相似。機場的人工海堤不會受到直接影響；電纜會被引入海堤底的現有電纜導槽入口內。由於電纜鋪設過程不會滋擾這裏的生物群落，預計海堤上的海洋生物不會受到電纜鋪設工程的直接影響。

B3.4.2 *海底電纜走廊－潮間軟底生境*

潮間軟底生境除了能供養底內動物外，通常亦能供養較大的底表動物。這些生物的大小一般都超過 1 毫米，通常生活於表面沉積物之上或內部。一個於近期完成，全港最全面的海底情況研究，在北大嶼山海域內設置了十三個樣本收集站，其中兩個非常接近建議電纜走廊 [1]。北大嶼山海域的底棲生物，無論在種類和數量上，都比香港其他地區少。因此，該區的潮間帶軟底生境的生態價值屬偏低。

B4 *海洋生態影響評估*

建議海底電纜工程對海洋生態資源可能造成的影響可以分爲兩類：對生境／海洋生物的直接滋擾而造成的影響，以及由於挖泥和鋪設電纜令沉積物擴散，因而改變水質參數所造成的影響。

B4.1 *施工期間的直接影響*

預計挖泥和電纜鋪設工作不會造成任何長遠的直接影響。然而，在屯門和機場進行的挖泥工程將會造成短期影響。

軟底生境：在挖泥和電纜鋪設工作停止後，受影響地區的海洋生態資源亦會重返當地，而底棲動物便會重新聚居於海床。然而，預計這些海底工程仍會造成短期影響。故此預計，潮間帶軟底生境所受到的直接影響不會成爲重大關注。

(1) CityU Professional Services Limited (2002)。爲漁農自然護理署進行之「香港之深海生物群落顧問研究最後報告」。

人工硬底生境：預計不會損失任何生境。然而，岸端的建造工程會對潮間帶人工海堤造成短期影響。因此，預計建議進行的建造工程對這項人工生境的影響不會成爲重大關注。

海洋哺乳類動物：電纜鋪設工作對海洋哺乳類動物可能造成的影響通常都不認爲是不良影響。由於中華白海豚是一種很靈活的動物，預計行駛緩慢的海底電纜鋪設船隻和機器都不會對牠們造成很大影響。

B4.2 間接影響－施工期間

是項工程在施工階段對海洋生態資源可能造成的間接影響包括在登岸地點進行挖泥工程而揚起沉積物。被揚起的沉積物對水質可能造成的影響如下：

- 懸浮固體濃度增加（詳見下文）；
- 溶解氧濃度下降（詳見水質評估，預計影響不會顯著）；及
- 水體的營養濃度增加（詳見水質評估，預計影響不會顯著）。

懸浮固體

潮下帶軟底生物：海底的固著生物會受到懸浮沉積物增加的影響。這些影響可以是致命的或近乎致命的（例如：需要不斷把沉積物沖出體外的持續壓力令生殖能力下降）。沉積對生物的影響視乎其他因素而定，例如生物本身的容忍能力、固著生物的生長方向，以及水流等。香港的底內生物群落位於軟泥和沙中。這些生境經常受到風雨、海床急流和拖網作業的滋擾，令沉積物揚起，成爲水體中的懸浮沉積物。因此，底棲無脊椎動物不會受到挖泥工程所造成的懸浮沉積物和沉積過程的不良影響。

預計貼近挖泥區外圍的底棲群落只會受到短暫影響。受影響的範圍會較小，因爲沉積物會在距離挖泥地點頗近的地方沉回海床（*附件 A*）。根據預測的沉積率，北大嶼山海域的天然底棲群落不會受到影響。該處經常受到近底拖網、風浪和珠江淡水徑流的滋擾。因此，那裏的生物應較能適應海床上的滋擾。由於當地屬典型的動物會重新聚集於受影響的地區，暫時損失該區部份低生態價值的生物群落應屬可接受的程度。

潮間帶生境：研究區內可能會受挖泥工程影響的潮間帶生境包括：登岸地點附近的沙質海岸和沿海岸線建造的海堤。由於沙質海岸和人工海堤只具有偏低的生態價值，區內的生境不會受到不可接受的影響。預計紅樹林、海草和潮間帶泥灘，以及馬蹄蟹育幼場等生態環境敏感受體均不會受到是項工程影響，因爲這些地區距離建議中的電纜走廊和挖泥地區最少 4 公里。

海洋哺乳類動物：懸浮固體濃度增加對海洋哺乳類動物的影響，通常都是因爲牠們的獵物可能會受到影響而造成，因此對海洋哺乳類動物而言是間接影響。由於懸浮固體濃度的增加預計不會對漁業資源造成不可接受的影響，因此，預計海洋哺乳類動物亦不會受到影響（第 4.9 節）。一如*附件 A* 所述，環保署的資料顯示研究區內的沉積物並非已受污染的種類（沒有超過最低化學超標水平），因此預計，海豚不會因爲挖泥和噴注工程釋出已溶解污染物而受到影響。此外，由於鋪設電纜的工程船隻移動緩慢，預計這類船隻不會對海洋哺乳類動物造成碰撞風險。而且，預計挖泥工程和噴注工程所產生的水底噪音都不會對工程地區附近的海豚造成不良影響。

B4.3 運作影響

電纜在運作時無需滋擾海床。因此，無論水質或海洋生態資源都不會受到不良影響。

B5 電纜鋪設工程之緩解措施

在鋪設電纜時會實施下列措施，以便減少工程對生態資源（包括海豚）可能造成的影響。

- 雖然較低的挖泥速度表示沉積物的流失量會較少，承建商仍會在挖泥機四周裝設淤泥屏障，以便減少沉積物從屯門和機場的登岸點向外擴散。
- 應該向是項工程的所有船隻的操作人員說明區內可能有海豚出沒，以及在這些動物附近操作時的安全守則。
- 應該規定船隻駕駛員採用預先擬訂和慣常使用的路線，以便區內的海豚易於適應。
- 應該規定船隻駕駛員控制和管理好船隻的所有廢水。
- 應該嚴格執行不得傾倒垃圾、食物、油類或化學品的政策。應該在向承建商進行簡介時說明這項政策。
- 應該設法盡量減少是項工程在施工期間對區內的水質造成影響。
- 在施工期間，應該把電纜鋪設船隻四周 250 米的範圍劃爲海豚專用區。在開始鋪設電纜前，應該對工程區四周 250 米內的專用區檢視最少 30 分鐘。若發現有鯨類動物在專用區內，便應延遲展開電纜鋪設工程，直至牠們離開爲止；及
- 若在專用區內發現海豚，便應停止建造工程，直至觀察員證實區內連續 30 分鐘沒有再發現海豚蹤跡爲止。

除了上述措施外，承建商亦會進行水質監察，以便對屯門登岸地點挖泥工程所產生的沉積物卷流的擴散情況預測加以驗證。同時，一隊合資格的人員會在鋪設海底電纜期間監察海豚的情況，以便評估牠們是否受到影響。

B6 *總結*

顧問對建議海底電纜走廊和登岸點附近的北大嶼山海域進行了基線海洋生態狀況檢討。

所有已知的生態環境敏感受體均距離建議中的電纜鋪設路線最少 4 公里。在實施緩解措施後，預計因屯門和機場進行的挖泥工程，以及進行橫過龍鼓水道的電纜鋪設工程而增加的懸浮沉積物，將不會超過水質指標的規定。由於水質敏感受體距離建議中的電纜鋪設路線頗遠，預料電纜鋪設工程和挖泥工程不會影響生態資源，亦不會對水質造成不良影響，或令生境受損。應予強調的是，預料中華白海豚（*Sousa chinensis*）不會受到是項工程影響，但仍需對良好施工方法和保護海豚守則的實施情況加以核驗，作爲環境監察與審核程序的其中一環，藉以評估這些動物在施工期間是否受到任何影響。除此之外，無需進行其他生態影響緩解措施。

Annex C
附錄C

Marine Archaeology Assessment
海洋考古評估

CONTENTS

C1 MARINE ARCHAEOLOGICAL INVESTIGATION

This *Annex* presents a Marine Archaeological Investigation (MAI) of the project area which includes a CLP 132kv submarine cable. This MAI includes a desktop study, geophysical survey and establishment of archaeological potential and evaluates the potential for direct and indirect adverse impacts to these resources.

C2 RELEVANT LEGISLATION AND ASSESSMENT CRITERIA

The following legislation is applicable to the assessment of archaeological and historic resources in Hong Kong:

- *Environmental Impact Assessment Ordinance (Cap. 499.S16). Technical Memorandum on the EIA Process (EIAO-TM);*
- *Antiquities and Monuments Ordinance (Cap. 53);* and,
- *Hong Kong Planning Standards and Guidelines (HKPSG).*

C2.1 ENVIRONMENTAL IMPACT ASSESSMENT ORDINANCE (CAP. 499)

The *EIAO-TM* outlines the approaches required in investigating and assessing the impacts on marine archaeological sites. The following sections of the *EIAO – TM* are applicable:

> *Annex 19: "There is no quantitative standard in deciding the relative importance of these sites, but in general, sites of unique archaeological, historical or architectural value will be considered as highly significant. A baseline study shall be conducted: (a) to compile a comprehensive inventory of places, buildings, sites and structures of architectural, archaeological and historical value within the proposed project area; and (b) to identify possible threats of, and their physical extent, destruction in whole or in part of sites of cultural heritage arising from the proposed project."*

The *EIAO – TM* also outlines the criteria for assessment of impact on sites of cultural heritage as follows:

> *Annex 10: "The criteria for evaluating impact on sites of cultural heritage includes: (a) The general presumption in favour of the protection and conservation of all sites of cultural heritage because they provide an essential, finite and irreplaceable link between the past and the future and are points of reference and identity for culture and tradition; (b) Adverse impacts on sites of cultural heritage shall be kept to the absolute minimum."*

The *EIAO – TM* also outlines the approach in regard to the preservation in totality; and in part to cultural resources:

Annex 19: "Preservation in totality will be a beneficial impact and will enhance the cultural and socio-economical environment if suitable measures to integrate the sites *of cultural heritage into the proposed project are carried out. If, due to site constraints and other factors, only preservation in part is possible, this must be fully justified with alternative proposals or layout designs, which confirm the impracticability of total preservation."*

C2.2 ANTIQUITIES AND MONUMENTS ORDINANCE (CAP.53)

In addition to the *EIAO*, the heritage resources of Hong Kong are protected by a range of legislative and planning mechanisms. The *Antiquities and Monuments Ordinance (Cap. 53)*, provides powers for the designation of Antiquities and Monuments Sites or Declared Monuments in Hong Kong. The Ordinance provides statutory protection against the threat of development for declared monuments, historic buildings and archaeological sites on land and underwater which have been recommended by the Antiquities Advisory Board (AAB), approved by the Chief Executive and gazetted in the government gazette to enable their preservation for posterity. Human artefacts, relics and built structures may be gazetted and protected as monuments. The Antiquities Authority may, after consultation with the Antiquities Advisory Board (AAB) and with Government approval, declare any place, building, site or structure which the Antiquities Authority considers to be of public interest by reason of its historical, archaeological or palaeontological significance, to be a monument, historical building, archaeological or palaeontological site or structure. Once declared a site of public interest, no person may undertake acts that are prohibited under the Ordinance, such as to demolish or carry on building or other works, unless a permit is obtained from the Antiquities Authority.

For archaeological sites, all relics dated prior to 1800 AD belong to the Hong Kong Government. Archaeological sites are classified into three categories, as follows:

- ***Designated*** – those that have been declared as monuments and are to be protected and conserved at all costs;
- ***Administrative Protection*** – those which are considered to be of significant value but which are not declared as monuments and should be either protected, or if found not possible to protect these sites then salvaged; and
- ***Monitored*** – those which are of lesser significance or whose potential is not fully assessed which should not be disturbed with the exception of minor works if they are permitted and monitored by AMO.

The Legislation also sets out the procedures for the issuing of Licences to Excavate and Search for Antiquities, the effect of which is to forbid all such activities being undertaken without such a Licence. It also provides for the penalties exacted for infringement of the Ordinance, including fines and imprisonment.

Over the years, surveys have been undertaken to identify archaeological sites in Hong Kong. The AMO has established boundaries for the identified sites and a set of administrative procedures for the protection of the known archaeological sites. However, the present record of archaeological sites is known to be incomplete as many areas have not yet been surveyed. There is a need therefore to ensure that the procedures and mechanisms, which enable the preservation or formal notification of previously unknown archaeological resources that may be revealed or discovered during project assessment or construction, are identified and implemented at an early stage of the planning of a project.

Section 11 of the *AM Ordinance* requires any person who discovers an antiquity, or supposed antiquity, to report the discovery to the Antiquities Authority. By implication, construction projects need to ensure that the Antiquities Authority, the Antiquities Advisory Board is formally notified of archaeological resources which are discovered during the assessment or construction of a project.

C2.3 HONG KONG PLANNING STANDARDS AND GUIDELINES

The HKPSG, *Chapter 10 (Conservation)*, provides general guidelines and measures for the conservation of historical buildings, archaeological sites and other antiquities.

C3 ASSESSMENT METHODOLOGY

C3.1 MARINE ARCHAEOLOGY INVESTIGATIONS (MAI) GUIDELINES

The AMO established a *Guidelines for MAI* which explain the standard practice, procedures and methodology which must be undertaken in determining the marine archaeological potential, presence of archaeological artefacts and defining suitable mitigation measures. Desktop study, geophysical survey and establishing archaeological potential are considered the first stage of a MAI. Subject to the results of the first stage MAI, further investigation may or may not be required.

C3.2 SCOPE

The scope of the study is based on the cable corridor (130 m each side of the centre line of the cable route) as shown in the vessel track plots presented in *Figures C3.1 to 3.4* and referred to below as the 'project area.' The proposed submarine power cable system is to be laid from Pillar Point to Chek Lap Kok Airport.

C3.3 DESKTOP STUDY

A desktop search has been undertaken to compile a comprehensive inventory of the archaeological resources along the cable corridor. This has included the review of several archaeological publications, as well as a review of the United Kingdom Hydrographic Office 'Wreck' files, to determine the archaeological potential of the waters of the proposed cable corridor. In addition to this, a review of the results of the geophysical survey undertaken during the assessment of a suitable cable route has been reviewed in order to identify any anomalies in the results that may indicate objects of archaeological potential.

C3.4 GEOPHYSICAL SURVEY

A hydrographic and geophysical survey was undertaken from 6 September 2005 to 30 September 2005 to map the location of existing power cables and telecommunications cable. In addition to this information, the survey was implemented to:

- Map sea bed topography in detail;
- Map the texture and features on the sea bed;
- Map the underlying and significant geological horizons; and
- Collect marine subsoil for various chemical and geotechnical testing.

The survey was carried out by EGS (Asia) Limited using the following equipment:

C3.4.1 Side Scan Sonar

- Klein System 3000 with digital towed fish;

The recording parameters for the side scan sonar survey were as follows:

Vessel Speed:	1.4 -2.0 m / sec
Pulse Length	25 μs
Fix Interval:	10 sec
Source Frequency:	100 and 500 kHz
Slant range:	75 m

The side scan sonar fish was towed from the stern of the vessel, 3 m beneath the sea surface (depending on water depth). All data was logged to the C-View SDMP where four channels (100kHz port and 500kHz starboard) were simultaneously recorded together with navigation, fix, vessel heading, cable out angle and length, fish heading and water depth. Side scan sonar interpretation was carried out on the screen of a PC in the EGS office and all features were individually marked or grouped into regions. This data was directed straight to Autocad without the need for re-digitizing.

C3.4.2 Seismic Profiler

- This survey deployed a C-Boom Low Voltage Boomer (LVB) and hydrophone, a Waverley thermal recorder.

The recording parameters for the survey are listed as follows:

Vessel Speed:	1.4 -2.0 m / sec
Fix Interval:	10 sec
Layback:	23m
Sweep Speed:	80 ms (seismic paper recorder)

The LVB was towed from the stern of the vessel, at a distance where noise from the vessel was kept to a minimum.

C3.4.3 Magnetic Survey

- A Sea Spy Magnetometer (Overhauser Series) consisting of the following components; over-the side transducer; on board PC with manufacturer's and EGS software.

The towfish (over-the side transducer) was deployed at a distance of 20 m from the stern of the vessel and a depth sensor, attached to the towfish providing readings to help maintain a consistent height above the seabed. EGS has written software for the display of marine magnetic data in profile form on the PC screen in two forms:

- A large display within the range 10 to 50 nT;
- A smaller display to a scale of 10 times the above large display.

C3.4.4 Swath (Multibeam) Bathymetry

- The Allied Signal 'Bottom Chart' multibeam system and consisting of transducers mounted on the starboard side of the vessel; a swath PC; and a TSS gyro Compass, TSS DMS05 motion compensator (swath), TSS 335B heave compensator (SBES) to support the system and compensate for vessel movement.

The swath system is a multi beam echo sounder that emits a 'fan' (at an angle of 150 at the survey vessel) to measure very accurately the depth of the seabed.

C3.4.5 Position fixing

Position fixing was achieved using Differential Global Positioning System, comprising:

- C-Nav Globally corrected Global Position System (GcGPS) providing an accuracy of +/- 0.3m and the EGS computerised navigation system to control the steering of the boat.

The GcGPS antenna was mounted directly above the swath (multibeam) transducers

C3.4.6 *C-View operating and interpretation software package*

This system provided screen displays on 2 monitors for seismic profiling and side scan systems. All raw data was logged digitally.

The equipment was deployed from a Class III commercial licensed survey vessel.

C3.5 *ESTABLISHING ARCHAEOLOGICAL POTENTIAL*

The geophysical data sets were analysed in detail and integrated with the results to map features and anomalies with archaeological potential. This will enable the design of a strategy for their investigation and evaluation. If cultural remains are identified, further investigation may be required, however, the requirement for such work is also based on the review of archaeological potential for the waters. If there is no indication of such material, or the review of archaeological potential indicates that there is no potential for features of interest to be present, additional work will not be recommended.

C3.6 *IMPACT ASSESSMENT*

Preservation in totality is taken as the first priority and the assessment has taken into account the requirement as specified in *Section 2.1* of *Annex 10* and *Section 2.6 -2.14* of *Annex 19* of the *EIAO-TM* requirement.

C4 *BASELINE CONDITION FOR MARINE ARCHAEOLOGY*

C4.1 *GEOTECHNICAL BACKGROUND*

Generally, the submarine deposits in the Hong Kong region are subdivided into three formations, Sham Wat Formation, Chek Lap Kok Formations and the overlying Hang Hau Formations.

The Chek Lap Kok Formations, the lowest part of the Quaternary succession are considered to be Middle to Late Pleistocene in age and consists of colluvium, alluvium and lacustrine sediments Fyfe, et.al., (2000). The marine sediments on top of this formation are sediments related to the Holocene period (from about 13,000 BP to the present day) and referred to as the Hang Hau Formations consisting of clayey silt sediments and some sand (mud, sandy mud).

The Sham Wat Formation, found between Chek Lap Kok Formations and Hang Hau Formations is considered to be the Eemian deposit with uncertain age and consisting of soft to firm silty clays with yellowish mottling. This formation is presently not widespread but only in a subcrop beneath the Hang Hau Formation (Fyfe, et.al. 2000).

More modern sediments are related to the discharge from the Pearl River, (and which would have an effect on the project area, being located down stream from the mouth of the Pearl River) having a seasonal discharge of about 370,000 million cubic metres each year (ibid). They consist of sand, mud and some gravel.

Fyfe, et.al (2000) further explains the rate of sedimentation:

"In general, present day sedimentation rates in Hong Kong waters are low, though they were undoubtedly greater earlier in the Holocene when sea level was rising rapidly. … Without tidal flushing, the sediment entering Victoria Harbour from the Pearl River, sewage solids and losses from dredging and reclamation might be expected to raise the seabed level by 40mm per year. However, comparison of Hydrographic charts of Victoria Harbour from 1903 to 1980 revealed no conclusive evidence of net sedimentation, implying that the seabed is a state of dynamic equilibrium. Assuming that sedimentation in Hong Kong waters began about 8 000 years ago, deposition of the 10 to 20 m of marine mud must have occurred at an average sedimentation rate of between 1.25 and 2.5 mm per year. Available evidence indicates that the rate of Holocene sedimentation has not been steady. Radiocarbon dating suggests that the majority of sedimentation has taken place over the past 4 000 to 5 000 years."

