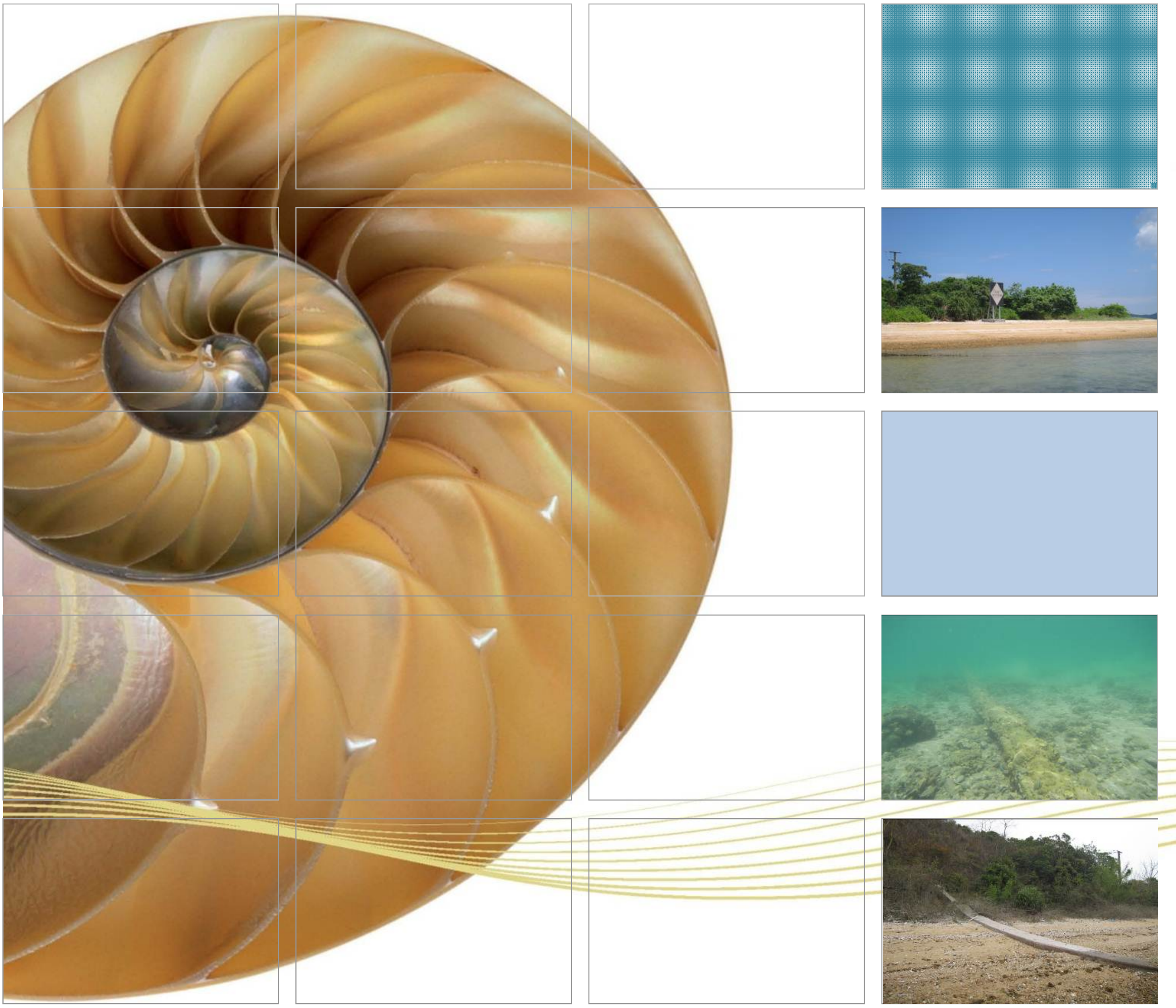

CLP 中電

Replacement of the Existing 11kV Submarine Cable Circuit Connecting Liu Ko Ngam and Pak Sha Tau Tsui at Kat O
連接了哥岩與吉澳白沙頭咀之現有 11 千伏海底電纜更換工程

Project Profile
工程項目簡介

30 May 2013
2013 年 5 月 30 日

Environmental Resources Management
16/F, DCH Commercial Centre
25 Westlands Road
Quarry Bay, Hong Kong
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ERM

Replacement of the Existing 11kV Submarine Cable Circuit Connecting Liu Ko Ngam and Pak Sha Tau Tsui at Kat O
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Project Profile
工程項目簡介

ERM Document Code: 0114462_Kat O Cable_PP.doc
環境資源管理顧問有限公司文件編號：0114462_Kat O Cable_PP.doc

Client 客戶: CLP Power Hong Kong Limited (CLP) 中華電力有限公司（中電）	Project No 項目編號: ： 0114462
Summary 綜述: This document presents the Project Profile for the Replacement of the Existing 11kV Submarine Cable Circuit Connecting Liu Ko Ngam and Pak Sha Tau Tsui at Kat O. 本報告是連接了哥岩與吉澳白沙頭咀之現有 11 千伏海底電纜更換工程的項目簡介。	Date: 30 May 2013 日期：2013 年 5 月 30 日 Approved by 批核: *Terence Fong* *方靜威* *Partner* *合夥人*

Revision 校訂	Description 描述	By 經由	Checked 核對	Approved 批核	Date 日期

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Project Profile

CONTENTS

ANNEXES

1 BASIC INFORMATION

1.1 PROJECT TITLE

Replacement of the Existing 11kV Submarine Cable Circuit Connecting Liu Ko Ngam and Pak Sha Tau Tsui at Kat O (hereafter referred to as the Project).

1.2 NAME OF PROJECT PROPONENT

CLP Power Hong Kong Limited (CLP)

1.3 NAME AND TELEPHONE NUMBER OF CONTACT PERSON

Name : Mr Pang Yiu Ming

Title : Engineer I, North Region
CLP Power Hong Kong Limited

Phone No : 9155 6299 (mobile)

1.4 PURPOSE AND NATURE OF THE PROJECT

CLP is planning to enhance the security of power supply to Kat O Island. At present, there is only one set of 11kV submarine cable circuit that from Liu Ko Ngam to Kat O. The existing 11kV submarine cable is however more than 30 years old and deteriorating. This will subsequently limit the continuous supply of the electricity in the future. CLP is therefore planning to replace the existing 11kV submarine cable connecting Liu Ko Ngam to Pak Sha Tau Tsui, Kat O (Crooked Island) to ensure continuous electricity supply on the island (*Figure 1.1*).

1.5 LOCATION AND SCALE OF PROJECT & HISTORY OF THE PROJECT SITE

1.5.1 Location

The proposed replacement submarine cable alignment runs between Liu Ko Ngam and Pak Sha Tau Tsui on Kat O and is located next to the existing utilities including the existing 11kV submarine cable and two water mains (see *Figure 1.1*). After landing, the proposed replacement 11kV submarine cable circuit will connect to the existing Overhead Line (OHL) system with minimal additional underground cables and poles at Liu Ko Ngam and Pak Sha Tau Tsui respectively.

1.5.2 History of the Project Site

The seabed in vicinity of the proposed submarine cable has been previously disturbed by the installation of the existing 11kV submarine cable connecting

Liu Ko Ngam and Pak Sha Tau Tsui (by CLP in the 1980s) and the two existing submarine water mains connecting Pak Sha Tau Tsui and Sai Lau Kong (by Water Supplies Department (WSD) in 2006).

1.5.3 *Scale of the Project*

The Project involves the installation of an 11kV cable circuit consisting of two individual cables, with an intended burial depth up to 5 m for the submarine cable section and about 1 m for the land section. The two submarine cables (except the shore end sections which will be of only about 1 m separation and joining into a single cable trench at each landing site) will be 30 m away from each other and running parallel along the alignment. In areas (especially near the landing site) where the cable burial depth does not meet the requirements due to seabed geotechnical constraints, a protective cover such as a concrete slab will be adopted. The total length of the proposed cable alignment is approximately 880 m.

The cable laying process will only require minor works within the marine environment. Only small scale construction works are required onshore at each of the cable landing sites, i.e. Liu Ko Ngam and Pak Sha Tau Tsui for connecting the submarine cable with existing overhead land cable systems.

1.6 *CABLE ROUTE SELECTION PROCESS*

1.6.1 *Selecting the Landing Sites*

CLP plans to replace the existing 11kV submarine cable connecting Liu Ko Ngam to Pak Sha Tau Tsui, Kat O (Crooked Island), which is more than 30 years old and deteriorating. Therefore the cable replacement will mainly follow the alignment of the existing 11kV submarine cable and make use of the existing landing sites connecting to the existing 11kV OHL electricity system which located within Country Park. The selection of cable landing points was based on the following considerations (*Figure 1.2*):

- Avoiding the Marine Parks and Lai Chi Wo Beach Site of Special Scientific Site (SSSI) as far as practically possible.
- Selecting technically feasible areas (i.e. soft mud and sand) to minimise the construction difficulties.
- Following the alignment of the existing 11kV submarine cable and making use of the existing landing sites which has been disturbed in the past, so as to avoid other natural and undisturbed areas.
- Making use of the existing 11kV OHL electricity system to avoid installing new OHL system.

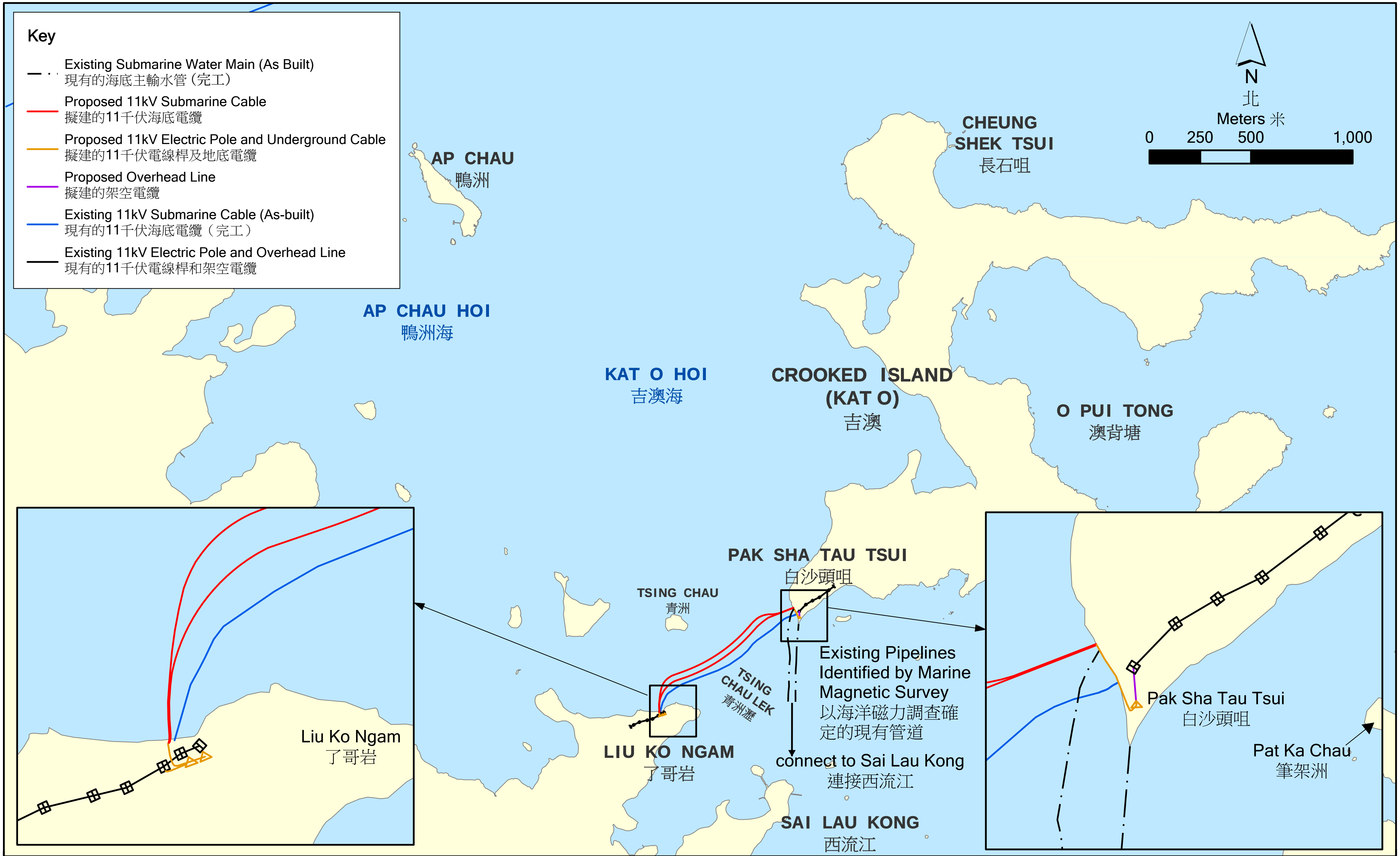

Figure 1.1
圖1.1

Alignment of the Proposed 11kV Submarine Cable Circuit from Liu Ko Ngam to Pak Sha Tau Tsui

了哥岩至白沙頭咀的擬建11kV海底電纜路線

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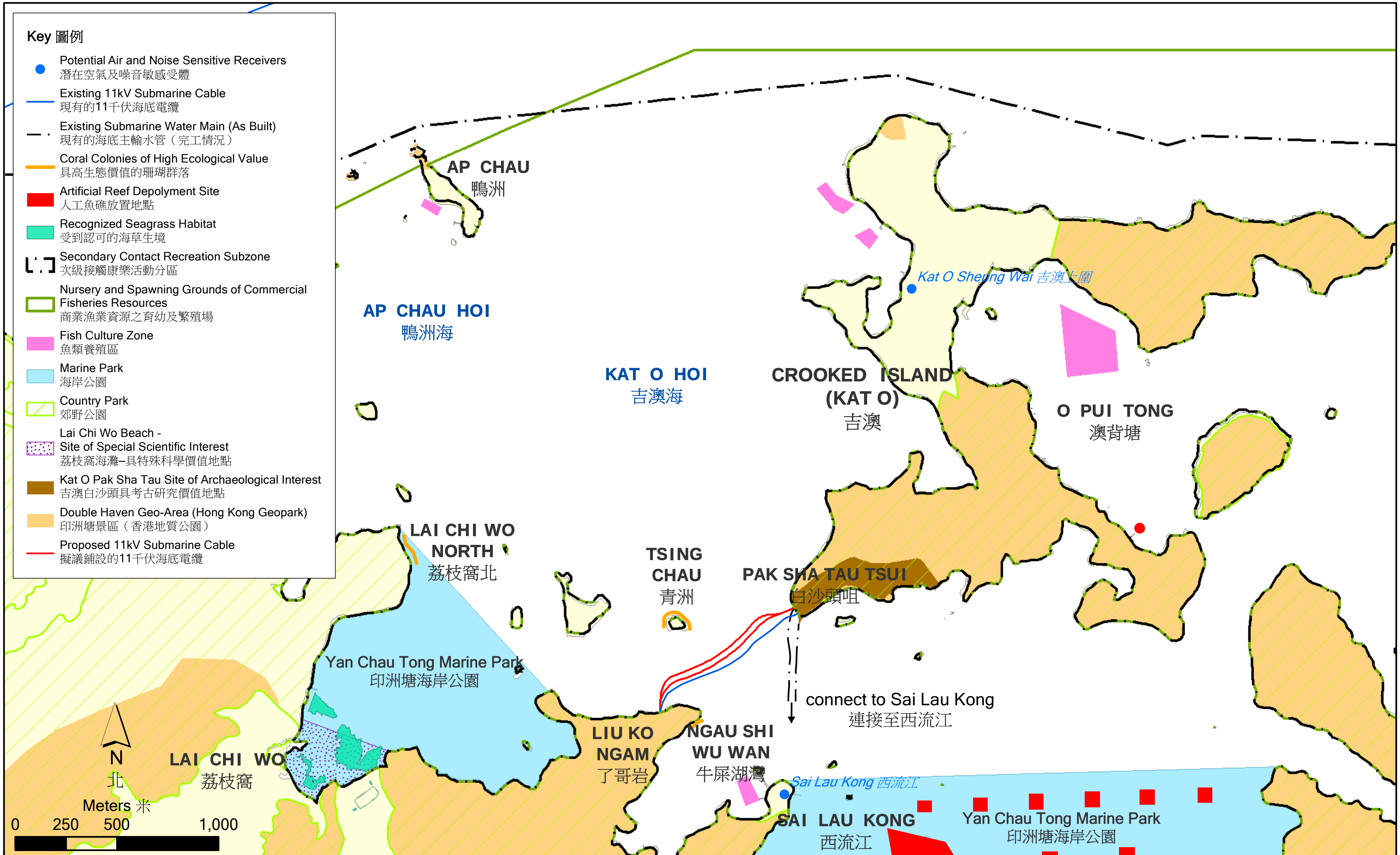

Figure 1.2
圖1.2

Identified Major Elements within the Areas Surrounding the Proposed Cable Route

擬議電纜路線附近地區環境的已知主要元素

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Date: 30-Oct-2012

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1.6.2 *Marine Route Planning Consideration*

There are some existing environmental and physical constraints to the 11kV cable route, which have confined the alignment of the cable (*Figure 1.2*). The following constraints have been taken into consideration:

- Avoiding the Marine Parks and Lai Chi Wo Beach Site of Special Scientific Site (SSSI) as far as practically possible.
- Avoiding the location of Fish Culture Zones (FCZs).
- Avoiding shallow sediment areas to meet the optimal burial depth requirement.
- Avoiding crossing existing utilities including the existing 11kV submarine cable connecting Liu Ko Ngam and Pak Sha Tau Tsui and the two existing submarine water mains connecting Pak Sha Tau Tsui and Sai Lau Kong.

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

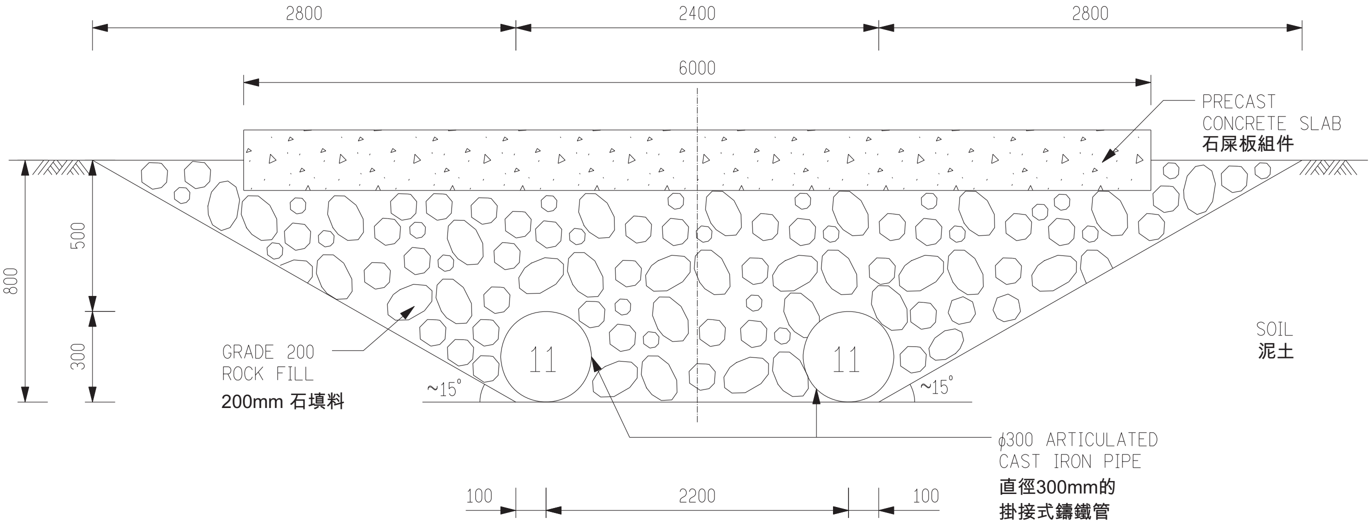
- For simultaneous cable burial/laying operation, sharp bending of cable alignment has been avoided and the cable route wall be kept as straight as possible.
- Selecting the shortest cable alignment to minimise the potential for adverse impacts to the environment.

1.6.3 *Shore-end Construction Method Consideration*

A number of alternative shore-end construction methods have been considered by the Project Proponent in terms of environmental impact and technical feasibility. *Table 1.1* below outlines the key considerations in determining the favoured shore-end construction method.

Table 1.1 Shore end Construction Considerations

Option Description	Technical Aspect	Environmental Aspect
Submarine Cables to be laid under seabed level with 500mm cover by Dredging Method	• From technical point of view, this is the most direct and conventional method to remove **soft material** in the seabed. • At the shore ends of Liu Ko Ngam and Pak Sha Tau Tsui, the cables can be laid within a pre-dredged approaching trench. • The work would be undertaken by a single grab dredger of approximately 3 m^3 grab at both shore ends. • The cables within the trench will be placed by divers, backfilling with clean sand over the cable once it is in place. • The dredging rates are not expected to exceed 300 m^3 per day for the grab dredgers used at the cable landing sites. • The total volume of dredged materials from both shore ends is expected to be approximately 650 m^3 at both of the landing sites. • At least 500mm cover will be provided to the submarine cables at both landing sites. • The separation of the two 11kV cables would be about 2m at both landing points. • The estimated length of the pre-dredged trench at each landing point would be about 75 m long measuring from the High Water Mark (HWM) level. • The average width of the trenches would be about 4m from the centreline of the trenches (with a total 8 m wide working corridor). It should be noted that marine mud will only be able to sustain a slope gradient of about 15 degree and therefore a total 8 m wide working corridor will be required (please refer to *Figure 1.3* for the typical section of the trench).	• Potential loss of coral colonies and associated benthic communities within the 8m wide shore end working corridor. • Potential water quality impacts to the nearby sensitive receivers including Marine Park, coral communities and Fish Culture Zone which can be mitigated by installation of silt curtain and reduced dredging rate.
Adopt Horizontal Direct Drilling (HDD) instead of grab dredging for the 2 shore-end cable laying	• In this method, a 10m x 10m cofferdam (sheet pile walls) will be installed at the sea to receive the drill bit of the HDD. During sheet pile installation works, the seabed will be disturbed. Upon completion of the works, the sheetpiles situated below seabed level will be left in place. • This method would require contractors with high degree of expertise in marine works since the risk, in term of worker safety, for constructing a cofferdam in the middle of the sea is extremely high. • In this method, a HDD machine will be placed on the shore while a receiving pit will be proposed in the sea at about 75m from the shoreline. • This method would require a cofferdam in the sea to serve as a receiving pit. In order to provide watertightness, sheet piling will be used to form the cofferdam. As sheetpiles cannot be driven through the rock layer, low rock head level is required for this method. • Based on preliminary estimation, in order to provide adequate stability to the cofferdam, the sheetpiles should be driven at least 30m below seabed level. Based on the subsoil survey data carried out on site, the rock level is situated at approximate 10m below seabed level only, which would obstruct the sheetpile from being driven further down (see *Figure 1.4*). Thus, this method is considered as **not feasible**. • Besides, bentonite will be used to strengthen the surrounding drill hole when the HDD method is adopted. There will be potential risk of polluting the seawater due to the escape of drilling fluid through the walls of the drillhole to the seabed, especially from the outlet point at the sea.	• Since this method is considered as engineering not feasible, environmental consideration do not further evaluate.



SECTION FOR OPTION 1

方案1的橫截面圖

SCALE 1:25

比例尺 1:25

Sketch provided by Black & Veatch Hong Kong Limited

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Figure 1.3

圖 1.3

Submarine Cables to be laid under Seabed Level with 500mm cover by Dredging Method

以挖掘法把海底電纜鋪設於海床下，

並在其上加蓋500mm的覆蓋層

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DATE: 06/11/2012

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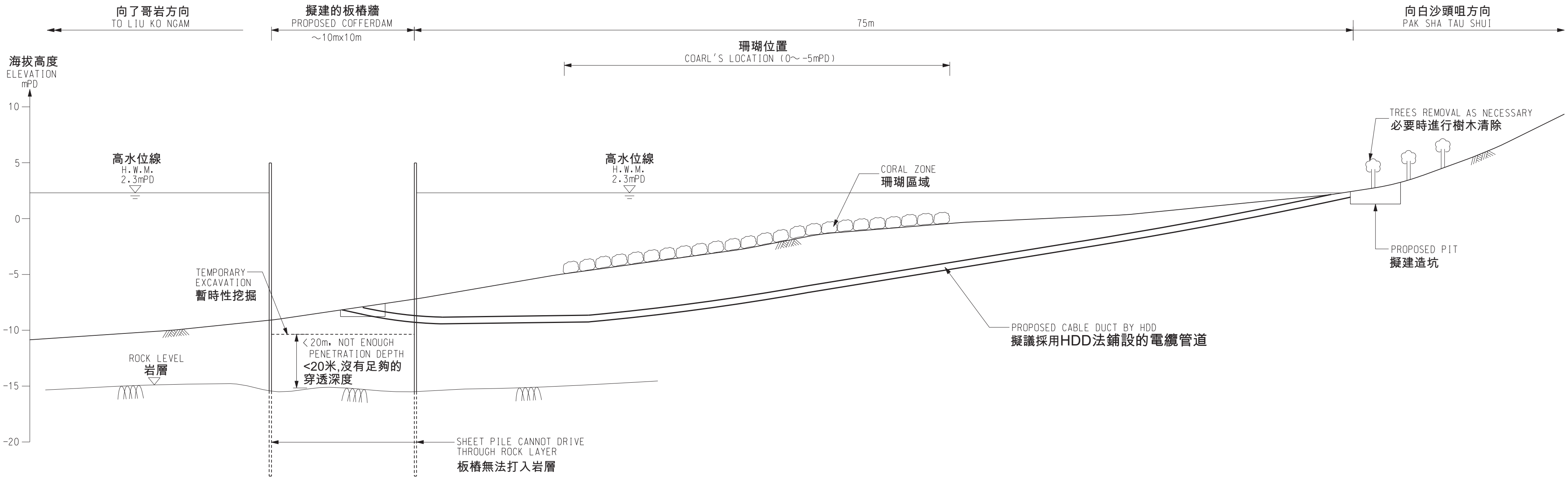

LONGITUDINAL PROFILE FOR OPTION 2

方案2的橫截面圖

SCALE 1:250

比例尺 1:250

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Figure 1.4

圖 1.4

Horizontal Direct Drilling (HDD) for 2 Shore End Cable Laying

以水平定向鑽挖法(HDD)進行兩個岸端纜段的鋪設

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Option Description	Technical Aspect	Environmental Aspect
Adopt HDD method to install cable from one shore-end to another end	• This method would require a working pit on each sides of the sea. A HDD machine will be placed at one side of the sea while the pit on the other side would serve as the receiving pit to receive the drill bit of the HDD. • The total length of the alignment will be about 880m, which is considered as a very long alignment. • In order to carry out HDD works for this length, large HDD machine will be required to provide sufficient resistance pressure for the works. Based on other projects with similar drilling length, a working pit with 12m (W) x 23m (L) will be required for the accommodation of the HDD machine. Referring to *Figure 1.5* showing the longitudinal profile of the site, there is only 10m wide of space available at both landing points measuring from the high tide level to the vegetated and sloping area. Due the limited land available on both landing points, this option will considered as **not feasible**.	• Since this method is considered as engineering not feasible, environmental consideration do not further evaluate.
Rock cutting method apply to the shore-end coral zone, while the dredging method will apply to shore-end non-coral zone	• This method is suitable for shallow trench which involve hard material such as boulders and bedrock. • Performed by up to 2 divers with specialised hand cutting tools within the coral zone. • A trench (1.0 m (width) x 0.6m (depth) will be formed at the shore end landing section (not more than 50m at both Liu Ko Ngam and Pak Sha Tau Tsui and at least 10-20m section from the recorded coral colonies. Please refer to *Figure 1.6* for the typical section. The submarine cables will be installed inside the trench and protected by steel articulated pipes. The trench will be subsequently backfilled to the level of the neighbourhood seabed. • The separation of the two 11kV cables within the coral zone would be about 1m. • Rock material generated will be removed manually by divers. • 5 m wide silt curtain will be employed and the divers activities restricted within the silt curtain. • Dredging method will be performed within non-coral zone. • The total volume of dredged materials at both landing sites for this option is expected to be approximately 480 m^3. •	• Reduced number of coral colonies impacted by the cable laying activities. • Potential water quality impacts to the nearby sensitive receivers including Marine Park, coral communities and Fish Culture Zone which can be mitigated by installation of silt curtain and reduced dredging rate.

Taking into account the considerations above, it is proposed that the 'Rock Cutting' method (at the coral zone) plus "Dredging Method" (at non-coral zone) is the most appropriate based on technical feasibility and environmental outcomes. Potential impacts would be expected to impact the hard coral colonies located within the 5 m silt curtain area, although this number is significantly reduced in comparison to the "Dredging Method" and other approaches considered in *Table 1.1*. This is further considered in *Section 4.*

1.7 NUMBER AND TYPES OF DESIGNATED PROJECTS TO BE COVERED BY THE PROJECT PROFILE

The Replacement of the Existing 11kV Submarine Cable Circuit Connecting Liu Ko Ngam and Pak Sha Tau Tsui at Kat O is classified as a Designated Project (DP) under Schedule 2, Part I, Category C, Item C.12 – dredging operation which is less than 500m from the nearest boundary of the Marine Park. According to *Section 5 (11)* of the *EIAO*, application for an Environmental Permit (EP) is required for the construction and operation of the Project.

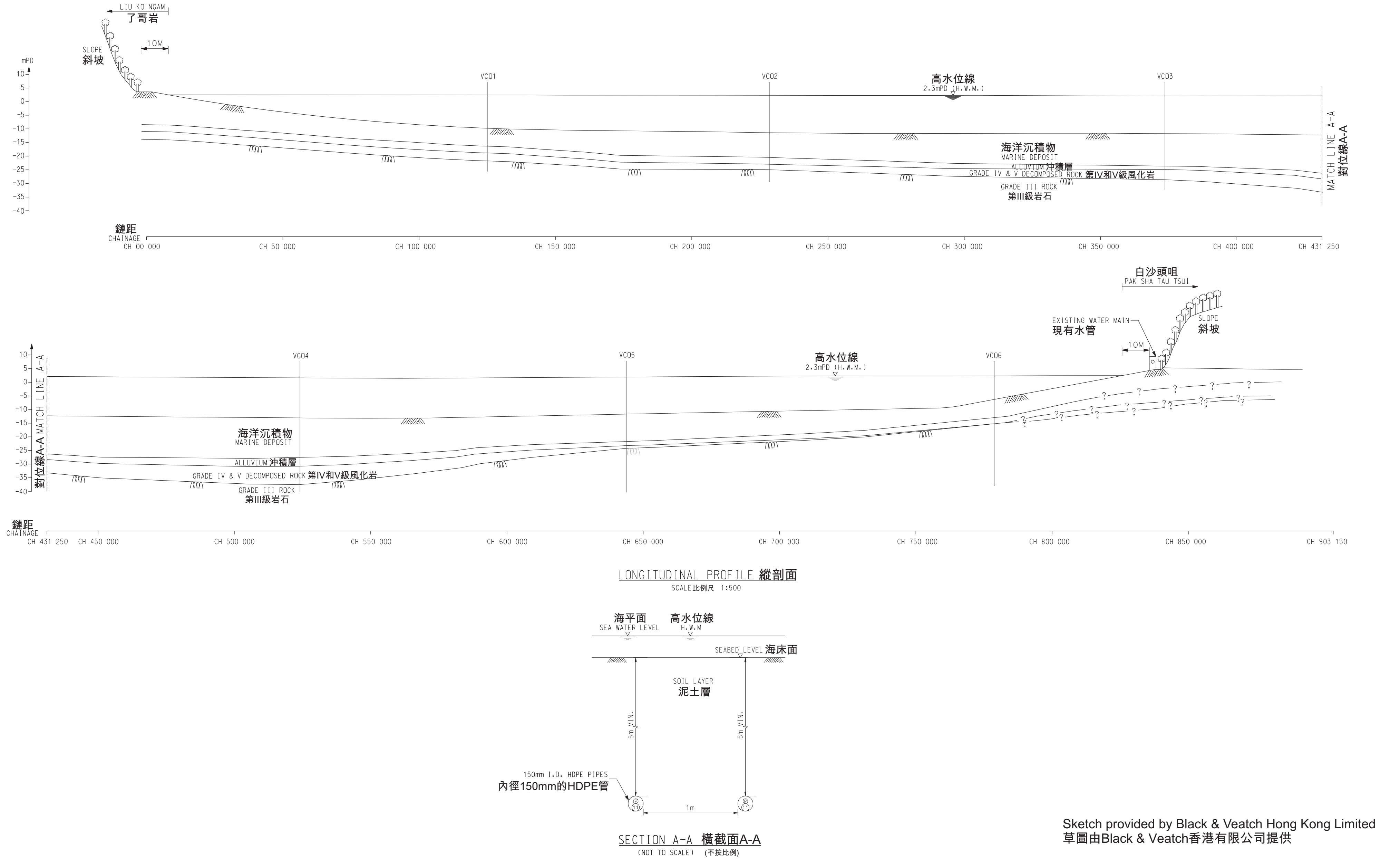

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Figure 1.5
圖 1.5

Installation by HDD Method from One Shore End to Another End
採用水平定向鑽挖法(HDD)將電纜從一個岸端鋪設至另一個岸端

FILE: 0114462k-chi
DATE: 06/11/2012

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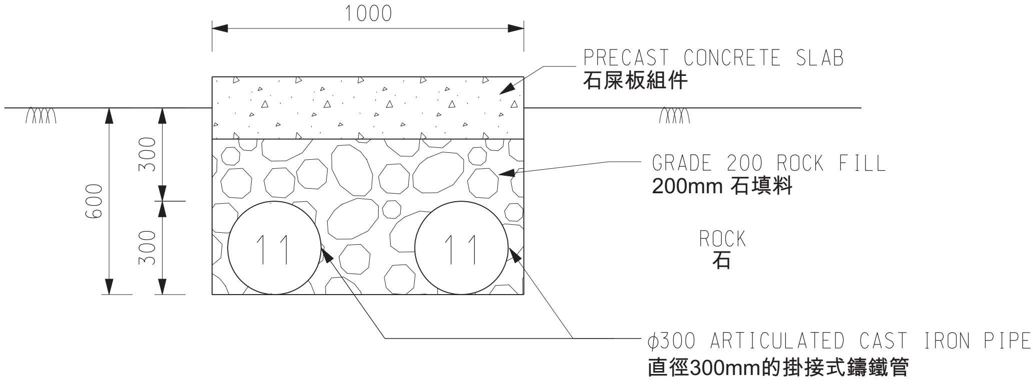

SECTION FOR OPTION 4
方案4的橫截面圖

SCALE 1:25
比例尺 1:25

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Figure 1.6
圖 1.6

Installation by Rock Cutting Method Applied to the Shore End Coral Zone
在岸端珊瑚區採用岩石切削法進行電纜鋪設

FILE: 0114462l-chi
DATE: 06/11/2012

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2 OUTLINE OF PLANNING AND IMPLEMENTATION PROGRAMME

2.1 PROJECT PLANNING AND IMPLEMENTATION

The project will be led and managed by CLP. Planning and construction of the submarine cable system will be undertaken by contractor to be appointed by CLP.

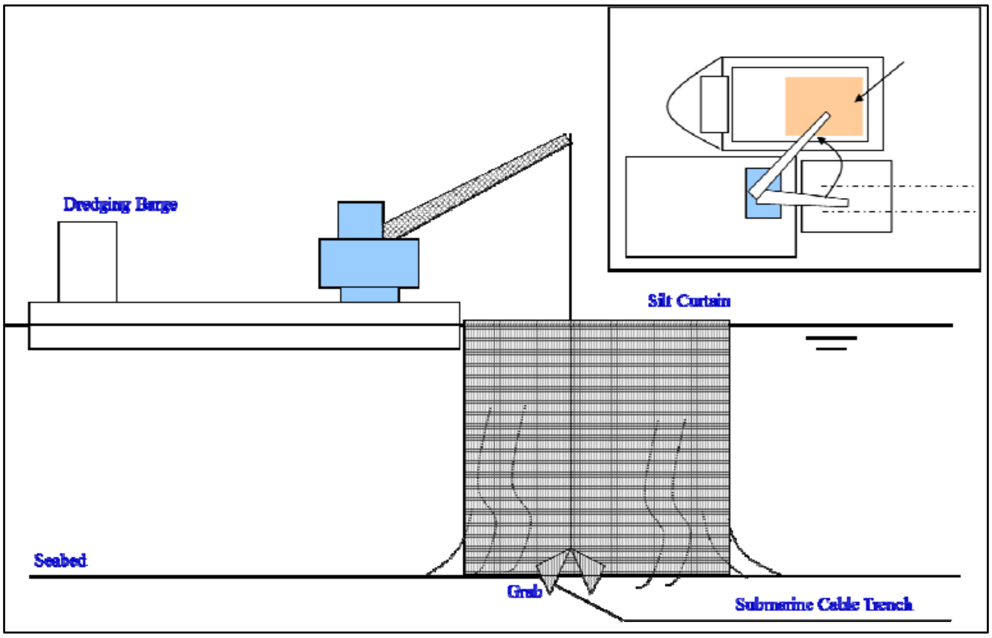
The Project will be constructed through the following activities:

- **Proposed Shore -end Cable Laying Installation Method**– At the shore ends of Liu Ko Ngam and Pak Sha Tau Tsui, the cables will be laid within a pre-dredged approaching trench.

  – It is proposed that the 'Rock Cutting' method is used to install the shore-end cables within coral zone. This will be performed by no more than 2 divers using specialized rock cutting equipment. About 1.0m (Width) x 0.6m (Depth) trench will be formed at the shore-end landing section (not more than 50m at both Liu Ko Ngam and Pak Sha Tau Tsui, but only 10-20m section with coral colonies recorded). The rock materials generated will be removed manually by divers. The submarine cables will be installed parallel inside the rock trench and protected by steel articulated pipes. They will be subsequently backfilled to the level of the neighbourhood seabed. In order to avoid potential water quality impacts, a 5m wide silt curtain will be employed and the divers' activities also restricted within the silt curtain.

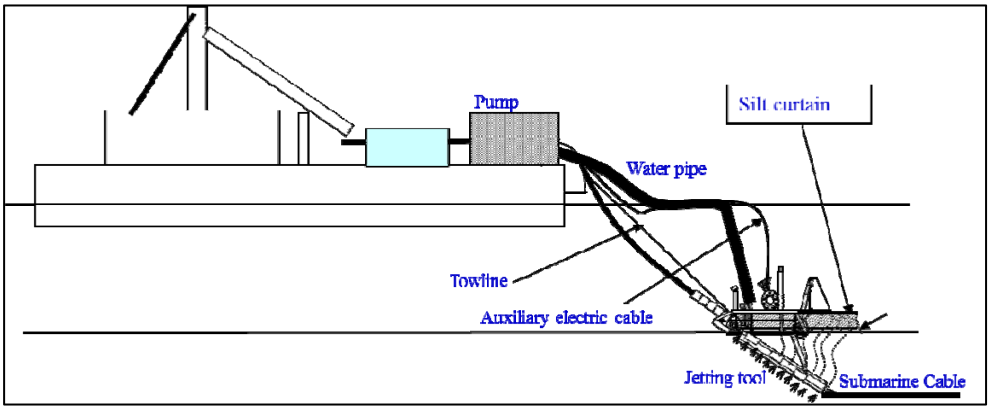
  – Outside the coral zones, the work would be undertaken by a single grab dredger of approximately 3 m^3 grab at both shore ends (*Figure 2.1*). The cables within the dredged trench will be placed by divers, backfilling with clean sand over the cable once it is in place. The dredging rates are not expected to exceed 300 m^3 per day for the grab dredgers used at the cable landing sites. The total volume of dredged materials is expected to be approximately 480 m^3 at both of the landing sites. At least 0.5 m cover will be provided to the submarine cables at both landing sites. The separation of the two 11kV cables would be about 2m at both landing points except for the coral zone which they will be placed in 1m apart. The estimated length of the pre-dredged trench at each landing point would be about 75 m long measuring from the High Water Mark (HWM) level. The average width of the trenches outside the coral zone would be about 4m from the centerline of the trenches (with a total 8 m wide working corridor). The average width of the trenches within the coral zone would be 1m wide.

Figure 2.1 Grab Dredging Operation



- **Cable Laying Methodology** – The proposed replacement 11kV submarine cable will be installed by jetting method - simultaneously laying and burying the cable using a water jetting burial machine/ tool (*Figure 2.2*). 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 cable will be laid for the majority of the cable length to a burial depth of approximately 5 m below the surrounding seabed. It should be noted that the seabed can be expected to naturally reinstate to before-work level and condition shortly after completion of the works. As part of the cable installation, the Route Clearance Operation (RC) and Pre-lay Grapnel Run (PLGR) over part of the proposed cable route where cable burial section are to be conducted. The RC and PLGR operations are scheduled to take place before actual cable laying operation. The aim of RC and PLGR are to remove any Out of Service Cables, debris or obstacles, which may pose a threat to the cable or the burial machine, deposited in the cable corridor. The penetration of grapnel fluke will not be more than 0.8 m. The clearance area will cover 5 m on both side of cable (with a total of 10 m wide for each cable route). All debris recovered from seabed will be disposed to the approved dumping ground. Since the RC and PLGR operation will only be carried out by mechanical towing in a very short period of time and restricted to limited areas, impacts to the marine environment do not expect to be anticipated. The route clearance operation will not be carried out on both landing site where corals are found. In areas where shallower burial depths are required, the cables will require a protective cover, such as a concrete slab, but the seabed level expects to be remains unchanged after construction.

Figure 2.2 Simultaneous Cable Lay and Burial Operation using Jetting Method



- **Connection to Existing Cable System** - After landing, the proposed replacement 11kV submarine cable circuit will connect to the existing OHL system with minimal underground cable and one to two new wooden electricity poles at each of Liu Ko Ngam and Pak Sha Tau Tsui landing respectively (*Figure 1.1*). The landing site at Liu Ko Ngam is located within the Plover Cove Country Park while the landing site at Pak Sha Tau Tsui is located within the Plover Cove (Extension) Country Park. The length of the new underground cables at each landing site (Liu Ko Ngam and Pak Sha Tau Tsui) is approximately 50 m. Once the proposed cables pass beyond the HWM at the both landing points, they will be laid in a 0.75 m (W) x 1.0 m (D) cable trench and connected to new wooden electricity pole. The soil to be excavated for the construction of each wooden pole foundation would be about 1.8 m (W) x 1.4 m (L) x 1.6 m (D). The equipment to be involved during the construction are mainly hand tools, one or two backhoes and concrete mixer. They will then be connected to the existing electricity pole via underground cable. The cable trenches will be excavated by open excavation method using backhoe and hand tools. The excavated materials associated with the new underground cables and wooden electricity pole installation at Liu Ko Ngam and Pak Sha Tau Tsui are estimated to be approximately 45 m^3 and 40 m^3 respectively. The OHL wooden poles will be transported to the site by helicopter and installed manually and mainly using hand tools. Vegetation removal may be required but no tree felling will be involved in this Project. Two of the existing OHL poles at Liu Ko Ngam will be removed (only the wooden pole above ground) after the installation of the new wooden electricity poles. The abandoned OHL wooden poles will also be transported off site by helicopter.

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 submarine cable installation work is planned to commence in second quarter of 2014 and will take about 6 months to complete. The expected construction schedule is presented as follows:

Landing Site Preparation and Cable Landing	approximately 12 weeks
Cable Laying across Tsing Chau Lek by jetting method	approximately 4 weeks
Post Lay Protection	approximately 8 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 SHIPPING LANES AND FAIRWAYS

No major shipping route/fairway is located in vicinity of the proposed cable route.

3.2 SUBMARINE CABLES, PIPELINES AND OUTFALLS

There are several submarine utilities located to the south of the proposed cable route including the existing 11kV cable circuit and water pipes.

3.3 FISH CULTURE ZONE

The following FCZs are located in the vicinity of the proposed cable route:

- Ap Chau FCZ (~2.5 km away from the proposed cable route);
- Kat O FCZ (~1.8 km away from the proposed cable route);
- O Pui Tong FCZ (~1.7 km away from the proposed cable route); and,
- Sai Lau Kong FCZ (>510 m away from the proposed cable route).

3.4 COUNTRY PARK

The proposed landing sites are located within two Country Parks. The landing site at Liu Ko Ngam is located within the Plover Cove Country Park while the landing site at Pak Sha Tau Tsui is located within the Plover Cove (Extension) Country Park. 11kV underground cable will be proposed to connect the submarine cable from the landing points to existing the OHL system at Liu Ko Ngam and Pak Sha Tau Tsui. The length of the new underground cables at each landing site (Liu Ko Ngam and Pak Sha Tau Tsui) is approximately 50m. It should be noted that minor public utility works, including power lines with a voltage level of not more than 66kV, partly or wholly in the Country Park would not be defined as a DP under the *EIAO*. However, permission is required from the Country and Marine Parks Authority.

3.5 MARINE PARK

The Yan Chau Tong Marine Park (Lai Chi Wo portion) is located within 500 m from the proposed cable route (approximately 430 m from the nearest distance of the Marine Park boundary to the proposed cable alignment). The Marine Park is designated to protect the diverse marine life and the ecologically important habitats including seagrass bed in Lai Chi Wo, which are over 1.5km away from the proposed cable landing site at Liu Ko Ngam.

A gazetted artificial reef deployment site is also located in Yan Chau Tong within the Marine Park boundary.

3.6 LAI CHI WO SITE OF SPECIAL SCIENTIFIC SITE

The Lai Chi Wo Beach Site of Special Scientific Site (SSSI) is located over 1.5 km away from the proposed cable landing site at Liu Ko Ngam and the proposed cable route. In view of the ecological importance of seagrass communities, the seagrass bed (*Zostera japonica*) at Lai Chi Wo was designated as a SSSI in 1979. The seagrass bed had been included in the designation of Yan Chau Tong Marine Park in 1996.

3.7 HONG KONG GEOPARK

The proposed cable landing sites, both Liu Ko Ngam and Pak Sha Tau Tsui are located within the Double Haven Geo-Area which is part of the Northeast New Territories Sedimentary Rock Region of the Hong Kong Geopark.

3.8 CULTURAL HERITAGE

No declared monuments, government historic buildings, graded or proposed graded historic buildings listed by the Antiquities and Monuments Office (AMO) are located adjacent to the two cable landing sites (i.e. Liu Ko Ngam and Pak Sha Tau Tsui) and submarine routing alignments.

The cable landing site at Pak Sha Tau Tsui is located within the Kat O Pak Sha Tau Site of Archaeological Interest recorded by the AMO.

4 POSSIBLE IMPACT ON THE ENVIRONMENT

4.1 SUMMARY OF POTENTIAL ENVIRONMENTAL IMPACTS

The construction impacts associated with the proposed 11kV submarine cable circuit are summarized in *Table 4.1* and 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 with the possible exception of visual impacts. It should also be noted that impacts on the geological features and geological landscape asset of the Hong Kong Geopark, including the sand spit of Pak Sha Tau Tsui at the Northeast New Territories Sedimentary Rock Region, are not expected to be anticipated due to the Project.

Table 4.1 Potential Sources of Environmental Impacts (Construction)

Potential Sources of Impact	Impact
• Gaseous Emission	×
• Dust	×
• Odour	×
• Noise	✓
• Night-time Operations	×
• Traffic Generation	×
• Liquid Effluents, Discharges, or Contaminated Runoff	×
• Generation of Waste or By-products	✓
• 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	✓
• Disruption of Water Movement or Bottom Sediment	✓
• Unsightly Visual Appearance	×
• Ecological Impacts:	
- Terrestrial	✓
- Marine	✓
• Fisheries	✓
• Cultural Heritage	✓

Notes: ✓ = Possible to result in impacts

× = Not expected to result in impacts

4.2 NOISE

Noise Sensitive Receivers (NSRs) (see *Figure 1.2*) 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 the cable trenching works, installation of new wooden electricity pole and cable laying works are not expected to result in impacts to sensitive receivers. The nearest NSRs are Sai Lau Kong and Kat O Sheung Wai which are located over 500 m and 1 km from the proposed cable landing points at Liu Ko Ngam and Pak Sha Tau Tsui respectively.

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 NSRs. 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*

Land based activities for the Project will involve cable installation and construction of the wooden electricity poles and the potential impacts on water quality will be primarily limited to surface water runoff. The following measures will, however, be implemented during the land based construction activities to minimise potential 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;
- Guidelines for handling and disposal of construction site discharges as set out ProPECC PN1/94 should be followed in order to minimize the potential impacts to the water quality; and
- All construction waste will be handled and disposed of in accordance with the *Waste Disposal Ordinance*.

Given the above-mentioned measures no adverse impacts (either direct or indirect) on water quality from the shore-based construction activities are expected.

4.3.2 *Marine-based Activities*

The marine-based construction activities will involve burying the cable below the existing seabed. The submarine cable 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 cable is expected to be installed over an approximate 4 week period. The maximum speed during cable laying will be approximately 800 m per day.

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 60 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 40 m of the dredging operation at the shore ends of both Liu Ko Ngam and Pak Sha Tau Tsui. 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. It should also be noted that rock cutting will only generate minimal and localised impact on water quality.

No long term disruption to bottom sediment will occur and no disruptions to water movement will result from this Project. Best Management Practices (BMPs) should be applied to avoid and minimize contaminated runoff from work sites, marine plants and vessels. 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

4.4.1 Construction Phase

The land-based construction activities associated with the Project may generate the following broad categories of waste:

- Small quantity of construction and demolition (C&D) materials, total about 800 m^3 of excavated soil at both Liu Ko Ngam and Pak Sha Tau Tsui, generated from excavation works; and

- Small quantities of general refuse, including food waste from the on-site work force and packaging from the construction materials.

It is estimated that about 45 m^3 and 40 m^3 of spoil will be excavated for new underground cables and wooden electricity poles installation at Liu Ko Ngam and Pak Sha Tau Tsui respectively. All the excavated spoil will be reused onsite. General refuse will be taken away from the work site by the workers for proper disposal on a daily basis

With proper housekeeping measures and refuse collection in place, minimal or no impact is expected to result from refuse generated during the construction phase of the Project.

The cable circuits 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 800 m^3 of these materials will need to be dredged at both landing sites. The EPD data show that the sediment of the study area is 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.

4.4.2 Operational Phase

No waste management issues are anticipated during the operation of the Project.

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 Project. There will be no disturbance during operation of the Project.

4.6 LANDSCAPE AND VISUAL

With regard to landscape and visual impacts, the key landscape impacts will occur during construction and during operation impacts will potentially be mainly visual rather than landscape. Additionally, landscape and visual impacts have been assessed at the landing sites and on land in this section, while the marine ecology section (Section 4.7) covers landscape impacts to the seabed and notes impacts to marine resources have largely been avoided through the selection of landing sites, cable alignment and the employment of particular cable laying techniques.

4.6.1 *Construction Phase*

The vegetation at the backshore of the landing sites is dominated by coastal vegetation, with young woodland and shrubland at the hillside of the landing sites at Liu Ko Ngam and Pak Sha Tau Tsui respectively (*Figures 4.1 & 4.2*). Liu Ko Ngam and Pak Sha Tau are also part of the Hong Kong Geopark (Double Haven Geo-Area).

Site visits confirmed that the new electricity poles will be located within coastal vegetation on land covered mainly by grasses and shrubs, which will need to be partially removed for the construction of the Project. There is very limited vegetation along the majority of the cable trench for the underground cable. Only limited vegetation clearance and no tree felling (the route will be fine-tuned if necessary to preserve all trees during construction) will be required for the new underground cables and wooden electricity pole installation. With the limited scale of vegetation removal and disturbance of existing landscape resources, the small size of the working areas, the small number of construction equipment required on site and short construction period, impact on the existing landscape is expected to be low. Equally the Project is not expected to affect the Geopark.

4.6.2 *Operational Phase*

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 from these elements of the Project. Equally the landscape impacts at operation are expected to be minimal since most cabling will be underground (impacts to seabed covered in *Section 4.7*)

The new wooden electricity poles are about 9 m (above ground) tall, which is the same height as the existing electricity poles, and will be located next to the existing OHL system. The wooden electricity poles will match the country park environment and complement that of the existing structures of the immediate surroundings and so are considered compatible with the existing view (this can be considered a detailed design mitigation measure). The new wooden electricity poles may be visible to visitors (accessed by boat, but unlikely by the hikers as the sites are located away from existing hiking trails) passing through the area but the view will be transient and the change in view is minimal as illustrated by graphical presentations of the Project at Liu Ko

Ngam and Pak Sha Tau Tsui landing sites from the sea in *Figures 4.3* and *4.4* respectively. With minimal change to transient views of occasional visitors, the visual impact of the Project will be minimal.

Taking into account the one to two wooden electricity poles to be installed, presence of the existing OHL systems and the location far from existing hiking trails and villages (i.e. potential visual sensitive receivers), the new structures of the Project are not expected to be easily visible and will not give rise to significant additional landscape and visual impacts.

Therefore the overall landscape and visual impacts of the Project are considered to be low and are anticipated to be acceptable.

4.7 MARINE ECOLOGY

A review of the baseline marine ecological conditions of Liu Ko Ngam and Pak Sha Tau Tsui in the vicinity of the proposed submarine cable alignment and landing sites have been undertaken (see *Annex B1*).

The soft bottom benthic fauna have been identified to be of low ecological value. Although these soft bottom assemblages will be disturbed during the cable laying works, similar communities are predicted to colonise the habitats within a short period of time and thus the impacts are not regarded as unacceptable.

Based on the results of recent field surveys, the intertidal sandy and boulder shores found at the proposed cable landing sites support low abundances and diversity of intertidal organisms. Most of these species are common and widespread on other similar shores in Hong Kong, and are considered of low ecological concern. Impacts to these assemblages are, therefore, not regarded as unacceptable.

A total of 18 and 16 hard coral species were recorded from the coral mapping surveys in the landing sites of Liu Ko Ngam and Pak Sha Tau Tsui, respectively. Generally, the coral species recorded in these two surveyed area can commonly be found throughout the eastern and northeastern waters of Hong Kong. The density of corals is low at both landing sites which is less than 1.3 colonies per m^2. Size of individual colonies was mostly smaller than 15 cm in diameter.

As a result of the cable installation works, it is expected that a total of six (6) and seven (7) hard coral colonies would be directly affected by the rock cutting works at the landing sites of Liu Ko Ngam and Pak Sha Tau Tsui, respectively. In addition, a total of 16 and 25 hard coral colonies (including those within the one-metre (1 m) wide rock cutting works area) at Liu Ko Ngam and Pak Sha Tau Tsui, respectively, may potentially be subjected to indirect disturbances due to the movement of divers and perturbations to water quality within the five-metre (5 m) wide working corridor enclosed by the silt curtain at the landing sites. The affected coral colonies were generally small in size and of common distribution in northeastern and eastern waters

Coastal Vegetation 海岸植物

Shrubby Grassland 多灌木草地

Young Woodland 尚未成熟的林地

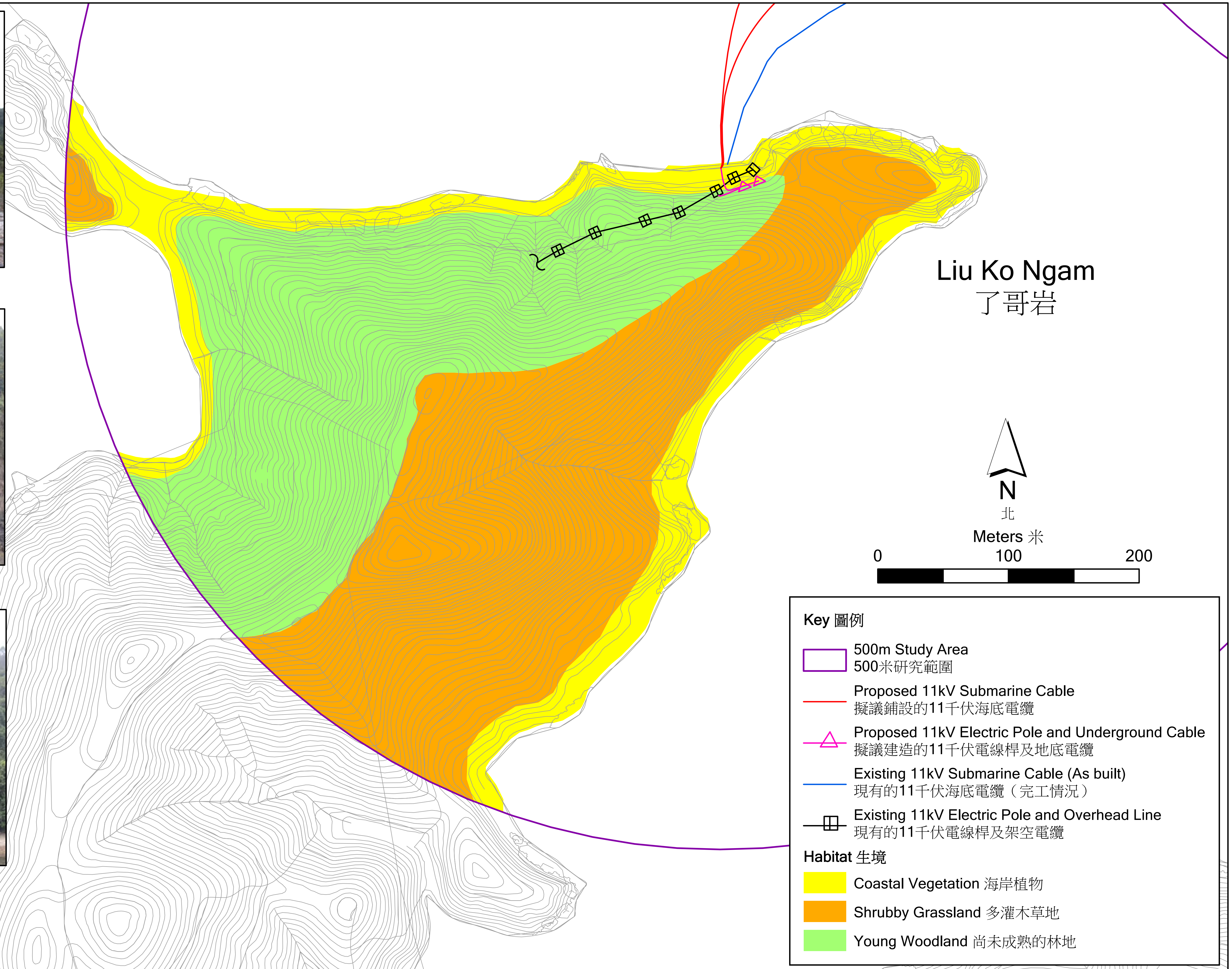


Figure 4.1
圖4.1

Habitat Map at Liu Ko Ngam Landing Point

了哥岩登岸點生境地圖

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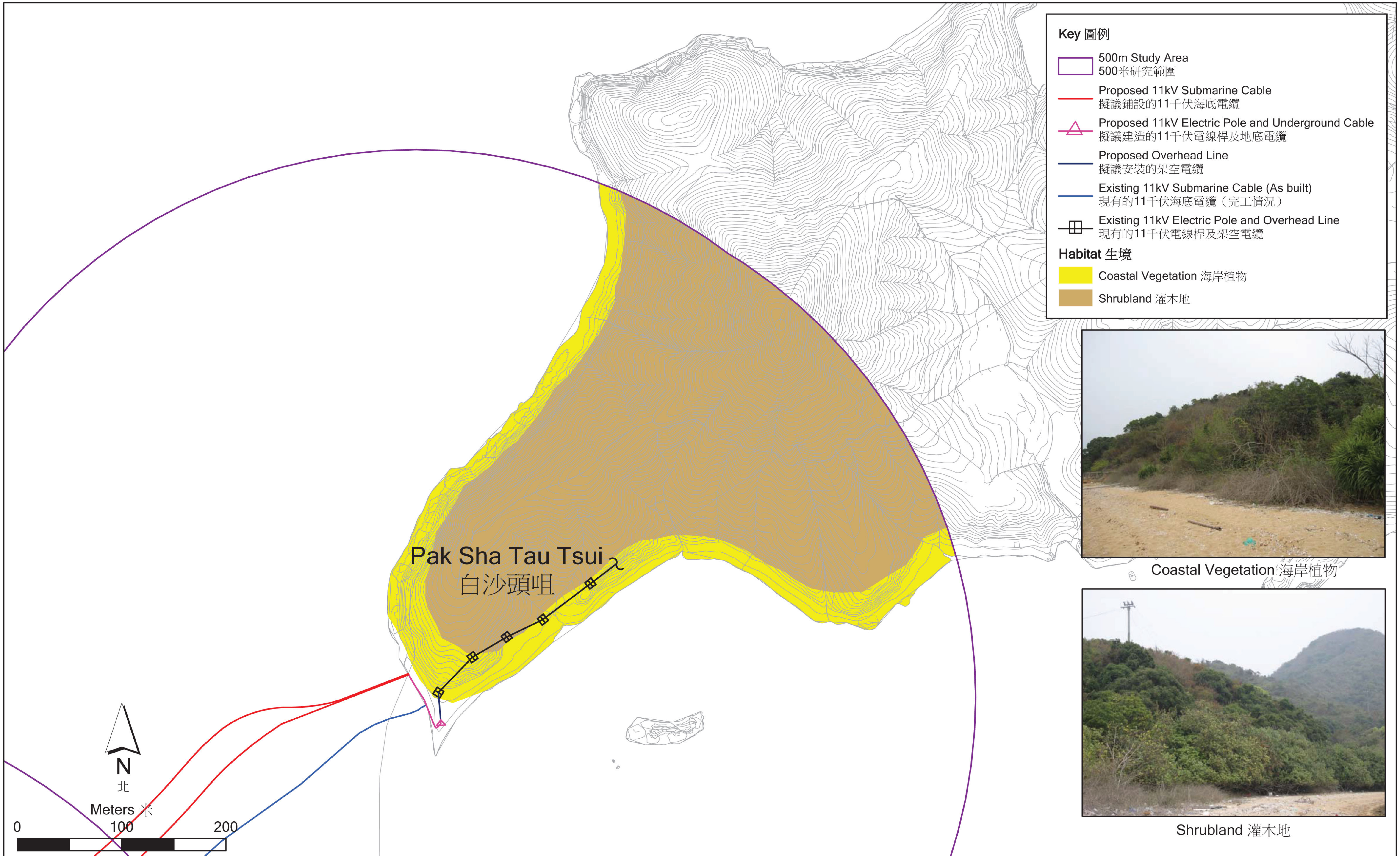

Figure 4.2
圖4.2

Habitat Map at Pak Sha Tau Tsui Landing Point

白沙頭咀登岸點生境地圖

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View Without Development
沒有相關發展的景象

View With Development
建成相關發展的景象

Figure 4.3
圖 4.3

Photomontage showing the Site Before and After the Construction at Liu Ko Ngam
顯示了哥岩登岸地點在施工前和施工後情況的合成照片

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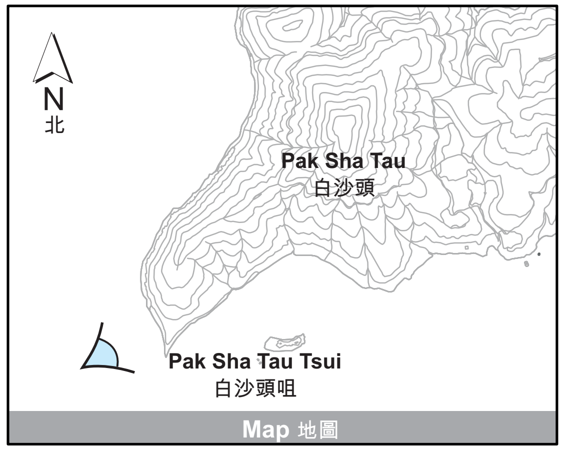

View Without Development
沒有相關發展的景象

View With Development
建成相關發展的景象

Figure 4.4
圖 4.4

Photomontage showing the Site Before and After the Construction at Pak Sha Tau Tsui
顯示白沙頭咀登岸地點在施工前和施工後情況的合成照片

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of Hong Kong. Therefore, no unacceptable residual impacts to the coral assemblages are predicted to occur due to the Project.

Indirect impacts associated with the change in water quality on the recorded coral communities, Yau Chau Tong Marine Park (the nearest point of the Marine Park located approximately 430 m form to the proposed cable landing site and cable route) and Lai Chi Wo Beach SSSI (which is located over 1.5 km away from the proposed cable landing site and cable route) are not regarded as significant due to the small scale of the works, the short duration of impacts, and the limited dispersion of sediment plume.

Impacts to marine ecological resources have largely been avoided through the selection of landing sites and cable alignment that minimises landscape and ecological impacts to coral communities and through the employment of cable laying techniques that result in little disruption to the marine environment.

4.8 *TERRESTRIAL ECOLOGY*

Small scale construction works are required onshore at each of the cable landing sites, i.e. Liu Ko Ngam and Pak Sha Tau Tsui for connecting the submarine cable (after landing) with the existing overhead land cable systems.

4.8.1 ***Legislation and Guidelines***

The following legislation and guidelines provide the framework for the protection of species and habitats of ecological importance for ecological impact assessment in Hong Kong:

- *Country Parks Ordinance* (Cap 208);
- *Forests and Countryside Ordinance* (Cap 96);
- *Town Planning Ordinance* (Cap 131);
- *Wild Animals Protection Ordinance* (Cap 170);
- *Protection of Endangered Species of Animals and Plants Ordinance* (Cap 586); and
- *Hong Kong Planning Standards and Guidelines Chapter 10* (HKPSG).

Reference was also made to the *Technical Memorandum on Environmental Impact Assessment Process* (EIAO-TM) issued under the EIAO in the evaluation of potential ecological impacts.

4.8.2 ***Literature Review of Ecological Characteristics of the Study Area***

A literature review was conducted for the Project Site (1) (2). There is very limited ecological information available regarding the Study Area from the

(1) *Porcupine!* Newsletter of Department of Ecology & Biodiversity, University of Hong Kong Issues 1 to 33.

(2) AFCD Biodiversity Newsletters (2002-2010)

literature review. Subsequently, a field survey was conducted in 2011 and 2012 to determine the existing ecological conditions within the Study Area.

4.8.3 Ecological Baseline Conditions

Habitat and Vegetation

Liu Ko Ngam

Terrestrial habitats found within the Liu Ko Ngam Study Area consisted of young woodland, shrubby grassland and coastal vegetation (*Figure 4.1*). Within the Study Area, 79 species were found in young woodland, 20 species found in shrubby grassland; 35 species in coastal vegetation and 19 species in the works area (coastal vegetation) (see *Annex B2*).

Young woodland was mainly located on the hillside of the Study Area. Young woodland was the second most common habitat within the Liu Ko Ngam Study Area, covering approximately 41% of the Study Area. No plant species of conservation interest were found within this habitat. Overall the young woodland was young in age and considered to be of low to moderate ecological value.

Shrubby grassland was by far the dominant habitat within the Liu Ko Ngam Study Area, covering approximately 43% of area. Plant species recorded in this habitat were mainly very common or common and no plant species of conservation interest were found. Overall, shrubby grassland is considered to be of low ecological value.

The coastal vegetation in the Liu Ko Ngam Study Area was made up of the backshore of the cobble beach and accounted for approximately 16% of the whole Liu Ko Ngam Study Area. Plant species recorded in this habitat were mainly very common or common and no plant species of conservation interest were found. Overall, coastal vegetation is considered to be of low ecological value.

The new electric pole installation is located within an area shown as coastal vegetation on the habitat map in *Figure 4.1* and has the same characteristics as the coastal vegetation habitat in the Liu Ko Ngam Study Area. No rare or protected plant species were found within the Liu Ko Ngam works area and it is considered to be of low ecological value.

Pak Sha Tau Tsui

Terrestrial habitats found within the Pak Sha Tau Tsui Study Area consisted of shrubland and coastal vegetation (*Figure 4.2*). Within the Study Area, 54 species were found in shrubland; 44 species in coastal vegetation and 13 species in the Pak Sha Tau Tsui works area (coastal vegetation) (see *Annex B2*).

Shrubland was the dominant habitat within the Pak Sha Tau Tsui Study Area, covering approximately 79% of area. Plant species recorded in this habitat were very common or common and no plant species of conservation interest were found. Overall, shrubland is considered to be of low ecological value.

The coastal vegetation in the Pak Sha Tau Tsui Study Area was made up of the backshore of the sandy beach and accounted for approximately 21% of the whole Pak Sha Tau Tsui Study Area. Plant species recorded in this habitat were very common or common and no plant species of conservation interest were found. Overall, coastal vegetation is considered to be of low ecological value.

The new electric pole installation is located within an area shown as coastal vegetation on the habitat map in *Figure 4.2* and has the same characteristics as the coastal vegetation habitat in the Pak Sha Tau Tsui Study Area. No rare or protected plant species were found within the works area and it is considered to be of low ecological value.

Photographic records of habitats identified within the Study Areas are also presented in *Figures 4.1* and *4.2*. The area of each habitat found within the Study Area and their ecological value are presented in *Table 4.2*.

Table 4.2 Area and Ecological Value of Each Habitat Identified within the Study Area

Habitat	**Area**	**Ecological Value**	**Note**
Liu Ko Ngam			
Young Woodland	~7.5 ha	Low to moderate	Young woodland was dominated by the native trees *Schefflera heptaphylla* and *Sterculia lanceolata*. The average height of mixed woodland was 3 - 4 m. The understorey was dominated by the climber *Millettia nitida* and *Caesalpinia crista,* shrubs *Rhus succedanea* and *Psychotria asiatica.* No plant species of conservation interest were recorded in the young woodland.
Shrubby Grassland	~7.9 ha	Low	Shrubby grassland was dominated by a few very common, native species including the grass *Miscanthus sinensis,* the shrub *Baeckea frutescens* and the climber *Cassytha filiformis.* No plant species of conservation interest were recorded in the shrubby grassland.
Coastal Vegetation	~3.0 ha	Low	Coastal vegetation was dominated by a few common, native species including the shrub *Clerodendrum inerme* and the tree *Paliurus ramosissimus*. No plant species of conservation interest were recorded in the coastal vegetation.
Works Area (Coastal Vegetation)	~45 m^2	Low	The Liu Ko Ngam works area was dominated the very common climbers *Millettia nitida* and *Caesalpinia crista* and young *Schefflera heptaphylla* . Neither rare protected nor plant species of interest was recorded in the works area.
Pak Sha Tau Tsui			
Shrubland	~10.8 ha	Low	Shrubland was dominated by a few very common, native shrub species including *Sageretia thea, Cratoxylum cochinchinense* and *Rhaphiolepis indica.* No plant species of conservation interest were recorded in the shrubby grassland.

Habitat	Area	Ecological Value	Note
Coastal Vegetation	~2.8 ha	Low	Coastal vegetation was dominated by a few common, native species including the shrub *Clerodendrum inerme* and *Vitex rotundifolia*, the tree *Pandanus tectorius, Paliurus ramosissimus* and *Cerbera manghas*. No plant species of conservation interest were recorded in the coastal vegetation.
Works Area (Coastal Vegetation)	~40 m^2	Low	The Pak Sha Tau Tsui works area was dominated the very common species, *Lantana camara, Pandanus tectorius,* and *Hibiscus tiliaceus*. Although *Pandanus tectorius,* and *Hibiscus tiliaceu* when fully grown are considered a tree, plants found were young. Neither rare protected nor plant species of interest was recorded in the works area.

General Wildlife

The abundance and species richness of general wildlife in the Study Area is low; with the majority of the recorded wildlife species being common or very common in Hong Kong. At Liu Ko Ngam Study Area, a total of 6 bird species including Chinese Bulbul, Fork-tailed Sunbird, Great Cormorant, Red-whiskered Bulbul, Common Tailorbird and Great Heron were recorded during the survey. At Pak Sha Tau Tsui Study Area, a total of 6 bird species including Red-whiskered Bulbul, Red-whiskered Bulbul, Barn Swallow, Black Kite, Masked Laughingthrush and Spotted Dove were recorded during the survey. One Black Kite was observed flying above the Pak Sha Tau Tsui Study Area at the time of the survey. Despite being a common and widespread resident in Hong Kong, the Black Kite is considered a bird species of conservation interest in Hong Kong for the purpose of ecological evaluation. In the People's Republic of China (PRC), it is a *Class II Protected Animal* due to over-hunting.

4.8.4 *Construction and Operational Phase Impacts*

The potential ecological impacts that may arise during the construction and operational phases are evaluated based on the results of the field survey and the information gathered from the literature review.

Construction Phase

As a result of the construction activities (minor excavation works), the following are likely sequential outcomes to the habitat in the immediate proximity of the Project Site.

- Direct habitat loss from land take for the construction activities for the surface structures of the Project;
- Direct loss of inactive/less mobile/habitat-specific birds and general wildlife nesting/inhabiting the affected habitat (none recorded during the survey);

- Associated impacts to birds and general wildlife, including restriction of utilisation (i.e. transit, feeding and roosting), temporary and permanent loss of ecological habitat by birds and general wildlife; and

- Impacts to the surrounding habitat and associated birds and general wildlife due to physical disturbance of this habitat including disturbance, inappropriate storage or dumping of construction material, or hill fire.

The potential impacts on the habitat affected by the Project are presented in *Table 4.3*.

Table 4.3 Potential Impacts to Habitat Identified within the Works Area

Impacted Habitat	**Project Component**	**Area of Habitat Impacted**	**Ecological Value**	**Overall Ecological Impact**	**Note**
Coastal vegetation at Liu Ko Ngam	Cable trench and wooden electric pole installation	~45 m² (~0.2% of this habitat in the whole Study Area)	Low	Low	The impacted area is very small in the context of the large extent of similar habitat in the vicinity. No rare or protected species were found within the Project Site.
Coastal vegetation at Pak Sha Tau Tsui	Cable trench and wooden electric pole installation	~40 m² (~0.2% of this habitat in the whole Study Area)	Low	Low	The impacted area is very small in the context of the large extent of similar habitat in the vicinity. No rare or protected species were found within the Project Site.

Given the anticipated temporary and small scale of construction activities and limited area of coastal vegetation to be disturbed on the works area as presented in *Table 4. 3*, extensive similar habitats available in the vicinity and assuming good construction practices are followed (*Section 5.1.1*), the ecological impact (including potential impacts on the associated wildlife as listed above) during the construction phase is expected to be low.

Operational Phase

Ecological impact is not anticipated during the operational phase.

4.9 FISHERIES

A review of the existing information on the fisheries resources and fishing operations in vicinity of the cable route has been undertaken (see *Annex C*), the area transversed by the cable alignment was previously identified as nursery and spawning grounds of commercially fisheries resources. Spawning of majority of species appears to be concentrated during the period from June to September in Hong Kong waters, and this is assumed that spawning of fishes in this area is also concentrated in this period.

Moderate numbers of fishing vessels, mostly purse seiners and sampans, operated in waters around the proposed cable system. These vessels, which are less than 15 m in length, are the major type of fishing operation vessels along the cable route. The nearest FCZ to the proposed submarine cable is located at Sai Lau Kong, which is approximately 510 m southeast of the cable route but with very limited number of operators. Other FCZs, namely O Pui Tong, Kat O and Ap Chau, are all situated over ~1.5 km from the proposed submarine cable route. 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.

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

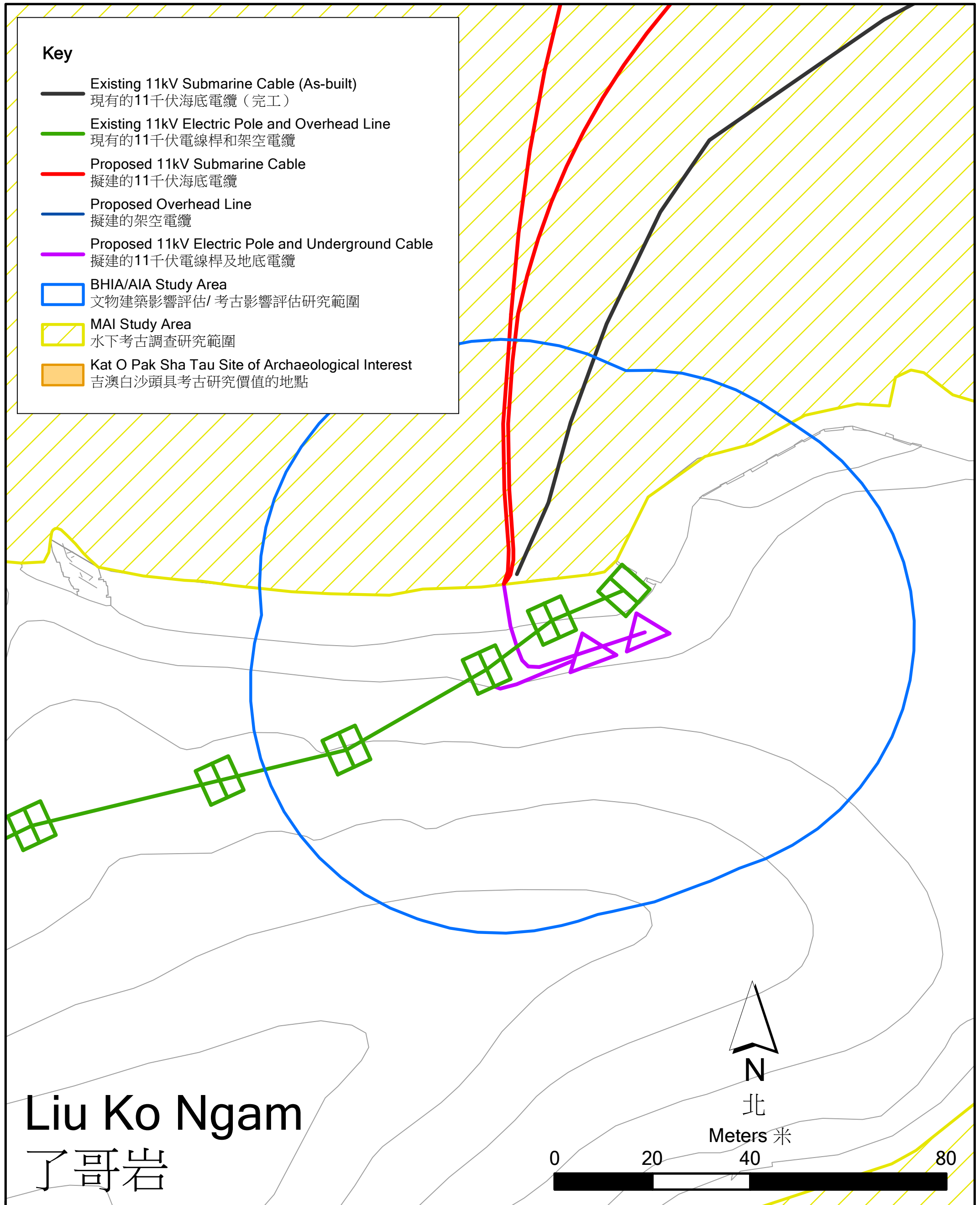
This section has been prepared to provide a cultural heritage impact assessment (CHIA) comprising the Built Heritage Impact Assessment (BHIA), the Archaeological Impact Assessment (AIA) and, the Marine Archaeological Investigation (MAI) for the Project.

The CHIA Study Area of the Project comprises of two parts, the BHIA/AIA Study Area, and the MAI Study Area. For the BHIA and AIA, the boundary of study area is defined as 50 m from the locations and alignments of the proposed electricity poles and underground cables at two landing sites; and it is referred as BHIA/AIA Study Area in this PP. For the MAI, the boundary of study area is defined as approximately 297 m and 380 m from the proposed submarine cable in water; and it is referred as MAI Study Area in this PP. *Figure 4.5* presents the BHIA/AIA Study Area and *Figure D1-1* in *Annex D1* presents the MAI Study Area.

4.10.1 Legislation and Guidelines

The following legislations and guidelines are applicable to the assessment of impacts on sites of cultural heritage in Hong Kong:

- *Environmental Impact Assessment Ordinance* (EIAO) (Cap. 499.S16), Technical Memorandum on the EIA Process, Annex 10 and 19 (EIAO TM) and Guidance Notes on Assessment of Impact on Sites of Cultural Heritage in EIA Studies;
- *Antiquities and Monuments Ordinance* (Cap. 53);



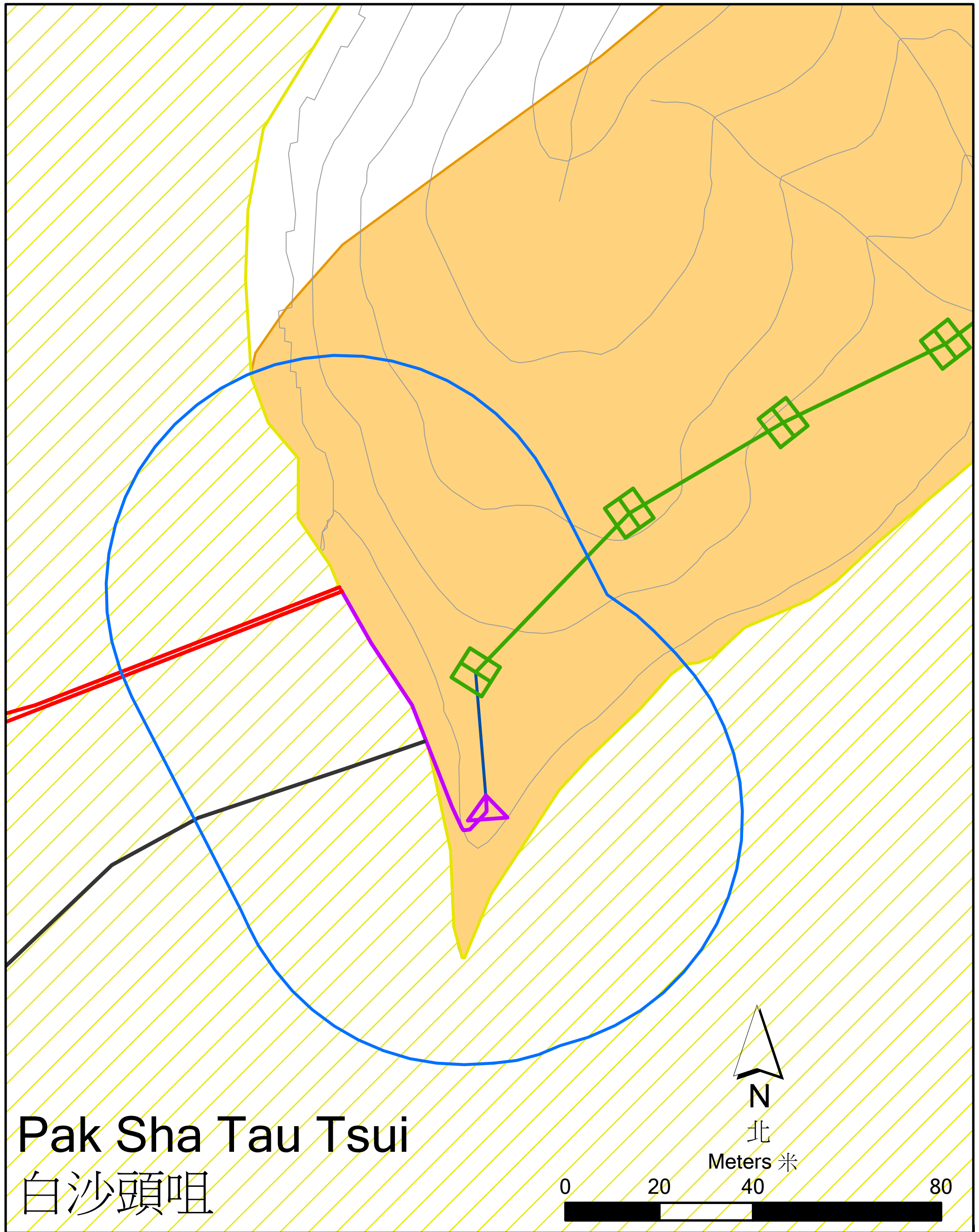


Figure 4.5
圖 4.5

BHIA/AIA Study Area

文物建築影響評估/ 考古影響評估研究範圍

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- Guidelines for Cultural Heritage Impact Assessment (CHIA);
- Hong Kong Planning Standards and Guidelines (HKPSG); and
- *Land (Miscellaneous Provisions) Ordinance*.

4.10.2 *Built Heritage*

The Study Area for BHIA is defined as 50 m from the Project alignment. The following paragraphs present the baseline condition and impact assessment of built heritage within the BHIA/AIA Study Area.

Baseline Condition

No declared monuments, government historic buildings, graded or proposed graded historic buildings listed by the Antiquities and Monuments Office (AMO) are located adjacent to the two cable landing sites (ie Liu Ko Ngam and Pak Sha Tau Tsui) and along submarine routing alignments.

Construction and Operational Phase Impacts

As no built heritage is identified within the BHIA/AIA Study Area, no construction and operational phase impact is anticipated.

4.10.3 *Terrestrial Archaeology*

The Study Area for AIA is defined as 50 m from the Project alignment. The following paragraphs present the baseline condition and impact assessment of terrestrial archaeology within the BHIA/AIA Study Area.

Baseline Condition

Liu Ko Ngam

The cable landing site at Liu Ko Ngam is located at a shallow recent cobble beach (see *Figure 4.5*) with lack of flat area favorable for accumulation of archaeological deposits and ancient settlement, it is considered to have nil archaeological potential and there is no sites of archaeological interest at Liu Ko Ngam.

Pak Sha Tau Tsui

The cable landing site is located within the Kat O Pak Sha Tau Site of Archaeological Interest recorded by the AMO. Previous archaeological survey in 2000 [1] (2000 Survey) reported that Late Neolithic Age cultural layer was identified at approximately 42 to 74 cm below the existing ground level at T2 and T3 where very fragmented coarse pottery shards were unearthed. The shards were too small to determine their typology. In addition, Qing dynasty building foundation remains were unearthed from T1 and T3. Late Neolithic coarse shards, earthenware shards, stone tools and Song, Ming and

(1) 古物古蹟辦事處 (2000)，《新界餘下偏僻村落供水計劃第二期考古調查工作報告》。

Qing dynasties porcelain and pottery shards were discovered from the field scan and disturbed layers in various test pits.

Therefore, an archaeological survey is considered necessary to obtain further archaeological field data to better assess the potential archaeological impacts caused by the Project. The archaeological survey was conducted by a licenced archaeologist from 17 July to 3 August 2012. The detailed survey finding is presented in *Annex D2* in this PP.

The archaeological survey (AS) concluded that all identified cultural layers are dated to modern period. A total of 31 general finds and one special find were identified. The general finds include village ware, porcelain and tile shards. The special find is a perforated stone artifact dated to Bronze Age but it was an isolated find identified from field scan which is a secondary deposit artifact. All of the finds are regarded as secondary deposits and therefore not considered to have significant value.

The surveyed locations in this AS are located further south and west of T6 and further away from T2 and T3 of the 2000 Survey. The surveyed locations in this AS is very close to the existing coastline, thus, no in-situ cultural remains was unearthed.

Based on the AS result, the chance of finding significant archaeological remains at the Site where the proposed project works to be impacted is very low. This is further supported by the fact that previous archaeological survey in 2000 has indicated that in-situ pre-historic archaeological deposits are mainly located at the hill slope away from the modern beach area where the project works locates.Construction and Operational Phase Impacts Assessment

<u>Liu Ko Ngam</u>

The cable landing site at Liu Ko Ngam is considered to have nil archaeological potential. Thus, no construction and operational phase impact is anticipated.

<u>Pak Sha Tau Tsui</u>

Given that the proposed electric pole and underground cable will be constructed along the surveyed locations, only direct impact to insignificant archaeological remains (secondary deposits) is anticipated during the construction phase. The potential archaeological impact due to the construction work of the Project is considered minimal and acceptable. Nevertheless, as a special find and some archaeological materials were found during the survey for this Project, it is recommended that prior to excavation works commence in Kat O Pak Sha Tau Site of Archaeological Interest, the project proponent shall notify AMO the commencement date of excavation work so that AMO could arrange site monitoring visits of the excavation work. In addition, during the excavation work in Kat O Pak Sha Tau Site of Archaeological Interest, AMO shall be notified in case of discovery of any antiquities or supposed antiquities. . No operational phase archaeological impact is identified.

4.10.4 Marine Archaeology

An assessment of the potential marine archaeological resources of the project area was concluded in 2010 by a professional marine archaeologist, Dr Bill Jeffery, based in a review of historical records, UK Wrecks database and the results of hydrographic and geophysical surveys of the proposed cable alignment (see *Annex D1*). The findings concluded that no marine archaeological features are identified and the construction and operation of the proposed submarine cable will therefore not cause any impacts on marine archaeological resources in the area.

4.11 OTHERS

Air Pollutant Emissions: Only a small quantity of air pollutant emissions (SO_2 PM_{10} 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 (ASRs). The nearest ASRs are Sai Lau Kong and Kat O Sheung Wai which are located over 500m and 1 km from the proposed cable landing points at Liu Ko Ngam and Pak Sha Tau Tsui respectively.

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 ENVIRONMENTAL PROTECTION MEASURES AND FURTHER IMPLICATIONS

5.1 ENVIRONMENTAL PROTECTION MEASURES

5.1.1 Construction Phase

Potential ecological impacts associated with the Project during the construction phase will likely to be disturbance of limited coastal vegetation which is also considered a landscape impact. With the low ecological value of the habitat and the very small area of this land that will be affected (<0.004% of this habitat in the Study Area), potential ecological disturbance caused by the Project and landscape impact is anticipated to be low. Further ecological and landscape disturbance could be minimised by implementation of good construction practices which are listed as follow:

- Avoid impact on trees during construction by preserving and protecting them;
- Fine-tune the alignment of the underground cable on-site so as to minimize the potential impacts to the existing vegetation and trees as far as possible;
- Avoid any damage and disturbance, particularly those caused by filling and illegal dumping, to the remaining and surrounding natural young woodland or shrubland habitats;
- Regularly check the works area boundaries to ensure that they are not breached and that no damage occurs to surrounding areas;
- Prohibit and prevent open fires within the site boundary during construction and provide temporary fire fighting equipment in the work areas; and
- Reinstate temporary work sites/disturbed areas, immediately after completion of the construction works.

During cable installation, the following mitigation measures to minimise the impacts, as well as the disturbance to the surrounding habitats and marine assemblages, are recommended.

- Employ a silt curtain around the shore-end works site in order to reduce the dispersion of sediments during the cable laying works. In order to avoid any impacts to the environment as well as the nearby marine life, the silt curtain should be decommissioned carefully and follow the following procedures: (1) ensure no obvious sediment plumes observed inside the silt curtain, (2) lift up the bottom of the silt curtain, and (3) decommission and drag the silt curtain out;

- Install a frame-type silt curtain/ screen on both sides of the water jetting burial machine/ tool in order to reduce the dispersion of sediments during the cable laying works; and

- To minimise impacts to the coral colonies (which is not considered unacceptable), translocating the potentially affected and movable (ie feasible for translocation) coral colonies within the area enclosed by the silt curtain at the landing sites is recommended.

In previous stage of assessment, potential terrestrial archaeological impact associated with the Project at the landing site at Pak Sha Tau Tsui was anticipated. A small scale archaeological survey has been recommended, which included at least three test pits (of size range from 1m x 1m to 2m x 1.5m). The recommended archaeological survey was conducted by the licenced archaeologist at the landing site at Pak Sha Tau Tsui from 17 July to 3 August 2012. Field scanning, seven (7) auger holes and three (3) test pits were conducted. An Archaeological Survey Report is prepared and attached as Annex D2 with the PP to present the findings of the archaeological survey. The potential archaeological impact due to the construction work of the Project is considered minimal and acceptable. Nevertheless, as a special find and some archaeological materials were found during the survey for this Project, it is recommended that prior to excavation works commence in Kat O Pak Sha Tau Site of Archaeological Interest, the project proponent shall notify AMO the commencement date of excavation work so that AMO could arrange site monitoring visits of the excavation work. In addition, during the excavation work in Kat O Pak Sha Tau Site of Archaeological Interest, AMO shall be notified in case of discovery of any antiquities or supposed antiquities.

In addition, specific measures have been proposed to minimize the impacts on water quality and marine ecology during the construction phase in *Annexes A & B1*), and no other environmental protection measures have been recommended as being necessary for this Project.

5.1.2 Operation Phase

The only impact from the Project during operation is anticipated to potentially be visual, from the new wooden electricity pole(s) that will be installed. The detail design of the electricity pole will mitigate for this as explained:

- Electricity pole(s) will be made from wood and treated as necessary (e.g. painted) to blend with the natural surrounding environment. They will also be the same or similar height to the electricity poles that already exists in the vicinity.

Since no further operational impact is anticipated due to the Project, no further environmental protection measures are required.

5.2 *POSSIBLE SEVERITY, DISTRIBUTION AND DURATION OF ENVIRONMENTAL EFFECTS*

The marine installation works for the submarine cable circuit are expected to take approximately 24 weeks. 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 circuit.

5.3 *CUMULATIVE IMPACTS*

At present there are no planned concurrent projects in vicinity of the proposed cable route, no cumulative impact is expected during the construction and operation of the Project.

5.4 *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 circuit, as described above, have been used around the world, and are widely accepted to have no impact on the surrounding environment. The working period is normally very short and no waste or contaminant disposal issues or excessive noise will be generated by such an operation.

6 *ENVIRONMENTAL MONITORING AND AUDIT*

Although no unacceptable environmental impacts have been identified, it is recommended to carry out water quality monitoring and coral monitoring to verify that the project works will not result in any impacts to water quality, marine ecology and fisheries. The EM&A requirements are discussed in *Annex E*.

7 USE OF PREVIOUSLY APPROVED EIA REPORTS

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

- *Proposed 132kV Submarine Cable Route for Airport "A" to Castle Peak Power Station Cable Circuit, CLP Power.* The Project Profile for this study was submitted to EPD on 18 Jul 2006 (AEP 267/2007). The approximate length of the cable in Hong Kong SAR waters was around 6.2 km. 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 29 March 2007 (EP-267/2007). The proposed methodology of the cable installation for this Project will be similar to this 132kV submarine cable circuit.

- *Asia Submarine-cable Express (ASE) – Tseung Kwan O, NTT Com Asia Limited.* The Project Profile for this study was submitted to EPD on 7 Oct 2011 (AEP-433/2011). The study concluded that there would be no adverse long term or cumulative effects/impacts to the environment and the Environmental Permit granted on 20 Dec 2011 (EP-433/2011).

- *South-East Asia Japan Cable System (SJC) Hong Kong Segment, China Telecom (Hong Kong) International Limited.* The Project Profile for this study was submitted to EPD on 22 Jun 2011 (AEP-423/2011). 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 Oct 2011 (EP-423/2011).

- *Asia-America Gateway (AAG) Cable Network, South Lantau, Reach Networks Hong Kong Ltd.* The Project Profile for this study was submitted to EPD on 5 Oct 2007 (AEP-298/2007). The study concluded that there would be no adverse long term or cumulative effects/impacts to the environment and the Environmental Permit granted on 20 Dec 2007 (EP-298/2007).

- *VSNL Intra Asia Submarine Cable System - Deep Water Bay, Videsh Sanchar Nigam Ltd.* The Project Profile for this study was submitted to EPD on 31 Aug 2007 (AEP-294/2007). The study concluded that there would be no adverse long term or cumulative effects/impacts to the environment and the Environmental Permit was granted on 23 Nov 2007 (EP-294/2007).

- *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).

- *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).

Annex A

Water Quality Assessment

A1 WATER QUALITY ASSESSMENT

A1.1 INTRODUCTION

This *Annex* presents an evaluation of the potential water quality impacts associated with the construction and operation of the 11kV submarine cable system. The cable will connect between Liu Ko Ngam and Pak Sha Tau Tsui. Mitigation measures are outlined where potential adverse impacts are identified.

A1.2 RELEVANT LEGISLATION, GUIDELINES & ASSESSMENT CRITERIA

The following legislation and relevant guidance or non-statutory guidelines are applicable to the evaluation of water quality impacts associated with the construction and operation of the Project.

- *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); and,*
- *Practice Note for Professional Persons, Construction Site Drainage (ProPECC PN1/94).*

A1.2.1 Water Pollution Control Ordinance

The *Water Pollution Control Ordinance (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 and landing sites for the proposed submarine cable system are located within the Mirs Bay WCZ. A summary of the WQOs for the Mirs Bay 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 11kV submarine cable system.

Table A1 Summary of Water Quality Objectives for Mirs Bay WCZ

Parameters	**Mirs Bay WCZ**
Dissolved Oxygen (DO)	> not less than 2 mg/L for 90%f samples (Bottom) > not less than 4 mg/L for 90%f samples (Depth-averaged)
Nutrients	Annual mean depth-averaged total inorganic nitrogen not to exceed 0.3 mg/L
Unionised Ammonia	Annual mean not to exceed 0.021 mg/L
E.coli	Annual geometric mean not to exceed 610 cfu/100mL (for Secondary Contact Recreation subzone and Fish Culture subzone)

Parameters	Mirs Bay WCZ
pH	To be in the range 6.5 - 8.5, change due to waste discharge not to exceed 0.2
Salinity	Change due to waste discharge not to be greater than ±10%
Temperature	Change due to waste discharge not to exceed 2°C due to waste discharge
Suspended Solids	Not to exceed 30% of the natural ambient level
Toxicants	Toxicants are not to be present at levels producing a significant toxic effect
Chlorophyll-*a*	No criteria established

A1.2.2 Technical Memorandum on Environmental Impact Assessment Process (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.

A1.2.3 Technical Memorandum for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters (TM-ICW)

All discharges during both the construction and operation phases of the proposed development are required to comply with the *Technical Memorandum Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters (TM-ICW)* issued under *Section 21* of the *WPCO*.

The *TM-ICW* defines acceptable discharge limits to different types of 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 specified discharge volumes. These are defined by the Environmental Protection Department (EPD) and are specified in licence conditions for any new discharge within a WCZ.

A1.2.4 Practice Note for Professional Persons, Construction Site Drainage

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 provide useful guidelines on water pollution associated with construction activities.

A1.2.5 Sediment Quality

Dredged sediments destined for marine disposal are classified according to a set of regulatory guidelines for designation of sediments (*Management of Dredged / Excavated Sediment, ETWBTC No. 34/2002*) issued by the Environment, Transport and Works Bureau (ETWB) in August 2002. These guidelines comprise a set of sediment quality criteria, which include organic pollutants and other toxic substances. The requirement for the marine disposal of sediment is specified in the *ETWBTC No. 34/2002* and *Works Branch Technical Circular No. 12/2000*. Marine disposal of dredged materials is controlled under the *Dumping at Sea Ordinance 1995*.

A1.3 BASELINE CONDITIONS

A1.3.1 *Water Quality*

Mirs Bay WCZ

The proposed submarine cable alignment is located within the Mirs Bay WCZ. There are two EPD routine water quality monitoring stations in the vicinity of the cable route. Recent water quality data for these stations, which were collected between 2007 and 2011 (1) and are the most up to date published data, are summarised in *Table A2.* The locations of the stations are shown in *Figure A1*.

Table A2 Summary of EPD Routine Water Quality Monitoring Data (2007 – 2011) for the Mirs Bay WCZ

WQ Parameter	**MM2 Kat O Hoi**	**MM7 Yang Chau Tong**
Temperature (°C)	23.5 (14.9 – 29.8)	23.4 (14.5 - 29.8)
Salinity	32.2 (30.0 – 33.6)	32.3 (30.3 - 33.5)
pH	8.1 (7.6 - 8.6)	8.1 (7.7 - 8.5)
Dissolved Oxygen – Depth-averaged (mg L^{-1})	6.8 (3.7 - 12.1)	6.5 (2.4 - 12.1)
Dissolved Oxygen - Bottom (mg L^{-1})	6.0 (1.2 - 11.5)	5.8 (0.2 - 11.6)
BOD_5 (mg L^{-1})	1.0 (0.2 - 2.6)	1.0 (0.3 - 2.2)
Suspended Solids (mg L^{-1})	2.3 (0.8 – 5.7)	1.8 (0.6 – 8.4)
Total Inorganic Nitrogen (mg/L)	0.07 (0.01 - 0.22)	0.06 (0.01 - 0.19)
Unionised Ammonia (mg L^{-1})	0.002 (0.001 – 0.008)	0.002 (0.001 - 0.007)
Chlorophyll-*a* (µg L^{-1})	4.3 (0.5 - 20.6)	3.8 (0.8 – 11.0)
Escherichia coli (cfu 100mL^{-1})	2 (1 - 670)	1 (1 - 23)

Notes:
1. Data presented are depth averaged calculated by taking the means of three depths, i.e. surface (S), mid-depth (M) and bottom (B), except as specified.
2. Data presented are annual arithmetic means except for *E. coli*, which are geometric means.
3. Data enclosed in brackets indicate the ranges regardless of the depths.
4. Data presented showed full compliance with the WQOs.

(1) EPD Marine Water Quality Data (2007 – 2011). [*http://epic.epd.gov.hk/ca/uid/marinehistorical/p/1*]. Accessed in May 2013.

Data collected between 2007 and 2011 indicated the compliance to the WQO for depth-averaged Dissolved Oxygen (DO) but with a wide variation. Data between 2007 and 2011 for bottom DO also displayed a wide variation. Non-compliance with WQO for bottom DO occurred in 2007 at both stations (MM2 and MM 7) but bottom DO stayed in compliance with WQO continuously from 2008 to 2011 at both stations. From 2007 to 2011, levels of nutrients (Total Inorganic Nitrogen/TIN) and Unionised Ammonia (UIA) all stayed in compliance with WQOs for TIN (0.3 mg/L) and UIA (0.021 mg/L) continuously. *E.coli* levels at both stations complied with WQO (610 cfu/100mL) between 2007 and 2011 although data at MM2 displayed a wide range. In addition, the levels of chlorophyll-*a* were stable in recent years which indicated that there was no significant increase in phytoplankton in the areas.

Water Quality of Marine Park

The Agriculture, Fisheries and Conservation Department (AFCD) commenced a routine water quality monitoring programme to collect baseline water quality data from existing and proposed Marine Parks/Marine Reserves in Hong Kong. The water quality monitoring results for the Yan Chau Tong Marine Park (2008 – 2012) (1) are summarised in *Table A3*.

Table A3 ***Summary of Water Quality in the Yan Chau Tong Marine Park (2008 – 2012)***

	Yan Chau Tong Marine Park		
WQ Parameter (Depth-averaged)	**Yan Chau Tong**	**Lai Chi Wo**	**Kau Ma Shek**
Temperature (°C)	23.1	23.6	23.6
Salinity (ppt)	32.4	32.3	32.3
pH	8.1	8.2	8.2
Dissolved Oxygen (mg/L)	6.6	6.7	6.9
BOD (mg/L)	1.4	1.7	1.7
Suspended Solids (mg/L)	11.4	13.7	14.2
Total Inorganic Nitrogen (mg/L)	0.102	0.103	0.103
Unionized Ammonia (mg/L)	0.002	0.003	0.003
Chlorophyll-*a* (µg/L)	2.7	5.1	4.0
E. coli (cfu/100 mL)	1	1	1

A1.3.2 Sediment Quality

EPD collects sediment quality data as part of the marine water quality monitoring programme. There are two EPD routine sediment quality monitoring stations in vicinity of the cable route. Sediment quality data for these stations are available for 2007 – 2011(2) and summarised in *Table A4*. Locations of these stations are shown in *Figure A1*.

(1) AFCD Marine Water Quality Data (2008 – 2012). [*http://www.afcd.gov.hk/english/country/cou_vis/cou_vis_mar/cou_vis_mar_mon/cou_vis_mar_mon_wat.html*]. Accessed in May 2013.

(2) EPD Sediment Quality Data (2007 – 2011). [*http://epic.epd.gov.hk/ca/uid/marinehistorical/p/1*]. Accessed in May 2013.

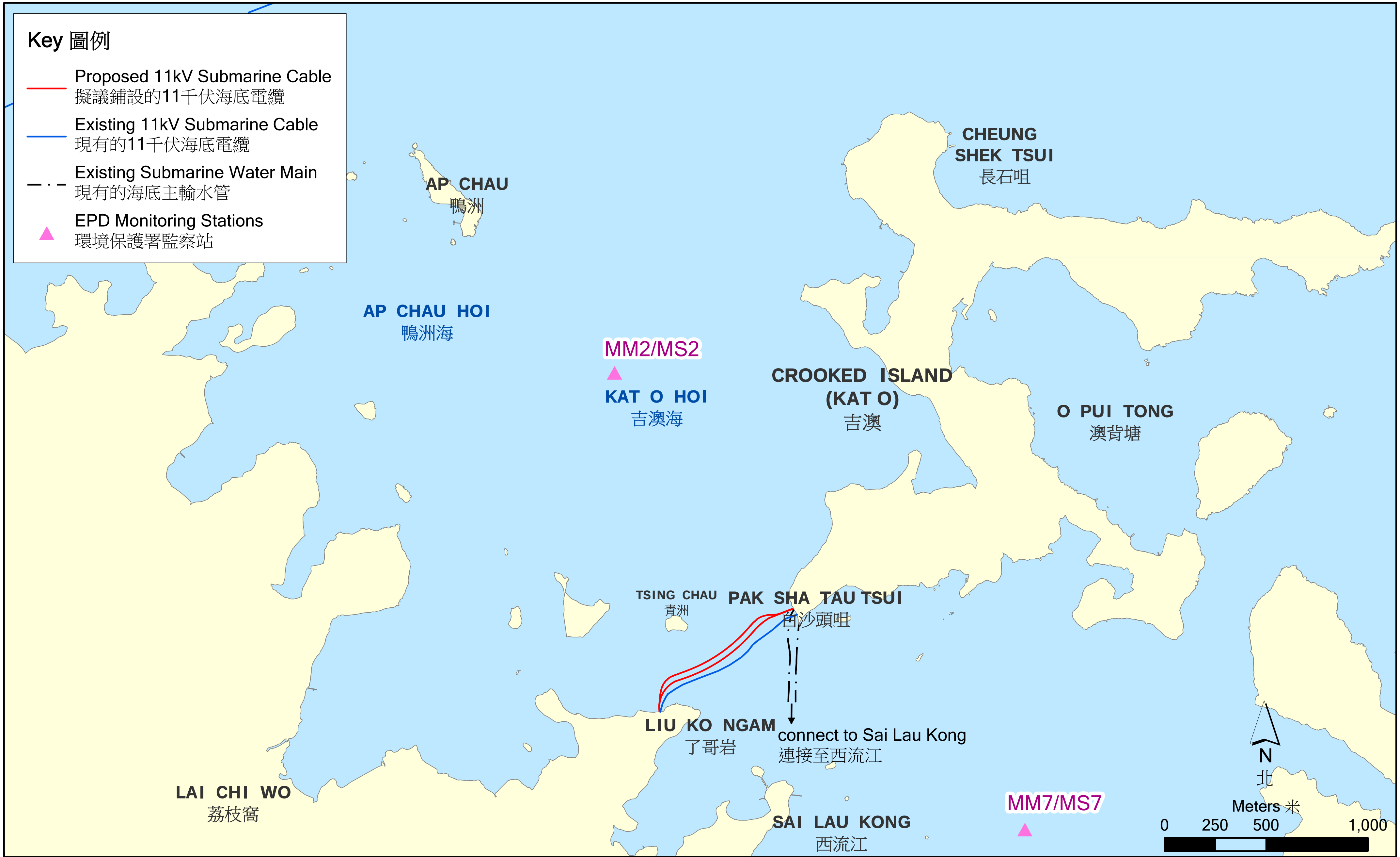

Figure A1
圖A1

Location of the Routine Water Quality and Sediment Monitoring Stations

例行水質及沉積物監察站位置圖

Environmental Resources Management

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Table A4 *Summary of Sediment Quality Monitoring Data (2007 – 2011) for the Mirs Bay WCZ*

SQ Parameter	MS2	MS7	Lower Chemical Exceedance Level (LCEL) (1)	Upper Chemical Exceedance Level (UCEL) (1)
COD (mg kg-1)	15200 (13000 - 17000)	16500 (13000 - 19000)	--	--
Total Carbon (%w/w)	0.6 (0.5-0.8)	0.7 (0.6 - 0.9)	--	--
Ammonia Nitrogen (mg kg-1)	9.9 (0.1-20.0)	9.5 (4.8 – 14.0)	--	--
TKN (mg kg-1)	557 (460-610)	598 (340 - 710)	--	--
Arsenic (mg kg-1)	7.1 (5.7 - 7.9)	6.7 (5.8 - 7.6)	12	42
Cadmium (mg kg-1)	0.3 (0.1 - 0.3)	0.2 (0.1-0.5)	1.5	4
Chromium (mg kg-1)	36 (33 - 39)	35 (31 - 39)	80	160
Copper (mg kg-1)	21 (14 - 23)	20 (16-26)	65	110
Lead (mg kg-1)	46 (39 - 51)	43 (38 - 48)	75	110
Mercury (mg kg-1)	0.06 (0.06 - 0.07)	0.07 (0.06 - 0.09)	0.5	1
Nickel (mg kg-1)	24 (21 - 25)	24 (22 - 27)	40	40
Silver (mg kg-1)	0.1 (0 - 1)	0 (0 - 0)	1	2
Zinc (mg kg-1)	104 (92 - 120)	101 (82 - 120)	200	270
Low Molecular Weight PAHs (2) (µg kg-1)	90 (90-100)	92 (90-160)	550	3160
High Molecular Weight PAHS (3) (µg kg-1)	37 (24-73)	57 (25-200)	1700	9600
Total PCBs (4) (µg kg-1)	18 (18 - 18)	18 (18 - 18)	23	180

Notes:

1. Sediment quality criteria for the classification of sediments under WBTC (W) No. 34 /2002.
2. Lower molecular weight PAHs include acenaphthene, acenaphthylene, anthracene, fluorene, naphthalene, and phenanthrene.

3. Higher molecular weight PAHs include Dibenzo(ah)anthracene, Benzo(k)fluoranthene, Chrysene, Pyrene, Indeno(1,2,3-cd)pyrene, Benzo(ghi)perylene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(a)anthracene, and Fluoranthene.
4. Total PCBs include 18 congeners: PCB 8, 18, 28, 44, 52, 66, 77, 101, 105, 118, 126, 128, 138, 153, 169, 170, 180, 187.
5. Data presented are arithmetic mean; ranges are enclosed in brackets.
6. All parameters are reported on a dry weight basis, unless otherwise stated.

The above data indicated that the sediment in vicinity of the proposed cable route was not contaminated based on the existing sediment classification guidelines.

A1.3.3 Water 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 fisheries and areas of ecological interest. The identified WSRs in these two categories, shown on *Figure A2*, are summarised as follows:

- **Fisheries:** Fish Culture Zones at Ap Chau, Kat O, O Pui Tong and Sai Lau Kong; Artificial Reefs at Yan Chau Tong Marine Park; Nursery Area of Commercial Fisheries Species

- **Sites of Ecological Interest:** Yau Chau Tong Marine Park; Seagrass at Lai Chi Wo in Yau Chau Tong Marine Park; Coral colonies of high ecological value at Tsing Chau, Ngau Shi Wu Wan and Lai Chi Wo North (details refer to *Annex B1*);

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

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

ID	Water Quality Sensitive Receivers	Approximate Distance to Proposed Cable Circuit (m)
A1	Artificial Reef at Yan Chau Tong Marine Park	1,000
F1	Fish Culture Zone at Sai Lau Kong	510 (distance include areas blocked by headland; if just consider direct route in the sea, the nearest distance will be ~560m)
F2	Fish Culture Zone at O Pui Tong	1,700
F3	Fish Culture Zone at Kat O	1,800
F4	Fish Culture Zone at Ap Chau	2,500
F5	Spawning ground/Nursery Area of commercial fisheries resources	Immediate vicinity
E1	Yau Chau Tong Marine Park	430 (distance include areas blocked by headland; if just consider direct route in the sea, the nearest distance will be ~570m)
E2	Seagrass at Lai Chi Wo	1,500
E3	Lai Chi Wo Beach Site of Special Scientific Site	1,500
E4	Coral colonies of high ecological value at Tsing Chau, Ngau Shi Wu Wan and Lai Chi Wo North	220, 250 and 1,400

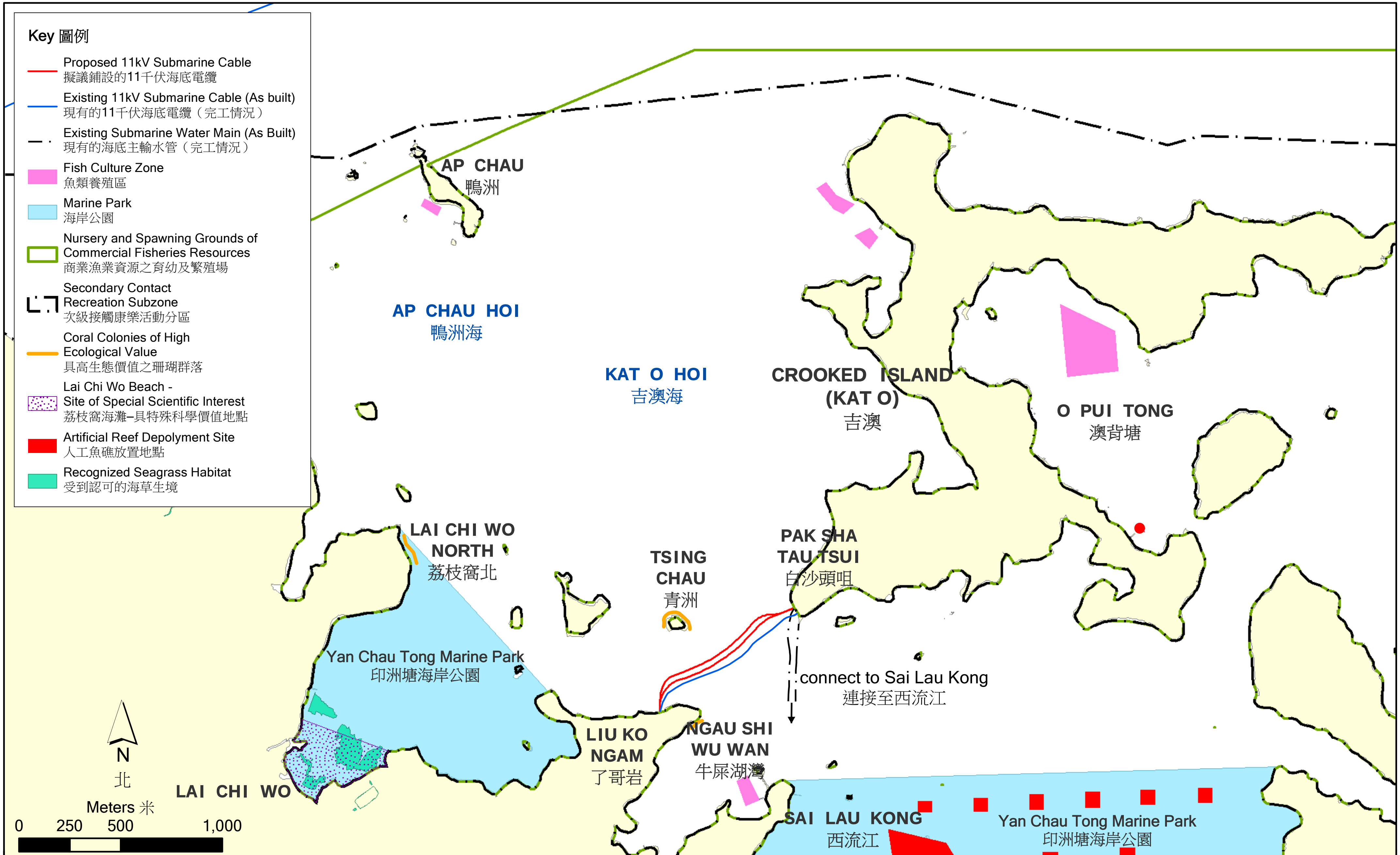

Figure A2
圖A2

Location of Water Quality Sensitive Receivers

水質敏感受體位置圖

Environmental Resources Management

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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.

A1.4 *IMPACT ASSESSMENT*

The potential water quality impacts associated with the construction and operation of the proposed 11kV submarine cable system are described below.

A1.4.1 ***Construction Phase***

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 have 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:

- Asia Submarine-cable Express (ASE) - Tseung Kwan O (AEP-433/2011). Environmental Permit granted on 20 December 2011 (EP-433/2011).

- *Proposed 132kV Submarine Cable Route for Airport "A" to Castle Peak Power Station Cable Circuit, CLP Power* (AEP 267/2007). Environmental Permit granted on 29 March 2007 (EP-267/2007).

- *VSNL Intra Asia Submarine Cable System - Deep Water Bay, Videsh Sanchar Nigam Ltd* (AEP-294/2007). Environmental Permit granted on 23 Nov 2007 (EP-294/2007).

- *132kV Cable Circuits from Cable Circuits from Ma Oh Shan to Pak Shek Kok, CLP Power.* Gazetted under Foreshore Seabed (Reclamation) Ordinance in 2007.

- *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 jetting machine deployed from a lay barge. The two submarine cables laying by jetting machine will be conducted one after one. The jetting machine utilises water injection jets to fluidise the seabed sediments, which enables the machine 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 jetting machine. 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 followed by backfilling with the excavated materials.

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, assumption of worst case scenario) 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 jetting machine)

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.

Further to the experience of previous submarine cable laying works, 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 speeds at the seabed are lower than those near the water surface, due to such effects as bottom friction. In addition, the current speed is generally very low (below 0.3 m s^{-1}) (1) in the area. For the purposes of the assessment it is assumed that the current velocity is 0.3 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 sediment plume. 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 water 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 = 0.3 m s^{-1}

height of sediment = 1 m

width of sediment = 6 m

(1) Tidal Stream Atlas (2006). Hydrographic Office, Marine Department, HKSAR.

Initial Concentration = 7.33 kg m^{-3}

Typically the settling velocity of SS is determined by examining the relationship between SS initial concentrations and the cohesive nature of the sediment being disturbed. This in Hong Kong typically that as SS concentration increases so will settling velocity as sediment particles flocculate, gain mass and settle faster. However, this relationship does not hold true when initial concentrations exceed values such as 1 kg m^{-3} [(1)]. As the predicted initial concentration exceeds this value for this project, a more conservative settling velocity of 10 mms^{-1} has been adopted.

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 **5.0 mm s^{-1}**. This is the same approach as was adopted in the EIA for the gas pipeline serving the Lamma Power Station Extension [(2)].

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 /0.005 m s^{-1} **= 200 s**

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

Distance Travelled **=** 200 s x 0.3 m s^{-1} **= 60 m**

The above calculation indicates that the sediments disturbed during laying of the cable will settle onto the sea bed within approximately **60 m** of the cable alignment.

Dredging Works at Shore Ends

Due to the shallow water depth, cable burial will be undertaken by rock cutting at coral zone and excavation of a trench using a grab dredger outside the coral zone (with a size of approximately 3 m^3) at both shore ends of Liu Ko Ngam and Pak Sha Tau Tsui. The cable within the trench will be placed by divers, backfilling with clean sand over the cable once it is in place. The materials to be excavated at the landing sites are expected to be fine materials and the quantity will be small (approximately 800 m^3). During dredging a portion of the fine sediments will be lost to suspension to the surrounding marine waters.

For predicting the near field behaviour of sediments disturbed during the dredging operations, a similar approach has been taken which was applied to

(1) Hydraulics Research (1988) Estuarine Muds Manual.

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

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

Settling Velocity (W)

In the modelling of sediment plumes from the construction of the WDII reclamations (4) 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)

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(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.

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

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 (1). 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 grab dredger working at a maximum rate of 300 m^3 day^{-1} at each site over a 10-hour working day. In a study assessing the impacts of dredging areas of Kellett Bank for mooring buoys (2) it was determined that a representative loss rate for grab dredgers working in areas 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 **0.142 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***

(1) ERM (2000). *Ibid*.

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

Distance from Source	**Both Liu Ko Ngam and Pak Sha Tau Tsui (Grab Dredging)**
	Concentration (mg L^{-1})
10	160
20	80
40	40
80	20
100	16
200	8
300	5
400	4
500	3
1000	1
2000	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 [(1)] 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*.

(1) Maunsell Consultants Asia Ltd (1995). *Op cit*.

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

Distance from Source (m)	Both Liu Ko Ngam and Pak Sha Tau Tsui (Grab Dredging)
	Concentration (mg L^{-1})
10	40
20	20
40	10
80	5
100	4
200	2
300	1
400	1
500	1
1000	0
2000	0

Note:
The mean depth-averaged values of data gathered at EPD monitoring stations MM2 and MM7 during the period of 2005 - 2010 were calculated as 2.7 mg L^{-1} and 2.0 mg L^{-1}, respectively.

Based on the results presented above, SS elevation due to the dredging operations is localised. It should be noted that rock cutting will only generate minimal and localised impact on water quality.

A1.4.2 *Potential Impact Identification*

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

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 only 60 m which is considered to be very small and away from the sensitive receives. 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 3 mg L^{-1} will only occur within 100 m of the dredging operation at the shore ends. Impacts to the water quality associated with the dredging work will be of short duration and of low concentration.

Relatively small SS elevation (<2 mg L^{-1}) is predicted to occur at the closest WSR at Ngau Shi Wu Wan which is over 250 m from the Niu Ko Ngam landing site. Tsing Chau is located approximately 220 m from the cable alignment, but approximately 400 m and 520 m from the Niu Ko Ngam and Pak Sha Tau Tsui landing sites respectively. It is expected that the SS elevation at the other WSRs would be much lower, which is considered to be negligible. Impacts to the water quality associated with the dredging work will be of short duration, resulting in negligible SS elevation and complying with the WQO.

In comparison to the situation without silt curtain deployment during the dredging, the increase in SS concentration in excess of more than 3 mgL^{-1} will extend up to 500 m from the works area at the shore ends of Liu Ko Ngam and Pak Sha Tau Tsui. It was shown that deploying a silt curtain around the dredging areas can effectively reduce the SS elevations to more environmentally acceptable levels and minimise the extent of sediment plume dispersion.

Based on the results, it is thus expected that the elevation of SS would not cause unacceptable impacts to those remote WSRs.

A1.4.3 Operation 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.

Hence, no mitigation measures for the cable system during the operational phase are considered necessary.

A1.5 MITIGATION MEASURES DURING CABLE LAYING

During cable laying the following will be undertaken.

- Although the sediment loss during grab 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 sites (see *Figure A3* for indicative design).

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

- 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.

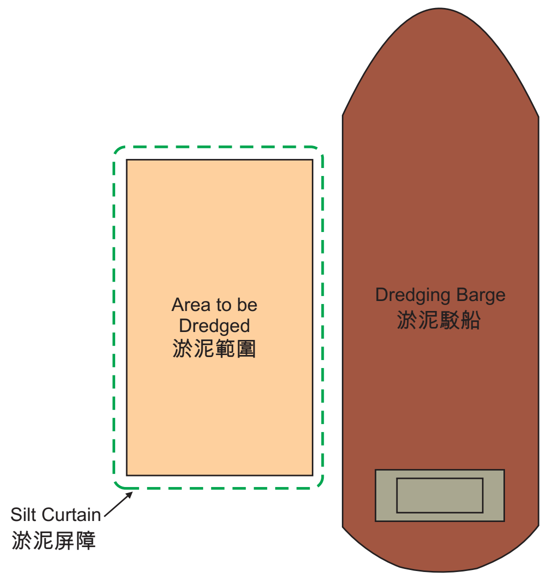
- The forward speed of the jetting machine should be limited to a maximum of 80 m hr^{-1} and normal working hours (7am – 7pm) operation.

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.

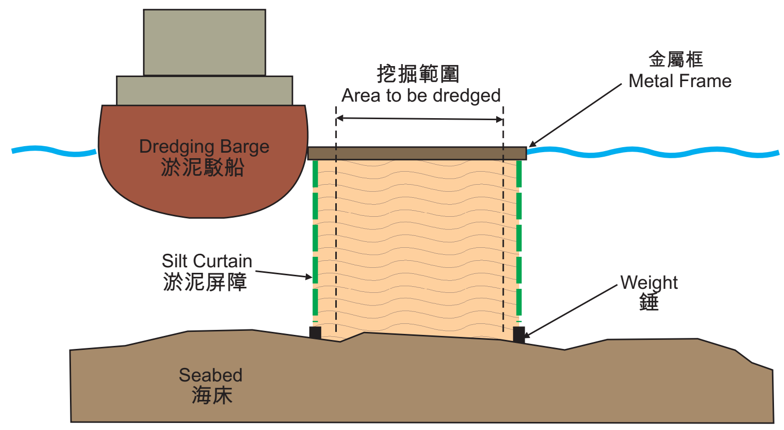
A1.6 *CONCLUSIONS*

A review and assessment of sediment dispersion impacts associated with dredging works at the approach to both shore ends, ie Liu Ko Ngam and Pak Sha Tau Tsui, 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 220 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 60 m of the cable alignment. The result of a sediment plume dispersion calculation suggests that grab dredging at the shore ends is expected to result in negligible SS elevation of less than 3 mg L^{-1} at the closest water sensitive receiver, with adoption of silt curtain around the grab dredger. A silt curtain has been demonstrated as effective in reducing the extent of sediment dispersion. Due to the remoteness of most water quality sensitive receivers from the cable laying and dredging works and short duration of working period, they are unlikely to be affected by changes in water quality within the assessment area and are likely to comply with the WQO.



(a) Cage Type Silt Curtain Arrangement for Grab Dredging
登岸地點的淤泥屏障布置



(b) Cross-secton of Cage Type Silt Curtain Arrangment
淤泥屏障布置的橫切面

Figure A3
圖 A3

Indicative Arrangement of Cage Type Silt Curtain
淤泥屏障的布置示意圖

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Annex B

Marine Ecology Assessment

Annex B1

Marine Ecology Assessment

B1 MARINE ECOLOGY ASSESSMENT

B1.1 INTRODUCTION

This *Annex* presents the baseline conditions of marine ecological resources in the vicinity of the proposed submarine cable alignment and landing points as well as results of the assessment of the potential ecological impacts from the construction and operation of the cable system. Baseline conditions for each ecological component in vicinity of the proposed cable system are evaluated based on information from the literature and recent field verification conducted for the purposes of this assessment. Measures required to mitigate identified adverse impacts are recommended, where appropriate.

B1.2 RELEVANT LEGISLATION, GUIDELINES & ASSESSMENT CRITERIA

The criteria for evaluating marine ecological impacts are laid out in the *EIAO-TM Annex 16* of the *EIAO TM* sets out the general approach and methodology for the assessment of impacts to marine ecological resources 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.

B1.3 LITERATURE REVIEW

Baseline conditions of the marine ecological resources in this report have been derived from the literature review. The literature review included Government and private sector reports, independent and Government published literature as listed below:

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

- Shin PKS and Cheung SG (2005) *A Study of Soft Shore Habitats in Hong Kong for Conservation and Education Purposes* (Final Report) ECF Project 23/99 City University of Hong Kong.

- Morton B and Morton J (1983) The Sea Shore Ecology of Hong Kong. HKU Press.

- Morton B, Williams G and Lee SY (1996) The benthic marine ecology of Hong Kong: A dwindling heritage? In *Coastal Infrastructure Development in Hong Kong: A Review.* Hong Kong Government Press, Hong Kong. pp. 233-267.

- Morton B (2003) Marine Protected Areas in Hong Kong: Progress towards Coastal Zone Management (1977-2002) In *Perspectives on Marine*

Environmental Change in Hong Kong and Southern China 1997-2001 (ed. B Morton), Hong Kong 2001, HKU Press, pp. 797-824.

- DeVantier L and McCorry D (2002) Corals and Coral Communities of Hong Kong. Ecological Values and Status 2001-02. Underwater Survey in Coastal Waters of Hong Kong. Final Report to Agriculture, Fisheries and Conservation Department.

The purpose of the literature review is to obtain adequate data to allow accurate prediction of the project's likely impacts upon ecological resources, and any areas/ habitats identified as having special conservation interest.

B1.3.1 Yan Chau Tong Marine Park

The Yan Chau Tong Marine Park (Lai Chi Wo portion) is located within 500m from the proposed cable route. The Marine Park is designated to protect the diverse marine life and the ecologically important habitats including seagrass in Lai Chi Wo, which are over 1.5km away from the proposed cable landing sites or the cable alignment.

B1.3.2 Subtidal Soft Bottom Assemblages

Information on the subtidal soft bottom assemblages in the vicinity of the proposed cable corridor is available from the *Consultancy Study on Marine Benthic Communities in Hong Kong* (1). Yan Chau Tong sampling station (station 110) is close to the proposed area of works and data extracted from them can be considered to be representative of the assemblages within the proposed cable corridor.

According to the findings of the *Consultancy Study*, the substratum of the two sampling stations is covered by very fine sand and/or silt. Their benthic assemblages are typical of Hong Kong waters and similar to benthic assemblages in majority of other subtidal habitats in Hong Kong. In both summer and winter surveys, Yan Chau Tong (station 110) had very low species and individual number, and biomass: summer (species 2 per $0.5m^2$, individuals 16 m^{-2}, biomass 0.16 g m^{-2}) and winter (species 5 m^{-2}, individuals 24 m^{-2}, biomass 0.24 g m^{-2}), in comparison with the average values of benthic assemblages in Hong Kong (34 species per 0.5 m^2, 450 individuals per m^2 and 28 g per m^2). Species dominant in both summer and winter surveys was the polychaete *Sigambra hanaokai*. Other species present in the summer included the bivalve *Anisocorbula crassa*, and in the winter the polychaetes *Otopsis* sp., *Paraprionospio pinnata* and *Prionospio* sp., and the phoronid *Phoronis australis*.

Concerning the species diversity in summer and winter, both of them show low diversity <2), in comparison to other survey areas. In both seasons, no species of conservation concern were found in both stations along the proposed cable corridor.

(1) CityU Professional Services Limited (2002). Consultancy Study on Marine Benthic Communities in Hong Kong (Agreement No. CE 69/2000). Final Report submitted to AFCD.

B1.3.3 *Marine Ecological Conditions of Liu Ko Ngam and Pak Sha Tau Tsui*

As revealed by the literature review, there is limited information on the marine ecological resources within the Study Area, in particular at Liu Ko Ngam and Pak Sha Tau Tsui, available.

To fill these information gaps for the baseline marine ecological conditions, quantitative intertidal and subtidal dive surveys were carried out within the Study Area.

B1.4 BASELINE INTERTIDAL SURVEYS

Intertidal marine ecological survey was carried out to gather baseline information of the marine ecological resources within the Study area. Field survey was conducted on the intertidal shores at both landing sites in 2010 and updated surveys were conducted in 2012.

B1.4.1 *Survey Methods*

A combination of qualitative and quantitative techniques was used. Qualitative spot checks were conducted on the intertidal habitats by recording the occurrence of species from visual reconnaissance surveys at three shore heights: 2 m (high-shore), 1.5 m (mid-shore) and 1 m (low-shore) above Chart Datum (CD). Organisms encountered were recorded and their relative abundance noted.

For quantitative transect surveys, at each of the two survey locations, three 50 m horizontal (belt) transects (T1 – T3 and T4 – T6) along the shore were surveyed at each of the three shore heights: 2 m (high-shore), 1.5 m (mid-shore) and 1 m (low-shore) above CD (see *Figure B1* for survey transect). On each transect, five quadrats (50 cm x 50 cm) were placed randomly to assess the abundance and diversity of flora and fauna (Σn = 5 quadrats x 3 transects x 3 heights = 90). For the sandy shores at Pak Sha Tau Tsui (T4 and T5), sediment (volume of each quadrat = 50 cm x 50 cm x 20 cm = 62,500 cm^3) was wet-sieved *in situ* (mesh size of 2 mm) to obtain all mobile organisms living on, or in, the sediment within each quadrat.

All organisms found in each quadrat were identified and recorded to the lowest possible taxonomic level to allow density per quadrat to be calculated. Sessile species, such as algae (encrusting, foliose and filamentous), barnacles and oysters, in each quadrat were also identified and estimated as percentage cover on the rock surface using a double-strung, 50 cm x 50 cm quadrat.

B1.4.2 *Intertidal Soft Bottom & Hard Bottom Assemblages*

From the literature review, there is no existing information on the intertidal sandy shore and rocky shore assemblages in the vicinity of the proposed cable landing sites.

The following presents the results from the baseline field surveys conducted for this study. A list of organisms encountered during the qualitative spot checks and their relative abundances, as well as the results of the quantitative transect surveys at Liu Ko Ngam and Pak Sha Tau Tsui are provided from *Tables B1 to B4.* Representative photos of the intertidal habitats surveys at Liu Ko Ngam and Pak Sha Tau Tsui are shown in *Figure B1*.

Liu Ko Ngam

The survey location at Liu Ko Ngam consists of narrow, gently sloping boulder shores (or named as cobble beach) and exhibited a low diversity of species. A total of 21 intertidal species were recorded during the survey. These species are all very common and widespread species on boulder shores of Hong Kong.

Dominant (in terms of abundance) organisms recorded included the littorinid snails *Echinolittorina radiata* and *E. malaccana* in the high-shore, the topshell *Monodonta labio* and the rock oyster *Saccostrea cucullata* in the mid-shore , and the turban shell *Lunella coronata* and the nerite *Nerita albicilla* in the low-shore (*Tables B1 & B2*). Both the abundance/ density of mobile species and percentage cover of sessile fauna were considered to be low (49 individuals m^{-2} and 32.5 % m^{-2} respectively).

Table B1 ***Relative Abundance of Intertidal Biota Recorded at Liu Ko Ngam***

Group	Species	Relative Abundance		
		High-shore	**Mid-shore**	**Low-shore**
Bivalve	*Isognomon* sp.	0	1	0
Bivalve	*Septifer virgatus*	0	0	1
Chiton	*Acanthopleura japonica*	0	1	0
Limpet	*Patelloida pygmaea*	0	1	1
Limpet	*Nipponacmea concinna*	0	0	1
Snail	*Clypeomorus batillariaeformis*	0	1	1
Snail	*Echinolittorina malaccana*	3	0	0
Snail	*Echinolittorina radiata*	3	0	0
Snail	*Lunella coronata*	0	1	3
Snail	*Monodonta labio*	1	2	2
Snail	*Morula musiva*	0	1	2
Snail	*Nerita albicilla*	1	1	2
Snail	*Planaxis sulcatus*	0	1	0
Crab	*Gaetice depressus*	1	1	2
Crab	*Epixanthus frontalis*	0	0	1
Crab	*Metapograpsus frontalis*	0	0	1
Sea Slater	*Ligia exotica*	2	1	0
Barnacle (%)	*Capitulum mitella*	0	1	0
Barnacle (%)	*Tetraclita* spp.	0	1	0
Rock Oyster (%)	*Saccostrea cucullata*	0	3	2
Algae (%)	Encrusting corallines	0	0	1
Algae (%)	*Kyrtuthrix maculans*	2	1	0

Relative Abundance of species: 0 = Not Present; 1 = Uncommon within Transect; 2 = Common within Transect; 3 = Very Common within Transect

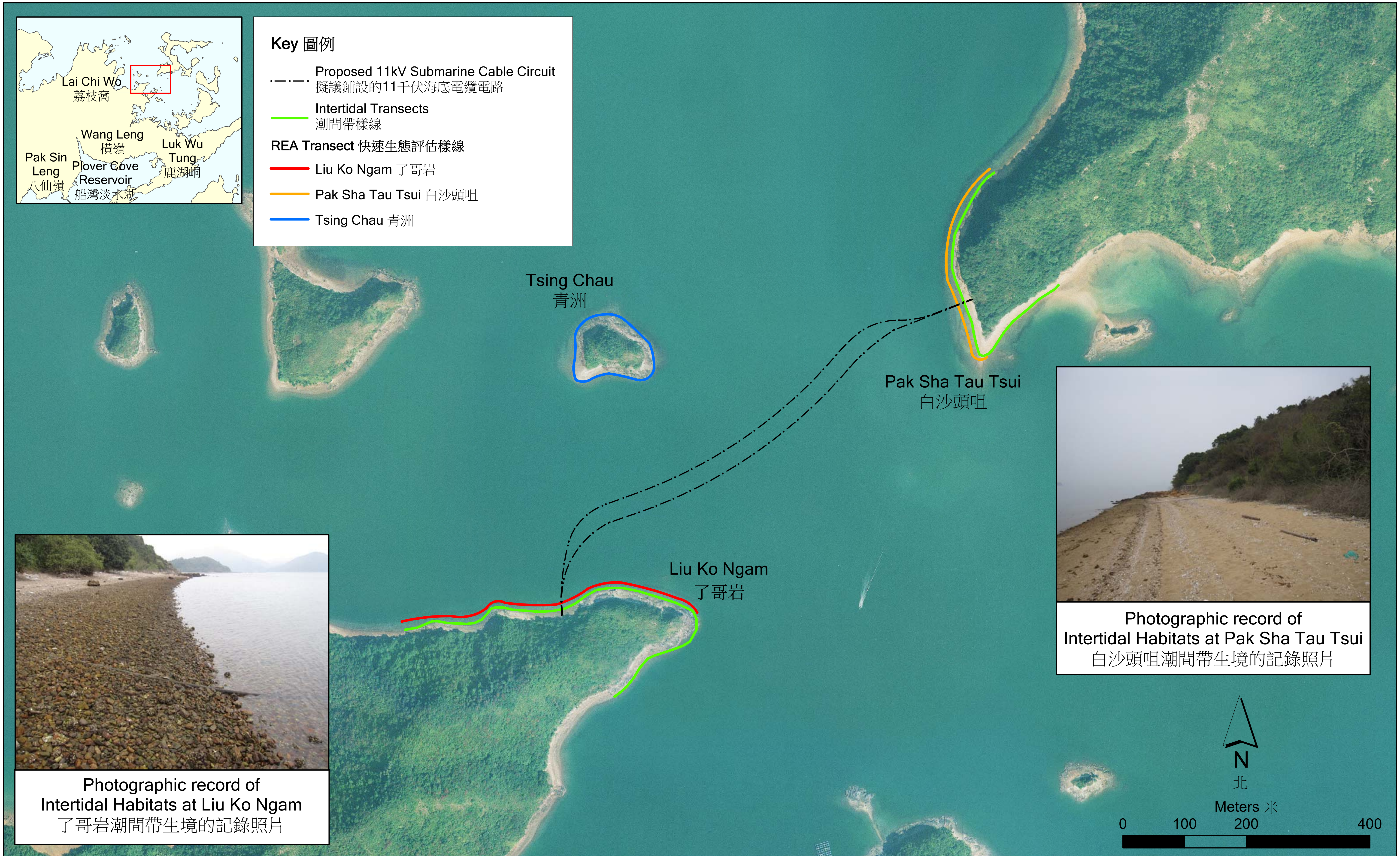

Figure B1
圖B1

Intertidal and Dive Survey Sites

潮間帶及潛水調查地點

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Table B2 ***Mean Density (m^{-2}) of Intertidal Fauna and Mean Percentage Cover (%) of Sessile Fauna and Flora recorded along Transects T1 to T3 at Liu Ko Ngam during the Field Survey***

		Relative Abundance								
		T1			T2			T3		
Group	**Species**	**H**	**M**	**L**	**H**	**M**	**L**	**H**	**M**	**L**
Chiton	*Acanthopleura japonica*	0	0	0	0	0.8	0	0	0	0
Limpet	*Patelloida pygmaea*	0	0	0	0	0	1.6	0	1.6	4.8
Snail	*Clypeomorus batillariaeformis*	0	0	0	0	0	3.2	0	8	12.8
Snail	*Echinolittorina malaccana*	35.2	0	0	37.6	0	0	0	0	0
Snail	*Echinolittorina radiata*	25.6	0	0	37.6	0	0	0	0	0
Snail	*Lunella coronata*	0	0	0	0	1.6	16.8	0	6.4	42.4
Snail	*Monodonta labio*	0.8	16	20	0	2.4	7.2	0.8	11.2	32
Snail	*Morula musiva*	0	0	0	0	0	8.8	0	0.8	3.2
Snail	*Nerita albicilla*	0.8	11.2	15.2	0.8	4	2.4	0	12.8	16
Snail	*Planaxis sulcatus*	0	1.6	1.6	0	4	0	0	0.8	0
Bivalve	*Septifer virgatus*	0	0	0	0	0	0.8	0	0	0
Crab	*Hemigrapsus sanguineus*	0.8	0	0	0	0.8	1.6	0	1.6	4
Crab	*Metapograpsus frontalis*	0	0	0	0	0	0.8	0	0	0.8
Barnacle (%)	*Tetraclita* spp.	0	0.8	0	0	0	0	0	0	0
Rock Oyster (%)	*Saccostrea cucullata*	0	9.6	16.8	0	60	80	0	64	0.8
Algae (%)	*Kyrtuthrix maculans*	36	16	16	8	32	0	16	0	0
Algae (%)	Encrusting corallines	0	0	0	0	0	2.4	0	0	0

Pak Sha Tau Tsui

The survey location at Pak Sha Tau Tsui consists of narrow steeply sloping sandy shores on the southwestern tip of the Kat O Island and a boulder shore to the north of the sandy shores. The intertidal habitats exhibited a low diversity of species. A total of 21 species were recorded during the survey. These species are all very common and widespread species on both sandy and boulder shores of Hong Kong.

For the sandy shores (i.e. T4 & T5), the bivalves *Atactodea striata* were the dominant (in terms of abundance) infauna recorded during the survey. The planaxid snails *Planaxis sulcatus* and the rock oyster *Saccostrea cucullata* were dominant in the mid-shore while the turban shell *Lunella coronata* were dominant in the low-shore on the boulder shore at Pak Sha Tau Tsui (*Tables 4.3 & 4.4*). Both the abundance/ density of mobile species and percentage cover of sessile fauna on the sandy and boulder shores were considered to be low (sandy shore: 29.3 individuals m^{-3}; boulder shore: 28.5 individuals m^{-2} and 32.3 % m^{-2} respectively).

Table B3 *Relative Abundance of Intertidal Biota Recorded at Pak Sha Tau Tsui*

Group	Species	Relative Abundance		
		High-shore	Mid-shore	Low-shore
Bivalve	*Atactodea striata*	1	2	2
Bivalve	*Donax* sp.	0	1	0
Bivalve	*Septifer virgatus*	1	0	0
Limpet	*Patelloida pygmaea*	0	1	1
Limpet	*Siphonaria japonica*	0	1	0
Snail	*Clypeomorus batillariaeformis*	1	1	1
Snail	*Echinolittorina malaccana*	1	0	0
Snail	*Echinolittorina radiata*	1	0	0
Snail	*Lunella coronata*	0	1	2
Snail	*Morula musiva*	0	1	1
Snail	*Nerita albicilla*	0	1	1
Snail	*Planaxis sulcatus*	0	2	1
Crab	*Gaetice depressus*	0	0	2
Crab	*Ocypode* sp.	1	0	0
Sea Slater	*Ligia exotica*	1	0	0
Sea Anemone	*Anthopleura* sp.	0	1	2
Barnacle (%)	*Balanus amphitrite*	1	0	0
Barnacle (%)	*Tetraclita* spp.	1	0	0
Rock Oyster (%)	*Saccostrea cucullata*	0	3	3
Algae (%)	Encrusting corallines	0	0	1
Algae (%)	*Hildenbrandia rubra*	0	0	1

Relative Abundance of species: 0 = Not Present; 1 = Uncommon within Transect; 2 = Common within Transect; 3 = Very Common within Transect

Table B4 *Mean Density (m^{-3} for T4 & T5, m^{-2} for T6) of Intertidal Fauna and Mean Percentage Cover (%) of Sessile Fauna and Flora recorded along Transects T4 to T6 at Pak Sha Tau Tsui during the Field Survey*

Group	Species	Relative Abundance								
		T4			T5			T6		
		H	M	L	H	M	L	H	M	L
Limpet	*Patelloida pygmaea*	0	0	0	0	0	0	0	2.4	1.6
Limpet	*Siphonaria japonica*	0	0	0	0	0	0	0	2.4	0
Snail	*Echinolittorina malaccana*	0	0	0	0	0	0	0.8	0	0
Snail	*Echinolittorina radiata*	0	0	0	0	0	0	0.8	0	0
Snail	*Lunella coronata*	0	0	0	0	0	0	0	11.2	19.2
Snail	*Nerita albicilla*	0	0	9.6	0	0	0	0	2.4	0
Snail	*Morula musiva*	0	0	0	0	0	0	0	2.4	3.2
Snail	*Thais clavigera*	0	0	0	0	0	0	0	0	0
Snail	*Planaxis sulcatus*	0	0	0	0	0	0	0	31.2	4.8
Snail	*Clypeomorus batillariaeformis*	0	0	0	0	0	0	0	0	0.8
Bivalve	*Septifer virgatus*	0	0	0	0	0	0	0.8	0	0
Bivalve	*Atactodea striata*	6.4	86.4	48	0	0	19.2	0	0	0
Bivalve	*Donax* sp.	0	6.4	0	0	0	0	0	0	0
Crab	*Gaetice depressus*	0	0	0	0	0	0	0	0	1.6
Sea anemone	*Anthopleura* sp.	0	0	0	0	0	0	0	2	9.4
Barnacle (%)	*Tetraclita* spp.	0	0	0	0	0	0	0.6	0	0

		Relative Abundance								
		T4			T5			T6		
Group	Species	H	M	L	H	M	L	H	M	L
Rock Oyster (%)	*Saccostrea cucullata*	0	0	0	0	0	0	0	53	27
Algae (%)	*Hildenbrandia rubra*	0	0	0	0	0	0	0	0	5

B1.4.3 *Ecological Significance of Potentially Affected Intertidal Shores*

The assemblages present on the intertidal shores at the the proposed cable landing sites at Liu Ko Ngam and Pak Sha Tau Tsui were of similar composition and abundance to other sheltered boulder shores and sandy shores in Hong Kong. None of the species recorded can be considered as rare and none are of recognised conservation value.

B1.5 BASELINE SUBTIDAL DIVE SURVEYS

It is noted that the well know areas of coral communities of high ecological concern found within Crooked Habour (Kat O Hoi) include Ngau Shi Wu Wan (of coral coverage about 59%) and Lai Chi Wo North (of coral coverage about 47.5%), these two sites are identified as Reef Check Sites and being monitored annually (1) (location refer to *Figure A1*). However, there was limited information on coral assemblages in the vicinity of the proposed cable landing sites, as well as the proposed cable route. To fill these information gaps, subtidal dive surveys were carried out within the Study Area.

Subtidal dive surveys were undertaken in two stages. For the Stage 1 survey, Rapid Ecological Assessment (REA) was employed as a semi-quantitative survey technique to assess the benthic communities along the coastline of the proposed cable landing points at Pak Sha Tau and Liu Ko Ngam (*Figure B1*). Qualitative spot dive checking survey was also carried out along selected points of the proposed cable alignment where potential hard substrates were identified by the geophysical survey. These potential hard substrates are areas in which corals are likely to be developed on. The objective of the dive survey is to identify subtidal marine ecological sensitive receivers, particularly the presence of any coral communities, for the landing points and along the alignment of the proposed 11kV submarine cable circuit. Information collected was used to adjust the cable landing locations and alignment to avoid dense coral areas in order to minimize permanent loss of corals within the working corridor, which is an area of 2.5 m from the centreline of the two cables. For the following Stage 2 survey, detailed coral mapping was conducted within the working corridor at the two landing points after adjustment of the landing locations based on results of the Stage 1 survey. During the mapping exercise, locations of corals within the working corridor were recorded at the landing sites as far as practicable which will be used for quantifying the impacts to corals, particularly direct impacts from cable landing which will lead to permanent loss of corals. Feasibility of translocation of corals to a suitable recipient site which is not anticipated to be

(1) http://www.afcd.gov.hk/english/conservation/con_mar/con_mar_cor/con_mar_cor_hkrc/con_mar_cor_hkrc.html.

affected by the cable laying works was also assessed. Methodology and detail results of the dive surveys are presented below.

B1.5.1 Stage 1 - Semi-Quantitative Subtidal Dive Survey

For the first stage subtidal dive survey, a standardised semi-quantitative Rapid Ecological Assessment (REA) survey technique was used to assess the benthic communities along the coastline of the proposed cable landing points (*Figure B1*). The objective of the dive survey is to collect information on subtidal marine ecological sensitive receivers, particularly coral communities, for the adjustment of locations of proposed landing of the proposed 11kV submarine cable circuit. The surveys were undertaken in 2010 and 2011. Methodology and results of the surveys are presented below.

Methodology

The REA technique is now one of the standard practices for EIA marine baseline surveys in Hong Kong and has been modified from the standardized REA survey technique established for the assessment of coral communities on the Great Barrier Reef (1) for the marine environment of Hong Kong (2).

At each survey area, the REA survey was conducted along a survey transect which was parallel to the shoreline in the water depth range of 0 to -5 m CD. This depth zone represents the region in which most hard corals are typically found and isolated, small size colonies were occasionally recorded at greater depth (ie > -5 m CD). The REA methodology encompasses an assessment of the benthic cover (Tier I) and taxon abundance (Tier II) undertaken in a swathe ~ 4 m wide, 2 m either side of each transect (though is will adjusted for the underwater conditions encountered and may possibly be reduced). An explanation of the two assessment categories (Tiers) used in the survey are presented below.

<u>Tier I - Categorisation of Benthic Cover</u>

Upon the completion of each survey transect, five ecological and seven substratum attributes will be assigned to one of seven standard ranked (ordinal) categories (see *Tables B5* and *B6*).

(1) DeVantier, L.M., G. De'Ath, T.J. Done and E. Turak (1998). *Ecological assessment of a complex natural system: A case study from the Great Barrier Reef.* Ecological Applications 8: 480-496.

(2) Fabricius, K.E. and D. McCorry. (2006). *Changes in octcoral communities and benthic cover along a water quality gradient in reefs of Hong Kong*. Marine Pollution Bulletin 52: 22-33.

Table B5 Categories to be used in the Surveys - Benthic Attributes

Ecological	Substratum
Hard coral	Hard substrate
Dead standing coral	Continuous pavement
Soft coral	Bedrock
Black coral	Rubble
Macroalgae	Sand
Turf algae	Silt
Coralline algae	Large boulders (>50 cm)
	Small boulders (<50 cm)

Table B6 Categories to be used in the Surveys - Ordinal Ranks of Percentage Cover

Rank	Percentage Cover (%)
0	None recorded
1	1-5
2	6-10
3	11-30
4	31-50
5	51-75
6	76-100

Tier II - Taxonomic Inventories to Define Types of Benthic Communities

An inventory of benthic taxa will also be compiled for each transect. Taxa will be identified *in situ* to the following levels:

- Scleractinian (hard) corals to species wherever possible.
- Soft corals, gorgonians, sea anemones and conspicuous macroalgae recorded according to morphological features and to genus level where possible.
- Other benthos (including sponges, zoanthids, ascidians and bryozoans) recorded to genus level wherever possible or phylum plus growth form.

Following the completion of the survey of each transect, each taxon in the inventory is ranked in terms of abundance in the community (see *Table B7*). These broad categories rank taxa in terms of relative abundance of individuals, rather than the contribution to benthic cover along each transect. The ranks are subjective assessments of abundance, rather than quantitative counts of each taxon.

Table B7 Ordinal Ranks of Taxon Abundance

Rank	Abundance
0	Absent
1	Rare [a]
2	Uncommon
3	Common
4	Abundant
5	Dominant

Note:

(a) The classification of "rare" abundance refers to low abundance (small quantity) on the transect, rather than in terms of distribution in Hong Kong waters.

A set of environmental site descriptors are also recorded for each REA transect as follows:

A. The coral communities are classified into one of three categories based on the amount of three dimensional coral accretions:

- Extremely sparse corals (<1% cover) not forming a community, developed as subsidiary components among other sessile benthos (e.g. *Perna* sp., oysters, bryozoans);
- coral communities with no biogenic carbonate accretion developed on rock, sand or rubble; and
- coral communities with substantial biogenic accretion – three dimensional structures – but no reef flats (incipient reefs).
- Dimensional structure – but no reef flats (incipient reefs).

B. The degree of exposure to prevailing wave energy is ranked from 1 – 4, where:

1 = sheltered (highly protected by topographic features from prevailing waves);

2 = semi-sheltered (moderately protected);

3 = semi-exposed (only partly protected); and

4 = exposed (experienced the full force of prevailing wave energy).

C. Sediment deposition on the substratum (particle sizes ranging from very fine to moderately coarse) rated on a four point scale, from 0 – 3, where:

0 = no sediment;

1 = minor (thin layer) sediment deposition;

2 = moderate sediment deposition (thick layer), but substrate can be cleansed by fanning off the sediment; and

3 = major sediment deposition (thick, deep layer), and substrate cannot be cleaned by fanning.

During the REA survey, the field data will be recorded by an observer experienced in the underwater identification of sessile benthic taxa (coral specialist), swimming along identified sections of the shoreline on SCUBA from haphazardly-chosen starting points. The transect will run approximately parallel with the shoreline and a standardised swathe of seabed surveyed along all transects.

All field data will be checked upon completion of each REA transect and a dive survey proforma sheet completed at the end of each fieldwork day. Upon completion of the fieldwork photographs for each transect will be compiled. Photographs for each REA transect are then reviewed and REA data verified.

Once the transect photographs are reviewed and REA data checked all data will be input and stored in Excel spreadsheets. Data will be stored in two spreadsheets separated into:

- site (transect) information (Tier I and II data), depth and environmental descriptors; and
- species abundance data for each transect.

Species lists, species richness and mean values for ecological and substratum types will be compiled for each of the transects surveyed. The rank abundance values will be converted to a mid-value percentage cover for presentation.

Results

The subtidal benthic habitats of the following survey sites were assessed using the REA survey technique within the Study Area (*Figure B1*):

(a) Liu Ko Ngam (LKN - landing site);

(b) Pak Sha Tau (PST – landing site); and

(c) Tsing Chau (TC).

Each survey site was further divided into different zones, if necessary, accordingly to findings of the REA survey and each zone represents an area with similar habitat characteristics and species composition (*Figure B2*). Data on the ecological and physical attributes recorded at each zone/site are presented in *Tables B8* to *B10* and detailed descriptions of the subtidal benthic habitats observed at each site are presented below.

Table B8 Seabed Attributes along the REA Survey Transects

Station	Ecological Attribute							Physical Attribute						
	HC[a]	DC	SC	BC	TA	MA	CA	BR	LB	SB	RC	RBL	SN	SL
LKN-1	3	3	0	0	3	0	1	0	2	0	0	2	4	0
LKN-2	3	3	0	0	3	0	1	0	2	3	0	2	3	0
LKN-3	3	3	0	0	2	0	2	0	2	4	3	3	3	0
PST	2	3	0	0	3	0	2	0	2	4	2	3	4	0
TC-1	2	3	0	0	2	0	2	0	2	2	0	0	0	0
TC-2	4	3	0	0	2	0	2	0	2	3	0	2	2	0
TC-3	1	2	0	0	2	0	2	2	0	3	0	2	4	0

Notes:

(a) 1=<5% cover, 2= 6-10% cover, 3 = 11-30% cover, 4 = 31-50% cover, 5 = 51-75% cover, 6 = 76-100% cover.

(b) HC = Hard Coral, DC = Dead Coral, SC = Soft Coral, BC = Black Coral, TA = Turf Algae, MA = Macroalgae, CA = Coralline Algae, BR = Bedrock, LB = Large Boulders, SB = Small Boulders, RC = Rock, RBL = Rubble, SN = Sand, SL = Silt.

Table B9 Relative Abundance of Hard Coral Species Recorded during the REA Survey (please refer to Table B3 for explanation of the rank used)

Family	Genus	Species	LKN-1	LKN-2	LKN-3	PST	TC-1	TC-2	TC-3
Acroporidae	*Acropora*	*tumida*			3	1			
	Acropora	*pruinosa*			3				
Oculinidae	*Galaxea*	*astreata*			2			2	
Agariciidae	*Pavona*	*decussata*		2	4	4		3	
Fungiidae	*Lithophyllon*	*undulatum*	2	3	3	3	2	3	
Pectiniidae	*Echinophyllia*	*aspera*			3	2	2		2
Merulinidae	*Hydnophora*	*exesa*							
Dendrophylliidae	*Turbinaria*	*peltata*			2	1			
Mussidae	*Acanthastrea*	*echinata*			2		3	3	
Faviidae	*Favia*	*favus*		2	2				
	Favia	*rotumana*			3		3	3	
	Favia	*veroni*	3	3	4	3	3	3	
	Favites	*chinensis*	2	2	2				
	Favites	*abdita*	2	2					
	Favites	*acuticollis*						1	
	Goniastrea	*aspera*	2	2	2		3	2	
	Platygyra	*carnosus*	3	3	3	2	2	3	
	Platygyra	*acuta*					3	4	
	Oulastrea	*crispata*							
	Leptastrea	*purpurea*	3	4	4	3	3	3	2
	Cyphastrea	*spp*	3	3	3	2			
Poritidae	*Porites*	*sp*	3	3	3			3	
	Goniopora	*columna*	2	2	2	2	3	3	
	Goniopora	*sp*					2		
	Goniopora	*stutchburyi*							
	Goniopora	*djiboutiensis*						3	
Total Number of Hard Coral Species Recorded			**10**	**12**	**18**	**10**	**11**	**14**	**2**

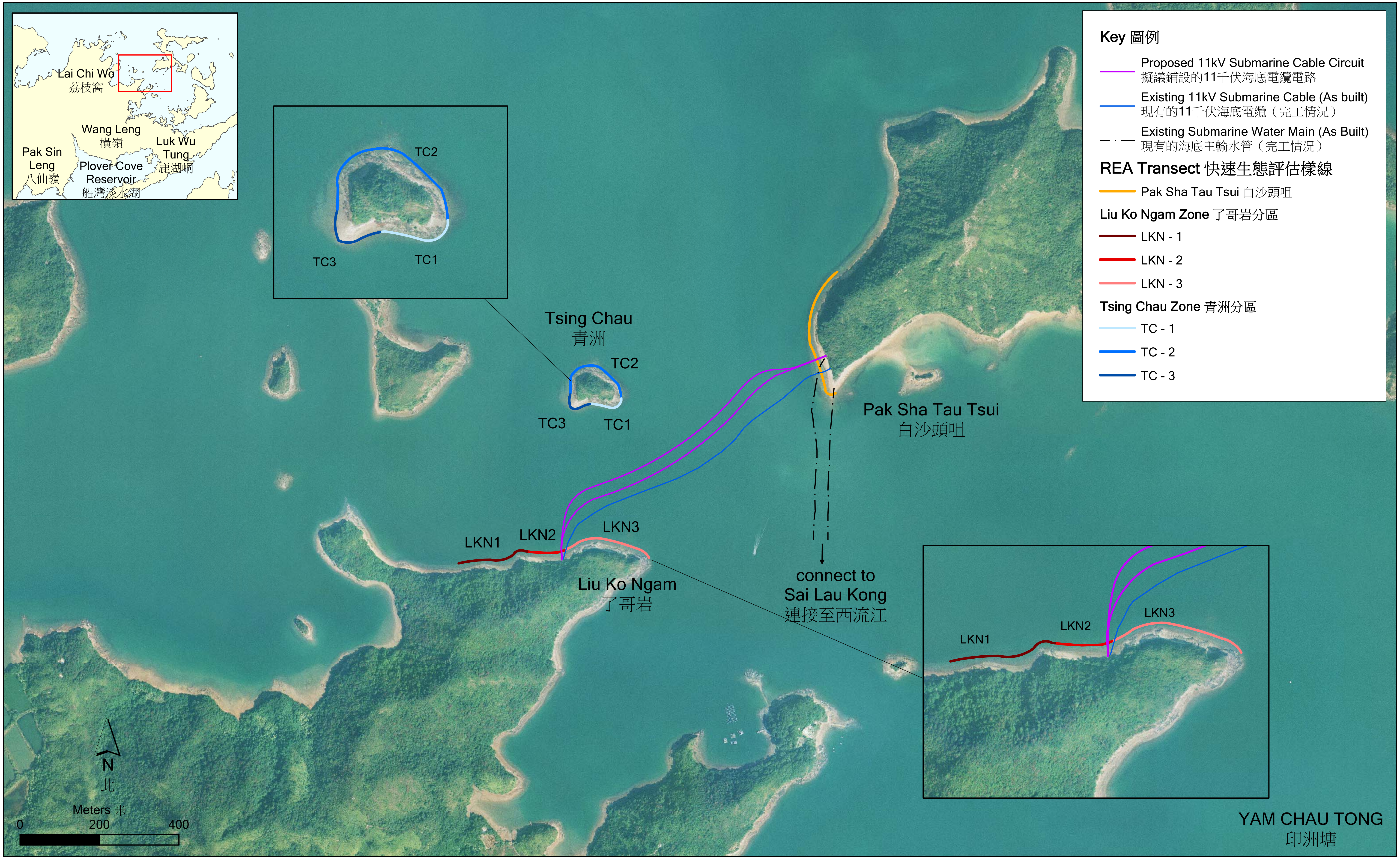

Figure B2
圖B2

REA Survey Findings - Zonation of Dive Survey Sites

快速生態評估調查結果 – 潛水調查地點分區圖

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Date: 30-Oct-2012

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Table B10 Relative Abundance of Species (excluding Hard Coral) Recorded during the Subtidal Coral Survey (please refer to Table 3.3 for explanation of the rank used)

Phylum/Family	Genus	Species	LKN-1	LKN-2	LKN-3	PST	TC-1	TC-2	TC-3
Porifera	Sponge		3	3	3	3	2		2
Cnidarian	Sea anemones					3	4	3	
Cnidarian	Zoanthids				3	3	2		
Ascidian	Tunicates					3	2		2
Mollusca	*Saccostrea*	*cucullata*	4	4	4	4	3	3	3
Echinodermata	*Diadema*	*setosum*	4	3	2	3	2	2	2
Total Number of Species Recorded (excluding Hard Coral)			**3**	**3**	**4**	**6**	**6**	**3**	**4**

Liu Ko Ngam (Landing Site)

The subtidal benthic habitat at Liu Ko Ngam (LKN) is further divided in three zones (*Figure B2*) and their representative photos are provided in *Figures B3-5.* Generally, the seabed of the three zones was predominately composed of hard substrates which included bedrock, boulders, rock and rubble (*Table B4*). Cover of hard corals of the three zones ranged between 11 to 30%. The three zones were determined by the differing abiotic and biotic components of the coral community recorded for this area of shoreline.