During the late Pleistocene period (18,000BP) sea levels began to rise until about 6,000 years BP and which is about the level of present day sea level. "The extent of the rise could be as great as perhaps 140 metres in parts" (ibid: 40).

The sediments of the Late Holocene period, considered to be relatively homogenous very soft to soft silty clay and with high moisture content, offers the greatest potential (as compared to the surface of the seabed which is often found to have been disturbed by fishing and other shipping related activities) to include well preserved remains associated with the occupation and use of the islands in Hong Kong waters. These remains could include shipwrecks, material associated with shipwrecks or other types of archaeological sites.

In the project area, these marine deposits varied from 0 to 20m.

C4.2 HISTORICAL BACKGROUND

Archaeological evidence indicates that seafarers have used the waters of Hong Kong for around 6,000 years (Bard, 1988). In Chau (1993) it is reported that:

"In the past decade, a great number of prehistoric sites have been discovered in the coastal sandbars which represent the opening up of the coastal and offshore island areas by the early settlers. Around six thousand years ago, the Neolithic folks had already settled in the coastal area of South China."

Coates (in Braga, 1957) stated that "Definite archaeological traces of this prehistoric activity have been found … on the beach at Shek Pik, on the south coast of Lantao [Lantau] Island. From these finds it is clear that about three thousand years ago the islands were used as a seasonal entrepôt for trade between the Yangtse mouth, the tribal states of what is to-day Kwangtung Province, and Indonesia." The islands at the mouth of the Pearl River were seen as more suitable for trade between the Cantonese merchants and those from other regions, and "Temporary settlements were built near the beaches. Cooking utensils have been found from this period on Lamma and Lantao, but no trace of buildings."

Further information states that:

"Local history, still very far from being recorded fully, begins with the migration of Chinese into the area during the Sung dynasty (960-1279). … Lantao Island is the next of the group to appear in history. The last reigning Sung emporer, Ti-ping, made Kowloon his rallying point in the long Chinese retreat before the Mongol invasion. In 1279, not far from Tsuen Wan, his forces met the Mongols and were finally defeated. After the battle large numbers of the Court and nobility escaped across the comparatively narrow, sheltered stretch of water to Lantao. … Of those who fled to Lantao, there were those who settled and possibly intermarried with the inhabitants, traces of these cultured refugees are to be found at Tai O. … The Mongols did not enjoy for long their conquest of South China. The early part of the fourteenth century was a troubled time in the South, and from the Kowloon peninsula a number of families moved to safety in remoter spots. The families at present occupying villages in the Shek Pik area of Lantao moved there during the period of Mongol rule (1279-1368)."(ibid).

Meacham (1994) noted that "The history of Chek Lap Kok [to the south of ESC 1 and west of the South Brothers] spans the entire period of human occupation in the Hong Kong area, from the earliest inhabitants of the painted pottery period around 4000 BC to the recent period." As part of the rescue archaeological project carried out on Chek Lap Kok before the construction of the international airport, archaeological work was carried out on several sites on Chek Lap Kok, including a 8th-10th century site encompassing kilns and coins; burial sites of the Northern Sung period; a site containing pottery from the Middle and Late Neolithic period (4000-1500 BC); burial / ritual sites dated 3700-3400 BC; a number of Tang lime kilns (dated 750 and 1200 AD); and a site containing hard and soft geometric pattern pottery, axe moulds and cloth from the Bronze age. In 1993, part of a cannon was discovered during dredging of the seabed between Chek Lap Kok and Tung Chung (Meacham, 1994). The discovery was then reported to the Provisional Airport Authority. Inscriptions found on the cannon revealed that it was manufacturing in 1808. This cannon is likely related to the fort at Tung Chung, reflecting the Chinese military presence in the area in the past.

Lantau Island, just to the south of the Study Areas, is the largest and most western of the islands in the Hong Kong group of islands and therefore provides shelter for the waters between it and Hong Kong Island. Being located at the outlet of the Pearl River "…rightly called the artery of Southern China" (Lo, 1963) the area had "…established contacts with the outer world by the Chin Dynasty (ibid: 2). An early maritime industry was the pearl fishing industry and "…governmental control of this activity only began in the time of the Five Dynasties…" (Lo, 1963). Lantau Island also became a prolific incense-producing district, although "…nothing remains of it to recall the origin of the name Hong Kong (i.e. Fragrant Port)" (ibid). The bay inside of Lantau Island attracted "…trading vessels from Arabia, Persia, India, IndoChina, and the East Indies…" (ibid), and local vessels involved in the fishing and salt making industries. Pirates were prolific in the area, as well as settling on Lantau Island, and forts and batteries were also built on the island to assist the Imperial Navy in controlling pirates.

It is only a few miles north of the project area, ie. Lin Tin (Neilingding) and Tuen Mun, that the Portuguese (the first European arrivals) established a presence there in 1513 . The Portuguese explorer, Jorge Alvares was permitted to land on Lin Tin and for "…about ten months he spent in the Canton River, at the anchorage of T'un Men…" as this was "…where all the foreign trade in south China was conducted (Braga, 1965). " Landward and closer to him, across the stretch of waters to the east, he could see towering Ching Shan (now known as 'Castle Peak') standing guard over the anchorage of T'un Men.

Further on this discovery of China by Europeans and containing an account of the significance of this area for trade in general can be found in a report by Tomé Pires (Cortesão, 1944) a Portuguese living in Malacca and which is "…based possibly to some extent on information gathered by Jorge Alvares in China." (ibid). "…Pires has a lot to say about the ports and the peoples who traded in China. He mentions that junks from Malacca anchor "in the port of Tumon." Those from Siam anchor, he states "in the port of Hucham." Our port of Tumon is three leagues nearer to China than the Siamese one." If our theory is correct that the island of Tumon is none other than Lin Tin Island, then it is likely that Hucham would be the port of Lantao Island." (ibid). Cortesão in Braga (1965) states "The city of Canton (Quamton) is where the whole kingdom of China unloads all its merchandise…" and "Salt is a great merchandise among the Chinese. It is distributed from China to these regions; and it is dealt with by fifteen hundred junks which come to buy it, and it is loaded in China to go to other places." (ibid).

Lo (1963) further illustrates the importance of the area in the vicinity of the project area:

Though the trading contacts of T'un-mên with overseas countries can be traced back to quite ancient times—probably beginning in the Liu Sung period—it was during the T'ang Dynasty that trade greatly extended. … As traffic increased and more travellers passed through T'un-mên literary men began to learn of this place and its trading activities.

The sovereign of Nan Han who seized power during the disintergration of the T'ang and established himself in southern China made it his policy to secure the support of outlaws, to extend his sway to the non-Chinese peoples, the Mans and the Tans (people who live on boats) and to derive the maximum profit from with foreign countries. Consequently special attention was paid to T'un-mên. When the Five Dynasties came to an end and the Sung emporers ascended the throne, governmental machinery in the T'un-mên area was elaborated. In addition to the royal garrison, an officer whose duty was to pursue and arrest bandits was installed. A system of administration for the land-locked waters and more remote seas was put into force at

T'un-mên and two other posts (one at P'i-p'a Chou at the northern tip of Lantau Island, and one at Tan-kan Chou of Ju-chou). …during the Sung only three places on the coast round the outlet for Canton, namely T'un-mên, Kuan-fu Ch'ang and Ta-Yu Shan (Lantau) were guarded by imperial troops.

It is evident that the region between Lantau and Lintin and *T'un-mên*—the region that takes in the project area was populated, and active in the movement of people and materials between various parts of China, and several other nations, over a period of at least 4000 years.

C4.3 INFORMATION FROM THE UNITED KINGDOM HYDROGRAPHIC OFFICE

Contact was made with the United Kingdom Hydrographic Office regarding shipwrecks on their database that encompassed the project area. It is found that nine shipwrecks and / or obstructions are recorded as shown in *Figure C4.1* and *Appendix 1*. Only one "Live, undefined obstruction" was found in the surrounding area and approximately 1,485 metres east of the cable route (see Site 58708). Of the other eight shipwrecks, two were identified as "Lift", i.e. salvaged, and the remaining six "Dead", i.e. not detected by repeated surveys and considered not to exist.

C4.4 GEOPHYSICAL SURVEY RESULT

The objective of the review of the geophysical survey was to define the areas of greatest archaeological potential, assess the depth and nature of the seabed sediments to define which areas consist of suitable material to bury and preserve archaeological material and to map anomalies on the seabed which may be archaeological material. The results are summarised below.

EGS (Asia) Limited carried out a hydrographic and geophysical survey of the project area (from Pillar Point to Chek Lap Kok) in accordance with their agreement for work, from 6 September 2005 to 30 September 2005. *Figures C3.1* to *3.4* showed the width of the surveyed area (130m each side of the centre line of the cable route) along the whole length of the cable route. The figures also highlight the tracks of the vessel, being 20m between tracks along the length of the route and every 100m, perpendicular to the route. This provided a comprehensive overlap for the side scan sonar and bathymetric surveys. The magnetic survey was implemented only on the cross tracks, essentially to locate the existing cables to the west of this new cable route. The figures show the existing CLP submarine cable and a HGC optical fibre submarine cable. In an area close to Pillar Point (and out to 1km offshore), EGS found numerous boats and vessels anchored, which affected the magnetic survey.

EGS geophysicists interpreted the survey data and produced comprehensive maps of the seabed and sub-seabed features (see *Figures C4.2* to *C4.5*). They found:

- Large areas of disturbed seabed attributed to anchoring, trawling (see *Figure C4.6*);

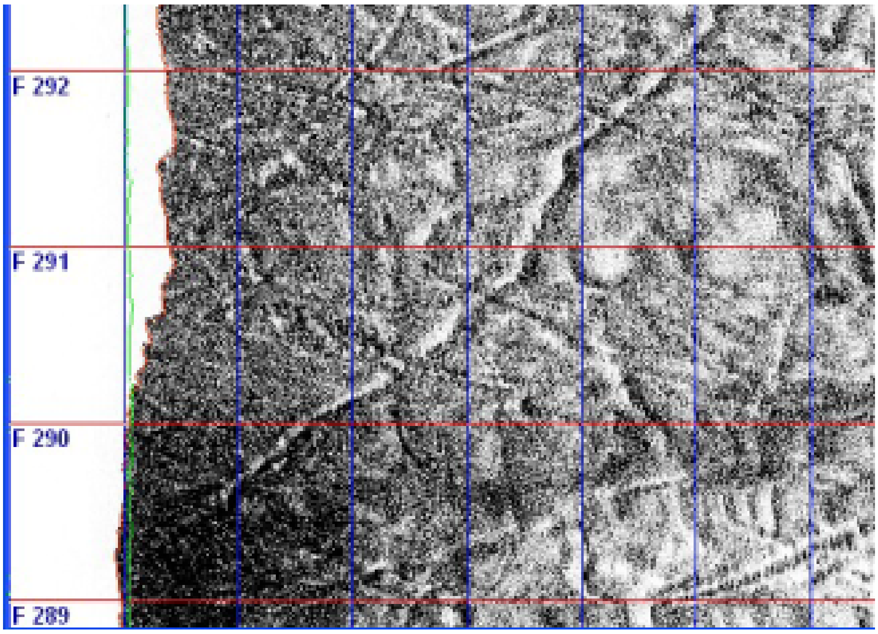

Figure C4.6 Anchor scars on the seabed

- Large areas of dumped materials, one of these areas is associated with one of the three sonar contacts;
- Higher reflective areas attributed to gravel or sand materials;
- Lower reflectivity areas attributed to relatively clean or undisturbed marine muds; and
- Two other sonar contacts interpreted as possible artificial reefs.

The major features were trawl and anchor scars and possible coarser sand sediments on the seabed. The side scan sonar also mapped a linear feature along the proposed sewerage pipeline and it correlated very well with the magnetic contact. Two sonar contacts, SC02 & SC03 (see *Figures C4.7* and *C4.8*) were identified by EGS geophysicists as possible artificial reefs given an area identified as an 'Artificial Reef Complex' is adjacent to and within 100m of the cable route in this locality, as shown in *Figure C4.1*. Another object, SC01 was identified as debris (see *Figure C4.9)*. Summary of Sonar Contacts are presented in *Table C4.1*)

Table C4.1 List of the Seabed Sonar contacts

Contact No.	Northing Easting (UTM Grid)	Distance and direction from CL of cable route	Dimensions (m)	Description
SC01	821932.7 N 812846.1 E	50m west	7.34x4.62x1.86	Object
SC02	821180.4 N 812603.2 E	10m east	30.57x10.3x2.22	Possible artificial reef
SC03	820931.5 N 812434.1 E	40m east	19.01x5.74x1.25	Possible artificial reef

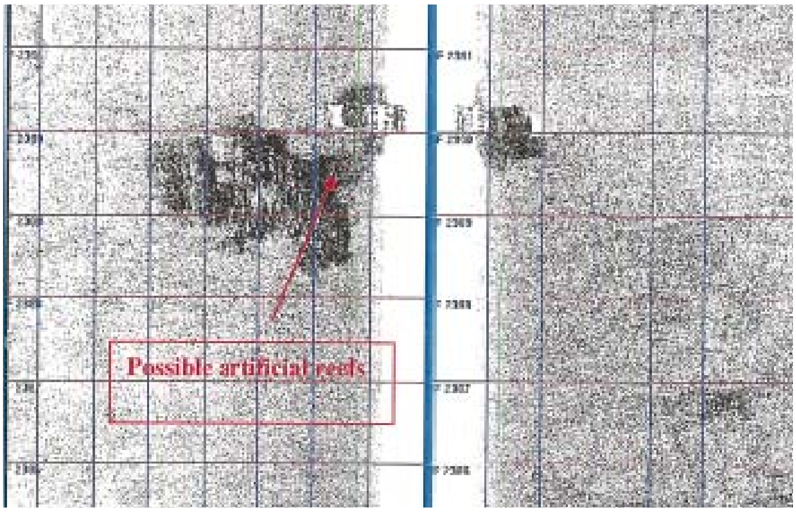

Figure C4.7 Example of Possible Artificial Reefs (SC03)

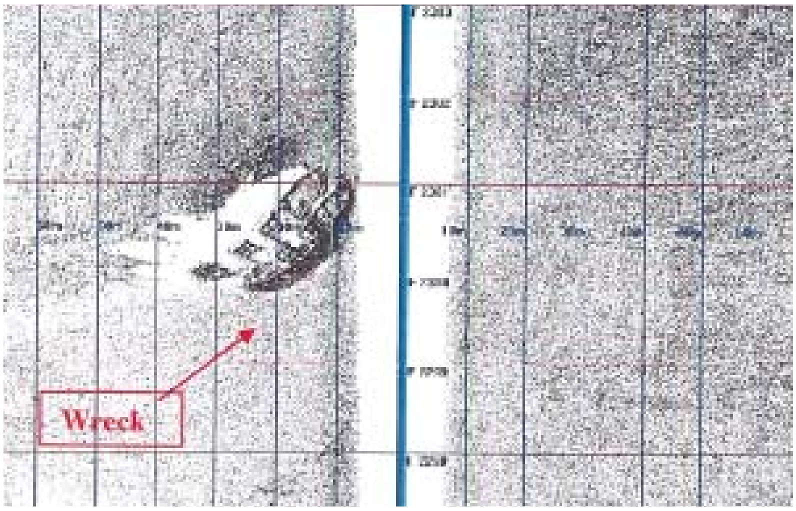

Figure C4.8: Example of Possible Artificial Reefs (Wreck) (SC02)

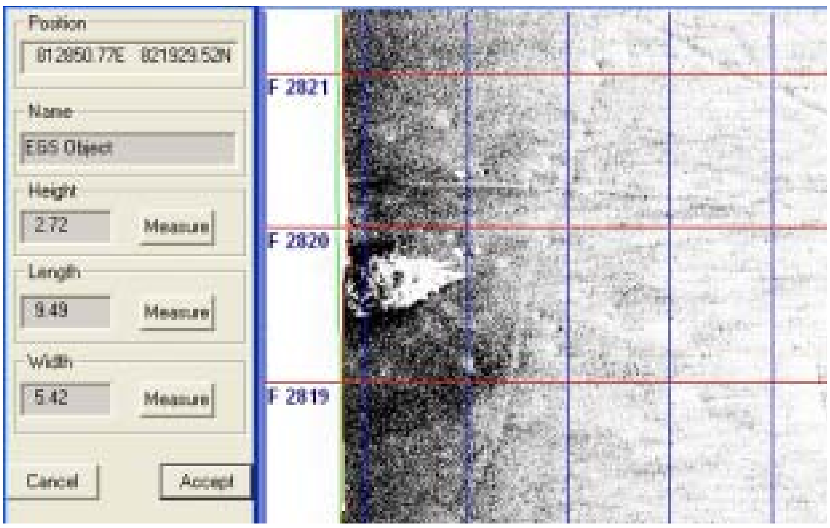

Figure 4.9 Seabed debris (SC01)

A review of the raw data and maps throughout the cable route by a marine archaeologist, Mr William Frederick Jeffery, verified the conclusions of the geophysicists.

The other surveys, the magnetic, multibeam bathymetric and boomer surveys provided information about the depth of the seabed; the depth of the various marine deposits (and which varied to a depth of 20m); alluvium and various grade rocks; and the location of the existing submarine cables and pipelines. The boomer survey revealed 31 sub seabed anomalies and which EGS geophysicists characterised as "possible obstruction[s] beneath the seabed." Many are located in association with the numerous sea-bed debris and materials that have been dumped (see *Figures C4.2* to *C4.5)* but some are not. Another possibility is that some are archaeological features, given similar seismic readings could be obtained for this type of sub seabed feature. No magnetic data were recorded for the cross tracks other than in the vicinity of the current sub seabed cables, and given some of the sub seabed anomalies fall on the cross tracks this may have been useful to see if the feature contained any ferrous material (indicating man-made objects), however there could possibly be natural magnetism in some of the rocks.

C5 IMPACT ASSESSMENT

Although the baseline review of the literature found the project area has the potential to contain underwater cultural heritage sites, the UK Hydrographic Office Wrecks Database found no sites of historical or archaeological significance to be located in the cable route.

Of the 31 sub seabed anomalies, all, many or some could be natural features or dumped materials. The surface of the seabed is characterised by a general distribution of debris and dumped materials which given the movement of sediments could now be below the seabed. It is also a possibility that some are modern man-made objects, or even pre-1800 man-made objects. From the current data available it is not possible to discern the difference.

C6 MITIGATION MEASURES

No seabed material was interpreted to be of historical or archaeological significance and therefore no mitigation measures are necessary. An investigation needs to be carried out to better interpret the 31 sub seabed anomalies. At this stage, this is best done through more geophysical analysis, surveys and interpretation.

C7 SUMMARY AND CONCLUSIONS

An assessment of the potential marine archaeological resources of the project area was conducted based on a review of historical records, UK Wrecks database and the results of hydrographic and geophysical surveys of the proposed cable route corridor. Although three seabed anomalies (sonar contacts) were found in the new cable corridor, two have been characterised as artificial reefs (10 & 40m east of the centre line), the third as debris (50m west of the centre line) and they are not expected to have any historical or archaeological significance.