Eighteen (18) species of hermatypic hard coral were recorded at LKN-3 which was greater than that recorded at the other two zones of Liu Ko Ngam (10 for LKN-1 and 12 for LKN-2). The hard coral community was dominated by species from the Family Faviidae (*Table B5*) and this is the coral community type most commonly recorded in the north eastern waters of Hong Kong (1). Large sized colonies of massive and submassive growth forms were abundant at the other three zones.

In the area between LKN-2 and LKN-3, a stand of dead *Pavona* was observed with zoanthids and small hard coral colonies colonizing the dead coral framework. *Acropora tumida, A. pruinosa, Galaxea astreata* and *Acanthastrea echinata* observed at LKN-3 during the REA survey are considered as uncommon hard coral species in Hong Kong though they are most frequently recorded in the northeastern waters (2). Other hard coral species recorded at Liu Ko Ngam have been reported as common species in Hong Kong waters.

Other common subtidal species recorded at Liu Ko Ngam included the rock oyster *Saccostrea cucullata*, the sea urchins *Diadema setosum* and sponges (*Table 3.6*). All species recorded are considered as common and widespread in similar subtidal habitats of Hong Kong waters.

From the survey results, it is confirmed that the proposed cable landing point which is situated at LKN-2 supports coral assemblages of similar composition and abundance to areas in its immediate vicinity (LKN-1 and LKN-3). Therefore, there is limited scope to reduce the potential direct loss of corals within the cable corridor by relocating the cable landing point to nearby area. Instead, it is suggested to undertake a detailed coral mapping exercise at the proposed landing point to quantify the permanent loss of corals as a result of cable landing and assess the feasibility and extent of potential coral translocation exercise as mitigation measures to minimize the impacts as far as practicable.

(1) DeVantier, L and D. McCorry (2003). Corals and coral communities of Hong Kong: Ecological values and status 2001-02. Underwater Survey in Coastal Waters of Hong Kong (Tender Ref. AFD/SQ/19/01)
(2) Chan, L.K. Alan et. al. (2005). Field Guide to Hard Corals of Hong Kong. Published by Friends of the Country Park.

Figure B3 *Representative photos taken at LKN-1*

Similar to LKN-2 & LKN-3, the hard coral community was dominated by species from the Family Faviidae and this is the coral community type most commonly recorded in the north eastern waters of Hong Kong

Figure B4 *Representative photos taken at LKN-2*

Stand of dead *Pavona* was observed with zoanthids and small hard coral colonies colonizing the dead coral framework

Figure B5 *Representative photos taken at LKN-3*

Acropora tumida, A. pruinosa, Galaxea astreata and *Acanthastrea echinata* observed at LKN-3 during the REA survey are considered as uncommon hard coral species in Hong Kong though they are most frequently recorded in the northeastern waters

Note: The existing 11kV submarine cable is shown in the photo on the lower left hand corner. It should be noted that significant number of coral colonies successfully re-colonise on the existing cable.

Pak Sha Tau (Landing Site)

Representative photos taken for the subtidal habitat at Pak Sha Tau Tsui (PST) are provided in *Figure B6* and the REA survey data are presented in *Tables B4-6*. The seabed of Pak Sha Tau Tsui was comprised predominately of small boulders, rubble and sand (*Table B4*) with hard coral cover of 6-10%. The existing water main and power cable were encountered during the dive survey with no significant coral growth established on either side of the existing submarine utilities (*Figure B6*).

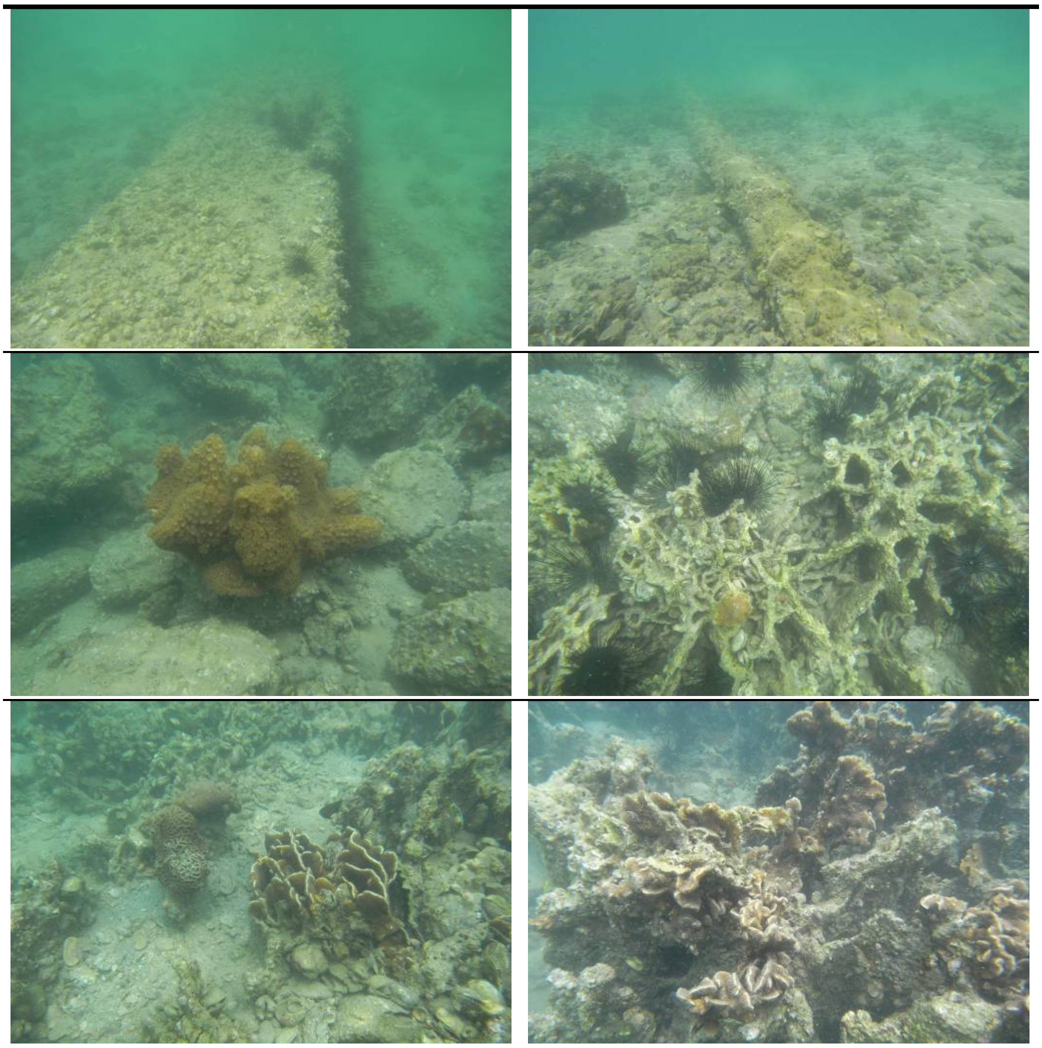
Ten (10) species of hermatypic hard coral were recorded at Pak Sha Tau Tsui. *Pavona decussata, Lithophyllon undulatum, Favia veroni* and *Lepastrea purpurea* were four common hard coral species recorded in this area (*Table B5*). An extensive area consisting of a dead *Pavona* stand was observed and colonisation by small hard coral colonies was recorded. All hard coral species recorded at Pak Sha Tau Tsui, except *Acropora tumida*, are considered as common species in Hong Kong [(1)]. *Acropora tumida* has been reported as an uncommon species in Hong Kong but is typically associated with the coral communities recorded from the northeastern waters.

Other common subtidal species recorded at Pak Sha Tau Tsui included the rock oyster *Saccostrea cucullata*, the sea urchins *Diadema setosum*, sponges and sea anemones (*Table B6*). All species recorded are considered as common and widespread in similar subtidal habitats of Hong Kong waters.

Similar to Liu Ko Ngam, it is noted that the similar hard coral assemblages were recorded along the surveyed area of Pak Sha Tau Tsui. The potential to minimize direct loss of corals within the working corridor by relocating the cable landing point to nearby area is thus limited. It is thus suggested to carry out the detailed coral mapping exercise at the currently proposed landing point in order to quantify the potential permanent loss of corals caused by cable landing works and study the feasibility and extent of potential coral translocation exercise to alleviate such impacts.

(1) Chan, L.K. Alan et. al. (2005). *Op. cit.*

Figure B6 Representative photos taken at Pak Sha Tau (PST)



The seabed of Pak Sha Tau Tsui was comprised predominately of small boulders, rubble and sand with hard coral cover of 6-10%. The existing water main and power cable were encountered during the dive survey with no significant coral growth established on either side of the existing submarine utilities.

Note: The existing water main is shown in the photo on the top left hand corner. The existing 11kV submarine cable is shown in the photo of the top right hand corner.

Tsing Chau

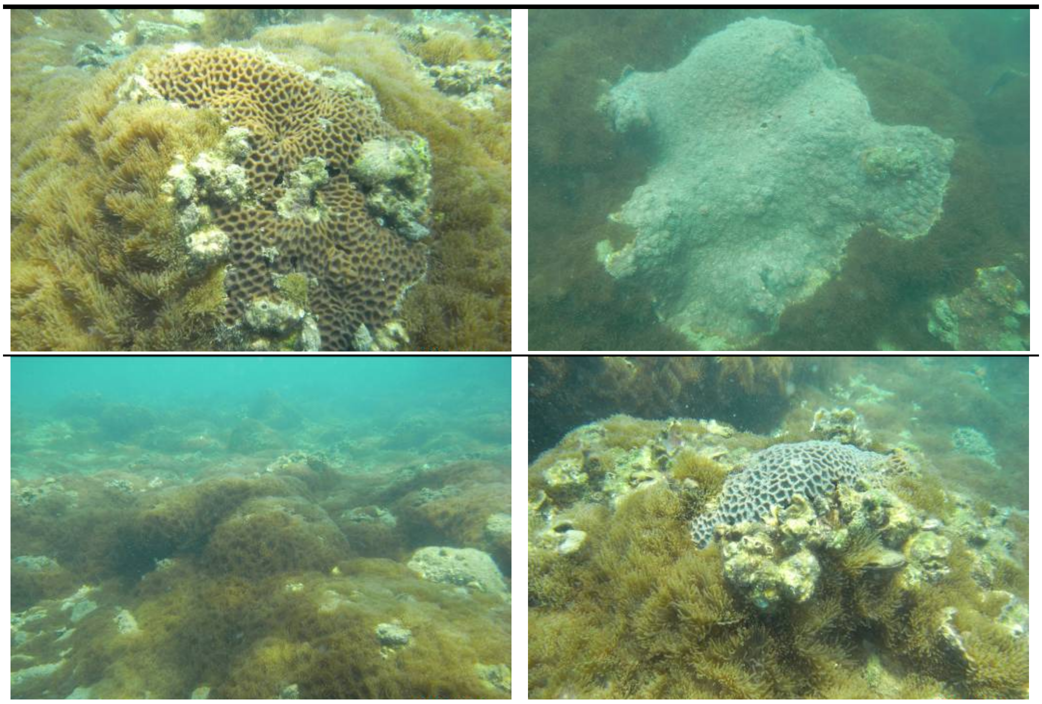
The subtidal benthic habitat at Tsing Chau (TC) was investigated as it is relatively close to the proposed submarine cable route and thus could potentially be considered as a marine ecological sensitive receiver.

Results of the REA survey show that the subtidal benthic habitat at Tsing Chau can be further divided in three zones (TC-1, TC-2 and TC-3; *Figure B2*) and representative photographs are provided in *Figures B7-9*. The seabed of all the three zones was generally rocky in nature with higher cover of sand recorded at TC-3 (*Table B4*). Cover of hard corals was higher at TC-2 which was between 31 to 50% while lower hard coral cover was recorded at TC-1 (6-10%) and TC-3 (1-5%).

Only two (2) species of hermatypic hard coral were recorded at TC-3 while eleven (11) and fourteen (14) species were recorded at TC-1 and TC-2, respectively. Again, the hard coral community was dominated by species from the Family Faviidae (*Table B5*). Of particular note is the high relative abundance of large *Platygyra* and *Goniopora* colonies recorded at TC-2. *Galaxea astreata, Acanthastrea echinata, Favites acuticollis* and *Goniopora djiboutiensis* recorded during the REA survey at Tsing Chau are considered as uncommon hard coral species in Hong Kong though these are species typically recorded for the coral communities of the northeastern waters (1). Other hard coral species recorded at Tsing Chau have been reported as common species in Hong Kong waters.

Other common subtidal species recorded at Tsing Chau included the sea urchins *Diadema setosum* and sea anemones (*Table B6*). At TC-1, sea anemones were frequently observed growing on dead corals. All species recorded are considered as common with widespread distribution within Hong Kong waters.

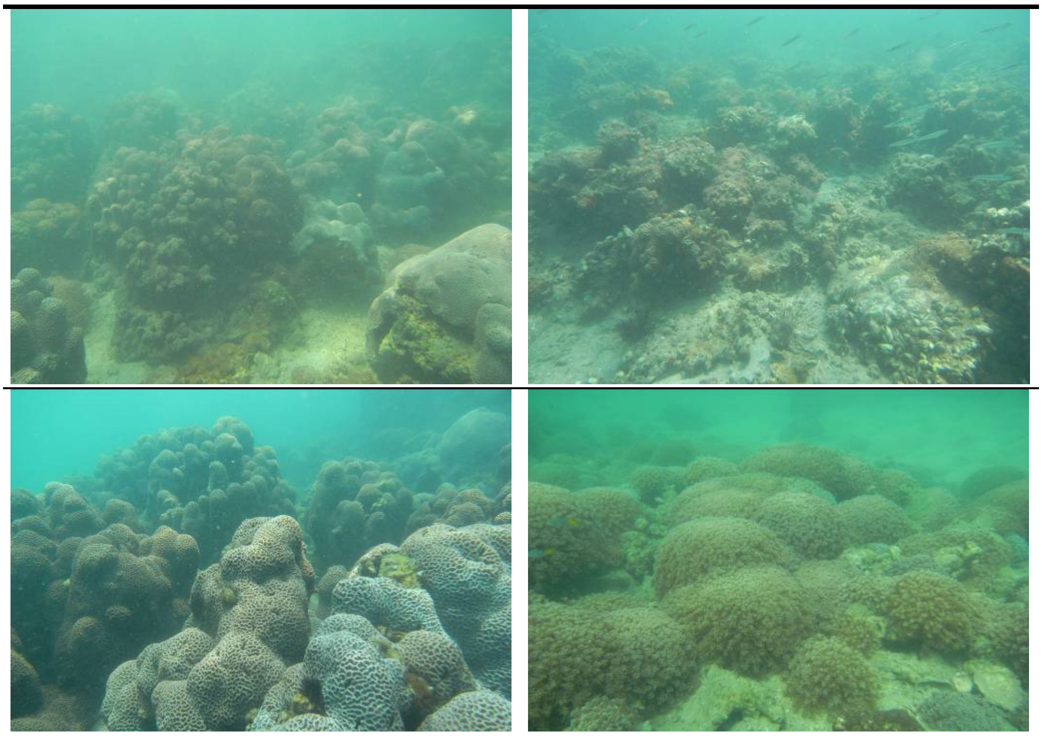
Figure B7 ***Representative photos taken at TC-1***



Low hard coral cover was recorded at TC-1 (6-10%), and sea anemones were frequently observed growing on dead corals.

(1) (1) Chan, L.K. Alan et. al. (2005). *Op. cit.*

Figure B8 *Representative photos taken at TC-2*



Cover of hard corals was higher at TC-2 which was between 31 to 50%. Of particular note is the high relative abundance of large *Platygyra* and *Goniopora* colonies recorded at TC-2.

Figure B9 *Representative photos taken at TC-3*

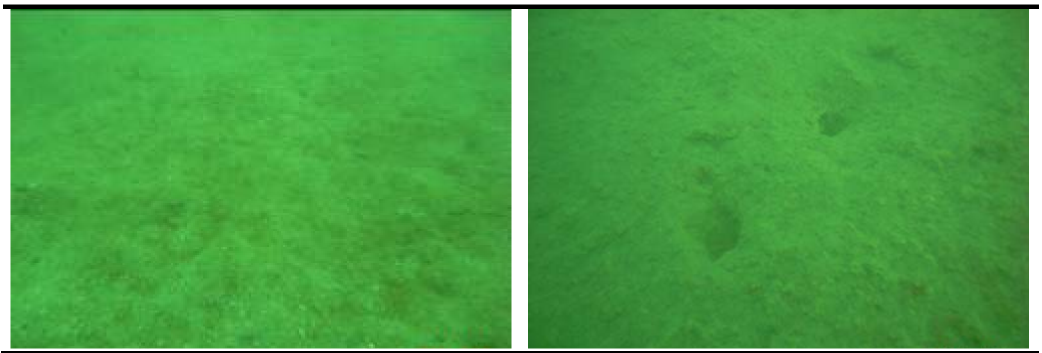
The seabed of all the three zones was generally rocky in nature with higher cover of sand recorded at TC-3. Only two species of hermatypic hard coral and low hard coral cover (1-5%) were recorded at TC-3.

B1.5.2 *Spot Dive Checking of Potential Coral Area in the vicinity of the Proposed Cable Alignment*

Locations of potential coral area in the vicinity of the proposed cable alignment were identified from results of the geophysical survey (*Figure B10*). Qualitative spot dive checking was undertaken at these locations to verify presence of any corals (*Figure B10*). At the two proposed landing sites, hard corals were found along the shoreline and their distribution was generally limited to a water depth of not deeper than -2.5 m CD. Along the proposed cable alignment, the seabed was mainly composed of sand beyond this depth limit for corals (*Figure B11*). The survey results are consistent with the findings of geophysical survey (*Figure B10*) which identified main areas of corals on sand/gravel matrix along the shoreline in the shallower water region.

Given the absence of any corals along the proposed cable alignment at a depth of greater than -2.5 m CD, it is not considered necessary to adjust the cable routing in this water depth region (ie beyond -2.5 m CD) from the perspective of avoiding direct loss of corals as a result of cable laying works. It should be noted that potential direct impacts to corals due to cable laying works in shallower water region (ie less than -2.5 m CD) will be further assessed.

Figure B11 ***Representative photos taken at water depth >-2.5 m CD during the spot dive checking***



B1.5.3 *Summary and Recommendation of Stage 1 Survey*

Potential hard substrates identified along the proposed cable alignment by the geophysical survey were investigated during the Stage 1 survey using spot dive checking technique. No hard substrates or corals were found at these locations and it is thus not considered necessary to adjust the proposed cable alignment from the perspective of avoiding direct impacts to corals during cable laying works.

Results of the Stage 1 surveys indicated that the Tsing Chau north (TC-2) has the highest coral coverage within the Study Area and considered to be coral area of ecological concern. The proposed cable landing sites at Liu Ko Ngam and Pak Sha Tau Tsui supported similar hard coral assemblages to areas in the immediate vicinity. However, LKN-3 zone should be avoided as it has the highest number of hermatypic hard coral species and of uncommon hard coral species including *Acropora tumida, A. pruinosa, Galaxea astreata* and *Acanthastrea echinata* recorded during the Stage 1 survey.

Figure B10
圖B10

Potential Area of Coral with Sand/Gravel Matrix

基質屬沙／碎石而可能有珊瑚存在的地區

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Date: 30-Oct-2012

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It is thus considered that the direct impacts to coral colonies will expect to be similar along LKN-1 and LKN-2 at Liu Ko Ngam or landing along the dive survey transect at Pak Sha Tau Tsui. In order to avoid crossing of the existing 11kV submarine cable and water mains, the cable landing points should be located at the north of the existing submarine utilities. The overall environmental impacts will also be minimised if the landing points of the new cable circuit situated close to the landing of the existing 11kV submarine cable.

A detailed coral mapping exercise at the two proposed landing points which already avoided the dense coral zone is recommended to be undertaken for the assessment of direct impacts to corals as a result of cable landing works and for evaluation of feasibility and scope of coral translocation exercise as a potential mitigation measures to alleviate such impacts.

It should also be noted that hard coral assemblages were identified at Tsing Chau which is in relatively close vicinity to the proposed cable alignment. Indirect impacts to corals as a result of potential water quality impacts of the cable laying works should thus be considered during the impact assessment.

B1.5.4 Detailed Coral Mapping

Under the Stage 2 subtidal dive survey, detailed coral mapping was conducted at the proposed cable landing sites at Liu Ko Ngam and Pak Sha Tau Tsui where of minimal coral coverage in 2011 and updated surveys were conducted in 2012. The objective of the coral mapping exercise is to quantify the approximate number of corals within the cable working corridor for evaluation of the potential direct impacts of the cable landing works at the proposed landing sites. Information collected was also used to assess the feasibility and extent of coral translocation works as a mitigation measures to minimize impacts to corals.

Survey Methods

Dive reconnaissance surveys were conducted at both landing sites (along LNK-1, LKN-2 and PST transects) in order to visually identify the landing point of the least coral colonies. Detailed coral mapping was subsequently conducted at the identified landing point of the least coral colonies at both Liu Ko Ngam and Pak Sha Tau Tsui.

At the two proposed cable landing sites, a grid system was set-up underwater using transect tapes in an area of 15 m (perpendicular to the shoreline) x 20 m (parallel to the shoreline), within which the proposed cable alignment was approximately running along a central line from shallow to deep water (*Figures B12-13*). The size of each grid was 5 m x 5 m and a total of 12 grids were established at each site representing a total area of 300 m^2. The grid system was setup in the depth zone of approximately 0 m to -2 m CD since corals were not observed beyond this depth zone at both landing sites.

Within each grid the following data were collected:

- The approximate location of each coral colony (hard, soft or black corals);

- All coral colonies were recorded to species level, where possible;
- The size of each coral colony was recorded to three size classes of <10 cm, 10-50 cm and > 50 cm; and
- Additional parameters recorded for individual coral colonies included: associated substrate of the coral colony (whether based on rock or sand), condition (based on percentage cover of partial mortality) and translocation feasibility (movable or immovable).

The coral survey data were then used to generate a coral habitat map to exhibit the accurate positional information on the coral colonies recorded from the two landing points. The co-ordinates for all coral colonies recorded were generated based on distance along and from all survey transects. Position of each coral colony was plotted using Arcview and each coral colony was classified by species, size class and translocation feasibility.

Coral Mapping Results at Liu Ko Ngam

The slope of the seabed was very gentle within the survey grid area from 0 to -2 m CD. The seabed was predominantly composed of sand from 0 to -0.5 m CD. Sand and dead hard coral colonies of *Pavona decussata* were observed as the major abiotic attributes from -0.5 to -1.6 m CD, after which the main seabed substrate changed to sand again. A stand of dead *Pavona* was observed within Grid 4 with zoanthids and small hard coral colonies colonizing the dead coral framework. Growth of corals was limited by depth and corals were not found at a depth of deeper than -2.5 m. Corals were found to extend to 15 m from the shoreline.

A total of 18 species of hard corals representing seven families were recorded at Liu Ko Ngam during coral mapping surveys. Of the coral families listed (*Table B11*), Agariciidae and Faviidae were relatively more abundant than the others and they are considered typical of coral communities in Hong Kong. Except for Grids 7-8 within which no hard corals were found, the species richness of hard corals was similar between grids except which ranged from 4 to 8.

The corals recorded for Liu Ko Ngam were ranked according to their abundance rating for Hong Kong [(1)] (*Tables B11*). The majority of corals were common, abundant or dominant in their abundance ranking (15 out of 18 species recorded). Although *Montipora turgescens* was considered as a rare species in overall Hong Kong waters, it is considered prevalent in northeastern and eastern waters in which the Project site located. The abundance rating of others was unknown due to species identification issues as for some colonies *in situ* identification to species level was not possible. Detailed specimen investigation was required for proper taxonomic identification of these colonies. These colonies with unknown abundance rating do not necessarily indicate the presence of a possibly rare/uncommon coral species.

(1) Chan et al. 2005. Field Guide to Hard Corals of Hong Kong (AFCD).

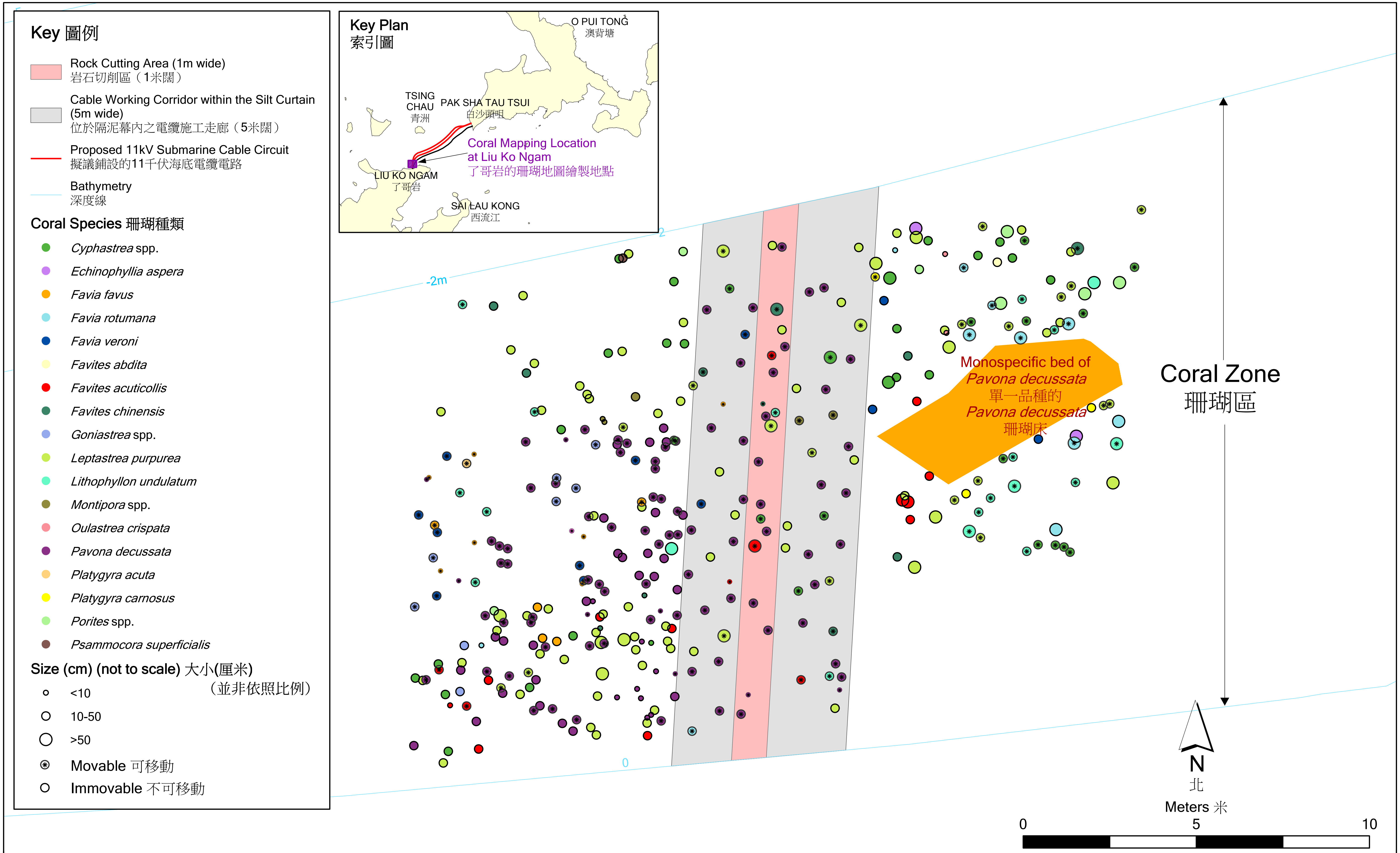

Figure B12
圖B12

Coral Mapping at Liu Ko Ngam

了哥岩的珊瑚地圖

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Environmental Resources Management
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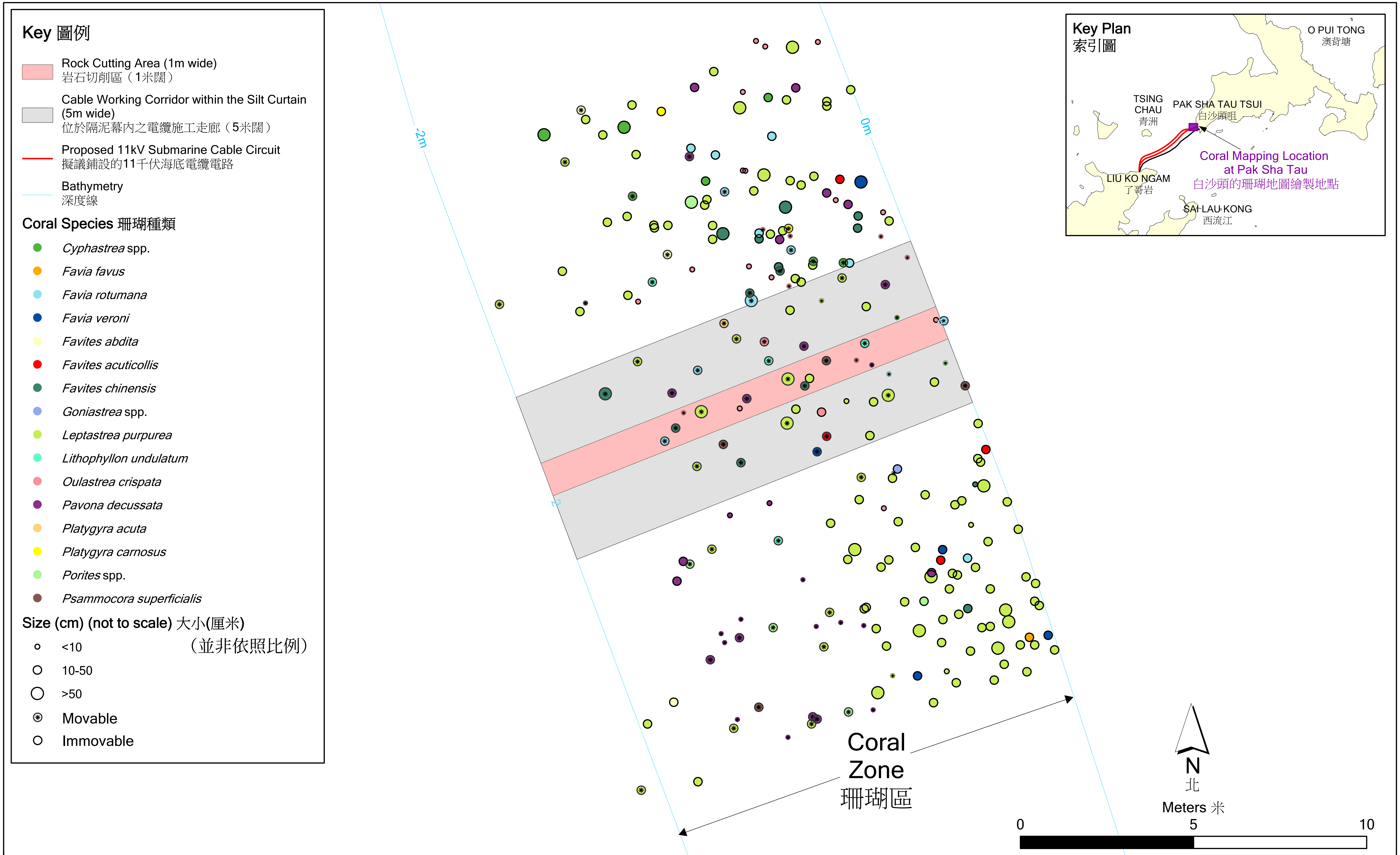

Figure B13
圖B13

Coral Mapping at Pak Sha Tau Tsui

白沙頭咀的珊瑚地圖

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Date: 30-Oct-2012

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Figure B12 shows the coral distribution with details of the species, colony size and immovability throughout Liu Ko Ngam proposed landing point. The mean coral colony density for the bay was low at 1.26 colonies per m^2. There were several aggregated patches of corals in the shallows within Grids 1, 2 and 3 with 53 to 76 colonies recorded. However, for Grid 7-8 which are also located in the shallower water region, no hard corals were found within the grid area. Hard corals were mostly associated with sand with around 10% of them (37 colonies) attached to dead coral substrates found at Grid 4. It is should be noted that a living stand of *Pavona decussata* which measured about 14.7 m^2 in area was recorded extending among Grids 9-12. The size of corals were generally smaller than 15 cm with majority (~72%) of them in the size class of 10-50 cm (274 out of 379 colonies; *Figure B12*).

A total of 379 coral colonies were recorded within Liu Ko Ngam survey grid area during the survey (*Table B11*). There were a total of 120 hard coral colonies, consisting of 10 species, located within the proposed cable working corridor which will be enclosed by silt curtain during the rock cutting works (ie 2.5 m from either sides of the centreline of the two cable alignments) (*Figure B12* and *Table B12*). Most of the coral colonies were in the size range of 10-50 cm and they were generally smaller than 20 cm in diameter. The predominating species recorded inside the cable corridor were *Leptastrea purpurea* and *Pavona decussata*. Most of these corals were non-removable by hands (*Table B12*). However, out of the total 120 hard coral colonies recorded within the proposed cable corridor, 100 of them belong to the Genus *Cyphastrea, Favia, Favites, Leptastrea* (for this genus coral colonies larger than 50 cm in size were generally in submassive growth form) and *Pavona* were in submassive or massive growth form which are feasible for translocation by mechanical means. For translocating these corals, it would be required to cut them off the substrate at its base before transfer them to the designated recipient site. In addition to the above species, a total of four (4) coral colonies of other species were considered movable by hands and thus a total of 104 colonies are expected to be feasible for translocation. Provided that coral translocation are properly implemented for the 104 hard coral colonies before commencement of cable installation works, it is estimated that a total of six (6) hard coral colonies located within the one-metre (1 m) wide rock cutting works area will be directly affected while a total of 16 hard coral colonies (including the 6 hard coral colonies within the 1 m wide rock cutting area) will be indirectly disturbed due to diver movement and perturbation to water quality within the 5 m wide area enclosed by the silt curtain.

In addition to hard corals, other common invertebrates included sea urchins *Diadema setosum* and the sea cucumber *Holothuria leucospilota* were recorded within the survey area at Liu Ko Ngam.

Table B11 List of Scleractinian Coral Species recorded within the Survey Grids at Liu Ko Ngam (LKN)

Family	**Species**	**Hong Kong Abundance Rating (1)**	**Grid No.**												
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Total at LKN**
Acorporidae	*Montipora turgescens*	Unknown					5								**5**
Agariciidae	*Pavona decussata*	Abundant	27	23	64	13									**127**
Faviidae	*Cyphastrea spp.*	Unknown	1	6	3		6	1				5	8	9	**39**
	Favia favus	Abundant	1	3	1	7									**12**
	Favia rotumana	Abundant		1								3	3	5	**12**
	Favia veroni	Common			1	6					4	1	1		**13**
	Favites abdita	Dominant												1	**1**
	Favites acuticollis	Common	6	5							7				**18**
	Favites chinensis	Dominant	3					2			4		2	1	**12**
	Goniastrea spp.	Unknown		2		7									**8**
	Leptastrea purpurea	Abundant	31	12	5		6	8			9	6	9	10	**96**
	Oulastrea crispata	Common											2		**2**
	Platygyra acuta	Dominant				1									**1**
	Platygyra carnosus	Common										2	1		**3**
Fungiidae	*Lithophyllon undulatum*	Common			2	3	1	2				8		3	**19**
Pectiniidae	*Echinophyllia aspera*	Common										1	1		**2**
Poritidae	*Porites spp.*	Common to Dominant		1			1						1	4	**7**
Siderastreidae	*Psammocora superficialis*	Abundant					1								**1**
		Total Number of Hard Coral Colonies	**69**	**53**	**76**	**37**	**20**	**13**	**0**	**0**	**24**	**26**	**28**	**33**	**379**
		Total Number of Hard Coral Species	**6**	**8**	**6**	**6**	**6**	**4**	**0**	**0**	**4**	**7**	**9**	**7**	**18**

(1) Chan et al. 2005. *Op. cit.*

Table B12 ***Coral Colonies Potentially Impacted by the Proposed Cable Route Landing at Liu Ko Ngam***

Coral Species	Size (in diameter cm)			Movable/ Feasible for Translocation	Immovable
	< 10	10 - 50	> 50		
Cyphastrea spp.	0	8	1	9	0
Favia favus	1	0	0	1	0
Favia rotumana	0	1	0	1	0
Favia veroni	0	2	0	2	0
Favites acuticollis	1	9	0	10	0
Favites chinensis	1	5	1	7	0
Leptastrea purpurea	0	19	18	21	16
Lithophyllon undulatum	0	2	0	2	0
Montipora spp.	0	2	0	2	0
Pavona decussata	5	44	0	49	0
Total no.	8	92	20	104	16

Coral Mapping Results at Pak Sha Tau Tsui

A total of 12 grids were laid in the bay of Pak Sha Tau Tsui (*Figure B13*). The seabed topography of Pak Sha Tau was similar to that of Liu Ko Ngam in which the slope of the seabed was very gentle within the survey area from 0 to -2.3 m CD. Sand and small boulders were the major abiotic attributes recorded for the seabed composition from 0 to -0.6 m CD, while dead hard coral colonies of *Pavona decussata* was the main abiotic substrate from -0.6 to -1.8 m. Beyond -1.8 m the seabed was again mainly composed of sand. Hard corals were observed growing on both sand, dead coral framework and boulders. Hard corals were not observed at deeper than -2.5 m CD and corals were found extent to about 15 m from the shoreline.

A total of 16 species of hard corals representing five families were recorded at Pak Sha Tau Tsui during the coral mapping surveys. Corals from the family Faviidae, particularly the coral species *Leptastrea purpurea* in which 140 colonies were recorded, were relatively more abundant than the others and they are considered typical of coral communities in Hong Kong. For individual grids, the number of hard coral species recorded was ranging from 1 to 8 (excluding Grid K in which no hard coral was recorded) and lower species richness of coral was recorded in Grids E, F and L which were at deeper water region of the surveyed area.

In terms of abundance rating in Hong Kong [(1)] (*Tables B13*), the majority of coral species recorded at Pak Sha Tau Tsui are considered as common, abundant or dominant (14 out of 16 species recorded). The abundance rating of two species was unknown as it was not able to identify them *in situ* to the species level which is the taxonomic level the abundance reference was referred to. These colonies with unknown abundance rating, again, do not necessarily indicate the presence of a possibly rare/uncommon coral species.

(1) Chan et al. 2005. *Op. cit.*

Figure B13 shows the coral distribution with details of the species, colony size and immovability throughout Pak Sha Tau Tsui. The mean coral colony density for the survey area was low at 0.97 colonies per m^2. Hard coral colonies were mainly recorded in Grids A, B, G and H which were in shallower waters when compared to the other grids. A total of 188 colonies were recorded in these four grids. The number of coral colonies recorded dropped with depth. Hard corals were found mostly attached to sand (145 colonies) with others attached to dead corals (52 colonies), small bounder (61 colonies) or rubble (32 colonies). The size of coral colonies was generally smaller than 15 cm with majority (~69%) of them in the size class of 10-50 cm (200 out of 290 colonies). Only 30 colonies measured more than 50 cm in diameter.

A total of 290 coral colonies were recorded within Pak Sha Tau Tsui survey grid area during the survey (*Table B13*). There were a total of 108 hard coral colonies, consisting of 14 species, located within the proposed cable working corridor which will be enclosed by silt curtain during the rock cutting works (ie 2.5 m from either sides of the centreline of the two cable alignments) (*Figure B13* and *Table B14*). Most of the coral colonies (67 out of 108) were in the size range of 10-50 cm and they were generally smaller than 15 cm in diameter. *Leptastrea purpurea* was the most abundant species recorded inside the cable working corridor. Twenty-five (25) colonies were non-removable by hands (*Table B14*). However, out of the total 108 hard coral colonies recorded within the proposed cable working corridor, fifty six (56) of them belong to the Genus *Cyphastrea, Favia, Favites, Pavona, Platygyra* and *Porites* were in submassive or massive growth forms which are feasible for translocation by mechanical means. For translocating these corals, it would be required to cut them off the substrate at its base before transfer them to the designated recipient site. In addition to the above species, a total of 27 coral colonies of other species were considered movable by hands and thus a total of 83 colonies are expected to be feasible for translocation. Provided that coral translocation are properly implemented for the 83 hard coral colonies before commencement of cable installation works, it is estimated that a total of seven (7) hard coral colonies located within the one-metre (1 m) wide rock cutting works area will be directly affected while a total of 25 hard coral colonies (including the 7 hard coral colonies within the 1 m wide rock cutting area) will be indirectly disturbed due to diver movement and perturbations to water quality within the 5 m wide area enclosed by the silt curtain.

In addition to hard corals, other common invertebrates included sea urchins *Diadema setosum* and the sea cucumber *Holothuria leucospilota* were recorded within the survey area at Pak Sha Tau.

Table B13 List of Scleractinian Coral Species recorded within the Survey Grids at Pak Sha Tau Tsui

Family	Species	Hong Kong Abundance Rating (1)	Grid No.												
			A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**Total at Pak Sha Tau**
Agariciidae	*Pavona decussata*	Abundant	3	3	7	1	1		1	1	7	14			**38**
Faviidae	*Cyphastrea spp.*	Unknown	2	2		3									**7**
	Favia favus	Abundant								1					**1**
	Favia rotumana	Abundant	10	4						1					**15**
	Favia veroni	Common	2						2	3					**7**
	Favites abdita	Dominant				2								1	**3**
	Favites acuticollis	Common		1					3	1					**5**
	Favites chinensis	Dominant	11	2					3	1					**17**
	Goniastrea spp.	Unknown							1						**1**
	Leptastrea purpurea	Abundant	19	12	9	14	2	1	26	43	6	5		3	**140**
	Oulastrea crispata	Common	20	6	4				2						**32**
	Platygyra acuta	Dominant									1				**1**
	Platygyra carnosus	Common	1			1									**2**
Fungiidae	*Lithophyllon undulatum*	Common			2						5				**7**
Poritidae	*Porites spp.*	Common to Dominant				1				1	2	2			**6**
Siderastreidae	*Psammocora superficialis*	Abundant			2		5					1			**8**
		Total Number of Hard Coral Colonies	**68**	**30**	**24**	**22**	**8**	**1**	**38**	**52**	**21**	**22**	**0**	**4**	**290**
		Total Number of Hard Coral Species	**8**	**7**	**5**	**6**	**3**	**1**	**7**	**8**	**5**	**4**	**0**	**2**	**16**

(1) Chan et al. 2005. *Op. cit.*

Table B14 ***Coral Colonies Potentially Impacted by the Proposed Cable Route Landing at Pak Sha Tau Tsui***

Coral Species	**Size (in diameter cm)**			**Movable/ Feasible for Translocation**	**Immovable**
	< 10	**10 - 50**	**> 50**		
Cyphastrea spp.	0	2	0	2	0
Favia rotumana	0	9	1	10	0
Favia veroni	0	1	0	1	0
Favites acuticollis	0	3	0	3	0
Favites chinensis	0	9	0	9	0
Leptastrea purpurea	2	20	11	18	15
Lithophyllon undulatum	0	7	0	7	0
Oulastrea crispata	24	0	0	14	10
Pavona decussata	2	8	0	10	0
Platygyra acuta	0	1	0	1	0
Porites spp.	0	2	0	2	0
Psammocora superficialis	1	5	0	6	0
Total no.	29	67	12	83	25

B1.6 *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 plumes during jetting, dredging and cable laying.

B1.6.1 *Direct Impacts during Construction*

The works site for the shore-end dredging works (outside the coral zones) require 4 m from either sides of the centreline of the two cable alignments at Liu Ko Ngam and Pak Sha Tau Tsui with consideration of the size of the working barge and required anchorage points, even the actual dredging works are confined along the cable trench. While the 'Rock Cutting' works will require about 1.0m (Width) x 0.6m (Depth) trench at the shore-end landing section (not more than 50m at both Liu Ko Ngam and Pak Sha Tau Tsui, but only 10-20m section with coral colonies recorded). The following impact assessment, assuming direct impacts to the inter-tidal and benthic assemblages within the works site cannot be avoided during the construction works, is considered as the *worst-case scenario*.

Intertidal Habitats: Short term impacts are predicted to occur on the intertidal habitats at Liu Ko Ngam and Pak Sha Tau Tsui as a result of the shore-end construction activities. The intertidal boulder and sandy shore habitats at Liu Ko Ngam and Pak Sha Tau Tsui will be reinstated after the installation works respectively. The marine ecological resources in the affected area are expected to return due to recolonisation of the habitat by intertidal fauna once these marine works have been completed. Therefore, direct impacts to the intertidal habitats at Liu Ko Ngam and Pak Sha Tau Tsui as a result of the proposed construction works are not anticipated to be significant.

Subtidal Soft Bottom 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. Jetting would disturb the low ecological value subtidal soft bottom habitat along the approximately 880 m alignment of the cable route temporarily. Along the whole cable alignment (including those sections require protective cover), natural backfill will be occurred and return to original sea bed level shortly after the jetting. Owing to the relatively limited ecological value, the short-term nature of the direct impacts on the subtidal soft bottom habitat is not anticipated to be significant.

Subtidal Habitats:

Liu Ko Ngam: Potential impacts would be expected to the hard coral colonies located within the 5 m 'Rock Cutting' working corridor within the coral zone. In order to minimise the potential impacts on coral communities, detailed surveys were conducted along the shorelines at Liu Ko Ngam to identify landing point of lower coral density. Further to a detailed coral mapping survey at the landing point of lower coral density, cable working corridor of minimal number of coral colonies was selected. Within the cable working corridor, the number of potentially affected hard coral colonies will be greatly reduced from 120 to 16 given the implementation of translocating the 104 coral colonies which are considered to be feasible for translocation from the impacted area to the recipient site before construction works commencement (*Table B12*, *Figure B12*). Among the 16 coral colonies, a total of 6 hard coral colonies would be directly affected by the rock cutting works (within the one-metre wide rock cutting works area). The 10 affected hard coral colonies (within the 5 m wide working corridor enclosed by the silt curtain) may potentially be subjected to indirect disturbances due to the movement of divers and perturbations to water quality at the coral zone. Coral colonies that are considered not feasible for translocation are *Leptastrea purpurea* which are species of common distribution in the northeastern and eastern waters of Hong Kong. In addition, the size of these colonies is generally small of less than 15 cm in diameter. Therefore, the residual impact related to the loss of the small number of coral colonies, which are small in size and of common distribution in surrounding waters of the project site, are considered acceptable. It should be noted that, with reference to the field observation, coral colonies can successfully re-colonise on hard substrate, ie the existing cable, after previous disturbance.

Pak Sha Tau Tsui: Potential impacts would be expected to the hard coral colonies located within the 5 m 'Rock Cutting' working corridor within the coral zone. In order to minimise the potential impacts on coral communities, detailed surveys were conducted along the shorelines at Pak Sha Tau Tsui to identify landing point of lower coral density. Further to a detailed coral mapping survey at the landing point of lower coral density, cable working corridor of minimal number of coral colonies was selected. Within the cable corridor, the potentially affected hard coral colonies will be greatly reduced from 108 to 25 given the implementation of translocating the 83 coral colonies which are considered to be feasible for translocation from the impacted area to the recipient site before construction works commencement (*Table B14*, *Figure B13*). Among the 25 coral colonies, a total of 7 hard coral colonies would be directly affected by the rock cutting works (within the one-metre wide rock cutting works area). The 10 affected hard coral colonies (within the 5 m wide working corridor enclosed by the silt curtain) may potentially be subjected to indirect disturbances due to the movement of divers and perturbations to water quality at the coral zone. Coral species that are considered not feasible for translocation are *Leptastrea purpurea* and *Oulastrea crispata*, which are common species recorded in the northeastern and eastern waters of Hong Kong. The size of these colonies is also small, particularly for colonies of *Oulastrea crispate* which were all smaller than 10 cm in diameter. For *Leptastrea purpurea*, colonies considered not feasible for translocation were generally less than 15 cm in diameter. Given that cable landing works would lead to the loss of small number of coral colonies which are generally small in size and of common distribution in surrounding waters of the project site, the residual impact of direct disturbance to coral habitat is considered acceptable. It should be noted that, with reference to the field observation, coral colonies can successfully re-colonise on hard substrate, ie the existing cable, after previous disturbance.

B1.6.2 Indirect Impacts during Construction

Indirect impacts to marine ecological resources during the construction phase include sediment release associated with the jetting and dredging works outside the coral zone. It should be noted that rock cutting will only generate minimal and localised impact on water quality. Potential impacts to water quality from sediment release, mainly due to jetting and dredging works, 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)

Intertidal Habitats: Intertidal habitats within the assessment areas, which may be affected by the dredging works, including the sandy and boulder shore habitats 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 and rock boulder y shores at both Liu Ko Ngam and Pak Sha Tau Tsui and the short construction duration.

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 sediment loads in the water column. Benthic invertebrates are, therefore, not likely to be adversely affected by the jetting and dredging works with respect to sediment suspension and settlement.

Impacts to benthic assemblages immediately outside of the dredging/ jetting areas are expected to occur temporarily. The area is expected to be small, as sediment will be deposited within a short distance of the jetting works (*Annex A*). The predicted deposition rates are not likely to impact the natural benthic assemblages in Liu Ko Ngam and Pak Sha Tau Tsui which supports low abundance of benthic infauna. The organisms present are considered to be adapted to seabed disturbances and were reported to be in sparse abundance. 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.

Subtidal Hard Bottom Habitat: At the landing points at Liu Ko Ngam and Pak Sha Tau Tsui, the cable will be laid in a grab dredged trench. The grab dredging works will be conducted within a silt curtain which will assist in controlling sediment dispersion. As a consequence of this mitigation measure, no unacceptable indirect impacts to corals are expected to occur during the cable landing works.

The movement and operation of the working barges may stir up the sea bottom and cause re-suspension of sediment affecting the nearby coral communities at Liu Ko Ngam and Pak Sha Tau Tsui, particularly during low tide. With the implementation of good operational practice of the working barge (ie no overloading and avoid movement during low tide, particularly close to shallow areas), no unacceptable adverse impacts to the coral communities will be expected.

Although adverse indirect impacts to corals are not predicted to occur, coral monitoring will be undertaken during cable installation to verify that the project has no adverse ecological impact on the corals. This monitoring plan is presented in *Annex E*.

Yau Chau Tong Marine Park and Lai Chi Wo Beach Site of Special Scientific Site (SSSI): Indirect impacts associated with the change in water quality on the Yau Chau Tong Marine Park (the nearest point of the Marine Park located approximately 430 m from to the proposed cable landing site and cable route) and Lai Chi Wo Beach SSSI (which is located over 1.5 km away from the proposed cable landing site and cable route) are not regarded as significant due to the small scale of the works, the short duration of impacts, and the limited dispersion of sediment plume.

B1.6.3 Operation Phase

During the operation of the proposed cable, the seabed sediments will not be disturbed and therefore impacts to marine ecological resources, as well as indirect impacts associated with the change in water quality are not expected.

B1.7 MITIGATION MEASURES DURING CABLE INSTALLATION

Annex 16 of the EIAO TM states that the general policy for mitigation of significant ecological impacts, in order of priority, is:

Avoidance: Potential impacts should be avoided to the maximum extent practicable by adopting suitable alternatives;

Minimisation: Unavoidable impacts should be minimised by taking appropriate and practicable measures such as constraints on intensity of works operations or timing of works operations; and

Compensation: The loss of important species and habitats may be provided for elsewhere as compensation. Enhancement and other conservation measures should always be considered whenever possible.

B1.7.1 Avoidance

In order to replace the existing 11kV submarine cable connecting Liu Ko Ngam to Pak Sha Tau Tsui, Kat O (Crooked Island), which is more than 30 years old and deteriorating, the cable replacement will mainly follow the alignment of the existing 11kV submarine cable and make use of the existing landing sites connecting to the existing 11kV OHL electric system. The selection of cable landing points and alignment of the cable was based on the following considerations:

- Avoiding the Marine Parks.
- Avoiding the location of Fish Culture Zones (FCZs).
- Selecting technically feasible areas (i.e. soft mud and sand) to minimise the construction difficulties.
- Following the alignment of the existing 11kV submarine cable and making use of the existing landing sites which has been disturbed in the past, so as to avoid other natural and undisturbed areas.
- Making use of the existing 11kV OHL electric system to avoid installing new OHL system.

B1.7.2 Minimisation

During the early planning stage, selecting the shortest cable alignment to minimise the potential for adverse impacts to the environment is one of the key consideration. It is noted that areas of high coral coverage is commonly found in the shorelines of north-eastern Hong Kong waters. In order to minimise the potential impacts on coral communities, detailed surveys were conducted along the shorelines at Liu Ko Ngam to Pak Sha Tau Tsui to identify landing points of lower coral density. Further to a detailed coral mapping survey at the landing points of lower coral density, cable working corridor of minimal number of coral colonies was selected.

Apart from selection of cable route and landing points, alternative construction methods of minimal impacts on corals were also considered. It is proposed that the 'Rock Cutting' method (at the coral zone) plus "Dredging Method" (at non-coral zone) is the most appropriate shore-end construction method based on technical feasibility and environmental outcomes.

During cable installation, the following mitigation measures to further minimise the impacts, as well as the disturbance to the surrounding habitats and marine assemblages, are recommended.

- Employ a silt curtain around the shore-end works site in order to reduce the dispersion of sediments during the cable laying works. In order to avoid any impacts to the environment as well as the nearby marine life, the silt curtain should be decommissioned carefully and follow the following procedures: (1) ensure no obvious sediment plumes observed inside the silt curtain, (2) lift up the bottom of the silt curtain, and (3) decommission and drag the silt curtain out.

- To minimise impacts to the coral colonies (which is not considered unacceptable), translocating the potentially affected and movable (feasible for translocation) coral colonies is recommended. Local successful experience in coral translocation for the *Reconstruction of Pier at Pak A, Sai Kung* indicated that the important factors include:

  (1) short distance between donor site and receiving site;

  (2) movability of the coral colonies; and

  (3) provision of low impact and manual methodology for the coral translocation.

  A detailed coral survey would be conducted prior to works commencement to ascertain the existence of the coral colonies within the works site and silt curtain would not directly affect any coral cable route and silt curtain will take place to ensure that the impacts to corals are minimized whenever necessary. Translocation of the movable coral colonies recorded within the works site is considered as the last resort. Coral translocation works, if required, should be conducted two weeks before the commencement of the works. The coral colonies to be translocated should exhibit good health condition (without signs of stress). The methodology of the coral translocation is presented in *Table B15*. The detailed methodology and approach of the coral survey and translocation works should be approved by AFCD before the commencement of the coral survey and translocation works. The coral survey and translocation works shall be undertaken by a qualified person with a relevant ecology postgraduate degree and relevant experience in conducting such works.

Table B15 Proposed Methodology of Coral Translocation

List	Details
Assessment of Coral Status Prior to Translocation	Each coral colony should be identified within the proposed works site before translocation. The conditions of the coral colonies, including partial mortality, bleaching or lesions noted, and the type and size of the attached substrate should be recorded. Representative photographs of each of the coral colony recorded should also be taken.
Coral Translocation	The translocation of coral colonies should be carried out by manual lifting. To have a significantly higher chance of survival, all the corals colonies to be translocated should keep submerged at all times (not exposed to the atmosphere, wind and direct sunlight) during the moving process. The employment of a manual underwater method can ensure that translocated corals to be collected and moved carefully and deposited in the correct orientation. Identified coral colonies should be moved with the associated attached substrate, eg boulder, to the receiver site. Once the coral colony identification is underway a team of divers follow behind with the underwater lifter and remove the documented colonies in a consistent manner. Small moveable colonies could be transferred through the use of an underwater lifter. Underwater lifter consists of a 1 m^2 platform suspended underneath a 200 kg lift bag. Individual coral colonies can be placed on the platform by divers wearing gloves. An effort should be made to minimise the amount of contact by the divers and the length of time the coral colonies to be handled. Care should be taken with the use of the platform and the individual lifting exercises to avoid contact with the coral tissue at all times. Corals could be transferred to the northern side of Town Island West (near the existing pier) by attaching the lifter to the dive boat. The dive boat should be moved at constant slow speed (<2 knots). The vertical orientation of each coral colony should be maintained during the moving process. Once the lifter reached the receptor site, divers should position the coral loaded platform to a seabed free of coral colonies. Coral colonies should then be lifted individually from the platform and placed on the seabed carefully in order to minimise disturbance to the seabed sediments. Spacing between coral colonies should be matched as much as possible with the original distribution of the corals to avoid interspecific competition between different species.
Assessment of Translocated Coral Colonies	Each translocated coral colonies should be re-assessed immediate after the translocation. The conditions of the coral colonies, including partial mortality, bleaching or lesions noted, and the type and size of the attached substrate should be recorded. Representative photographs of each of the translocated coral colony recorded should also be taken.

Although unacceptable residual impacts to coral assemblages are not predicted to occur, water quality and coral monitoring during cable installation works will be undertaken to verify that the project has no adverse ecological impacts on the corals and the marine environment.

B1.8 *CONCLUSIONS*

A review of the baseline marine ecological conditions of Liu Ko Ngam and Pak Sha Tau Tsui in the vicinity of the proposed submarine cable alignment and landing sites have been undertaken.

The soft bottom benthic fauna have been identified to be of low ecological value. Although these soft bottom assemblages will be disturbed during the cable laying works, similar communities are predicted to colonise the habitats within a short period of time and thus the impacts are not regarded as unacceptable.

Based on the results of recent field surveys, the intertidal sandy and boulder shores found at the proposed cable landing sites support low abundances and diversity of intertidal organisms. Most of these species are common and widespread on other similar shores in Hong Kong, and are considered of low ecological value. Impacts to these assemblages are, therefore, not regarded as unacceptable.

A total of 18 and 16 hard coral species were recorded from the coral mapping surveys in the landing sites of Liu Ko Ngam and Pak Sha Tau Tsui, respectively. Generally, the coral species recorded in these two surveyed area can commonly be found throughout the eastern and northeastern waters of Hong Kong. The density of corals is low at both landing sites which is less than 1.3 colonies per m^2. Size of individual colonies was mostly smaller than 15 cm in diameter.

As a result of the cable installation works, it is expected that a total of 16 and 25 hard coral colonies would be potentially affected at the landing sites of Liu Ko Ngam and Pak Sha Tau Tsui, respectively. The affected coral colonies were generally small in size and of common distribution in northeastern and eastern waters of Hong Kong. Therefore, no unacceptable residual impacts to the coral assemblages are predicted to occur due to the project.

Indirect impacts associated with the change in water quality on the recorded coral communities, Yau Chau Tong Marine Park and Lai Chi Wo Beach SSSI are not regarded as significant due to the small scale of the works, the short duration of impacts, and the limited dispersion of sediment plume.

Impacts to marine ecological resources have largely been avoided through the selection of landing sites and cable alignment that minimises impacts to coral communities and through the employment of cable laying techniques that result in little disruption to the marine environment.

Mitigation measures that have been recommended to minimise impacts to water quality are also expected to control impacts to marine ecological resources, particularly the hard coral colonies in the vicinity of the cable alignment. These mitigation measures include the deployment of silt curtain around the works site, limiting the maximum speed of the cable laying machine and dredging rate, and implementing good house-keeping practices during land based activities. It is also recommended to undertake a coral translocation exercise in order to minimise the potential loss of corals at the landing sites of Liu Ko Ngam and Pak Sha Tau Tsui as a result of the cable landing works.

Annex B2
附錄乙2

Terrestrial Ecological Survey Data
陸地生態調查數據

Table B2.1 *Plant species recorded within the Terrestrial Study Area (March 2011)*

表乙2.1 *在研究範圍內錄得之植物品種（2011年3月）*

Species name 品種名稱	Chinese name 中文名稱	Growth form 生長形式	Status 狀況*	Liu Ko Ngam				Pak Sha Tau Tsui		
				Works Area 工程地點	Shrubby grassland 灌木草地	Young woodland 尚未成熟的樹林	Coastal vegetation 海岸植物	Works Area 工程地點	Shrubland 灌木	Coastal vegetation 海岸植物
Sageretia thea	雀梅藤	Shrub 灌木	Very Common 十分常見		2	2	2	1	4	2
Psychotria asiatica	山大刀	Shrub 灌木/Tree 喬木	Very Common 十分常見	1		3	1	1	3	1
Rhaphiolepis indica	車輪梅	Shrub 灌木/Tree 喬木	Very Common 十分常見	1	2	2	2		3	
Millettia nitida	亮葉崖豆藤	Climber 攀爬類	Very Common 十分常見	3		4	1		1	
Schefflera heptaphylla	鵝掌柴	Tree 喬木	Very Common 十分常見	2		4			3	
Clerodendrum inerme	苦郎樹	Shrub 灌木	Common 常見				4			4
Caesalpinia crista	華南雲實	Climber 攀爬類	Very Common 十分常見	3		4				
Pandanus tectorius	露兜樹	Tree 喬木	Very Common 十分常見				2	2		3
Cassytha filiformis	無根藤	Climber 攀爬類	Very Common 十分常見		3			1	2	
Hibiscus tiliaceus	黃槿	Tree 喬木	Very Common 十分常見				2	2		2
Paliurus ramosissimus	馬甲子	Tree 喬木	Common 常見				3			3
Rhus succedanea	野漆	Shrub 灌木/Tree 喬木	Common 常見			3			2	1
Sterculia lanceolata	假蘋婆	Tree 喬木	Very Common 十分常見			3		1	2	
Vitex rotundifolia	單葉蔓荊	Shrub 灌木	Common 常見				2			4
Cerbera manghas	海杧果	Tree 喬木	Common 常見				2			3
Dalbergia benthamii	兩廣黃檀	Climber 攀爬類	Common 常見		1	2			2	
Microcos paniculata	布渣葉	Shrub 灌木/Tree 喬木	Common 常見		1	2			2	
Tetracera asiatica	錫葉藤	Climber 攀爬類	Very Common 十分常見	2		3				
Ampelopsis cantoniensis	廣東蛇葡萄	Climber 攀爬類	Very Common 十分常見	1		3				
Cratoxylum cochinchinense	黃牛木	Shrub 灌木/Tree 喬木	Very Common 十分常見						4	
Lantana camara	馬纓丹	Shrub 灌木	Very Common 十分常見					2		2
Miscanthus sinensis	芒	Herb 草本	Very Common 十分常見		4					
Phyllanthus cochinchinensis	越南葉下珠	Shrub 灌木	Very Common 十分常見			2	2			
Rhodomyrtus tomentosa	崗棯	Shrub 灌木	Very Common 十分常見						2	2
Baeckea frutescens	崗松	Shrub 灌木	Very Common 十分常見		3					
Byttneria aspera	刺果藤	Climber 攀爬類	Very Common 十分常見			2			1	
Gnetum luofuense	羅浮買麻藤	Climber 攀爬類	Very Common 十分常見	1		2				
Ilex asprella	梅葉冬青	Shrub 灌木	Very Common 十分常見	1		2				
Litsea rotundifolia	豺皮樟	Shrub 灌木	Very Common 十分常見		1	2				
Mallotus paniculatus	白楸	Tree 喬木	Very Common 十分常見		1	2				
Syzygium hancei	韓氏蒲桃	Tree 喬木	Common 常見						2	1
Vitex negundo	黃荊	Shrub 灌木	Common 常見					1		2
Acronychia pedunculata	山油柑	Tree 喬木	Very Common 十分常見			2				
Aporusa dioica	銀柴	Tree 喬木	Very Common 十分常見			2				
Bauhinia glauca	羊蹄甲藤	Climber 攀爬類	Very Common 十分常見			2				
Breynia fruticosa	黑面神	Shrub 灌木	Very Common 十分常見				1		1	
Bridelia tomentosa	土蜜樹	Shrub 灌木/Tree 喬木	Very Common 十分常見						2	
Dicranopteris pedata	芒萁	Fern 蕨類	Very Common 十分常見						1	1
Diospyros eriantha	烏柿	Tree 喬木	Very Common 十分常見			1	1			
Elaeocarpus sylvestris	山杜英	Tree 喬木	Very Common 十分常見	1		1				

Species name 品種名稱	Chinese name 中文名稱	Growth form 生長形式	Status 狀況*	Liu Ko Ngam				Pak Sha Tau Tsui		
				Works Area 工程地點	Shrubby grassland 灌木草地	Young woodland 尚未樹林	Coastal vegetation 海岸植物	Works Area 工程地點	Shrubland 灌木	Coastal vegetation 海岸植物
Embelia ribes	白花酸藤子	Climber 攀爬類	Common 常見						2	
Excoecaria agallocha	海漆	Tree 喬木	Common 常見				2			
Gymnema sylvestre	匙羹藤	Climber 攀爬類	Very Common 十分常見			2				
Loeseneriella concinna	希藤	Climber 攀爬類	Common 常見			1	1			
Melastoma sanguineum	毛稔	Shrub 灌木	Very Common 十分常見						2	
Millettia speciosa	美麗崖豆藤	Climber 攀爬類	Common 常見	1		1				
Photinia benthamiana	閩粵石楠	Tree 喬木	Common 常見			1	1			
Phyllanthus reticulatus	小果葉下珠	Shrub 灌木	Common 常見					1		1
Pinus massoniana	馬尾松	Tree 喬木	Common 常見						2	
Scolopia chinensis	刺柊	Tree 喬木	Common 常見			1				1
Cymbopogon hamatulus	扭鞘香茅	Herb 草本 草本	Very Common 十分常見							2
Smilax glabra	土茯苓	Climber 攀爬類	Very Common 十分常見	1		1				
Viburnum odoratissimum	珊瑚樹	Tree 喬木	Very Common 十分常見					1	1	
Wikstroemia indica	了哥王	Shrub 灌木	Common 常見				1			1
Zanthoxylum avicennae	簕欓花椒	Tree 喬木	Common 常見	1		1				
Zanthoxylum nitidum	兩面針	Climber 攀爬類	Very Common 十分常見						2	
Albizia corniculata	天香藤	Climber 攀爬類	Common 常見						1	
Archidendron lucidum	亮葉猴耳環	Tree 喬木	Common 常見			1				
Atalantia buxifolia	酒餅簕	Shrub 灌木	Common 常見		1					
Berchemia floribunda	多花勾兒茶	Climber 攀爬類	Common 常見			1				
Caryopteris incana	蘭香草	Herb 草本 草本	Common 常見				1			
Cinnamomum camphora	樟	Tree 喬木	Common 常見			1				
Croton lachnocarpus	毛果巴豆	Shrub 灌木	Very Common 十分常見			1				
Dalbergia hancei	藤黃檀	Climber 攀爬類	Common 常見						1	
Daphniphyllum calycinum	牛耳楓	Tree 喬木	Common 常見			1				
Derris alborubra	白花魚藤	Climber 攀爬類	Common 常見							1
Thuja orientalis	側柏	Tree 喬木	不適用							1
Diospyros vaccinioides	小果柿	Shrub 灌木	Very Common 十分常見			1				
Diplospora dubia	狗骨柴	Shrub 灌木/Tree 喬木	Common 常見			1				
Embelia laeta	酸藤子	Climber 攀爬類	Very Common 十分常見		1					
Euonymus nitidus	中華衛矛	Shrub 灌木	Very Common 十分常見			1				
Ficus hirta	粗葉榕	Shrub 灌木	Common 常見			1				
Ficus microcarpa	細葉榕	Tree 喬木	Common 常見						1	
Ficus subpisocarpa	筆管榕	Tree 喬木	不適用				1			
Garcinia oblongifolia	黃牙果	Tree 喬木	Very Common 十分常見			1				
Glochidion lanceolarium	艾膠算盤子	Shrub 灌木	Common 常見							1
Heterosmilax japonica	肖菝葜	Climber 攀爬類	Common 常見						1	
Lespedeza chinensis	中華胡枝子	Shrub 灌木	Restricted 受局限				1			
Liriope spicata	山麥冬	Herb 草本	不適用				1			
Litsea glutinosa	潺槁樹	Tree 喬木	Very Common 十分常見						1	
Lygodium japonicum	海金沙	Fern 蕨類	Very Common 十分常見						1	
Machilus chekiangensis	浙江潤楠	Tree 喬木	Very Common 十分常見						1	
Machilus velutina	絨毛潤楠	Tree 喬木	Common 常見			1				

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				Works Area 工程地點	Shrubby grassland 灌木草地	Young woodland 尚未成熟的樹林	Coastal vegetation 海岸植物	Works Area 工程地點	Shrubland 灌木	Coastal vegetation 海岸植物
Maclura cochinchinensis	構棘	Climber 攀爬類	Common 常見				1			
Melodinus suaveolens	山橙	Climber 攀爬類	Common 常見			1				
Merremia umbellata	山豬菜	Climber 攀爬類	Common 常見			1				
Clausena lansium	黃皮	Tree 喬木	不適用							1
Psidium guajava	番石榴	Tree 喬木	不適用							1
Phyllanthus emblica	油甘子	Tree 喬木	Very Common 十分常見						1	
Psychotria serpens	蔓九節	Climber 攀爬類	Very Common 十分常見							1
Rourea microphylla	小葉紅葉藤	Climber 攀爬類	Common 常見			1				
Sapium discolor	山烏桕	Tree 喬木	Very Common 十分常見			1				
Asparagus cochinchinensis	天門冬	Herb 草本	Common 常見							1
Centella asiatica	崩大碗	Herb 草本	Very Common 十分常見							1
Symplocos glauca	羊舌樹	Tree 喬木	Common 常見			1				

Notes 註：

* Status according to Corlett, R., Xing, F. W., Ng, S. C., Lawrence, Chau K. C. & Laura, Wong M. Y. (2000). *Hong Kong vascular plants: distribution and status*. Memoirs of the Hong Kong Natural History Society. 23: 1-147.

* 表中所列狀況，是根據 Corlett, R., Xing, F. W., Ng, S. C., Lawrence, Chau K. C. & Laura, Wong M. Y. (2000). 「香港維管植物：分佈和狀況」。香港自然史學會紀念集。 23: 1-147.

† Origin according to AFCD website. Available at http://www.afcd.gov.hk/english/conservation/hkbiodiversity/database/search.asp?lang=en&refine=1 [Accessed May 2010]

† 根據漁農自然護理署網頁所述原生地。有關資料，可於以下網址取得： http://www.afcd.gov.hk/english/conservation/hkbiodiversity/database/search.asp?lang=en&refine=1 〔於 2010 年 5 月瀏覽〕

Relative abundance: 1 = Scarce; 2 = Occasional; 3 = Frequent; 4 = Abundant

相對數量： 1 = 稀少； 2 = 偶有發現； 3 = 經常發現； 4 = 數量豐富

Annex C

Assessment of Potential Impacts to Fisheries Resources and Fishing Operations

C1 FISHERIES ASSESSMENT

C1.1 INTRODUCTION

This *Annex* presents information on the existing fisheries resources and fishing operations within and adjacent to the proposed cable corridor and evaluates the potential for direct and indirect impacts to these resources. No impacts are expected to occur during the operation of the submarine cables. The cable is unlikely to be damaged by fishing activity, as it will be buried to a depth of not less than 5 m within the seabed for the majority of the cable corridor, and the seabed will be reinstated to the before-work level and condition very shortly. As a result, impacts to fisheries resources during the operation of the cable will not be discussed further.

C1.2 RELEVANT LEGISLATION, GUIDELINES AND ASSESSMENT CRITERIA

The criteria for evaluating fisheries impacts are laid out in *Annex 17* of the *EIAO TM* and *Annex 9* of the *EIAO TM* recommends some general criteria that can be used for evaluating fisheries impacts. Other legislation which applies to fisheries resources include: the *Fisheries Protection Ordinance (Cap 171)* which provide for the conservation of fish and other aquatic life and regulates fishing practices; and the *Marine Fish Culture Ordinance (Cap 353) 1983* which regulates and protects marine fish culture and other related activities.

C1.3 BASELINE CONDITIONS & SENSITIVE RECEIVERS

In Hong Kong, the commercial marine fishing industry is divided into capture and culture fisheries. As a result, the following baseline information is presented under the headings Capture Fisheries and Culture Fisheries. The baseline has been derived from the most up-to-date information on the Hong Kong fishery (1). Information from other relevant studies were also reviewed in order to determine if the waters of the proposed cable corridor are important spawning grounds or nursery areas for commercial fisheries (2) . Mariculture information was obtained from the Agriculture, Fisheries and Conservation Department (AFCD) Annual Reports (3).

(1) Agriculture, Fisheries and Conservation Department (2006) Port Survey 2006. Hong Kong SAR Government.
(2) ERM - Hong Kong, Ltd (1998) Fisheries Resources and Operations in Hong Kong Water. Final Report for the Agriculture, Fisheries and Conservation Department. Hong Kong SAR Government.
(3) Agriculture, Fisheries and Conservation Department Annual Report 2011 -2012. [*http://www.afcd.gov.hk/misc/download/annualreport2012/index.html*] Accessed in May 2013.

C1.3.1 *Capture Fisheries*

Fishing Operations

The area and number of vessels operating in Hong Kong waters during 2005 are presented in *Figure C1* (4). Moderate numbers of fishing vessels (100 – 400 vessels), mostly purse seiners and sampans, operated in waters around the proposed cable system in 2005. These vessels, which are less than 15 m in length, are the major type of fishing operation vessels along the cable route (*Figure C2*).