The boomer survey however revealed 31 sub seabed anomalies and their character is unknown at this stage. It is recommended that further geophysical work be carried out before the cable installation works to:

1. Better interpret the anomalies, perhaps from the current survey data or additional surveys and including a more precise depth of the anomalies;

2. Determine the rates of sedimentation, scouring in this area and therefore a time-frame / analysis for when the sub seabed anomalies were sitting on the seabed;

3. Determine the magnetic nature of the rocks / debris and dumped materials in this area and whether a magnetic survey of the 31 sub seabed anomalies would be able to differentiate between natural features, debris, dumped materials and man-made objects that contain ferrous material. If a magnetic survey is concluded to be helpful in differentiating between man made objects and the surrounding material, a magnetic survey should be implemented, possibly in association with other types of geophysical surveys;

4. A review of these data should be conducted by a geophysicist and a marine archaeologist.

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目錄

C1 *海洋考古調查*

本附錄旨在闡述於中電一條 132kV 海底電纜工程範圍內進行的一項海洋考古調查。是次調查包括文獻研究、地球物理調查和確定考古潛力，以及評估是項工程對這些資源可能造成的直接及間接不良影響。

C2 *相關法例及評估準則*

評估香港的考古及歷史資源乃依據下列法例。

- *環境影響評估條例（第 499 章 16 條）環境影響評估程序的技術備忘錄（以下簡稱「環評技術備忘錄」）*
- *古物古蹟條例（第 53 章）*；及
- *香港規劃標準與準則*。

C2.1 *環境影響評估條例（第* ***499*** *章）*

「環評技術備忘錄」闡述在勘察和評估海洋考古遺址可能受到的影響時，所需要採用的方法。以下是「環評技術備忘錄」中適用的條文：

附件 19：「現時沒有量化的標準決定這些地點的相對重要性，但一般而言，具有獨特考古歷史或建築學上的價值的地點，會視爲非常重要。須進行基線研究，(a) 就擬議的工程項目範圍，編制一份詳盡的清單具有建築學、考古學及歷史價值的地方、建築物、場地及構築物；及 (b) 確定擬議工程項目所帶來對文化遺產地點可能造成的威脅、其程度、全面或部分損壞。」

該備忘錄亦說明了對重要的文化遺產地點的評估準則如下：

附件 10：「評估對文化遺產地點影響的準則包括：(a) 一般假設爲贊同保護及存護所有文化遺產地點，由於其提供基本、有限和不可替代的對古今的連繫，是文化和傳統的參考點和身分；(b) 對文化遺產地點的不良影響應減至最低。」

該備忘錄亦說明了對文化資源作整體或部份保存的方法：

附件 19：「整體保存會是有利的影響，如果採取適當的措施把文化遺產地點與擬議的工程項目結合，可以改善文化及社會經濟環境。　如果基於地點的限制或其他因素只可作部分保存，必須考慮其他建議或規劃設計，證明全面保存並不可行。」

C2.2 古物及古蹟條例（第 53 章）

除了「環評技術備忘」之外，香港的文化遺產資源亦受到一系列的法例和規劃機制保護。「古物古蹟條例（第 53 章）」讓主管當局有權在香港指定“古物及古蹟地點”或“法定古蹟”。此條例所提供的法律保護，令陸上和海底的法定古蹟、歷史建築和考古遺址等免受發展計劃的威脅。這類爲後世而保護的地點，是由古物諮詢委員會推薦，交由行政長官批准，並於憲報公布。舉凡人類文物、古代遺物及建構物，均可藉憲報宣布爲古蹟而受到保護。根據這條條例，古物事務監督如認爲任何地方、建築物、地點或構築物因具有歷史、考古或古生物學意義而符合公眾利益，可於諮詢古物諮詢委員會，並獲行政長官批准後，藉憲報公告宣布該處爲古蹟、歷史建築物或考古或古生物地點或構築物。文物一旦宣布爲古蹟，除了已獲古物事務監督所發之許可證者外，任何人士均不得在其上進行上述條例禁止的行爲，例如拆卸、建築或其他工程。

至於考古遺址，所有 1800 年以前的古代遺物均屬於香港政府所有。考古遺址可分爲下列三類：

- *指定考古遺址* – 指已公布爲法定古蹟的地點，應不惜代價予以保護及保育；
- *藉行政措施保護的考古遺址* – 指被認爲具有重要價值，但未宣布爲法定古蹟的地點。這類地點應予保護，但如未能加以保護，則應進行搶救發掘；及
- *受監察的考古遺址* – 指重要性較低或未全面評估潛在價值的地點。這類地點，除了在古物古蹟辦事處批准及監察下進行的小型工程外，應免受干擾。

此條例亦規定了挖掘及搜尋古物的發牌程序，其目的是禁止任何人在未獲發牌許可前進行這類活動。條例內亦有註明違反該條例的罰則，包括罰款和監禁。

香港一直以來都在進行各種考古調查，以找出考古遺址。古物古蹟辦事處已爲各個已知的考古遺址劃定邊界，並制定了一套行政程序來保護這些考古遺址。然而，現時的考古遺址記錄並不完整，有很多區域仍有待調查。因此，有需要確保一項工程在規劃初期便能夠識別和實施一些適當的程序和機制，來確保在工程評估或施工時若發現前所未見的考古資源，會加以保存和向當局申報。

「古物古蹟條例」第 11 條規定任何人若發現古物或懷疑爲古物的東西，必須向古物事務監督報告有關的發現。換言之，建造工程必須確

保，若在工程評估或施工時發現任何考古資源，都需要正式通知古物事務監督和古物諮詢委員會。

C2.3 香港規劃標準與準則

「香港規劃標準和準則」第 10 章（保育）列載了關於保育歷史建築物、考古遺址和其他文物的一般指引和措施。

C3 評估方法

C3.1 海洋考古勘察指引

古物古蹟辦事處制訂了一套「海洋考古勘察指引」，闡述在判斷海洋考古潛質、文物的存在和擬定適當緩解措施時必須採用的標準方法和程序。文獻研究、地球物理調查和確定潛在考古價值，都是海洋考古勘察的第一階段。是否需要作更深入調查，則視乎這個階段的結果而定。

C3.2 範圍

是項研究的範圍，是根據*圖 C3.1* 至 *3.4* 所展示的電纜走廊（電纜鋪設路線中軸線兩側各 130 米）而制訂，並於下文稱爲「工程範圍」。擬建之海底電纜系統，會從望后石鋪設至赤鱲角機場。

C3.3 文獻研究

是項研究搜集了有關的文獻，爲電纜走廊沿途區域的考古資源編制了一份全面的清單。文獻搜尋工作，包括檢閱多份考古學的學刊，以及檢閱了英國水文處的“沉船”檔案，藉以確定擬建電纜走廊附近海域的潛在考古價值。此外，亦檢閱了在評估適當的電纜敷設路線時所進行的地球物理調查結果，以識別出任何可能具考古潛質的物質。

C3.4 地球物理調查

在 2005 年 9 月 6 日至 2005 年 9 月 30 日期間，是項研究進行了一項水文及地球物理調查，並在地圖上標示出現有電纜和通訊電纜的位置。除此之外，是次調查的其他目標如下：

- 繪製詳細的海床地貌圖；
- 繪出海床的質地和特徵；

- 繪出海床下重要的地質層次；及
- 採集海洋底土，以便進行各種化學及地力學化驗。

這次調查工作由 EGS(亞洲)有限公司運用下列儀器進行：

C3.4.1 側面掃描聲納

- Klein 3000 型系統，連同數碼拖行器；

側面掃描聲納調查的記錄參數如下：

船速：	1.4 -2.0 m / sec
脈沖波長：	25 μs
固定間距：	10 sec
源頭頻率：	100 及 500 kHz
傾斜距離：	75 米

側面掃描拖行器是由勘察船於船尾在海面下約 3 米（視乎水深而定）拖行。所有數據都以 C-View 海床數據管理系統加以記錄，其中包括同時記錄四個頻道（左舷 100kHz 及右舷 500kHz），以及導航、方位、船隻航向、電纜送出角度和長度、拖行器航向和水深。側面掃描聲納資料的解讀是在 EGS 的辦公室，透過一台桌面電腦的屏幕進行。每項特徵都加上獨立標記或群組區域。這些數據可以直接輸入至 Autocad 軟件，無需再轉換成數碼資料。

C3.4.2 震動輪廓勘察器

- 此調查使用了一部 C-Boom 低電壓探測器和水中拾音器，以及一個 Waverley 熱感記錄器。

這次調查所記錄的參數如下：

船速：	1.4 -2.0 m / sec
固定間距：	10 sec
墮後距離：	23m
橫掃速度：	80 ms (地震記錄儀)

探測器是從船尾拖行，並與船身保持一定距離，令船隻發出的噪音影響減至最低。

C3.4.3 *磁力調查*

- 一部 Sea Spy 磁力計（Overhauser 系列）包括下列組件：舷外傳感器、內置電腦，以及製造商和 EGS 提供的軟件。

拖行器（舷外傳感器）是設置於離船尾 20 米處，並連接著一個深度感應器，以提供深度讀數，以便在海床上保持穩定高度。EGS 所編寫的軟件，能把海洋磁力數據以兩種輪廓形式展示於電腦屏幕上：

- 大影像顯示，介乎 10 至 50 nT 的範圍；
- 小影像顯示，比例是上述大影像顯示的 10 倍。

C3.4.4 *前掃式（多聲束）測深計*

- Allied Signal 'Bottom Chart' 型多聲束系統，包括架設於船隻右舷的傳感器、內置電腦；以及一個 TSS 陀螺羅盤、TSS DMS05 移動補償器（前後移動）、TSS 335B 升降補償器，用作支撐整個系統和抵消船身的移動。

這個前掃式測深系統是一個多聲束的回音發射器，能夠發出扇形的聲束（於勘察船上呈 150 度角），藉以十分準確地量度海床的深度。

C3.4.5 *定位*

這次調查工作使用了全球差別定位系統來確定位置。這套系統包括下列各個部份：

- C-Nav 全球修正定位系統，準確度為+/- 0.3m，以及 EGS 的電腦化導航系統，用作控制勘察船的航向。

該套定位系統的天線是直接架設於前掃式（多聲束）傳感器之上。

C3.4.6 ***C-View*** *操作及解讀軟件*

這個系統提供兩個屏幕的畫面，可供震動輪廓系統和側面掃描系統使用。所有原始數據都以數碼記錄。

這些設備是安裝在一艘第三類商業牌照的勘察船上。

C3.5　確定考古潛質

地球物理數據經過詳細分析和整合後，便能夠展示具考古潛質的地點。這些資料有助於制訂勘察和評估策略。若能識別出文化遺留，便須作進一步調查，但在作此要求前，必先檢討有關海域的潛在考古潛質。若並無跡像顯示區內具有此物質，或者在調查區內考古潛質時顯示並無考古潛質之特徵存在，便不會建議作進一步調查。

C3.6　影響評估

評估工作最優先考慮的準則，是完整地保存具考古價值的地點或物品；同時，亦充份考慮到「環評技術備忘錄」附件 10 第 2.1 條和附件 19 第 2.6-2.14 條所說明規定。

C4　海洋考古基線狀況

C4.1　土力背景

香港地區的海底沉積層大致可以分爲三種地層：赤鱲角地層和覆蓋在上面的坑口地層，以及深屈地層。

赤鱲角地層是第四系最底部份，屬更新世中期至晚期，包括有崩積層、冲積層和湖泊沉積物（Fyfe 等人 (2000)）。在這個地層之上的海洋沉積物屬全新世時期（約從 13,000 BP 至現在），稱作坑口地層，成份包括黏質粉土沉積物和少量沙（泥、沙質泥）。

位於赤鱲角地層和坑口地層之間的深屈地層屬於 Eemian 沉積層，年齡不詳，成份有鬆軟至結實的黏土，帶黃色班紋。此地層現時並不廣泛分佈，只在坑口地層下發現一小片（Fyfe 等人 (2000)）。

較現代的沉積物則是來自珠江排放的物質（工程範圍位於珠江口下游，因此會受影響），每年的季節性排放量約達 3,700 億立方米（同上）。這些物質的成份有沙、泥和少量砂礫。

Fyfe 等人(2000)的著作詳細解釋了沉積率：

「一般而言，香港水域現在的沉積率偏低，雖然它在全新世時肯定比較高。當時海面正迅速上升。…在缺乏潮水冲刷的情況下，從珠江進入維多利亞港的沉積物、來自污水的污泥和塡海所添加的物料等，都會令人預期海港內的海床每年上升 4 厘米。然而，比較 1903 年至 1980 年維多利亞港的水文圖後發現，沒有確實證確顯示海港內有淨沉積出現，意味著海床是處於一種動態均衡的狀態。假設香港水域的沉

積過程是在大約 8000 年前開始，在每年介乎 1.25 至 2.5 毫米的平均沉積率的作用下，應該形成約 10 至 20 米的海泥沉積層。有證據顯示，全新世的沉積過程並不穩定。放射性碳測年顯示，大部份沉積層都是在過去 4,000 至 5,000 年間形成。」

在更新世晚期（18,000BP），海面開始上升，直至約 6,000BP 爲止。當時的海面與今日相若。「部份地方的上升幅度可能高達 140 米」（同上，第 40 頁）。

在全新世晚期的沉積物屬於相對較爲單一的極軟至鬆軟黏土，濕度高，提供最高潛質（相對於海床表面大多已受捕漁和其他航運活動所影響），存有保存良好，與在香港境內居住和使用有關的遺留。這些遺留可能包括沉船、與沉船有關的物品或其他考古遺址。

在工程範圍內，這種海洋沉積物的厚度介乎 0 至 20 米。

C4.2 歷史背景

考古證據顯示，航海人員使用香港海域約有 6,000 年的歷史（Bard, 1988）。在 Chau (1993) 的著作中有如下報導：

「在過去十年間，有多個在沿岸的沙洲的史前遺址陸續被發現，代表早期居民對沿岸地區和離島的開發成果。在大約六年前，新石器時代的人已經在華南沿岸地區定居。」

Coates（在 Braga, 1957 的著作中）指出：「在大嶼山南岸的石壁海灘上發現了這類史前活動的確實考古證據。從這些發現可知，約在三千年前，這些島嶼已被用作季節性的轉口港，在長江口、今日稱爲廣東省的部落和印度尼西亞之間從事貿易。」過去，珠江口的島嶼被視爲比較適合廣東商人和其他區域的商人進行貿易，以及「海灘附近建起了臨時聚落。在南丫島和大嶼山都曾發現這個時期的煮食工具，卻沒有任何建築物的痕跡。」

其他資料更指出：

「本地歷史（仍遠不及完整地記錄）是從中國人在宋朝（960 年-1279 年）時移居這個地區開始・・・。大嶼山是下一個在歷史舞台出現的群組。宋朝的末代皇帝昺在逃避蒙古人入侵的過程中到了九龍。在 1279 年，帝昺的部隊在離荃灣不遠處被蒙古人追上並徹底擊潰。戰爭後，大批大臣和貴族渡過相對較窄的海峽登陸大嶼山。 … 逃到大嶼山的人當中，部份在當地定居，甚至可能與當地居民通婚。這批有文化的難民的一些蹤蹟可以在大澳找到。 … 蒙古人統治華南地區的時

間不長。十四世紀早期，南方局勢動蕩，因此一些家族從九龍半島移居於更偏遠的地方。現時居住於大嶼山石壁一帶村落的家族，大約是在蒙古人統治時（1279-1368 年）移居當地。」（同上）

Meacham (1994) 指出：「赤鱲角（東沙洲 1 號污泥坑以南，及小磨刀島以西）的歷史橫跨了人類聚居於香港地區的整個時期，從大約公元前 4000 年彩陶時期的最早居民開始，直至近期。」在興建國際機場前，曾在赤鱲角進行考古搶救工程，其中包括在赤鱲角多個地點進行考古工作，包括一個八至十世紀有古窰和古錢的遺址、北宋時期的墓地、一個新石器時代中期及晚期（公元前 4000-1500 年）有陶器的遺址、公元前 3700-3400 年的墓地／禮儀遺址、數個唐代的石灰窰（約屬公元 750 年及 1200 年），以及一個有軟硬幾何圖案的陶器、斧模和衣物的青銅器時代遺址。在 1993 年，在赤鱲角和東涌之間的海床挖泥時，發現一尊殘缺的古炮（Meacham, 1994）。這項發現其後向臨時機場管理局報告了。炮上的刻字說明該尊古炮是於 1808 年鑄造。這門古炮可能與東涌炮台有關，反映中國的軍事力量在當時已伸展至該區。

位於研究範圍南面的大嶼山，是香港眾多離島中最大和在最西面的一個，因此，爲它與香港島之間的海域提供了屏障。這個地區位於珠江口，「…名副其實是華南的大動脈」（Lo, 1963），早在「…秦代已經與外面世界有接觸。」（同上）早期的海上工業是採珠業，而「…到五代時官方才開始控制這項活動…」（Lo, 1963）。大嶼山亦變成一個產量豐富的製香地區，雖然「…沒有遺下甚麼可以令人追溯香港得名的由來」（同上）。大嶼山的內海灣吸引了「…來自阿拉伯、波斯、印度、印支半島和東印度群島的商船…」（同上），而本地船隻則參與捕漁和製鹽工業。區內海盜甚多，亦有聚居於大嶼山。朝廷的水師亦修築了城堡和炮台，以助剿滅海盜。

距離工程範圍以北只有數英哩的伶仃和屯門，是葡萄牙人（首批到達的歐洲人）於 1513 年建立據點的地方。葡萄牙探險家 Jorge Alvares 獲准於伶仃登陸，「…他在珠江口的屯門碇泊處逗留了十個月…」，因爲這裏是「…華南所有對外貿易進行之處（Braga, 1965）。」在他的東面內陸，與他隔海相望的是青山，俯瞰著屯門碇泊處。

有關歐洲人到達中國的更多敘述，以及這一地區對一般貿易的重要性的說明，可以在 Tomé Pires 的報道中看到（Cortesão, 1944）。這是一位居住於馬六甲的葡萄牙人。他的報道「…可能在一定程度上是以 Jorge Alvares 在中國收集到的資料爲依據。」（同上）「...Pires 對中國的港口和人物見聞頗多。」他提及來自馬六甲的帆船停舶於

Tumon 港。他指出，來自暹羅的船隻則停泊「在 Hucham 港內。」我們的 Tumon 港比暹羅的港口距離中國近了三里。「若我們的理論正確，Tumon 島就是伶仃島，因此，Hucham 很可能就是大嶼山的海港。」（同上）Cortesão 在 Braga (1965)一書中提到：「所有運到中國的貨品都在廣州市（Quamton）卸貨...」，而「鹽對中國人來說是好商品。它從中國被販運到這些區域，由一千五百艘船隻從各地到中國購鹽，然後轉運至其他地方。」（同上）

Lo (1963) 的著作進一步說明這個地區對工程範圍一帶的重要性：

雖然屯門與海外的貿易往來可以追溯至古代－大概在劉宋時期－卻是在唐朝時期貿易才大幅擴展。 ... 當交通日增，商旅往來屯門者日眾時，文人才開始聽聞這個地方和它的商貿活動。

唐亡後在嶺南立國的南漢，決意要取得被放逐南方的人的擁戴，並擴展治權至蠻、蜑（水上人）等外族，更要從外國賺取厚利。於是對屯門特別重視。在宋朝隨著五代的結束而興起之後，加強了對屯門一帶的治理。朝廷除了派兵駐防外，更設官專責剿匪。此外，更在屯門和其他兩個海港（在大嶼山北端的琵琶洲和在朱洲的擔桿洲）設立一套行政制度，以便管理近岸和偏遠的海域。 ...；在宋代，沿岸只有廣州附近的屯門、官府場和大嶼山這三個地方有朝廷軍隊駐守。

文獻顯示，介乎大嶼山、伶仃和屯門一帶的地區－即是項工程所在的地區，是有居民生活的地區，而且是中國各地和海外多個國家的人和物經常往來的地區，歷時最少 4000 年。

C4.3 英國水文處的資料

調查已與英國水文處聯絡，諮詢他們有關是項工程範圍的沉船資料庫。該處的資料庫中，有九項相關的沉船及／或障礙物的記錄，詳見圖 C4.1 及附件 1 所示。當中，只有一項「仍存在，未明確的障礙物」在該地點附近，在電纜鋪設路線東面約 1,485 米（見地點 58708）。其他八艘沉船，有兩艘被識別爲「已打撈」，其餘六艘則屬「已死」，即經多次勘察仍未能偵測到，因此被視爲不存在。

C4.4 地球物理調查結果

檢閱地球物理調查結果的目的，是要界定最具考古潛質的地區，以及評估海床沉積物的深度和性質，以便找出含有適當物質，足以埋藏和保存考古物質，並繪出海床上可能是考古物質的不尋常地方。有關的結果摘述如下。

EGS（亞洲）有限公司按照工作合約，於 2005 年 9 月 6 日至 2005 年 9 月 30 日期間，對工程範圍（從望后石至赤鱲角）進行了一項水文及地球物理調查。*圖 C3.1* 至 *3.4* 展示了沿著整條電纜鋪設路線伸延的勘察地區的闊度（在電纜路線中軸線每一側各 130 米）。這些附圖亦展示了船隻的軌跡，即沿路線長度的軌跡之間為 20 米，而垂直於路線則為每隔 100 米。這樣便能令側面掃描聲納和測深器勘察之間全面重疊。磁力調查則只在軌跡相交的地方實施，基本上是要在這條新電纜路線以西的地區找出現有電纜。上述附圖展示了現有的中華電力海底電纜和一條和記環球電訊的光纖海底電纜。EGS 在一個靠近望后石的地區（離岸約 1 公里），發現有多艘船隻碇泊。這些船隻會對磁力調查造成影響。

EGS 的地球物理學家解讀了調查數據，並製備了完整的海床和海床以下特徵的地圖（見*圖 C4.2* 至 *C4.5*）。他們發現下列各項：

- 海床上有大片已經受到船錨和拖網干擾的範圍（見*圖 C4.6*）；

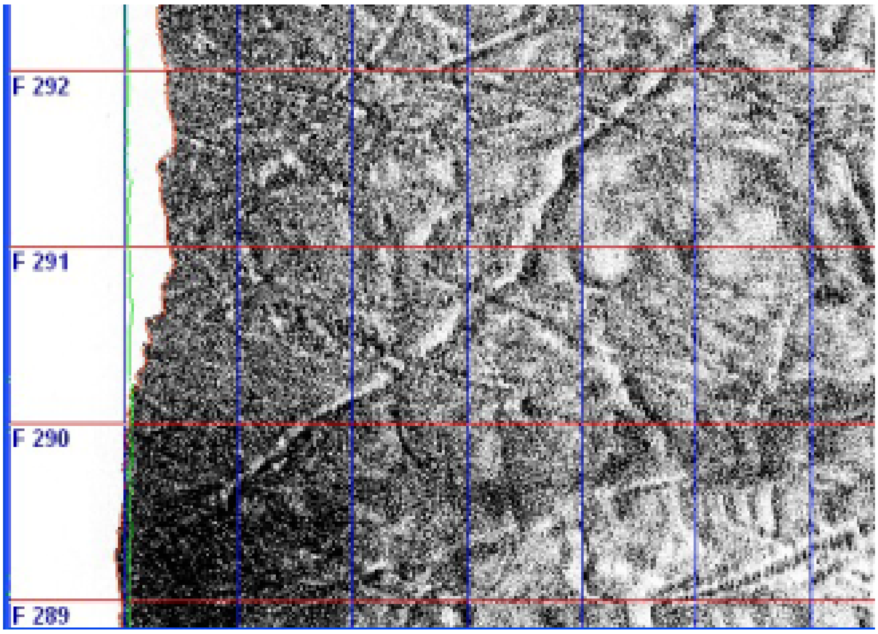


圖 C4.6 *海床上的船錨痕跡*

- 大範圍的海床由被傾倒的物料覆蓋，其中一個地區是三個聲納接觸點之一；
- 有較高反射率的地區是由砂礫或沙類物質造成；
- 有較低反射率的地區是由於比較清潔或未受滋擾的海泥；及
- 其餘兩個聲納接觸點可能是人工魚礁。

主要的特徵是拖網和船錨痕跡，以及海床上的粗沙沉積物。側面掃描聲納亦在擬建污水管的地方繪出一個線形物體，與磁力接觸點非常吻合。

EGS 的地球物理學家認爲兩個聲納接觸點 SC02 和 SC03（見圖 C4.7 和 C4.8）可能是人工魚礁，因爲該處毗鄰 100 米範圍內，有一個已被識別爲人工魚礁群的地區（見圖 C4.1）。另外一個物體 SC01，則被識別爲碎物（見圖 C4.9)。表 C4.1 是聲納接觸的摘要。

*表 **C4.1*** *海床聲納接觸清單*

接觸編號	北緯 東經 （**UTM** 網格）	與電纜路線中軸距離和方向	大小（米）	說明
SC01	821932.7 N 812846.1 E	50 米　西	7.34x4.62x1.86	物體
SC02	821180.4 N 812603.2 E	10 米　東	30.57x10.3x2.22	可能是人工魚礁
SC03	820931.5 N 812434.1 E	40 米　東	19.01x5.74x1.25	可能是人工魚礁

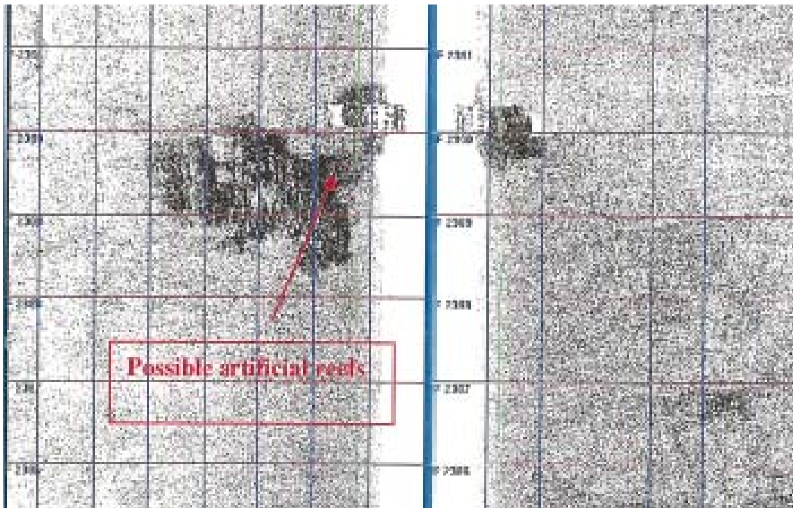


*圖 **C4.7*** *可能的人工魚礁例子（**SC03**）*

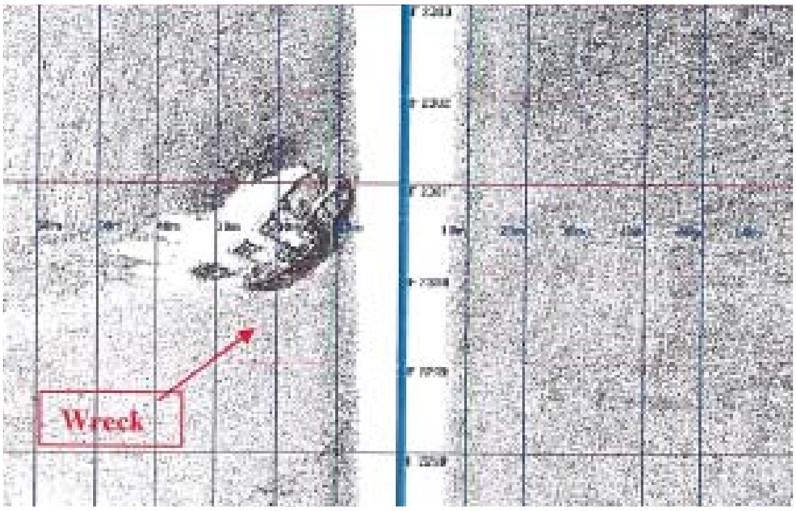


*圖 **C4.8**：可能的人工魚礁例子（沉船）（**SC02**）*

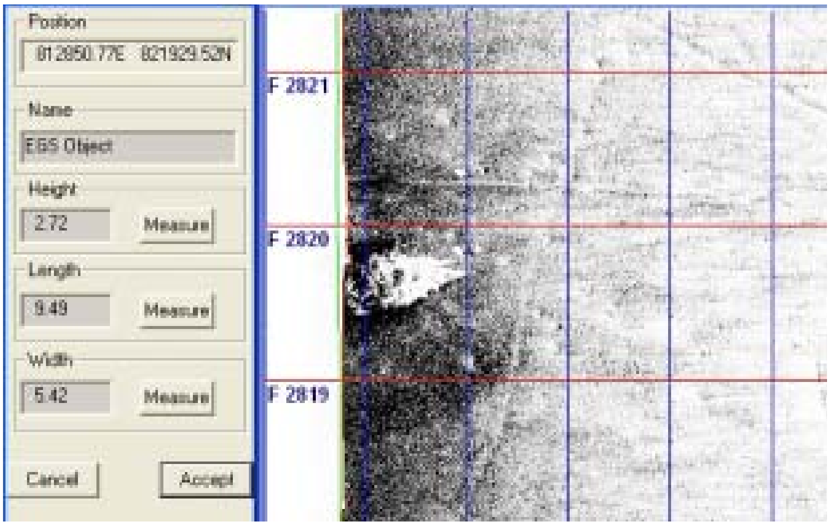


*圖 **4.9**　　海床碎物（**SC01**）*

由一位海洋考古學家 William Frederick Jeffery 先生對整個電纜路線上的原始資料和地圖加以檢討後，所得結論與地球理學家一樣。

其他調查，包括磁力、多聲束測深計和探測器等的調查提供了海深度的資料、各種海洋沉積層的深度（變化可達 20 米）、沖積物和各種等級的石塊，以及現有海底電纜和管道的位置。探測器的調查展示了 31 個海床下的異常地方，而 EGS 的地球物理學家亦認爲「可能是海床下的障礙物」。當中有不少是海床上眾多的碎物和被傾倒的物質之一（見*圖 C4.2* 至 *C4.5*），但部份則並非如此。另一個可能性是，部份障礙物是考古物質，因爲這類海床下的特色地方的震動探測器讀數與現在的讀數相若。除了現時位於海床下的電纜外，並沒有在軌道相交的地方的磁場數據。由於部份海床下的異常地方正好位於軌道相交處，因此，可能有助於檢驗這些地方是否含有鐵質物料（顯示屬人造物品），但亦可能是石塊的天然磁性。

C5 *影響評估*

雖然在檢閱基線狀況時所進行的文獻檢閱發現工程範圍可能有水下文化遺產的地點，但在英國水文處的沉船數據庫內，卻找不到電纜沿線有任何具歷史或考古價值的地點。

在 31 個海床下的異常地方中，可能全部，或有很多，或只有部份是天然物質或被傾倒的物質。海床表面通常都有不少碎物和被傾倒的物質。根據沉積物的移動情況，這些碎物和被傾倒的物質可能已被覆蓋在海床下。另一個可能是，當中有部份是現代的人造的物件，甚或是 1800 年以前的人造物件。以現時可以取得的數據，兩者難於分辨。

C6 *緩解措施*

沒有任何海床上的物質被評爲具有歷史或考古價值，因此無需實施任何緩解措施。然而，有需要進行調查，以更能解釋海床下的 31 處異常地方。在現階段，最好的方法是進行更多地球物理分析、調查和解釋。

C7 *摘要與總結*

本研究已根據檢閱歷史記錄、英國的沉船數據庫，以及有關擬建電纜鋪設走廊的水文和地球物理調查結果，對工程範圍的海洋考古資源潛質進行了評估。雖然在新電纜走廊上發現了三個海床異常地方（聲納接觸點），但其中兩個被識別爲人工魚礁（在中軸線以東 10 米及 40 米），第三個則屬碎物（在中軸線以西 50 米）。預計它們都沒有任何歷史或考古價值。

震動探測器的調查找到了 31 個海床下的異常地方，其特徵在現階段尚未確知。玆建議在電纜安裝施工前，再進行更深入的地球物理調查工作，務求：

1. 更能解釋這些異常地點，可以是根據現有的調查數據，或進行額外調查，包括取得該等異常地點的準確深度的數據；

2. 確定這一地區沉積率和沖刷情況，以便對這些海床下的異常地點何時出現在海床上有一個時間參考／分析；

3. 確定區內石塊／碎物和被傾倒物質的磁力性質，以及一次磁力調查的結果能否把這 31 個海床下的異常地點與天然特徵、碎物、被傾倒物質和人造物品所含鐵的物質加以區分。若認爲磁力調查有助於把人造物品與四周的物質區分，便應該進行磁力調查，甚至可以連同其他種類的地球物理勘察一併進行。

4. 這些數據應該交由地球物理學家和海洋考古學家加以檢討。

C8 *參考書目*

Bard, 1988, In Search of the past: A guide to Antiquities of Hong Kong（探尋過去：香港古物指南）

Braga, J. M., 1965, *China Landfall 1513. Jorge Alvares Voyage to China.* A complilation of some relevant material. Macao. Imprensa Nacional. *（Jorge Alvares 的中國旅程* 一書中的部份相關資料*）*

EGS, 2005, Proposed Submarine cable system between Pillar Point and Chek Lap Kok Airport. Hydrographic and Geophysical Surveys. HK 197305 （望后石與赤鱲角機場間的擬建海底電纜系統的水文及地球物理調查）

Fyfe, J.A., Shaw, R., Campbell, S.D.G., Lai, K.W. and Kirk, L.A., 2000, *The Quaternary Geology of Hong Kong.* Hong Kong Geological Survey, Geotechnical Engineering Office, Civil Engineering Department, The Government of Hong Kong, SAR. （*香港的第四系地質*）

Lo, Hsiang-Lin, 1963, *Hong Kong and its External Territories before 1842.* Institute of Chinese Culture. Hong Kong. （1842 年以前的香港及外部地域）

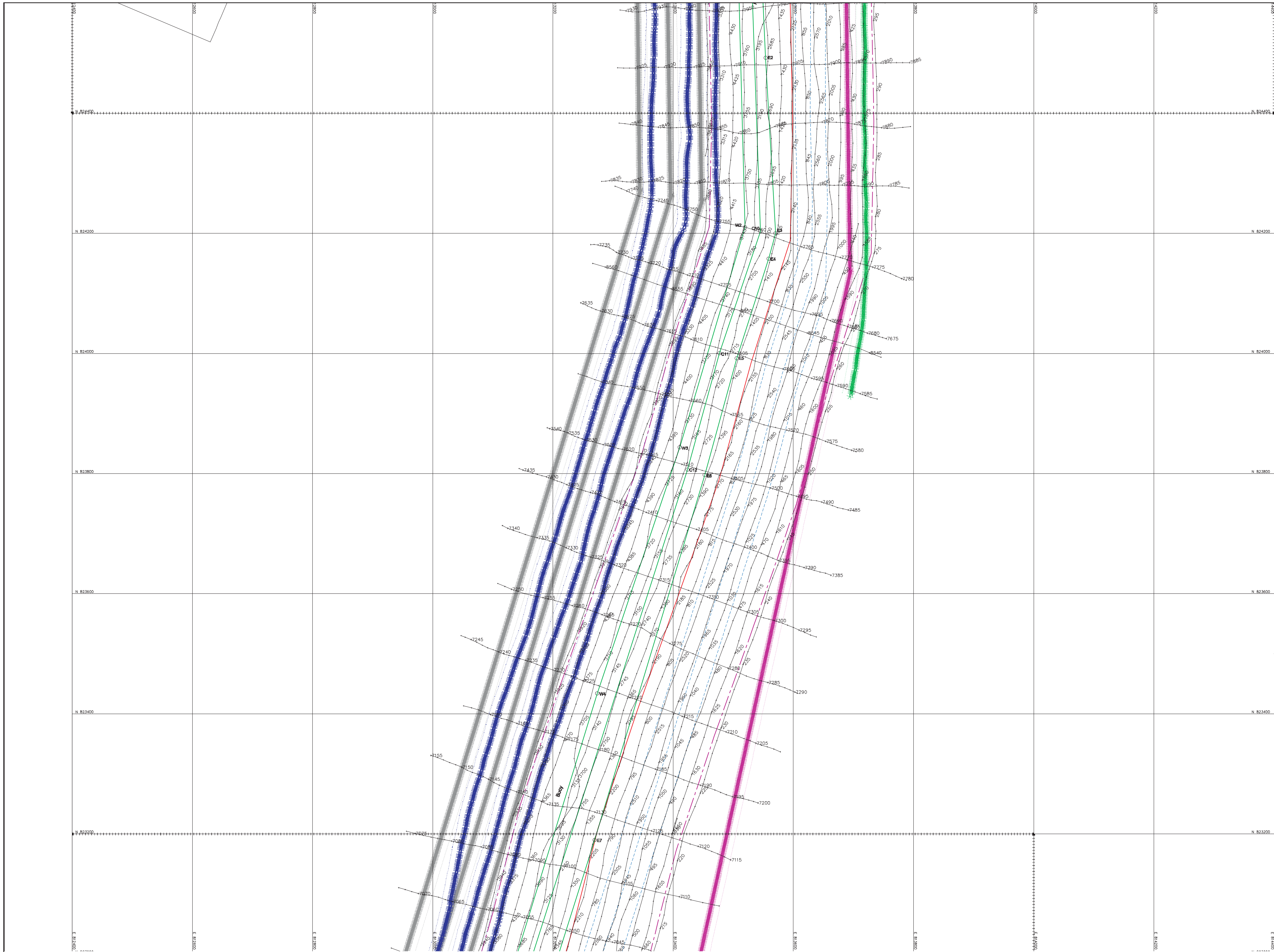
Meacham, William, 1994, *Archaeological Investigation on Chek Lap Kok.* The Hong Kong Archaeological Society. Hong Hong. （赤鱲角考古調查）

Figure C3.1
圖C3.1

Vessel Track Plot of the Proposed Cable (Sheet 1 of 4)
建議中電纜的船隻軌跡圖（第一頁．共四頁）

Environmental Resources Management
ERM

FILE:0046048d6
DATE:11/07/2006



圖例
Legend :

中電132kV海底電纜（建議中往機場的2號路線）
CLP 132kv submarine cable
(Proposed No.2 circuit to airport island)

測量船軌道的固定位置
Vessel track with fix positions

建議中的電纜系統的中軸線
Proposed centreline for new cable system

測量邊界
Survey boundary

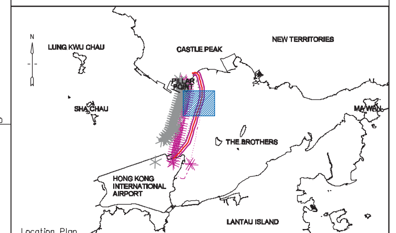
現有之中電海底電纜（中電提供）
Existing CLP 132kv submarine cable (provided by CLP)

現有之中電海底電纜（測量結果）
Existing CLP 132kv submarine cable (as surveyed)

現有之和記環球海底光纖電纜系統（中電提供）
HGC optical fibre submarine cable (provided by CLP)

現有之和記環球海底光纖電纜系統（測量結果）
HGC optical fibre submarine cable (as surveyed)

重疊圖表
Chart overlap



Location Plan

Project :

PURCHASE ORDER No. 4500275886 & 4500281121
PROPOSED SUBMARINE CABLE SYSTEM
BETWEEN PILLAR POINT AND CHEK LAP KOK AIRPORT
HYDROGRAPHIC AND MARINE GEOPHYSICAL SURVEYS

AREA : NORTH OF CHEK LAP KOK AIRPORT | **FIGURE NUMBER : 1.2**

Drawing Title :

VESSEL TRACK PLOT

Notes :
1. Survey Date : 06–30/09/2005
2. Grid System : Hong Kong Metric Grid
3. Survey Datum : Hong Kong Principal Datum
4. Positioning : C–Nav GcGPS
5. Coastline taken from 1:20000 Series HM20C, Survey and Mapping Office, Lands Department

Revision no.	Date	Drawn by	Checked by	Approved by	Remarks
0	25–10–2005	Clarence Siu	S K Wong	Matthew Lai	Preliminary
1	22–12–2005	Clarence Siu	S K Wong	Matthew Lai	Final