Figure C1 ***Distribution of Fishing Operations (All Vessels) in Hong Kong Waters as recorded by AFCD Port Survey 2006***

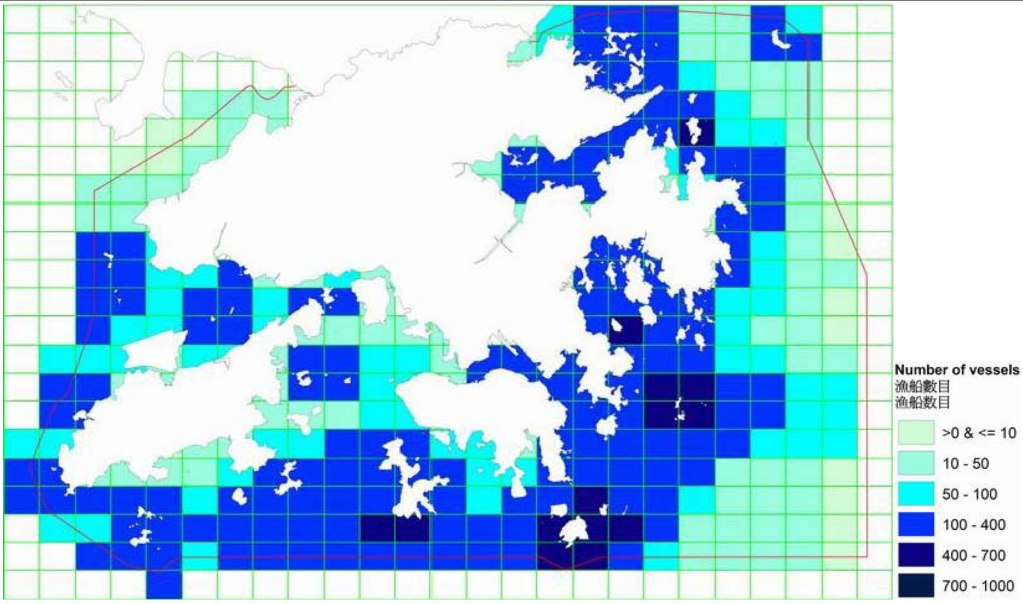
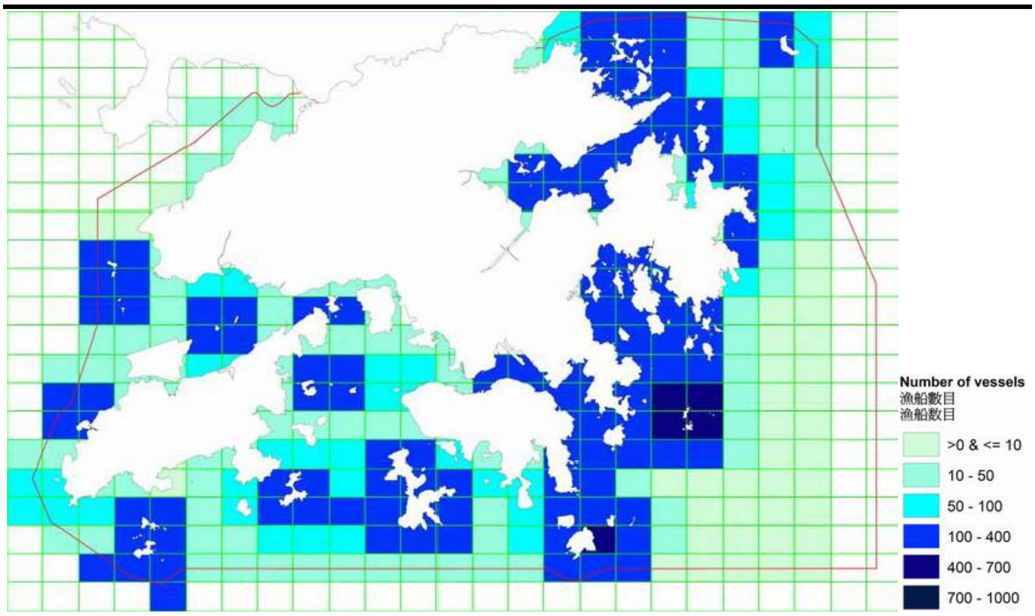


Figure C2 ***Distribution of Fishing Operations (Vessels not exceeding 15 m in length) in Hong Kong Waters as recorded by AFCD Port Survey 2006***



(4) AFCD (2013) Fisheries: Capture Fisheries Latest Status. Accessed in May 2013. [*http://www.afcd.gov.hk/english/fisheries/fish_cap/fish_cap_latest/fish_cap_latest.html*]

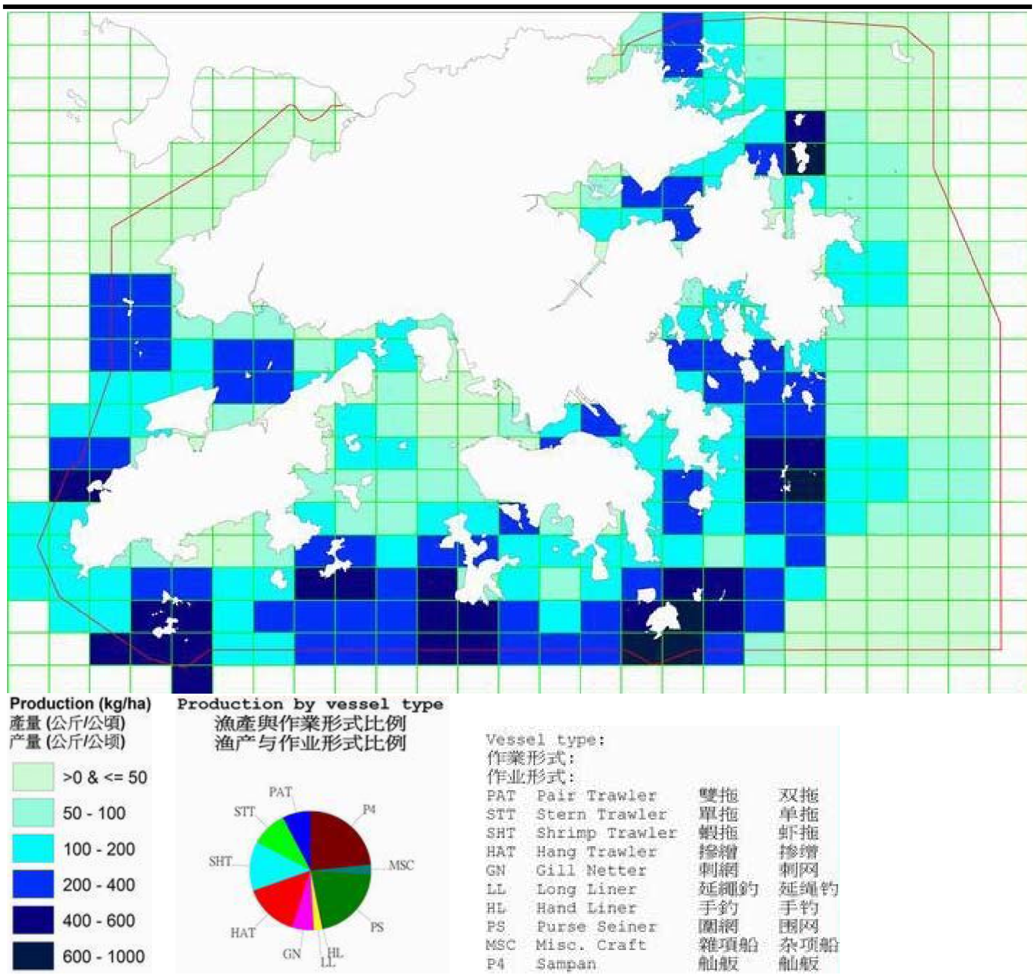
Fisheries Production

Although no figures are available on the individual location in Hong Kong waters, it is estimated that Hong Kong fisheries production in 2012 totalled 155,230 tonnes (5).

Data from the AFCD Port Survey 2006 indicated that fisheries production in waters around the proposed cable system in Kat O waters in 2005 was moderate, with 200 – 400 kg ha^{-1} for adult fish and with ≤ 50 tails ha^{-1} fish fry production and accounting for HK$ 5,000 to $10,000 ha^{-1} in value (*Figures C3 – C5*) (6).

For waters in Yan Chau Tong, low level of adult fisheries production (100 – 200 kg ha^{-1}) and moderate level of fish fry production (50 – 100 tails ha^{-1}) were recorded, accounting for HK$ 2,000 – 5,000 ha^{-1} in value (*Figures C3 – C5*).

Figure C3 ***Distribution of Fisheries Production (Adult Fish) in terms of Weight (kg ha^{-1}) in Hong Kong Waters as recorded by AFCD Port Survey 2006***



(5) AFCD (2013) Fisheries: Aquaculture Latest Status. Accessed in May 2013. [*http://www.afcd.gov.hk/english/fisheries/fish_aqu/fish_aqu_mpo/fish_aqu_mpo.html*]
(6) AFCD (2013) *Op Cit.*

Figure C4 *Distribution of Fisheries Production (Fish Fry) in terms of tails ha^{-1} in Hong Kong Waters as recorded by AFCD Port Survey 2006*

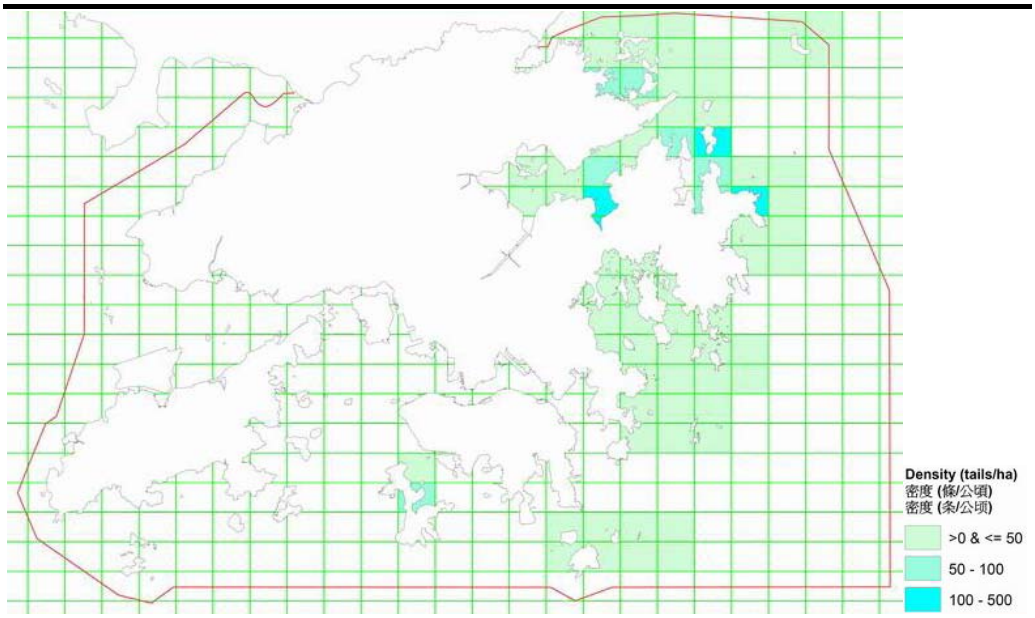
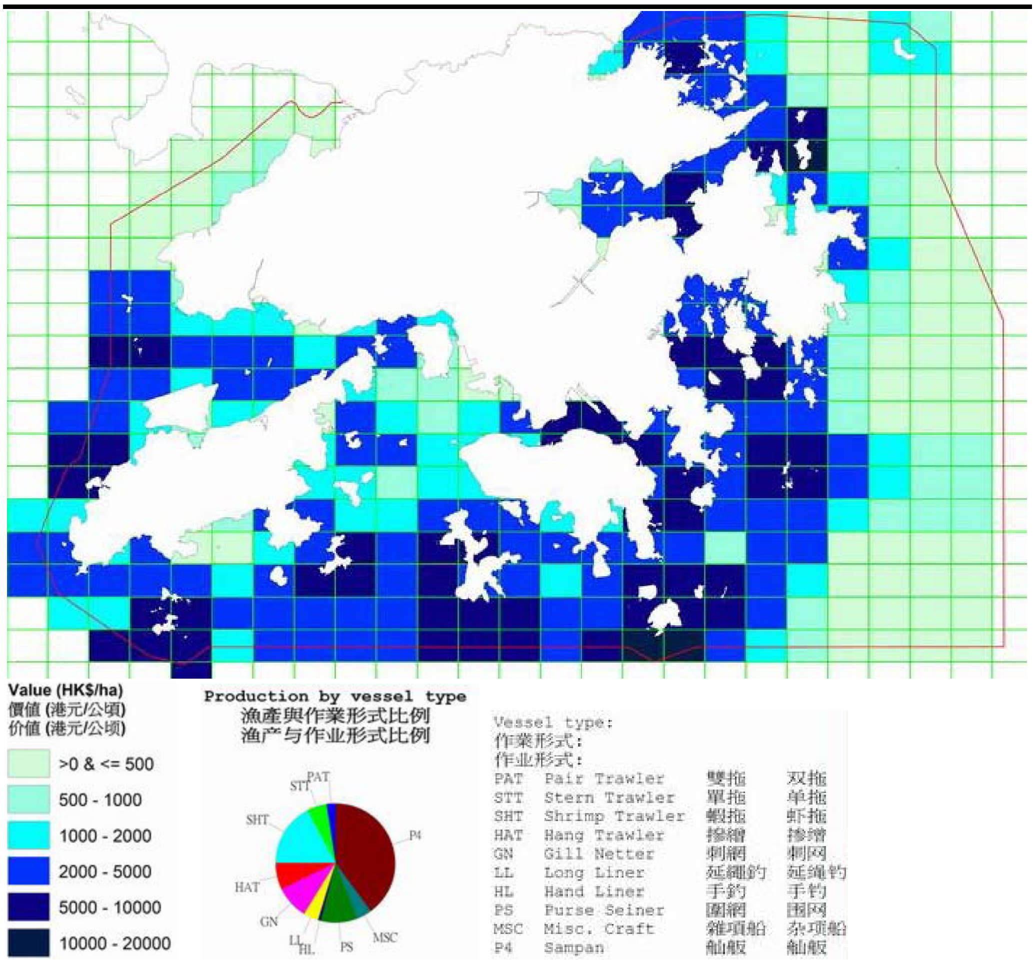


Figure C5 *Distribution of Fisheries Production (Adult Fish & Fish Fry) in terms of Value (HK$ ha^{-1}) in Hong Kong Waters as recorded by AFCD Port Survey 2006*



C1.3.2 Culture Fisheries

The nearest Fish Culture Zone to the proposed submarine cable is located at Sai Lau Kong, which is approximately 510 m southeast of the cable route. Other FCZs, namely O Pui Tong, Kat O and Ap Chau, are all situated over ~1.5 km from the proposed submarine cable route (refer to *Figure 1.2* of the main text).

Although no figures are available on the individual production of these FCZs, it is known that Hong Kong production in 2012 totalled 1,299 tonnes (7). The fish species commonly cultured in FCZs are of high commercial value including the giant grouper (*Epinephelus lanceolatus*), mangrove snapper (*Lutjanus argentimaculatus*) and the pompano (*Trachinotus blochii*).

C1.3.3 Nursery and Spawning Grounds of Commercial Fisheries Resources

The area transversed by the cable alignment was previously identified as nursery and spawning grounds of commercially fisheries resources (8) (refer to *Figure 1.2* of the main text). Spawning of majority of species appears to be concentrated during the period from June to September in Hong Kong waters, and this is assumed that spawning of fishes in this area is also concentrated in this period. As previously mentioned, the fish fry production from the area traversed by the cable route was moderate showing production of 50-100 tails ha^{-1} (*Figure C4*).

C1.3.4 Artificial Reef Deployment

The AFCD has been undertaking a programme to enhance existing marine habitats and fisheries resources through the siting, construction and deployment of artificial reefs (ARs). Generally ARs provide hard bottom, high profile habitat in areas without natural cover and may potentially act as fish enhancement devices. The Yan Chau Tong Marine Park and O Pui Tong ARs were deployed with the key objective of enhancing the marine habitat quality and fisheries resources (refer to *Figure 1.2* of the main text). A total of 19,820 m^3 consisting of boat, tyre, concrete-coated tyre, quarry rock, pre-cast concrete and biofilter core have been deployed on the seabed from 1998 to 2003 in Yan Chau Tong Marine Park. For O Pui Tong, a total of 4 units with volume of 200 m^3 tyre modules were deployed in 2000. They are located at least 1 km away from the proposed cable route, and are considered unlikely to be affected by the construction and operation of this Project due to the large separation distance. Results of the water quality modelling exercise support this conclusion (*Annex A*).

(7) AFCD (2013) Fisheries: Aquaculture Latest Status. Accessed in May 2013. [*http://www.afcd.gov.hk/english/fisheries/fish_aqu/fish_aqu_mpo/fish_aqu_mpo.html*]
(8) ERM - Hong Kong (1998) Fisheries Resources and Operations in Hong Kong Waters. *Op cit.*

C1.4 *FISHERIES IMPORTANCE*

Based on the preceding review of the available information, the fishing grounds within the Study Area are considered to be of moderate value and importance compared to other fishing grounds in Hong Kong.

C1.5 *SENSITIVE RECEIVERS*

Based on the preceding review of the available information on the capture and culture fisheries of the waters in the vicinity of the proposed cable system, the potential sensitive receivers that may be affected are identified as follows:

- Fish Culture Zones at Sai Lau Kong, O Pui Tong, Kat O and Ap Chau
- Recognised Nursery and Spawning Grounds of Commercial Fisheries Resources
- Artificial reefs in the Yan Chau Tong Marine Park and O Pui Tong

C1.6 *IMPACT ASSESSMENT*

C1.6.1 *Identification of Potential Fisheries Impacts*

Direct Impacts

The proposed cables will be submerged through the jetting technique to a depth of 5 m within the seabed. Through the employment of this burial technique, the seabed will be reinstated by resettlement of disturbed sediments and natural erosion. Recolonisation of the sediments by benthic infauna is expected to occur, therefore, providing food for bottom dwelling fisheries resources. Minor interruptions to fishing operations are expected to occur only during the cable installation phase of the proposed project. These disruptions are, however, minimal as the duration of time required for cable installation has been determined to be about 4 weeks. Following completion of construction works, it is anticipated that the seabed would be reinstated with natural backfill and the level will be at its original state. Therefore, no long-term direct impacts to fisheries resources or fishing operations are expected to occur aside from minor short-term disturbances to the seabed in the immediate vicinity of cable laying activities. These disturbances are not predicted to affect either fisheries resources or fishing operations.

Indirect Impacts

Indirect impacts may occur through elevation in suspended solids (SS) resulting from the disturbance of the seabed through the burial of the cables. However, elevation in SS due to dredging at the two landing sites is expected to be highly localised (within 60 m from the cable alignment and within 300 m from the two landing sites of dredging operation) and would not attain levels that would cause concern with regards to fisheries resources beyond the immediate vicinity of the works. The nearest Fish Culture Zone to the proposed submarine cable and landing site is located at Sai Lau Kong, which is approximately 500 m southeast of the cable route. Other FCZs, namely O Pui Tong, Kat O and Ap Chau, are all situated over ~1.5 km from the proposed submarine cable route and landing site. Sediments that may be lost in suspension are likely to remain in the lower part of the water column and settle back onto the seabed within a short period of time. Cable laying and burial at the shore is not predicted to cause unacceptable impacts to water quality and consequently unacceptable impacts to fisheries will not occur. As a result, indirect impacts to fisheries resources are predicted to be minimal.

C1.6.2 Impact Evaluation

From the information presented above, the fisheries impact associated with the Project is considered to be low. An evaluation of the impact in accordance with the *EIAO TM Annex 9* is presented as follows:

- *Nature of Impact:* As a result of the small scale and relatively localized disturbances to the seabed, no unacceptable impacts to fisheries resources and subsequently fishing operations are predicted to occur during the cable laying process or during operation.

- *Size of Affected Area:* The total length of the cable in Hong Kong waters is approximately 880 m. The construction of the Project will not result in the direct loss of fisheries habitats within the Study Area. Temporary loss of fisheries habitats / fishing ground within the Study Area would be resulted from the jetting and dredging operation, due to the small size of the temporary affected areas and short duration, no unacceptable impacts are predicted. Further to the water quality assessment, negligible impacts to fisheries will be expected due to the long separation distance between most of the sensitive receivers and the Project Site as well as the small scale of the construction works. Elevations in SS associated with dredging works are expected to be highly localised (within 60 m from the cable alignment and within 300 m from the two landing sites of dredging operation). Jetting works would cause minor disturbance of the seabed.

- *Size of Fisheries Resources/Production:* The fishing areas in vicinity of the proposed cable system are of moderate ranking for adult fish production in Hong Kong Waters. Due to the small size of the directly affected areas and short duration, the influence on fisheries resources/production should be negligible and acceptable.

- *Destruction and Disturbance of Spawning and Nursery Grounds:* The proposed cable route passes through waters that have been identified as nursery and spawning grounds. The cable laying works are of relatively short duration in Hong Kong, and given that sediment will disperse a maximum of 60 m from the alignment during jetting operations and 300 m from the two landing sites of dredging operation, the construction and operation of the proposed submarine cable system is not expected to result in unacceptable impacts to nursery and spawning grounds in Hong Kong waters.

- *Impact on Fishing Activity:* Based on the small size of the affected areas; and because no changes in seabed character would occur to affect fisheries operations; and because the construction works would be restricted to the foreshore at Liu Ko Ngam and Pak Sha Tau Tsui and the proposed cable (approximately 880 m in length), the impacts on fishing activities are expected to be negligible.

- *Impact on Aquaculture Activity:* Given the increase in SS elevations during jetting and dredging works would be highly localised and minimal, impact on Fish Culture Zone activity is not expected.

C1.7 MITIGATION MEASURES

Impacts to fisheries resources and fishing operations have largely been avoided as good construction practice and associated measures have been recommended in the *Water Quality Assessment* (see *Annex A*). Hence, no fisheries-species mitigation measures are required during installation of the submarine cable.

C1.8 CONCLUSIONS

Reviews of existing information on commercial fisheries resources and fishing operations located within the assessment area have been undertaken. Information from a study on fishing operations in Hong Kong and the most up-to-date AFCD Port Survey indicated that fisheries production values in the vicinity of the assessment area vary but are generally moderate.

Sensitive receivers including nursery area, artificial reefs and Fish Culture Zones have been identified; however, the assessment of water quality impacts demonstrated that these areas will not be affected.

During the cable installation, the predicted elevations of suspended sediment at this locality are negligible. Similarly elevated SS levels arising due to dredging works are expected to be highly localised and are not expected to impact commercial fishery resources in the vicinity of the works. Despite disturbance to the seabed, cable laying would not cause temporary or permanent loss of fishing ground. Furthermore, no impacts on fisheries operations, following completion of cable laying works, are expected as the seabed will be restored to its original profile.

No specific mitigation measures are required for fisheries resources. Mitigation measures recommended to reduce impacts to water quality are also expected to mitigate any impacts to fisheries resources. No adverse residual impact due to the construction of the submarine cable is expected after the implementation of the proposed mitigation measures to control water quality impacts. The implementation of the water quality mitigation measures stated in the *Water Quality Assessment* should be checked as part of the environmental monitoring and audit procedures during the construction period. No other fisheries-specific measures are considered necessary.

Annex D

MAI

Annex D1

Marine Archaeological Investigation

CONTENTS

D1 MARINE ARCHAEOLOGICAL INVESTIGATION

D1.1 INTRODUCTION

This *Annex* presents a Marine Archaeological Investigation (MAI) of the Project Site which includes the 11kV 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.

It should be noted that a separate *Marine Archaeological Investigation Report* was submitted to Antiquities and Monuments Office (AMO) on 18 November 2010 and comments were received from AMO on 17 December 2010 and 8 February 2011.

D1.2 LEGISLATIVE REQUIREMENTS AND EVALUATION CRITERIA

The following legislation and guidelines are applicable to the assessment of marine archaeological sites in Hong Kong:

- *Environmental Impact Assessment Ordinance (Cap. 499) and the associated Technical Memorandum on the EIA Process (EIAO-TM);*
- *Antiquities and Monuments Ordinance (Cap. 53);*
- *Land (Miscellaneous Provisions) Ordinance (Cap. 28);*
- *Hong Kong Planning Standards and Guidelines; and*
- *Guidelines for Marine Archaeological Investigation prepared by AMO.*

D1.2.1 ***Environmental Impact Assessment Ordinance Technical Memorandum on the EIA Process***

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."

D1.2.2 Antiquities And Monuments Ordinance, Cap. 53

The *Antiquities and Monuments Ordinance (Cap. 53)* (*AM Ordinance*) provides statutory protection against the threat of development on Declared Monuments, historical buildings and site of archaeological interest to enable their preservation for posterity. The *AM Ordinance* also establishes the statutory procedures to be followed in making such a declaration.

"This Ordinance provides for the preservation of objects of historical, archaeological and palaeontological interest…"

The Ordinance defines an antiquity as a relic (a movable object made before 1800) and a place, building, site or structure erected, formed or built by human agency before the year 1800. The Ordinance also states, amongst other things, that the discovery of an antiquity shall be reported to the Authority (Secretary for Development); that ownership of all relics discovered after 1976 shall be vested in the Government; that the Authority can declare a place, building, site or structure to be a monument, historical building or archaeological or palaeontological site or structure (and therefore introducing certain additional controls for these sites); and that licences and permits can be granted for excavation and for other work.

Over the years, surveys have been undertaken to identify sites of archaeological interest in Hong Kong. The AMO has established boundaries for the identified sites and a set of administrative procedures for the protection of the known sites of archaeological interest. However, the present record of sites of archaeological interest 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.

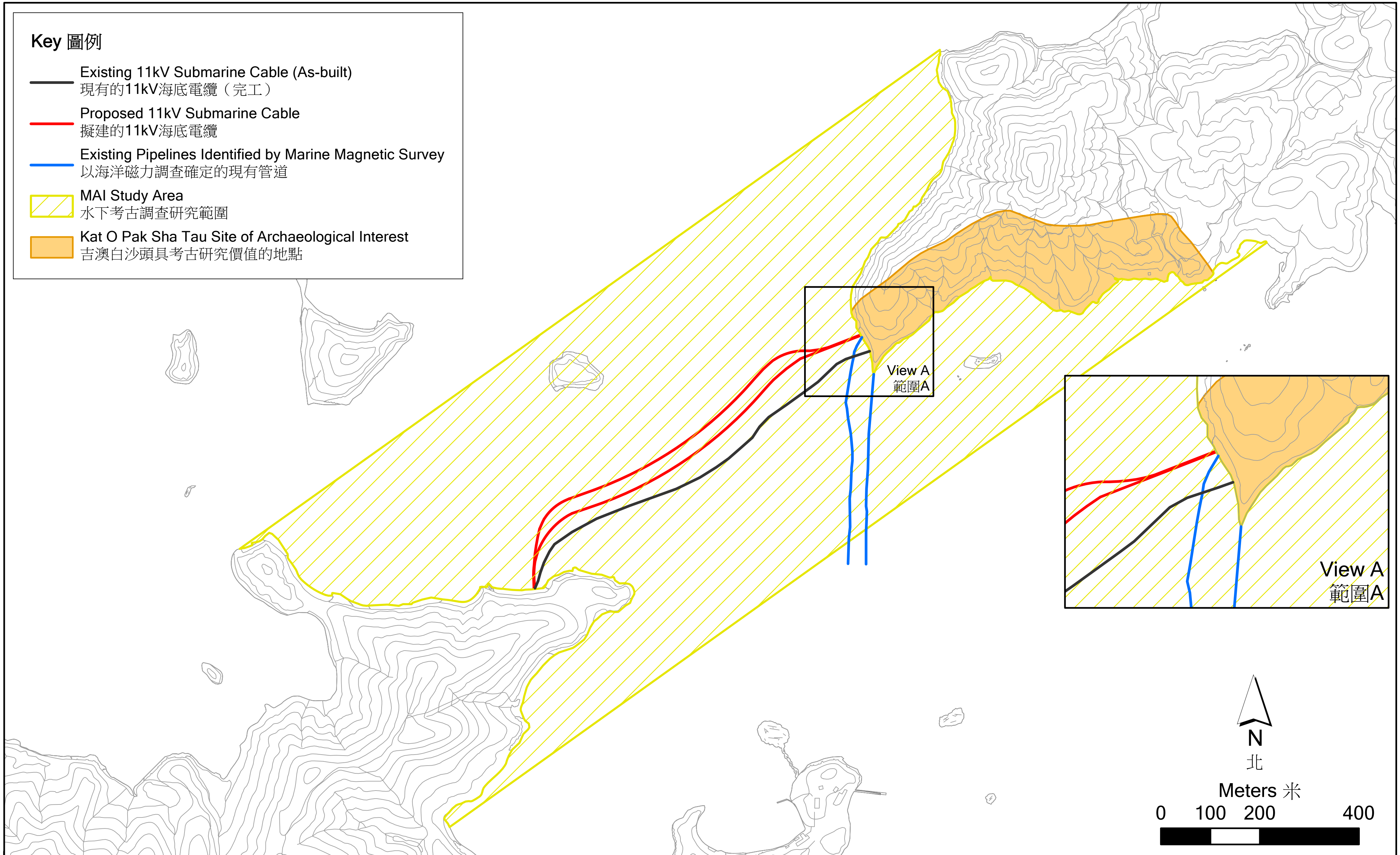


Figure D1-1
圖D1-1

MAI Study Area

水下考古調查研究範圍

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Date: 17-Oct-2012

Environmental Resources Management

ERM

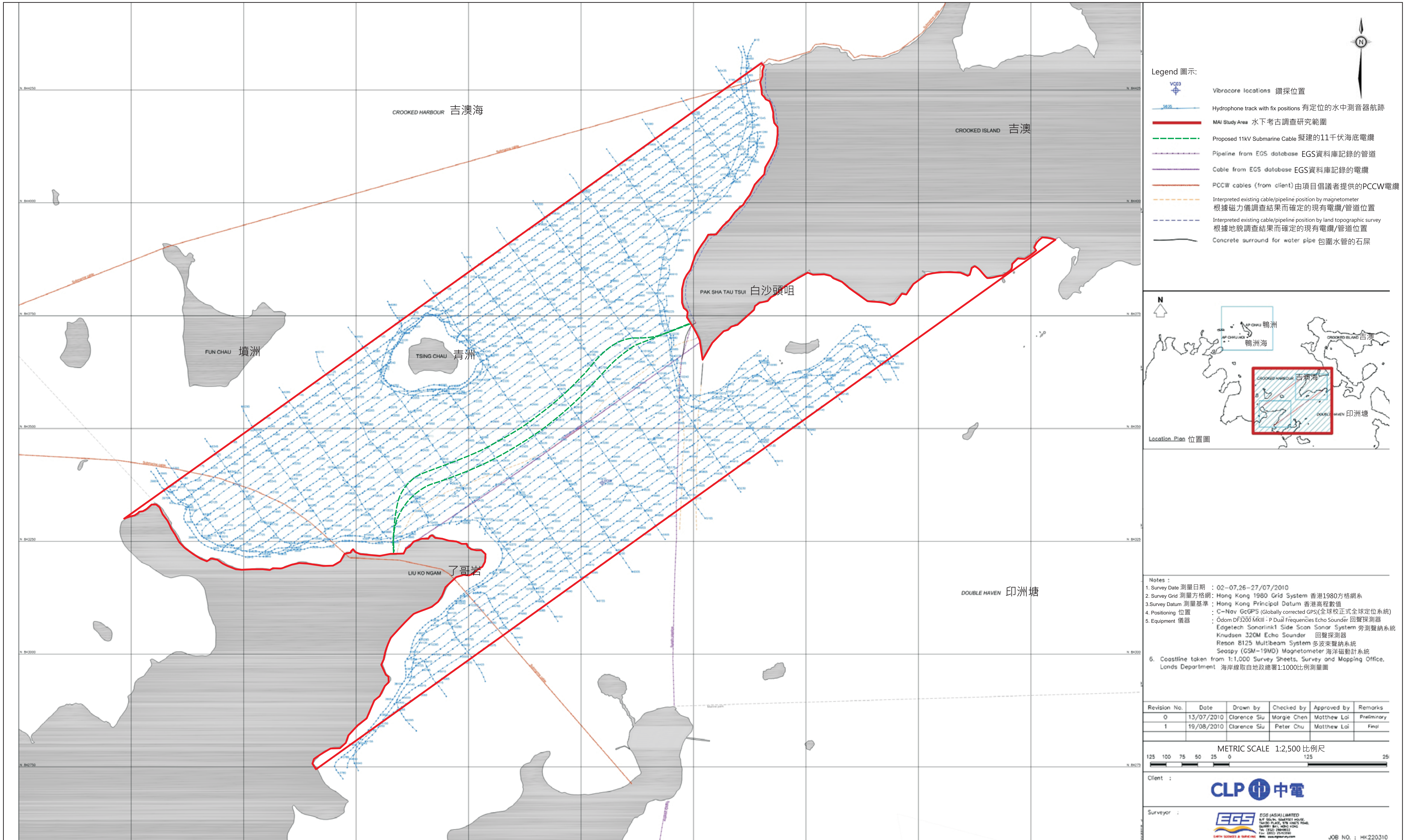

Figure D1-2

圖D1-2

Hydrophone Track Plot 水中測音器航跡圖

Environmental Resources Management

ERM

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DATE: 16/10/2012

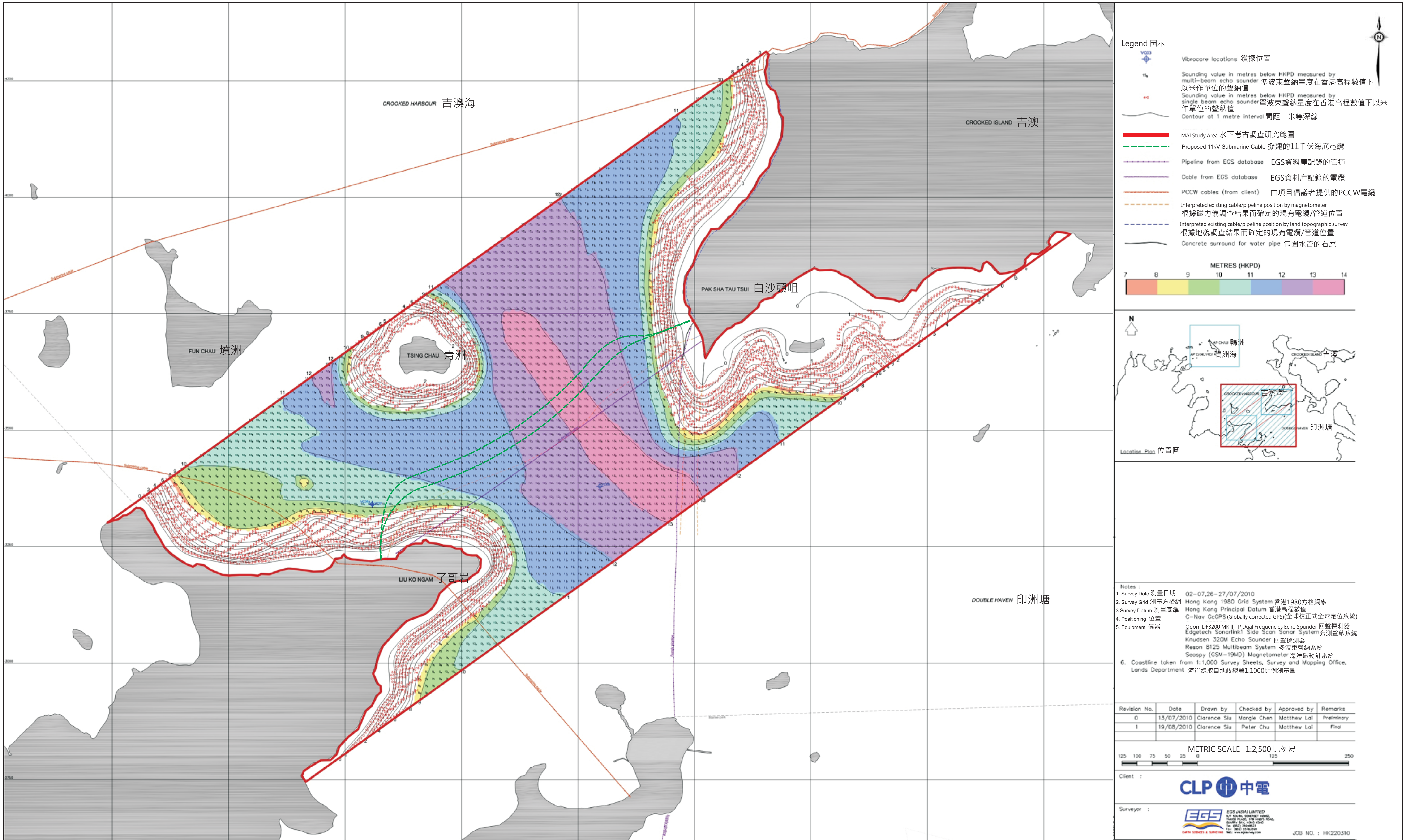

Figure D1-3

圖 D1-3

Seabed Levels 海床標高

Environmental Resources Management

ERM

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DATE: 16/10/2012

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 (AAB)(1), is formally notified of archaeological resource which are discovered during the assessment or construction of a project.

D1.2.3 Land (Miscellaneous Provisions) Ordinance (Cap. 28)

Under this *Ordinance*, it is required that a permit should be obtained for any excavation within the Government land prior to any excavation work commencing.

D1.2.4 Hong Kong Planning Standards And Guidelines

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

D1.2.5 Marine Archaeological Investigation (MAI) Guidelines

Guidelines for MAI which detail 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 can be found in *Annex D1-1*. Baseline review, geophysical survey and establishing archaeological potential are considered the first stage (Phase I) of a MAI. Subject to the results of the first stage MAI, further investigation may or may not be required.

D1.3 ASSESSMENT METHODOLOGY

D1.3.1 Marine Archaeological Investigation (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.

D1.3.2 Study Area

The Study Area for this MAI is defined as the potential area feasible for the proposed development as shown in *Figure D1-1*. The MAI Study Area shall include area within a distance range between 297m and 380m from the proposed 11kV submarine cable in Kat O.

(1) The Antiquities and Monuments Office is the entry point to pass information to the AAB. The AAB is a statutory body consisting of expertise in relevant fields to advise on any matters relating to antiquities and monuments.

D1.3.3 Desktop Study

A desktop research 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.

D1.3.4 Geophysical Survey

A geophysical survey was undertaken by EGS (Asia) Limited from 2 to 7 July 2010 to exam the seabed and below seabed in order to locate and define any sites of marine archaeological potential in the Study Area.

The geophysical survey involved a seismic boomer, multibeam sonar, echo sounder, magnetometer and side scan sonar survey using two different vessels to suit the instruments and the survey locations (see *Figure D1-2*). A 700 metre wide survey corridor centred on the preliminary proposed cable route was surveyed. The main survey traverses were carried out in a NE-SW orientation 20 metres apart, and cross traverses 100 metres apart were also implemented. A total of 136 km of survey traverses were completed. From the 26 - 27 July 2010, nine vibrocores were taken along the proposed cable route using a third vessel. These surveys and the vibrocoring allowed for a comprehensive investigation of the seabed, and below the seabed. The depth of water in the Study Area varied from 0.3 to 13.2 metres (see *Figure D1-3*).

The following equipment was employed during the geophysical surveys:

- C-Nav GcGPS (Globally corrected GPS)
- Odom DF 3200 MKIII-P Dual Frequencies Echo Sounder
- Reson 8125 multibeam system
- Edgetech Sonarlink1 Side Scan Sonar System
- High Resolution sub-bottom profiler
- Knudsen 320M Echo Sounder
- Seaspy (GSM-19MD) Magnetometer

D1.3.5 Establish Marine 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.

D1.3.6 Impact Assessment and Recommendations

Based on the findings and analysis of the baseline conditions and evaluation of the marine archaeological potential, an impact assessment was conducted to evaluate the potential impacts of the proposed development on the marine archaeological resources/sites, and recommend necessary marine archaeological actions or mitigation measures to avoid and minimise the impacts.

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.

D1.4 BASELINE CONDITIONS

D1.4.1 Desktop Study Findings

Geotechnical Background

The submarine deposits in the Hong Kong region are subdivided into two formations, 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 the Chek Lap Kok Formations and Hang Hau Formations is considered to be the Eemian deposit with uncertained age and consists of soft to firm silty clays with yellowish mottling. This formation is presently not widespread but only in subcrop beneath the Hang Hau Formation (Fyfe et al. 2000).

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.

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.*

A site of archaeological interest on Kat O just outside the Study Area and called Kat O Pak Sha Tau (see *Figure D1-1*) has revealed occupation of the island during the Neolithic Period and Song to Qing periods. Other known sites of archaeological interest (Kat O Island (North), Kat O Island (South) and Kat O Sheung Wai) are located on the adjacent mainland. During the Qing Dynasty *Hakka* people appear to be dominant on Kat O. A Tin Hau Temple, Clan Halls and a Water and Moon Temple date to the middle of the Qing Dynasty. It has been suggested that the island got its name *Kat*, meaning prosperity, or good fortune, from the good shelter it gave to the many fishing vessels that anchored around its shores. The English name for the island *Crooked* is thought to relate to the shape of the island.

In the 1960s about 3,000 people resided on Kat O with a few hundred fishing boats anchored offshore. In 2006, it was thought 300 people lived on the island. In the mid 19th century it has been documented that Kat O had 2,000 pirate inhabitants and along with Sha Tau Kok was the largest pirate settlement to the east of Hong Kong (Lung Hong Kay 2001: 346).

Three 19th century cannons can also be found on the island and are considered of European origin.

Contemporary Description

The Study Area is an area between Kat O and Liu Ko Ngam, in the north east of the New Territories (see *Figure D1-1*). A brief contemporary description of the area around the south western side of Kat O and between the island and the mainland can be found in Glibbery (1994: 47-48):

> *On heading up the West coast [of Kat O], give the South West corner of the island – Pak Sha Tau (Sandy Point) - a wide berth, because of the reason suggested by its name. A well protected cove can be found at Sham Chung if you proceed to the head of the inlet and tuck yourself in to the Western side. There is plenty of water for anchoring and good holding in mud, but watch the echo sounder as the surrounding mud banks dry. The island's inhabitants mainly love at Kat O Wan on the North West coast.*
>
> *The West coast of Crooked Island and the East shore of the New Territories from Lui Ko Ngam to Starlet Inlet create Crooked Harbour. Tsing Chau (Table Island) lies to the North of Lui Ko Ngam, surrounded by rocks, with a rock wash off the North shore. A larger island Fun Chau is to the West, with a sandy spit off its Southern end.*

United Kingdom's Hydrographic Office 'Wreck' Files

The United Kingdom's Hydrographic Office in Taunton and the Hong Kong Marine Department's Hydrographic Office maintain databases of known shipwrecks in the Hong Kong Special Administrative Region (HKSAR).

These databases were investigated and no sites were found to be located within the Study Area.

Summary

Although the baseline review of the literature found the Study Area had the potential to contain underwater cultural heritage sites, no sites of historical or archaeological potential were identified from the literature or the databases as located within the Study Area.

D1.4.2 Geophysical Surveys Findings

With the aim of establishing marine archaeological potential and assessing any potential marine archaeological impacts arising from the proposed development, the geophysical survey defined the areas/sites of greatest archaeological potential, which would encompass an assessment of the depth and nature of the seabed sediments and map any seabed and sub-bottom anomalies which may be archaeological material. This information is provided below.

The side scan sonar survey was used to produce a seabed map which provided details on the nature of the seabed, how it has been impacted by maritime activities such as fishing, trawling and anchoring, and the location of any seabed features (see *Figures D1-4* and *D1-5*).

The nature of the seabed varies from the predominant silt/clay to sand/gravel and a mixture of low relief rock/coral and sand/gravel and in general the sedimentation was coarser throughout the Study Area in comparison with other areas of HKSAR particularly to the west of Hong Kong Island (see *Figure D1-6*). The seabed also shows signs of having been impacted by anchoring and trawling although less in comparison to the west of Hong Kong Island (see *Figure D1-7*).

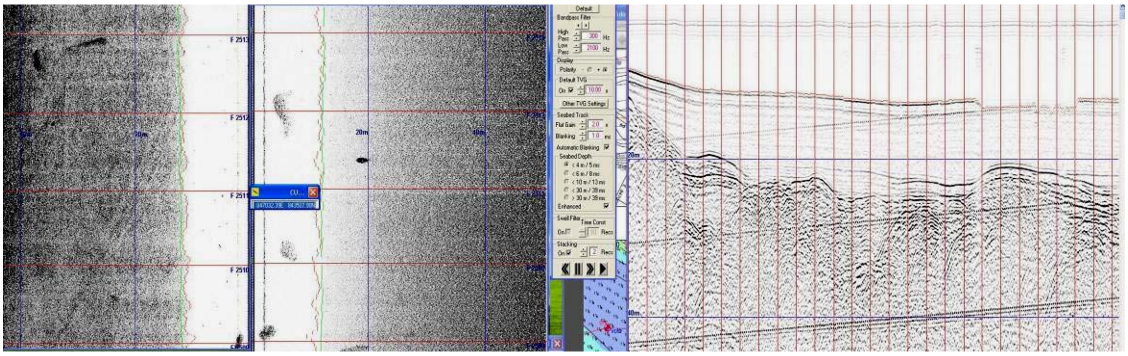

Figure D1-6 ***Coarse Seabed Sediments as Seen in the Side Scan Sonar Image (Left) and the Seismic Boomer Image (Right) and Found within the Area of 'Fine Sediments' (see Figures D1-4*** **and** ***D1-5)***

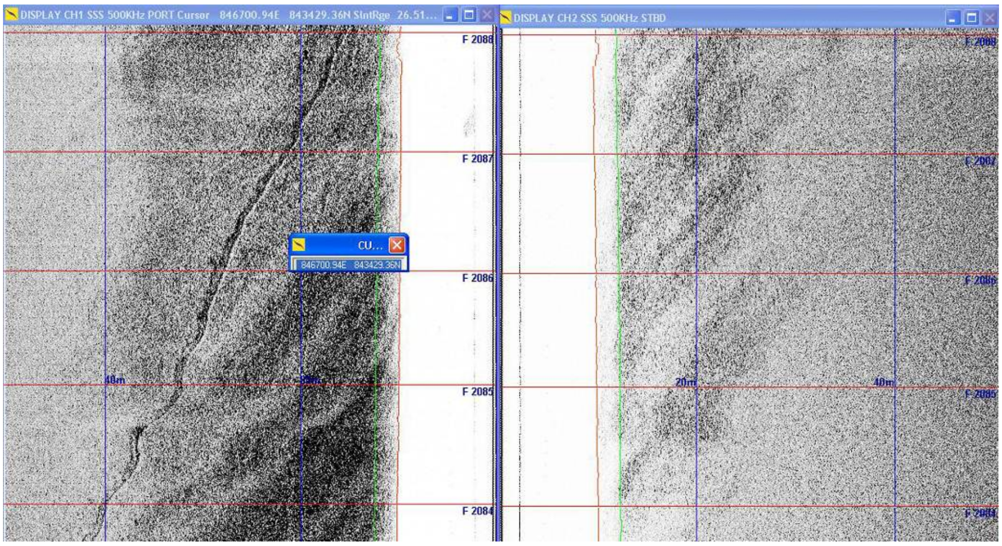

Figure D1-7 ***Scarring of the Seabed from Anchoring***

A number of seabed features (Sonar Contacts) were also located during the side scan sonar survey, seven in total with four being of unknown origin as listed in *Table D1*, the remaining three being rocks and a pipeline, with none being any closer than 180 metres from the proposed cable route (see *Figure D1-8*). Locations of the unknown Sonar Contacts can be found in *Figures D1-4 & D1-5*.

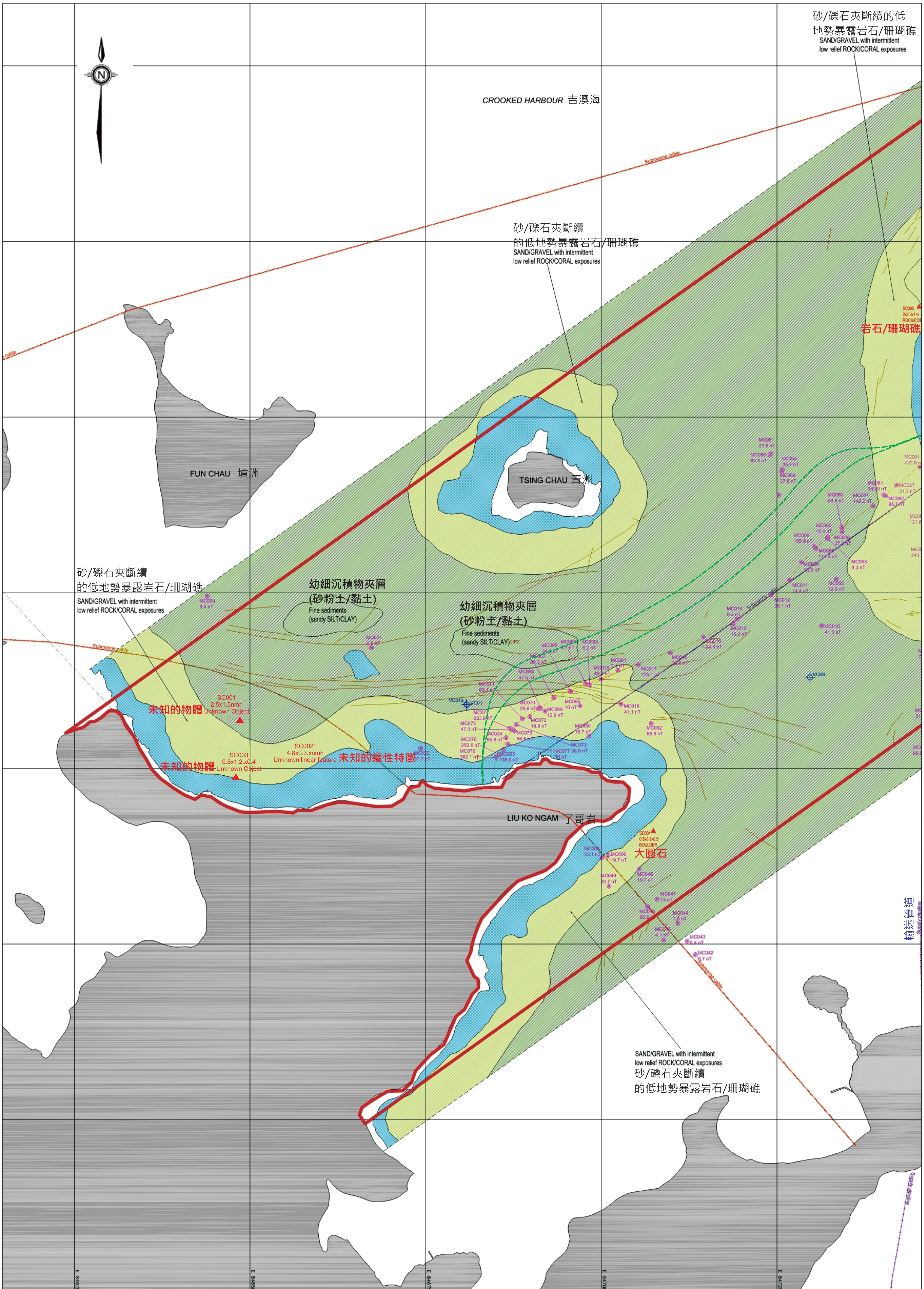

Figure D1-4 圖D1-4

Seabed Features (Sheet 1 of 2)
(Refer to Figure D1-5 for Legend)
海床特色（第1頁，共2頁）（有關圖例說明，請參閱圖D1-5）

FILE: 0114462c_1-chi
DATE: 16/10/2012

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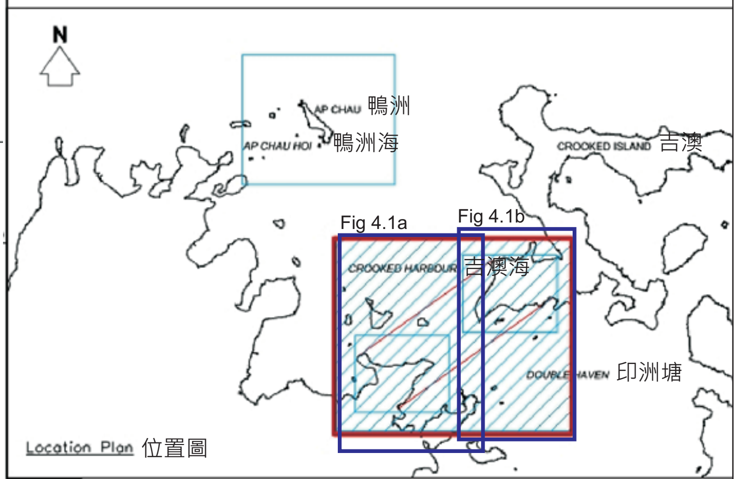
Legend :

VC03	Vibrocore locations 鑽探位置
	MAI Study Area 水下考古調查研究範圍
	Proposed 11kV Submarine Cable 擬建的11千伏海底電纜
	Pipeline from EGS database EGS資料庫記錄的管道
	Cable from EGS database EGS資料庫記錄的電纜
	PCCW cables (from client) 由項目倡議者提供的PCCW電纜
	Sonar contact (LxWxH) 聲納接觸位置 (長 寬 高)
	Linear features 線性特徵
MC_022 157.9nT	Magnetic contacts 磁力接觸位置
	Anchor / trawl marks 錨/拖網拖痕
	Fine sediments (SILT/CLAY) 幼細沉積物夾層 (粉土/黏土)
	CORAL with SAND/GRAVEL matrix 珊瑚礁夾砂/礫石陣
	Boulder 大圓石
	SAND/GRAVEL 砂/礫石
	Concrete surround for water pipe 包圍水管的石屎
	Interpreted existing cable/pipeline position by magnetometer 根據磁力儀調查結果而確定的現有電纜/管道位置
	Interpreted existing cable/pipeline position by land topographic survey 根據地貌調查結果而確定的現有電纜/管道位置



Notes :

1. Survey Date 測量日期 : 02-07,26-27/07/2010
2. Survey Grid 測量方格網 : Hong Kong 1980 Grid System 香港1980方格網系
3. Survey Datum 測量基準 : Hong Kong Principal Datum 香港高程數值
4. Positioning 位置 : C-Nav GcGPS (Globally corrected GPS)(全球校正式全球定位系統)
5. Equipment 儀器 : Odom DF3200 MKIII - P Dual Frequencies Echo Sounder 回聲探測器
   Edgetech Sonarlink1 Side Scan Sonar System 旁測聲納系統
   Knudsen 320M Echo Sounder 回聲探測器
   Reson 8125 Multibeam System 多波束聲納系統
   Seaspy (GSM-19MD) Magnetometer 海洋磁動計系統
6. Coastline taken from 1:1,000 Survey Sheets, Survey and Mapping Office, Lands Department 海岸線取自地政總署1:1000比例測量圖

Revision No.	Date	Drawn by	Checked by	Approved by	Remarks
0	13/07/2010	Clarence Siu	Margie Chen	Matthew Lai	Preliminary
1	19/08/2010	Clarence Siu	Peter Chu	Matthew Lai	Final

METRIC SCALE 1:2,500 比例尺

125 100 75 50 25 0 125 2

Client : CLP 中電

Surveyor : EGS (ASIA) LIMITED

JOB NO. : HK22031

Figure D1-5 圖D1-5

Seabed Features (Sheet 2 of 2)
海床特色（第2頁，共2頁）

FILE: 0114462c_2-chi
DATE: 09/05/2013

Environmental Resources Management
ERM

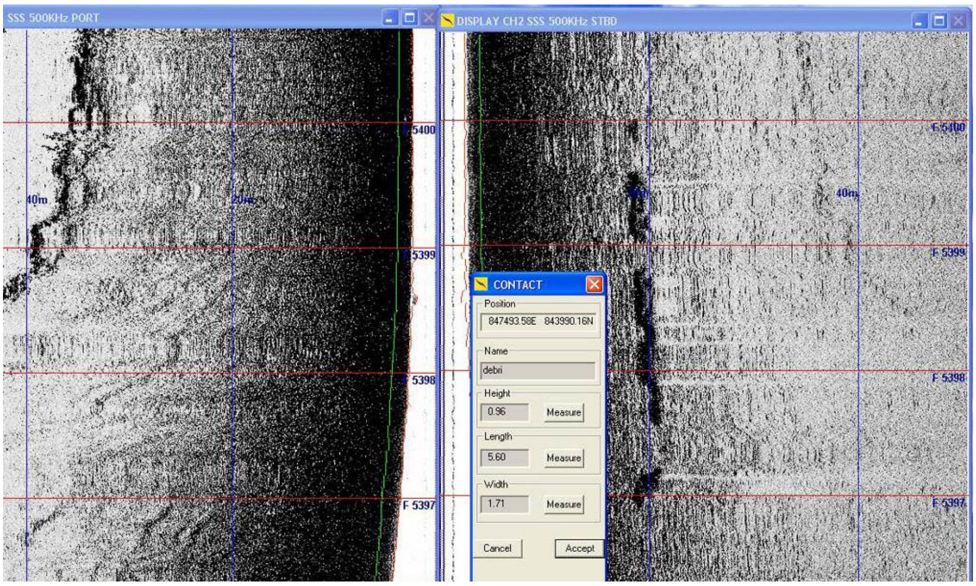


Figure D1-8 *Rocks or Debris Located during the Side Scan Sonar Survey and Identified as SC005 (see Figures D1-4 & D1-5)*

Table D1 *Unknown Sonar Contacts*

Sonar Contacts No.	Dimensions	Distance from the proposed Cable Route (m)	Coordinates
SC001	2.5 x 1.6 x nmh	353	846486 E, 843318 N
SC002	4.8 x 0.3 x nmh	289	846547 E, 843277N
SC003	0.8 x 1.2 x 0.4 m	355	846480 E, 843237 N
SC007	1.2 x 0.5 x 0.9 m	202	847608 E, 843564 N

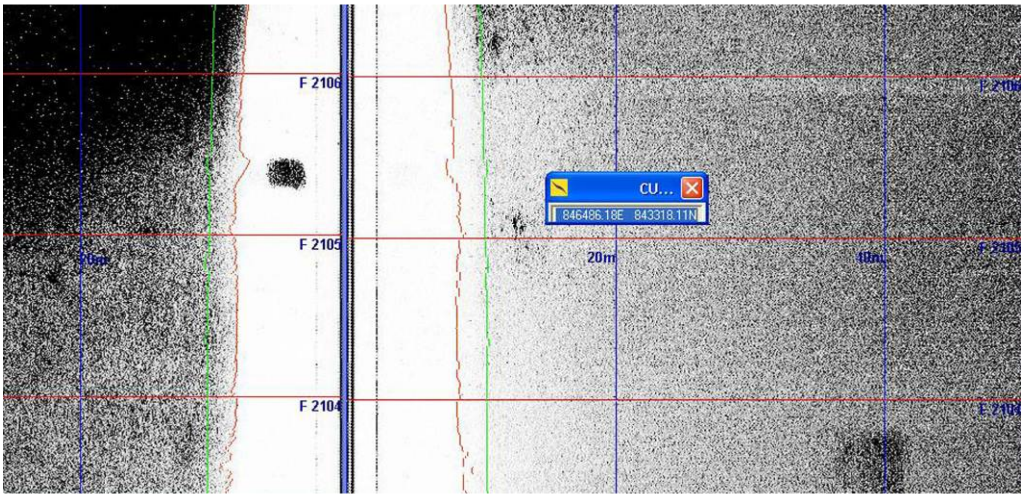


Figure D1-9 *SC001*

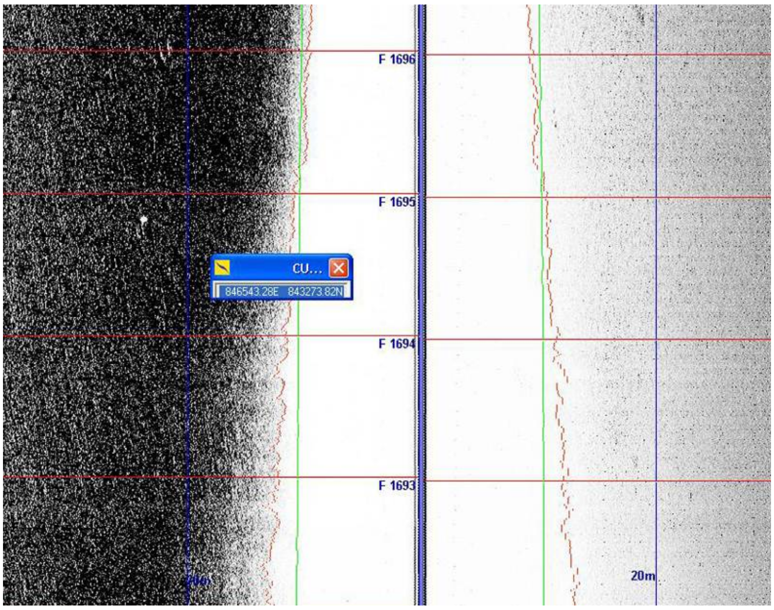


Figure D1-10   SC002

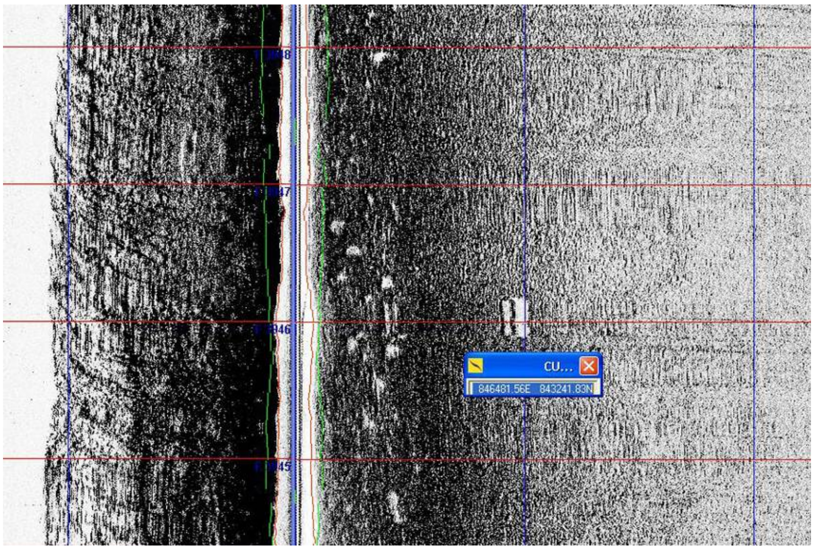


Figure D1-11   SC003

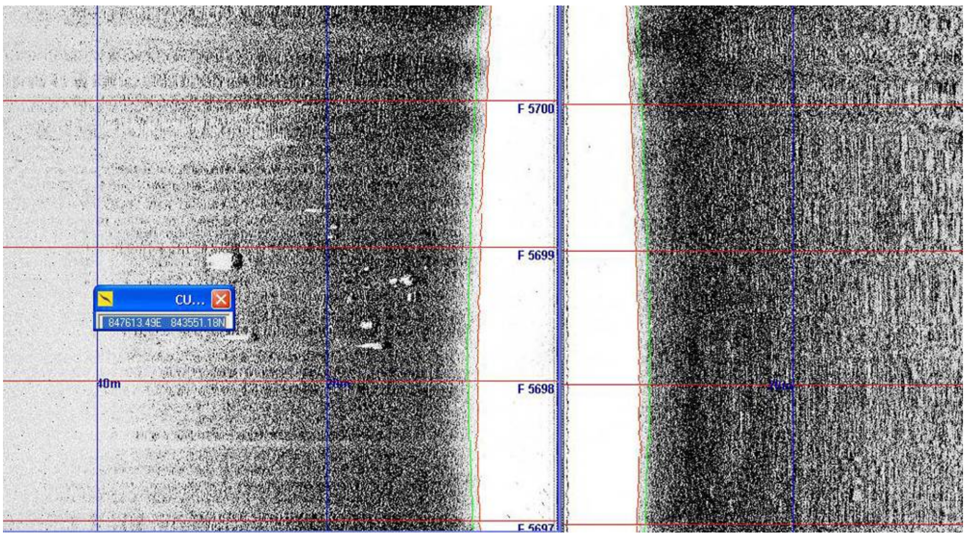


Figure D1-12   SC007

The four unknown Sonar Contacts SC001, 002, 003 and 007 all appear to be natural features such as rock. They are all in close proximity to the shore where numerous other rocks can be found.

Magnetometer Survey Results

The Magnetic survey was carried out to locate the existing cables and parts thereof, there being five, and the one pipeline. A number of anomalies not related to the cables or pipeline were found during the survey as presented in *Table D2* and locations shown in *Figures D1-4* and *D1-5*. These unknown magnetic anomalies were found to be from 17 metres to 436 metres from the proposed cable route.

Table D2 Unknown Magnetic Contacts

Magnetic Contact No.	Magnitude	Distance from the proposed Cable Route (m)	Coordinates
MC010	41.5 nT	128	847313 E, 843452 N
MC018	41.1 nT	70	847 028 E, 843341 N
MC020	9.4 nT	436	846439 E, 843495 N
MC021	6.5 nT	192	846672 E, 843421 N
MC022	37.7 nT	95	846742 E, 843278 N
MC050	16.7 nT	96	846982 E, 843296 N
MC051	21.9 nT	64	847241 E, 843697 N
MC052	35.7 nT	37	847257 E, 843675 N
MC057	5.2 nT	17	847252 E, 843639 N
MC058	84.4 nT	64	847239 E, 843695 N
MC059	37.5 nT	37	847256 E, 843673 N
MC062	66.5 nT	112	847071 E, 843313 N

Although none of the anomalies will be impacted by the proposed cable route the anomaly locations were investigated. No seabed features could be discerned, nor could any apparent sub-bottom features. With the towed magnetometer sensor being within two-five metres of the seabed, the relatively small variations in the earth's magnetic field that were recorded means that the ferrous objects are small objects, possibly dumped materials or naturally occurring materials either totally covered or indistinguishable. The following images are examples of these magnetic anomalies and are those closest to the proposed cable route (*Figures D1-13* to *D1-16*)

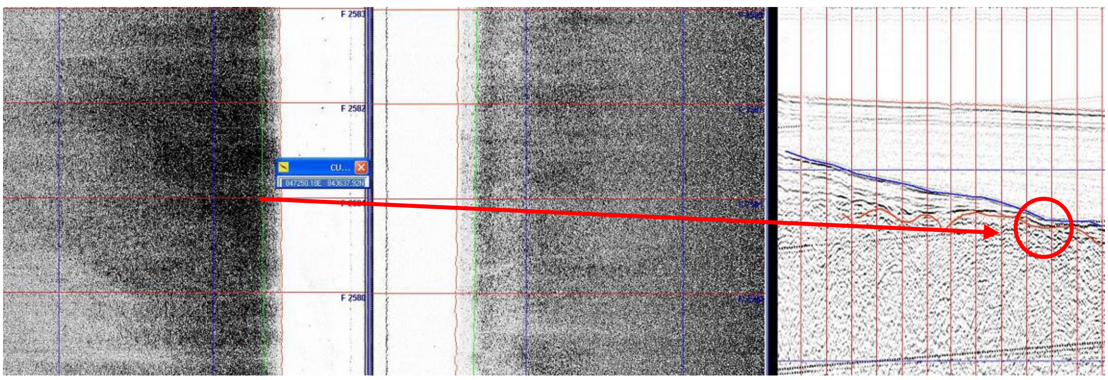


Figure D1-13 MC 057

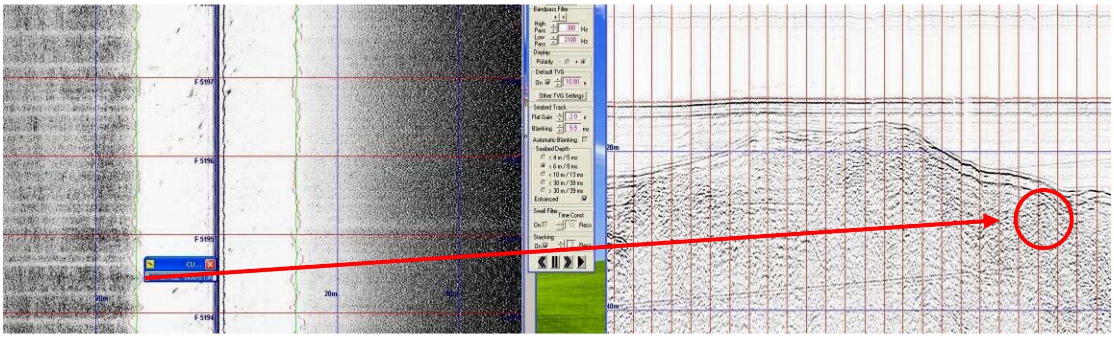


Figure D1-14 MC 052 and 059

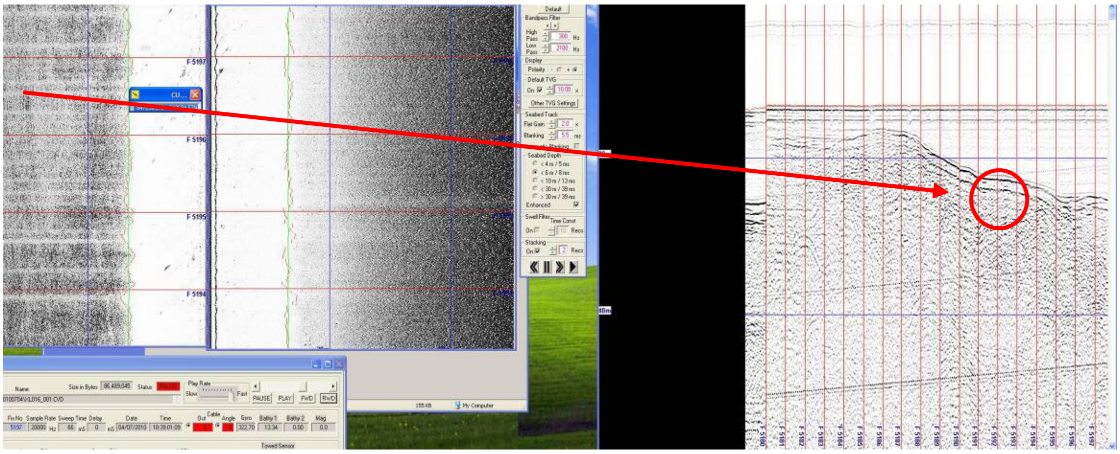


Figure D1-15 MC 051 and 058

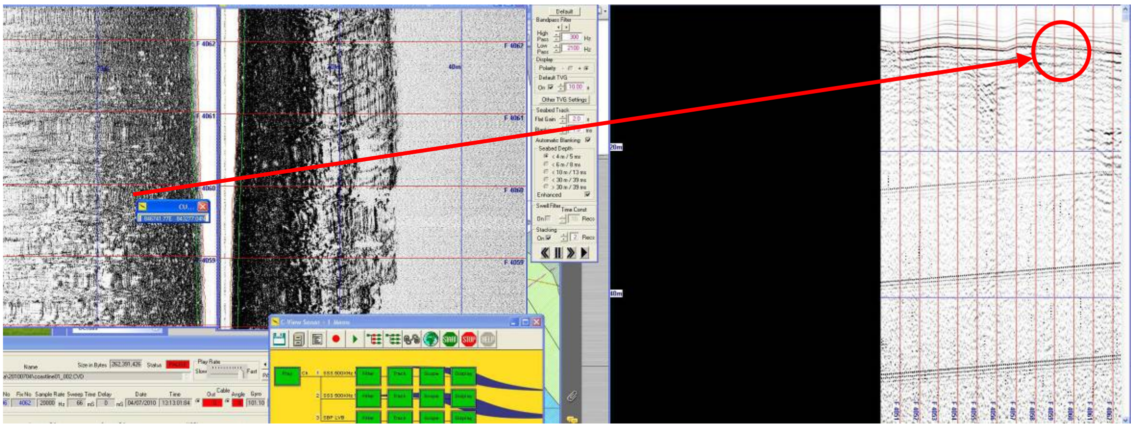
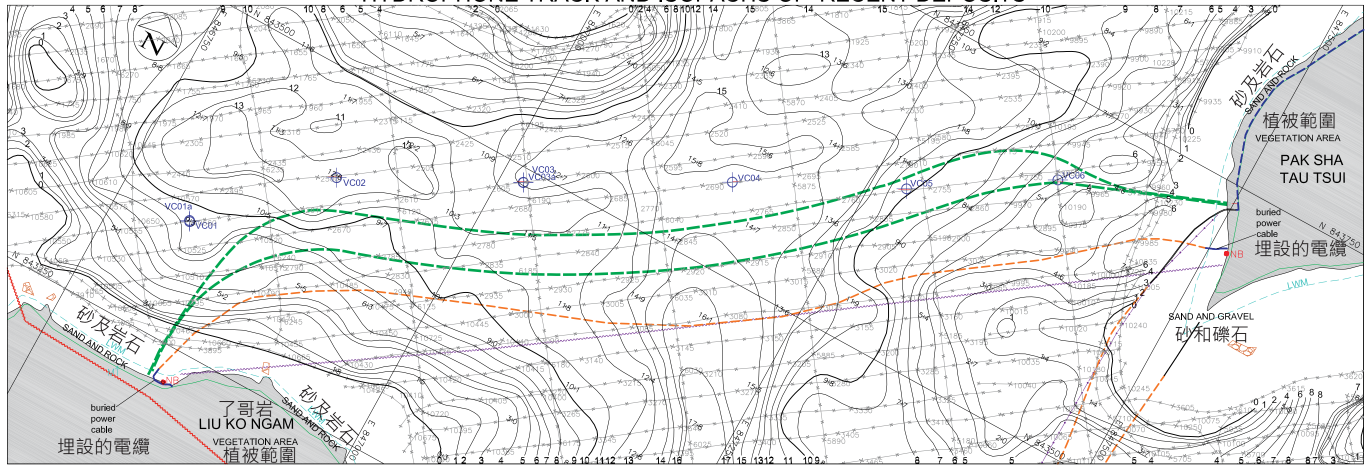


Figure D1-16 MC022

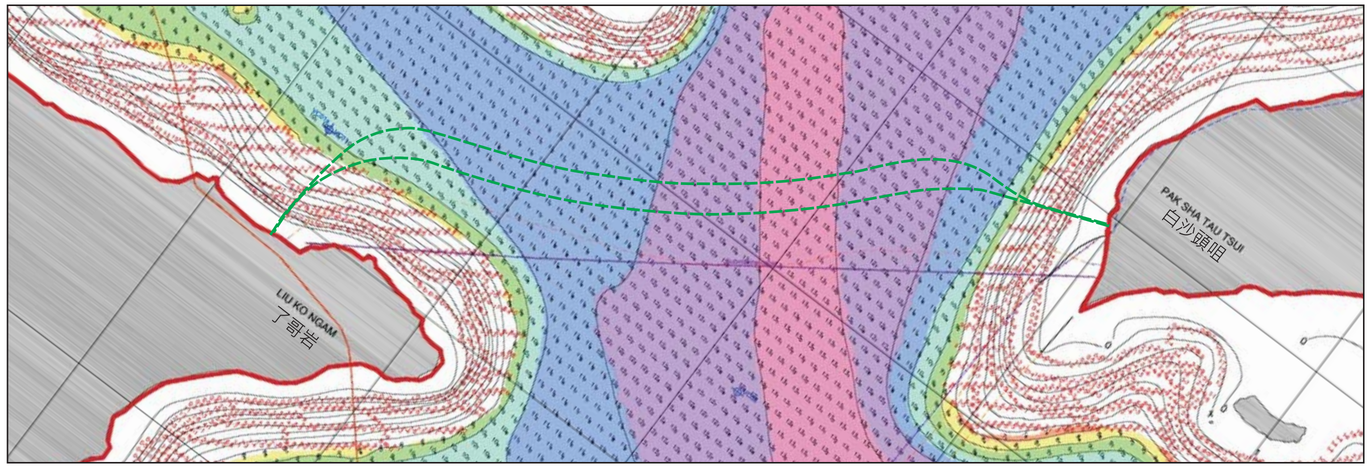
Sub-bottom Survey Results

No sub-bottom anomalies were found during this survey. While the seabed sediments in the Study Area contain the Hang Hau formations (varying from a few metres to 19 metres in the middle of the area) the vibrocoring conducted along the proposed cable route found the sediments to be a mixture of sand and clay and sometimes containing gravel which would not be ideal sediments to contain well-preserved remains as in the more muddy sediments to the west of Hong Kong island (see *Figure D1-17*).

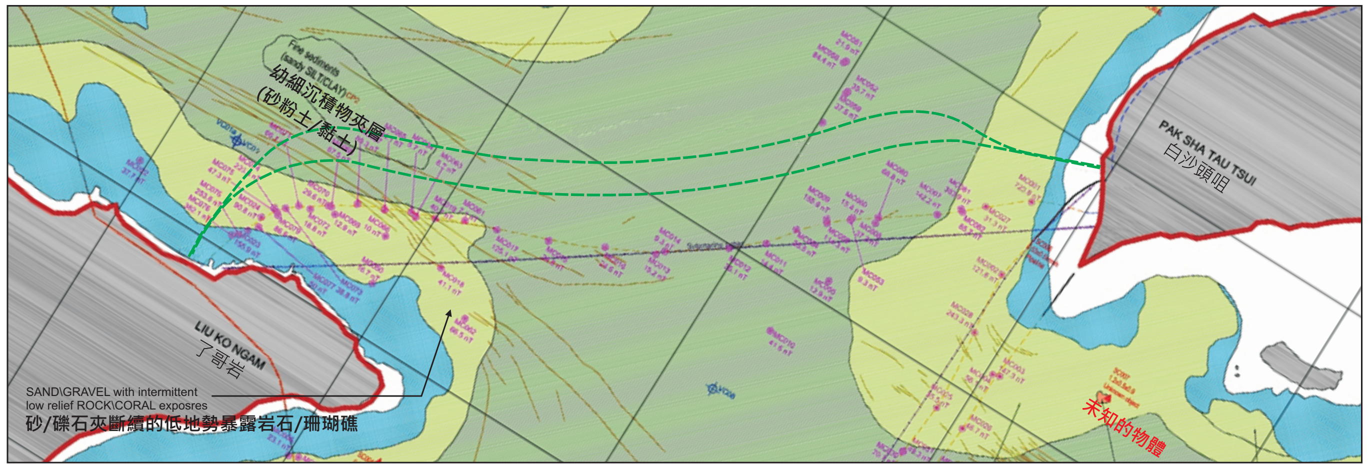
新近沉積物的水聽器追蹤及等原線
HYDROPHONE TRACK AND ISOPACHS OF RECENT DEPOSITS



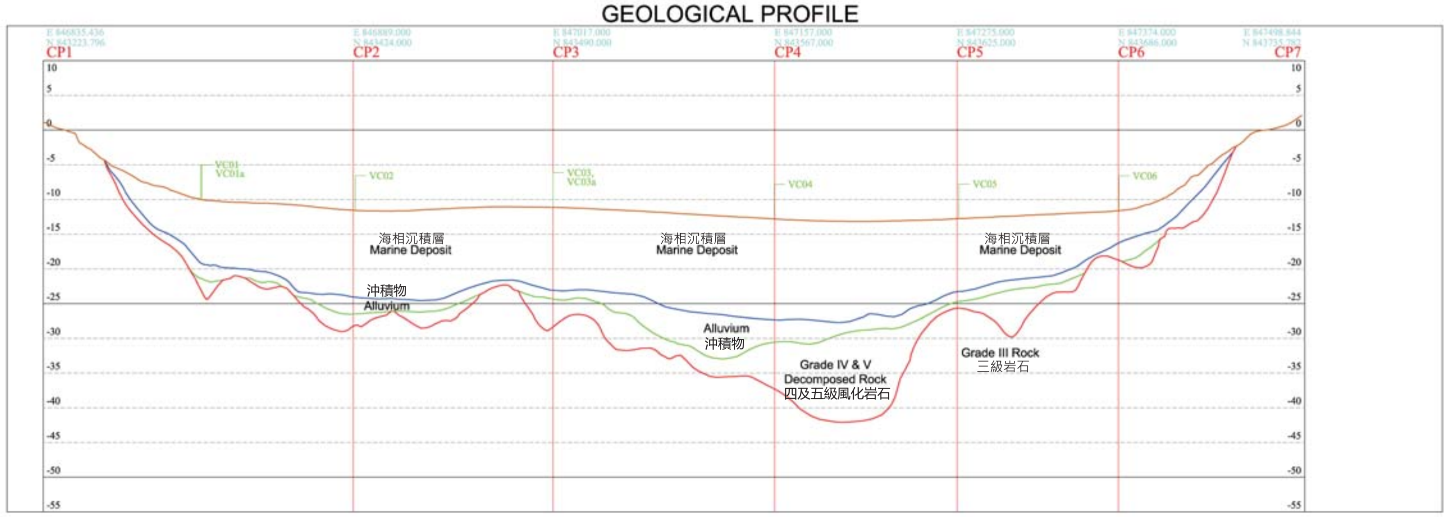
條帶式測深系統
SWATH BATHYMETRY



海床特色
SEABED FEATURES



地質概況
GEOLOGICAL PROFILE



LEGEND 圖示

General 一般

- Vibrocore locations 鑽探位置
- Proposed 11kV Submarine Cable 擬建的11千伏海底電纜
- Pipeline from EGS database EGS資料庫記錄的管道
- Cable from EGS database EGS資料庫記錄的電纜
- PCCW cables (from client) 由項目倡議者提供的PCCW電纜
- Interpreted existing cable/pipeline position by magnetometer 根據磁力儀調查結果而確定的現有電纜/管道位置
- Interpreted existing cable/pipeline position by land topographic survey 根據地貌調查結果而確定的現有電纜/管道位置
- Concrete surround for water pipe 包圍水管的石屎

First Panel - Hydrophone Track and Isopachs of recent deposits
面板一-新近沉積物的水聽器追蹤及等原線

- Isopachs value in metres (Thickness of the layer) 等原線值以米為單位 (夾層厚度)
- Contour at 1 metre interval 間距一米等深線
- Hydrophone track with fix positions 固定位置的水聽器追蹤
- Manhole (telecom) 沙井(電信)
- Notice Board 告示板
- Low Water Mark 低水位標記
- Vegetation Boundary 植被範圍
- Boulders 大圓石

Second Panel - Swath Bathymetry
面板二-條帶式測深系統

- Sounding value in metres below HKPD measured by multi-beam echo sounder 多波束聲納量度在香港高程數值下以米作單位的聲納值
- Sounding value in metres below HKPD measured by single beam echo sounder 單波束聲納量度在香港高程數值下以米作單位的聲納值
- Contour at 1 metre interval 間距一米等深線

METRES (HKPD)

7 8 9 10 11 12 13 14

Third Panel - SeaBed Features
面板三-海床特色

- Sonar contact (LxWxH) 聲納接觸位置 (長x寬x高)
- Linear features 線性特徵
- Magnetic contacts 磁力接觸位置
- Anchor / trawl marks 錨/拖網拖痕
- Fine sediments (SILT/CLAY) 幼細沉積物夾層 (粉土/黏土)
- Low relief ROCK/CORAL with SAND/GRAVEL matrix 砂/礫石夾斷續的低地勢暴露岩石/珊瑚礁
- Boulder 大圓石
- SAND/GRAVEL 砂/礫石
- Concrete surround for water pipe 包圍水管的石屎

Fourth Panel - Geological Profile
面板四- 地質概況

- Seabed 海床
- Base of Marine Deposits 海洋沉積物基線
- Top of Grade IV – V Rock 四及五級岩石的表面
- Top of Grade III Rock 三級岩石的表面
- Vibrocore Locations 鑽探位置

Fifth Panel - Pipeline Engineering
面板五- 管道工程

Location Plan 位置圖

Notes :
1. Survey Date 測量日期 : 02–07,26–27/07/2010
2. Survey Grid 測量方格網 : Hong Kong 1980 Grid System 香港1980方格網系
3. Survey Datum 測量基準 : Hong Kong Principal Datum 香港高程數值
4. Positioning 位置 : C-Nav GcGPS (Globally corrected GPS)(全球校正式全球定位系統)
5. Equipment 儀器 : Odom DF3200 MKIII - P Dual Frequencies Echo Sounder 回聲探測器
   Edgetech Sonarlink1 Side Scan Sonar System 旁測聲納系統
   Knudsen 320M Echo Sounder 回聲探測器
   Reson 8125 Multibeam System 多波束聲納系統
   Seaspy (GSM–19MD) Magnetometer 海洋磁動計系統
6. Coastline taken from 1:1,000 Survey Sheets, Survey and Mapping Office, Lands Department 海岸線取自地政總署1:1000比例測量圖
7. Horizontal Scale for Section : 1:2500 橫向截面比例: 1: 2500
   Vertical Scale for Section : 1:500 縱向截面比例: 1: 500

Revision No.	Date	Drawn by	Checked by	Approved by	Remarks
0	13/07/2010	Clarence Siu	Margie Chen	Matthew Lai	Preliminary
1	19/08/2010	Clarence Siu	Peter Chu	Matthew Lai	Final

METRIC SCALE 1:2,500 比例尺

125 100 75 50 25 0 125 250

Client : CLP 中電

Surveyor : EGS (ASIA) LIMITED

JOB NO. : HK220310

Figure D1-17 圖D1-17

Geological Profile 地質概況

Environmental Resources Management

ERM

F1-ILE: 0114462d-chi(2)
DATE: 16/10/2012

D1.5 MARINE ARCHAEOLOGICAL POTENTIAL

D1.5.1 Baseline Review and Geophysical Survey

The review of the historical documents and literature indicate that the region in the vicinity of the Study Area has been occupied since the Neolithic period although much of the settlement, and the intangible and tangible heritage comes from around the early to mid 18th century. The area appears to have seen activity from fishers, and pirates particularly during the 19th century but the area was away from the major trade routes and therefore the archaeological and cultural heritage potential of the Study Area is related to local use and local trade.