METRIC SCALE 1:2000

Client : **CLP Power Hong Kong Limited**

Surveyor :

EGS (ASIA) LIMITED
9/F SOUTH, SOMERSET HOUSE, TAIKOO PLACE, 979 KING'S ROAD, QUARRY BAY, HONG KONG
Tel : (852) 28948622
Fax : (852) 25763590
URL : www.egssurvey.com
EARTH SCIENCES & SURVEYING

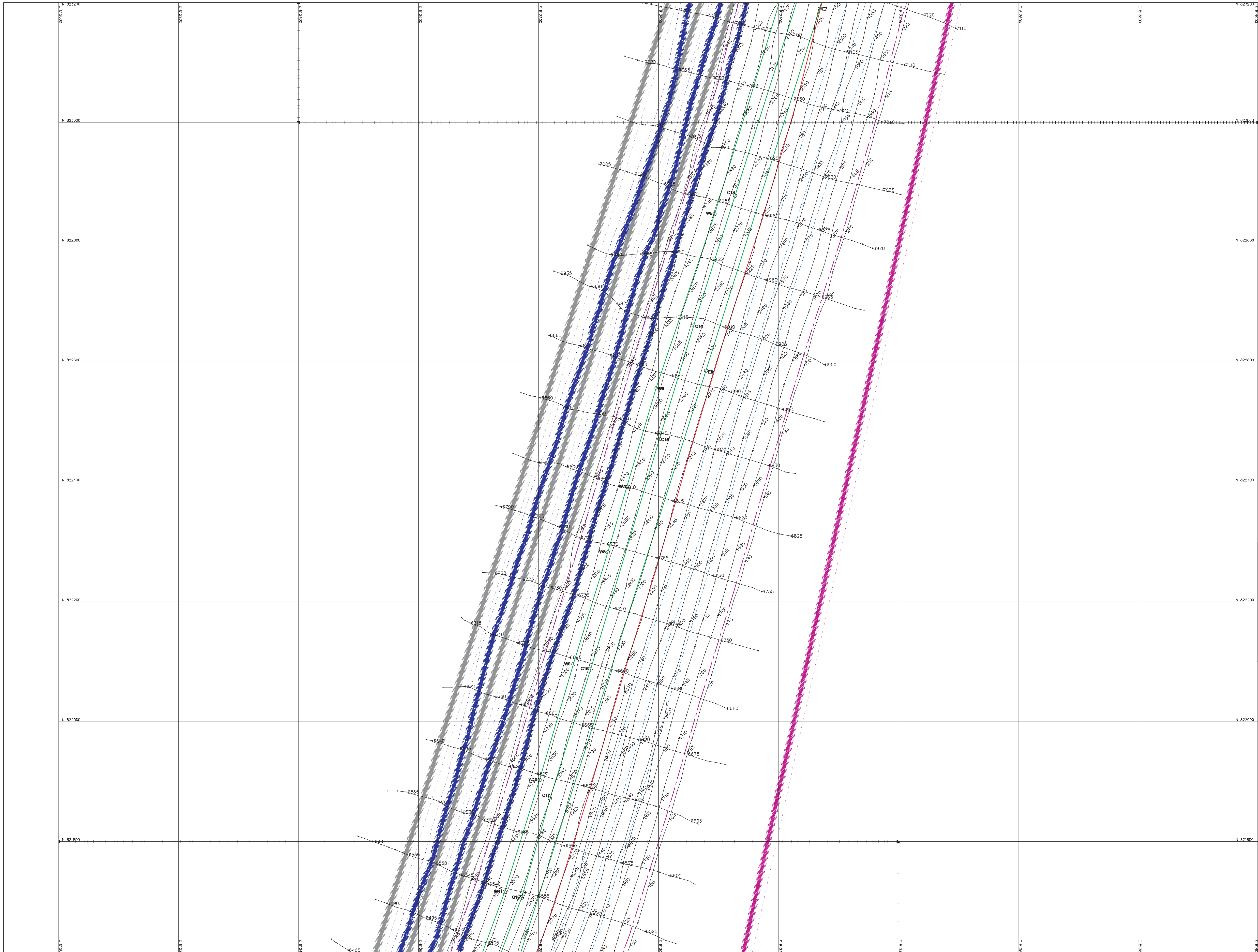
JOB NO. : HK197305

Figure C3.2
圖C3.2

Vessel Track Plot of The Proposed Cable (Sheet 2 of 4)
建議中電纜的船隻軌跡圖（第二頁．共四頁）

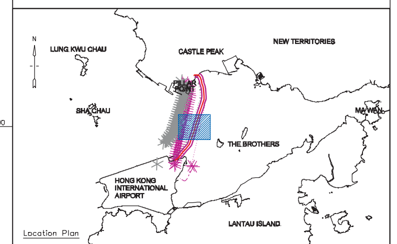
FILE:0043048d7
DATE:11/07/2006

Environmental Resources Management
ERM



圖例
Legend :

- 中電132kV海底電纜（建議中往機場的2號路線）
  CLP 132kv submarine cable
  (Proposed No.2 circuit to airport island)
- 測量船軌道的固定位置
  Vessel track with fix positions
- 建議中的電纜系統的中軸線
  Proposed centreline for new cable system
- 測量邊界
  Survey boundary
- 現有之中電海底電纜（中電提供）
  Existing CLP 132kv submarine cable (provided by CLP)
- 現有之中電海底電纜（測量結果）
  Existing CLP 132kv submarine cable (as surveyed)
- 現有之和記環球海底光纖電纜系統（中電提供）
  HGC optical fibre submarine cable (provided by CLP)
- 現有之和記環球海底光纖電纜系統（測量結果）
  HGC optical fibre submarine cable (as surveyed)
- 重疊圖表
  Chart overlap



Project :

PURCHASE ORDER No. 4500275886 & 4500281121
PROPOSED SUBMARINE CABLE SYSTEM
BETWEEN PILLAR POINT AND CHEK LAP KOK AIRPORT
HYDROGRAPHIC AND MARINE GEOPHYSICAL SURVEYS

AREA : NORTH OF CHEK LAP KOK AIRPORT | **FIGURE NUMBER : 1.3**

Drawing Title :

VESSEL TRACK PLOT

Notes :
1. Survey Date : 06–30/09/2005
2. Grid System : Hong Kong Metric Grid
3. Survey Datum : Hong Kong Principal Datum
4. Positioning : C–Nav GcGPS
5. Coastline taken from 1:20000 Series HM20C, Survey and Mapping Office, Lands Department

Revision no.	Date	Drawn by	Checked by	Approved by	Remarks
0	25–10–2005	Clarence Siu	S K Wong	Matthew Lai	Preliminary
1	22–12–2005	Clarence Siu	S K Wong	Matthew Lai	Final

METRIC SCALE 1:2000
100 80 60 40 20 0 100 200

Client : CLP Power Hong Kong Limited

Surveyor : EGS (ASIA) LIMITED
9/F SOUTH, SOMERSET HOUSE, TAIKOO PLACE, 979 KING'S ROAD, QUARRY BAY, HONG KONG
Tel : (852) 28948622

Figure C3.3
圖C3.3

Vessel Track Plot of The Proposed Cable (Sheet 3 to 4)
建議中電纜的船隻軌跡圖（第三頁．共四頁）

FILE:00468048d8
DATE:11/07/2006

Environmental Resources Management
ERM

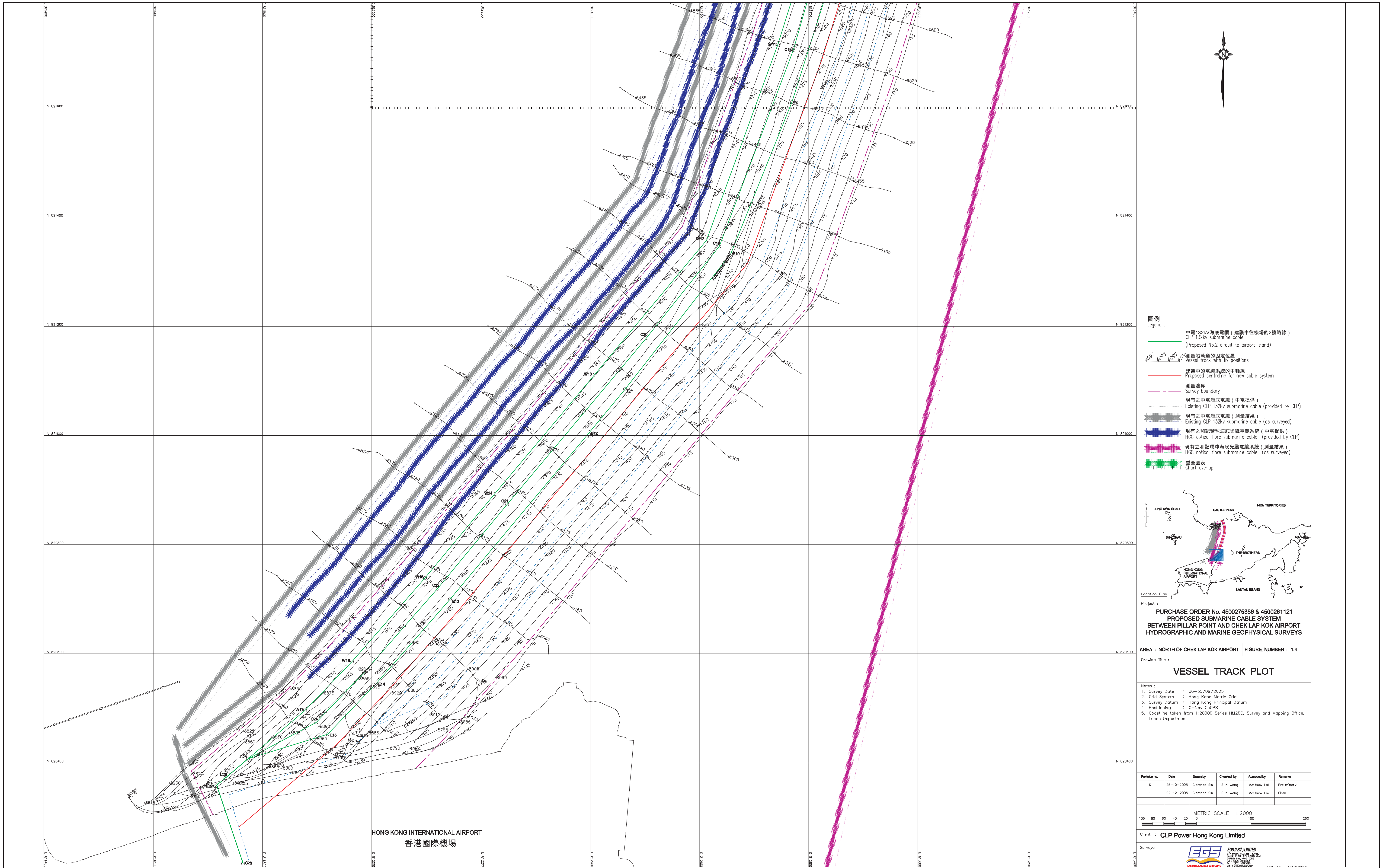


Figure C3.4
圖C3.4

Vessel Track Plot of The Proposed Cable (Sheet 4 of 4)
建議中電纜的船隻軌跡圖（第四頁．共四頁）

FILE:0046048d9
DATE:11/07/2006

Environmental Resources Management

Figure C4.1
圖C4.1

Location of Recorded Shipwrecks adjacent to the Proposed Submarine Cable Circuit Maintained by UK Hydrographic Office
建議中的海底電纜附近的英國海事處有記錄沉船殘骸位置