The findings from the review of the databases and the literature failed to locate any archaeological or historically significant material within the Study Area. Apart for the existing cables and a pipeline, the geophysical investigations located only a small amount of natural material, predominantly rocks, and some small ferrous objects or naturally occurring magnetic materials. The area has received some impact from anchoring and trawling. The nature of the sediments does not lend itself to containing well-preserved remains given its coarse nature.

D1.6 IMPACT ASSESSMENT

The findings of this Marine Archaeological Investigation conclude that there are no sites of marine cultural heritage / archaeological value identified within the Study Area, and the proposed cable route will not impact any such sites. Consequently, impacts to marine cultural heritage and sites of archaeological interest are not expected due to the construction and operation of the Project.

D1.7 MITIGATION MEASURES

No sites of marine cultural heritage / archaeological value identified within the Study Area and therefore no mitigation measures are considered necessary.

D1.8 CONCLUSION

An assessment of the potential marine archaeological resources of the project area was concluded based in a review of historical records, UK Wrecks database and the results of hydrographic and geophysical surveys of the proposed cable alignment. The findings concluded that no marine archaeological features are identified and the construction and operation of the proposed submarine cable will therefore not cause any impacts on marine archaeological resources in the area.

D2 REFERENCE

D2.1 ENGLISH

Bard, 1988, *In Search of the past: A guide to Antiquities of Hong Kong*. Hong Kong: the Urban Council.

Chau, Hing-wah, (ed) 1993, *Collected essays on the culture of the Ancient Yue People in South China.* Hong Kong Museum of History. Hong Kong.

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.

Glibbery, J., 1994, *In amongst the Sampans: A guide for sailing boats and junks in Hong Kong's waters*. Centurion Co., Hong Kong.

Lung Hong Kay, 2001, *Britain and the Suppression of Piracy on the Coast of China, with Special Reference to the Vicinity of Hong Kong 1842-1870.* Master's Thesis, University of Hong Kong.

D2.2 INTERNET

Government of the Hong Kong Special Administrative Region, *The Geographical Information System on Hong Kong Heritage – Archaeological Site* (accessed on 6 May 2011) [http://www5.lcsd.gov.hk/gishinter/html/viewer_en.htm].

Annex D1-1

Guidelines for Marine Archaeological Investigation (MAI)

The standard practice for MAI should consist of four separate tasks, i.e. (1) Baseline Review, (2) Geophysical Survey, (3) Establishing Archaeological Potential and (4) Remote Operated Vehicle (ROV)/Visual Diver Survey/Watching Brief.

(1) Baseline Review

1.1 A baseline review should be conducted to collate the existing information in order to identify the potential for archaeological resources and, if identified, their likely character, extent, quality and value.

1.2 The baseline review will focus on known sources of archive data. It will include:

a. Geotechnical Engineering Office (GEO) – the Department holds extensive seabed survey data collected from previous geological research.

b. Marine Department, Hydrographic Office – the Department holds a substantial archive of hydrographic data and charts.

c. The Royal Naval Hydrographic Department in the UK – the Department maintains an archive of all survey data collected by naval hydrographers.

1.3 The above data sources will provide historical records and more detailed geological analysis of submarine features which may have been subsequently masked by more recent sediment deposits and accumulated debris.

(2) Geophysical Survey

2.1 Extensive geophysical survey of the study area should deployed high resolution boomer, side scan sonar and an echo sounder. The data received from the survey would be analysed in detail to provide:

a. Exact definition of the areas of greatest archaeological potential.

b. Assessment of the depth and nature of the seabed sediments to define which areas consist of suitable material to bury and preserve archaeological material.

c. Detailed examination of the boomer and side scan sonar records to map anomalies on the seabed which may be archaeological material.

(3) Establishing Archaeological Potential

3.1 The data examined during Task 1 and 2 will be analysed to provide an indication of the likely character and extent of archaeological resources within the study area. This would facilitate formulation of a strategy for investigation.

3.2 The results would be presented as a written report and charts. If there is no indication of archaeological material there would be no need for further work.

(4) Remote Operated Vehicle (ROV)/Visual Diver Survey/Watching Brief

4.1 Subject to the outcome of Task 1, 2 and 3, accepted marine archaeological practice would be to plan a field evaluation programme to acquire more detailed data on areas identified as having archaeological potential. The areas of archaeological interest can be inspected by ROV or divers. ROV or a team of divers with both still and video cameras would be used to record all seabed features of archaeological interest.

4.2 Owing to the heavy marine traffic in Hong Kong, the ROV/visual diver survey may not be feasible to achieve the target. If that is the case, an archaeological watching brief is the most appropriate way to monitor the dredging operations in areas of identified high potential to obtain physical archaeological information.

4.3 A sampling strategy for an archaeological watching brief would be prepared based on the results of Task 1, 2 and 3 to focus work on the areas of greatest archaeological potential. Careful monitoring of the dredging operations would enable immediate identification and salvage of archaeological material. If archaeological material is found, the AMO should be contacted immediately to seek guidance on its significance and appropriate mitigation measures would be prepared.

4.4 If Task 4 is undertaken, the results would be presented in a written report with charts.

Annex D2

Archaeological Survey Report

REPORT

CLP Power Hong Kong Limited

Replacement of the Existing 11kV Submarine Cable Circuit Connecting Liu Ko Ngam and Pak Sha Tau Tsui at Kat O:

Archaeological Survey Report

April 2013

Environmental Resources Management
16/F DCH Commercial Centre
25 Westlands Road
Quarry Bay, Hong Kong
Telephone: (852) 2271 3000
Facsimile: (852) 2723 5660
E-mail: post.hk@erm.com
http://www.erm.com

REPORT

CLP Power Hong Kong Limited

Replacement of the Existing 11kV Submarine Cable Circuit Connecting Liu Ko Ngam and Pak Sha Tau Tsui at Kat O:

Archaeological Survey Report

April 2013

For and on behalf of
ERM-Hong Kong, Limited

Approved by: Terence Fong

Signed:

Position: Partner

金志伟

Certified by:
Licence holder: Dr Jin Zhiwei

Date: 26 April 2013

NON-TECHNICAL SUMMARY

CLP Power Hong Kong Limited (CLP) is planning to enhance the security of power supply to Kat O Island(吉澳島). Therefore, a project planning to replace the existing 11kV submarine cable connecting Liu Ko Ngam to Pak Sha Tau Tsui (白沙頭咀) at Kat O (Crooked Island) to ensure continuous electricity supply on the island has been proposed.

As the landing site at Pak Sha Tau Tsui falls within the Kat O Pak Sha Tau Site of Archaeological Interest. An Archaeological Survey (AS) has been considered necessary to obtain field data for subsequent Archaeological Impact Assessment (AIA) of the Site which may potentially impacted by the construction works of the Project.

Before the commencement of the AS, an Archaeological Survey Proposal was prepared and agreed with AMO. A *Licence to Excavate and Search for Antiquities* under the *Antiquities and Monuments Ordinance* was also granted to Dr Jin Zhiwei by the Authority in June 2012. The AS was conducted from 17 July 2012 to 3 August 2012. Field scanning of 1862m^2 of area, seven auger holes and three test pits were conducted during the AS.

The AS revealed that all identified cultural layers are dated to modern period. A total of 31 general finds and one special find were identified. The general finds include village ware, porcelain and tile shards. The special find is a perforated stone artifact dated to Bronze Age but it was an isolated find identified from field scan which is a secondary deposit artifact. All of the finds are regarded as secondary deposits and therefore not considered to have significant value.

The surveyed locations in this AS are located further south and west of T6 and further away from T2 and T3 of the 2000 Survey. The surveyed locations in this AS is very close to the existing coastline, thus, no in-situ cultural remains was unearthed.

Based on the AS result, the chance of finding significant archaeological remains at the Site where the proposed project works to be impacted is very low. This is further supported by the fact that previous archaeological survey in 2000 has indicated that in-situ pre-historic archaeological deposits are mainly located at the hill slope away from the modern beach area where the project works locates.

Nevertheless, as a special find and some archaeological materials were found during this survey, it is recommended that prior to excavation works commence in Kat O Pak Sha Tau Site of Archaeological Interest, the project proponent shall notify AMO the commencement date of excavation work so that AMO could arrange site monitoring visits of the excavation work. In addition, during the excavation work in Kat O Pak Sha Tau Site of Archaeological Interest, AMO shall be notified in case of discovery of any antiquities or supposed antiquities.

中文摘要

中華電力有限公司（中電）現正計劃改善吉澳島供電的可靠性。為了確保能夠向吉澳島持續供電，中電計劃更換連接了哥岩與吉澳白沙頭咀的現有11千伏海底電纜。

由於白沙頭咀位於吉澳白沙頭具考古研究價值的地點範圍內，因此，有必要進行考古調查，務求取得實地數據，以便稍後為將會受到本項目的施工影響的“考古地點”進行考古影響評估。

顧問公司在展開考古調查前，先制定了一份《考古調查計劃書》，然後提交予古物古蹟辦事處，以便取得同意。有關當局根據《古物及古蹟條例》的規定，於2012年6月發出“挖掘及搜尋古物牌照” 予金志偉博士。是次考古調查於2012年7月17日至2012年8月3日期間進行。在調查期間，共對1,862平方米的地區進行了地表採集，也鑽挖了七個鑽孔和挖掘了三個探方。

是次考古調查發現，所有被找到的文化分層的年代都是近代。

調查期間共收集了31件一般文物和一件重要文物。這些一般文物包括：鄉村器物的碎片、瓷器碎片和瓦片。地表採集所找到的一件重要文物，是一塊孤立的發現，屬於先秦時期的穿孔石製品，其性質是二次堆積的人工製品。由於全部文物都是二次堆積，因此，都沒有重要價值。

是次考古調查的地點，比2000年調查的T6位置較偏南和偏西，亦距離T2和T3較遠的位置，十分接近現在的海岸線，因此，沒有出土任何原生文化遺物。

基於是次考古調查的結果，在擬議進行本工程項目的地點發現重要考古遺存的可能性十分低。根據2000年調查的結果，原生的史前考古堆積主要位於山坡上，遠離本工程位置所在的現代沙灘，符合是次調查結果。

然而，由於是次調查發現了一件重要文物及一些考古遺物，建議項目倡議人在吉澳白沙頭具考古研究價值地點內進行挖掘工作前通知古物古蹟辦事處，以便該處安排監察工作。此外，在吉澳白沙頭具考古研究價值地點內進行挖掘期間，若有發現任何古物或疑似古物，應立即通知古物古蹟辦事處。

CONTENTS

1 INTRODUCTION

1.1 PROJECT BACKGROUND

CLP Power Hong Kong Limited (CLP) is planning to enhance the security of power supply to Kat O Island(吉澳島). At present, only one set of 11kV submarine cable circuit was laid from Liu Ko Ngam to Kat O. The existing 11kV submarine cable is however more than 30 years old and is deteriorating. In order to provide continuous supply of the electricity to the island, CLP is therefore planning to replace the existing 11kV submarine cable connecting Liu Ko Ngam to Pak Sha Tau Tsui (白沙頭咀) at Kat O (Crooked Island) to ensure continuous electricity supply on the island (the Project) (see *Figure D2-1.1*).

The *Replacement of the Existing 11kV Submarine Cable Circuit Connecting Liu Ko Ngam and Pak Sha Tau Tsui at Kat O* (the Project) is classified as a Designated Project (DP) under Schedule 2, Part I, Category C, Item C.12 – dredging operation which is less than 500m from the nearest boundary of the Marine Park. According to *Section 5 (11)* of the *EIAO*, application for an Environmental Permit (EP) is required for the construction and operation of the Project.

The proposed replacement of the existing 11kV submarine cable alignment runs between Liu Ko Ngam and Pak Sha Tau Tsui on Kat O Island and is located next to the existing utilities including the existing 11kV submarine cable and two water mains (see *Figure D2-1.1*). After landing, the proposed replacement of the existing 11kV submarine cable circuit will connect to the existing Overhead Line (OHL) system with minimal additional underground cables and poles at Liu Ko Ngam and Pak Sha Tau Tsui respectively.

The landing site at Pak Sha Tau Tsui falls within the Kat O Pak Sha Tau Site of Archaeological Interest where archaeological remains of Late Neolithic Age, Song, Ming and Qing Dynasties had been unearthed from previous archaeological survey. An archaeological survey (AS) is considered necessary to obtain field data for subsequent archaeological impact assessment (AIA) of the landing site at Pak Sha Tau Tsui (hereafter refers as "the Site") which will be directly impacted by the works of the Project.

An Archaeological Survey Proposal (the Proposal) has been prepared to define the scope of the archaeological survey (the AS) and agreed with the Antiquities and Monuments Office (AMO). A *Licence to Excavate and Search for Antiquities* (the Licence) under the *Antiquities and Monuments Ordinance* (Cap. 53) was granted to Dr Jin Zhiwei by the Authority in June 2012 before the commencement of the AS.

The AS was conducted at the Site from 17 July 2012 to 3 August 2012. Field scanning, seven (7) auger holes and three (3) test pits were conducted. This

Archaeological Survey Report (the Report) is prepared to present the findings of the AS.

1.2 *PROPOSED CONSTRUCTION WORKS AT THE SITE*

Only small scale construction works will be required onshore at the cable landing site for connecting the proposed submarine cable with the existing overhead line electric system.

The length of the new underground cables is approximately 89 m. Once the proposed cables pass beyond the High Water Mark (HWM) at the landing point, it will be laid in a 0.75 m (W) x 1.0 m (D) cable trench and connected to new wooden electrical pole. The soil to be excavated for the construction of each wooden pole foundation would be about 1.8 (W) x 1.4m (L) x 1.6m (D). They will then be connected to the existing electrical pole via overhead lines. The cable trenches will be excavated by open excavation method.

1.3 *ARCHAEOLOGICAL TEAM MEMBERS*

The individuals participated in the AS were as follows:

Dr Jin Zhiwei	Licenced Archaeologist
Mr Edward Chiu	Assistant Archaeologist
Mr Raymond Ng	Assistant Archaeologist
Ms Peggy Wong	Cultural Heritage Specialist
Ms Kitty Liu	Cultural Heritage Specialist

In addition to the above team members, 3 laborers were employed for the AS. Field recording and processing of field records were led by Dr Jin Zhiwei, and carried out by Mr Edward Chiu, Mr Raymond Ng and Ms Kitty Liu. Maps and drawings were produced by Mr Edward Chiu, GIS and graphic teams of ERM. Finds processing were conducted by Mr Edward Chiu, Mr Raymond Ng and Ms Kitty Liu. Photography of artefacts was taken by Mr Edward Chiu.

Authors of this Report include: Dr Jin Zhiwei, Ms Peggy Wong, Mr Edward Chiu, Mr Raymond Ng and Ms Kitty Liu.

1.4 *STRUCTURE OF THE REPORT*

Following this introductory section, the remainder of this Report comprises the following sections:

Section 2 presents the backgrounds of the Site;

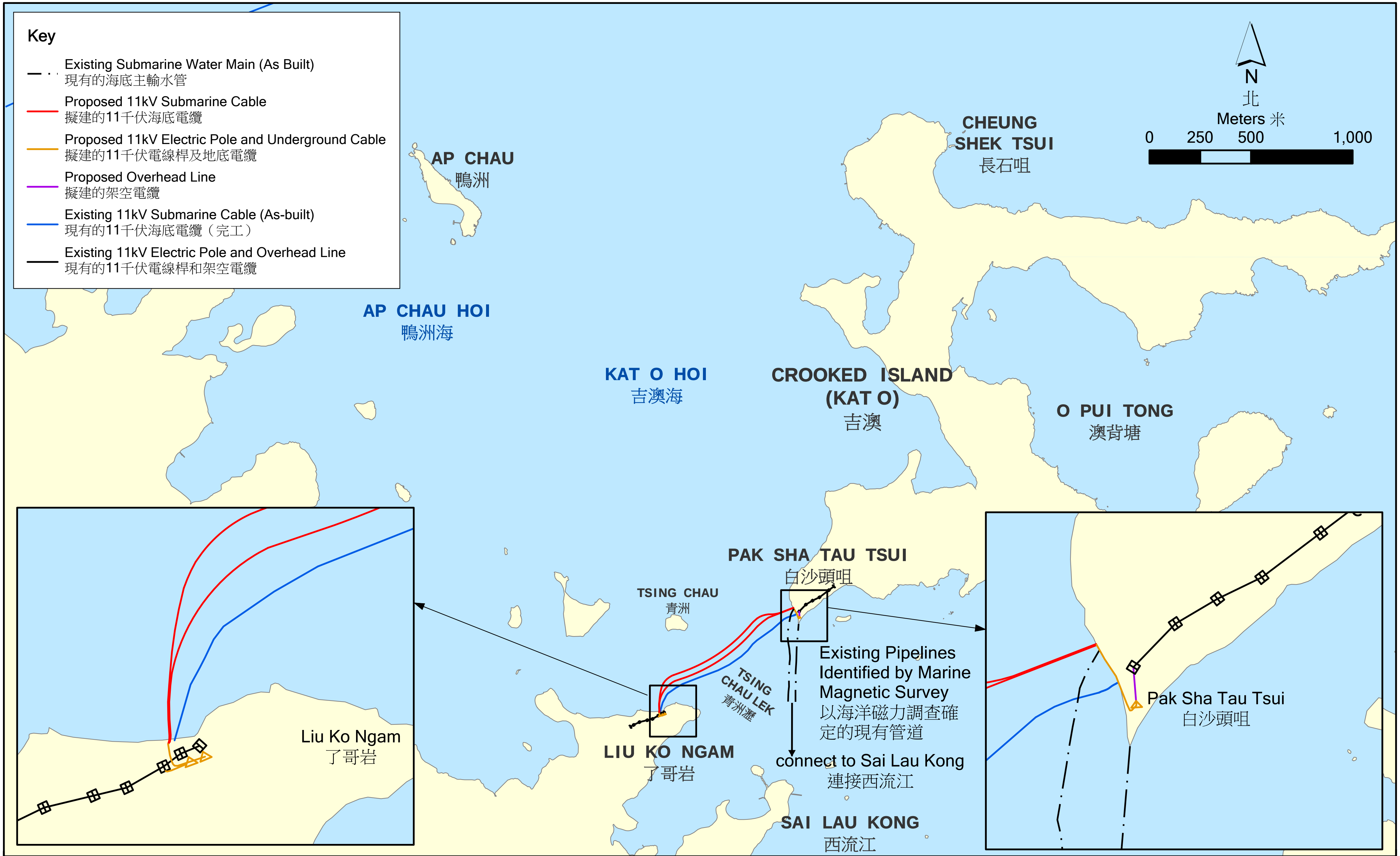


Figure D2-1.1
圖 D2-1.1

Alignment of the Proposed 11kV Submarine Cable Circuit from Liu Ko Ngam to Pak Sha Tau Tsui

了哥岩至白沙頭咀的擬建11kV海底電纜路線

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Section 3 presents the objectives and methodology of the archaeological survey;

Section 4 presents the findings of the archaeological survey;

Section 5 presents the conclusion; and

Section 6 presents the bibliography.

The following appendices are also included:

Appendix A presents the auger holes records;

Appendix B presents the test pits records;

Appendix C presents the list of special find and general finds;

Appendix D presents the description of special find;

Appendix E presents the photographic record of general finds; and

Appendix F presents the land survey record.

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2 BACKGROUNDS OF ARCHAEOLOGICAL SURVEY AREA

2.1 HISTORY AND TOPOGRAPHIC BACKGROUND

The Site is located at Pak Sha Tau Tsui at the toe of a spur at the southwest tip of Crooked Island (also known as Kat O) (吉澳). The spur starts from a low hill on northeast and it runs down to southwest. The Site is facing the strait, Tsing Chau Lek on southwest, and the Double Haven on southeast. Kat O Island is located northeast of Hong Kong close to the northern border between Hong Kong and Shenzhen. It is an eco-tourism destination and overlooking the Shenzhen Yantian Container Terminal (深圳鹽田港). The Kat O Island villagers were originated from Longgang（龍崗）, Xinhui（新會）, Yantian（鹽田）in Guangdong Province of mainland China since the Late Ming Dynasty. During the 1950s and 60s, there were above 4,000 residents living on the island.

Nowadays, young people moved out to the city for work and there are about 200 families living on the island. They are all Hakka and Tanka people. Due to population decreased, the only school on the island was closed in 2005(1).

Pak Sha Tau Tsui which is a cape extended into a strait called Tsing Chau Lek (青洲瀝). Tsing Chau Lek connects Crooked Harbour (also known as Kat O Hoi) (吉澳海) in the north and Double Haven (Yan Chau Tong) (印洲塘) in the southeast. To the southwest, opposite to Pak Sha Tau Tsui, across the Tsing Chau Lek, is a cape called Liu Ko Ngam (了哥岩) (another landing site of the cables). A small island called Pak Ka Chau (筆架洲) is located to the east of Pak Sha Tau Tsui. *Figure D2-2.1* illustrates the topographic setting of around Pak Sha Tau Tsui.

Double Haven is well protected from wind and sea wave as it is surrounded by three major islands and the land of northeast New Territories. Water is very calm and it is an excellent natural shelter from storm and sea wave.

2.2 GEOLOGICAL BACKGROUND

The Site is located on superficial deposit of Quaternary back beach deposit and beach deposit; also on solid geology of Tai Mo Shan Formation (GEO 1992). The geology map is shown in *Figure D2-2.2*.

2.3 ARCHAEOLOGICAL BACKGROUND

The Site is located within the Kat O Pak Sha Tau Site of Archaeological Interest recorded by the AMO where field scan, two auger holes and six test pits were conducted during the previous archaeological survey in 2000 (古物古蹟辦事處 2000) (2000 Survey). Their locations are shown in *Figure D2-2.3*.

(1) 吉澳 [information on line]; available from http://zh.wikipedia.org/wiki/%E5%90%89%E6%BE%B3; internet.

It is reported that Late Neolithic Age cultural layer was identified at approximately 42 to 74 cm below the existing ground level at T2 and T3 where very fragmented coarse pottery shards were unearthed. The shards were too small to determine their typology. In addition, Qing dynasty building foundation remains were unearthed from T1 and T3. Late Neolithic coarse shards, earthenware shards, stone tools and Song, Ming and Qing dynasties porcelain and pottery shards were discovered from the field scan and disturbed layers in various test pits.

(Source: FACE Magazine Limited 地圖製作部 2011: 7)

Figure D2-2.1

圖D2-2.1

Topographic Setting around Pak Sha Tau Tsui 白沙頭咀的地形環境

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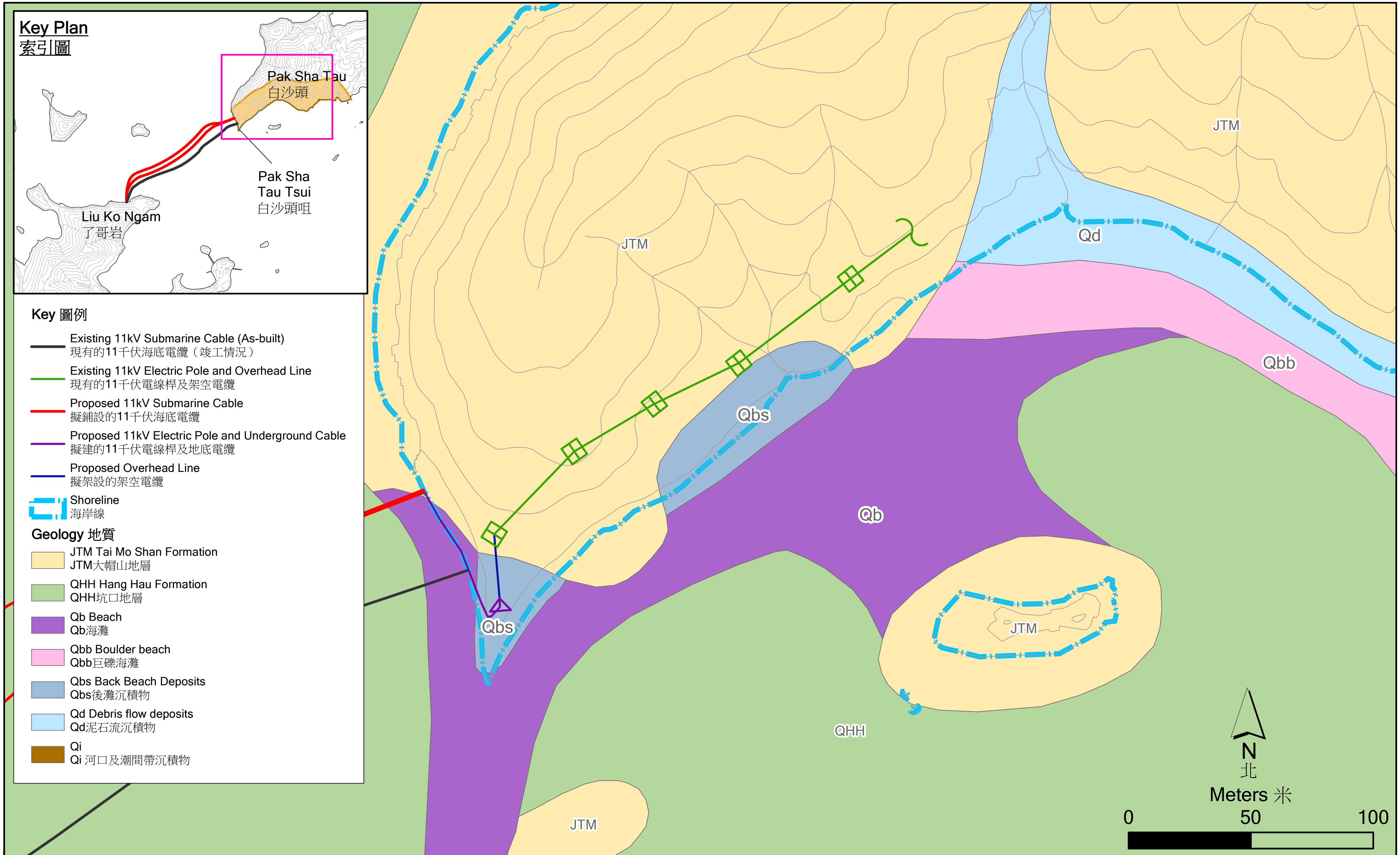

Figure D2-2.2
圖 D2-2.2

Geology

地質

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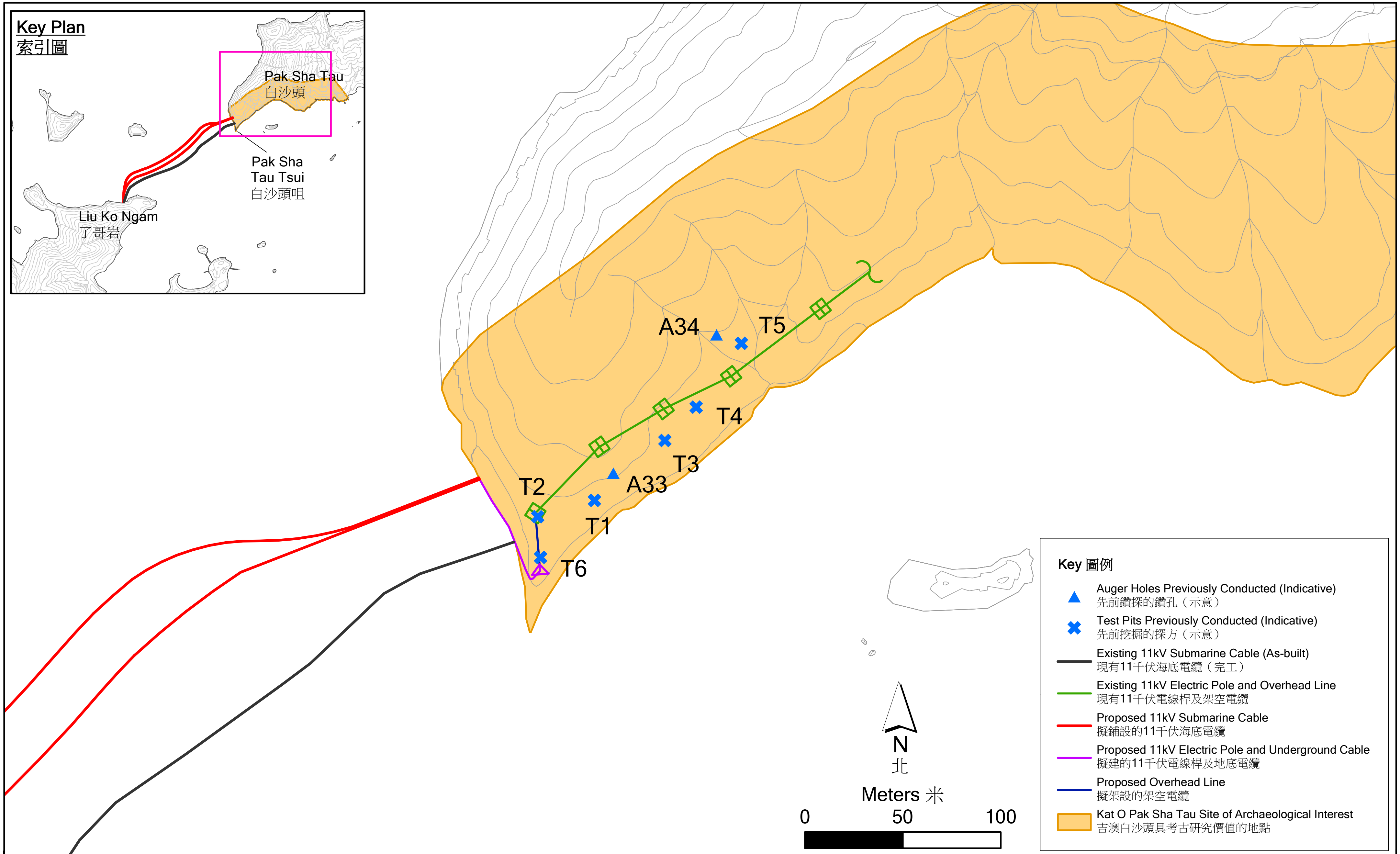

Figure D2-2.3
圖D2-2.3

Archaeological Background

考古背景

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3 OBJECTIVES AND METHODOLOGY

3.1 OBJECTIVES OF THE ARCHAEOLOGICAL SURVEY

The objective of the AS (2012 Survey) is to collect sufficient data for the AIA for the Project which requires excavation works at the landing site of Pak Sha Tau Tsui (therefore the Site) for connecting the proposed submarine cable with the existing overhead line electric system.

3.2 SCOPE OF THE ARCHAEOLOGICAL SURVEY

The scope of the AS included the following:

- to conduct field scan at and around the Site;
- to excavate 3 test pits in the size range from 1m x 1m to 2m x 1.5m; and
- to drill 7 auger holes (1) along the proposed works alignment.

The actual location of the proposed cable alignment was indicatively marked together with representatives from the Project Proponent on Site based on site condition. The location of the auger holes and test pits were subsequently adjusted where appropriate. Thus, adverse impact on the archaeological potential of the Kat O Pak Sha Tau Site of Archaeological Interest is not anticipated.

3.3 METHODOLOGY FOR THE ARCHAEOLOGICAL SURVEY

Upon agreement of the Proposal with AMO, a qualified archaeologist, Dr Jin Zhiwei, has applied and obtained the licence to *Excavate and Search for Antiquities* under the *AM Ordinance*. Access permit was also obtained from the Agriculture, Fisheries and Conservation Department (AFCD) as the Site falls within the Country Parks area.

Upon granting of the relevant licence and permit, the archaeological survey commenced and included the following tasks.

3.3.1 *Task 1 – Field Survey*

The AS was led by a qualified archaeologist and the fieldwork comprises the following tasks:

(1) During the fieldwork, when drilling the first auger hole (AH1), boulder was encountered at 0.60m below ground level, another auger hole (AH2) was drilled immediately next to AH1 to try to avoid the boulder. However, boulder was also encountered in AH2 at 0.52m below ground level. Thus, a layer of boulders is assumed to exist along the coast. For the above reason, seven auger holes were actually drilled, instead of six as proposed in the Proposal.

Task 1a: Field Scan

Field scan of the Site has been conducted. Field scan area and location of surface collections are marked in *Figure D2-3.1*.

Task 1b: Excavation (Auger Survey and Test Pitting)

A total of 3 test pits, comprising one 1.5m x 1.5m and two 2m x 1.5m test pits, and 7 auger holes were conducted to assemble field data for the AIA and their locations are presented in *Figure D2-3.2*. The setting out of the location of the test pits is determined based on site discussion with representatives from the project proponent which are located at the actual works locations. The test pits were excavated by hand under the supervision of the licenced archaeologist. The excavation of the test pits were terminated when reaching groundwater level (approximately 1.1 to 1.2m below ground level), and further excavation is considered unsafe. The field data collected has provided sufficient information to determine the archaeological potential of the impacted area. Upon discovery of archaeological finds, the AMO was notified immediately for site visit.

Daily field records were prepared which included the following information:

- A schedule detailing the field works completed during each day;
- A report on the resources and equipment deployed on site;
- A report on artefacts and archaeological features discovered and the method of treatment and conservation; and
- Weather conditions.

The archaeological team recorded the field archives during the course of the field works. The field archives were handled with reference to the *Guidelines for Handling of Archaeological Finds and Archives* (as at November 2011).

The levels of the excavated test pits were surveyed and certified by a land surveyor. The survey record is presented in *Appendix F*.

Task 1c: Relics and Archives Processing and Recording

Unearthed archaeological remains were collected, recorded, dated and sorted, and representative archaeological remains were photographed. All photographs are in color with the date, time, crew identification contained and a minimum of 400 Mega pixels in resolution in JPEG format. The relics and field records were processed and analysed in accordance with AMO's *Guidelines for Handling of Archaeological Finds and Archives* (as at November 2011).

According to *Section 10* of *AM Ordinance*, the ownership of the archaeological relics identified vest in the Hong Kong SAR Government. Upon acceptance of the finalised version of this Report by AMO, the finds, artefacts and

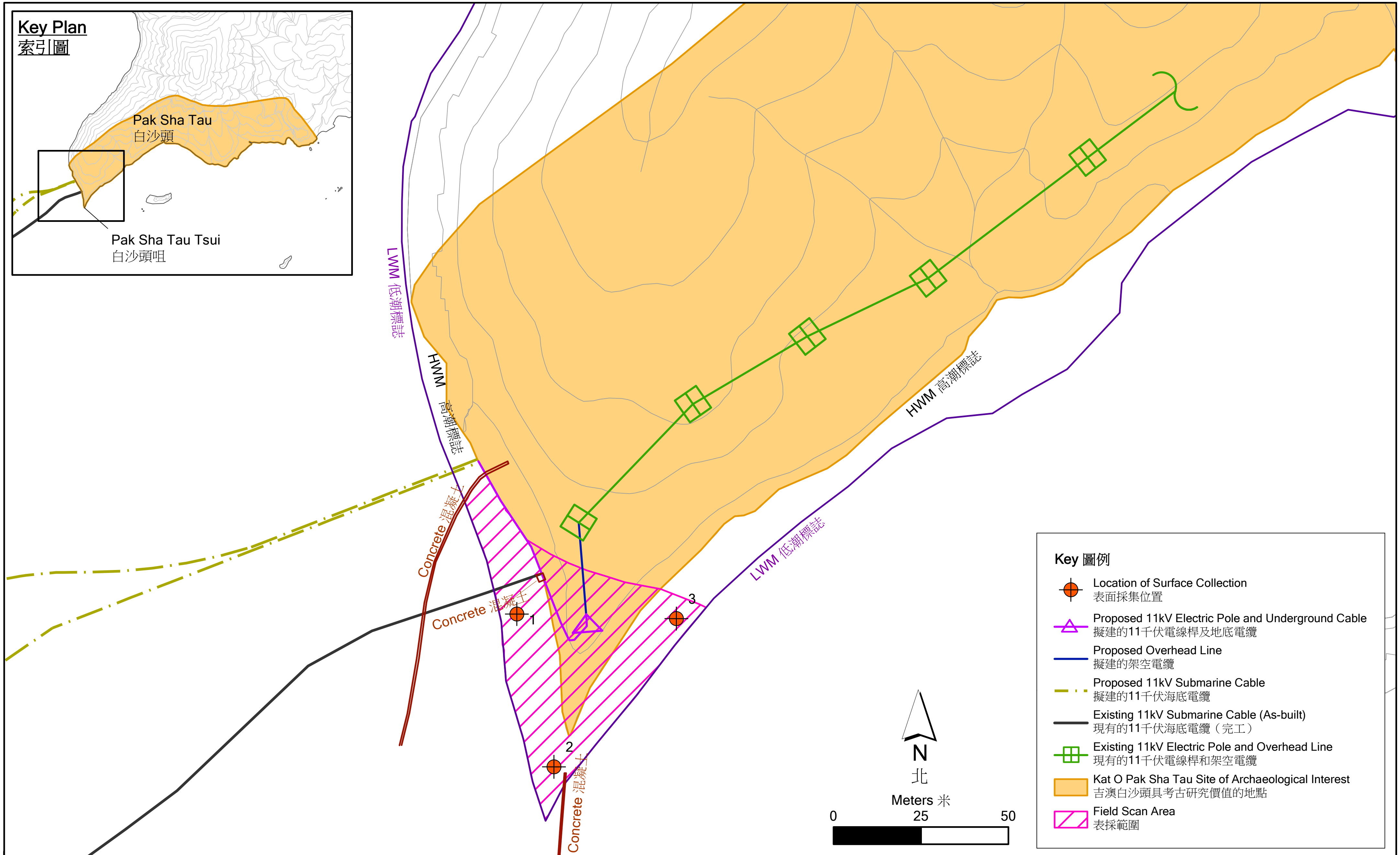

Figure D2-3.1
圖 D2-3.1

Field Scan Area

表採範圍

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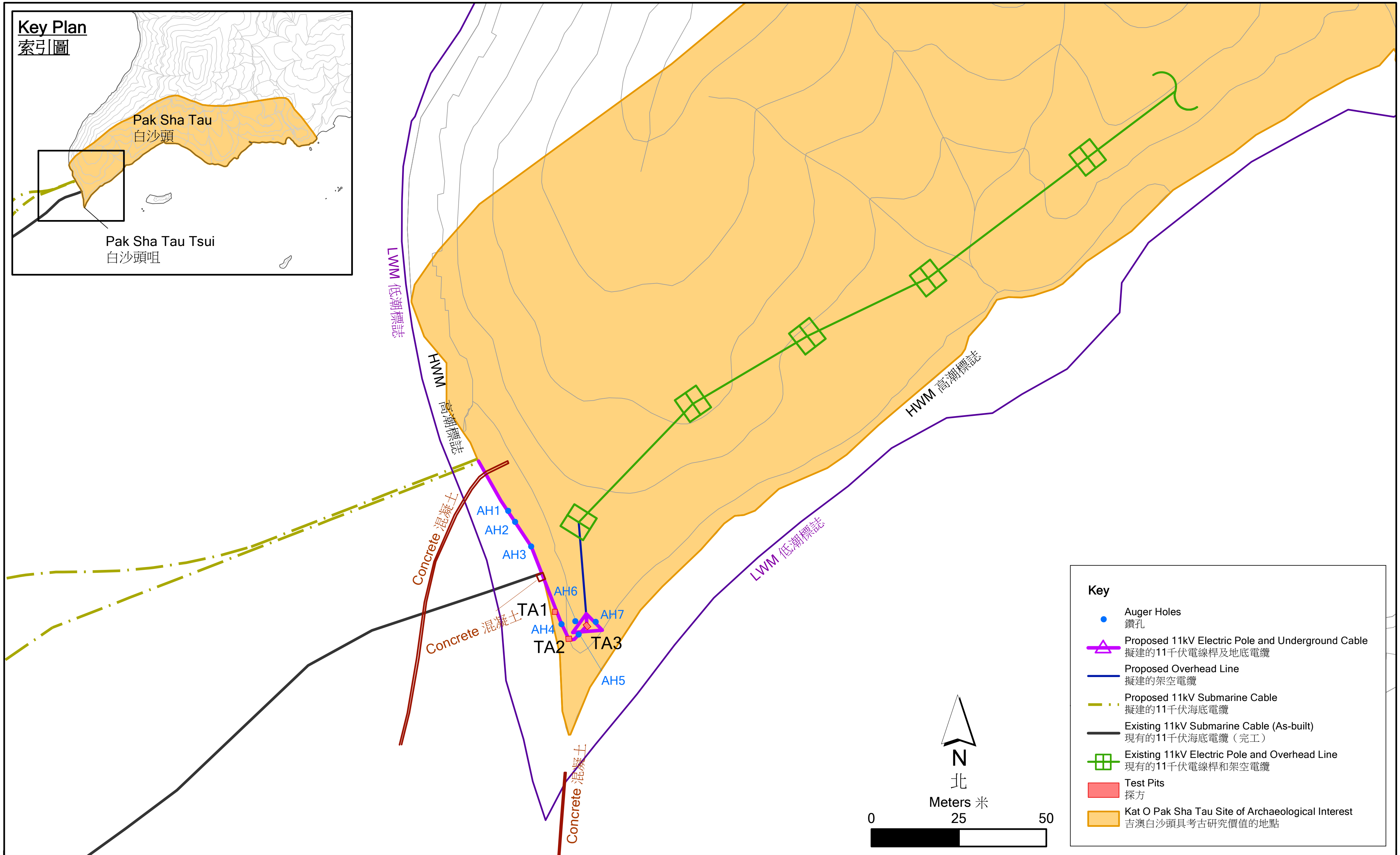

Figure D2-3.2
圖 D2-3.2

Locations of Conducted Test Pits and Auger Holes

已鑽探的鑽孔和探方位置

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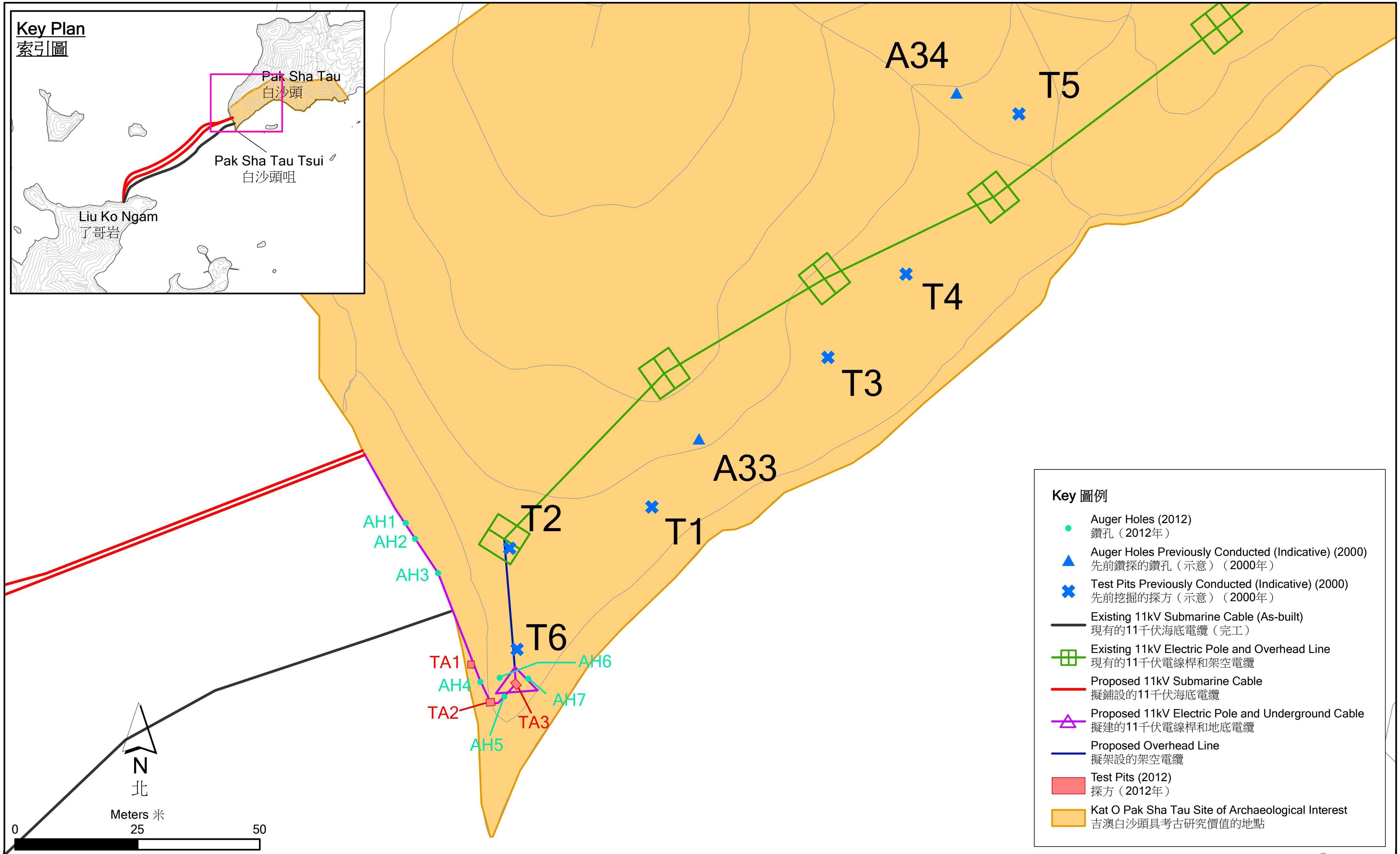

Figure D2-3.3
圖 D2-3.3

Site Plan Showing the Test Pit and Auger Hole Locations of 2000 and 2012 Surveys

展示2000年及2012年調查的探方及鑽孔位置的平面圖

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archives arising from the survey will be handed over to AMO in accordance with the conditions of the licence under the *AM Ordinance*.

3.3.2 Task 2 – Reporting

The survey findings are presented in this *Archaeological Survey Report* following AMO's *Guidelines for Archaeological Reports* (as at April 2011).

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4 FINDINGS OF THE ARCHAEOLOGICAL SURVEY

4.1 INTRODUCTION

A total area of 1,862m^2 was field scanned; seven (7) auger holes and three (3) test pits were conducted. The findings are presented below.

4.2 FIELD SCAN

Field scan was conducted around the Site during low tide. The field scanned area and location of surface collections are presented in *Figure D2-3.1*. Surface finds were collected at three sides of the Pak Sha Tau Tsui, therefore, tidal zone of the sandy beach west of TA1 (Location 1); tidal zone of the sandy beach at the southern cape (Location 2); and tidal zone of the sandy beach east of TA3 (Location 3).

Surface collections included thirteen pieces of general finds comprising village ware, porcelain and tile shards; and one isolated special find (one perforated stone artefact). Most of them show high degree of rounding, and some of them have sea shells stick on surface. They are listed in *Appendix C*. All shards of village ware and tile showed no obvious dating feature. Among those porcelain shards, one celadon shard may be produced in Tang Dynasty. Other blue-and-white and white porcelain shards can be dated to late Ming to Qing Dynasties and Republic of China period.

A perforated stone artefact, with flat body and oval shape was found at Location 2. It shows a high degree of rounding, but a bored hole can be clearly observed on the stone which was drilled from both sides. It is dated to Bronze Age. Detailed discussion and description of the stone artefact is presented in *Section 4.4* and *Appendix D* respectively.

4.3 AUGERING AND TEST PITTING

A total of seven auger holes and three test pits were conducted. No significant archaeological remains were identified at all locations. The summary of findings including the comparison with the 2000 Survey findings is also presented below.

4.3.1 *General Stratigraphy*

Both augering and test pitting revealed that greyish white sandy layers exist at the Site. The grain size of each sandy layer increases down the strata. Pebbles start to emerge at about 60cm below ground level, and become denser and increase in size as the depth increase. Fragments of sea shells are found in most layers, mostly concentrated at the surface layer. The amount of sea shell fragments decrease down the strata. At low tide, watertable emerges in TA1, TA2 and TA3 at about 1.1m below ground level.

The stratigraphy of TA1, TA2 and TA3 are similar to T1 and T6 conducted in 2000 Survey. They are located adjacent to the current coast affected by the tidal change, the deposits compose of shell fragments and sandy soil and can be regarded as three types: surface soil, disturbed soil and sterile, and with a small amount of secondary deposited artefacts.

4.3.2 *Unearthed Archaeological Remains*

Test pitting observed that modern materials such as glass and plastic in all layers (Layers 1, 2, 3 and 4) of all test pits. A concrete block was also identified in Layer 3 of TA2. Eighteen pieces of general finds were identified including village ware shards, porcelain shards and tile shards . In Layer 3 of TA1 and Layer 4 of TA2, a village ware was identified in each layer respectively and they are similar to village ware container used in early 20th Century. Thus, Layer 3 of TA1 and Layer 4 of TA2 can date to not earlier than 20th Century. Since Layer 3 of TA1 and Layer 4 of TA2 contains both early 20th century artefacts and modern materials, all the layers in the test pits are dated to early 20th century to modern period. No archaeological remain was unearthed in TA3.

All unearthed finds show a moderate degree of rounding, so as the pebbles co-existed with those finds, suggesting that all of them had been transported, moved and eroded by water current. Therefore, they are not in-situ archaeological deposits.

4.4 *ARTEFACTS*

A total of 32 artefacts were collected during the AS, in which, 14 of them were collected during field scan, and 18 of them were unearthed during test pitting. Among 32 artefacts collected, 31 of them were recorded as general finds comprising shards of village ware, porcelain and tile shards, and one of them (an isolated perforated stone) from surface collection was recorded as special find. Although it is a secondary deposited artefact, it may probably be a stone tool which is relatively special compare to other finds identified. The list of special find and general finds are presented in *Appendix C*.

The only special find is a perforated stone artefact. It is an isolated surface find collected in the tidal zone on the sandy beach at the southern cape of Pak Sha Tau Tsui marked as Location 2 in *Figure D2-3.1*. It shows a high degree of rounding, suggesting it was transported by water current and deposited at the as-found location. Some sea shells were observed attached to the find when it was found.

This perforated stone artefact is made of sedimentary rock in weak red [(1)] colour. A hole was bored at one end of the stone artefact. It was bored at the end with a slightly concave curved edge; while the other end without hole has a convex curved edge with apparent drilled traces. The hole was bored from both sides at the same location to form the hole with completed circle.

(1) Weak Red (10R 5/3) of Munsell Soil Color Charts (Washable Edition 2000)

Based on the manufacturing technique, this perforated stone artefact is dated to Bronze Age. Detailed description of the stone artefact is presented in *Appendix D*. The rest of the collected artefacts are presented in photographs in *Appendix E*.

For the artefacts which were unearthed in TA1 and TA2, the attached shells on artifacts indicated that they had been transported by water force and therefore are secondary deposits. In comparing the findings of T2 and T3 from the 2000 Survey to this 2012 Survey findings, T2 and T3 were located at higher level and further away from the tidal zone. Such location is considered more appropriate for settlement. This is supported by the fact that building foundation remain had been identified in T1 and T3. The stratum of T2 and T3 also showed that pre-historic cultural layer was identified (see *Figure D2-3.3* for their locations). On the other hand, T1 and T6 is located at lower level, closer to the tidal zone, such that disturbed layers were found in these two test pits.

In addition to the Bronze Age perforated stone identified, one piece of Tang Dynasty celadon was also identified from surface collection. Although the celadon shard is a secondary deposit, artefact dated to Tang dynasty is firstly reported in this Kat O Pak Sha Tau Site of Archaeological Interest. This implies that there is potential to identify Tang dynasty cultural layer in this Site of Archaeological Interest but this is subject to future investigation to confirm. Other general finds identified are mainly late Ming to Qing Dynasties, early 20th century or Republic of China period artefacts including village ware shards, tiles shards and porcelain shards. Many of them are very small pieces and with poor condition, some of them are attached with sea shell fragments, therefore their typology cannot be determined. Nevertheless, this implies that many of the artefacts were transported to the survey area by the water force and therefore they are all considered as secondary deposits. Since all the finds are secondary deposits, they are considered to have low significance in understanding the in-situ deposits of the Site.

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5 *CONCLUSIONS*

CLP Power Hong Kong Limited (CLP) is planning to enhance the security of power supply to Kat O Island(吉澳島). Therefore, a project planning to replace the existing 11kV submarine cable connecting Liu Ko Ngam to Pak Sha Tau Tsui (白沙頭咀) at Kat O (Crooked Island) to ensure continuous electricity supply on the island has been proposed.

As the landing site at Pak Sha Tau Tsui falls within the Kat O Pak Sha Tau Site of Archaeological Interest. An AS has been considered necessary to obtain field data for subsequent AIA of the Site which may potentially be impacted by the construction works of the Project.

Before the commencement of the AS, an Archaeological Survey Proposal was prepared and agreed with AMO. A *Licence to Excavate and Search for Antiquities* under the *Antiquities and Monuments Ordinance* was also granted to Dr Jin Zhiwei by the Authority in June 2012. The AS was conducted at the Site from 17 July 2012 to 3 August 2012. Field scanning of 1862m^2 of area, seven auger holes and three test pits were conducted during the AS.

The AS revealed that all identified cultural layers are dated to modern period. A total of 31 general finds and one special find were identified. The general finds include village ware, porcelain and tile shards. The special find is a perforated stone artifact dated to Bronze Age but it was an isolated find identified from field scan which is a secondary deposit artifact. All of the finds are regarded as secondary deposits and therefore not considered to have significant value.

The surveyed locations in this AS are located further south and west of T6 and further away from T2 and T3 of the 2000 Survey. The surveyed locations in this AS are very close to the existing coastline, thus, no in-situ cultural remains was unearthed.

Based on the AS result, the chance of finding significant archaeological remains at the Site where the proposed project works to be impacted is very low. This is further supported by the fact that previous archaeological survey in 2000 has indicated that in-situ pre-historic archaeological deposits are mainly located at the hill slope away from the modern beach area where the project works locates.

Nevertheless, as a special find and some archaeological materials were found during this survey, it is recommended that prior to excavation works commence in Kat O Pak Sha Tau Site of Archaeological Interest, the project proponent shall notify AMO the commencement date of excavation work so that AMO could arrange site monitoring visits of the excavation work. In addition, during the excavation work in Kat O Pak Sha Tau Site of Archaeological Interest, AMO shall be notified in case of discovery of any antiquities or supposed antiquities.

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Appendix A

Auger Holes Records

Detailed Record of Conducted Auger Holes

Auger Hole No.	Strata	Depth (m) (a)	Thickness (m)	Description
AH1	1	0.60	0.60	Greyish white sandy layer, with occasion sea shell fragments. No archaeological remains was identified.
	Hole Depth	0.60		Auger Hitting Boulder
AH2	1	0.52	0.52	Greyish white sandy layer, with occasion sea shell fragments. No archaeological remains was identified.
	Hole Depth	0.52		Auger Hitting Boulder
AH3	1	0.74	0.74	Greyish white sandy layer, with occasion sea shell fragments. No archaeological remains was identified.
	Hole Depth	0.74		Auger Hitting Boulder
AH4	1	0.60	0.60	Greyish white sandy layer, with occasion sea shell fragments. No archaeological remains was identified.
	Hole Depth	0.60		Auger Hitting Boulder
AH5	1	1.10	1.10	Greyish white sandy layer, with occasion sea shell fragments. No archaeological remains was identified.
	Hole Depth	1.10		Reached water table
AH6	1	1.17	1.17	Greyish white sandy layer, with occasion sea shell fragments. No archaeological remains was identified.
	Hole Depth	1.17		Reached water table
AH7	1	1.10	1.10	Greyish white sandy layer, with occasion sea shell fragments. No archaeological remains was identified.
	Hole Depth	1.10		Reached water table

Note: (a) Depth measure from the ground level to the surface of the stratum.

Appendix B

Test Pits Records

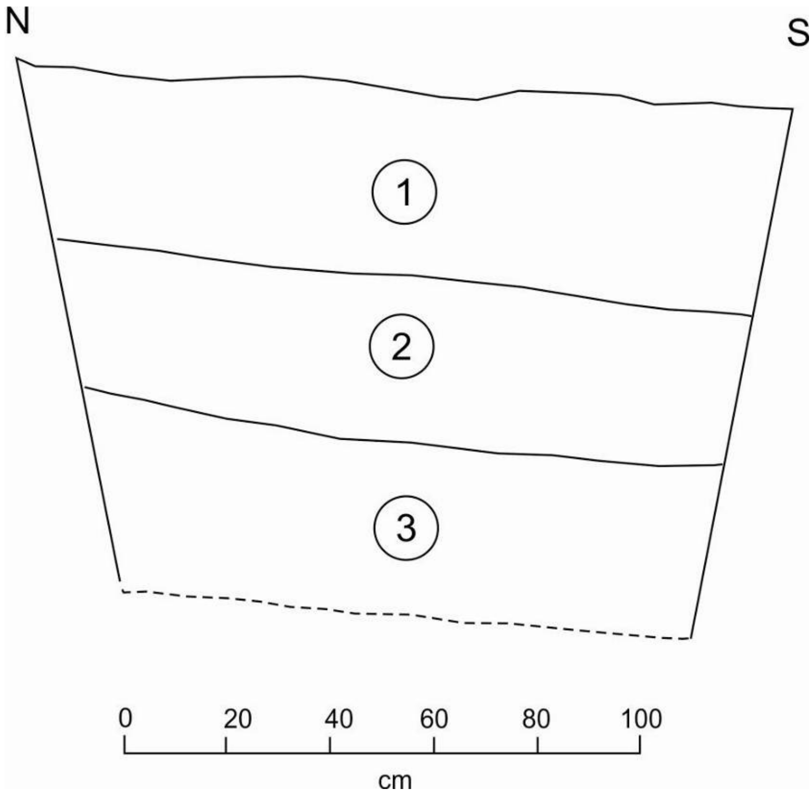
Detailed Record of Conducted Test Pits

Site Code	**KOPST2012**		**Test Pit No.**	**TA1**
Test Pit Coordinate	E847516.972	N843689.772	**Test Pit Measurement**	1.5m x 1.5m
Digging Method	Hand Digging		**Ground Level**	2.5 – 2.6mPD

Stratigraphy

Layer	Description	Cultural Remains	Archaeological Dating	Depth from Ground Level (m)	Thickness (m)
1	Greyish white sand with many sea shell fragments and plastic shards		Modern	0	0.35-0.40
2	Greyish white sand, coarser than Layer 1, with occasional sea shell fragments, Plastic sheet fragments and glass shards	Village ware shard, porcelain shards, tile shards	Modern	0.35-0.40	0.28-0.30
3	Greyish white sand, coarser than Layer 2, with rounded pebbles	Village ware shards, tile shard	Not earlier than 20th Century	0.65-0.70	>0.35-0.40

Drawing



East Section

Photographic Record

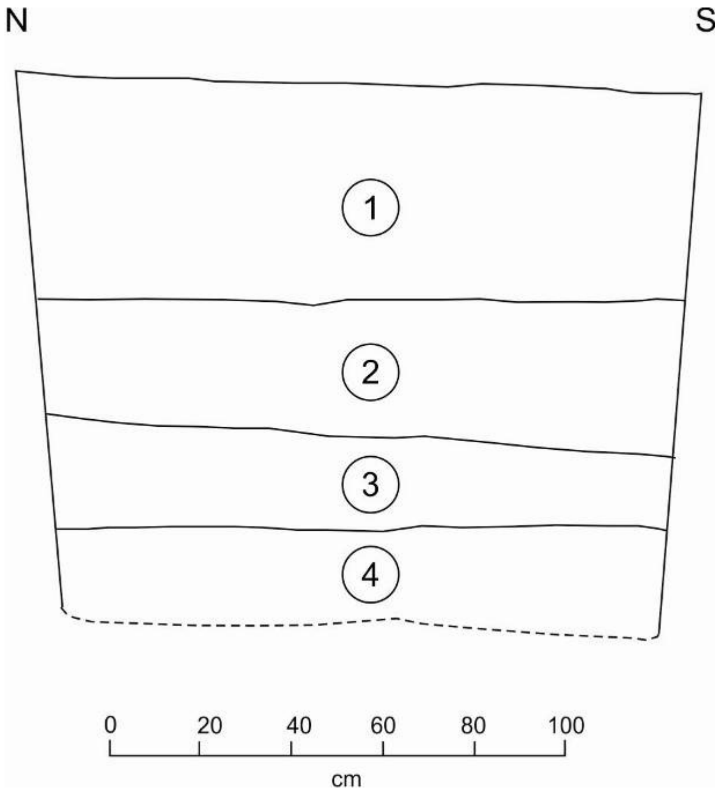
East Section

Site Code	KOPST2012		Test Pit No.	TA2
Test Pit Coordinate	E847520.905	N843681.966	**Test Pit Measurement**	2m x 1.5m
Digging Method	Hand Digging		**Ground Level**	2.5 – 2.6mPD

Stratigraphy

Layer	Description	Cultural Remains	Archaeological Dating	Depth from Ground Level (m)	Thickness (m)
1	Greyish white sand, with dense plant roots and sea shell fragments and plastic fragments		Modern	0	0.45-0.50
2	Greyish white sand, coarser than Layer 1, with some sea shell fragments and plastic fragments	Porcelain shard, tile shards	Modern	0.45-0.50	0.25-0.35
3	Greyish white sand, coarser than Layer 2, with less sea shell fragments and a concrete block.	Village ware shard, tile shards	Modern	0.75-0.80	0.15-0.25
4	Greyish white sand, coarser than layer 3, with pebbles	Village ware shard	Not earlier than 20th Century	0.95-100	>0.20-0.25

Drawing



East Section

Photographic Record

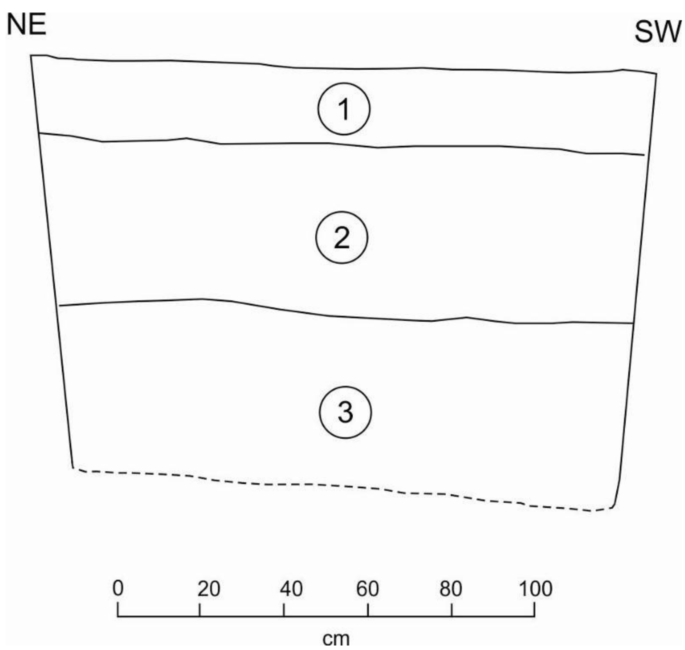
East Section

Site Code	KOPST2012		Test Pit No.	TA3
Test Pit Coordinate	E847525.792	N843686.775	**Test Pit Measurement**	2m x 1.5m
Digging Method	Hand Digging		**Ground Level**	2.5mPD

Stratigraphy

Layer	Description	Cultural Remains	Archaeological Dating	Depth from Ground Level (m)	Thickness (m)
1	Greyish white fine sand, with sea shell fragments and Modern rubbish	No cultural remains	Modern	0	0.19-0.20
2	Greyish white sand, with some sea shell fragments and Glass wine bottle shards	No cultural remains	Modern	0.19-0.20	0.40
3	Greyish white sand, coarser than Layer 2, with some sea shell fragments and glass wine bottle shards	No cultural remains	Modern	0.60	>0.40

Drawing



Southeast Section

Photographic Record

Southeast Section

Appendix C

List of Special Find and General Find

List of Special Find

SF Number	Location	Stratigraphy	Name	Quantity (pcs)
KOPST2012SC:SF01	Tidal zone of the sandy beach at the southern cape (Location 2)	Surface Collection	Perforated Stone Artifact (穿孔石製品)	1
			Total:	1

List of General Find

Location	Bag	Stratigraphy	Material		
			Village ware (Pottery)	Porcelain	Tile
Tidal zone of the sandy beach west of TA1 (Location 1)	01	Surface Collection	1	1	
Tidal zone of the sandy beach east of TA3 (Location 3)	02	Surface Collection	1	3	
Tidal zone of the sandy beach at the southern cape (Location 2)	03	Surface Collection	1		1
Tidal zone of the sandy beach at the southern cape (Location 2)	04	Surface Collection		5	
TA1	01	Layer 2	2	1	3
TA1	02	Layer 3	2		1
TA2	01	Layer 2		1	4
TA2	02	Layer 3	1		2
TA2	03	Layer 4	1		
		Total:	9	11	11

Appendix D

Description of Special Find

SF Number: KOPST2012SC: SF01
Name: Perforated Stone Artifact (穿孔石製品)
Photograph:


Two sides of the Perforated Stone Artifact

Quantity: 1 Piece
Material: Sedimentary Rock
Color of the stone material: Weak Red (10R 5/3) (1)
Approximate Dimension: 14cm (Length); 10cm (width); 0.2 - 1.7cm (thickness)
Shape: Irregular
Bore hole diameter: 0.96cm
Bore hole shape: Circle
Boring technique: hole bored from both sides
Dating: Bronze Age

(1) Weak Red (10R 5/3) of Munsell Soil Color Charts (Washable Edition 2000)

Appendix E

Photographic Record of General Find

Surface Collections

Late Ming-Qing Dynasties and Republic of China period village ware shard (left) and white porcelain (right) collected at tidal zone of the sandy beach west of TA1 (Location 1) (Bag 01)
(Up: Exterior; Low: Interior)

Surface Collections

Late Ming to Qing Dynasties and Republic of China period shards collected at tidal zone of the sandy beach east of TA3 (Location 3) (Bag 02)(Up: Exterior; Low: Interior): village ware shard (Bottom Left), celadon shard (Top left) and porcelains (Top right and Bottom Right)

Surface Collections

Late Ming to Qing Dynasties and Republic of China period shards collected at tidal zone of the sandy beach at the southern cape (Location 2) (Bag 03)
(Up: Exterior; Low: Interior): village ware shard (left) and tile shard (right)

Surface Collections

Tang Dynasty celadon (top right) shard and late Ming to Qing Dynasty blue and white porcelain shards collected at tidal zone of the sandy beach at the southern cape (Location 2) (Bag 04)
(Up: Exterior; Low: Interior)

General Finds of TA1

Village ware shards (Top middle and bottom right), tile shards (Left column and bottom middle) and late Ming to Qing Dynasty blue and white porcelain shard (Top right) unearthed from Layer 2 of TA1 (Bag 01)
(Up: Exterior; Low: Interior)

General Finds of TA1

Early 20th century to modern village ware shards (Left) and tile shard (right) unearthed from Layer 3 of TA1 (Bag 02)
(Up: Exterior; Low: Interior); the bottom left village ware shard shows incised comb pattern at the interior

General Finds of TA2

Early 20th century to modern celadon shard (Top left) and tile shards (middle and right) unearthed from Layer 2 of TA2 (Bag 01)
(Up: Exterior; Low: Interior)

General Finds of TA2

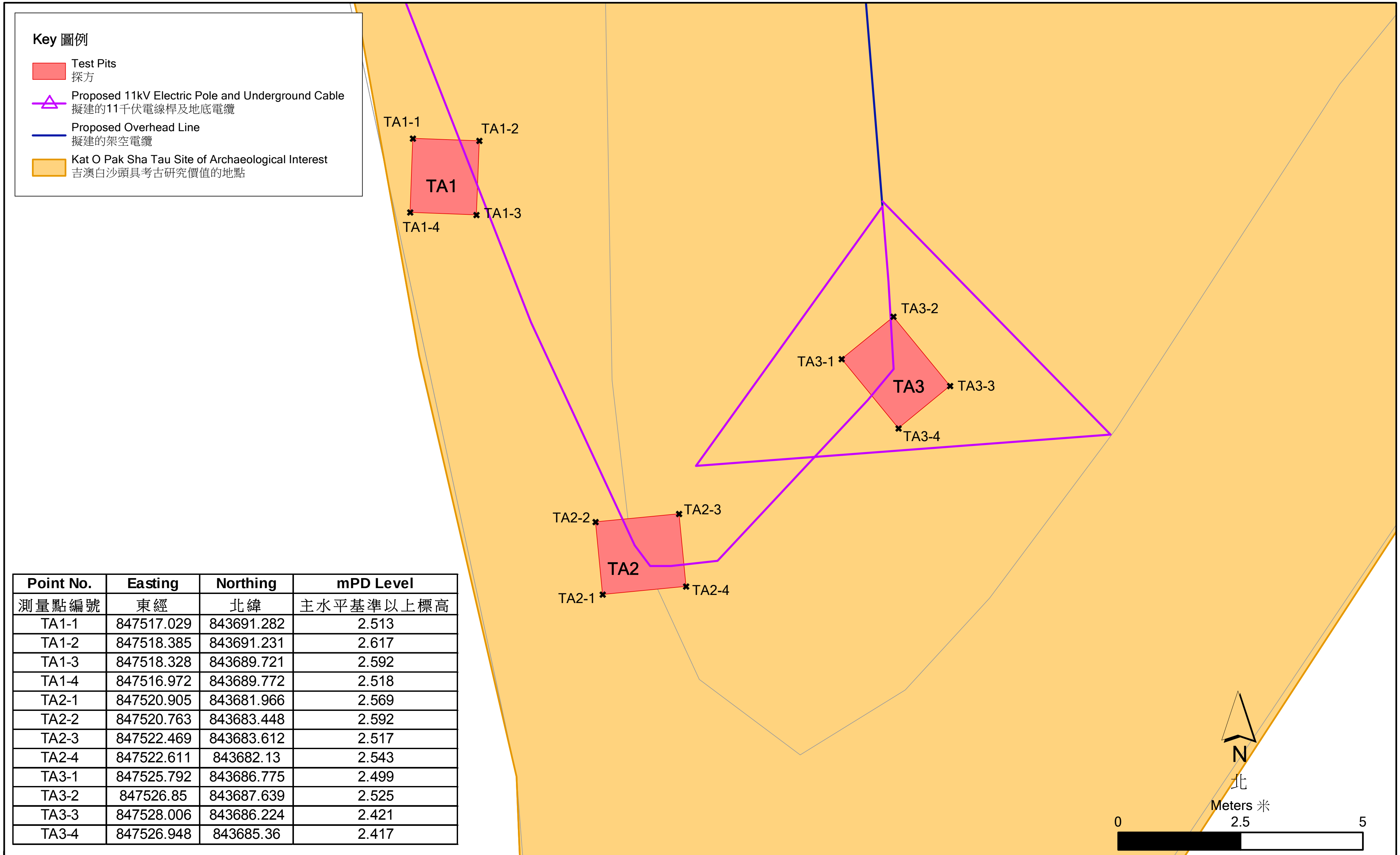
Early 20th century to modern village ware shard (bottom left) and tile shards unearthed from Layer 3 of TA2 (Bag 02)
(Up: Exterior; Low: Interior)

General Finds of TA2

Early 20th century to modern village ware shard unearthed from Layer 4 of TA2 (Bag 03)
(Up: Exterior; Low: Interior)

Appendix F

Land Survey Record



Point No. 測量點編號	Easting 東經	Northing 北緯	mPD Level 主水平基準以上標高
TA1-1	847517.029	843691.282	2.513
TA1-2	847518.385	843691.231	2.617
TA1-3	847518.328	843689.721	2.592
TA1-4	847516.972	843689.772	2.518
TA2-1	847520.905	843681.966	2.569
TA2-2	847520.763	843683.448	2.592
TA2-3	847522.469	843683.612	2.517
TA2-4	847522.611	843682.13	2.543
TA3-1	847525.792	843686.775	2.499
TA3-2	847526.85	843687.639	2.525
TA3-3	847528.006	843686.224	2.421
TA3-4	847526.948	843685.36	2.417

Annex F1
附件F1

Land Survey Record

土地測量記錄

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Date: 26/4/2013

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Annex E

Environmental Monitoring & Audit (EM&A) Requirements

CONTENTS

E INTRODUCTION

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 conform to the prediction in the Project Profile and are not resulting in any unacceptable impacts to nearby coral communities;
- 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.

E.1 WATER QUALITY SAMPLING

The following Section provides details of the water quality monitoring during the installation of the 11kV submarine cable.

E.1.1 Sampling Methodology

Parameters Measured

The parameters to be measured *in situ* are:

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

The only parameter to be measured in the laboratory is:

- suspended solids (SS) (mg L^{-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, water depth, time, weather conditions, sea conditions (where appropriate), tidal state (where appropriate), special phenomena and work activities undertaken around the monitoring and Works area that may influence the monitoring results.

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 mg L^{-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 should be measured from a split water sample from the SS sample. A suitable turbidity test kit should be used to measure the turbidity level.

- ***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, water depth gauge affixed to bottom of the water quality monitoring vessel is preferred. 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. The use of DGPS is preferred for positioning device, which should be well calibrated at appropriate checkpoint (e.g. Quarry Bay Survey Nail).

- ***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.

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.

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.

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 required reporting limit for SS is 1 mg L^{-1}.

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.

E.1.2 Monitoring Locations

The monitoring station locations have been established to identify potential impacts to water quality sensitive receivers which are shown in *Figure E1*.

Prior to, during and after the installation of the cable, water quality sampling will be undertaken at stations situated around the cable laying works. The monitoring at those stations is to ensure the construction works of the Project do not affect the sensitive areas nearby (shown in *Figure E1*).

- C1 is a Control Station to the north of the cable alignment (approximately 1.4 km away) with the same coordinates as EPD routine monitoring station MM2, which is not supposed to be influenced by the construction works due to its remoteness to the Project site;

- C2 is a Control Station to the south of the cable alignment (over a distance of 1.6 km) with the same coordinates as EPD routine monitoring station

MM7, which is not supposed to be influenced by the construction works due to its remoteness to the Project site;

- SR1 is Impact Station used to monitor the effect of the cable installation works on coral communities of high ecological concern at Tsing Chau;
- SR2 is Impact Station used to monitor the effect of the cable installation works on coral communities of high ecological concern at Ngau Shi Wu Wan;
- SR3 is Impact Station used to monitor the effect of the cable installation works on Lai Chi Wo/ Yan Chau Tong Marine Park (to the west of the Project site);
- SR4 is Impact Station used to monitor the effect of the cable installation works on Yan Chau Tong Marine Park (to the south of the Project site);
- SR5 is Impact Station used to monitor the effect of the cable installation works on Sai Lau Kong FCZ;
- G1 is regarded as a Gradient Station in between Impact Station SR1 and the construction work alignment;
- G2 is Gradient Station located between Impact Stations SR2, SR4 and SR5 and construction work alignment; and
- G3 is Gradient Station located between Impact Stations SR3 and the construction work alignment and landing point at Kiu Ko Ngam.

The suggested co-ordinates of these monitoring stations are listed in *Table E1*.