FILE: 0046048d14
DATE: 11/07/2006

Environmental Resources Management
ERM

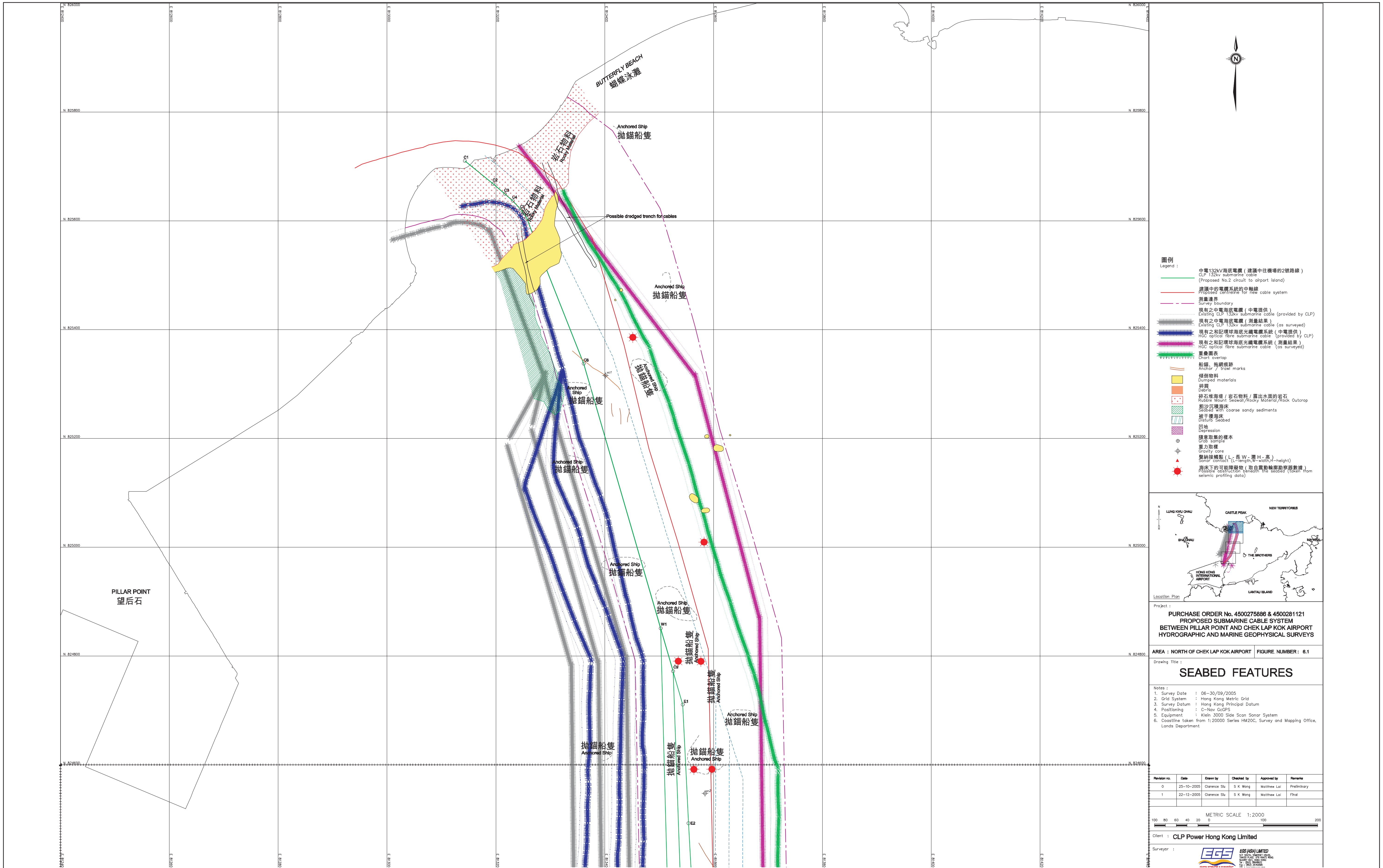


Figure C4.2
圖C4.2

Seabed Features (Sheet 1 of 4)
海床特徵（第一頁．共四頁）

FILE:0046084d10
DATE:11/07/2006

Environmental Resources Management
ERM

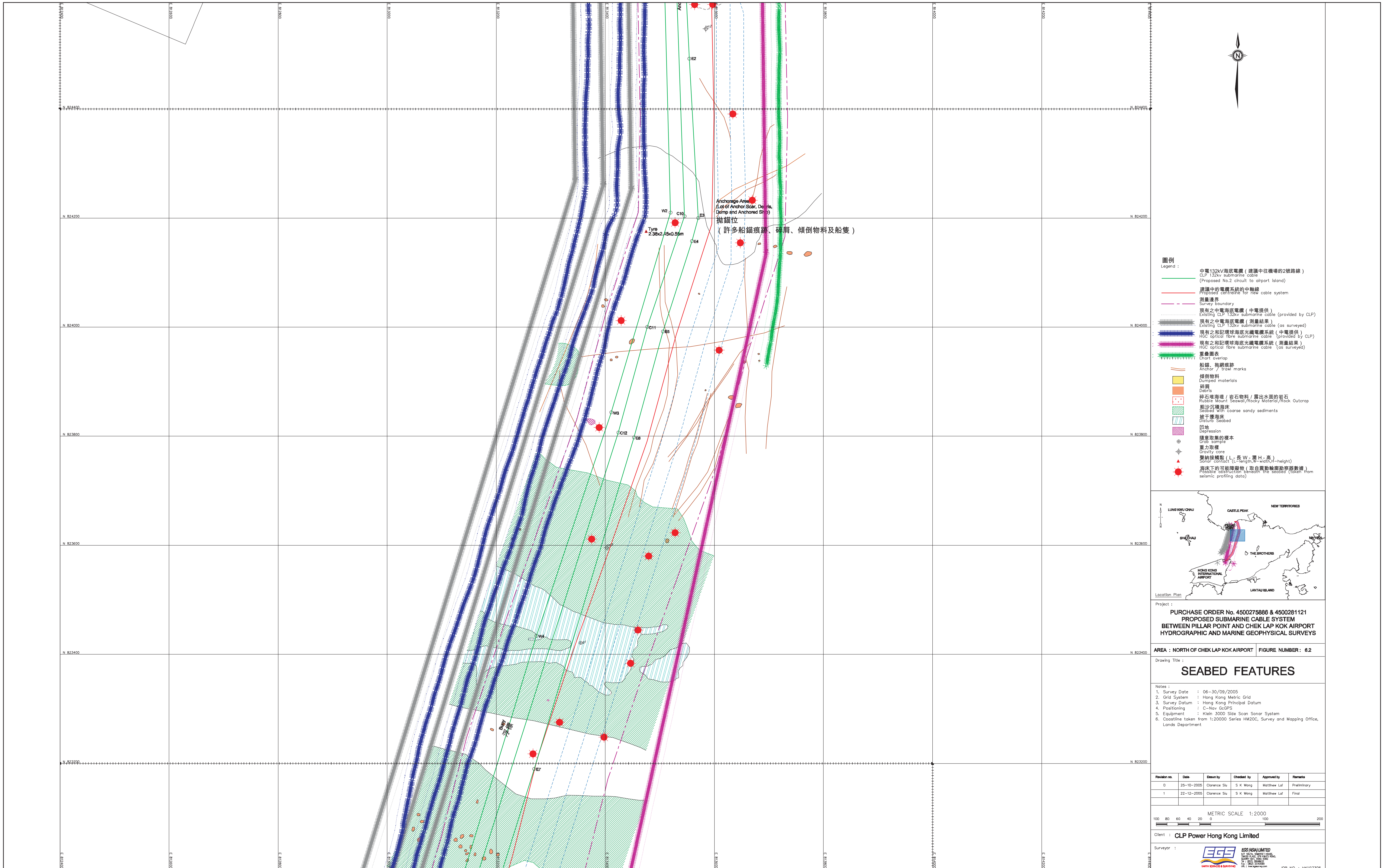


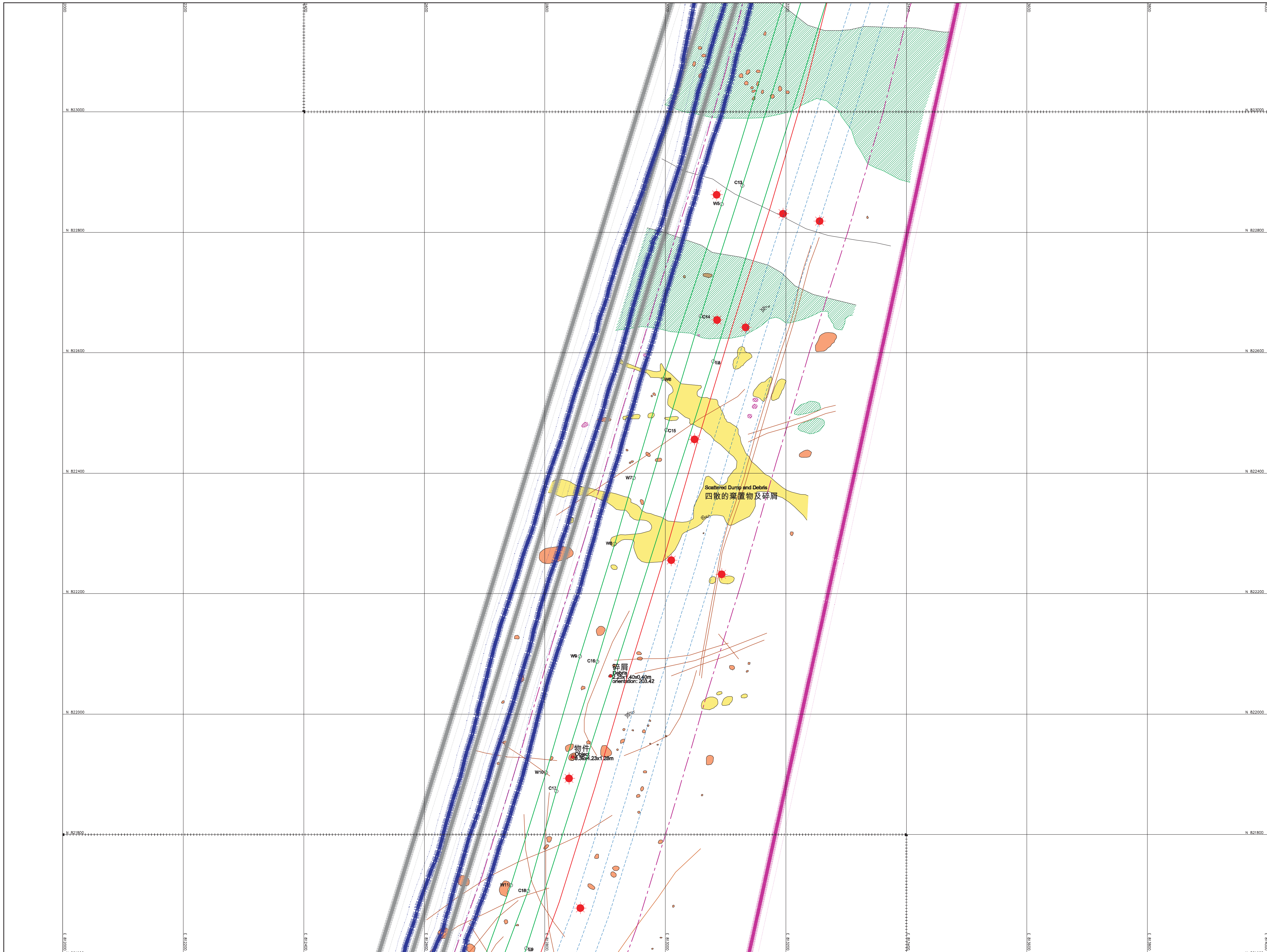
Figure C4.3
圖C4.3

Seabed Features (Sheet 2 of 4)
海床特徵（第二頁．共四頁）

FILE:0046084d11
DATE:11/07/2006

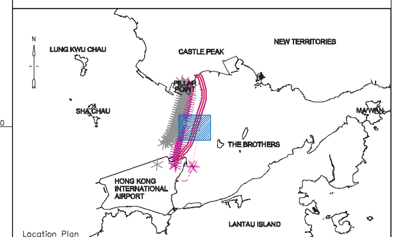
Environmental Resources Management

ERM



圖例
Legend :

- 中電132kV海底電纜（建議中往機場的2號路線）CLP 132kv submarine cable (Proposed No.2 circuit to airport island)
- 建議中的電纜系統的中軸線 Proposed centreline for new cable system
- 測量邊界 Survey boundary
- 現有之中電海底電纜（中電提供）Existing CLP 132kv submarine cable (provided by CLP)
- 現有之中電海底電纜（測量結果）Existing CLP 132kv submarine cable (as surveyed)
- 現有之和記環球海底光纖電纜系統（中電提供）HGC optical fibre submarine cable (provided by CLP)
- 現有之和記環球海底光纖電纜系統（測量結果）HGC optical fibre submarine cable (as surveyed)
- 重疊圖表 Chart overlap
- 船錨、拖網痕跡 Anchor / trawl marks
- 傾倒物料 Dumped materials
- 碎屑 Debris
- 碎石堆海堤 / 岩石物料 / 露出水面的岩石 Rubble Mount Seawall/Rocky Material/Rock Outcrop
- 粗沙沉積海床 Seabed with coarse sandy sediments
- 被干擾海床 Disturb Seabed
- 凹地 Depression
- 隨意取集的樣本 Grab sample
- 重力取樣 Gravity core
- 聲納接觸點（L - 長 W - 濶 H - 高）Sonar contact (L–length,W–width,H–height)
- 海床下的可能障礙物（取自震動輪廓勘察器數據）Possible obstruction beneath the seabed (taken from seismic profiling data)



Location Plan

Project :

PURCHASE ORDER No. 4500275886 & 4500281121
PROPOSED SUBMARINE CABLE SYSTEM
BETWEEN PILLAR POINT AND CHEK LAP KOK AIRPORT
HYDROGRAPHIC AND MARINE GEOPHYSICAL SURVEYS

AREA : NORTH OF CHEK LAP KOK AIRPORT | FIGURE NUMBER : 6.3

Drawing Title :

SEABED FEATURES

Notes :
1. Survey Date : 06–30/09/2005
2. Grid System : Hong Kong Metric Grid
3. Survey Datum : Hong Kong Principal Datum
4. Positioning : C–Nav GcGPS
5. Equipment : Klein 3000 Side Scan Sonar System
6. Coastline taken from 1:20000 Series HM20C, Survey and Mapping Office, Lands Department

Revision no.	Date	Drawn by	Checked by	Approved by	Remarks
0	25–10–2005	Clarence Siu	S K Wong	Matthew Lai	Preliminary
1	22–12–2005	Clarence Siu	S K Wong	Matthew Lai	Final

METRIC SCALE 1:2000
100 80 60 40 20 0 100 200

Client : CLP Power Hong Kong Limited

Surveyor : EGS (ASIA) LIMITED
9/F SOUTH, SOMERSET HOUSE, TAIKOO PLACE, 979 KING'S ROAD, QUARRY BAY, HONG KONG
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JOB NO. : HK197305

Figure C4.4
圖C4.4

Seabed Features (Sheet 3 of 4)
海床特徵（第三頁．共四頁）

FILE:0046084d12
DATE:11/07/2006

Environmental Resources Management
ERM

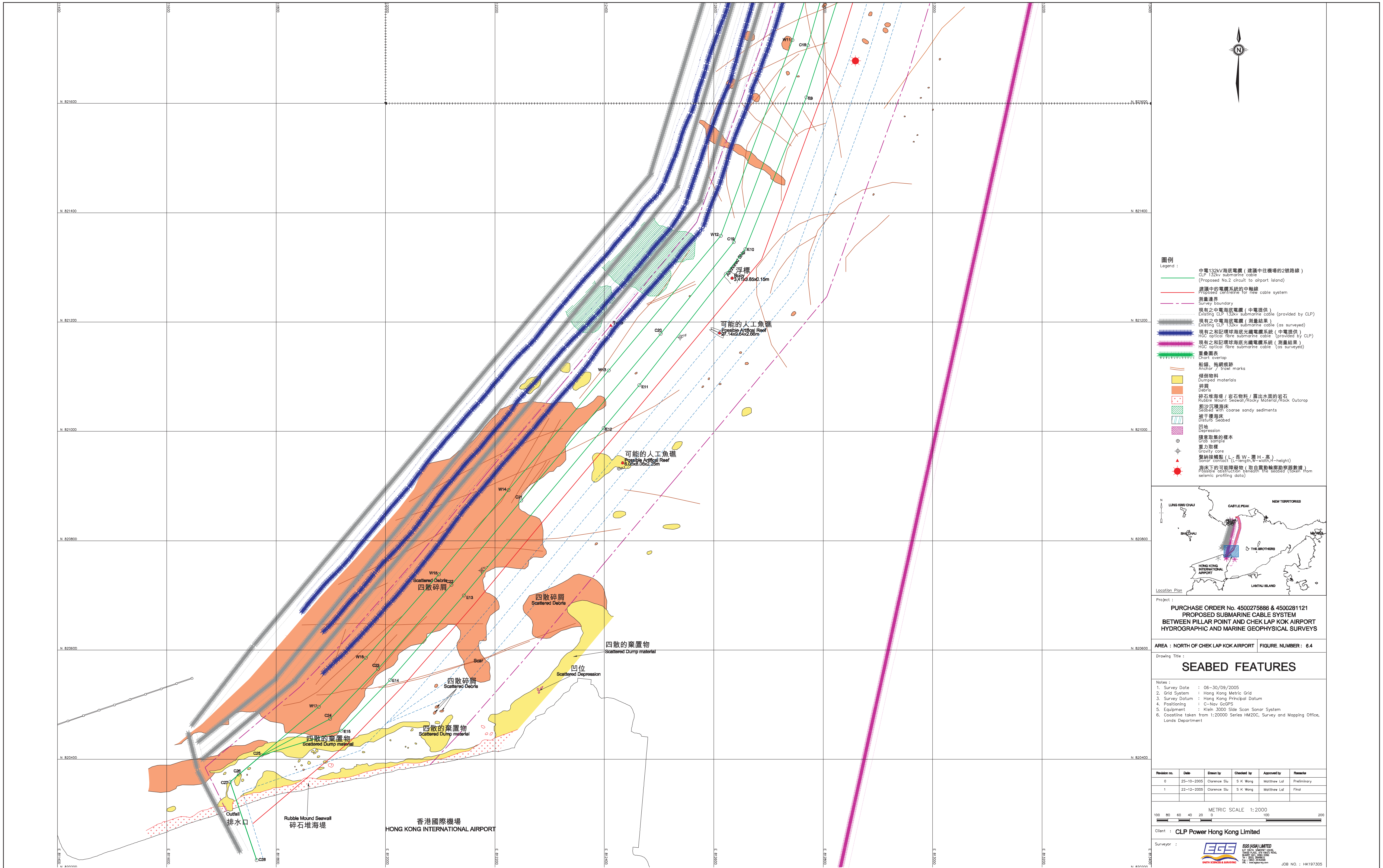

Figure C4.5
圖C4.5

Seabed Features (Sheet 4 of 4)
海床特徵（第四頁．共四頁）

FILE:0046084d13
DATE:11/07/2006

Environmental Resources Management
ERM

Appendix 1
附件 1

List of Known Shipwrecks adjacent to Study Area, Database from the United Kingdom Hydrographic Office, Taunton
來自英國海事處資料庫有關研究範圍附近的已知沉船清單

Wreck Number	58708	**Classification =**	Unclassified
Symbol	OB 5.1	**Largest Scale Chart =**	4122, 4123
Charting Comments			
Old Number			
Category	Undefined		

WGS84 Position **Latitude =** 22 21′.800 N **Longitude =** 113 58′.210 E
WGS84 Origin Original
Horizontal Datum WGD WGS (1984)

Position Method
Position Quality Precisely known
Position Accuracy
Area at Largest Scale No

Depth 5.1 metres
Drying Height
Height
General Depth 6 metres
Vertical Datum Lowest astronomical tide
Depth Method
Depth Quality Depth known
Depth Accuracy
Conspic Visual NO **Conspic Radar** NO
Historic NO **Military** NO **Existence Doubtful** NO
Non Sub Contact NO

Last Amended 25/11/2005
Position Last Amended 12/07/2003
Position Last **Latitude =** 22 21′.800 N **Longitude =** 113 58′.200 E
Name
Type OBSTRUCTION
Flag
Dimensions **Length =** **Beam =** **Draught =**
Tonnage
Cargo
Date Sunk

Sonar Dimensions **Length =** **Width =** **Shadow Height =**
Orientation

Magnetic Anomaly
Debris Field
Scour **Depth =** **Length =** **Orientation =**

Markers
General Comments

Circumstances of Loss

Surveying Details
**25.8.00 OB 4.8MTRS SHOWN IN 2221.800N, 11358.200E [WGD] ON HONG KONG 1503 [APR’00 EDN]. NE 1919.
**12.7.03 SHOWN IN 2221.800N, 11358.210E [WGD] ON HONG KONG 1503 [APR’00 EDN, ADOPTION]. NC 4123 & 4122.
**25.11.05 SHOWN AS OB 5.1MTRS ON HONG KONG 1503 [OCT’05 EDN, LARGEST SCALE ADOPTION]. NE 4123.

Wreck Number	46765	**Classification =**	Unclassified
Symbol	WK 9.0	**Largest Scale Chart =**	4123
Charting Comments			

Old Number 111303059
Category Dangerous wreck

WGS84 Position **Latitude =** 22 23′.108 N **Longitude =** 113 54′.125 E
WGS84 Origin Undefined
Horizontal Datum UND UNDETERMINED

Position Method
Position Quality Precisely known
Position Accuracy
Area at Largest Scale No

Depth 9.0 metres
Drying Height
Height
General Depth 16 metres
Vertical Datum Lowest astronomical tide
Depth Method
Depth Quality Least depth known
Depth Accuracy
Conspic Visual NO **Conspic Radar** NO
Historic NO **Military** NO **Existence Doubtful** NO
Non Sub Contact NO

Last Amended 26/11/2005
Position Last Amended 07/01/1999
Position Last **Latitude =** 22 23′.108 N **Longitude =** 113 54′.125 E

Name TUNG HONG 22
Type BARGE
Flag CHINESE
Dimensions **Length =** 43.3 metres **Beam =** 8.8 metres **Draught =**
Tonnage 351 Gross
Cargo SAND
Date Sunk
Sonar Dimensions **Length =** **Width =** **Shadow Height =**
Orientation

Magnetic Anomaly
Debris Field
Scour **Depth =** **Length =** **Orientation =**

Markers W CARDINAL LT BUOY, Q(9)15S CLOSE W
General Comments
Circumstances of Loss

Surveying Details
**HH550/406/03 17.2.97 UNCHARTED SUNKEN WK WITH LESS THAN 10MTRS OF WATER OVER IT LOCATED IN 222311.9N, 1135358.7E [?WGD]. (MARINE DEPT NM 28.97). NM ACTION TO BE TAKEN BY CB8.
**HH550/406/03 25.2.97 WK LEAST DEPTH 9MTRS IN 222306.5N, 1135407.5E ON HONG KONG SURVEY 1560 (DTD 14.1.97). W CARDINAL LT BUOY, Q(9)15S, CLOSE W. - NM 1071/97.
**HH550/406/03 7.3.97 ABOVE DETAILS REPEATED. W CARD LT BUOY, Q(9)15S IN 222311.9N, 1135357.0W [HKE]. (MARINE DEPT NOTICE 37/97). NFA.
**HH550/406/03 25.3.97 ABOVE INFORMATION REPEATED. (MARINE DEPT NOTICE 57/97). NFA.
**HH550/406/03 19.3.98 WRECK AND W CARDINAL BUOY REMOVED. (MARINE DEPT, FAX DTD 10.3.98). AMENDED TO LIFT. - NM 1410/98.

Wreck Number	46712		**Classification**	**=** Unclassified	
Symbol	WK 10.5		**Largest Scale Chart**	**=** 4123	
Charting Comments					
Old Number	111302456				
Category	Dangerous wreck				
WGS84 Position	**Latitude =** 22 22'.808 N	**Longitude =** 113 54'.167 E			
WGS84 Origin	Undefined				
Horizontal Datum	HKD HONG KONG (1963)				
Position Method					
Position Quality	Precisely known				
Position Accuracy					
Area at Largest Scale	No				
Depth	10.5 metres				
Drying Height					
Height					
General Depth	20 metres				
Vertical Datum	Lowest astronomical tide				
Depth Method	Found by echo-sounder				
Depth Quality	Least depth known				
Depth Accuracy					
Conspic Visual	NO	**Conspic Radar**	NO		
Historic	NO	**Military**	NO	**Existence Doubtful**	NO
Non Sub Contact	NO				
Last Amended	25/11/2005				
Position Last Amended					
Position Last	**Latitude =**	**Longitude =**			
Name					
Type					
Flag					
Dimensions	**Length =**	**Beam =**		**Draught =**	
Tonnage					
Cargo					
Date Sunk					
Sonar Dimensions	**Length =**	**Width =**		**Shadow Height =**	
Orientation					
Magnetic Anomaly					
Debris Field					
Scour	**Depth =**	**Length =**		**Orientation =**	
Markers	ISO DANGER LT BUOY, FL(2)10S CLOSE W				
General Comments					
Circumstances of Loss					

Surveying Details

**HH550/406/02 26.6.95 WRECK, LEAST DEPTH BY SOUNDING, 13.1MTRS IN 222248.5N, 1135410.0E. ISOLATED DANGER LT BUOY, FL(2)10S CLOSE W. (HONG KONG NM 34(T)/95). - NM 2084/95.
**HH550/406/03 10.1.97 SHOWN AS WK 10.5MTRS ON HONG KONG 1514 [NOV'96 EDN]. - NM 513/97.
**HH550/406/03 19.3.98 WK AND ISOLATED DANGER BUOY REMOVED. (MARINE DEPT, FAX DTD 10.3.98). AMENDED TO LIFT. - NM 1410/98.

Wreck Number 46784 **Classification =** Unclassified
Symbol **Largest Scale Chart =** 4123
Charting Comments POSN FOR FILING ONLY [SEE 46765 - LIFT]

Old Number 111303588
Category Dangerous wreck

WGS84 Position **Latitude =** 22 23′.008 N **Longitude =** 113 54′.250 E
WGS84 Origin Undefined
Horizontal Datum UND UNDETERMINED

Position Method
Position Quality Unreliable
Position Accuracy
Area at Largest Scale No

Depth
Drying Height
Height
General Depth 15 metres
Vertical Datum Lowest astronomical tide
Depth Method
Depth Quality Depth unknown
Depth Accuracy
Conspic Visual NO **Conspic Radar** NO
Historic NO **Military** NO **Existence Doubtful** NO
Non Sub Contact NO

Last Amended 12/07/2003
Position Last Amended

Position Last **Latitude =** **Longitude =**

Name
Type
Flag
Dimensions **Length =** **Beam =** **Draught =**
Tonnage
Cargo
Date Sunk

Sonar Dimensions **Length =** **Width =** **Shadow Height =**
Orientation

Magnetic Anomaly
Debris Field
Scour **Depth =** **Length =** **Orientation =**

Markers
General Comments

Circumstances of Loss

Surveying Details
**HH550/406/01 11.12.97 WK 9MTRS IN 222300.5N, 1135415E. (CHINESE NM 21/195/97) CONSIDERED TO BE PROBABLY THE SAME WK AS [111303059/467645]. AWAIT FURTHER. NCA. LATER: RECORD 46765 AMENDED TO LIFT MAR’98.

POSITIONS BELOW THIS POINT ARE IN DEGREES, MINUTES AND DECIMALS OF A MINUTE
**12.7.03 NOT SHOWN ON HONG KONG 1503 [APR’00 EDN, ADOPTION]. SOURCE DATA DIAGRAM SHOWS AREA SURVEYED 1998-1999. AMENDED TO DEAD. NC 4123.