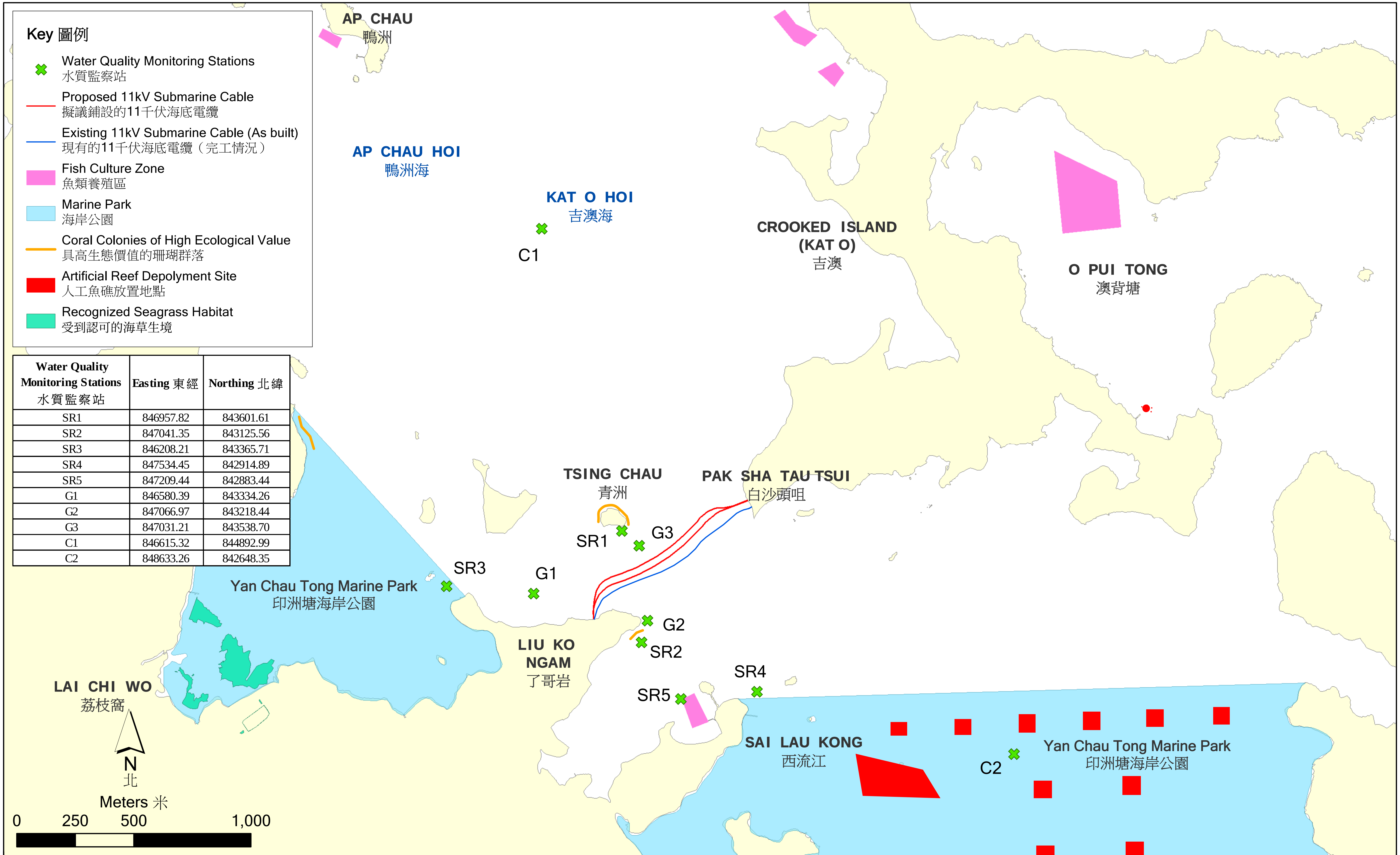
Table E1 ***Co-ordinates of Monitoring Stations (HK Grid)***

Station	Nature	Easting	Northing
C1	Control Station	846615.32	844892.99
C2	Control Station	848633.26	842648.35
SR1	Impact Station	846957.82	843601.61
SR2	Impact Station	847041.35	843125.56
SR3	Impact Station	846208.21	843365.71
SR4	Impact Station	847534.45	842914.89
SR5	Impact Station	847209.44	842883.44
G1	Gradient Station	846580.39	843334.26
G2	Gradient Station	847025.97	843218.44
G3	Gradient Station	847031.21	843538.70

E.1.3 Sampling Procedures

Monitoring Frequency

The monitoring stations will be sampled during Baseline Monitoring, Impact Monitoring and Post Project Monitoring. The Impact Monitoring will be carried out when the seabed is disturbed, for example, cable laying operations, underwater trenching, cable burying by divers, backfilling of underwater



Water Quality Monitoring Stations 水質監察站	Easting 東經	Northing 北緯
SR1	846957.82	843601.61
SR2	847041.35	843125.56
SR3	846208.21	843365.71
SR4	847534.45	842914.89
SR5	847209.44	842883.44
G1	846580.39	843334.26
G2	847066.97	843218.44
G3	847031.21	843538.70
C1	846615.32	844892.99
C2	848633.26	842648.35

Figure E1
圖E1

Water Quality Monitoring Stations

水質監察站

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Date: 30-Oct-2012

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trench. Post Project Monitoring will be conducted after completion of the cable installation.

Baseline Monitoring

Baseline Monitoring will comprise sampling on three occasions (days) prior to, but no more than three weeks before, cable laying work. The monitoring will be undertaken at ten locations (five impact monitoring, three gradient and two control monitoring stations) in total, as shown on *Figure E1*. Samples will be taken during mid flood and mid ebb tidal state on each sampling occasion.

Impact Monitoring

Impact Monitoring will comprise sampling two times a week during the cable installation works at the same location as the Baseline Monitoring Stations. Samples shall be taken during both mid flood and mid ebb tidal states on each sampling occasion.

In case the Impact Monitoring is ceased with reasons such as the operations of the cable installation has no disturbance of seabed or the works are suspended due to safety issue or adverse weather conditions etc for more than 1 week. The Contractor should send a confirmation letter to EPD and AFCD 1 week before the cessation of Impact Monitoring

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.

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. Tidal range should not be less than 0.5m for capturing representative tide. The interval between two successive monitoring events shall not be less than 36 hours unless otherwise specified.

Depths

Each station will be sampled and measurements will be taken at three depths, 1 m below the sea surface (surface), mid depth and 1m above the sea bed (bottom). For stations that are less than 3 m in depth, only the mid depth sample will be taken. For stations that are less than 6 m in depth, only the surface and bottom samples will be taken.

E.1.4 Compliance / Action Event Plan

Water quality monitoring results will be evaluated against Action and Limit levels shown in *Table E2*.

Table E.2 Action and Limit Level for Water Quality

Parameter	Action Level	Limit Level
DO in mgL^{-1} [a]	<u>Surface and Middle</u> 5%-ile of baseline data for surface and middle layer, and 20% exceedance of value at any impact station compared with corresponding data from control stations <u>Bottom</u> 5%-ile of baseline data for bottom layers and 20% exceedance of value at any impact station compared with corresponding data from control stations	<u>Surface and Middle</u> 4mg/L [e] or 1%-ile of baseline for surface and middle layer [d] <u>Bottom</u> 2mg/L [e] or 1%-ile of baseline data for bottom layer [d]
SS in mgL^{-1} (Depth-averaged [b]) [c]	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
Turbidity in NTU (Depth-averaged [a]) [c]	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

Notes:

a. For DO, non-compliance of the water quality limits occurs when monitoring result is lower than the limits.

b. "Depth-averaged" is calculated by taking the arithmetic means of reading of all three depths (at 1 metre below surface, mid-depth and 1 metre above seabed, see *Section E.1.3* for the definition of sampling water depth).

c. For SS and turbidity, non-compliance of the water quality limits occurs when monitoring result is higher than the limits.

d. Either one or both will be chosen as the Action Level and Limit Level upon the completion of baseline monitoring.

e. Limit level for DO was derived from the Water Quality Objectives (WQO) for Mirs Bay Water Control Zone under the Water Pollution Control Ordinance (WPCO) Chapter 358I.

The measures that will be undertaken in the event that the Action or Limit Levels are exceeded are shown in *Table E3*.

Table E3 Event and Action Plan

Event	Contractor
Action Level Exceedance	**Step 1** - repeat sampling event to confirm findings. **Step 2** - if findings are confirmed, 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 3** - repeat measurements after implementation of mitigation for confirmation of compliance. **Step 4** - if non compliance continues - increase measures in Step 2 and repeat measurements in Step 3. If non-compliance occurs at a third time, the cable laying operations should be suspended.
Limit Level Exceedance	Inform EPD and AFCD and confirm notification of the non-compliance in writing within 24 hours after a limit level exceedance is recorded. Undertake **Steps 1-3** immediately, if further non-compliance continues at the Limit Level, suspend cable laying operations until an effective solution is identified.

E.1.5 Reporting

Schedule for impact monitoring should be submitted to EPD and AFCD at least 1 week before commencement of the monitoring works for agreement. A letter report shall be provided to EPD and AFCD that shall include the monitoring results and an interpretation of monitoring results. The monitoring data should be provided graphically to show the relationship between the Control, Gradient and Impact Stations and compliance or non-compliance with respect to the Action/Limit Levels.

The reports to be provided by the environmental contractor 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. An Impact Monitoring Report shall be provided within one week of completing every weekly monitoring survey for the first three impact monitoring weeks. If there are no exceedances recorded during the first three weeks, a Bi-weekly Impact Monitoring Report shall be provided within 1 week of completing every two weekly monitoring surveys. The post Project Monitoring Report shall be provided within one week of completion of the Post Project Survey.

E.2 CORAL MONITORING AND TRANSLOCATION PLAN

According to the results of the recent subtidal dive and coral mapping surveys, a total of 18 and 16 hard coral species were recorded within the cable working corridors at Liu Ko Ngam and Pak Sha Tau Tsui respectively.

The location of the proposed cable route landing has avoided the dense coral areas. Within the cable working corridors, the number of potentially affected hard coral colonies will be greatly reduced from 120 to 16 at Liu Ko Ngam and 108 to 25 at Pak Sha Tau Tsui given the implementation of translocating the 104 and 83 coral colonies (at Liu Ko Ngam and Pak Sha Tau Tsui respectively) which are considered to be feasible for translocation from the impacted area to the recipient site before construction works commencement. No unacceptable impacts to the coral assemblages are predicted to occur as a result of these measures.

The Rock Cutting technique at the landing sites at at Liu Ko Ngam and Pak Sha Tau Tsui will be conducted within a 5 m silt curtain which will assist in controlling sediment dispersion. As a consequence of this mitigation measure, no unacceptable indirect impacts to corals are expected to occur during the cable landing works. Although adverse impacts to corals are not predicted to occur, coral monitoring will be undertaken during cable installation to verify that the project has no adverse ecological impact on the corals.

E.2.1 *Monitoring and Translocation Objectives*

The objective of the coral monitoring during the cable installation works is to detect any adverse impact to corals in the vicinity of the project works during cable laying and, where such impacts are identified and are found to be associated with the cable installation works, to ensure appropriate action is undertaken to effectively reduce such impacts.

The coral monitoring will be reviewed in conjunction with the water quality monitoring results, which will provide concentrations of suspended solids from cable laying activities.

To further minimise impacts to the coral colonies (which is not considered unacceptable), translocating the potentially affected and movable coral colonies within the works site at at Liu Ko Ngam and Pak Sha Tau Tsui will be undertaken prior the commencement of construction activities. The coral survey and translocation works shall be undertaken by a qualified person with a relevant ecology postgraduate degree and at least three years of relevant experience in such works.

E.2.2 *Coral Translocation Plan*

A detailed coral survey will be conducted prior to works commencement to ascertain the existence of the coral colonies within the works site. This survey will also be used to guide the installation of the silt curtain. Coral translocation works should be conducted two weeks before the commencement of the works and the coral colonies to be translocated exhibiting good health condition (without signs of stress). The methodology for the coral translocation is presented as follows.

Assessment of Coral Status Prior to Translocation

Each coral colony should be identified within the proposed works site before translocation. The conditions of the coral colonies, including partial mortality, bleaching or lesions noted, and the type and size of the attached substrate should be recorded. Representative photographs of each of the coral colony recorded should also be taken.

Coral Translocation

The translocation of coral colonies should be carried out by manual lifting. To have a significantly higher chance of survival, all the corals colonies to be translocated should keep submerged at all times (not exposed to the atmosphere, wind and direct sunlight) during the moving process. The employment of a manual underwater method can ensure that translocated corals are collected, moved and deposited carefully and in the correct orientation.

Identified coral colonies should be moved with the associated attached substrate, e.g. boulder, to the receiver site. Small moveable colonies could be transferred through the use of an underwater lifter. Underwater lifter consists of a 1 m^2 platform suspended underneath a 200 kg lift bag. Individual coral colonies can be placed on the platform by divers wearing gloves. Once the coral colony identification is underway a team of divers follow behind with the underwater lifter and remove the documented colonies in a consistent manner. An effort should be made to minimise the amount of contact by the divers and the length of time the coral colonies are handled. Care should be taken with the use of the platform and the individual lifting events to avoid contact with the coral tissue at all times.

It is suggested that corals are transferred to the northern side of Tsing Chau, which is also identified as a Control Site presented in *Figure E2* and *Section E.2.3*, by attaching the lifter to the dive boat. The dive boat should be moved at constant slow speed (<2 knots). The vertical orientation of each coral colony should be maintained during the moving process.

Once the lifter reaches the receptor site, divers should position the coral loaded platform to a seabed free of coral colonies. Coral colonies should then be lifted individually from the platform and placed on the seabed carefully in order to minimise disturbance to the seabed sediments. Spacing between coral colonies should be matched as much as possible with the original distribution of the corals to avoid interspecific competition between different species.

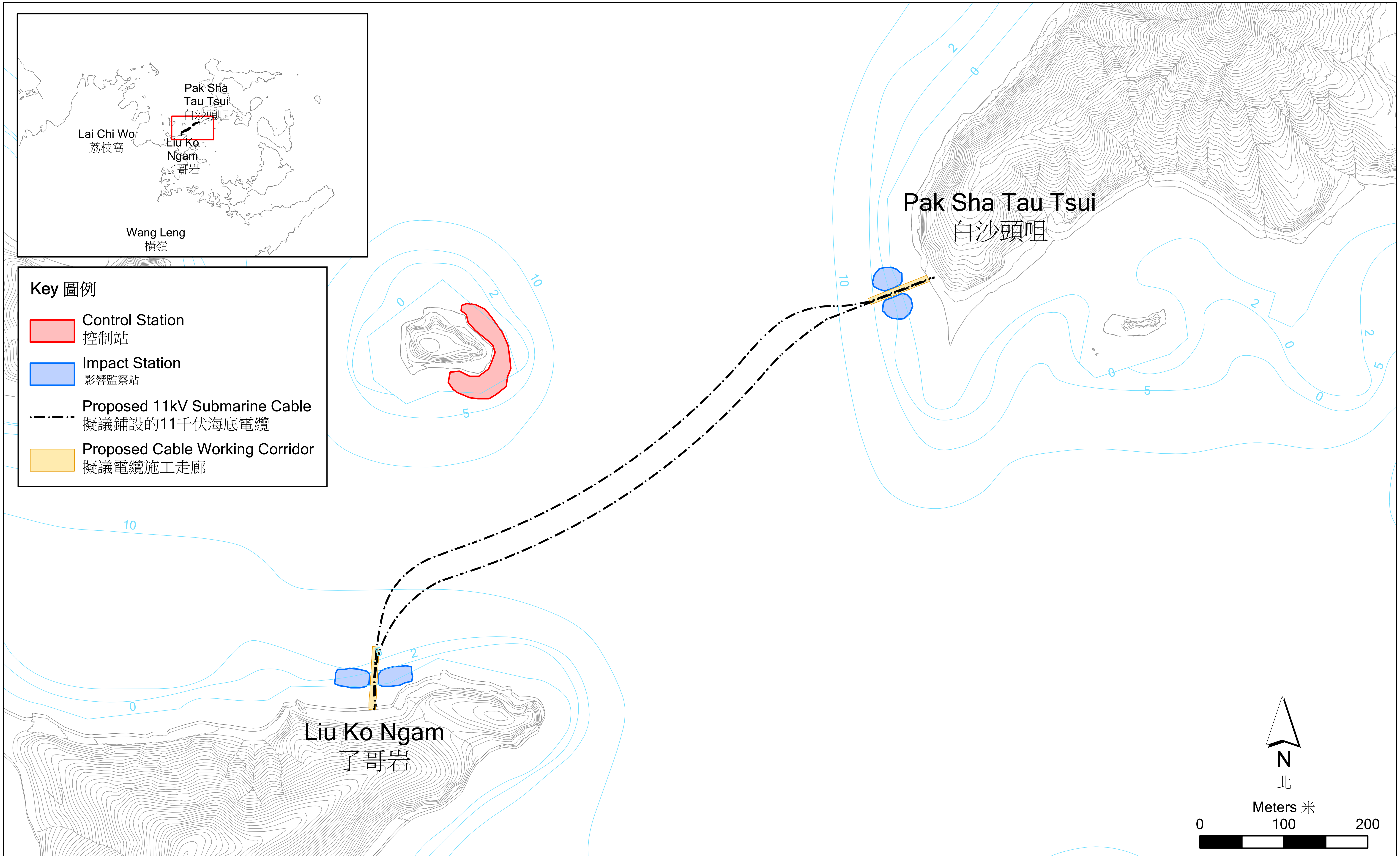

Figure E2
圖E2

Coral Monitoring Stations

珊瑚監察站

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Assessment of Translocated Coral Colonies

Each translocated coral colony should be re-assessed immediately after the translocation and during the post project monitoring. The conditions of the coral colonies, including partial mortality, bleaching or lesions noted, and the type and size of the attached substrate should be recorded. Representative photographs of each of the translocated coral colonies should also be taken for comparison of health status before and after translocation.

E.2.3 Coral Monitoring Plan

Monitoring Locations

The monitoring programme for the potentially indirectly affected coral colonies includes undertaking dive surveys at both the impact and control stations. The impacts to corals during cable installation can then be inferred through a comparison between these two stations and the water quality monitoring results.

In Liu Ko Ngam and Pak Sha Tau Tsui, the impact station will comprise representative coral communities situated in the bay, closest to the cable laying working corridor, and the control station will comprise representative coral communities situated north of Tsing Chau (*Figure E2*). During coral monitoring, safety considerations shall be the first priority and coral monitoring shall not be undertaken in the immediate proximity of the construction works during the operation of plant. The environmental contractor shall ensure good communication with the cable installation contractor during the coral monitoring and shall inform the cable installer the timing and programme of monitoring works in advance to arrange a suitable time for monitoring.

The control station at north of Tsing Chau is considered to be appropriate as the coral assemblages are similar as the impact station. The assemblages are considered to be of reasonable distance from the potential impact zone as they are not expected to be affected by the cable installation. Thus, any effects noted at the control site will be due to other environmental perturbations and therefore will act as a check against which effects at the impact sites will be compared.

The number and location of the corals to be monitored at the impact and control stations (the corals to be tagged) shall be identified in the field. A minimum of 20 coral colonies shall be selected at each site (impact and control sites) to enable statistical evaluation. The corals shall be tagged randomly at each site and the coral colonies to be monitored at the control station shall be of similar characteristics and located at a similar depth as those identified for the impact stations.

Coral Monitoring Methodology

Observers experienced in the field identification of sessile benthic taxa using SCUBA gear shall undertake the coral monitoring work. The observers shall be qualified marine biologists with a specialist knowledge of corals and a post graduate degree in marine biology. The same coral specialists should be used for each dive survey to maintain consistency in the documentation of the tagged coral condition and shall be approved by AFCD in advance of undertaking the monitoring work. A safe system of work in connection with the diving operation shall be undertaken by the environmental contractor. The system adopted shall follow the applicable Code of Practice (Safety and Health at Work for Industrial Diving).

The coral surveys that will be required include one survey before cable laying (for the Baseline Survey and coral tagging), and twice weekly monitoring during the cable installation (Impact Monitoring) and one survey upon completion of the cable installation work (Post Project Monitoring). The approach to undertaking this work is described as follows.

Baseline Survey / Coral Tagging

A dive survey will be undertaken at the impact station and control station areas prior to cable installation work. The dive survey will include a general reconnaissance survey to gain information on the coral abundance in the area for identification of the number of coral colonies to be tagged. General information shall be provided on the diversity, abundance and health status (bleaching, live/dead coral ratio and siltation coverage) of the corals in the general area. The corals to be tagged and monitored shall be identified in the field as described below.

Priority shall be given to tagging the largest, undamaged colonies closest to the cable laying area, as these colonies are likely the most prone to sediment damage and the recording of the condition of the corals will be more clearly identified in colonies not damaged in previous incidents.

During the Baseline Monitoring, each of the tagged coral colonies shall be identified to genus or species levels and each tagged colony shall be photographed. Information on the coral colonies shall be recorded, including their specific location, size and general condition of their environment. Other information shall also be recorded such as the survey date, time, atmospheric, sea and tidal conditions.

The sediment cover of each tagged coral colony shall be recorded including the percent of coverage, colouration and texture of the sediment and the approximate thickness of the sediment layer both on the colony and on adjacent bedrock or boulder substrate. Any contiguous patches of sediment cover >10% shall be counted. The health status of each tagged coral colony, including bleaching effect and live/dead ratio, shall also be recorded.

Photographs shall also be taken of each tagged coral colony within the Impact and Control areas, along with landscape shots.

Impact Monitoring

The focus of the impact monitoring will be to determine if the corals are impacted during cable installation works and if such impact is a result of cable laying works. The results of the coral monitoring will be reviewed in association with the water quality monitoring results. Impact monitoring shall be undertaken during any process of the cable installation, including landing site preparation, cable laying and landing works, and backfilling.

Similar information to be obtained during the Baseline Survey shall be obtained during each impact monitoring event, including information on: the health status of the corals, condition of their environment survey date, time, atmospheric, sea and tidal conditions during the survey and sediment cover in terms of percentage of coverage and approximate thickness. Each coral colony shall also be photographed.

Post Project Monitoring

The post project monitoring will comprise one survey within two weeks after completion of the cable installation works. The same information to be obtained during the Impact Monitoring shall be obtained during the Post Project Monitoring.

E.2.4 Compliance / Action Event Plan

The coral monitoring results will be evaluated against Action and Limit Levels and will be based on the conditions of the corals and the percentage of sedimentation coverage during cable laying work with the percentage of sedimentation coverage prior to cable laying work. The Action and Limit Levels that have been identified for coral monitoring are shown in *Table E4.*

Table E4 Action and Limit Level for Coral Monitoring

Level	**Descriptions**
Action Level	If during the Impact Monitoring a 15% increase in the percentage of sedimentation on the corals occurs at more that 20% of the tagged coral colonies at the Impact Monitoring Station, which is not recorded at the Control Monitoring Station, then the Action Level, is exceeded.
Limit Level	If during the Impact Monitoring a 25% increase in the percentage of sedimentation on the corals occurs at more that 20% of the tagged coral colonies at the Impact Monitoring Station, which is not recorded at the Control Monitoring Station, then the Limit Level, is exceeded.

The measures that will be undertaken in the event that the Action or Limit Levels are exceeded are shown in *Table E5.*

Table E5 Action and Limit Level for Coral Monitoring

Event	Contractor
Action Level Exceedance	**Step 1** - compare results with water quality monitoring results and repeat coral sampling event within two days, if Action Level is still exceeded notify AFCD. **Step 2** - 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 3** - repeat survey after implementation of mitigation for confirmation of compliance. **Step 4** - if non compliance continues - increase measures in Step 2 and repeat measurements in Step 3. If non compliance occurs a third time suspend cable laying operations.
Limit Level Exceedance	Undertake **Steps 1-3** immediately, if further non compliance continues at the Limit Level, suspend cable laying operations until an effective solution is identified.

E.2.5 Reporting

Letter reports shall be provided to AFCD, which shall include the monitoring results in addition to the operating practices of the dredging works and cable burial machine during sampling (including position, cable burial depth, etc.) and an interpretation of monitoring results in regard to cable laying works and coral conditions.

The data shall include brief survey notes comprising, at minimum, site descriptions including information on weather conditions during the surveys and any notable physical features of the sites, a qualitative descriptions of the biological environment of each site and the conditions of corals at each site including percentage of sedimentation and photographic evidence.

The following reports shall be submitted:

- A Coral Translocation & Baseline Monitoring Survey Report;
- Weekly Impact Monitoring Survey Reports during cable installation; and,
- Post Project Survey Report.

The Coral Translocation & Baseline Monitoring Survey Report shall be provided before the cable laying work and each Impact Monitoring Report will be provided within one week of the completion of the weekly monitoring surveys. The Post Project Monitoring Report shall be provided within one week of completion of the post project survey.

工程項目簡介

目錄

附件

1 基本資料

1.1 工程項目名稱

連接了哥岩與吉澳白沙頭咀之現有 11 千伏海底電纜更換工程（以下簡稱“本工程項目”）。

1.2 工程項目倡議人名稱

中華電力有限公司（中電）

1.3 聯絡人姓名及電話號碼

姓名 : 彭耀明先生

職銜 : 中華電力有限公司北區一級工程師

電話號碼 : 9155 6299 (手提電話)

1.4 工程項目的目的和性質

中電現正計劃改善吉澳供電的可靠性。現時，在了哥岩與吉澳之間，只有一組 11 千伏的海底電纜連接。該組電纜已使用超過 30 年，正在老化。這種情況會令日後的持續供電受到限制。為了確保能夠向吉澳島持續供電，中電計劃更換連接了哥岩與吉澳白沙頭咀的現有 11 千伏海底電纜（*圖 1.1*）。

1.5 工程項目的位置、規模和工地歷史

1.5.1 位置

擬議作為替換的新海底電纜走線，位於了哥岩和吉澳島上的白沙頭咀之間，毗鄰一些現有的公用設施，這些設施包括現有的 11 千伏海底電纜和兩條主輸水管（見*圖 1.1*）。在登岸後，擬議作為替換的 11 千伏海底電纜會連接至現有的架空電纜系統，並會盡量減少需要在了哥岩新增的地下電纜和在白沙頭咀新增的電線桿。

1.5.2 項目工地歷史

擬議鋪設的電纜附近海床，已經在先前安裝連接了哥岩和白沙頭咀（由中電於 1980 年代安裝）的現有 11 千伏海底電纜，以及兩條連接白沙頭咀和西流江的現有的海底主輸水管（由水務署於 2006 年安裝）而受到滋擾。

1.5.3 本工程項目的規模

本工程項目會安裝一組共兩條 11 千伏的電纜線路，其海底纜段的掩埋深度預計為 5 米，而陸地纜段則約掩埋 1 米深。兩條海底電纜會以相隔 30 米的距離，平

行地沿著預定鋪設路線伸延，但近岸的纜段只有 1 米的分隔距離，並會在每個登岸點靠攏會合，以便進入一條纜槽內。在部份地區（特別是接近登岸地點的地區），海床的土力限制令電纜的掩埋深度不能符合要求，因此會以混凝土板形成的保護層覆蓋。擬議電纜鋪設路線的總長度約達 880 米。

電纜鋪設過程只需要在海洋環境進行小型工程。在每個登岸地點（即了哥岩和白沙頭咀）亦只需要在岸上進行小規模建築工程，以便把海底電纜連接至現有的架空陸地電纜系統。

1.6 電纜路線篩選過程

1.6.1 登岸地點的篩選

中電計劃更換連接了哥岩與吉澳白沙頭咀的一組使用超過 30 年，日漸老化的現有 11 千伏電纜。因此，作為替換的新電纜會大致上沿著現有 11 千伏海底電纜的走線，並使用現有登岸地點來連接現有位於郊野公園內的 11 千伏架空電纜系統。電纜登岸點的篩選是基於以下考慮（*圖 1.2*）：

- 盡可能遠離海岸公園和荔枝窩海灘具特殊科學價值地點。
- 選擇技術上可行的地區（即軟泥和沙質），以減少建築上的困難。
- 沿用現有 11 千伏海底電纜的走線，並使用在過去已受滋擾的現有登岸地點，藉此避開天然和未受滋擾的地區。
- 利用現有 11 千伏的架空電纜系統，以避免安裝新的架空電纜系統。

1.6.2 海上路線的規劃考慮

現有的 11 千伏電纜路線在環境上和實質上，都有一些現存限制，局限了電纜的走線（*圖 1.2*）。下列各項限制都在考慮範圍內：

- 盡可能遠離海岸公園和荔枝窩海灘具特殊科學價值地點(SSSI)。
- 避開各個魚類養殖區（FCZs）。
- 避開淺海沉積區，務求電纜鋪設工程能夠符合最佳掩埋深度的要求。
- 避免橫過現有的公用設施，包括連接了哥岩和白沙頭咀的現有 11 千伏海底電纜，以及連接白沙頭咀和西流江的兩條現有海底輸水管。

除了避開上述各項限制外，亦考慮了下列事項：

- 為了能夠同時進行電纜掩埋／鋪設工序，已盡量避免電纜走線出現急轉彎的情況，而且已盡量令沿線的電纜壁保持直線。
- 選擇最短的電纜走線，盡量減少對環境的潛在不良影響。

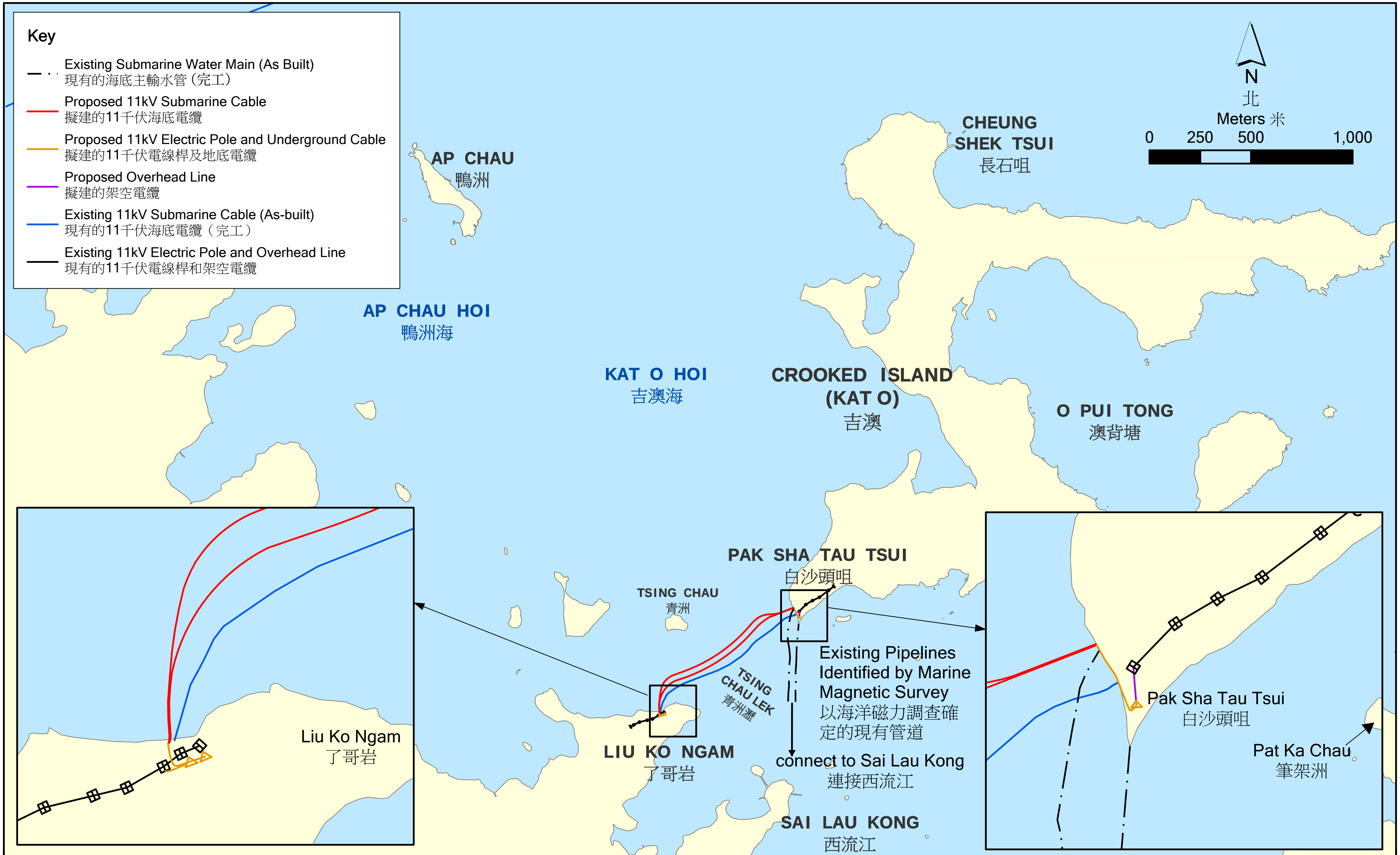

Figure 1.1
圖1.1

Alignment of the Proposed 11kV Submarine Cable Circuit from Liu Ko Ngam to Pak Sha Tau Tsui

了哥岩至白沙頭咀的擬建11kV海底電纜路線

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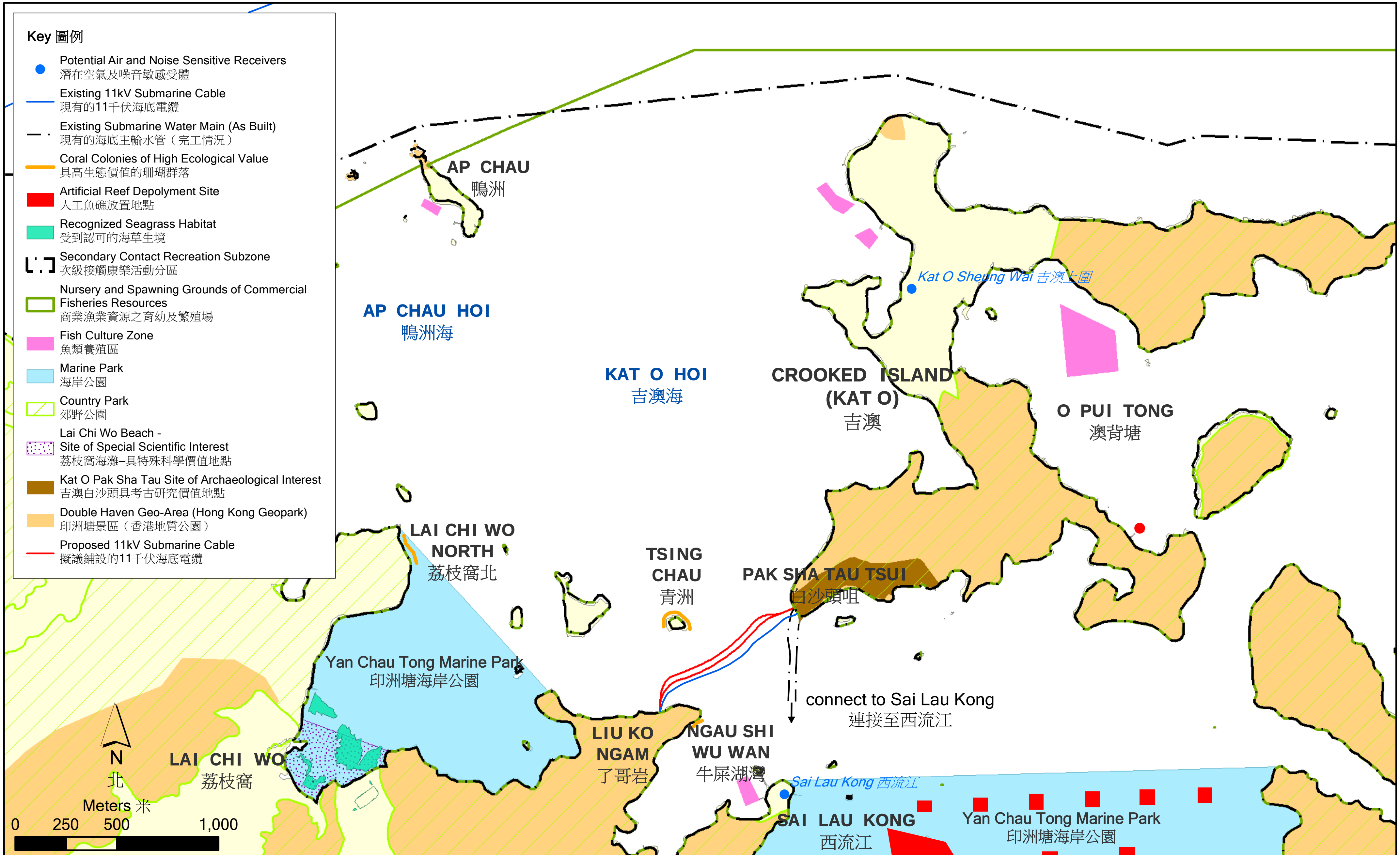

Figure 1.2
圖1.2

Identified Major Elements within the Areas Surrounding the Proposed Cable Route

擬議電纜路線附近地區環境的已知主要元素

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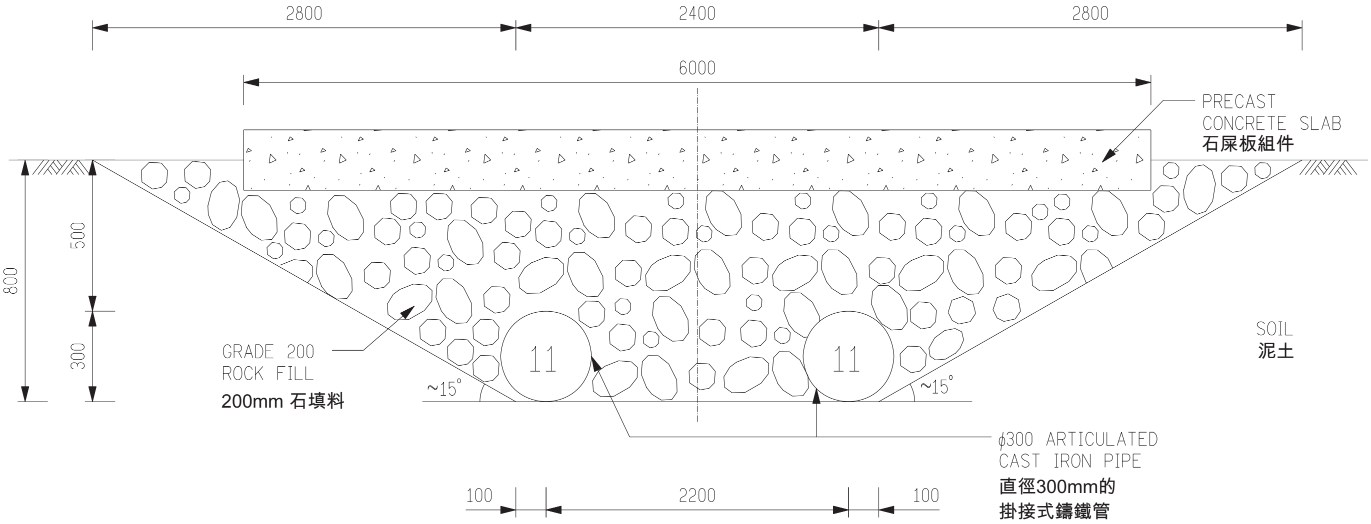
1.6.3 岸端建築方法考慮

工程項目倡議人考慮過多種岸端建築方法的環境影響和技術可行性。*表 1.1* 羅列了在決定最可取的岸端建築方法時所考慮的主要因素。

表1.1 岸端建築工程所考慮的事項

方案說明	技術範疇	環境範疇
以挖掘法把海底電纜鋪設在海床下，其上有 500mm 的覆蓋層	• 從技術角度而言，這是最直接和最傳統的移走海床上軟物料方法。 • 可以在了哥岩和白沙頭咀的岸端，把電纜鋪設在一條預先挖好的接引槽內。 • 這項工程會在兩個岸端，各以一艘抓斗挖泥船進行（抓斗大小約為 3 立方米）。 • 纜槽內的電纜會由潛水員安放，再以清潔海沙回填於電纜之上。 • 在電纜登岸地點所用的抓斗挖泥船速度，預計不會超過每日 300 立方米。 • 估計從兩個登岸點大約會挖出合共 650 立方米的物料。 • 在兩個登岸點的海底電纜都會有最少 500 毫米的覆蓋層。 • 兩條 11 千伏電纜在登岸點的分隔距離約為 2 米。 • 估計在兩個登岸點的預挖纜槽的長度，從高水位線起計約達 75 米 • 纜槽的平均闊度是從中心線起，兩側各闊約 4 米，合共形成一條闊達 8 米的工作走廊。應予注意的是，海泥只能夠承受約 15 度角的斜度，因此必須有合共 8 米闊的工作走廊（有關典型的纜槽橫截面，請參閱*圖 1.3*）。	• 可能會失去該條 8 米闊位於岸端的工作走廊內的珊瑚群落及相關的底棲生物群落。 • 附近的水質敏感受體，包括海岸公園、珊瑚群落和魚類養殖區可能會受到水質影響，但可以透過裝設隔泥幕和降低挖泥速度來緩解該影響。
可以採用水平定向鑽挖法而不是抓斗挖泥法來進行兩個岸端纜段的鋪設工程	• 這個方法會在海中安裝一條 10 米 x 10 米的圍堰（板樁牆），用於承接水平定向鑽挖法的鑽頭。在進行板樁安裝工程時，海床會受到滋擾。在完工後，位於海床以下的板樁會被留在原處。 • 這個方法需要承建商有很高的海事工程技術，因為在大海中建造一條圍堰所涉及的工人安全風險非常高。 • 在運用這個方法時，會把一個水平定向鑽挖機放置於岸上，而在離海岸線約 75 米的海中，會裝設一個接收坑。 • 因此，這個方法需要在海中建造一條圍堰作為接收坑。為了令圍堰不透水，會用板樁來建造圍堰。由於板樁不能穿過岩層，因此，這個方法只適用表土下岩層頂部的標高較低的地方。 • 根據初步估計，為了令圍堰有足夠的穩定性，板樁應該打進海床下最少 30 米深。根據在現場進行的底土測量數據，岩層位於海床下約 10 米處，會妨礙板樁打入更深的水平（見*圖 1.4*）。因此，這個方法<u>不可行</u>。 • 此外，若採用水平定向鑽挖法，便會用膨潤土加固鑽孔四周。這個方法有污染海水的潛在風險，因為鑽液可能會透過鑽孔壁滲入海床，特別是在海中的排放點。	• 由於這個方法在工程上不可行，因此，無需再評估有關的環境範疇因素。



SECTION FOR OPTION 1
方案1的橫截面圖

SCALE 1:25
比例尺 1:25

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Figure 1.3
圖 1.3

Submarine Cables to be laid under Seabed Level with 500mm cover by Dredging Method
以挖掘法把海底電纜鋪設於海床下，
並在其上加蓋500mm的覆蓋層

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DATE: 06/11/2012

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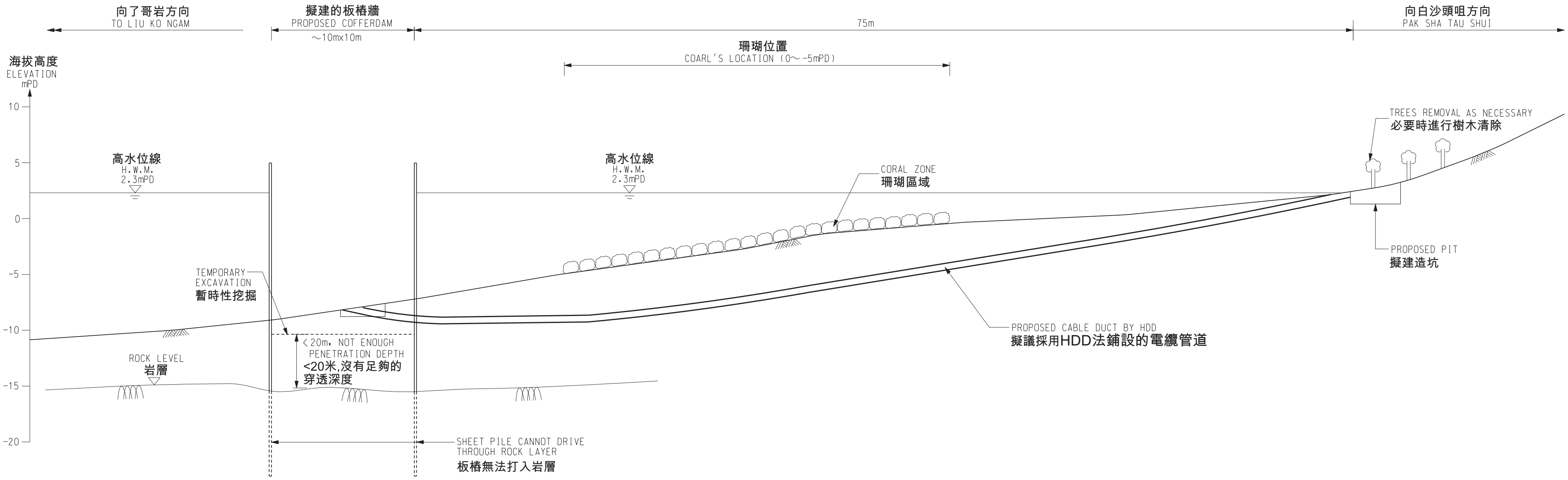

LONGITUDINAL PROFILE FOR OPTION 2
方案2的橫截面圖
SCALE 1:250
比例尺 1:250

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Figure 1.4
圖 1.4

Horizontal Direct Drilling (HDD) for 2 Shore End Cable Laying
以水平定向鑽挖法(HDD)進行兩個岸端纜段的鋪設

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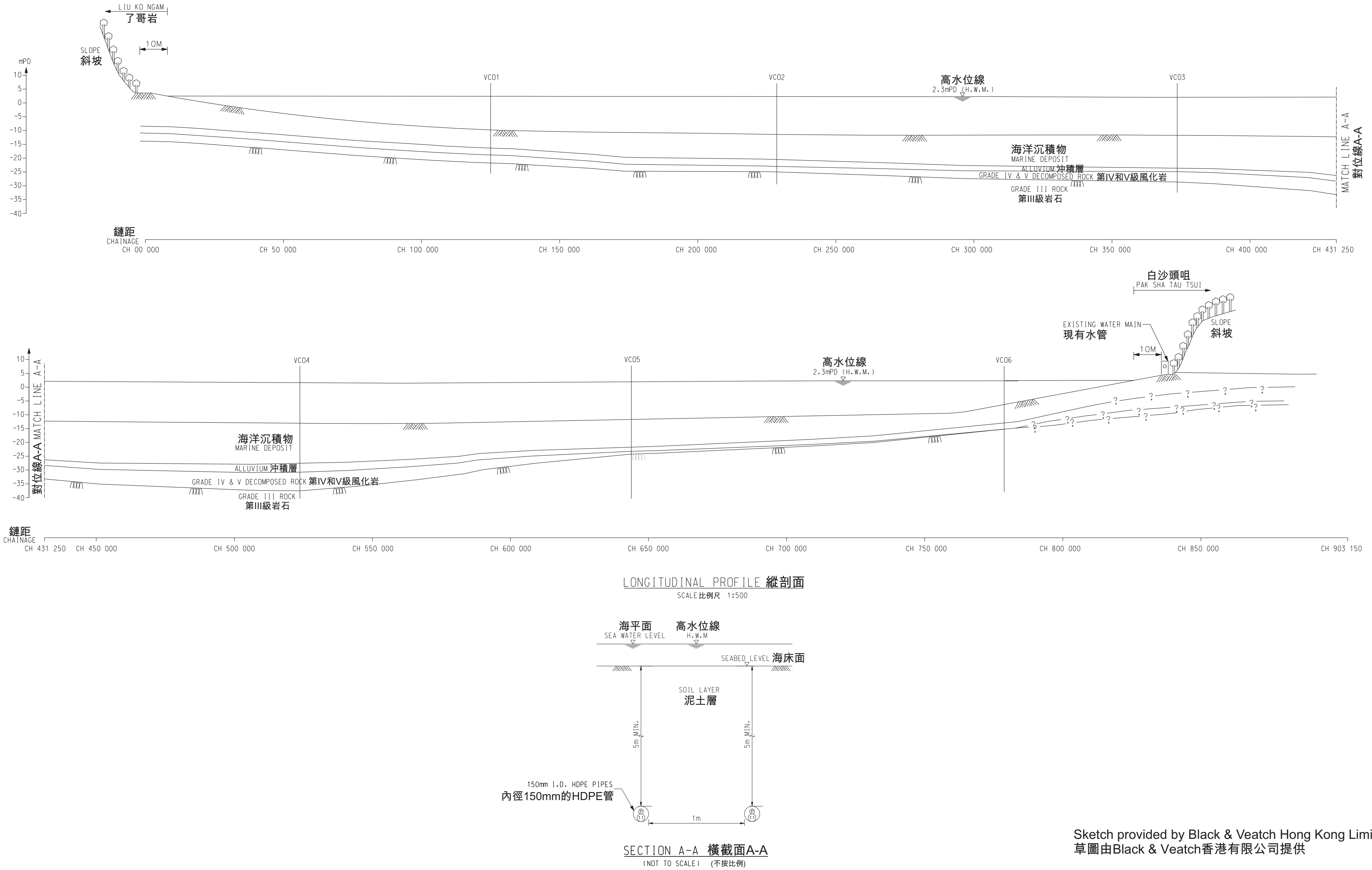
方案說明	技術範疇	環境範疇
採用水平定向鑽挖法來把電纜從一個岸端鋪設至另一端	• 這個方法需要在海域兩側都設有工作坑。水平定向鑽挖機會被放置於海域的其中一邊，而在另一邊則會被用作接收坑，以便接收水平定向鑽挖機的鑽頭。 • 電纜走線的總長度約為 880 米，屬於十分長的走線。 • 為了在這個長度進行水平定向鑽挖工程，需要使用大型的水平定向鑽挖機，以便為工程提供足夠的阻抗壓力。根據有相近鑽挖長度的其他工程經驗，本工程項目需要有一個 12 米（闊）x23 米（長）的工作坑來容納水平定向鑽挖機。*圖 1.5* 展示了登陸地點的縱向剖面圖，兩個登陸地點從高潮的水位至山腳有植被覆蓋的斜坡之間的可用土地只有 10 米闊。。由於兩個登岸點的可用土地不足夠，這個方案<u>不可行</u>。	• 由於這個方法在工程上不可行，因此，無需再評估有關的環境範疇因素。
在岸端珊瑚區採用岩石切削法，而在岸端的非珊瑚區則採用挖掘法。	• 這個方法適合在有硬質物料（例如巨礫和基岩）的地方建造較淺的纜槽。 • 由 1-2 名潛水員以專門的手動切削工具在珊瑚區內進行。 • 在岸端的登岸纜段會建造一條闊 1.0 米、深 0.6 米的纜槽（在了哥岩和白沙頭咀的長度不超過 50 米，而且距離有記錄的珊瑚群落最少 10-20 米）有關典型的橫截圖說明，請參閱*圖 1.6*。海底電纜會鋪設於纜槽內，並會由鋼質活節管保護。然後，纜槽會被回填至附近海床的水平。 • 兩條 11 千伏電纜在珊瑚區的分隔距離約為 1 米。 • 這項工程所產生的石質物料會由潛水員以人手清理。 • 施工區內會裝設 5 米闊的隔泥幕，而潛水員只可以在隔泥幕的範圍內活動。 • 在非珊瑚區內會採用挖掘法。 • 預計這個方案在兩個登岸地點所挖出的物料總體積會約有 480 立方米。	• 受電纜鋪設活動影響的珊瑚群落數目有所減少。 • 附近的水質敏感受體，包括海岸公園、珊瑚群落和魚類養殖區都可能會受到水質影響，但可以透過安裝隔泥幕和降低挖泥速度來紓緩該影響。

在考慮上述各項因素後，根據技術可行性和環境影響方面的準則，“岩石切削法”（在珊瑚區）加上“挖掘法”（在非珊瑚區）是最適合岸端建築工程採用的方法。預計在隔泥幕的5米範圍內的硬珊瑚可能會受到這項工程的影響，雖然受影響的珊瑚數目已經比單一的“挖掘法”和其他*表1.1*中考慮的方法可能造成的影響少得多。這方面的情況會在*第4章*再作考慮。

1.7 工程項目簡介涵蓋的指定工程項目數目及種類

根據《環境影響評估條例技術備忘錄》附表2第I部的C類C.12條的規定，連接了哥岩與吉澳白沙頭咀之現有11千伏海底電纜更換工程，屬於距離一個海岸公園的最近界線少於500米的挖泥作業，因此是一項指定工程項目。根據《環境影響評估條例》第5 (11) 條的規定，必須為本工程項目的施工和運營申請環境許可證。



Sketch provided by Black & Veatch Hong Kong Limited
草圖由Black & Veatch香港有限公司提供

Figure 1.5
圖 1.5

Installation by HDD Method from One Shore End to Another End
採用水平定向鑽挖法(HDD)將電纜從一個岸端鋪設至另一個岸端

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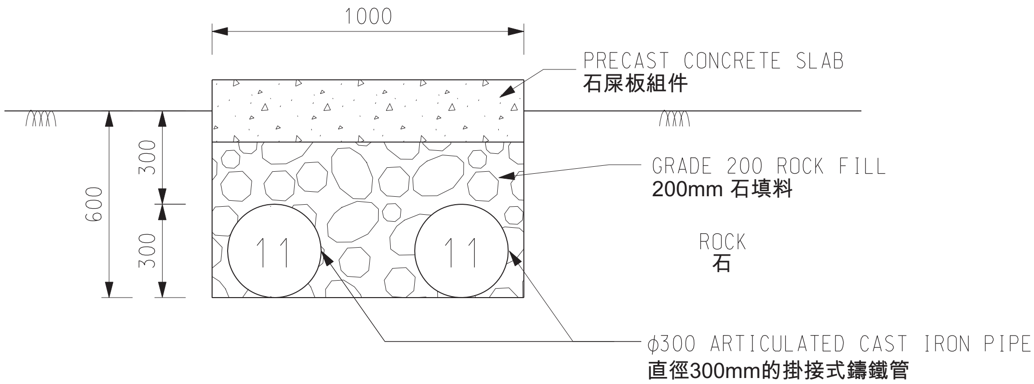

SECTION FOR OPTION 4
方案4的橫截面圖

SCALE 1:25
比例尺 1:25

Sketch provided by Black & Veatch Hong Kong Limited
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Figure 1.6
圖 1.6

Installation by Rock Cutting Method Applied to the Shore End Coral Zone
在岸端珊瑚區採用岩石切削法進行電纜鋪設

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2 *計劃大綱及計劃的執行*

2.1 *工程項目的規劃和執行*

本工程項目會由中電主導和管理。海底電纜系統的規劃和施工，都會由中電所委聘的承建商負責進行。

本工程項目會透過下列活動建造：

- **擬議岸端電纜鋪設方法** – 在了哥岩和白沙頭咀岸端的電纜會鋪設在一條預先挖好的接引槽內。

  – 建議在珊瑚區內採用"岩石切削法"來鋪設岸端的電纜。這個方法是由 1-2 名潛水員以專門的手動岩石切削工具進行。在岸端的登岸纜段會建造一條闊 1.0m 米、深 0.6 米的纜槽（在了哥岩和白沙頭咀的長度不超過 50 米，但在有記錄的珊瑚群落則只有 10-20 米的纜段）。這項工作所產生的石質物料會由潛水員以人手清理。海底電纜會在纜槽內平行鋪設，並會由鋼質活節管保護。然後，纜槽和電纜都會被回填至鄰近海床的水平高度。為免影響水質，會裝設闊 5 米的隔泥幕，而潛水員亦只會在隔泥幕範圍內活動。

  – 在珊瑚區以外的兩個岸端地區，會使用一艘抓斗挖泥船，其抓斗約為 3 立方米（*圖 2.1*）。電纜會由潛水員放進纜槽，再放置完畢后以清潔海沙回填覆蓋電纜。預計在電纜登岸地點所使用的抓斗挖泥船，其挖泥速度不會超過每日 300 立方米估計在兩個登岸地點合共會挖出約 480 立方米的物料。在兩個登岸地點的海底電纜之上，將會有最少 0.5 米的覆蓋層。兩條 11 千伏的電纜在兩個登岸點的分隔距離是約達 2 米，但在珊瑚區內則只會是 1 米。每個登岸點的預挖纜槽估計會長約 75 米（從高水位線開始量度）。在珊瑚區外，纜槽的中軸線兩側會平均各闊約 4 米（合共形成一條 8 米闊的工作走廊）；而在珊瑚區內纜槽的平均闊度，則只會達 1 米。

- **電纜鋪設方法** – 擬議作為替換的 11 千伏海底電纜會以沖噴法鋪設，即用一部水力沖噴掩埋機／工具同時鋪設和掩埋電纜（*圖 2.2*）。該機器會噴出水柱，把海床上的沉積物液化，讓電纜可以鋪設在海床下的要求掩埋深度。預料大部份纜段都會被埋在海床以下約 5 米的深度。應予注意的，是海床會在這項工程完成後的短時間內，自然回復至工程前的水平和狀況。在鋪設電纜之前，會沿著擬議電纜鋪設路線中準備掩埋電纜的段落，先進行路綫清理和敷設前掃海工作。路綫清理和敷設前掃海工作都會在真正的電纜鋪設工程之前進行。這兩項工作的目的，是要把可能出現在電纜走廊內的任何對電纜或掩埋機構成潛在威脅的物品，例如報廢的電纜、碎屑或障礙物等予以清理。掃海工作所用的抓鈎探進海床的深度不會超過 0.8 米。清理工作會覆蓋電纜兩側的 5 米以內範圍（即每條電纜鋪設路線都有 10 米闊的清理範圍）。這項工作從海床上收回的所有碎屑都會棄置於獲批准的卸泥場。由於路綫清理和敷設前掃海工作只會以機械拖行的方式，在短時間內進行，並會局限於有限的地區內，因此，預計不會對海洋環境造成影響。在兩個登岸地點的已知珊瑚區內，不會進行路線清理工作。在電纜掩埋深

度較淺的地區，需要為電纜加上保護覆蓋層，例如用混凝土板覆蓋，但完工後的海床水平會保持不變。

圖 2.1 *抓斗挖泥作業*

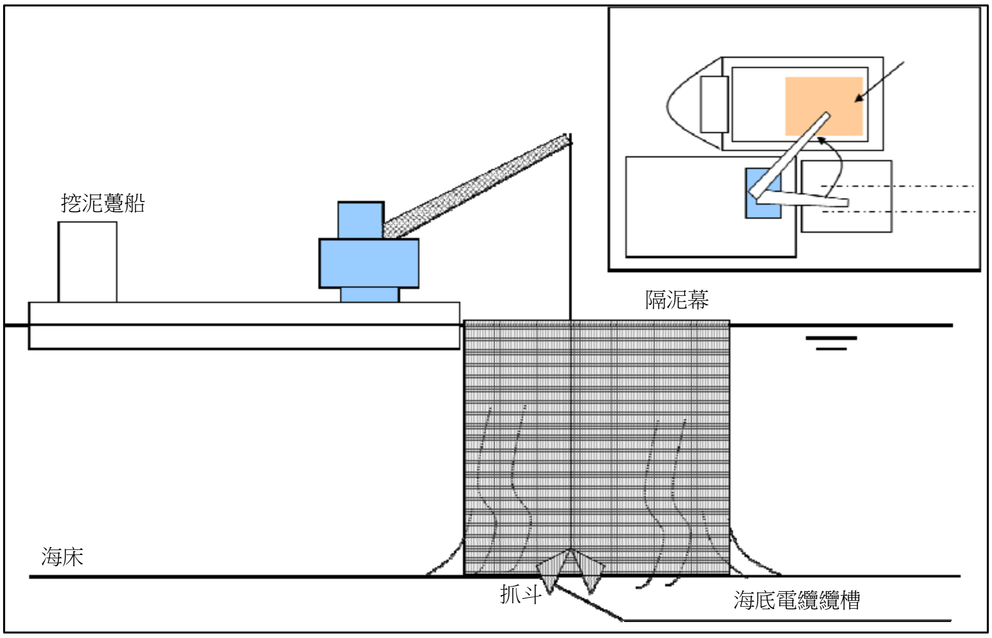
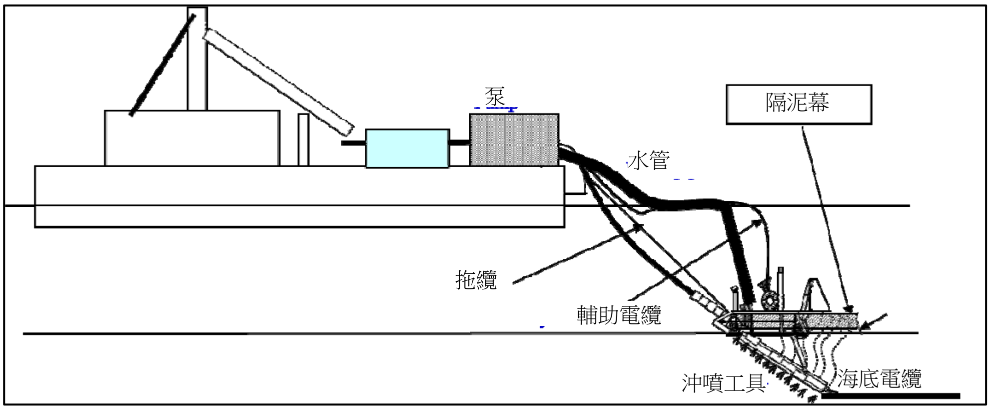


圖 2.2 *以沖噴法同時進行電纜鋪設和掩埋工程*



- **與現有電纜系統的連接** – 擬議作為替換的 11 千伏新海底電纜在了哥岩和白沙頭咀分別登岸後，都會以最少的地下電纜和一至兩根木製電線桿，連接至現有的架空電纜系統（*圖 1.1*）。了哥岩登岸地點位於船灣郊野公園內，而白沙頭咀的登岸地點則位於船灣（擴建部分）郊野公園內。在兩個登岸地點（了哥岩和白沙頭咀）的新地下電纜都是約長 50 米。在兩個登岸點的擬議鋪設電纜越過高水位線之後，都會鋪置於一條 0.75 米闊、1.0 米深的纜槽內，並連接至新的木製電線桿。建造每條木電線桿的基座時，大約需要挖掘 1.8 米闊、1.4 米長、1.6 米深的泥土。在施工時所用的工具主要是手動工具、一或兩部反鏟挖土機和混凝土攪拌機。然後，新鋪設的電纜會以地下電纜連接至現有的電線桿。有關的纜槽會使用反鏟挖土機和手動工具，以明挖法建成。在了哥岩和白沙頭咀的地下電纜和木電線桿安裝工程，估計會分別產生約 45 立方米和 40 立方米的掘出物料。架空電纜的木電線桿會由直升機運至現場，然後由人手主要使用手動工具安裝。本工程項目可能要清除一些草本灌木等植被，但無需砍伐樹木。在了哥岩裝設新的木電

線桿後，會拆去兩根現有的架空電纜電線桿（僅移除地面部份的木桿）。被拆下的架空電纜木桿也會由直升機運走。

所有近岸和陸地上的建築工程都會在正常工作時段（上午七時至下午七時）進行。若稍後發現有必要進行黃昏或夜間工程，便會申請建築噪音許可證。

2.2 *工程項目執行計劃*

按照計劃，海底電纜的鋪設工程將於 2014 年第二季動工，需時約 6 個月完成。預計施工時間表如下：

登岸地點準備工程和電纜登岸工程	約 12 星期
以沖噴法鋪設橫過青洲瀝的電纜	約 4 星期
鋪設電纜後的保護工程	約 8 星期

3 周圍環境的主要元素

電纜沿線一帶環境的各項主要元素均展示於*圖 1.2*。

3.1 海運路線及航道

在擬議電纜鋪設路線附近沒有任何主要的海運路線或航道

3.2 海底電纜、管道和渠口

在擬議電纜鋪設路線南面有多項海底公用設施，包括現有的 11 千伏電纜和水管。

3.3 魚類養殖區

下列魚類養殖區均位於擬議電纜鋪設路線附近：

- 鴨洲魚類養殖區（距離擬議電纜鋪設路線約 2.5 公里）；
- 吉澳魚類養殖區（距離擬議電纜鋪設路線約 1.8 公里）；
- 澳背塘魚類養殖區（距離擬議電纜鋪設路線約 1.7 公里）；及
- 西流江魚類養殖區（距離擬議電纜鋪設路線>510 米）；

3.4 郊野公園

擬議登岸地點位於兩個郊野公園內。了哥岩登岸地點位於船灣郊野公園內，而白沙頭咀的登岸地點則位於船灣（擴建部分）郊野公園內。因此，建議用 11 千伏的地下電纜會將海底電纜從登岸點連接至了哥岩和白沙頭咀的現有架空電纜系統。在兩個登岸地點（了哥岩和白沙頭咀）的新地下電纜都是長約 50 米。應予注意的，是根據《環境影響評估條例》，小型公用設施工程，包括電壓不超過 66 千伏的電纜，無論是部份或全部位於郊野公園內，都不屬於指定工程項目。然而，這類工程必須獲得郊野公園及海岸公園管理局的許可。

3.5 海岸公園

印洲塘海岸公園（荔枝窩部份）位於擬議電纜鋪設路線的 500 米範圍內（擬議電纜鋪設路線與海岸公園邊界之間最接近的距離約有 430 米）。這個海岸公園的目的，是要保護海洋生物的多樣性和具有重要生態價值的生境，包括距離了哥岩擬議登岸地點超過 1.5 公里的荔枝窩海草床。

此外，在印洲塘海岸公園範圍內，也有一個已於憲報公佈的人工魚礁放置地點。

3.6 荔枝窩具特殊科學價值地點

荔枝窩海灘具特殊科學價值地點距離了哥岩擬議電纜登岸地點和擬議電纜鋪設路線都超過 1.5 公里。由於海草群落具有重要生態價值，因此荔枝窩的海草床（*Zostera japonica*）於 1979 年被指定為具特殊科學價值地點。到了 1996 年，這個海草床也被包括在印洲塘海岸公園內。

3.7 香港地質公園

了哥岩和白沙頭咀的擬議電纜登岸地點都位於香港地質公園新界東北沉積岩園區的印洲塘景區內。

3.8 文化遺產

在兩個電纜登岸地點（即了哥岩和白沙頭咀）和海底電纜鋪設路線附近，都沒有古物古蹟辦事處所公佈的法定古蹟、政府文物地點、已評級或建議評級的歷史建築物。

白沙頭咀電纜登岸點位於納入古物古蹟辦事處記錄的吉澳白沙頭具考古研究價值的地點內。

4 對環境可能造成的影響

4.1 潛在環境影響摘要

擬議鋪設的 11 千伏海底電纜在施工時可能造成的影響，均羅列於表 4.1，並於下文詳細闡述。預計海底電纜在運營期間，除了可能的視覺影響外不會對環境造成其他影響。應該注意的，是本工程項目預計不會影響香港地質公園的地質特色和地質景觀資產，包括位於新界東北沉積岩園區內的白沙頭咀的沙洲。

表 4.1 環境影響（施工）潛在來源

影響的潛在來源	影響
• 氣體排放物	×
• 塵埃	×
• 氣味	×
• 噪音	✓
• 夜間作業	×
• 新增交通	×
• 液體流出物，排放物，或已受污染的徑流	×
• 廢物或副產品的產生	✓
• 危險物品的製造、儲存、使用、處理、運輸或棄置	×
• 危險物料或廢物	×
• 發生意外而導致污染或危險的風險	×
• 廢舊物料，包括可能已受污染物料的棄置	✓
• 對海水的流動或海底沉積物的干擾	✓
• 不悅目的外觀	×
• 生態影響	
- 陸地	✓
- 海洋	✓
• 漁業	✓
• 文化遺產	✓

註： ✓ = 可能造成影響

× = 預計不會造成影響

4.2 噪音

本工程項目的工地都不接近任何噪音敏感受體（見*圖 1.2*），而陸上工程的規模亦較小，只屬於小型公用設施工程。因此，在挖掘纜槽、安裝新木製電線桿和鋪設電纜時所產生的噪音，預計不會影響任何敏感受體。最接近的噪音敏感受體是西流江和吉澳上圍。它們與了哥岩和白沙頭咀的擬議電纜登岸點，分別距離超過 500 米和 1 公里。

在鋪設電纜的過程中，只有躉船和電纜鋪設設備會產生極小量噪音。這些噪音與該區現有的海上交通所產生的噪音相近，因此不會影響噪音敏感受體。故此，本工程項目不會造成直接或間接的不良噪音影響。

4.3 *水質*

4.3.1 *陸上活動*

本工程項目的陸上活動包括安裝電纜和建造木電線桿，因此，潛在的水質影響會局限於地面流徑。然而，在進行陸上建築工程時，會實施下列各項措施，務求盡量減少對水質可能造成的影響。

- 在雨季期間，會用帆布或類似布料覆蓋物料堆，以減少流失；
- 在進行電纜登岸和建造工程時，會小心處理，以免物料漏進鄰近海洋水域，亦會確保沒有任何廢舊物料被排入附近海域；
- 為了減少水質的潛在影響，應該遵守專業人士環保事務諮詢委員會 PN1/94 號專業守則所闡述的建築工地排水指引；及
- 所有建築廢物都會按照《廢物處置條例》的規定來處理和棄置。

預料在實施上述各項措施後，岸上的建築工程將不會對水質造成直接或間接的不良影響。

4.3.2 *海上活動*

海上的建築活動主要是把電纜埋在現有海床下。鋪設工程會以水力沖噴掩埋機鋪設海底電纜，並同時把電纜掩埋於現有海床下最深達 5 米之處。若掩埋深度少於 3 米，便需要為電纜提供保護。沖噴機會噴出水柱，把海床上的沉積物液化，讓電纜可以鋪設在海床下的必要掩埋深度。整個電纜鋪設工程預計需時約 4 個星期完成。鋪設工程的最高速度是每日大約 800 米。

鋪設電纜時，會在電纜掩埋機四周形相濃度相對較高的懸浮沉積物，但這些沉積物會保持貼近海床，並會迅速重新沉澱。在鋪設電纜時受滋擾的沉積物會在一段十分短的時間內保持懸浮狀態，因此，從海床沉積物中釋出污染物和增加接收水體需氧量的可能性很有限，所以預料這項工程不會對水質造成不良影響。

是次研究也分析了水體中的幼細懸浮沉積物隨水漂流的可能性。結果顯示，懸浮沉積物的最遠漂流距離約達 60 米（見*附件 A*）。

在岸端的電纜鋪設工程中，挖泥工程會在水體中釋出懸浮固體；而且在回填時也會如此，但範圍小很多。根據對沉積物的可能漂流情況分析，預測在裝設隔泥幕後，沉積物濃度增加至超過每公升 10 毫克的情況，只會在了哥岩和白沙頭咀兩個岸端挖泥工程範圍的 40 米範圍內出現。鑑於施工期很短，因此岸端挖泥工程對水質造成的影響會為時短暫，而且程度較低。預計岩石切割亦只會造成輕微及少範圍的水質影響。

本工程項目不會對海底沉積物造成長遠滋擾，亦不會防礙海水的流動。為了避免和減少來自工地、海事機器和船隻的已受污染徑流，應該採用最佳管理方法。海事工程在進行期間和在竣工之後，都不會對水質造成不良影響。本工程項目會進行水質監察，以便核實有關登岸地點挖泥工程的沉積物捲流擴散預測。

4.4 *廢物管理*

4.4.1 *施工階段*

本工程項目的陸上施工活動可能會產生下列各大類廢物：

- 在了哥岩和白沙頭咀的挖掘工程產生小量建造及拆卸（拆建）物料和共約 800 立方米的掘出泥土，及
- 小量一般垃圾，包括現場工作人員產生的廢棄食物，以及建築材料的包裝物料。

在了哥岩和白沙頭咀的地下電纜和木電線桿安裝工程，估計會分別產生約 45 立方米和 40 立方米的掘出物料。所有被掘出的物料都會在現場重新再用。一般垃圾會由工人每日從工地帶走，並作妥當處置。

在實施適當的工地管理措施和垃圾收集安排後，預計本工程項目在施工階段所產生的垃圾，只會造成極輕微的影響或不會造成任何影響。

海底電纜的鋪設，會採用沖噴法（在海中的纜段）和挖泥法（只在登岸地點）相結合的方式，把電纜鋪設在海床之下。只有挖泥法會產生需要處置的海洋沉積物。估計在兩個登岸地點需要挖出約 800 立方米的沉積物。根據環保署的數據顯示，研究範圍內的沉積物並非受污染的類別（請參閱*附件 A* 的論述）。為了確定和大致顯示沉積物的質量，以及各種需予挖掘的沉積物的體積，工程項目倡議人會在進行挖泥工程前，先進行海洋沉積物的採樣和化驗。沉積物的採樣計劃（包括採樣站、化學分析組合和生物測試計劃），是會根據《環境運輸及工務局技術通告第 34/2002 號》所闡述的指引而擬訂。在進行採樣和化驗後，會按照《海上傾倒物料條例》的規定，準備一份《沉積物質量報告》，並提交予環保署批准。《沉積物質量報告》的內容會按照《環境運輸及工務局技術通告 34/2002 號》附件 A 的要求，包括採樣詳情、化學測試結果、質量控制記錄，以及建議的沉積物分類和描述。最終的棄置地點會由海洋填料委員會決定，並會在開始挖泥工程前，向環保署申請卸泥牌照。在實施上述各項程序後，電纜鋪設工程和纜井建造工程都不會產生直接或間接的不良廢物影響。

4.4.2 *運營階段*

預計本工程項目在運營期間，不會造成廢物管理問題。

4.5 *對海水的流動或海底沉積物的干擾*

本工程項目在施工期間，不會防礙海水的流動，而且對海底沉積物也只會造成輕微干擾；而在運營期間亦不會造成干擾。

4.6 *景觀和視覺*

在景觀和視覺影響方面，景觀影響主要會出現在項目的施工階段，而在項目的運營階段則以視覺影響為主。另外，本部份主要在岸上對登陸點的景觀和視覺影響進行評估，至於項目對海床造成的景觀影響則記述于海洋生態一部份（第 4.7 節）。該部份表明，本項目通過登陸地點和電纜海上路線的篩選、以及特定電纜鋪設技術的採用，極大限度地避免了對海洋資源的影響。

4.6.1 *施工階段*

在兩個登岸地點的後濱地帶植物，以海岸植物為主，以及在了哥岩和白沙頭咀登岸地點的山坡，分別有尚未成熟的樹林和灌木地（*圖 4.1* 以及*圖 4.2*）。了哥岩和白沙頭咀同時也是香港地質公園的一部份（印洲塘景區）。

實地視察證實了新電線桿會位於主要由草和灌木覆蓋的岸邊，而且，在本工程項目施工時，需要清除部份植物。在地下電纜的大部份纜槽沿線都沒有任何植物。在鋪設新的地下電纜和安裝木電線桿時，只需要清除有限的植物，但無需砍伐樹木。鑑於本工程項目需要清除的植物和對現有景觀資源的滋擾都屬有限，而且，工程的範圍很小，現場也只需要使用小量建築設備，施工期亦很短，因此，對現有景觀的影響也會較低。同樣地，預計項目不會對地質公園造成影響。

4.6.2 *運營階段*

由於電纜的導線管會埋於地底，而海底電纜亦是埋在海床下，因此，項目的主要組成部份不會對公眾造成視覺障礙或不便。同樣地，由於電纜埋於地底（對海床的影響點第 4.7 節），項目在運營階段造成的景觀影響也屬於低。

新的木電線桿會跟現有的電線桿一樣高約 9 米（在地面上），並會設於現有的架空電纜系統旁。木質的電線桿能夠配合郊野公園的環境和四周的現有結構，同時與現有的景色相兼容（可以作為一項詳細設計階段的緩解措施予以考慮）。經過該區的訪客可以看見新的木電線桿（坐船的訪客可以看到，但遠足人士則不會看到，因為這些地點都遠離現有的遠足路徑），不過，影響只屬暫時性質，由*圖 4.3* 以及*圖 4.4* 對項目在了哥岩和白沙頭咀兩個登岸地點的圖形展示可見，其對偶爾經過的訪客所造成的視覺影響極為輕微。由於項目僅對經過訪客的短暫景觀視野造成暫微笑的改變，項目的視覺影響為低。

考慮到只需要安裝一至兩根木電線桿，而且毗鄰有現存的架空電纜系統，其位置亦遠離現有的遠足徑和村落（即潛在視覺敏感受體），因此，本工程項目的新建結構會較不顯眼。而且不會造成其他不良的景觀及視覺影響。

因此，本工程項目的整體景觀及視覺影響屬於偏低且可以接受。

4.7 *海洋生態*

是次研究檢視了在海底電纜走線和登岸地點附近的了哥岩和白沙頭咀的海洋生態基線情況（見*附件 B1*）。

結果顯示，該區的軟底底棲動物的生態價值屬偏低。雖然這些軟底生物群落在鋪設電纜時會受到滋擾，但相近的群落會在一段短間內重新聚集於這些生境。故此，有關的影響並非不可接受。

根據最近的實地調查所得，在擬議電纜登岸地點的沙質和巨礫海岸潮間帶所發現的生物，無論是數量或種類都偏少。這些物種中，大部份都是在香港其他類似的海岸所常見和廣泛分佈，因此都屬於受到較少生態關注的種類。所以這些群落所受到的影響並非不可接受。

在了哥岩和白沙頭咀登岸地點所進行的珊瑚地圖調查，分別在該兩個登岸地點記錄到 18 和 16 種硬珊瑚。一般而言，在這兩個調查區內所記錄到的珊瑚種類，都是在香港東部和東北部海域經常發現的品種。兩個登岸地點所發現的珊瑚密度都偏低，每平方米只有少於 1.3 個個體。大部份群落的直徑都小於 15 毫米。

預計電纜鋪設工程會令了哥岩和白沙頭咀登岸地點，分別有六個和七個硬珊瑚個體，受到岩石切削工程的直接影響。此外，了哥岩和白沙頭咀分別有 16 和 25 個硬珊瑚個體（包括在闊一米的岩石切削區內的群落），可能會因為登岸地點隔泥幕所圍繞的五米闊工作走廊內的潛水員移動和水質變化而受到間接影響。受影響的珊瑚群落通常都較小，而且是普遍分佈於香港東北部和東部的海域。因此，預計本工程項目不會對珊瑚群落造成不可接受的剩餘影響。

因為本工程項目的規模細小，所造成的影響都維時短暫，而且沉積物捲流的擴散亦有限，本工程項目令水質變化而對記錄到的珊瑚群落、印洲塘海岸公園（該公園最近的一點距離擬議電纜登岸地點和電纜路線大約 430 米）和荔枝窩海灘具特殊科學價值地點（距離擬議電纜登岸地點和電纜鋪設路線超過 1.5 公里）所造成的間接影響都不顯著。

本工程項目篩選了可以盡量減少景觀影響和減少對珊瑚群落造成生態影響的登岸地點和電纜走線；也採用了可以減少干擾海洋環境的電纜鋪設技術，從而避免了對海洋生態資源可能造成的絕大部份影響。

4.8 陸地生態

為了把登岸後的海底電纜連接至現有的架空陸上電纜系統，需要在了哥岩和白沙頭咀兩個電纜登岸地點進行小規模的岸上建築工程。

4.8.1 法例和指引

下列各項法例和指引提供了保護香港具生態價值的物種和生境，以及進行生態影響評估的構架：

- 《郊野公園條例》（第 208 章）；
- 《林區及郊區條例》（第 96 章）；
- 《城市規劃條例》（第 131 章）；
- 《野生動物保護條例》（第 170 章）；
- 《保護瀕危動植物物種條例》（第 586 章）；
- 《香港規劃標準與準則》第 10 章。

Coastal Vegetation 海岸植物

Shrubby Grassland 多灌木草地

Young Woodland 尚未成熟的林地

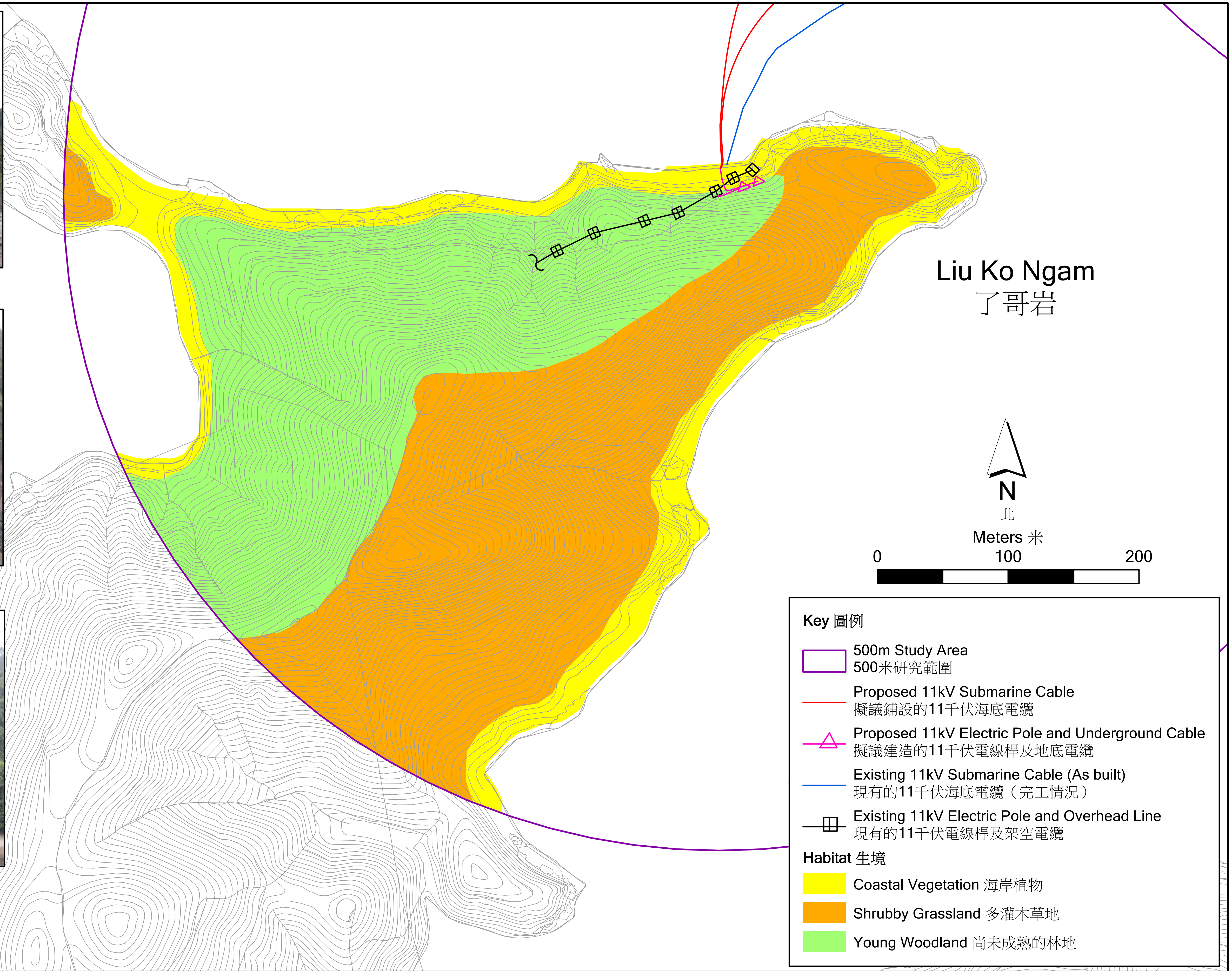


Figure 4.1
圖4.1

Habitat Map at Liu Ko Ngam Landing Point

了哥岩登岸點生境地圖

File: T:\GIS\CONTRACT\0114462\mxd\Aug2012\0114462_Habitat_Liu_Ko_Ngam.mxd
Date: 31-Oct-2012

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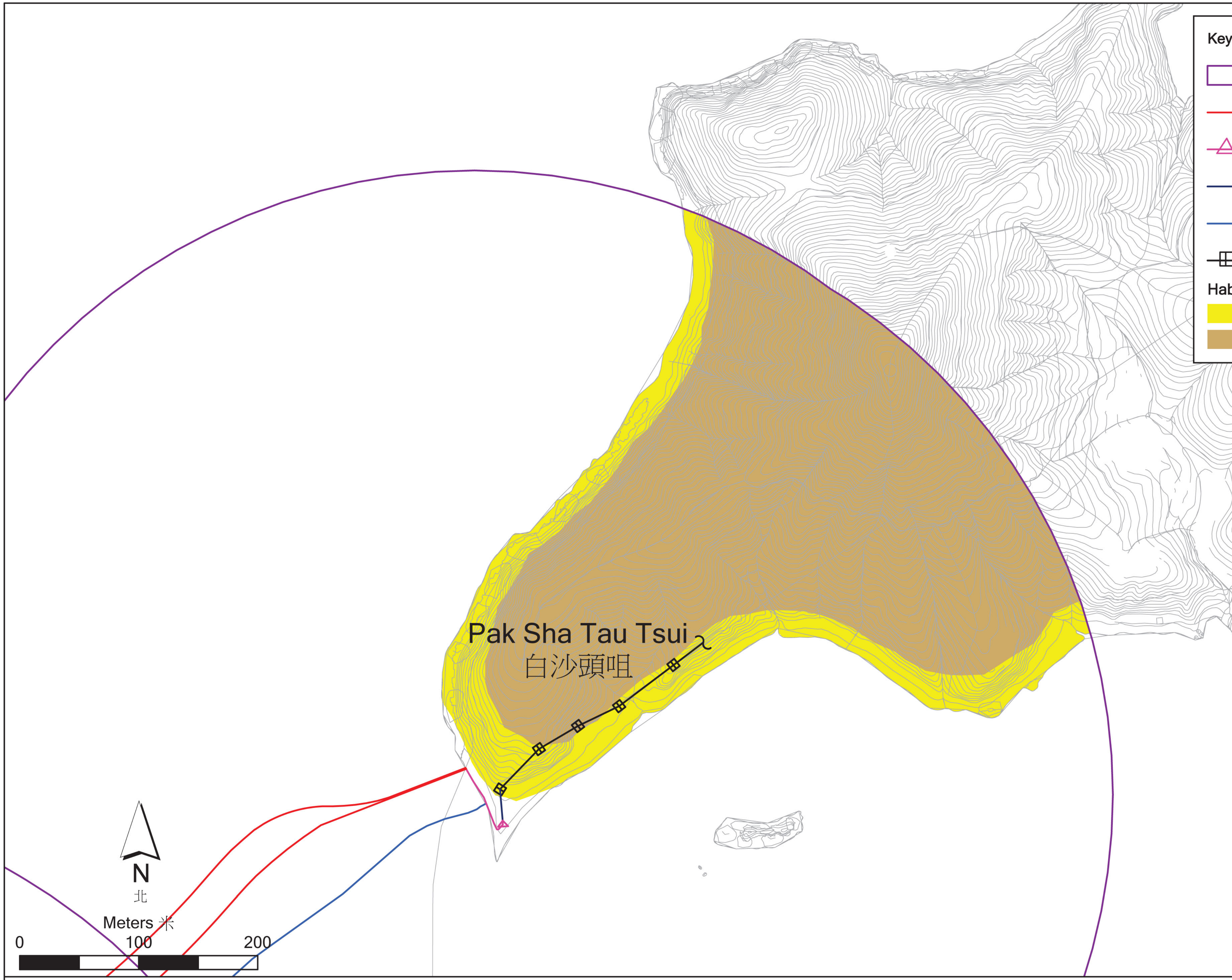


Coastal Vegetation 海岸植物


Shrubland 灌木地

Figure 4.2
圖4.2

Habitat Map at Pak Sha Tau Tsui Landing Point

白沙頭咀登岸點生境地圖

File: Aug2012\0114462_Habitat_Pak Sha Tau Tsui.mxd
Date: 31-Oct-2012

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View Without Development
沒有相關發展的景象

View With Development
建成相關發展的景象

Figure 4.3
圖 4.3

Photomontage showing the Site Before and After the Construction at Liu Ko Ngam
顯示了哥岩登岸地點在施工前和施工後情況的合成照片

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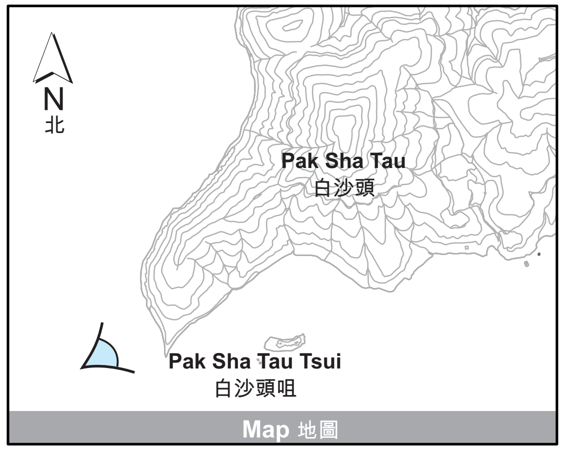
FILE: 0114462f1-chi
DATE: 21/05/2013



View Without Development
沒有相關發展的景象

View With Development
建成相關發展的景象

Figure 4.4
圖 4.4

Photomontage showing the Site Before and After the Construction at Pak Sha Tau Tsui
顯示白沙頭咀登岸地點在施工前和施工後情況的合成照片

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在評估潛在生態影響時，同時參考了根據《環境影響評估條例》訂立的《環境影響評估程序技術備忘錄》。

4.8.2 *有關研究範圍生態特徵的文獻檢閱*

是次研究為本工程項目地點檢閱了相關文獻[(1)] [(2)]。在文獻檢閱中，有關研究範圍的可用生態資料十分有限。因此，是次研究在 2011 年和 2012 年進行了實地調查，以確定研究範圍內現有的生態條件狀況。

4.8.3 *生態基線情況*

生境和植物

了哥岩

在了哥岩研究範圍內發現的陸地生境包括尚未成熟的樹林、多灌木草地和海岸植物（*圖 4.1*）。在研究範圍內，共計 79 種植物發現于尚未成熟的樹林中、20 種植物發現于多灌木草地、35 種植物發現于海岸植物生境。在工程範圍內，共計發現 19 種植物（全部在海岸植物生境）（見附件 B2）。

尚未成熟的樹林主要位於研究範圍內的山坡上，是了哥岩研究範圍內第二常見的生境，覆蓋了大約 41%的研究範圍面積。在這種生境內沒有發現具保育價值的植物品種。整體而言，尚未成熟樹林的生長年期較短，其生態價值屬偏低至中等。

了哥岩研究範圍內最常見的生境是多灌木草地，它覆蓋了大約 43%的研究範圍。在這種生境內記錄到的植物主要是十分常或常見的品種，並沒有具保育價值的類別。整體而言，多灌木草地的生態價值屬低。

了哥岩研究範圍的海岸植物是位於卵石海灘後濱地帶的植物，覆蓋了了哥岩研究範圍約 16%面積。在這種生境內記錄到的植物主要是十分常或常見的品種，並沒有具保育價值的類別。整體而言，海岸植物的生態價值屬低。

新電線桿的安裝地點位於*圖 4.1* 的生境地圖上所顯示的海岸植物地區內，其特點與了哥岩研究範圍的海岸植物生境的特點相同。在了哥岩工作區內，沒有發現任何稀有或受保護的植物品種。該區的生態價值偏低。

白沙頭咀

在白沙頭咀研究範圍內發現的陸地生境包括灌木地和海岸植物（*圖 4.2*）。在研究範圍內，共計 54 種植物發現于灌木地、44 種植物發現於海岸植物。在白沙頭咀工程範圍內，共計發現 13 種植物（全部在海岸植物生境）（見附件 B2）。

白沙頭咀研究範圍內最常見的生境是灌木地，它覆蓋了大約 79%的研究範圍。在這種生境內記錄到的植物都是十分常或常見的品種，並沒有具保育價值的類別。整體而言，灌木地的生態價值屬低。

(1) *Porcupine!*（香港大學生態及生物多樣性學系通訊第 1 至 33 期）
(2) 漁農自然護理署《香港物種探索》（2002-2010 年）

白沙頭咀研究範圍的海岸植物生境由沙質海灘後濱地帶組成，覆蓋了白沙頭咀研究範圍約 21%的面積。在這種生境內記錄到的植物都是十分常或常見的品種，並沒有具保育價值的類別。整體而言，海岸植物生境的生態價值屬低。

新電線桿的安裝地點位於*圖 4.2* 的生境地圖上所顯示的海岸植物地區內，其特點與白沙頭咀研究範圍的海岸植物生境的特點相同。在白沙頭咀的工作範圍內，沒有發現任何稀有或受保護的植物品種。該範圍的生態價值屬低。

圖 4.1 和 *4.2* 展示了研究範圍內所記錄到的生境照片 。表 4.2 則列出研究範圍內每種生境的面積和生態價值。

表4.2　　研究範圍內生境的面積和生態價值

生境	面積	生態價值	註
了哥岩			
尚未成熟的樹林	~7.5 公頃	低至中等	尚未成熟的樹林主要是本土樹木：鴨腳木（*Schefflera heptaphylla*）和假蘋婆（*Sterculia lanceolata*）混雜林地的平均高度為 3 - 4 米。下層林木則主要是攀爬植物類的亮葉崖豆藤（*Millettia nitida*）和假老虎簕（*Caesalpinia crista*），以及灌木類的野漆樹（*Rhus succedanea*）和山大刀（*Psychotria asiatica*）。尚未成熟的樹林中沒有記錄到具保育價值的植物品種。
多灌木草地	~7.9 公頃	低	多灌木草地的主要植物是一些十分常見的本土品種，包括草類中的芒（*Miscanthus sinensis*）；灌木類的崗松（*Baeckea frutescens*）和攀爬植類的無根藤（*Cassytha filiformis*）。多灌木草地中沒有記錄到任何具保育價值的植物品種。
海岸植物	~3.0 公頃	低	海岸植物主要是一些十分常見的本土植物，包括灌木類的苦郎樹（*Clerodendrum inerme*）和樹木類的馬甲子（*Paliurus ramosissimus*）。海岸植物中沒有記錄到具保育價值的植物品種。
工程範圍（海岸植物）	~45 平方米	低	了哥岩工程範圍的主要植物是十分常見的攀爬類植物亮葉崖豆藤（*Millettia nitida*）和假老虎簕（*Caesalpinia crista*），以及鴨腳木（*Schefflera heptaphylla*）幼株。工程範圍內沒有記錄到稀有、受保護或具價值的植物品種。
白沙頭咀			
灌木地	~10.8 公頃	低	灌木地的主要植物是一些十分常見的本土灌木品種，包括：雀梅藤（*Sageretia thea*）、黃牛木（*Cratoxylum cochinchinense*）和車輪梅（*Rhaphiolepis indica*）。灌木地中沒有記錄到具保育價值的植物品種。
海岸植物	~2.8 公頃	低	海岸植物主要是一些常見的本土植物，包括灌木類的苦郎樹（*Clerodendrum inerme*）和單葉蔓荊（*Vitex rotundifolia*）；樹木類的露兜樹（*Pandanus tectorius*）、馬甲子（*Paliurus ramosissimus*）和海芒果（*Cerbera manghas*）。海岸植物中沒有記錄到具保育價值的植物品種。
工程範圍（海岸植物）	~40 平方米	低	白沙頭咀工程範圍的主要植物是十分常見的種類：馬纓丹（*Lantana camara*）、露兜樹（*Pandanus tectorius*）和黃槿（*Hibiscus tiliaceus*）。雖然完全成長的露兜樹（*Pandanus tectorius*）和黃槿（*Hibiscus tiliaceu*）都屬於樹木類，但這裏所發現的植株，都尚未成熟。工程範圍內沒有記錄到稀有、受保護或具價值的植物品種。

野生動物

研究範圍內野生動物的數量和種類都不多，而且，大部份記錄到的品種，都是在香港常見和十分常見的類別。在調查期間，在了哥岩研究範圍記共錄到 6 種鳥類，包括白頭鵯、叉尾太陽鳥、鷓鴣、紅耳鵯、長尾蓬葉鶯和蒼鷺。而在白沙頭咀研究範圍也錄得 6 種鳥類，包括：紅耳鵯、紅耳鵯、家燕、黑鳶、黑臉噪鶥和珠頸斑鳩。在調查期間，亦見到一隻黑鳶在白沙頭咀研究範圍上空飛翔。黑鳶是香港常見和分佈廣泛的留鳥，但在香港的生態評估當中，仍被視作具保育價值的鳥類。在中華人民共和國，這種鳥被過度捕獵，因此被列作二級受保護動物。

4.8.4 *施工和運營階段的影響*

是次研究根據實地調查的結果和檢閱文獻所得的資料，評估了本工程項目在施工和運營階段可能造成的生態影響。

施工階段

本工程項目的施工活動（小型挖掘工程）會對毗鄰項目地點的生境產生以下影響：

- 在建造本工程項目的地面結構時所佔用的土地會直接造成生境損失；
- 對一些不活躍／活動性較低／依賴特定生境的鳥類，以及在受影響的生境中築巢／定居的野生動物（在調查期間沒有記錄到）的直接損失；
- 對鳥類和一般野動物造成的關聯影響，包括對生境使用（即經過、覓食和棲息）的限制、鳥類和一般野生動物的生境受到臨時和永久的損失；及
- 由於對生境的滋擾（包括滋擾、不適當地儲存或傾倒建築物料、及山火等）而影響附近生境及其相關鳥類和野生動物。

表 4.3 列出受本工程項目影響的生境可能受到的影響。

表4.3 ***工程範圍內生境可能受到的影響***

受影響生境	本工程項目的組成部份	受影響生境的面積	生態價值	整體生態影響	註
了哥岩的海岸植物	電纜槽和木電線桿的安裝工程	~45 平方米（此生境佔整個研究範圍約 0.2%）	低	低	相對於附近大範圍的相似生境而言，受影響的範圍十分細小。在本工程項目地點內沒有發現稀有或受保護的物種。
白沙頭咀的海岸植物	電纜槽和木電線桿的安裝工程	~40 平方米（此生境佔整個研究範圍約 0.2%）	低	低	相對於附近大範圍的相似生境而言，受影響的範圍十分細小。在本工程項目地點內沒有發現稀有或受保護的物種。

本工程項目的建築活動規模細小，維時亦短暫，而且，如表 4.3 所述，工地上受滋擾的海岸植物範圍有限，而附近亦有大範圍的相似生境，因此，若能採用良好的施工方法（第 5.1.1 節），預計本工程項目在施工階段造成的生態影響（包括對上述野生動物的潛在影響）屬於低。

運營階段

預計本工程項目在運營階段不會造成生態影響。

4.9 *漁業*

在檢視過有關電纜鋪設路線附近的現有漁業資源和捕漁作業資料後（見附件C），發現電纜走線經過的地區，曾被識別為具商業價值的漁業資源的育幼和繁殖場。香港海域內大部份魚類的繁殖期集中在6月至9月，因此推測，這區的魚類繁殖也集中在這個時期。

在擬議電纜系統附近海域有中等數量的漁船作業，大部是圍網漁船和舢舨。這些小於15米長的船隻，是在電纜鋪設路線一帶作業的主要漁船種類。與擬議鋪設的海底電纜最接近的魚類養殖區，是位於電纜路線東南約510米的西流江，但該處的經營者數目十分有限。其他魚類養殖區，包括澳背塘、吉澳和鴨洲等，全都距離擬議海底電纜路線超過1.5公里。若與香港海域的其他捕漁區比較，有關的捕漁區在每公頃漁獲量的排名上，大致屬於中等。

鑑於建議採用的電纜鋪設和安裝方法，預測本工程項目不會對漁業資源和捕漁作業造成不可接受的影響。對海床可能造成的滋擾，也只會非常輕微、局部和為時短暫。根據資料顯示，由電纜鋪設工程所揚起的沉積物，都只屬低濃度和局部性質，因此不會對水質、漁業資源和捕漁作業造成不可接受的影響。

由於沒有發現不可接受的潛在影響，因此并無建議實施的特定緩解措施。

4.10 *文化遺產*

本節所述，是有關本工程項目的文化遺產影響評估，其中包括文物建築影響評估、考古影響評估和水下考古調查。

本工程項目的文化遺產影響評估研究範圍由兩部份組成：文物建築及考古影響評估研究範圍，以及水下考古調查研究範圍。在文物建築影響評估和考古影響評估方面，研究範圍包括距離兩個登岸地點的電線桿所在地和地下電纜走線的50米範圍內。在本工程項目簡介中，這個研究範圍稱為文物建築及考古影響評估研究範圍。在水下考古調查方面，研究區範圍為距離擬鋪設的海底電纜大約297米和380米的範圍內。在本工程項目簡介中，這個研究範圍稱為水下考古調查研究範圍。*圖4.5*展示了文物建築及考古影響評估研究範圍；而*附件D1*中的*圖D1-1*則展示了水下考古調查研究範圍。

4.10.1 *法例和指引*

以下法例和指引，均適用於香港文化遺產地點的影響評估：

- 《環境影響評估條例》（第499.S16章）、《環境影響評估程序技術備忘錄》附件10和19，以及《評估對文化遺產地點影響的指南》；
- 《古物及古蹟條例》（第53章）；
- 文化遺產影響評估的指引

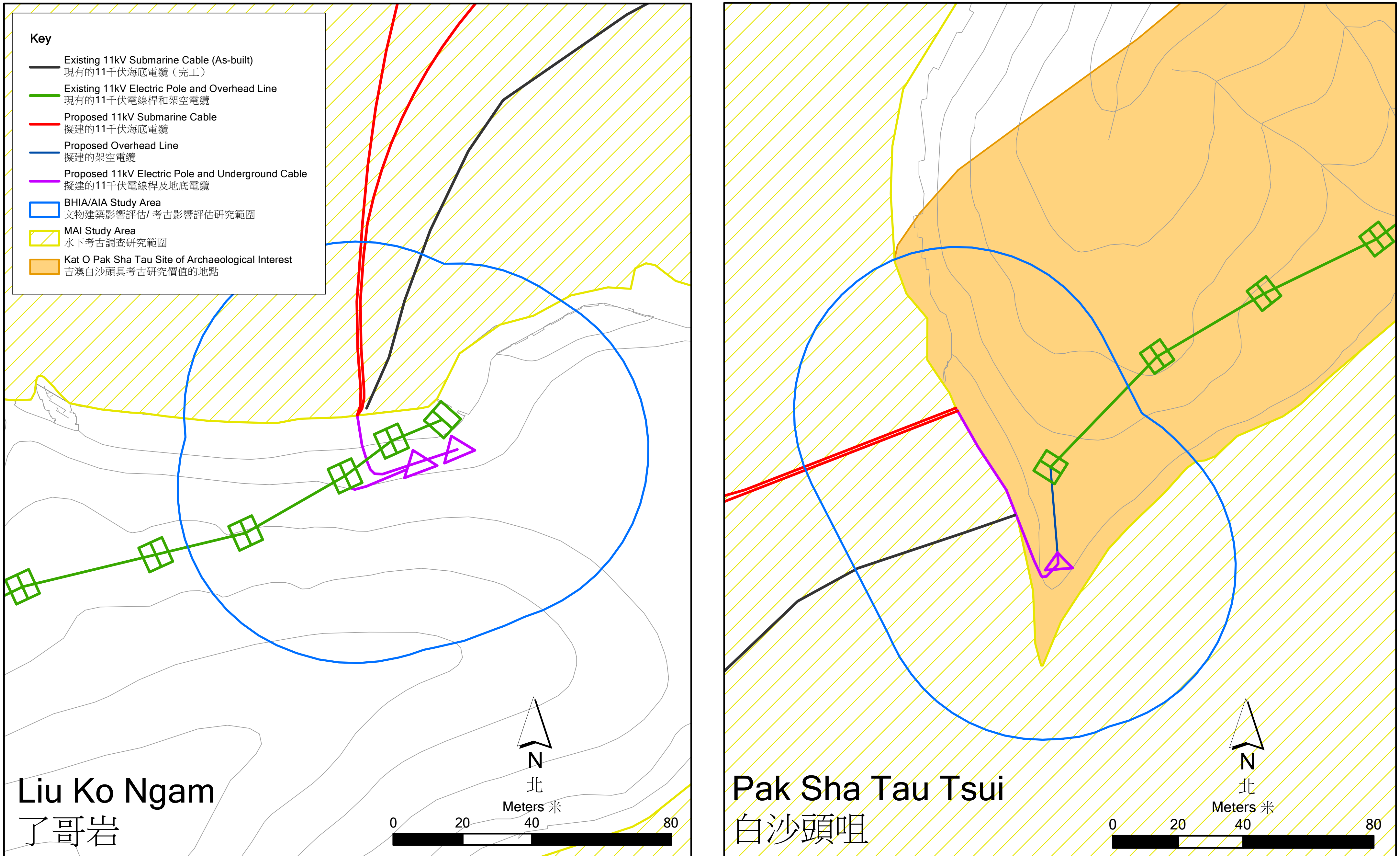

Figure 4.5
圖 4.5

BHIA/AIA Study Area

文物建築影響評估/ 考古影響評估研究範圍

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Date: 9/5/2013

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- 《香港規劃標準與準則》；及
- 《土地（雜項條文）條例》。

4.10.2 *文物建築*

文物建築影響評估的研究範圍為距離本工程項目走線的 50 米範圍內。下文闡述了在文物建築及考古影響評估研究範圍內的文物建築基線情況和影響評估。

基線情況

在兩個電纜登岸地點（即了哥岩和白沙頭咀）和海底電纜走線附近，都沒有任何古物古蹟辦事處所公佈的法定古蹟、政府文物地點、已評級或建議評級歷史建築物。

施工和營運階段影響

由於文物建築影響評估研究範圍內沒有已知的文物建築，因此本工程項目在施工和營運階段都不會對它們造成任何影響。

4.10.3 *陸地考古*

考古影響評估的研究範圍為距離本工程項目走線的 50 米範圍內。下文闡述了在文物建築及考古影響評估研究範圍內的陸地考古基線情況和影響評估。

基線情況

<u>了哥岩</u>

了哥岩的電纜登岸地點位於一個形成不久的淺水卵石海灘（見*圖 4.5*），該處沒有適合形成考古遺留和古代聚居地的平坦地區，因此屬於沒有考古潛質的地點。了哥岩亦無香港具考古研究價值的地點。

<u>白沙頭咀</u>

電纜登岸地點位於古物古蹟辦事處記錄中的吉澳白沙頭具考古研究價值的地點。根據 2000 年的考古調查[1]報告，該處於 T2 及 T3 離地面大概 42 到 74 厘米處曾發現新石器時代晚期的文化層和一些十分零碎的粗砂陶碎片出土。然而，這些陶片太小，難以分辨類型。此外，亦曾在 T1 及 T3 出土清代建築物的地基遺物。在地表採集和各個探方的已受擾亂的地層中，發現了新石器時代晚期的粗砂陶片、陶片、石器，以及宋、明和清等朝代的陶瓷碎片。

因此，有必要進行考古調查，務求取得更多實地考古數據，以便準確地評估本工程項目可能造成的考古影響。考古調查於 2012 年 7 月 17 日至 8 月 3 日由一位持牌考古學家進行。是次考古調查的詳情，請參閱本工程項目簡介的*附件 D2*。

是次考古調查結果顯示，所有發現到的文化層均屬近代。調查結果一共發現 31 件一般文物及一件重要文物。一般文物包括鄉村器物的碎片、瓷器碎片和瓦

(1) 古物古蹟辦事處 (2000)，《新界餘下偏僻村落供水計劃第二期考古調查工作報告》。

片。地表採集所找到的重要文物，是一塊來孤立的發現，屬於先秦時期的穿孔石製品，屬二次堆積物。所有發現均為二次堆積物，沒有重要價值。

是次考古調查的地點，比 2000 年調查的 T6 位置較偏南和偏西，亦距離 T2 及 T3 較遠的位置，十分接近現在的海岸線，因此，沒有出土任何原生文化遺物。

根據調查結果，在擬議進行本工程項目的地點發現重要考古遺存的可能性十分低。根據 2000 年調查的結果，原生的史前考古堆積主要位於山坡上，遠離本工程位置所在的現代沙灘，符合是次調查結果。

施工和運營階段影響評估

了哥岩

了哥岩的電纜登岸地點沒有任何考古潛質。因此，本工程項目在施工和運營階段都不會造成考古影響。

白沙頭咀

鑑於擬建的電線桿和地下電纜都會沿著已調查的地點建造，因此，預計在施工階段只會對不重要的考古文物(二次堆積)造成直接影響。由於應該沒有潛在的原生堆積，本工程項目的建築工程亦只會造成極輕微和可以接受的潛在考古影響。

4.10.4 ***然而，由於在調查中發現了一件重要文物及一些考古遺物，建議項目倡議人在吉澳白沙頭具考古研究價值地點內進行挖掘工作前通知古物古蹟辦事處，以便該處安排監察工作。此外，在吉澳白沙頭具考古研究價值地點內進行挖掘期間，若有發現任何古物或疑似古物，應立即通知古物古蹟辦事處。營運階段亦不會造成任何考古影響。水下考古***

專業的水下考古學家 Bill Jeffery 博士，在 2010 年根據擬議電纜走線區的歷史記錄、英國沉船數據庫，以及水道測量及地球物理調查結果，對本工程項目所涉及的地區，進行了水下考古資源潛質評估（見附件 D1）。評估結果認為，該區沒有任何水下考古特點，因此，擬議海底電纜鋪設工程無論在施工或營運期間，都不會對區內的水下考古資源造成任何影響。

4.11 其他

空氣污染物的排放：當電纜登岸地點進行建造工程時，只會由柴油推動的設備排放小量空氣污染物（二氧化硫、飄塵 [PM_{10}]）和氮氧化物）。這些排放物都不會影響空氣質素敏感受體。最接近的空氣質素敏感受體是西流江和吉澳上圍，與了哥岩和白沙頭咀的擬建電纜登岸點分別距離 500 米和 1 公里。

氣味：估計本工程項目不會造成任何氣味影響。

新增交通：預料本工程項目只會產生極小量的交通，亦不會產生顯著的噪音或氣體排放物。

危險物品：本工程項目不會涉及任何危險物品。

夜間作業：預料所有電纜鋪設和掩埋工作都會在正常工作時段內，在岸上進行。倘若有需要在黃昏或晚間進行任何工程，屆時會先申請建築噪音許可證。

有害物料或廢物：本工程項目不會產生任何有害的物質或廢物。

發生意外而造成污染或危害的風險：本工程項目預計不會發生可能導致污染或危害的意外。海底電纜採用穩定的硅光纖製成，並有多層抗腐蝕的聚乙烯和鍍鋅鋼絲保護。根據設計，這種電纜在海水中的正常使用年期超過 25 年。因此，無論是在海底電纜的施工或運營階段，都不會發生可能導致污染或危害的意外。

廢舊或已污染物料的處置：本工程項目會確定海洋沉積物的質量，並在《沉積物質量報告》中匯報，而最終的卸置地點則會由海洋填料委員會決定。本工程項目在展開挖泥工程前，會先向環保署申請卸泥牌照。根據環保署的數據顯示，需予挖掘的沉積物未受污染。

5 環保措施及其他對環境的影響

5.1 環境保護措施

5.1.1 施工階段

本工程項目在施工階段可能造成的生態影響會是對有限海岸植物的滋擾，這同時也是工程所造成的景觀影響。由於有關生境的生態價值屬低，而且受影響的面積亦較小（這個生境只佔研究範圍少於 0.004%），因此，預料本工程項目可能造成的生態滋擾和景觀影響為低。此外，亦可以透過採用下列各項良好的施工方法來減少出現其他生態滋擾以及景觀影響：

- 通過保存及保護樹木以減少對其產生的影響；
- 在現場對地下電纜的走線進行微調，務求能盡量減少現有植物和樹木可能受到的影響；
- 避免四周餘下的天然尚未成熟的樹林或灌木地生境受到任何破壞和滋擾，特別是由填土和非法傾倒廢物而造成的破壞和滋擾。
- 定期檢查工程範圍的界線，以確保沒有越界情況出現，而且附近地區沒有受到破壞；
- 禁止和防止在施工期間在工地範圍內使用明火，並在工程範圍內提供臨時消防設備；及
- 在建築工程竣工後，立即把臨時工地／受滋擾地區復原。

建議在鋪設電纜時，實施下列各項緩解措施，藉以減少工程對四周生境和海洋生物群落的影響和滋擾。

- 在岸端工程地點的四周裝設隔泥幕，務求在鋪設電纜期間，減少沉積物擴散。為免對環境和附近海洋生物造成任何影響，在拆除隔泥幕時，應該按照下列步驟： (1) 檢查清楚隔泥幕內沒有任何明顯的沉積物捲流；(2) 慢慢地提起隔泥幕的底部；及 (3) 慢慢地把隔泥幕拉出水面；
- 在沖噴法掩埋機／工具的兩側安裝框架式隔泥幕／隔泥網，以減少沉積物在鋪設電纜時擴散。
- 為了盡量減少珊瑚群落所受到的影響（這些影響並非不可接受）建議把被登岸地點隔泥幕圍繞的地區內，可能會受影響和可以移動（即可以改變其位置）的珊瑚群落加以遷移。

在上一階段的評估中，預計本工程項目在白沙頭咀登岸地點可能會造成陸地考古影響。因此建議進行一次小規模的考古調查，其中包括最少三個探方（大小介乎 1 米 x 1 米至 2 米 x 1.5 米）。這項建議考古調查由一位持牌考古學家於 2012 年 7 月 17 日至 8 月 3 期間，在白沙頭咀的登岸地點進行；其中包括地表採集、七個鑽孔和三個探方。調查的結果在一份《考古調查報告》中闡述，並納

入本工程項目簡介中，成為附件 D2。根據該次調查的結果，本工程項目的建築工程所產生的潛在考古影響極之輕微及可以接受。然而，由於是次調查發現了一件重要文物及一些考古遺物，建議項目倡議人在吉澳白沙頭具考古研究價值地點內進行挖掘工作前通知古物古蹟辦事處，以便該處安排監察工作。此外，在吉澳白沙頭具考古研究價值地點內進行挖掘期間，若有發現任何古物或疑似古物，應立即通知古物古蹟辦事處。

本簡介已建議了具體的措施來減少本工程項目在施工階段對水質和海洋生態的影響（請參閱附件 A 和 B1）。除此之外，并無其他建議的環境保護措施。

5.1.2 運營階段

本工程項目在運營階段唯一可能造成的影響相信來自于視覺方面，由與建立新的木質電線杆而引起。 這一影響可以通過對電線杆的詳細設計而得到減緩：

- 新的電線桿由木製而成，並會根據需要進行加工（如繪上顏色）以同周圍的自然環境相融合。同時，它們將會跟現有附近的電線桿高度相彷。

除此之外，日次項目的運營不會造成其他影響，因此，無需實施其他環境保護措施。

5.2 環境影響的可能嚴重程度、分布及持續時間

海底電纜的鋪設工程預計需時約 24 個星期。工程所造成的剩餘環境影響只會局限於電纜沿線附近，而且程度較低，因此屬於可以接受的水平。

根據預測，海底電纜在運營期間不會造成任何環境影響。

5.3 累積影響

目前，擬議電纜鋪設路線附近沒有已規劃，並會於同期進行的項目，因此，本工程項目在施工和運營期間都不會與其他項目形成累積影響。

5.4 其他影響

根據電子測量的結果，擬議登岸點的土力環境已獲證實為適合鋪設海底電纜。

上文所闡述的電纜鋪設和掩埋方法，已經在全球各地使用，並獲廣泛接受認為不會影響附近環境。這類工程的施工期通常都很短，而且不會產生需要予以處置的廢物或污染的問題，亦不會產生過高的噪音。

6 環境監察與審核

雖然本工程項目沒有已知不可接受的環境影響，但仍建議對水質和珊瑚情況進行監察，以便證實有關的工程不會對水質、海洋生態和漁業造成影響。有關環境監察與審核方面的要求，於*附件 E* 探討。

香港環境資源管理顧問有限公司在進行是次評估時，參考了近期已經取得環境許可證的相若項目，其中包括：

- *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（中華電力有限公司）*。該項目的工程項目簡介於 2006 年 7 月 18 日提交環保署（AEP 267/2007）。該電纜在香港海域的長度約為 6.2 公里。該項研究認為，有關的工程不會對環境造成不良的長遠影響或累積影響，並於 2007 年 3 月 29 日獲發環境許可證（EP-267/2007）。本工程項目的建議電纜鋪設方法與這條 132 千伏海底電纜的鋪設方法相似。
- *亞洲快線海底光纜系統－將軍澳（NTT Com Asia Limited）*。該項目的工程項目簡介於 2011 年 10 月 7 日提交環保署（AEP-433/2011）。該項研究認為，有關的工程不會對環境造成不良的長遠影響或累積影響，並於 2011 年 12 月 20 日獲發環境許可證（EP-433/2011）。
- *東南亞日本海底光纜網絡工程香港段（中國電信）*。該項目的工程項目簡介於 2011 年 6 月 22 日提交環保署（AEP-423/2011）。該項研究認為，有關的工程不會對環境造成不良的長遠影響或累積影響，並於 2011 年 10 月 24 日獲發環境許可證（EP-423/2011）。
- *南大嶼山亞美海底光纜系統（Reach Networks Hong Kong Ltd）*。該項目的工程項目簡介於 2007 年 10 月 5 日提交環保署（AEP-298/2007）。該項研究認為，有關的工程不會對環境造成不良的長遠影響或累積影響，並於 2007 年 12 月 20 日獲發環境許可證（EP-298/2007）。
- *VSNL 亞洲區內海底通訊電纜-深水灣段（Videsh Sanchar Nigam Ltd.）*。該項目的工程項目簡介於 2007 年 8 月 31 日提交環保署（AEP-294/2007）。該項研究認為，有關的工程不會對環境造成不良的長遠影響或累積影響，並於 2007 年 11 月 23 日獲發環境許可證（EP-294/2007）。
- *黃竹坑–春坎角 132kV 電路之 132kV 海底電纜敷設工程（香港電燈有限公司）（港燈）*。該項目的工程項目簡介於 2002 年 3 月 26 日提交環保署（AEP-132/2002）。該項研究認為，有關的工程不會對環境造成不良的長遠影響或累積影響，並於 2002 年 4 月 16 日獲發環境許可證（EP-132/2002）。
- *C2C 通訊電纜網絡–香港段：春坎角（GB21〔香港〕有限公司）*。該項目的工程項目簡介於 2000 年 12 月提交環保署（AEP-087/2000）。該項研究認為，有關的工程不會對環境造成不良的長遠影響或累積影響，並於 2001 年 2 月 16 日獲發環境許可證（EP-087/2001）。

附件 A

水質評估

A1 水質評估

A1.1 引言

本附件闡述有關連接了哥岩和白沙頭咀的 11 千伏海底電纜系統在施工和運營期間潛在水質影響的評估，并闡述相關的緩解措施。

A1.2 相關的法例、指引和評估準則

下列各項法例和相關的指南或非法定指引，都適用於評估本工程項目在施工和運營時對水質可能造成的影響。

- 《水污染管制條例》；
- 《環境影響評估條例》（第 499 章第 16 條）和《環境影響評估程序技術備忘錄》（以下簡稱"環評技術備忘錄"）的附件 6 和 14；
- 《排放入排水及排污系統、內陸及海岸水域的流出物之技術備忘錄》（以下簡稱"廢水排放技術備忘錄"）；及
- 專業人士環保事務諮詢委員會專業守則《建築工地的排水渠》（專業守則 1/94 號）。

A1.2.1 《水污染管制條例》

《水污染管制條例》是香港控制水污染和水質的最基本法例。根據該法例，香港海域被劃分為 10 個水質管制區。每個水質管制區都有一套法定的"水質指標"。擬議海底電纜系統的鋪設路線和登岸地點，都位於大鵬灣水質管制區內。*表 A1* 列出大鵬灣水質管制區的水質指標。這些指標也可以在評估擬議鋪設的 11 千伏海底電纜系統在施工和運營階段的任何排放物是否符合規定時，作為評估準則。

表 A1 大鵬灣水質管制區水質指標摘要

參數	大鵬灣水質管制區
溶解氧	90%的樣本（海底）均不少於每公升 2 毫克。 90%的樣本（深度平均）均不少於每公升 4 毫克。
營養	深度平均的總無機氮的年度平均值不多於每公升 0.3 毫克。
非離子氨氮	年度平均不多於每公升 0.021 毫克。
大腸桿菌	年度幾何平均不多於每 100 毫克 610 個菌落形成單位 (cfu)（"適用於次級接觸康樂活動分區"和"魚類養殖分區"）
酸鹼度	須介乎 6.5 - 8.5，而且，因排放廢物而引起的變化不可超過 0.2。
鹽度	因排放廢物而引起的變化不可超過±10%。
溫度	因排放廢物而引起的變化不可超過 2°C。
懸浮固體	不可超過天然周邊水平 30%。
有毒物質	有毒物質的含量不可以到達足以造成顯著毒效的水平。
葉綠素-a	無既定準則

A1.2.2 *環境影響評估程序技術備忘錄（環評技術備忘錄）*

《環評技術備忘錄》的附件 6 和 14 為評估水質影響提供一般指引和評估準則。《環評技術備忘錄》認為在採用上述水質準則來評估排放點的情況時，可能沒法達到水質指標，因為有些範圍所受到的影響會較大（環保署稱之為**混合區**），亦即污染物被排入後開始被稀釋的地方。這種地區是根據每個項目的具體情況而界定。一般而言，初始稀釋區的接受準則，是不可以削弱水體的完整性，亦不可以令生態系統受損。

A1.2.3 *《排放入排水及排污系統、內陸及海岸水域的流出物之技術備忘錄》（廢水排放技術備忘錄）*

本工程項目在施工和運營階段的所有排放物都必須符合根據《水污染管制條例》第 21 條而頒布的《技術備忘錄 - 排放入排水及排污系統、內陸及海岸水域的流出物的標準》（廢水排放技術備忘錄）。

廢水排放技術備忘錄對各種接收水體都釐訂了可以接受的排放上限。按照《廢水排放技術備忘錄》的要求，排放入排水及排污系統、內陸和水質管制區海岸水域的流出物，都須符合特定排放體積的污染物濃度標準。這些標準都是由環境保護署（環保署）釐訂，並在發給水質管制區內任何新排放源的牌照條件中註明。

A1.2.4 *專業守則《建築工地的排水渠》*

除了上述各項法定要求外，環保署於 1994 年頒布的專業人士環保事務諮詢委員會專業守則 1/94 號《建築工地的排水渠》，亦為建築活動可能造成的水污染提供有用的指引。

A1.2.5 *沉積物質量*

會被棄置於海中的挖出沉積物，是按照環境運輸及工務局於 2002 年 8 月環境運輸及工務局技術通告 34/2002 號《挖出／掘出沉積物的管理》所闡述的一套規管指引進行分類。這些指引包括了一套沉積物質量準則，當中包括有機污染物和其他有毒物質的準則。有關沉積物棄置海中的規定，是在環境運輸及工務局技術通告 34/2002 號和工程科技術通告 12/2000 號中闡述。把挖出物料棄置海中的行為，是在 1995 年的《海上傾倒物料條例》中受到管制。

A1.3 *基線情況*

A1.3.1 *水質*

大鵬灣水質管制區

擬議海底電纜的鋪設路線位於大鵬灣水質管制區內。在電纜沿線附近有兩個環保署的例行水質監測站。這兩個監測站所公佈的最新水質數據是在 2007 至 2010 年期間收集[1]，均列於*表 A2*。監測站的位置則展示於*圖 A1*。

(1) 環保署海水水質數據（2005 - 2010）。 [*http://epic.epd.gov.hk/ca/uid/cmarinehistorical/p/1*]。 於 2012 年 9 月瀏覽。

Figure A1
圖A1

Location of the Routine Water Quality and Sediment Monitoring Stations

例行水質及沉積物監察站位置圖

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表 A2 *大鵬灣水質管制區之環保署例行水質監測數據（2007 年 – 2011 年）*

水質參數	MM2 吉澳海	MM7 印洲塘
溫度（°C）	23.5 (14.9 – 29.8)	23.4 (14.5 - 29.8)
鹽度	32.2 (30.0 – 33.6)	32.3 (30.3 - 33.5)
酸鹼度	8.1 (7.6 - 8.6)	8.1 (7.7 - 8.5)
溶解氧 – 深度平均（每公升毫克量）	6.8 (3.7 - 12.1)	6.5 (2.4 - 12.1)
溶解氧 – 海底（每公升毫克量）	6.0 (1.2 - 11.5)	5.8 (0.2 - 11.6)
五天生化需氧量（每公升毫克量）	1.0 (0.2 - 2.6)	1.0 (0.3 - 2.2)
懸浮固體（每公升毫克量）	2.3 (0.8 – 5.7)	1.8 (0.6 – 8.4)
總無機氮（每公升毫克量）	0.07 (0.01 - 0.22)	0.06 (0.01 - 0.19)
非離子氨氮（每公升毫克量）	0.002 (0.001 – 0.008)	0.002 (0.001 - 0.007)
葉綠素-a（每公升微克量）	4.3 (0.5 - 20.6)	3.8 (0.8 – 11.0)
大腸桿菌（每 100 毫公升菌落形成單位）	2 (1 - 670)	1 (1 - 23)

註：

1. 所列出的數據是將三個不同深度（即水面(S)、中間深度(M) 和水底(B)）的數值計算其平均數而得出的深度平均值。
2. 所列出的數據，除了大腸桿菌的數據是年度幾何平均之外，其餘都是年度算術平均。
3. 括號內的數據是不計深度的最低和□高值。
4. 所列出的數據都完全符合水質指標。

在 2007 至 2011 年間收集的數據都符合有關溶解氧（深度平均）的水質指標，但變化很大。在 2007 至 2011 年間收集有關水底溶解氧的數據亦有很大落差。在 2007 年，於（MM2 和 MM7）兩個站所錄得的水底溶解氧都不符合水質指標，其後，在 2008 至 2010 年期間，溶解氧保持在一個平穩而且符合水質指標的水平。在 2007 至 2011 年間記錄到的營養物水平（總無機氮約為每公升 0.3 毫克）和非離子氨氮（每公升 0.021 毫克）都連續地符合水質指標。

兩個監測站在 2007 至 2011 年間所錄得的大腸桿菌（每 100 毫升 610 個菌落形成單位）都符合水質指標，即使在 MM2 所顯示的數據都有很大的變化。此外，近年的葉綠素-a 水平亦較穩定，顯示出區內的浮游植物近年沒有顯著增加。

海岸公園的水質

漁農自然護理署開展了一個定期水質監測計劃，旨在收集香港各個現有和建議海岸公園／海岸保護區的基線水質數據。有關印洲堂海岸公園的水質監測結果（2008 - 2012 年）[1] 均列於*表 A3*。

(1) 漁農自然護理署海水水質數據 (2008 – 2012)。[*http://www.afcd.gov.hk/english/country/cou_vis/cou_vis_mar/cou_vis_mar_mon/cou_vis_mar_mon_wat.html*]. 於 2013 年 5 月瀏覽。

表 A3 *印洲堂海岸公園水質摘要 (2008 – 2012)*

水質參數（深度平均）	印洲堂海岸公園		
	印洲堂	荔枝窩	狗麻石
溫度（°C）	23.1	23.6	23.6
鹽度（ppt）	32.4	32.3	32.3
酸鹼度	8.1	8.2	8.2
溶解氧（每公升毫克量）	6.6	6.7	6.9
生化需氧量（每公升毫克量）	1.4	1.7	1.7
懸浮固體（每公升毫克量）	11.4	13.7	14.2
總無機氮（每公升毫克量）	0.102	0.103	0.103
非離子氨氮（每公升毫克量）	0.002	0.003	0.003
葉綠素-a（每公升微克量）	2.7	5.1	4.0
大腸桿菌（每 100 毫升菌落形成單位）	1	1	1

A1.3.2 *沉積物質量*

環保署在其海水水質監測計劃中收集沉積物質量數據。在電纜沿線附近有兩個環保署的例行沉積物質量監測站。這兩個監測站於 2007 - 2011 年間的沉積物質量數據 [(1)]，均列於*表 A4*。*圖 A1* 展示了兩個監測站的位置。

表 A4 *大鵬灣水質管制區沉積物質量監察數據摘要（2007 - 2011 年）*

沉積物質量參數	**MS2**	**MS7**	化學超標下限 [(1)]	化學超標上限 [(1)]
化學需氧量（每公斤毫克量）	15200 (13000 - 17000)	16500 (13000 - 19000)	--	--
總碳（每公斤毫克量）	0.6 (0.5-0.8)	0.7 (0.6 - 0.9)	--	--
氨氮（每公斤毫克量）	9.9 (0.1-20.0)	9.5 (4.8 – 14.0)	--	--
總克氏氮（每公斤毫克量）	557 (460-610)	598 (340 - 710)	--	--
砷（每公斤毫克量）	7.1 (5.7 - 7.9)	6.7 (5.8 - 7.6)	12	42
鎘（每公斤毫克量）	0.3 (0.1 - 0.3)	0.2 (0.1-0.5)	1.5	4

(1) 環保署沉積物質量數據 (2007 – 2011 年) [*http://epic.epd.gov.hk/ca/uid/marinehistorical/p/1*]。於 2013 年 5 月瀏覽。

沉積物質量參數	MS2	MS7	化學超標下限 (1)	化學超標上限 (1)
鉻（每公斤毫克量）	36 (33 - 39)	35 (31 - 39)	80	160
銅（每公斤毫克量）	21 (14 - 23)	20 (16-26)	65	110
鉛（每公斤毫克量）	46 (39 - 51)	43 (38 - 48)	75	110
汞（每公斤毫克量）	0.06 (0.06 - 0.07)	0.07 (0.06 - 0.09)	0.5	1
鎳（每公斤毫克量）	24 (21 - 25)	24 (22 - 27)	40	40
銀（每公斤毫克量）	0.1 (0 - 1)	0 (0 - 0)	1	2
鋅（每公斤毫克量）	104 (92 - 120)	101 (82 - 120)	200	270
低份子量多環芳烴(2)（每公斤微克量）	90 (90-100)	92 (90-160)	550	3160
高份子量多環芳烴(3)（每公斤微克量）	37 (24-73)	57 (25-200)	1700	9600
總多氯聯苯(4)（每公斤微克量）	18 (18 - 18)	18 (18 - 18)	23	180

註：

1. 工務局技術通告第 34 /2002 號所規定的沉積物分類質量標準。
2. 低分子量多環芳烴包括：苊、苊烯、蒽、芴、萘和菲。
3. 高份子量多環芳烴包括：二苯駢(ah)蒽、苯駢(k)熒蒽、䓛、芘、茚駢(1,2,3-cd)芘、苯駢(ghi)苝、苯駢(a)芘、苯駢(b)熒蒽、苯駢(a)蒽和熒蒽。
4. 總多氯聯苯包括 18 種同源物質：多氯聯苯 8, 18, 28, 44, 52, 66, 77, 101, 105, 118, 126, 128, 138, 153, 169, 170, 180, 187。
5. 所列的數據均為算術平均；括號內為變化的範圍。
6. 除非另有註明，否則，所有參數均屬乾重量。

上述數據顯示，按照現有的沉積物分類指引，擬議電纜鋪設路線附近的沉積物未受污染。

A1.3.3 水質敏感受體

是次研究已找出在電纜鋪設路線和登岸地點附近的兩大類水質敏感受體，即漁業和具生態價值地區。*圖 A2* 所示的兩大類已知水質敏感受體，均摘述如下：

- **漁業：**鴨洲、澳背塘和西流江的魚類養殖區；印洲塘海岸公園的人工魚礁；商業魚類的育幼區。
- **具生態價值的地點：**印洲塘海岸公園；印洲塘海岸公園內的荔枝窩草場；位於青洲、牛屎湖灣和荔枝窩北的具高生態價值珊瑚群落（詳見*附件 B1*）。

擬議電纜鋪設路線和各個已知的具代表性敏感受體之間的距離，均列於*表 A5*。

表 A5 擬議電纜與各個敏感受體之間的最短距離

代號	水質敏感受體	與擬議電纜的大約距離
A1	印洲塘海岸公園的人工魚礁	1,000
F1	西流江的魚類養殖區	510（距離包括被岬角阻擋的地區，如果只是考慮在海上直接的路線，最近的距離將約 560 米）
F2	澳背塘的魚類養殖區	1,700
F3	吉澳的魚類養殖區	1,800
F4	鴨洲的魚類養殖區	2,500
F5	商業漁業資源的繁殖場／育幼區	毗鄰
E1	印洲塘海岸公園	430 距離包括被岬角阻擋的地區，如果只是考慮在海上直接的路線，最近的距離將約 570 米）
E2	荔枝窝沙滩具特殊科学价值地点	1,500
E3	位於青洲、牛屎湖灣和荔枝窩北的具高生態價值珊瑚群落	220, 250 和 1,400

應予注意的，電纜與各個敏感受體之間的真實距離可能會大於*表 A5* 所列的距離，視乎電纜在工程區內的具體鋪設位置而定。

A1.4 影響評估

下文闡述擬議鋪設的 11 千伏海底電纜系統在施工和運營期間可能產生的水質影響。

A1.4.1 施工階段

電纜鋪設工程

負責使用電纜掩埋機掩埋一段電纜的承建商，已經就其施工方法提供了有關資料。

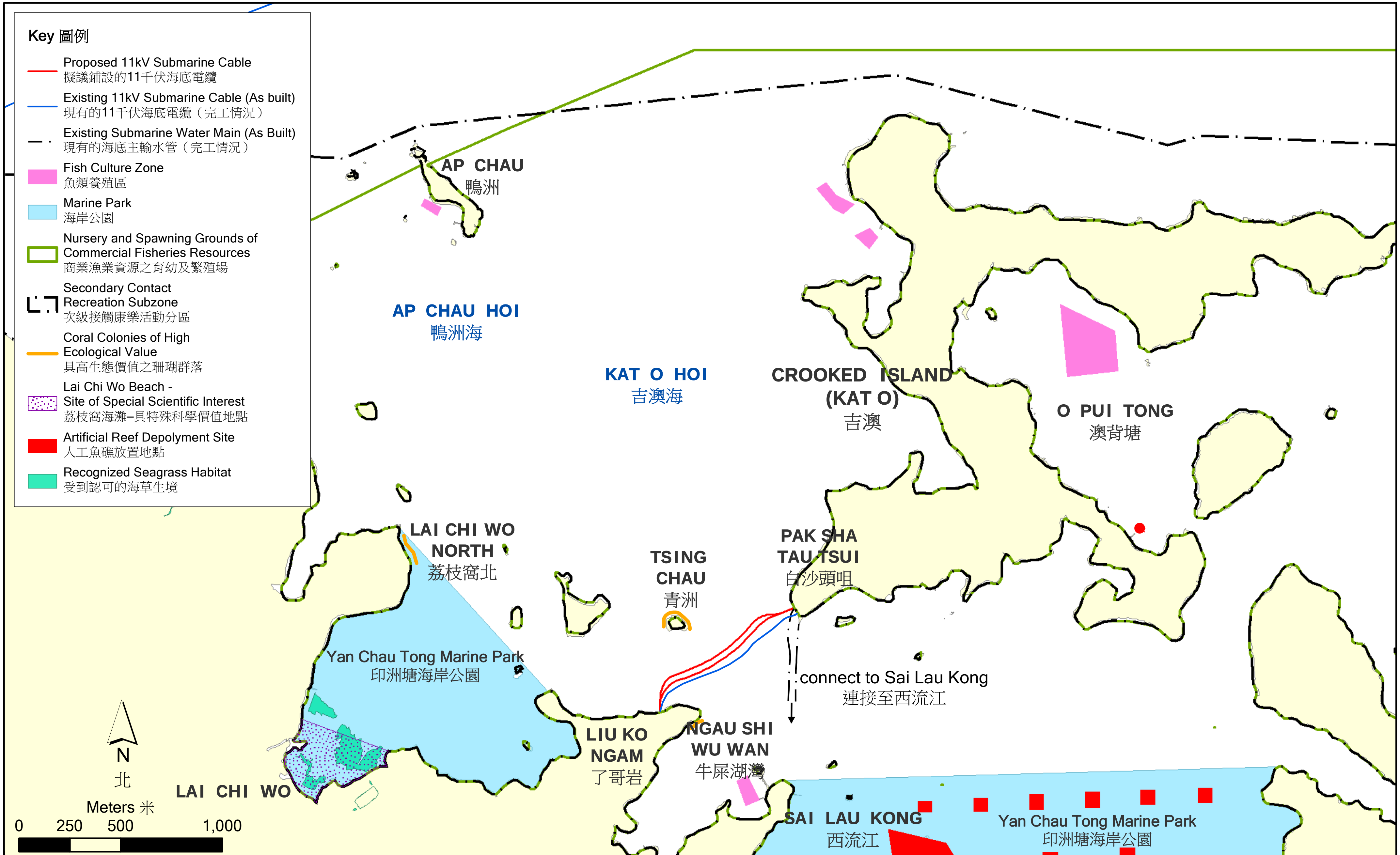

Figure A2
圖A2

Location of Water Quality Sensitive Receivers

水質敏感受體位置圖

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下列各項已獲發環境許可證的工程項目簡介，都是利用下文所述的施工方法來計算懸浮沉積物的漂移情況：

- *亞洲快線海底光纜系統－將軍澳*（AEP-433/2011）。於 2011 年 12 月 20 日獲發環境許可證（EP-433/2011）。
- *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（中華電力有限公司）*（AEP 267/2007）。於 2007 年 3 月 29 日獲發環境許可證（EP-267/2007）。
- *VSNL 亞洲區內海底通訊電纜-深水灣段（Videsh Sanchar Nigam Ltd.）*（AEP-294/2007）。於 2007 年 11 月 23 日獲發環境許可證（EP-294/2007）。
- *馬鞍山至白石角 132kV 電纜電路（中華電力有限公司）*。於 2007 年按照前濱及海床（填海工程）條例》於憲報公佈。
- *黃竹坑─春坎角 132kV 電路之 132kV 海底電纜敷設工程（香港電燈有限公司）*。於 2002 年 4 月 16 日獲發環境許可證（EP-132/2002）。
- *FLAG 北亞光纖環系統*（AEP 052/2001）。於 2001 年 6 月 18 日獲發環境許可證（EP-099/2001）。
- *香港新電訊有限公司：本地通訊電纜（香港新電訊有限公司）*（AEP-086/2000）。於 2001 年 2 月 16 日獲發環境許可證（EP-086/2000）。
- *C2C 通訊電纜網絡─香港段：春坎角（GB21〔香港〕有限公司）*（AEP-087/2000）。於 2000 年 2 月 16 日獲發環境許可證（EP-087/2000）。
- *東亞海底通訊電纜系統（將軍澳）（亞洲環球電訊）*（AEP-081/2000）。於 2000 年 10 月 4 日獲發環境許可證（EP-081/2000）。
- *東亞海底通訊電纜系統（將軍澳）（亞洲環球電訊）*（AEP-079/2000）。於 2000 年 9 月 6 日獲發環境許可證（EP-079/2000）。
- *亞太 2 號(APCN2)海底光纜系統塘福登陸段光纜鋪設工程（EGS）*。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 段約第 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）。
- *大網仔至橋咀之 11 千伏電纜電路（中華電力有限公司）*。於 2004 年按照前濱及海床（填海工程）條例》於憲報公佈。
- *龍鼓灘至蛇口海底電纜系統（中華電力有限公司）*。於 2005 年按照前濱及海床（填海工程）條例》於憲報公佈。

在電纜走廊的大部份段落，都會由一艘裝有沖噴機的鋪纜躉船進行電纜鋪設工作。兩條海底電纜會以沖噴機逐一鋪設。沖噴機會噴出水柱來液化海床上的沉積物，藉此讓沖噴機把電纜安全和準確地插入至所需的掩埋深度。纜槽的大部

份空間都會由鋪設電纜時受滋擾的沉積物充填，其餘的空間則會透過自然沉積被充填。在鋪設電纜時，海床上的沉積會受滋擾，而且有一小部份會懸浮在貼近沖噴機四周的水體底部。這小量懸浮沉積物會被潮水以平流傳送的方式，帶離電纜走廊。

近岸的一段纜槽因為水淺的關係，會用抓斗挖泥船挖掘，再在鋪設好電纜後，以挖出的物料回填，藉此掩埋電纜。

計算沉積物的漂移

沉積物成為懸浮狀態的速度是按以下方法計算：

釋放速度 = 受滋擾沉積物的橫剖面面積 x 電纜鋪設機的速度 x 沉積物的乾密度 x 流失百分比

滋擾的深度 = 5 米（即在最壞情況下電纜的掩埋深度）

滋擾的闊度 = 每條電纜 2 米（海床受滋擾的闊度）

最大橫剖面面積 = 每條電纜 5 平方米（由沖噴機形成的 V 型纜槽）

流失率 = 20%（大部份沉積物未受滋擾）

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（香港沉積物的典型密度）

釋放速度 = 每秒 13.2 公斤

在鋪設電纜期間，海床的沉積會在水體的低部被釋放，因而令局部的懸浮沉積物濃度偏高，而沉澱速度也偏高。這是因為，在一個非常局部範圍的高濃度懸浮沉積物，會傾向於結聚成較大的沉積物顆粒（即絮凝過程）。它們會比單獨的沉積物顆粒有更高的沉澱速度。

根據過去海底電纜鋪設工程的經驗，預計無論水深多少，懸浮沉積物都會保持在海床上方 1 米的範圍內。雖然因為有海底摩擦力等效應，接近海床的水流速度會比接近水面的低。此外，該區的水流速度通常都十分低（低於每秒 0.3 米）[(1)]。是次評估假設水流速度為每秒 0.3 米。這是電纜工程區一帶的海面水流速度估計上限，是一個極之謹慎的數值。預料沉積物初時會沿著電纜走線的中心線擴散最多 6 米。這是縱軸方向的沉積物捲流。懸浮固體大多會在電纜鋪設工程四周形成。然而，是次評估謹慎地假設有一股側向洋流把沉積物帶向水質敏感受體，藉此評估有關的潛在影響。

根據上述情況，並假設同時出現最壞的情形，即沉積物在開始時沿著最初的擴散範圍在水體最底的 1 米處均勻地混合，這樣，懸浮沉積物的起始濃度便可計算如下：

起始濃度 = 釋出速度 ／ （水流速度 x 沉積物高度 x 沉積物闊度）

(1) 潮汐地圖冊 (2006)。香港特別行政區海事處海道測量部。

釋放速度 = 每秒 13.2 公斤

水流速度 = 每秒 0.3 米

沉積物高度 = 1 米

沉積物闊度 = 6 米

起始濃度 = 每秒 7.33 公斤

一般而言，確定懸浮固體沉澱速度的方法，是檢視懸浮固體的起始濃度和受滋擾沉積物的內聚性質之間的關係。在香港的典型情況是：當懸浮固體濃度增加時，沉澱速度也會增加，因為沉積物粒子會發生絮凝而令質量增加從而加速沉澱。然而，若起初濃度超過每立方米 1 公斤時，這種關係便不再成立 [1]。在本工程項目的預測起始濃度超過這個數值的情況下，便採用了每秒 10 毫米這個更為謹慎的沉澱速度。

然而，當沉積物逐漸沉澱於海床時，懸浮沉積物的濃度便會逐漸減少。為了反映濃度逐漸減少的情形，上述的沉澱速度也被降低一半，變作**每秒 5.0 毫米**。這是南丫發電廠擴建部份的輸氣管道鋪設工程環境影響評估[2] 所採用的同樣方法。

這樣，沉積物沉澱至海床所需的時間便等於沉積物的最大高度除幾平均沉澱速度。

沉澱時間 = 1 米 /每秒 0.005 米 **= 200 秒**

沉積物漂移的距離便等於沉澱時間乘以水流速度。

漂移距離 = 200 秒 x 每秒 0.3 米 = 60 米

上述計算結果顯示，在鋪設電纜時受滋擾的沉積物會在電纜走線約 **60 米**的範圍內沉澱至海床。

岸端挖泥工程

由於了哥岩和白沙頭咀兩個岸端地區比較淺水，電纜掩埋工程會在珊瑚區以岩石切削法，在珊瑚區以外以一艘抓斗挖泥船（抓斗的大小約為 3 立方米）在兩個岸端地區挖掘纜槽。然後由潛水員把電纜放置在纜槽內，再用清潔的海沙回填在電纜上。預料在登岸點挖出的物料會比較幼細，而且數量較少（約 800 立方米）。在進行挖掘工程時，一部份幼細沉積物會被揚起，並在附近海域呈懸浮狀態。

是次評估採用了“第十號及第十一號貨櫃碼頭填海及臨濱結構詳細設計”[3] 和評估竹篙灣填海 [1] 時所用的相近方法來預測在挖泥時受滋擾的沉積物在近區的

(1) 水力學研究 (1988)。河口淤泥手冊。

(2) 香港環境資源管理有限公司（1998）為香港電燈有限公司進行的“南丫島擬建之 1,800 兆瓦燃氣發電廠”環境影響評估。

(3) 茂盛顧問（亞洲）有限公司（1995）。《大嶼山港口發展第一階段、第十號及第十一號貨櫃碼頭及後援用地填海及臨濱結構詳細設計－環評最終報告》

變化。這個方法是用一個簡單的模型來計算捲流中央線的懸浮沉積物深度平均濃度；只需要運用模型中的平流－擴散方程式，為一個連續的線性來源求解 [2]。這個模型適合用於計算纜槽挖掘工程所引起的懸浮沉積物濃度，因為這條方程式是按照沉積物來自一條連續的線來計算。這樣計算出的結果，是沉積物在挖泥時變為懸浮物數量的合理近似值。

該條方程式如下：

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

其中：　$C(x)$ = 距離來源 x 處的濃度

q = 沉積物流失率

D = 水深

X = 與來源距離

ω = 擴散速度

上述方程式只適用於 γ 的值（以下列公式計算出）較小，而且 ω/u 的值也較小的情況。

$$\gamma = Wt/D$$

其中　W = 懸浮沉積物的沉澱速度

t = 時間

D = 水深

沉澱速度（W）

在模擬灣仔發展計劃第二期填海工程[3] 施工所造成的沉積物捲流時，假設幼細沉積物的沉澱速度是每秒 **0.0001** 米。這個數值適合作為本工程項目中，已成為懸浮物的幼細挖出物料的沉澱速度。

時間（t）

"t"的值是以潮汐週期（即從退潮轉至漲潮之間的時間）的一半計算。在香港，大潮時退潮階段的最長時間，即從高水位變成低水位的時間，可以長達 **8** 小時。

水深（D）

(1) 香港環境資源管理顧問有限公司（2000）。《北大嶼山竹篙灣國際主題公園及有關主要基礎設施建造工程-環境影響評估》

(2) R E Wilson. "懸浮沉積物捲流的濃度和空間延展估計模型"《河口及海岸科學》（1979 年）第 9 期第 65-78 頁。

(3) 茂盛工程顧問（亞洲）有限公司（2001）。《灣仔發展計劃第 II 期綜合可行性研究之環境影響評估研究報告》

在淺水區（少於海圖深度基準面以下 3 米）的底層是由岩石、碎石和沙組成；而在深水區（海圖深度基準面以下 5 米）則變為較多泥。因此，沿著挖泥工程時沉積物擴散方向的具代表性水深大約是 **5** 米。

擴散速度（ω）

是次評估假設擴散速度為**每秒 0.01** 米。這個數值是在先前香港電燈有限公司在深水灣鋪設 132 千伏電纜時，以及在竹篙灣發展項目 (1)的填海工程中，進行有關近區沉積物捲流的研究所採用的數值。擴散速度代表著中軸線上的沉積物濃度因為橫向散佈而減少的速度。

所以，根據以上資料計算，γ 的值是 0.58，屬於細小。另外，按審慎原則，假設電纜走線附近的水流速度會高達每秒 1.5 米。這樣， ω/u 的值便是 0.007，也屬細小。因此，上述方程式適合本工程項目採用。

沉積物流失率（q）

幼細沉積物成為懸浮物的流失率是根據工程施工的速度和方法計算。纜槽的挖掘工作，會由一艘抓斗挖泥船負責，並以每日最多挖掘 300 立方米的速度，在每個登岸地點每天進行 10 個小時。在評估奇力灘建造浮筒而進行挖泥工程(2) 的影響時，確定了抓斗挖泥船在沒有顯著碎物的地區工作的具代表性沉積物流失率，是每挖掘一立方米流失 17 公斤。然而，這個數值是在挖掘多泥沉積物的情況下確定的，其中的幼細沉積物含量可能超過 80%。因此，抓斗挖泥作業所導致的流失率是**每秒 0.142** 公斤。

距離來源 x 處的濃度（C(x)）

運用上述方程式進行的評估結果均列於以下的*表 A6*。

表 A6　　在岸端挖泥導致的懸浮沉積物預測升幅

與來源距離	了哥岩和白沙頭咀均適用（抓斗挖泥）
	濃度（每公升毫克量）
10	160
20	80
40	40
80	20
100	16
200	8
300	5
400	4
500	3
1000	1
2000	1

(1)　香港環境資源管理顧問有限公司 (2000)。同上。

(2)　香港環境資源管理顧問有限公司 (1997)。"在奇力灘挖泥以重設六個政府繫船浮筒"環境影響評估。

中電已建議在挖泥船四周裝設隔泥幕，藉以減少漂離挖泥作業區的沉積物數量。在灣仔發展計劃第二期填海工程的環評中[(1)] 顯示，裝設隔泥幕可以把懸浮固體的擴散程度減少 4 倍。有關裝設隔泥幕之後的懸浮固體濃度，請參閱*表 A7*。

表 A7 *在裝設隔泥幕後岸端挖泥工程導致的懸浮沉積物預測升幅*

與來源距離（米）	了哥岩和白沙頭咀均適用（抓斗挖泥）
	濃度（每公升毫克量）
10	40
20	20
40	10
80	5
100	4
200	2
300	1
400	1
500	1
1000	0
2000	0

註：
根據在環保署監測站 MM2 和 MM7 所收集到的數據計算，該兩個站在 2005 - 2010 年期間的深度平均值分別為每公升 2.7 毫克和 2.0 毫克。

根據上表所列的結果顯示，挖泥作業導致懸浮固體增加的情形，只在局部地方發生。應該指出的是，岩石切割亦只會產生最小和局部的水質影響。

A1.4.2 *識別潛在影響*

下文闡述了本工程項目對海洋水域可能造成的直接或間接影響：

懸浮固體增加

電纜鋪設工程會在電纜鋪設機四周形成一個高濃度的沉積物懸浮區，區內的沉積物會貼近海床，而且會迅速沉澱。是次評估分析了幼細懸浮沉積物的可能漂移情況，並判斷懸浮沉積物的最大漂移距離是 60 米。一般意見認為，這個距離很小，而且是往離開敏感受體的方向漂移。受電纜鋪設工程滋擾的沉積物會在一段十分短的時間內在局部地區保持懸浮狀態，因此預計不會對水質造成不良影響。

在岸端進行電纜鋪設工程的挖泥工程時，會把懸浮固體釋放至附近水體，而且在回填時也會如此，但程度較輕。根據對可能漂移情況和濃度的分析結果，預測在裝設隔泥幕後，只會在岸端挖泥作業的 100 米範圍內，濃度才會增加至超過每公升 3 毫克。挖泥工程對水質可能造成的影響會為時短暫，而且濃度較低。

預測在最近的水質敏感受體牛屎湖灣（距離了哥岩登岸地點超過 250 米）的懸浮固體濃度，只會有相對較小的增加（小於每公升 2 毫克）。青洲與電纜走線的距離約為 220 米，但與了哥岩和白沙頭咀登岸地點則分別距離約 400 米和 520

(1) 茂盛工程顧問（亞洲）有限公司 (1995)。同上。

米。預計在其他水質敏感受體的懸浮固體濃度會更低，以致屬微不足道的水平。挖泥工程對水質可能造成的影響會為時短暫，而且懸浮固體的濃度屬微不足道，亦符合水質指標。

比較而言，在挖泥時沒有裝設隔泥幕的情況下，懸浮固體濃度增加至超過每公升 3 毫克的地方，會擴展至距離了哥岩和白沙頭咀岸端工程區 500 米的範圍內。由此可見，在挖泥區四周裝設隔泥幕能夠有效地把懸浮固體的濃度，減少至更環保的水平，並能盡量縮小沉積物捲流擴散的範圍。

根據上述結果，預計懸浮固體濃度的上升，不會對距離遙遠的水質敏感受體造成不可接受的影響。

A1.4.3 運營階段

應予注意的是，在採用電纜掩埋機來鋪設電纜後，本工程項目便不會對海底沉積物造成任何長遠的干擾，亦不會防礙水流。在進行海事工程的時候或完工之後，都不會對水質造成任何不良影響。電纜的運營不會對四周海域排放任可污染物。雖然在使用電纜掩埋機鋪設電纜時，會令海底的沉積物出現小規模的暫時移位，但在電纜完成鋪設後，海底沉積物便會自然地重新沉澱。

故此，在電纜系統的運營階段無需實施任何緩解措施。

A1.5 在鋪設電纜時的緩解措施

在鋪設電纜期間，會進行下列事項：

- 雖然在進行抓斗挖泥時只會有小量沉積物流失，承建商仍會在挖泥船四周裝設隔泥幕，以減少沉積物從登岸地點擴散（有關的設計示意圖，請參閱*圖 A3*）。
- 必須使用閉合式抓斗挖泥船，以免懸浮固體擴散至海中。
- 運送被挖出物料的所有躉船，都必須安裝船底密封裝置，以防止在裝載和運送物料時出現滲漏。
- 所有躉船都應該裝載至適當水平，以確保在裝載和運送物料時，不會有物料溢出，並應保持有足夠的干舷，以確保甲板不會受到海浪沖洗。
- 沖噴機的前進速度應該限制在最高每小時 80 米，而且須於正常工作時段（上午七時至下午七時）作業。

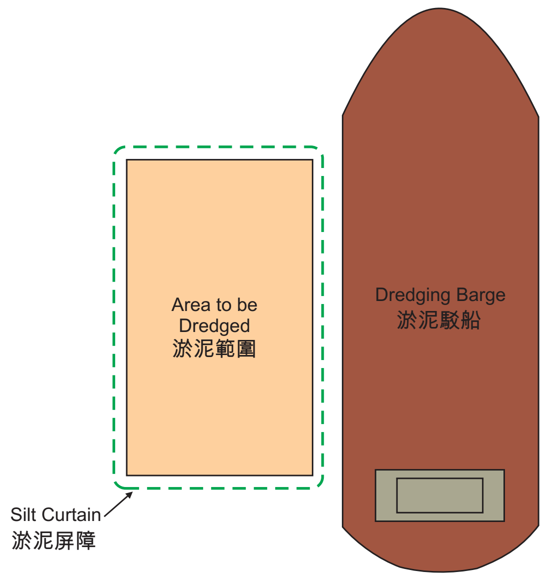
除了上述各項外，承建商還會進行水質監察，藉以核實有關登岸地點挖泥時沉積物捲流擴散情況的預測。

A1.6 總結

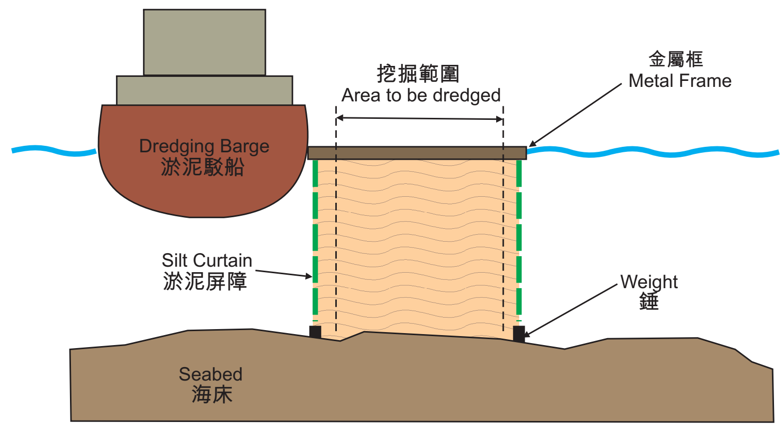
是次研究對了哥岩和白沙頭咀兩個岸端進行的挖泥工程，以及沿著建議電纜走線進行的電纜鋪設工程可能造成的沉積物擴散影響，進行了檢討和評估。

此外，亦找出了各個水質敏感受體。它們大都位於距離擬議電纜鋪設路線最少 220 米的地方。有關沉積物從施工區漂移的距離計算顯示，在鋪設電纜時受滋擾

的沉積物會在電纜走線 60 米的範圍內，重新沉澱至海床。有關沉積物捲流擴散的計算結果顯示，若能在抓斗挖泥船四周採用隔泥幕，則在岸端地區進行的抓斗挖泥工程，只會令最接近的水質敏感受體處的懸浮固體增加少於每公升 3 毫克。由此可見，隔泥幕能有效地減少沉積物擴散的範圍。由於大部份水質敏感受體都距離電纜鋪設工程和挖泥工程很遠，而且工程為時較短，因此，這些受體不會受到評估區內的水質變化影響，而且會符合水質指標。



(a) Cage Type Silt Curtain Arrangement for Grab Dredging
登岸地點的淤泥屏障布置



(b) Cross-secton of Cage Type Silt Curtain Arrangment
淤泥屏障布置的橫切面

Figure A3
圖 A3

Indicative Arrangement of Cage Type Silt Curtain
淤泥屏障的布置示意圖

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Environmental
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附件B

海洋生態評估

附件 B1

海洋生態評估

B1 海洋生態評估

B1.1 引言

本附件闡述在擬議海底電纜走線及登岸點附近的海洋生態資源的基線情況，以及電纜系統在施工和運營期間的潛在生態影響評估結果。對於擬建電纜系統附近各項生態元素的基線情況所作出的評估，均參考了相關的文獻資料，以及近期為是次評估而進行的實地考察結果。同時，亦對各項已知不良影響建議適當的緩解措施。

B1.2 相關的法例、指引和評估準則

評估海洋生態影響的準則均於《環評技術備忘錄》的*附件 16* 中闡述。該附件說明了在評估工程項目或建議對海洋生態資源可能造成的影響時所應採用的一般取向和方法，務求評估工作能夠完整和客觀地識別、預測和評價有關的影響。《環評技術備忘錄》的附件 8 推薦了一些可以用來評估這些影響的準則。

B1.3 文獻檢閱

本附件的海洋生態資源基線情況都是根據文獻檢閱的結果；其中包括下列各種政府和私營機構的報告，以及各種獨立出版和政府出版的文獻：

- CityU Professional Services Limited (2002) *Consultancy Study on Marine Benthic Communities in Hong Kong*. Final Report to Agriculture, Fisheries and Conservation Department.
〔城大專業顧問有限公司（2002）：《香港海洋底棲生物群落顧問研究》。提交予漁農自然護理署的最後報告。〕

- Shin PKS and Cheung SG (2005) *A Study of Soft Shore Habitats in Hong Kong for Conservation and Education Purposes* (Final Report) ECF Project 23/99 City University of Hong Kong.
〔《香港軟灘棲地保育及教育研究》（最後報告）；環境及自然保育基金項目 23/99 號，香港城市大學。〕

- Morton B and Morton J (1983) The Sea Shore Ecology of Hong Kong. HKU Press.
〔《香港海岸生態環境》。香港大學出版社。〕

- Morton B, Williams G and Lee SY (1996) The benthic marine ecology of Hong Kong: A dwindling heritage? In *Coastal Infrastructure Development in Hong Kong: A Review*. Hong Kong Government Press, Hong Kong. pp. 233-267.
〔“香港底棲海洋生態環境：萎縮中的遺產？”收錄於《香港海岸基礎設施發展回顧》。香港政府印務局於香港出版。第 233-267 頁。〕

- Morton B (2003) Marine Protected Areas in Hong Kong: Progress towards Coastal Zone Management (1977-2002) In *Perspectives on Marine*