Wreck Number 46536 **Classification =** Unclassified
Symbol **Largest Scale Chart =** 4123
Charting Comments POSN FOR FILING ONLY

Old Number 111300459
Category Wreck showing any portion of hull/superstructure

WGS84 Position **Latitude =** 22 22′.242 N **Longitude =** 113 54′.708 E
WGS84 Origin Undefined
Horizontal Datum HKD HONG KONG (1963)

Position Method Air photography
Position Quality Unreliable
Position Accuracy
Area at Largest Scale YES

Depth
Drying Height
Height
General Depth 20 metres
Vertical Datum Lowest astronomical tide
Depth Method
Depth Quality Depth unknown
Depth Accuracy
Conspic Visual NO **Conspic Radar** NO
Historic NO **Military** NO **Existence Doubtful** NO
Non Sub Contact NO

Last Amended 25/11/2005
Position Last Amended
Position Last **Latitude =** **Longitude =**

Name
Type
Flag
Dimensions **Length =** 20.1 metres **Beam =** **Draught =**
Tonnage
Cargo
Date Sunk

Sonar Dimensions **Length =** **Width =** **Shadow Height =**
Orientation 045/225

Magnetic Anomaly
Debris Field
Scour **Depth =** **Length =** **Orientation =**

Markers
General Comments

Circumstances of Loss

Surveying Details
**18.6.85 STF CENTRED ON 222214.5N, 1135442.5E [HK] SHOWN ON PHOTOPLOT PG 1778/1-3. (LANDS SURVEY DEPT, HONG KONG DATED 30.11.83 & 22.12.83) NCA, POSN FOR FILING ONLY.
**23.2.88 NO LONGER EXISTS. (AUTHORITY NOT STATED) AMENDED TO DEAD.

Wreck Number	46770	**Classification =**	Unclassified
Symbol	OB 5.9	**Largest Scale Chart =**	4123
Charting Comments			

Old Number 111303126
Category Undefined

WGS84 Position **Latitude =** 22 20′.827 N **Longitude =** 113 54′.221 E
WGS84 Origin Original
Horizontal Datum WGD WGS (1984)

Position Method
Position Quality Precisely known
Position Accuracy
Area at Largest Scale No

Depth 5.9 metres
Drying Height
Height
General Depth 7 metres
Vertical Datum Lowest astronomical tide
Depth Method
Depth Quality Least depth known
Depth Accuracy
Conspic Visual NO **Conspic Radar** NO
Historic NO **Military** NO **Existence Doubtful** NO
Non Sub Contact NO

Last Amended 26/11/2005
Position Last Amended 19/03/1999
Position Last **Latitude =** 22 20′.832 N **Longitude =** 113 54′.212 E

Name HANG TUNG 320
Type MV
Flag CHINA
Dimensions **Length =** 53.0 metres **Beam =** 8.8 metres **Draught =**
Tonnage 485 Gross
Cargo 690 BOXES BEER
Date Sunk 18/06/1997

Sonar Dimensions **Length =** **Width =** **Shadow Height =**
Orientation

Magnetic Anomaly
Debris Field
Scour **Depth =** **Length =** **Orientation =**

Markers

General Comments

Circumstances of Loss
**CAPSIZED AND LATER SANK. PASSAGE FROM CHINA'S SOUTHERN GUANDONG PROVINCE TO NANJING. VESSEL IS 277 NET TONS, BUILT 1979. (LL, 20.6.97).

Surveying Details
**HH550/406/03 27.6.97 SANK IN 222054N, 1135354E. (LL, 20.6.97).
**HH550/406/03 27.6.97 SANK IN 222054N, 1135354E. WK IS DANGEROUS TO SURFACE NAVIGATION. AN E CARDINAL MARK HAS BEEN LAID TO MARK WK. (HONG KONG MARINE DEPT, FAX DTD 27.6.97) CHART AS DW WITH BUOY [ASSUMED UNLIT] CLOSE E - NM 2881/97.
**HH550/406/03 15.4.98 DW IN 222048N, 1135401E, MARKED BY E CARD PILLAR BUOY IN 222048N, 1135406E. (CHINESE NM 6/54/98) NCA YET, PROBABLY HORIZONTAL DATUM DIFFERENCE. CB8 TO QUERY HONG KONG RE DATUM.
**HH550/406/03 11.5.98 WK LIES IN 222049.9N, 1135412.7E [WGD]. HULL WAS 1.1MTR ABOVE DATUM. E CARD BUOY IS IN 222050.1N, 1135414.3E [WGD]. SALVAGE BEING ARRANGED. WK SHOULD BE REMOVED WITHIN THE NEXT TWO MONTHS. MARINE DEPT NOTICE HAS NOT AND WILL NOT BE ISSUED. (HONG KONG, CHINA, MARINE DEPARTMENT FAX DTD 29.4.98) NCA.
**8.8.98 SHOWN AS ST IN 222049.9N, 1135412.7E [WGD], MARKED BY E CARD BUOY. (HONG KONG FAX DTD 29.4.98 ABOVE) NE 1919.
**HH550/406/03 10.8.98 WK REMOVED BY MARINE DEPARTMENT SALVAGE UNIT ON 19.7.98. BUOY WITHDRAWN. (HONG KONG, CHINA, MARINE DEPARTMENT FAX 25.7.98) AMENDED TO LIFT - NM 3247/98.

POSITIONS BELOW THIS POINT ARE IN DEGREES, MINUTES AND DECIMALS OF A MINUTE
**HH550/406/03 19.3.99 LATEST SURVEY SHOWS THERE IS A HIGH POINT AT 5.9MTRS IN 2220.827N, 11354.221E [WGD]. (HONG KONG, CHINA, MARINE DEPT FAX 27.2.99) NCA YET.
**HH550/406/03 19.3.99 SUGGEST THAT THIS BE INSERTED AS FOUL 5.9MTRS IN 2220.827N, 11354.221E [WGD]. (HONG KONG, CHINA, MARINE DEPT FAX 17.3.99). AMENDED TO LIVE, FOUL 5.9MTRS IN REVISED POSN. - NM 1377/99.
**12.7.03 SHOWN AS OB 5.9MTRS IN 2220.827N, 11354.221E [WGD] ON HONG KONG 1503 [APR'00 EDN, ADOPTION]. NC 4123.
**25.11.05 NOT SHOWN ON HONG KONG 1503 [OCT'05 EDN, LARGEST SCALE ADOPTION]. AMENDED TO DEAD. DELETE. NE 4123.
**HH550/408/04 27.1.05 DELETED BY NM. - NM 345/06.

Wreck Number 67072
Classification = Unclassified
Symbol WK SW 2.7
Largest Scale Chart = 4123
Charting Comments
Old Number
Category Dangerous wreck

WGS84 Position **Latitude =** 22 20′.400 N **Longitude =** 113 56′.000 E
WGS84 Origin Undefined
Horizontal Datum UND UNDETERMINED

Position Method
Position Quality Precisely known
Position Accuracy
Area at Largest Scale No

Depth 2.7 metres
Drying Height
Height
General Depth 5 metres
Vertical Datum Lowest astronomical tide
Depth Method Swept by wire-drag
Depth Quality Least depth known
Depth Accuracy
Conspic Visual NO **Conspic Radar** NO
Historic NO **Military** NO **Existence Doubtful** NO
Non Sub Contact NO

Last Amended 25/11/2005
Position Last Amended
Position Last **Latitude =** **Longitude =**

Name
Type
Flag

Dimensions **Length =** **Beam =** **Draught =**
Tonnage
Cargo
Date Sunk

Sonar Dimensions **Length =** **Width =** **Shadow Height =**
Orientation

Magnetic Anomaly
Debris Field
Scour **Depth =** **Length =** **Orientation =**

Markers
General Comments

Circumstances of Loss

Surveying Details
**H5641/45 9.1.46 WK 0.5FMS IN 222024N, 1135600E. (AUTHORITY NOT STATED) - NM 3929/45.
**H5641/45 9.1.46 G CONL LT BUOY, GP.OCC.1.5S LAID CLOSE N OF WK. (AUTHORITY NOT STATED) - NM 4209/45.
**H8604/48 18.1.49 BUOY NOW UNLIT G CONL BUOY. (HONG KONG NM 29/48) - NM 72/49.
**H3924/59 7.4.61 NOW WK SW 1FM 3FT, MARKED BY G CONL BUOY CLOSE N. (HMS DAMPIER, 1959) NC 342.
**H1669/61 9.7.64 BUOY WITHDRAWN. (HMS DUFTON, HN 1/64 DTD 12.6.64) BR STD.
**H3189/66 24.5.67 DELETE WK. (MARINE DEPT., HONG KONG LTR DTD 18.5.67) AMENDED TO DEAD. DELETE. - NM.
**3.9.80 STILL SHOWN AS DW ON US 93036 [APR′80 EDN]. NCA.

Wreck Number 46669
Classification = Unclassified
Symbol
Largest Scale Chart = 4122
Charting Comments NOT CHARTED BY PRIMARY AUTHORITY

Old Number 111301981
Category Undefined

WGS84 Position **Latitude =** 22 19'.500 N **Longitude =** 113 59'.750 E
WGS84 Origin Undefined
Horizontal Datum UND UNDETERMINED

Position Method
Position Quality Unreliable
Position Accuracy
Area at Largest Scale No

Depth
Drying Height
Height
General Depth 16 metres
Vertical Datum Lowest astronomical tide
Depth Method
Depth Quality Depth unknown
Depth Accuracy
Conspic Visual NO **Conspic Radar** NO
Historic NO **Military** NO **Existence Doubtful** NO
Non Sub Contact NO

Last Amended 14/07/2003
Position Last Amended
Position Last **Latitude =** **Longitude =**

Name YUK YAT NO 8
Type TUG
Flag
Dimensions **Length =** **Beam =** **Draught =**
Tonnage
Cargo
Date Sunk 29/04/1993

Sonar Dimensions **Length =** **Width =** **Shadow Height =**
Orientation

Magnetic Anomaly
Debris Field
Scour **Depth =** **Length =** **Orientation =**

Markers
General Comments

Circumstances of Loss
**CAPSIZED AND SANK WITH LIGHTER STILL ATTACHED, THE 3 CREWMEN RESCUED BY PASSING PLEASURE CRAFT. (LL, 29.4.93)

Surveying Details
**HH550/406/01 14.5.93 SANK IN 221930N, 1135945E APPROX. (LL, 29.4.93) NCA YET, AWAIT HONG KONG ACTION.

POSITIONS BELOW THIS POINT ARE IN DEGREES, MINUTES AND DECIMALS OF A MINUTE
**14.7.03 NOT SHOWN ON HONG KONG 1502 [FEB'03 EDN, ADOPTION]. SOURCE DATA DIAGRAM SHOWS AREA SURVEYED 1998-1999. AMENDED TO DEAD. NC 4122.

Wreck Number 46540 **Classification =** Unclassified
Symbol STF **Largest Scale Chart =** 4122, 4123
Charting Comments

Old Number 111300496
Category Wreck showing any portion of hull/superstructure

WGS84 Position **Latitude =** 22 18′.030 N **Longitude =** 113 58′.283 E
WGS84 Origin Undefined
Horizontal Datum HKD HONG KONG (1963)

Position Method Air photography
Position Quality Precisely known
Position Accuracy
Area at Largest Scale YES

Depth
Drying Height
Height
General Depth 0 metres
Vertical Datum Lowest astronomical tide
Depth Method
Depth Quality Depth unknown
Depth Accuracy
Conspic Visual NO **Conspic Radar** NO
Historic NO **Military** NO **Existence Doubtful** NO
Non Sub Contact NO

Last Amended 25/11/2005
Position Last Amended 13/02/1989
Position Last **Latitude =** 22 18′.130 N **Longitude =** 113 58′.208 E
Name
Type JUNK
Flag
Dimensions **Length =** 16.8 metres **Beam =** **Draught =**
Tonnage
Cargo
Date Sunk

Sonar Dimensions **Length =** **Width =** **Shadow Height =**
Orientation 090/270

Magnetic Anomaly
Debris Field
Scour **Depth =** **Length =** **Orientation =**

Markers PLOTS IN RECLAIMED AREA
General Comments
Circumstances of Loss

Surveying Details
**18.6.85 STF BROADSIDE TO COAST IN 221807.8N, 1135812.5E ON PHOTOPLOT PG 1778/4 [CLS NOV/DEC 1983]. HK POSN: 221801.8N, 1135817E. NE 1919.
**19.12.96 NO LONGER CHARTED, PLOTS IN RECLAIMED AREA. AMENDED TO DEAD. DELETE. NE 1919.

Annex D
附錄D

EM&A
環境監察及審核規定

CONTENTS

D1 EM&A MEASURES

This Environmental Monitoring and Audit *Annex* has been prepared to:

- monitor the effectiveness of the control measures employed during the cable laying works;
- verify that the project works are not resulting in any impacts to Chinese White Dolphins, *Sousa chinensis*; and
- to ensure that any adverse impacts are detected during the cable laying process and that appropriate action is undertaken in the event that impacts are identified to sensitive receivers and are found to be associated with the cable installation works.

D2 WATER QUALITY SAMPLING

The following Section provides details of the water quality monitoring during the installation of the submarine cable.

D2.1 SAMPLING METHODOLOGY

D2.1.1 Parameters Measured

The parameters to be measured *in situ* are:

- dissolved oxygen (DO) (% saturation and mgL^{-1})
- temperature
- turbidity (NTU)
- salinity ($^{0}/_{00}$)

The only parameter to be measured in the laboratory is:

- suspended solids (SS) (mgL^{-1})

In addition to the water quality parameters, other relevant data shall also be measured and recorded in field logs, including the location of the sampling stations and cable burial machine at the time of sampling, water depth, time, weather conditions, sea conditions, tidal state, current direction and speed, special phenomena and work activities undertaken around the monitoring and works area that may influence the monitoring results.

D2.1.2 Equipment

For water quality monitoring, the following equipment shall be supplied and used by the environmental contractor.

- ***Dissolved Oxygen and Temperature Measuring Equipment*** - The instrument shall be a portable, weatherproof dissolved oxygen measuring instrument complete with cable, sensor, comprehensive operation manuals, and shall be operable from a DC power source. It shall be capable of measuring: dissolved oxygen levels in the range of 0 – 20 mgL^{-1} and 0-200% saturation; and a temperature of 0-45 degrees Celsius.

  It shall have a membrane electrode with automatic temperature compensation complete with a cable of not less than 35 m in length. Sufficient stocks of spare electrodes and cable shall be available for replacement where necessary (for example, YSI model 59 meter, YSI 5739 probe, YSI 5795A submersible stirrer with reel and cable or an approved similar instrument).

- ***Turbidity Measurement Equipment*** - Turbidity within the water shall be measured *in situ* by the nephelometric method. The instrument shall be a portable, weatherproof turbidity-measuring unit complete with cable, sensor and comprehensive operation manuals. The equipment shall be operated from a DC power source, it shall have a photoelectric sensor capable of measuring turbidity between 0-1000 NTU and shall be complete with a cable with at least 35 m in length (Hach 2100P or an approved similar instrument).

  The turbidity meter shall be calibrated, and after calibration, turbidity measurements shall be taken as a representation of levels of suspended solids only before laboratory test results for suspended solids are known.

- ***Salinity Measurement Instrument*** - A portable salinometer capable of measuring salinity in the range of 0-40 ppm shall be provided for measuring salinity of the water at each monitoring location.

- ***Water Depth Gauge*** - No specific equipment is recommended for measuring the water depth. However, the environmental contractor shall seek approval of their proposed equipment with the client prior to deployment.

- ***Current Velocity and Direction*** – No specific equipment is recommended for measuring the current velocity and direction. However, the environmental contractor shall seek approval of their proposed equipment with the client prior to deployment.

- ***Positioning Device*** - A Global Positioning System (GPS) shall be used during monitoring to ensure the accurate recording of the position of the monitoring vessel before taking measurements.

- ***Water Sampling Equipment*** - A water sampler, consisting of a transparent PVC or glass cylinder of not less than two litres, which can be effectively sealed with cups at both ends, shall be used (Kahlsico Water Sampler 13SWB203 or an approved similar instrument). The water sampler shall have a positive latching system to keep it open and prevent premature closure until released by a messenger when the sampler is at the selected water depth.

D2.1.3 Sampling / Testing Protocols

All *in situ* monitoring instruments shall be checked, calibrated and certified by a laboratory accredited under HOKLAS or any other international accreditation scheme before use, and subsequently re-calibrated at-monthly intervals throughout all stages of the water quality monitoring. Responses of sensors and electrodes shall be checked with certified standard solutions before each use. The turbidity meter shall be calibrated to establish the relationship between turbidity readings (in NTU) and levels of SS (in mgL^{-1}) where possible.

For the on-site calibration of field equipment, the BS 1427: 1993, Guide to Field and On-Site Test Methods for the Analysis of Waters shall be observed. Sufficient stocks of spare parts shall be maintained for replacements when necessary. Backup monitoring equipment shall also be made available so that monitoring can proceed uninterrupted even when equipment is under maintenance, calibration etc.

Water samples for SS measurements shall be collected in high density polythene bottles, packed in ice (cooled to 4° C without being frozen), and delivered to a HOKLAS laboratory as soon as possible after collection.

D2.1.4 Laboratory Analysis

All laboratory work shall be carried out in a HOKLAS accredited laboratory. Water samples of about 1,000 mL shall be collected at the monitoring and control stations for carrying out the laboratory determinations. The determination work shall start within the next working day after collection of the water samples. The SS laboratory measurements shall be provided to the client within 2 days of the sampling event (48 hours). The analyses shall follow the standard methods as described in APHA Standard Methods for the Examination of Water and Wastewater, 19th Edition, unless otherwise specified (APHA 2540D for SS).

The submitted information should include pre-treatment procedures, instrument use, Quality Assurance / Quality Control (QA / QC) details (such as blank, spike recovery, number of duplicate samples per-batch etc), detection limits and accuracy. The QA / QC details shall be in accordance with requirements of HOKLAS or another internationally accredited scheme.

D2.2 MONITORING LOCATIONS

The monitoring station locations have been established to identify potential impacts to ecological sensitive receivers.

Prior to, during and after the installation of the cable, water quality sampling will be undertaken at stations situated around the cable laying works at Tuen Mun and the Airport during dredging. The monitoring at those stations is to ensure the construction works of the Project do not affect the sensitive area nearby (shown in *Figure D1*).

- C1 and C2 are Control Stations at Tuen Mun which is not supposed to be influenced by the construction works due to its remoteness to the construction works;
- C3 and C4 are Control Stations near the Airport which is not supposed to be influenced by the construction works due to its remoteness to the construction works;
- U1 and D1 are situated approximately 300 m either side from the cable alignment for monitoring the effect of dredging at Tuen Mun landing point;
- U2 and D2 are located approximately 300 m either from the cable alignment for monitoring the effect of dredging at the Airport landing point;
- SR1 is used to monitor the effect of the construction works on Butterfly Beach; and
- SR2 is used to monitor the effect of the construction works Seawater Intake at the Airport.

The suggested co-ordinates of these monitoring stations are listed in *Table D1*.

The monitoring station to be sampled during Baseline Monitoring (prior to landing site preparation, cable laying and landing works), Impact Monitoring (during any works related to the cable installation, ie landing site preparation, cable laying and landing works) and Post Project Monitoring (after completion of the cable installation).

Table D1 Co-ordinates of Baseline & Post Project Sampling Stations (HK Grid)

Station	Easting	Northing
C1	814483.53	825367.63
C2	812973.57	824896.99
C3	812914.75	820729.91
C4	811110.64	820935.81
U1	813561.87	825446.07
U2	812189.18	820563.23
D1	813140.26	825298.99
D2	811444.01	820592.64
SR1	813483.43	825681.39
SR2	811493.03	820376.93

D2.3 SAMPLING PROCEDURES

D2.3.1 Monitoring Frequency

Baseline Monitoring

Baseline Monitoring will comprise sampling on three occasions (days) prior to but no more than two weeks before cable laying work. The interval between two sets of monitoring shall not be less than 36 hours. The monitoring will be undertaken at twelve locations (eight impact monitoring and four control monitoring stations) in total, as shown on *Figure 2.1*. Samples will be taken during mid flood and mid ebb tidal state on each sampling occasion.

Impact Monitoring

Impact Monitoring will comprise sampling three times a week during the cable installation works at the same location as the Baseline Monitoring Stations. The interval between the monitoring shall not be less than 36 hours. Samples shall be taken during both mid flood and mid ebb tidal states on each sampling occasion.

Post Project Monitoring

Post Project Monitoring will comprise sampling on three occasions (days) within one week after completion of the cable installation works at the same location as the Baseline Monitoring Stations during mid flood and mid ebb tides. The interval between two sets of monitoring shall not be less than 36 hours.

D2.3.2 Timing

The water quality sampling will be undertaken within a 3 hour window of 1.5 hour before and 1.5 hour after mid flood and mid-ebb tides. The environmental contractor will be responsible for liaison with the engineering contractor to ensure installation works are being undertaken during the water quality sampling.

D2.3.3 *Depths*

Each station will be sampled and measurements will be taken at three depths, 1 m below the sea surface, mid depth and 1m above the sea bed. For stations that are less than 3 m in depth, only the mid depth sample shall be taken.

D2.4 *COMPLIANCE / ACTION EVENT PLAN*

Water quality monitoring results will be evaluated against Action and Limit levels shown in *Table D2*.

Table D2 Action and Limit Level for Water Quality (based on the result of the Baseline Report)

Parameter	Action Level	Limit Level
SS in mgL^{-1} (Depth-averaged)	95%-ile of baseline data, and 20% exceedance of value at any impact station compared with corresponding data from control stations	99%-ile of baseline data, and 30% exceedance of value at any impact station compared with corresponding data from control stations
DO in mgL^{-1}	<u>Surface and Middle</u> 5%-ile of baseline data for surface and middle layer <u>Bottom</u> 5%-ile of baseline data for bottom layers	<u>Surface and Middle</u> 4mg/L or 1%-ile of baseline for surface and middle layer <u>Bottom</u> 2mg/L or 1%-ile of baseline data for bottom layer

Note: "Depth-averaged" is calculated by taking the arithmetic means of reading of all three depths.

The measures that will be undertaken in the event that the Action or Limit Levels are exceeded are shown in *Table D3*.

Table D3 Event Action Plan for Water Quality

Event	Contractor
Action Level Exceedance	**Step 1** - repeat sampling event. **Step 2** – Inform EPD and LCSD and confirm notification of the non-compliance in writing; **Step 3** - discuss with cable installation contractor the most appropriate method of reducing suspended solids during cable installation (e.g. reduce cable laying speed/volume of water used during installation, increase effectiveness of silt curtain). **Step 4** - repeat measurements after implementation of mitigation for confirmation of compliance. **Step 5** - if non compliance continues - increase measures in Step 3 and repeat measurements in Step 3. If non compliance occurs a third time suspend cable laying operations.
Limit Level Exceedance	Undertake **Steps 1-4** immediately, if further non compliance continues at the Limit Level, suspend cable laying operations until an effective solution is identified.

D2.5 REPORTING

A letter report shall be provided to EPD that shall include the monitoring results in addition to operating practices of the cable burial machine during sampling (including: position, speed, cable burial depth) and an interpretation of monitoring results. The monitoring data should be provided graphically to show the relationship between the Control and the Impact monitoring stations and compliance or non-compliance with respect to the Action / Limit Levels.

The reports to be provided shall include: one Baseline Monitoring Report; Weekly Impact Monitoring Reports; and one Post Project Monitoring Report. The Baseline Monitoring Report shall be provided before the cable laying work and each Impact Monitoring Report will be provided within 3 days of completing the weekly monitoring surveys. The post Project Monitoring Report shall be provided within one week of completion of the Post Project Survey.

D3 DOLPHIN MONITORING

The following section provides details of the dolphin monitoring to be undertaken to ensure that the water jetting construction works do not affect the Chinese White Dolphin, *Sousa chinensis*.

The objective of the dolphin monitoring during the submarine cable installation works is to avoid incident to dolphins in the vicinity of the cable alignment during cable laying to ensure appropriate action is undertaken to effectively reduce such impacts.

D3.1 DOLPHIN MONITORING METHODOLOGY

Visual dolphin monitoring should be conducted from the cable laying vessel during the cable installation works to evaluate whether there have been any effects on the animals. A dolphin exclusion zone within a radius of 250 m from the cable laying vessel which is undertaking water jetting should be implemented during the construction phase. An exclusion zone of 250 m radius should be scanned around the work area for at least 30 minutes prior to the start of cable laying. If cetaceans are observed in the exclusion zone, cable installation works should be delayed until they have left the area.

The observer shall stand on the open upper decks of the cable laying vessel, allowing for observer eye heights of 4 to 5 m above water level and relatively unobstructed forward visibility between 270° and 90°. Vessel-based observation by the observer shall be conducted by searching the 180° swath in front of the survey vessel (270° to 90°) with Fujinon 7X50 marine binoculars or equivalent, scanning the same area with the naked eye and occasional binocular check.

Survey personnel should be alert at all times during the surveying period.

A sighting record shall be filled out at the initial sighting with time, position, distance and angle data filled in immediately. All other information on sea state, weather conditions (Beaufort Scale), as well as notes on dolphin appearance, behaviour, direction of movement, response to boat and any other information can be completed at the end of the sighting.

A summary of equipment requirement is summarized in *Table D4.*

Table D4 Summary of Equipment Requirement

Equipment	**Type**
Observation	Fujinon 7X50 marine binoculars (or similar) with compass/reticule
Calibration	Leica Geovid laser range finder binnacles or equivalent
Records	Clipboard
Navigation and Positioning	Global Positioning System Device (Magellen NAV 5000D or similar approved) (+ spare batteries)

When dolphins are spotted within the exclusion zone, construction works will cease and will not resume until the observer confirms that the zone has been continuously clear of dolphins for a period of 30 minutes. (Thereby adequately spanning the approximate maximum dive time of the dolphins of 4 minutes). Dolphin sighting position, data on sighting angle, distance to the group, group size and behaviour should be recorded.

The dolphin surveys will be required solely during the period of undertaking water jetting construction works. Daily monitoring will be conducted till the completion of water jetting construction works.

D3.2 REPORTING

Weekly impact reports on dolphin monitoring shall be submitted and each of them should be provided within 2 days of the completion of the weekly monitoring surveys.

目錄

D1 引言

本附件旨在：

- 監察電纜鋪設工程所採用的控制措施的效果；
- 證實是項工程沒有對中華白海豚造成任何影響；及
- 確保能夠察覺電纜鋪設過程所造成的任何不良影響，並在敏感受體受到電纜鋪設工程影響時，能夠採取適當行動。

D2 水質樣本之收集

下文是在鋪設海底電纜時所進行的水質監察詳情。

D2.1 樣本收集方法

D2.1.1 需予量度之參數

需要在現場量度的參數如下：

- 溶解氧（飽和百分比及 mgL^{-1}）
- 溫度
- 混濁程度（NTU）
- 鹽度（$^0/_{00}$）

唯一需要在實驗室量度的參數是：

- 懸浮固體（mgL^{-1}）

除了各項水質參數外，其他需要量度和記錄於現場日誌中的相關數據包括：樣本收集站位置和收集樣本時電纜掩埋機的位置、水深、時間、天氣情況、海中情況、潮汐狀態、潮水方向和速度、特別現象，以及在監察和工程地區附近進行，並可能影響監察結果的工作和活動。

D2.1.2 設備

爲了進行水質監察，必須向環境事項承辦商提供下列設備，而承辦商亦必須加以使用。

- *溶解氧及溫度量度設備*－有關的儀器必須是方便攜帶、不受天氣影響的溶解氧量度設備，並附有電線、感應器、完整的操作手冊，並必須能夠以直流電操作。該儀器必須能夠量度：介乎 0 - 20 mgL^{-1}的溶解氧水平，及 0-200%的飽和度；以及攝氏 0-45 度的溫度。

  它必須有一片薄膜電極，連同自動溫度補償和一條不短於 35 米的電線。必須有足夠數量的後備電極和電線，以便需要時更換（例如 YSI 59 型量度器、YSI 5739 型探測器、YSI 5795A 型水中攪絆器連同電線及捲軸，或獲認可的相近設備）。

- *混濁度量度設備*－海水的混濁程度必須在現場用比濁法量度。有關的儀器必須是方便攜帶、不受天氣影響的混濁程度量度設備，並附有電線、感應器和完整的操作手冊。該儀器必須能夠以直流電操作，並必須附有一個能夠量度混濁度介乎 0 - 1000 NTU 的光電感應器，以及一條最少長 35 米的電線（Hach 2100P 或獲認可的類似設備）。

  混濁度計必須加以校準。在校準後所量度到的混濁度，只能在取得實驗室的懸浮固體化驗結果之前代表懸浮固體的濃度。

- *鹽度量度設備*－必須提供一個能夠量度 0-40 ppm 鹹度的便攜式鹹度計，以便量度每個監察站的海水鹹度。

- *水深計*－沒有建議任何特定的水深量度設備。然而，環境事務承辦商在使用任何建議設備前，必須先取得客戶的同意。

- *潮水速度和方向*－沒有建議任何量度潮水速度和方向的特定設備。然而，環境事務承辦商在使用任何建議設備前，必須先取得客戶的同意。

- *定位裝置*－在進行監察時，必須使用全球定位系統，以確保在進行量度之前能夠先記錄監察船的準確位置。

- *海水樣本收集設備*－必須採用一個容量不少於 2 公升的透明塑膠或玻璃圓筒形的海水樣本收集器，其兩端都必須可以有效密封。該收集器必須有一個可以令收集器保持開啓的栓鎖系統，以防止過早關上，直至收集器到達選定深度，並收到關閉指示爲止。

D2.1.3 樣本收集／化驗規則

所有現場監察儀器在使用前，都必須加以檢查和校準，並由一家經香港實驗所認可計劃或其他國際認可計劃鑑定合格的實驗室予以確認；然後在整個水質監察期間，亦須按月重新校準。在每次使用前，都必須以合格的標準溶液檢查感應器和電極的反應。混濁度計必須加以調校，盡可能確立混濁度讀數（以 NTU 爲單位）與懸浮固體濃度（以 mgL^{-1} 爲單位）之間的關係。

若需於現場調校設備，必須依照英國標準第 BS 1427: 1993 號「水樣本分析之實地及現場化驗方法」。必須保存足夠數量的零件／配件，以便需要時更換。同時，亦必須準備後備監察設備，務求當設備需要維修和調校時，仍能繼續進行監察工作。

用作量度懸浮固體的水樣本必須以高密度的聚乙烯瓶收集，並以冰塊包裹（冷凍至 4° C 但並不結冰），然後盡快送至一家經香港實驗所認可計劃認可的實驗室。

D2.1.4 *實驗室分析*

所有實驗室工作都必須在一所經香港實驗所認可計劃認可的實驗室進行。必須在監察及控制站收集約 1,000 mL 的水樣本，以便進行實驗室分析。分析工作必須在收集水樣本後的下一個工作天內開始進行。懸浮固體的實驗室量度結果必須在收集樣本後兩天（48 小時）內交予客戶。所有分析工作必須按照美國公共衛生協會的「水和廢水標準檢驗方法（第 19 版）」內所闡述的標準方法進行，另有註明者除外（APHA 2540D 有關懸浮固體的部份）。

應該提交的資料包括：預先處理的程序、所用儀器、質量保證／質量控制詳情（例如每批次的空白樣本、添加回收率、樣本複本數目等）。質量保證／質量控制的細節必須符合香港實驗所認可計劃或其他國際認可計劃的要求。

D2.2 *監察地點*

監察站的位置已被制定來辨認生態環境敏感受體的潛在影響。

在進行電纜鋪設之前、期間和之後，當屯門和機場進行挖泥工程時，都會在電纜鋪設工程附近的樣本收集站收集水質樣本。在那些監察站進行監察的目的，是要確保這個項目的建造工程不會影響附近的敏感地區（見*圖 D1*）。

- 位於屯門的 C1 和 C2 是控制站。這兩個站距離建造工程地點很遠，應該不會受到建造工程的影響；
- 位於機場附近的 C3 和 C4 是控制站。這兩個站距離建造工程地點很遠，應該不會受到建造工程的影響；
- U1 和 D1 分別位於電纜走廊兩側，距離走廊約 300 米，是要監察挖泥工程對屯門登岸點的影響；
- U2 和 D2 分別位於電纜走廊兩側，距離走廊約 300 米，是要監察挖泥工程對機場登岸點的影響；

- SR1 是用作監察建造工程對蝴蝶灣泳灘的影響；及
- SR2 是用作監察建造工程對機場海水進水口的影響。

這些監察站的建議座標均羅列於*表 D1*。

在這些監察站收集樣本是要進行基線監察（在進行登岸準備、電纜鋪設和登岸工程之前）、影響監察（在進行與電纜安裝有關的任何工程時，即登岸工地平整、電纜鋪設和登岸工程）及工程後監察（在電纜安裝完成後）。

表 D1 *基線及工程後樣本收集站座標（香港網格）*

收集站	東經	北緯
C1	814483.53	825367.63
C2	812973.57	824896.99
C3	812914.75	820729.91
C4	811110.64	820935.81
U1	813561.87	825446.07
U2	812189.18	820563.23
D1	813140.26	825298.99
D2	811444.01	820592.64
SR1	813483.43	825681.39
SR2	811493.03	820376.93

D2.3 *樣本收集程序*

D2.3.1 *監察頻率*

基線監察

基線監察包括在電纜鋪設工程進行前的兩個星期內進行三次（天）樣本收集。兩次監察之間的間距不可少於 36 小時。如*圖 2.1* 所示，監察工作會在合共十二個地點進行（八個影響監察站和四個控制監察站）。每次樣本收集都會在中漲潮和中退潮時進行。

影響監察

影響監察會在進行電纜安裝工程時，在基線監察站的位置，每星期收集樣本三次。兩次監察之間的間距不可少於 36 個小時。每次樣本收集都必須在中漲潮和中退潮時進行。

工程後監察

工程後監察會在電纜安裝工程完成後的一個星期內，於中漲潮和中退潮時，在基線監察站的位置收集樣本三次。兩次監察之間的間距不可少於 36 小時。

D2.3.2　時間安排

收集水質樣本的時間，是在中漲潮和中退潮之前和之後各 1.5 個小時，合共 3 個小時的時段內進行。環境事務的承辦商將會負責與工程承建商聯絡協調，確保在收集水質樣本時有電纜裝設工程正在進行。

D2.3.3　深度

每個監察站都會在三個不同深度收集樣本和進行量度，分別是海面下 1 米、中間深度和海床對上 1 米。水深少於 3 米的監察站只會收集中間深度的樣本。

D2.4　符合情況／行動計劃

水質監察結果會以*表 D2* 所示的行動及限制水平加以評估。

表 D2　水質之行動及限制水平（根據基線報告結果）

參數	行動水平	限制水平
以 mgL^{-1} 爲單位之懸浮固體值 （深度平均值）	基線數據的 95%等分值，及 任何影響監察站的數值與控制監察站的相應數據比較超出 20%。	基線數據的 95%等分值，及 任何影響監察站的數值與控制監察站的相應數據比較超出 30%。
以 mgL^{-1} 爲單位之溶解氧	<u>海面及中間</u> 海面層與中間層基線數據的 5%等分值。 <u>海底</u> 海底層基線數據的 5%等分值。	<u>海面及中間</u> 4mg/L 或海面層與中間層基線數據的 1%等分值。 <u>海底</u> 2mg/L 或海底層基線數據的 1%等分值。

註：「深度平均」是在三個不同深度所取得的讀數的算術平均值。

表 D3 羅列了在監察參數超過行動水平或限制水平時將會採取的行動。

*表 **D3*** *水質的事件及行動計劃*

事件	承辦商
超出行動水平	**第 1 步** – 重複收集樣本 **第 2 步** – 通知環保署和康樂及文化事務署，並確定是以書面形式通知不符合規定的情況。 **第 3 步–**與安裝電纜的承建商探討在安裝電纜時減少懸浮固體的最適當方法（例如降低電纜鋪設速度／用水體積、增加淤泥屏障的效率）。 **第 4 步** – 在實施緩解措施後，再次量度有關參數，以便確定是否符合規定。 **第 5 步** – 若不符合規定的情況持續，便須增加第 3 步的緩解措施，並重複第 3 步的參數量度。若第三次未能符合規定，暫停鋪設電纜。
超出限制水平	立即進行**第 1-4 步**。若持續地未能符合限制水平，暫停鋪設電纜，直至找出有效的解決方法爲止。

D2.5 *報告*

須在收集樣本時向環保署提交報告，包括監察結果和電纜掩埋機的操作（包括位置、速度、電纜掩埋深度），以及監察結果的分析。以圖表方式展示監察數據，以便展現控制監察站和影響監察站之間的關係，以及是否符合行動／限制水平。

必須提供的報告包括：一份基線監察報告、每星期一份影響監察報告，以及一份工程後監察報告。基線監察報告須於電纜鋪設工程展開前提供，而每份影響監察報告則於每星期的監察調查完成後 3 天內提供。工程後監察報告必須於工程後調查完成後一星期內提供。

D3 *海豚監察*

下文所述，是海豚監察的詳情，旨在確保水力噴注工程不會影響中華白海豚（*Sousa chinensis*）。

在安裝海底電纜時進行海豚監察的目的，是要避免在鋪設電纜時電纜走廊附近的海豚發生意外，並確保能夠採取適當行動，務求減少這種影響。

D3.1 *海豚監察方法*

在進行電纜安裝工程時，應該在鋪設電纜的船隻上進行視覺海豚監察，以便評估海豚是否受到影響。在施工期間，應該把進行水力噴注工程的電纜鋪設船隻四周 250 米的範圍劃爲海豚專用區。在開始鋪設電纜前，

應該對工程區四周 250 米內的專用區檢視最少 30 分鐘。若發現有鯨類動物在專用區內，便應延遲展開電纜鋪設工程，直至牠們離開為止。

觀察員必須站立在電纜鋪設船隻的上層露天甲板上，務求觀察員的眼睛比海面高出 4 至 5 米，而且前方 270° 及 90°之間的視線沒有障礙。觀察在船上進行的觀察，必須以 Fujinon 7X50 型或相同的海上望遠鏡，探視調查船前方 180° 的範圍（從 270° 至 90°），以肉眼掃視該區，並間中以望遠鏡檢查。

調查人員在進行調查期間必須時刻保持警覺。然而，在天氣惡劣，能見度受阻時（例如少於 1 公里），或當風力達到蒲福氏風級表 5 級時，便應該暫停調查。

船上需設有全球定位系統，並在每次進行實地調查時使用。

在看到海豚時，必須馬上填寫時間、位置、距離和角度等數據留作記錄。所有其他關於海上情況、天氣情況（蒲福氏風級表）的資料，以及有關海豚外貌、行為、移動方向、對船隻的反應和其他資料，都可以在該次觀察後填寫。

表 D4 是各項設備要求的摘要。

表 D4 *設備要求摘要*

設備	種類
觀察	Fujinon 7X50 型海洋望遠鏡（或類似），連同指南針／標線
調校	Leica Geovid 型激光測距器或相同設備
記錄	筆記板
導航及定位	全球定位系統裝置（Magellen NAV 5000D 或獲批准的相以設備）（備用電池）

若在專用區內發現海豚，便應停止建造工程，直至觀察員證實區內連續 30 分鐘沒有再發現海豚蹤跡為止（這樣便足以超過海豚約 4 分鐘的最長潛泳時間）。有關海豚的發現位置、發現角度、與海豚群落的距離、群落的數目和行為等數據，都應該加以記錄。

海豚調查只需要在進行水力噴注工程期間進行。在這段期間，每天都必須進行監察，直至水力噴注工程完成為止。

D3.2 *報告*

每星期都必須就海豚監察的結果提交影響報告，每份影響監察報告應於每星期的監察調查完成後 2 天內提交。

Figure D1
圖D1

Location of Water Quality Monitoring Stations
水質監察站位置

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