Environmental Change in Hong Kong and Southern China 1997-2001 (ed. B Morton), Hong Kong 2001, HKU Press, pp. 797-824.
〔"香港海洋保護區：海岸管理的進展（1977-2002）"，收錄於《1997-2001 年間香港及華南地區的海洋環境變化探視》（B Morton 主編），2001 年由香港大學出版社於香港出版，第 797-824 頁。〕

- DeVantier L and McCorry D (2002) Corals and Coral Communities of Hong Kong. Ecological Values and Status 2001-02. Underwater Survey in Coastal Waters of Hong Kong. Final Report to Agriculture, Fisheries and Conservation Department.
〔"香港的珊瑚及珊瑚群落－生態價值及 2001-02 年狀況"《香港近岸水域之水下調查》，提交予漁農自然護理署的最後報告。〕

檢閱文獻的目的，是要獲取足夠數據，以便準確預測本工程項目對生態資源和所有具保育價值的地區／生境可能造成的影響。

B1.3.1 *印洲塘海岸公園*

印洲塘海岸公園（荔枝窩部份）位於擬議電纜鋪設路線的 500 米範圍內。這部份海岸公園的設立，旨在保護各種海洋生物，以及各種具生態價值的生境，包括距離擬議電纜登岸地點或電纜走線超過 1.5 公里的荔枝窩海草。

B1.3.2 *潮下軟底生物群落*

有關擬議電纜走廊附近的潮下軟底生物群落的資料，可以參閱《香港海洋底棲生物群落顧問研究》(1)。印洲塘採樣站（110 號站）與擬議工程區很接近，因此，從該處取得的數據能夠代表擬議電纜走廊內的生物群落。

根據該項顧問研究的結果，兩個採樣站所在的地層，都覆蓋了十分幼細的沙及／或粉土。那裏的底棲生物群落是香港海域的典型生物群落，與香港大部份潮下生境的底棲生物群落相似。無論是在夏季或冬季的調查，印洲塘（110 號站）都只有很少的生物種類、個體數量和生物量；其中，在夏季的物種是每 0.5 平方米 2 個、個體是每平方米 16 個、生物量是每平方米 0.16 克；而在冬季，每平方米有物種 5 個、個體 24 個和生物量 0.24 克，相對於全港底棲生物群落的平均值為每 0.5 平方米有物種 34 個、每平方米有個體 450 個和生物量 28 克。無論是在夏季還是冬季的調查，數目最多的物種是多毛目環節動物花岡鈎毛蟲（*Sigambra hanaokai*）。在夏季的其他物種包括雙殼類動物厚異籃蛤（*Anisocorbula crassa*）；而在冬季則有多毛目環節動物 *Otopsis* sp., *Paraprionospio pinnata* 和 *Prionospio* sp.，以及帚虫 *Phoronis australis*。

在物種多樣性方面，無論是在夏季還是冬季，這裏的物種都比其他調查區少（少於 2）。在兩個季節中，擬議電纜走廊的兩個採樣站都沒有具保育價值的物種。

B1.3.3 *了哥岩和白沙頭咀的海洋生態狀況*

在檢閱有關文獻後，發現有關研究區內海洋生態資源的資料很有限，特別是有關了哥岩和白沙頭咀的海洋生態資料。

(1) 城大專業顧問有限公司（2002）：《香港海洋底棲生物群落顧問研究》（合約編號 CE 69/2000）。提交予漁農自然護理署的最後報告。

為了填補基線海洋生態狀況在這方面的資料缺乏，是次研究在研究區內進行了定量的潮間和潮下潛水調查。

B1.4 *潮間帶基線調查*

潮間帶海洋生態調查旨在收集研究區內海洋生態資源的基線資料。在兩個登岸地點的潮間帶海岸的實地調查是在 2010 年進行，其後於 2012 年再進行了數次更新研究區內海洋生態資源的基線調查。

B1.4.1 *調查方法*

調查採用了定量和定性結合的方法。在定性調查方面，是分別在三個海岸高度，即在海圖深度基準面以上 2 米（高岸區）、1.5 米（中岸區）和 1 米（低岸區）的地方，對各種潮間生境進行目視勘測，並記錄所發現的物種。除了記錄所見到的生物種類外，還會記錄其相對豐富程度。

在定量樣線調查方面，兩個調查地點的海岸上，都分別在三個海岸高度，即在海圖深度基準面以上 2 米（高岸區）、1.5 米（中岸區）和 1 米（低岸區）的地方，劃定三條長 50 米的水平樣線（T1 - T3 和 T4 - T6），以便進行調查。然後在每條樣線上，隨機地指定五個樣方（50 厘米 x 50 厘米），並評估其中的植物和動物的數量和多樣性（Σn = 5 個樣方 x 3 條樣線 x 3 個高度 = 90）。在白沙頭咀的沙質海岸上（T4 和 T5），研究人員對該處的沉積物（每個樣方的體積 = 50 厘米 x 50 厘米 x 20 厘米 = 62,500 立方厘米）進行了原地濕篩（篩眼為 2 毫米），以獲取在每個樣方的沉積物中（或之上）生活的所有流動生物。

在每個樣方內的所有生物都加以識別，並記錄其盡可能低的分類層級，以便計算每個樣方的密度。在每個樣方內的固著類生物，例如藻類（硬皮的、葉狀的和細絲狀的）、藤壺和蠔等也加以識別，並以雙排的 50 厘米 x 50 厘米樣方來估計牠們在石面的覆蓋百分比。

B1.4.2 *潮間軟底和硬底生物群落*

在文獻檢閱中，並沒有發現有關擬議電纜登岸地點附近的沙質和石質海岸的潮間帶生物群落的資料。

下文所述，為本項目進行的基線情況實地調查的結果。*表 B1* 至 *B4* 列出了在了哥岩和白沙頭咀進行的定性抽查所發現的生物及其相對豐富程度，以及定量樣線調查的結果。在了哥岩和白沙頭咀進行的潮間生境調查所拍攝的具代表性照片，則展示於*圖 B1*。

了哥岩

了哥岩的調查地點是一個狹長而坡度平緩的礫石海岸（或稱作卵石海灘），岸上的物種數量偏低。在調查期間共記錄到 21 種潮間生物。牠們全都是香港礫石海岸十分常見，而且分佈很廣的種類。

在數量上，該區主要的生物包括在高岸區的玉黍螺（*Echinolittorina radiata*）和顆粒玉黍螺（*E. malaccana*）；在中岸區屬馬蹄螺類的單齒螺（*Monodonta labio*）和牡蠣類的僧帽牡蠣（*Saccostrea cucullata*），以及在低岸區屬蠑螺類的珠螺（*Lunella coronata*）和蜒螺類的漁舟蜑螺（*Nerita albicilla*）（見*表 B1* 和 *B2*）。

流動物種的數量和種類，以及固著動物的覆蓋百分比都屬偏低（分別為每平方米 49 個和每平方米 32.5%）。

表 B1　　在了哥岩記錄到的潮間生物群的相對豐富程度

組別	物種	相對豐富程度 高岸區	中岸區	低岸區
雙殼貝	*Isognomon* sp.	0	1	0
雙殼貝	*Septifer virgatus*	0	0	1
石鱉	*Acanthopleura japonica*	0	1	0
帽貝	*Patelloida pygmaea*	0	1	1
帽貝	*Nipponacmea concinna*	0	0	1
螺	*Clypeomorus batillariaeformis*	0	1	1
螺	*Echinolittorina malaccana*	3	0	0
螺	*Echinolittorina radiata*	3	0	0
螺	*Lunella coronata*	0	1	3
螺	*Monodonta labio*	1	2	2
螺	*Morula musiva*	0	1	2
螺	*Nerita albicilla*	1	1	2
螺	*Planaxis sulcatus*	0	1	0
蟹	*Gaetice depressus*	1	1	2
蟹	*Epixanthus frontalis*	0	0	1
蟹	*Metapograpsus frontalis*	0	0	1
海蟑螂	*Ligia exotica*	2	1	0
藤壺（%）	*Capitulum mitella*	0	1	0
藤壺（%）	*Tetraclita* spp.	0	1	0
牡蠣（%）	*Saccostrea cucullata*	0	3	2
藻類（%）	珊瑚藻	0	0	1
藻類（%）	*Kyrtuthrix maculans*	2	1	0

物種的相對豐富程度： 0 = 不存在； 1 = 在樣線內不常見； 2 = 在樣線內常見； 3 = 在樣線內十分常見

表 B2　　實地調查時在了哥岩的 T1 至 T3 樣線錄得之潮間動物平均密度（每平方米）以及固著動物和植物平均覆蓋率（%）

組別	物種	相對豐富程度 T1 H	 M	 L	 T2 H	 M	 L	 T3 H	 M	 L
石鱉	*Acanthopleura japonica*	0	0	0	0	0.8	0	0	0	0
帽貝	*Patelloida pygmaea*	0	0	0	0	0	1.6	0	1.6	4.8
螺	*Clypeomorus batillariaeformis*	0	0	0	0	0	3.2	0	8	12.8
螺	*Echinolittorina malaccana*	35.2	0	0	37.6	0	0	0	0	0
螺	*Echinolittorina radiata*	25.6	0	0	37.6	0	0	0	0	0
螺	*Lunella coronata*	0	0	0	0	1.6	16.8	0	6.4	42.4
螺	*Monodonta labio*	0.8	16	20	0	2.4	7.2	0.8	11.2	32
螺	*Morula musiva*	0	0	0	0	0	8.8	0	0.8	3.2
螺	*Nerita albicilla*	0.8	11.2	15.2	0.8	4	2.4	0	12.8	16
螺	*Planaxis sulcatus*	0	1.6	1.6	0	4	0	0	0.8	0
雙殼貝	*Septifer virgatus*	0	0	0	0	0	0.8	0	0	0
蟹	*Hemigrapsus*	0.8	0	0	0	0.8	1.6	0	1.6	4

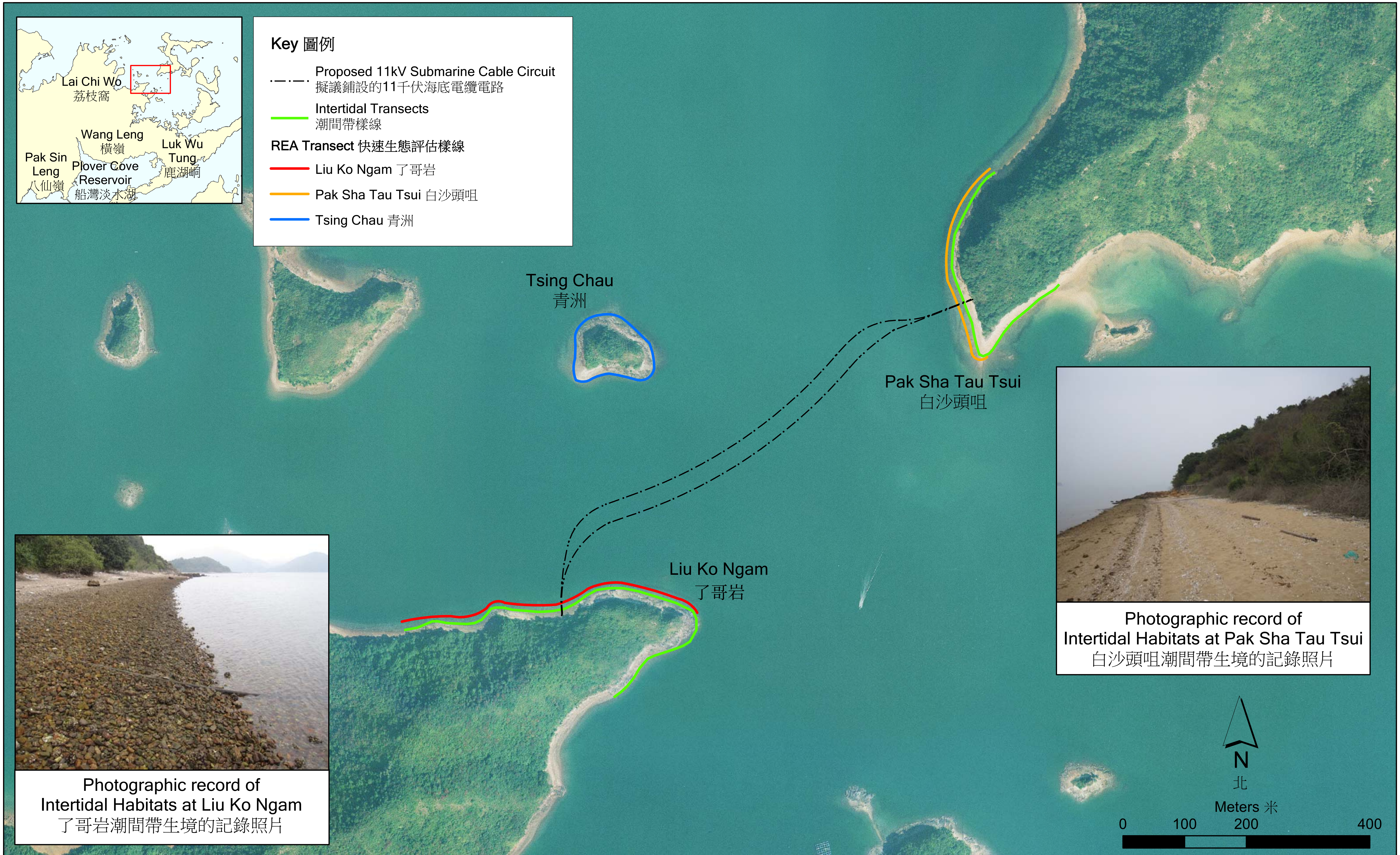

Figure B1
圖B1

Intertidal and Dive Survey Sites

潮間帶及潛水調查地點

File: T:\GIS\CONTRACT\0114462\mxd\0114462_dive survey area_Proposed11kV.mxd
Date: 30-Oct-2012

Environmental Resources Management

ERM

組別	物種	相對豐富程度								
		T1			T2			T3		
		H	M	L	H	M	L	H	M	L
	sanguineus									
蟹	*Metapograpsus frontalis*	0	0	0	0	0	0.8	0	0	0.8
藤壺（%）	*Tetraclita spp.*	0	0.8	0	0	0	0	0	0	0
牡蠣（%）	*Saccostrea cucullata*	0	9.6	16.8	0	60	80	0	64	0.8
藻類（%）	*Kyrtuthrix maculans*	36	16	16	8	32	0	16	0	0
藻類（%）	珊瑚藻	0	0	0	0	0	2.4	0	0	0

白沙頭咀

白沙頭咀的調查地點是位於吉澳島西南角的坡度頗陡的狹長沙質海岸，以及其北面的礫石海岸。這裏的潮間生境物種類別較少。在調查期間共記錄到 21 種潮間生物。牠們全都是香港的沙質和礫石海岸十分常見，而且分佈很廣的種類。

在沙質海岸上（即 T4 和 T5），雙殼貝類的尖峰蛤（*Atactodea striata*）是在調查期間記錄到的最主要（數目上）底內動物。在白沙頭咀礫石海岸的中岸區以平軸螺類的芝蔴螺（*Planaxis sulcatus*）和牡蠣類的僧帽牡蠣（*Saccostrea cucullata*）為主；而低岸區則以蠑螺類的珠螺（*Lunella coronata*）為主（*表 4.3* 和 *4.4*）。該區的沙質和礫石海岸上的流動物種的數量和種類，以及固著動物的覆蓋百分比都屬偏低（分別是沙質海岸：每立方米 29.3 個；礫石海岸：28.5 個和每平方米 32.3%）。

表 B3　　在白沙頭咀錄得的潮間生物群的相對豐富程度

組別	物種	相對豐富程度		
		高岸區	中岸區	低岸區
雙殼貝	*Atactodea striata*	1	2	2
雙殼貝	*Donax* sp.	0	1	0
雙殼貝	*Septifer virgatus*	1	0	0
帽貝	*Patelloida pygmaea*	0	1	1
帽貝	*Siphonaria japonica*	0	1	0
螺	*Clypeomorus batillariaeformis*	1	1	1
螺	*Echinolittorina malaccana*	1	0	0
螺	*Echinolittorina radiata*	1	0	0
螺	*Lunella coronata*	0	1	2
螺	*Morula musiva*	0	1	1
螺	*Nerita albicilla*	0	1	1
螺	*Planaxis sulcatus*	0	2	1
蟹	*Gaetice depressus*	0	0	2
蟹	*Ocypode* sp.	1	0	0
海蟑螂	*Ligia exotica*	1	0	0
海葵	*Anthopleura* sp.	0	1	2
藤壺（%）	*Balanus amphitrite*	1	0	0
藤壺（%）	*Tetraclita spp.*	1	0	0
牡蠣（%）	*Saccostrea cucullata*	0	3	3
藻類（%）	珊瑚藻	0	0	1
藻類（%）	*Hildenbrandia rubra*	0	0	1

物種的相對豐富程度： 0 = 沒有； 1 = 在樣線內不常見； 2 = 在樣線內常見； 3 = 在樣線內十分常見

表 B4 *實地調查時在白沙頭咀的 T4 至 T5 樣線錄得之潮間動物平均密度（T4 和 T5 是每立方米，而 T6 是每平方米）以及固著動物和植物平均覆蓋率（%）*

		相對豐富程度								
		T4			T5			T6		
組別	物種	H	M	L	H	M	L	H	M	L
帽貝	*Patelloida pygmaea*	0	0	0	0	0	0	0	2.4	1.6
帽貝	*Siphonaria japonica*	0	0	0	0	0	0	0	2.4	0
螺	*Echinolittorina malaccana*	0	0	0	0	0	0	0.8	0	0
螺	*Echinolittorina radiata*	0	0	0	0	0	0	0.8	0	0
螺	*Lunella coronata*	0	0	0	0	0	0	0	11.2	19.2
螺	*Nerita albicilla*	0	0	9.6	0	0	0	0	2.4	0
螺	*Morula musiva*	0	0	0	0	0	0	0	2.4	3.2
螺	*Thais clavigera*	0	0	0	0	0	0	0	0	0
螺	*Planaxis sulcatus*	0	0	0	0	0	0	0	31.2	4.8
螺	*Clypeomorus batillariaeformis*	0	0	0	0	0	0	0	0	0.8
雙殼貝	*Septifer virgatus*	0	0	0	0	0	0	0.8	0	0
雙殼貝	*Atactodea striata*	6.4	86.4	48	0	0	19.2	0	0	0
雙殼貝	*Donax sp.*	0	6.4	0	0	0	0	0	0	0
蟹	*Gaetice depressus*	0	0	0	0	0	0	0	0	1.6
海葵	*Anthopleura sp.*	0	0	0	0	0	0	0	2	9.4
藤壺（%）	*Tetraclita spp.*	0	0	0	0	0	0	0.6	0	0
牡蠣（%）	*Saccostrea cucullata*	0	0	0	0	0	0	0	53	27
藻類（%）	*Hildenbrandia rubra*	0	0	0	0	0	0	0	0	5

B1.4.3 *可能受影響的潮間海岸的生態價值*

在了哥岩和白沙頭咀這兩個擬議電纜登岸地點的潮間海岸區的生物群落，與香港其他有蔭蔽的礫石海岸和沙質海岸的生物成份和數目相差無幾。在該兩處記錄到的物種當中，沒有任何稀有和具保育價值的物種。

B1.5 *潮下帶基線情況潛水調查*

位於吉澳海內的香港著名高生態價值珊瑚區，包括牛屎湖灣（珊瑚覆蓋率約達 59%）和荔枝窩北（珊瑚覆蓋率約達 47.5%），都屬於珊瑚普查地點，而且每年都會進行監察[(1)]（其位置請參閱*圖 A1*）。然而，有關擬議登岸地點和擬議電纜鋪設路線附近的珊瑚群落的資料卻很有限。為了填補這方面的資料空隙，是次研究在研究區內進行了潮下潛水調查。

潮下潛水調查分兩個階段進行。第一階段是快速生態評估。這個階段採用一種半定量的調查方法來評估位於白沙頭和了哥岩的擬議電纜登岸點一帶海岸線的底棲生物群落（*圖 B1*）。此外，亦在擬議電纜走線上，經地球物理調查發現可能有硬質底層的特選地點，進行定性潛水抽樣調查。這些潛在的硬質底層都是可能有珊瑚生長的地區。潛水調查的目的，是要找出登岸點和擬議鋪設的 11 千

(1) http://www.afcd.gov.hk/english/conservation/con_mar/con_mar_cor/con_mar_cor_hkrc/con_mar_cor_hkrc.html

伏海底電纜走線一帶的潮下海洋生態敏感受體，特別是任何珊瑚群落。由此而收集到的資料會被用於調整電纜的登岸位置和走線，務求避開密集的珊瑚區，以減少工作走廊（兩條電纜中心線兩側各闊 2.5 米的地區）內會永久消失的珊瑚。當登岸位置根據第一階段調查的結果完成調整後，接著進行的第二階段調查便會在兩個登岸點的工作走廊內，繪製詳細的珊瑚地圖。在繪製珊瑚地圖時，會盡可能記錄登岸地點的工作走廊內的珊瑚位置，以便了解珊瑚受影響的具體數據，特別是電纜登岸將會造成的直接影響（即令珊瑚永久消失）。此外，亦評估了把珊瑚移植至一個預計不會受到電纜鋪設工程影響的合適地點的可行性。下文所述，是這些潛水調查的方法和詳細結果。

B1.5.1 第一階段－半定量潮下帶潛水調查

第一階段的潮下帶潛水調查，採用了一種標準的半定量快速生態評估調查法，來評估擬議電纜登岸點一帶海岸線的底棲生物群落（圖 B1）。潛水調查的目的，是要收集潮下海洋生態敏感受體的資料，特別是珊瑚群落的資料，以便調整擬議鋪設的 11 千伏海底電纜的登岸位置。有關的調查都是於 2010 年和 2011 年進行。下文所述，是這些調查的方法和結果。

方法

快速生態評估法已經是香港進行環評當中的海洋基線情況調查的一項標準方法。它是根據評估大堡礁的珊瑚群落時所擬訂的標準快速生態評估測量法[(1)]，再按照香港的海洋環境修訂而成 [(2)]。

在每個調查區內的快速生態評估調查，都會沿著一條與海岸線平行，並位於海圖深度基準面以下 0 米至 5 米處的調查樣線進行。這一個深度是大多數硬質珊瑚最常被發現的地區，但偶然會有一些零星的小群珊瑚在更深（超過海圖深度基準面以下 5 米）的地方被發現。快速生態評估方法，是在每條樣線兩側各闊 2 米而形成闊約 4 米的條狀地帶內（會視乎水底的情況調整，因此可能會縮小），評估底棲生物的覆蓋情況（第 I 級）和類別多寡（第 II 級）。這兩個評估類別（級）的內容，均於下文闡述。

<u>第 I 級－底棲生物覆蓋的分類</u>

在完成每條樣線的調查後，便會把五個生態屬性和七個基底屬性列作七個標準排序類別的其中一個（見*表 B5* 和 *B6*）。

表 B5 調查所用的類別－海底屬性

生態	基底
硬珊瑚	硬質基底
已死直立珊瑚	連續覆蓋物
軟珊瑚	基岩
黑珊瑚	碎石
大型藻	沙
坪狀藻	粉土

(1) DeVantier, L.M., G. De'Ath, T.J. Done 和 E. Turak (1998)。"一個複雜天然系統的生態評估：大堡礁的個案研究"，收錄於《生態學應用》第 8 卷，第 480-496 頁。

(2) Fabricius, K.E.和 D. McCorry. (2006)。"香港漁礁的水質梯度上的珊瑚群落和底棲生物覆蓋情況的變化"，收錄於《海洋污染通報》第 52 期第 22-33 頁。

生態	基底
珊瑚藻	大礫石（超過 50 厘米） 小礫石（小於 50 厘米）

表 B6　　調查所用類別－覆蓋百分比之等級序列

等級	覆蓋百分比（%）
0	沒有
1	1-5
2	6-10
3	11-30
4	31-50
5	51-75
6	76-100

第 II 級－界定各種底棲生物群落的種類目錄

進行調查時也會整理出每條樣線內的底棲生物詳細目錄。在發現底棲生物時，會在原地辨別其所屬類別，並須達到下列層級：

- 石珊瑚類的（硬）珊瑚盡可能分類至"種"一級。
- 軟珊瑚、柳珊瑚、海葵和觸目的大型藻等，須按其形態特色加以記錄，並盡可能分類至"屬"一級。
- 其他水底生物（包括海棉、六放珊瑚、海鞘和苔蘚動物）盡可能記錄至"屬"一級或"門"一級再加上生長形態。

在完成每條樣線的調查後，種類目錄內的每個種類都會根據其群落數目多寡來評級（見*表 B7*）。這些評級類別都是按照各個種類的數目多寡來排列，而不是按其覆蓋樣線的海底面積排列。各個評級都是根據主觀的數目評估估，而不是對每個種類的定量點算。

表 B7　　種類數目多寡的等級序列

等級	豐富程度
0	沒有
1	稀少[(a)]
2	不常見
3	常見
4	豐富
5	全面佔優

註：
(a)　這裏的"稀少"是只在樣線中的數目較少，而不是在香港水域的分佈稀少。

此外，亦對每條快速生態評估樣線記錄下列各項環境說明項目：

A.　根據珊瑚群落在三個維度上的增加數量，把牠們分成三個類別：

- 極為零散的珊瑚（覆蓋率少於 1%）並未形成群落，而是在其他水底生物（例如貽貝、蠔、苔蘚動物）之間作為次要組成部份而發展；
- 沒有生物碳酸鹽添附於石、沙或碎石上的珊瑚群落；及

- 有顯著生物基質添附－形成三維結構－但沒有礁坪的珊瑚群落（早期漁礁）。

- 三維結構－但沒有礁坪（早期漁礁）。

B. 受海浪沖刷的程度，分為 1 - 4 級，其中：

1 = 有掩蔽（受地形的高程度保護，免受一般海浪沖擊）；

2 = 半掩蔽（受中等程度保護）；

3 = 半暴露（只有部份受保護）；及

4 = 全暴露（受到一般海浪全力沖擊）。

C. 沉澱於基底上的沉積物（顆粒大小介乎十分幼細至中等粗糙）按 0 - 3 點評分，其中

0 = 沒有沉積物；

1 = 小量（薄層）沉積物沉澱；

2 = 中等數量的沉積物沉澱（厚層），但可以透過撥開沉積物而清理基底；及

3 = 大量沉積物沉澱（厚、深層），而且不可以透過撥開沉積物而清理基底。

在進行快速生態評估調查時，會由一位具有水底識別固著底棲種類的觀察員（珊瑚專家），以水肺潛水方式，從隨意選定的起點開始，沿著海岸的已知部份潛游，進行實地勘察，並記錄有關數據。樣線的方向，會與海岸線大約平行，並按照統一標準的闊度，調查所有樣線內的海床。

在完成每條快速生態評估樣線後，都會核驗所有實地數據；而在每個野外工作天完結時，都會填寫一份潛水調查臨時報表。在完成野外工作後，便會整理每條樣線的照片，並加以檢閱，以及核實快速生態評估的數據。

在完成檢閱所有樣線的照片和核驗所有快速生態評估的數據後，便會把所有數據輸入 Excel 試算表中，並加以儲存。這些數據會分為兩份試算表儲存：

- 有關現場（樣線）的資料（第 I 和第 II 級數據）、深度和環境說明；及

- 每條樣線的物種多寡數據。

對於每條調查過的樣線，都會整理出相關的物種清單、物種數目，以及生態和基底類別的平均值。各級的豐富程度數值也會被轉換成一個覆蓋百分比中間值，以便闡述。

結果

在研究區內的下列調查地點的潮下海底生境，都是採用快速生態評估調查法進行評估（*圖 B1*）：

(a) 了哥岩（LKN 登岸地點）；

(b) 白沙頭（PST 登岸地點）；及

(c) 青洲（TC）。

每個調查地點都會根據快速生態評估調查的結果，若有需要，再細分為不同分區，各有相近的生境特點和物種成份（*圖 B2*）。各個分區／地點所錄得的生態和物理屬性數據，均列於*表 B8* 至 *B10*；而在分區／地點內觀察到的潮下海底生境詳情，則於下文闡述。

表 B8　　　快速生態評估測量樣線內的海床屬性

調查站	生態屬性							物理屬性						
	HC(a)	**DC**	**SC**	**BC**	**TA**	**MA**	**CA**	**BR**	**LB**	**SB**	**RC**	**RBL**	**SN**	**SL**
LKN-1	3	3	0	0	3	0	1	0	2	0	0	2	4	0
LKN-2	3	3	0	0	3	0	1	0	2	3	0	2	3	0
LKN-3	3	3	0	0	2	0	2	0	2	4	3	3	3	0
PST	2	3	0	0	3	0	2	0	2	4	2	3	4	0
TC-1	2	3	0	0	2	0	2	0	2	2	0	0	0	0
TC-2	4	3	0	0	2	0	2	0	2	3	0	2	2	0
TC-3	1	2	0	0	2	0	2	2	0	3	0	2	4	0

註：

(a) 1=覆蓋率少於 5%； 2= 覆蓋率介乎 6-10%； 3 = 覆蓋率介乎 11-30%； 4 = 覆蓋率介乎 31-50%； 5 = 覆蓋率介乎 51-75%； 6 = 覆蓋率介乎 76-100%。

(b) HC = 硬珊瑚； DC = 死珊瑚； SC = 軟珊瑚； BC = 黑珊瑚； TA = 坪狀藻； MA = 大型藻； CA = 珊瑚藻； BR = 基岩； LB = 大礫石； SB = 小礫石； RC = 石塊； RBL = 碎石； SN = 沙； SL = 粉土。

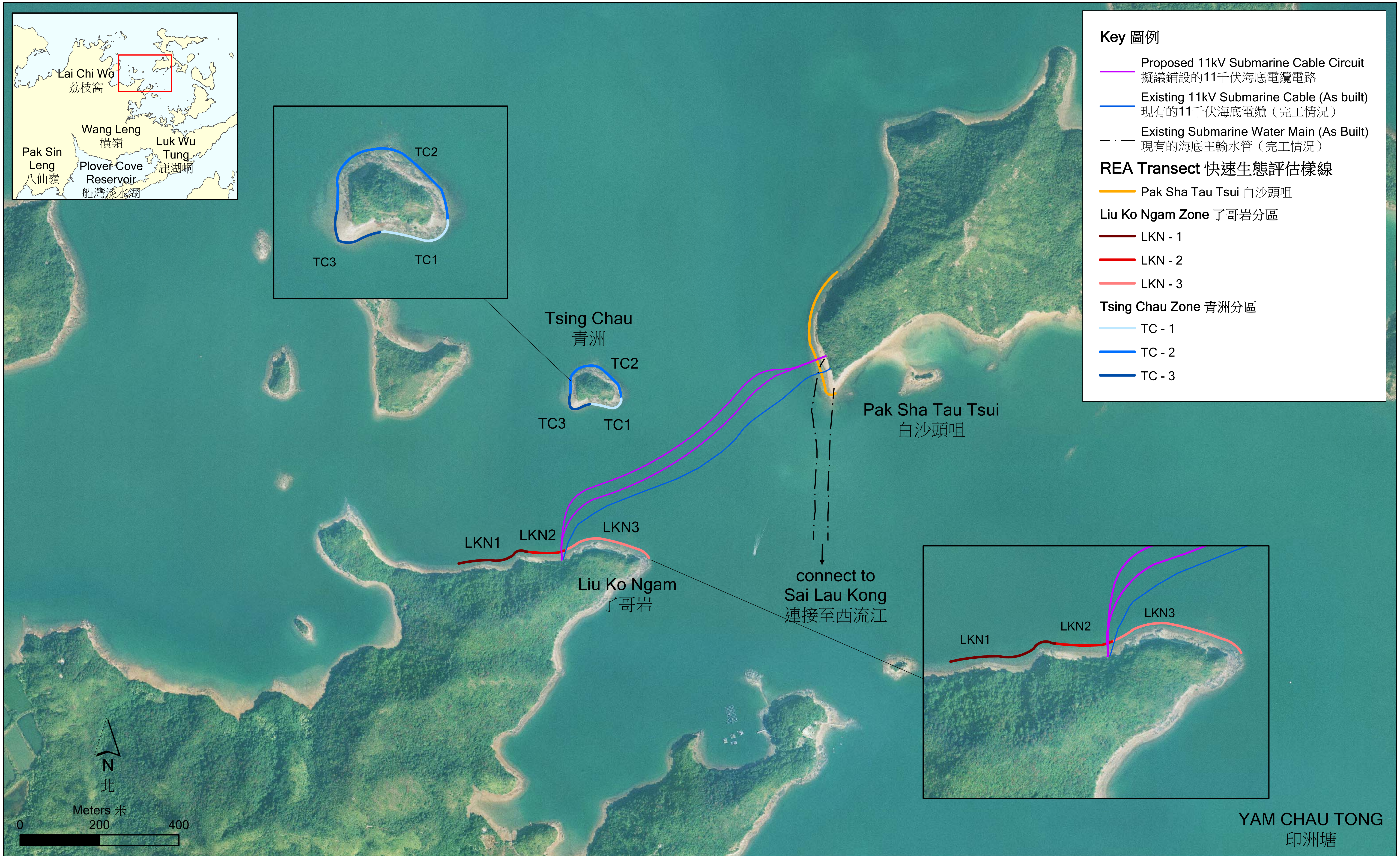

Figure B2
圖B2

REA Survey Findings - Zonation of Dive Survey Sites

快速生態評估調查結果 – 潛水調查地點分區圖

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Date: 30-Oct-2012

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表 B9 在快速生態評估調查中錄得的硬珊瑚種類的相對豐富程度（有關評級的解釋請參閱表 B3）

科	屬	種	LKN-1	LKN-2	LKN-3	PST	TC-1	TC-2	TC-3
Acroporidae	*Acropora*	*tumida*			3	1			
	Acropora	*pruinosa*			3				
Oculinidae	*Galaxea*	*astreata*			2			2	
Agariciidae	*Pavona*	*decussata*		2	4	4		3	
Fungiidae	*Lithophyllon*	*undulatum*	2	3	3	3	2	3	
Pectiniidae	*Echinophyllia*	*aspera*			3	2	2		2
Merulinidae	*Hydnophora*	*exesa*							
Dendrophylliidae	*Turbinaria*	*peltata*			2	1			
Mussidae	*Acanthastrea*	*echinata*			2		3	3	
Faviidae	*Favia*	*favus*		2	2				
	Favia	*rotumana*			3		3	3	
	Favia	*veroni*	3	3	4	3	3	3	
	Favites	*chinensis*	2	2	2				
	Favites	*abdita*	2	2					
	Favites	*acuticollis*						1	
	Goniastrea	*aspera*	2	2	2		3	2	
	Platygyra	*carnosus*	3	3	3	2	2	3	
	Platygyra	*acuta*					3	4	
	Oulastrea	*crispata*							
	Leptastrea	*purpurea*	3	4	4	3	3	3	2
	Cyphastrea	*spp*	3	3	3	2			
Poritidae	*Porites*	*sp*	3	3	3			3	
	Goniopora	*columna*	2	2	2	2	3	3	
	Goniopora	*sp*					2		
	Goniopora	*stutchburyi*							
	Goniopora	*djiboutiensis*						3	
錄得的硬珊瑚種類總數			**10**	**12**	**18**	**10**	**11**	**14**	**2**

表 B10　　在潮下珊瑚調查中錄得的非硬珊瑚種類的相對豐富程度（有關評級的解釋請參閱表 3.3）

門／科	屬	種	LKN-1	LKN-2	LKN-3	PST	TC-1	TC-2	TC-3
Porifera	Sponge		3	3	3	3	2		2
Cnidarian	Sea anemones					3	4	3	
Cnidarian	Zoanthids				3	3	2		
Ascidian	Tunicates					3	2		2
Mollusca	*Saccostrea*	*cucullata*	4	4	4	4	3	3	3
Echinodermata	*Diadema*	*setosum*	4	3	2	3	2	2	2
錄得的珊瑚種類總數（不包括硬珊瑚）			**3**	**3**	**4**	**6**	**6**	**3**	**4**

了哥岩（登岸地點）

了哥岩的潮下海底生境再被細分為三個分區（*圖B2*），而它們的具代表性照片則於*圖B3-5* 展示。一般而，三個分區的海床都主要是由硬質基底組成，其中包括基岩、礫石、石塊和碎石（*表B4*）。三個分區的硬珊瑚覆蓋率是介乎 11 至 30%。三個分區主要是取決於這部份海岸線所記錄到的珊瑚群落中，各不相同的非生物和生物成份

在 LKN-3 共錄得十八（18）種造礁珊瑚，比了哥岩的其他兩個分區所錄得的都多（LKN-1 有 10 種而 LKN-2 有 12 種）。硬珊瑚群落的主要品種是蜂巢珊瑚科（*表B5*）。這個品種是香港東北部海域最經常錄得的珊瑚群落 [1]。以團塊形和亞團塊形生長的大型珊瑚群落在其他三個分區都很多。

在 LKN-2 和 LKN-3 之間的地區，發現有一枝已死的牡丹珊瑚，上面有六放珊瑚和細小的硬珊瑚群落聚集在已死的珊瑚結構上。在 LKN-3 進行快速生態評估調查時發現的 *Acropora tumida*、*A. pruinosa*、*Galaxea astreata* 和 *Acanthastrea echinata*，都屬於在香港不常見的硬珊瑚種類，雖然牠們通常都較多在東北海域被發現[2]。在了哥岩錄得的其他硬珊瑚品種都屬於香港海域常見的類別。

在了哥岩錄得的其他常見潮下品種包括牡蠣類的僧帽牡蠣（*Saccostrea cucullata*）、海膽類的棘冠海膽（*Diadema setosum*）和海棉（*表 3.6*）。所有錄得的種類，都是在香港海域的相似潮下生境中常見和分佈廣泛的類別。

調查結果證實，擬議電纜登岸點所在的 LKN-2 地區內的珊瑚群落，無論在成份和數量上，都與其毗鄰地區（LKN-1 和 LKN-3）相似。因此，縱使把電纜登岸點移至毗鄰地區，對於減少電纜走廊內直接損失的珊瑚，幫助亦很有限。因此，建議為擬議登點繪製一份詳細的珊瑚地圖，以便了解電纜登岸工程造成的珊瑚永久損失的具體數字，並評估以移植珊瑚作為盡量減少影響的緩解措施的可行性和實施範圍。

(1) DeVantier, L 和 D. McCorry (2003)。"香港珊瑚和珊瑚群的生態價值和狀況（2001-02 年）"。《香港近岸海域的水下調查》（標書編號 AFD/SQ/19/01）。

(2) Chan, L.K. Alan 等人 (2005)。《香港石珊瑚圖鑑》。

圖 B3 *在 LKN-1 拍攝的具代表性照片*

與 LKN-2 和 LKN-3 相似，這裏的硬珊瑚群落的主要品種是蜂巢珊瑚科。這個品種是香港東北部海域最經常錄得的珊瑚群落。

圖 B4 *在 LKN-2 拍攝的具代表性照片*

發現一枝已死的牡丹珊瑚，上面有六放珊瑚和細小的硬珊瑚群落聚集在已死的珊瑚結構上。

圖 B5 *在 LKN-3 拍攝的具代表性照片*

在 LKN-3 進行快速生態評估調查時發現的 Acropora tumida、A. pruinosa、Galaxea astreata 和 Acanthastrea echinata，都屬於香港不常見的硬珊瑚種類，雖然牠們通常都較多在東北海域被發現。

註：現有的 11 千伏海底電纜展示於左下角的照片上。應予注意的是，已經有相當數量的珊瑚群落，成功地重新聚集於現有的電纜表面。

白沙頭（登岸地點）

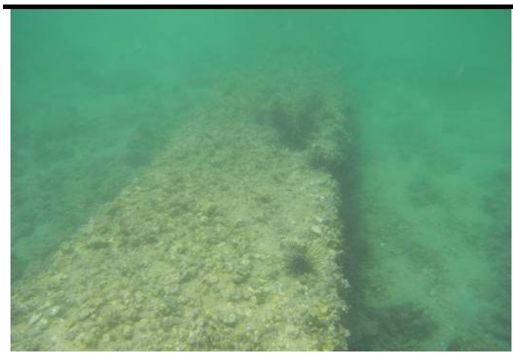
在白沙頭咀拍攝的潮下帶生境具代表性照片均展示於*圖 B6*，而快速生態評估調查的數據則列於*表 B4-6*。白沙頭咀的海床主要是小礫石、碎石和沙（*表 B4*），以及覆蓋率達到 6-10%的硬珊瑚。在進行潛水調查時，發現現有的主輸水管和電纜。這些海底公用設施的兩側都沒有顯著的珊瑚生長（圖 *B6*）。

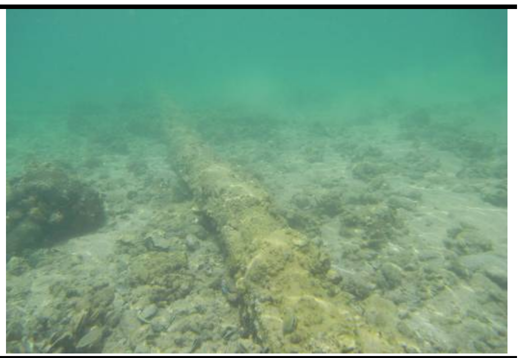
在白沙頭咀共錄得十（10）種造礁硬珊瑚。*Pavona decussata*、*Lithophyllon undulatum*、*Favia veroni* 和 *Lepastrea purpurea* 是這區經常被記錄到的四種硬珊瑚（*表 B5*）。在區內還看見一片已死的牡丹珊瑚，覆蓋範圍廣闊，而且已有較小叢的硬珊瑚群落在其上生長。在白沙頭咀錄得的硬珊瑚當中，除了 *Acropora tumida* 之外，都是香港常見的種類 (1)。*Acropora tumida* 曾被報導為香港不常見的品種，但在東北海域的珊瑚群落中，卻經常被記錄到。

在白沙頭咀錄得的其他常見潮下物種包括牡蠣類的 *Saccostrea cucullata*；海膽類的 *Diadema setosum*；海棉和海葵（*表 B6*）。所有被記錄到的物種，都是在香港海域的相近生境中常見和分佈很廣的類別。

與了哥岩的情形相若，在白沙頭咀調查區內所錄得的硬珊瑚群落都大致相似。因此，若要把電纜登岸點改在附近地區來減少工作走廊內直接損失的珊瑚，減幅將很有限。因此，建議為現時的建議登點繪製一份詳細的珊瑚地圖，以便了解電纜登岸工程可能造成的珊瑚永久損失的具體數字，並研究以移植珊瑚來減少這種影響的可行性和實施範圍。

圖 B6　　在白沙頭拍攝的具代表性照片





(1)　Chan, L.K. Alan 等人 (2005)。*同上*。

白沙頭咀的海床主要是小礫石、碎石和沙，以及覆蓋率達到 6-10%的硬珊瑚。在進行潛水調查時，發現現有的主輸水管和電纜。這些海底公用設施的兩側都沒有顯著的珊瑚生長。

註： 現有的主輸水管展示於左上角的照片上。現有的 11 千伏海底電纜展示於右上角的照片上。

青洲

由於青洲比較接近擬議海底電纜的鋪設路線，可能會是一個海洋生態敏感受體，因此，是次研究也勘察了當地的潮下海底生境。

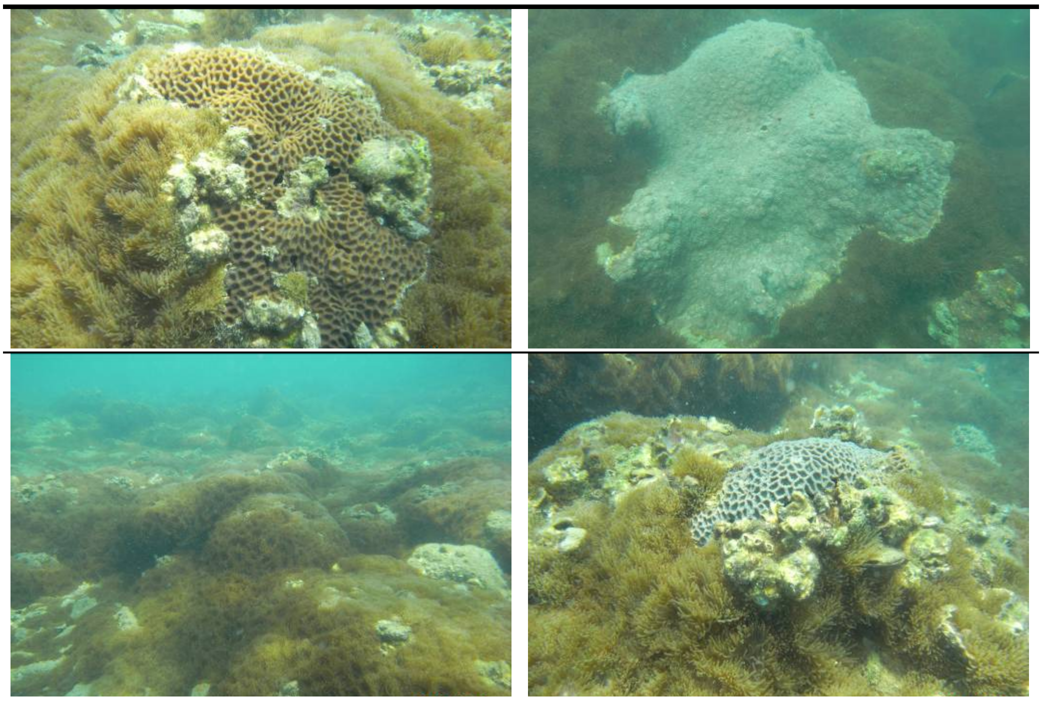
快速生態評估調查的結果顯示，青洲的潮下海底生境可以再細分為三個分區（TC-1、TC-2 和 TC-3；*圖 B2*），而它們的具代表性照片則於*圖 B7-9* 展示。三個分區的海床大致上都屬於石質，其中 TC-3 有較多沙覆蓋（*表 B4*）。TC-2 的硬珊瑚覆蓋率較高，介乎 31 至 50%之間，而 TC-1 和 TC-3 則較低，分別是 6-10%和 1-5%。 在 TC-3 只錄得兩（2）種造礁硬珊瑚，而在 TC-1 和 TC-2 則分別錄得十一（11）種和十四（14）種。這裏的硬珊瑚也是以蜂巢珊瑚科為主（*表 B5*）。值得特別注意的，是在 TC-2 錄得相對較多的大型 *Platygyra* 和 *Goniopora* 群落。在青洲進行快速生態評估調查時發現的 *Galaxea astreata*、*Acanthastrea echinata*、*Favites acuticollis* 和 *Goniopora djiboutiensis*，都屬於香港不常見的硬珊瑚種類，雖然牠們在東北海域都經常被發現[1]。

據報，在青洲錄得的其他珊瑚種類，都是香港海域常見的類別。

至於青洲所錄得的其他常見潮下物種則包括海膽類的棘冠海膽和海葵（*表 B6*）。在 TC-1 所發現的海葵，大都在已死的珊瑚上生長。所錄得的品種，全都是香港海域常見和分佈很廣的類別。

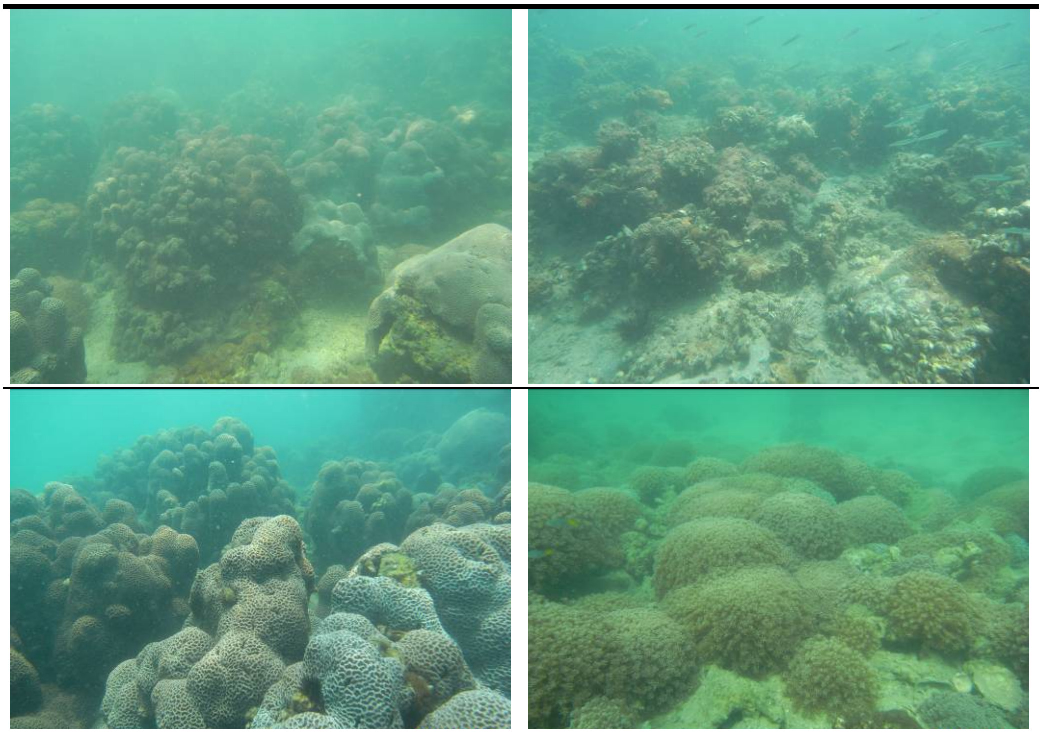
圖 B7　　在 TC-1 拍攝的具代表性照片

(1) Chan, L.K. Alan 等人 (2005)。*同上*。



在 TC-1 所錄得的硬珊瑚覆蓋率都偏低（6-10%），而且經常看到海葵在已死的珊瑚上生長。

圖 B8　　　在 TC-2 拍攝的具代表性照片



TC-2 的硬珊瑚覆蓋率較高，介乎 31 至 50%之間。值得特別注意的，是在 TC-2 錄得相對較多的大型 *Platygyra* 和 *Goniopora* 群落。

圖 B9　　　在 TC-3 拍攝的具代表性照片

三個分區的海床大致上都屬於石質，只有 TC-3 有較多沙覆蓋。在 TC-3 只發現兩種造礁硬珊瑚；該分區的硬珊瑚覆蓋率也較低（1-5%）。

B1.5.2 擬議電纜走線附近潛在珊瑚區的潛水抽樣檢查

擬議電纜走線附近的潛在珊瑚區位置是從地球物理調查的結果中識別出（*圖 B10*）。然後再對這些位置進行定性抽樣潛水檢查，以核實珊瑚的存在情況（*圖 B10*）。在兩個擬議登岸地點都發現沿海岸線一帶有硬珊瑚存在，但一般只局限於水深在海圖深度基準面以下不足 2.5 米的地方。在擬議電纜走線一帶，超過這個深度的海床都以海沙為主，令珊瑚的分佈受到限制（*圖 B11*）。潛水調查的結果與地球物理調查的結果吻合（*圖 B10*）。後者顯示，主要的珊瑚區是沿著海岸線的沙／碎石基質淺水區。

由於在水深超過海圖深度基準面以下 2.5 米的擬議電纜走線沿線都沒有任何珊瑚，因此，無需為了避免電纜鋪設工程對珊瑚造成直接損失而調整在這個深度海域內的電纜路線。應予注意的是，在淺水區（即在海圖深度基準面以下少於 2.5 米）進行的電纜鋪設工程對珊瑚可能造成的直接影響，會再作評估。

圖 B11 在進行抽樣潛水檢查時在水深超過海圖深度基準面以下 2.5 米處所拍攝的具代表性照片

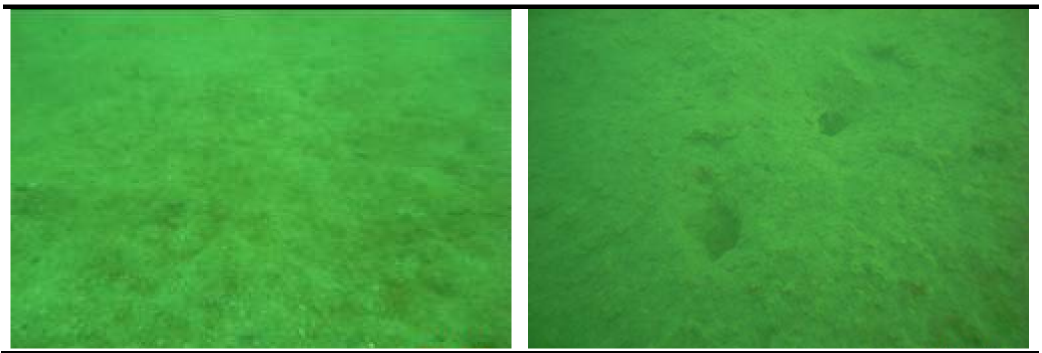


Figure B10
圖B10

Potential Area of Coral with Sand/Gravel Matrix

基質屬沙／碎石而可能有珊瑚存在的地區

File: T:\GIS\CONTRACT\0114462\mxd\0114462_Potential_Area_of_Coral_w_Sand_Gravel_Matrix.mxd
Date: 30-Oct-2012

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B1.5.3 第一階段調查的摘要和建議

第一階段調查採用抽樣潛水檢查的方法，探察了地球物理調查所找到的擬議電纜走線一帶的潛在硬質基底。抽樣檢查沒有在這些地點發現任何硬質基底或珊瑚，因此，無需為了避免電纜鋪設工程直接影響珊瑚而調整擬議電纜走線。

第一階段調查的結果顯示，青洲以北（TC-2）的地區，是研究區內珊瑚覆蓋率最高的地區，因此也是具生態價值的珊瑚區。了哥岩和白沙頭咀的擬議電纜登岸地點的硬珊瑚群落，與其毗鄰地區的群落相似。然而，應該避開 LKN-3 分區，因為，第一階段調查在該處記錄到大量造礁硬珊瑚種類，以及不常見的硬珊瑚種類，包括：*Acropora tumida*、*A. pruinosa*、*Galaxea astreata* 和 *Acanthastrea echinata*。

因此，無論是在了哥岩的 LKN-1 和 LKN-2，或在白沙頭咀登岸點的潛水調查樣線一帶，珊瑚群落都會受到相似的直接影響。為避要橫過現有的 11 千伏海底電纜和主輸水管，電岸登岸點應該位於現有的海底公用設施北面。倘若新電纜貼近現有的 11 千伏海底電纜登岸點，便可以把整體環境影響減至最少。

因此，建議為兩個已避開珊瑚密集區的建議登岸地點繪製詳細的珊瑚地圖，以便評估電纜登岸工程對珊瑚的直接影響，以及運用移植珊瑚的方法作為減少這種影響的緩解措施的可行性和實施範圍。

應該注意的是，在青洲也找到硬珊瑚群落。牠們比較接近擬議電纜走線。因此，在進行影響評估時，也應該考慮電纜鋪設工程的潛在水質影響可能對珊瑚造成的間接影響。

B1.5.4 詳細珊瑚地圖

根據第二階段潮下帶潛水調查的結果，是次研究於 2011 年在了哥岩和白沙頭咀(最少珊瑚覆蓋率)的擬議電纜登岸地點進行了詳細的珊瑚地圖繪製工作，並在 2012 年進行了更新調查。繪製珊瑚地圖的目的，是要了解電纜工作走廊內的珊瑚大約數目，以便評估在建議電纜登岸地點的登岸工程可能造成的直接影響。此外，也可以運用收集到的資料來評估以移植珊瑚這種緩解措施來減少影響珊瑚是否可行和可以實施的範圍。

調查方法

是次調查在兩個登岸地點（沿著 LNK-1、LKN-2 和白沙頭咀的樣線）都進行了潛水勘察，務求透過視覺找出最少珊瑚群落的登岸點。然後在了哥岩和白沙頭咀兩處所找到的最少珊瑚群落登岸點，進行詳細的珊瑚地圖繪製工作。

首先是在該兩個擬議登岸地點，以樣線帶在一個 15 米（與海岸線垂直）乘 20 米（與海岸線平行）的範圍內設定一個方格系統。擬議電纜走線會在這個範圍內，大約沿著一條中央線從淺水區伸延深水區（*圖 B12-13*）。每個方格的大小都是 5 米乘 5 米，因此每個登岸地點都會共有 12 個方格，覆蓋著 300 平方米的範圍。這個方格系統是設在水深約為海圖深度基準面以下 0 米至 2 米的地區內，因為在兩個登岸地點都沒有在更深的地區發現珊瑚。

是次調查在每個方格內都收集以下數據：

- 每個珊瑚群落（硬珊瑚、軟珊瑚或黑珊瑚）的大概位置；

- 所有珊瑚群落都盡可能記錄到“種”一級；

- 每個珊瑚群落的大小都按照三個分類來記錄：少於 10 厘米、10-50 厘米和大於 50 厘米；及

- 個別珊瑚群落所記錄的額外參數包括：珊瑚群落的相關基底（是石質還是沙質）；進行移植的條件（根據已部份死亡的珊瑚覆蓋率）和可行性（珊瑚屬可移動或不可移動）。

在完成這項珊瑚調查時，會以收集到的數據製作一份珊瑚生境地圖，以便展示在兩個登岸點所錄得的珊瑚群落的準確位置資料。所有錄得的珊瑚，都是根據牠們與所有調查樣線之間的距離來釐訂其座標。然後用 Arcview 軟件繪出每個珊瑚群落的位置，而且，每個珊瑚群落都按照種類、大小類別和移植的可行性來分類。

了哥岩的珊瑚地圖繪製結果

在是次調查的方格區內，海床的坡度很平緩，只是從海圖深度基準面的水平，下降至基準面以下 2 米。從基準面水平至基準面以下 0.5 米的海床，都是以海沙為主。從海圖深度基準面以下 0.5 米至 1.6 米的海床上，主要的非生物基質是沙和已死的 *Pavona decussata* 硬珊瑚群落，之後的海床基質便再次變成是以海沙為主。在第 4 號方格內有一枝已死的牡丹珊瑚，並有六放珊瑚和細小的硬珊瑚群落在已死珊瑚的架構上聚集生長。珊瑚的生長受水深限制，所以在基準面以下 2.5 米的地方，都沒有發現珊瑚。是次調查發現，該處的珊瑚覆蓋範圍伸延至離海岸線 15 米的地方。

在進行珊瑚地圖調查時，在了哥岩共記錄到 18 種硬珊瑚，分別屬於七個科。在珊瑚科的清單中（*表 B11*），菌珊瑚科和蜂巢珊瑚科的數量比其他科都多，而且被視為是香港的典型珊瑚群落。除了在第 7-8 號方格沒有發現任何硬珊瑚之外，其他各個方格內的硬珊瑚數量都相差無幾，介乎 4 至 8 之間。

在了哥岩錄得的珊瑚是按照牠們在香港的數量評分[(1)] 來評級（*表 B11*）。而大部份珊瑚的數目評級都屬於“常見”、“豐富”或“全面佔優”（18 個被記錄的種類當中的 15 個）。雖然 *Montipora turgescens* 在全港海域屬於稀有品種，但在本工程項目所在地的東北和北部海域，則屬於普遍品種。其他種類的數目評級都是“未知”，因為在原地沒法把部份群落辨別至“種”一級。這類群落需要進行詳細的樣本調查才能識別出適當的種類。這些被評為數目“未知”的群落，不一定屬於稀有／不常見的珊瑚品種。

圖 B12 展示了整個了哥岩擬議登岸點的珊瑚分佈，以及詳細的種類、群落大小和不可移動程度。整個海灣的平均珊瑚群落密都偏低，每平方米只有 1.26 個群落。在淺水區的第 1、2 和 3 號方格內有多叢互相結合聚生的珊瑚群落，共記錄到 53 至 76 個群落。然而，同樣位於較淺水地區的第 7-8 號方格內，卻沒有發現任何硬珊瑚。硬珊瑚大都生長於有沙的地區，其中有 10%（37 個群落）附著於第 4 號方格內的已死珊瑚基質之上。值得注意的，是有一叢仍然生存的 *Pavona decussata*，覆蓋了第 9 至 12 號方格，面積約達 14.7 平方米。珊瑚的大小通常都小於 15 厘米，而大部份（約 72%）都屬於 10-50 厘米的大小類別（在 379 個群中有 274 個；*圖 B12*）。

(1) Chan 等人 2005。《香港石珊瑚圖鑑》（漁農自然護理署）

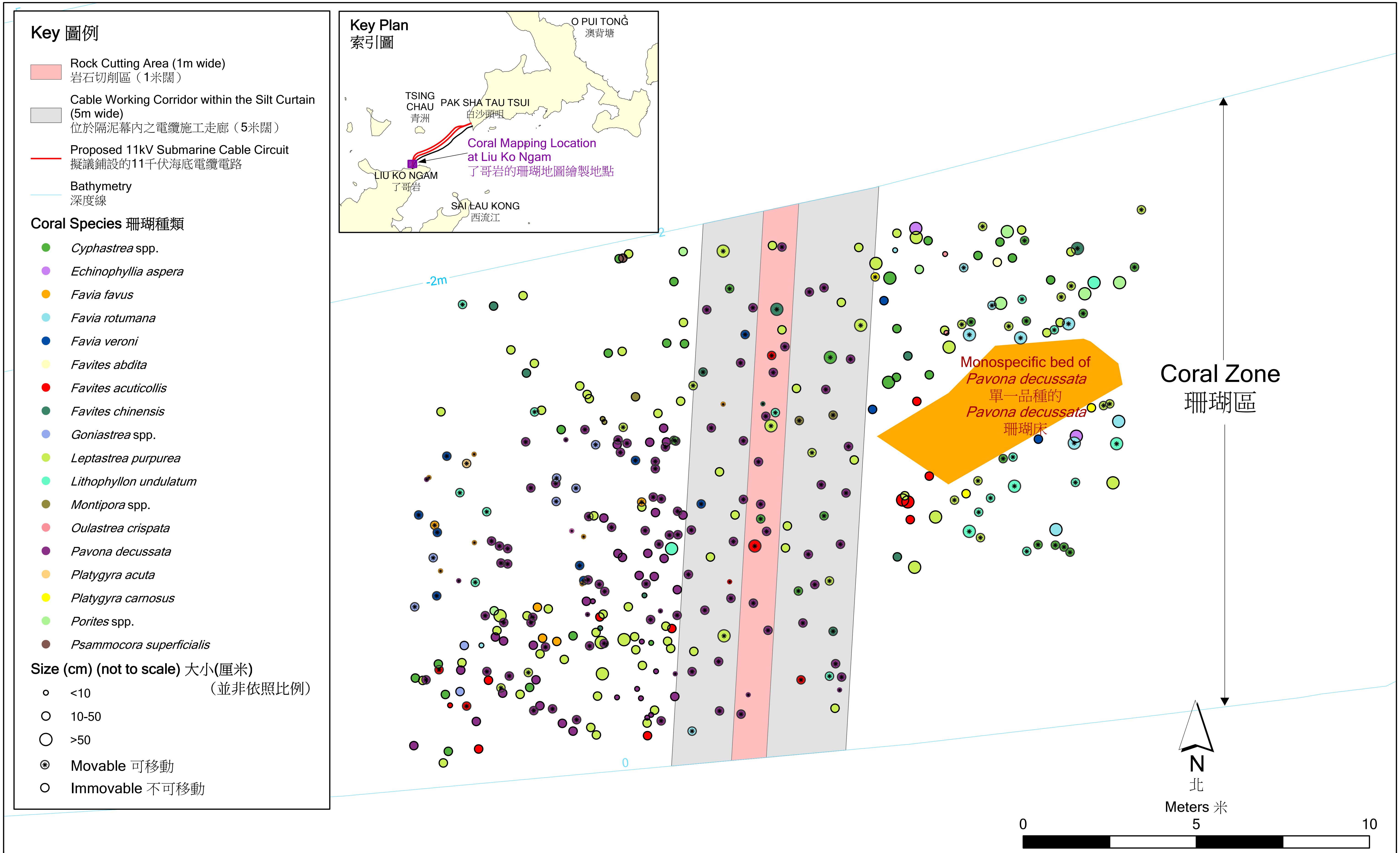

Figure B12
圖B12

Coral Mapping at Liu Ko Ngam

了哥岩的珊瑚地圖

File:T:\GIS\CONTRACT\0114462\mxd\Aug2012\0114462_Coral_Liu_Ko_Ngam.mxd
Date: 30-Oct-2012

Environmental Resources Management

ERM

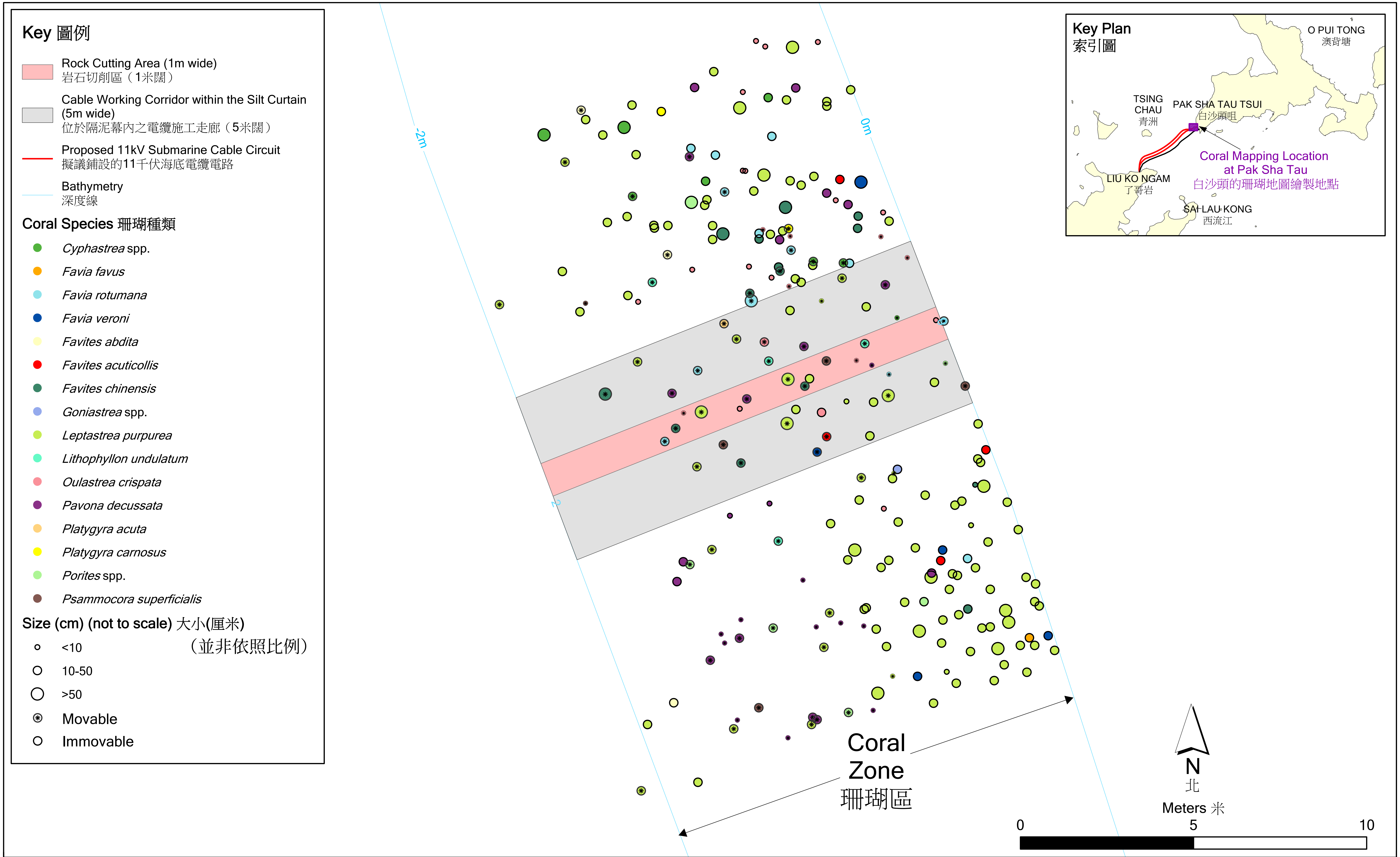

Figure B13
圖B13

Coral Mapping at Pak Sha Tau Tsui

白沙頭咀的珊瑚地圖

File:T:\GIS\CONTRACT\0114462\mxd\Aug2012\0114462_Coral_Pak_Sha_Tau.mxd
Date: 30-Oct-2012

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是次調查在了哥岩的調查方格區內，共錄得 379 個珊瑚群落（*表 B11*）。在擬議電纜工作走廊內，共錄得 120 個硬珊瑚群落，分屬 10 個種類。該區會因鑿岩工程而被隔泥幕封閉（即在兩條電纜走線的中央線兩側各 2.5 米的範圍）（*圖 B12* 和*表 B12*）。這些珊瑚群落的大小，大都介乎 10-50 厘米之間，其直徑通常都小於 20 厘米。在電纜走廊內數量最佔優的品種是 *Leptastrea purpurea* 和 *Pavona decussata*。這些珊瑚大都沒法用手移走（*表 B12*）。然而，在擬議電纜走廊內合共錄得的 120 個硬珊瑚群落當中，有 100 個屬於 *Cyphastrea*、*Favia*、*Favites* 和 *Leptastrea* 屬（這個屬的珊瑚群落若超過 50 厘米，通常都會以亞團塊形生長），以及 *Pavona* 屬（以亞團塊形和團塊形生長），可以用機械方法移植。若要移植這些珊瑚，便需要在其底部切割，令珊瑚與其基質分離，然後轉移到指定的接收地點。除了上述品種外，共有四個其他品種的珊瑚群落可以用手移走，因此，預計共有 104 個群落可以進行移植。若能在開展電纜鋪設工程前，妥當地移植上述的 104 個珊瑚群落，則會受到直接影響的珊瑚，估計是位於一米闊的岩石切削工程區內的六（6）個硬珊瑚群落；另有 16 個硬珊瑚群落（包括在一米闊的岩石切削區內的 6 個硬珊瑚群落）會因為隔泥幕所圍繞的 5 米闊範圍內的潛水員移動，以及水質受滋擾而受到間接影響。

在了哥岩的調查區內，除了有硬珊瑚外，亦記錄到其他常見的無脊椎動物，包括海膽類的 *Diadema setosum*，以及海參類的 *Holothuria leucospilota*。

表 B11　　在了哥岩的調查方格內錄得的石珊瑚種錄一覽表

科	種	香港數量評級 (1)	方格編號												
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	在了哥岩總數
Acroporidae	*Montipora turgescens*	未知					5								**5**
Agariciidae	*Pavona decussata*	豐富	27	23	64	13									**127**
Faviidae	*Cyphastrea spp.*	未知	1	6	3		6	1				5	8	9	**39**
	Favia favus	豐富	1	3	1	7									**12**
	Favia rotumana	豐富		1								3	3	5	**12**
	Favia veroni	常見			1	6					4	1	1		**13**
	Favites abdita	全面佔優												1	**1**
	Favites acuticollis	常見	6	5							7				**18**
	Favites chinensis	全面佔優	3					2			4		2	1	**12**
	Goniastrea spp.	未知		2		7									**8**
	Leptastrea purpurea	豐富	31	12	5		6	8			9	6	9	10	**96**
	Oulastrea crispata	常見											2		**2**
	Platygyra acuta	全面佔優				1									**1**
	Platygyra carnosus	常見										2	1		**3**
Fungiidae	*Lithophyllon undulatum*	常見			2	3	1	2				8		3	**19**
Pectiniidae	*Echinophyllia aspera*	常見										1	1		**2**
Poritidae	*Porites spp.*	常見至全面佔優		1			1						1	4	**7**
Siderastreidae	*Psammocora superficialis*	豐富					1								**1**
		硬珊瑚群落總數	**69**	**53**	**76**	**37**	**20**	**13**	**0**	**0**	**24**	**26**	**28**	**33**	**379**
		硬珊瑚種類總數	**6**	**8**	**6**	**6**	**6**	**4**	**0**	**0**	**4**	**7**	**9**	**7**	**18**

(1)　Chan 等人 2005。*同上*。

表 B12　　可能會受於了哥岩登岸的擬議電纜鋪設路線影響的珊瑚群落

珊瑚種類	大小（直徑之厘米數）			可移動／可移植	不可移動
	< 10	**10 - 50**	**> 50**		
Cyphastrea spp.	0	8	1	9	0
Favia favus	1	0	0	1	0
Favia rotumana	0	1	0	1	0
Favia veroni	0	2	0	2	0
Favites acuticollis	1	9	0	10	0
Favites chinensis	1	5	1	7	0
Leptastrea purpurea	0	19	18	21	16
Lithophyllon undulatum	0	2	0	2	0
Montipora spp.	0	2	0	2	0
Pavona decussata	5	44	0	49	0
總數	8	92	20	104	16

白沙頭咀的珊瑚地圖繪製結果

在白沙頭咀的海灣內，共設定了 12 個方格（*圖 B13*）。白沙頭的海床地形與了哥岩相似，海床的坡度很平緩，只是從海圖深度基準面的水平，下降至基準面以下 2.3 米。從海圖深度基準面以下 0 至 0.6 米的海床上的非生物物質主要是沙和小礫石，而從基準面以下 0.6 至 1.8 米的海床區的非生物基質，則主要是已死的 *Pavona decussata* 硬珊瑚群落。在基準面以下 1.8 米，便再次以海沙為主。在調查時看到有硬珊瑚在海沙、已死的珊瑚結構和礫石上生長。在海圖深度基準面以下 2.5 米處便看不到有硬珊瑚，其覆蓋範圍達到距離海岸線約 15 米的地區。

在進行珊瑚地圖調查時，在白沙頭咀共記錄到 16 種硬珊瑚，分別屬於五個科。其中以蜂巢珊瑚科，特別 *Leptastrea purpurea* 種的珊瑚數量最多，共錄得 140 個群落，比其他類別多，而且是香港的典型珊瑚群落。在個別方格方面，硬珊瑚種類的數目介乎 1 至 8 不等（除了方格 K 沒有任何硬珊瑚之外），其中以位於較深水地區的方格 E、F 和 L 內的種類較少。

在香港的數量評級方面 [(1)]（*表 B13*），在白沙頭咀錄得的珊瑚種類，大都屬於“常見”、“豐富”或“全面佔優”的類別（在錄得的 16 種當中的 14 種）。有兩個品種的數量評級被定為“未知”，因為沒法在原地把牠們的種類識別至進行數量評級所需要的分類層級。雖然這些群落的數量級別被評為“未知”，但不表示可能有“稀有／不常見”的珊瑚品種存在。

圖 B13 展示了整個白沙頭咀擬議登岸點的珊瑚分佈，以及詳細的種類、群落大小和不可移動程度。整個調查區的平均珊瑚群落密都偏低，每平方米只有 0.97 個群落。主要錄得硬珊瑚群落的方格，是位於較淺水地區的方格 A、B、G 和 H。在這四個方格內，共錄得 188 個群落。珊瑚群落的數目隨著水深增加而減少。調查所錄得的硬珊瑚，主要是依附在海沙上（145 個群落），其他則依附在已死的珊瑚上（52 個群落）、小礫石上（61 個群落）或碎石上（32 個群落）。珊瑚的大小通常都小於 15 厘米，而大部份（約 69%）都屬於 10-50 厘米的大小類別（在 290 個群落中有 200 個）。只有 30 個群落的直徑超過 50 厘米。

(1)　Chan 等人 2005。*同上*。

是次調查在白沙頭咀的調查方格區內，共錄得 290 個珊瑚群落（*表 B13*）。在擬議電纜工作走廊內，共錄得 108 個硬珊瑚群落，分屬 14 個種類。該區會因鑿岩工程而被隔泥幕封閉（即在兩條電纜走線的中央線兩側各 2.5 米的範圍）（*圖 B13* 和*表 B14*）。這些珊瑚群落的大小，大都介乎 10-50 厘米之間（在 108 個群落中有 67 個），其直徑通常都小於 15 厘米。在電纜走廊內，數量最豐富的品種是 *Leptastrea purpurea*。共有二十五（25）個群落不能用手移走（*表 B14*）。然而，在擬議電纜走廊內合共錄得的 108 個硬珊瑚群落當中，有五十六（56）個屬於 *Cyphastrea*、*Favia*、*Favites*、*Pavona*、*Platygyra* 和 *Porites* 屬。牠們都以亞團塊形和團塊形生長，可以用機械方法移植。若要移植這些珊瑚，便需要在其底部切割，令珊瑚與其基質分離，然後轉移到指定的接收地點。除了上述品種外，共有 27 個其他品種的珊瑚群落可以用手移走，因此，預計共有 83 個群落可以進行移植。若能在開展電纜鋪設工程前，妥當地移植上述的 83 個珊瑚群落，則會受到直接影響的珊瑚，估計是位於一米闊的岩石切削工程區內的七（7）個硬珊瑚群落；另有 25 個硬珊瑚群落（包括在一米闊的岩石切削區內的 7 個硬珊瑚群落）會因為隔泥幕所圍繞的 5 米闊範圍內的潛水員移動，以及水質受滋擾而受到間接影響。

在白沙頭的調查區內，除了有硬珊瑚外，亦記錄到其他常見的無脊椎動物，包括海膽類的 *Diadema setosum*，以及海參類的 *Holothuria leucospilota*。

表 B13　　在白沙頭咀的調查方格內錄得的石珊瑚種錄一覽表

科	種	香港數量評級 [1]	方格編號												
			A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	白沙頭咀總數
Agariciidae	*Pavona decussata*	豐富	3	3	7	1	1		1	1	7	14			**38**
Faviidae	*Cyphastrea spp.*	未知	2	2		3									**7**
	Favia favus	豐富								1					**1**
	Favia rotumana	豐富	10	4						1					**15**
	Favia veroni	常見	2						2	3					**7**
	Favites abdita	全面佔優				2								1	**3**
	Favites acuticollis	常見		1					3	1					**5**
	Favites chinensis	全面佔優	11	2					3	1					**17**
	Goniastrea spp.	未知							1						**1**
	Leptastrea purpurea	豐富	19	12	9	14	2	1	26	43	6	5		3	**140**
	Oulastrea crispata	常見	20	6	4				2						**32**
	Platygyra acuta	全面佔優									1				**1**
	Platygyra carnosus	常見	1			1									**2**
Fungiidae	*Lithophyllon undulatum*	常見			2						5				**7**
Poritidae	*Porites spp.*	常見至全面佔優				1				1	2	2			**6**
Siderastreidae	*Psammocorasuperficialis*	豐富			2		5					1			**8**
		硬珊瑚群落總數	**68**	**30**	**24**	**22**	**8**	**1**	**38**	**52**	**21**	**22**	**0**	**4**	**290**
		硬珊瑚種類總數	**8**	**7**	**5**	**6**	**3**	**1**	**7**	**8**	**5**	**4**	**0**	**2**	**16**

(1) 等人 2005。*同上*。

表 B14　　可能會受於白沙頭咀登岸的擬議電纜鋪設路線影響的珊瑚群落

珊瑚種類	大小（直徑之厘米數）			可移動／可移植	不可移動
	< 10	10 - 50	> 50		
Cyphastrea spp.	0	2	0	2	0
Favia rotumana	0	9	1	10	0
Favia veroni	0	1	0	1	0
Favites acuticollis	0	3	0	3	0
Favites chinensis	0	9	0	9	0
Leptastrea purpurea	2	20	11	18	15
Lithophyllon undulatum	0	7	0	7	0
Oulastrea crispata	24	0	0	14	10
Pavona decussata	2	8	0	10	0
Platygyra acuta	0	1	0	1	0
Porites spp.	0	2	0	2	0
Psammocora superficialis	1	5	0	6	0
總數	29	67	12	83	25

B1.6　*影響評估*

擬議海底電纜對海洋生態資源可能造成的影響可以分為兩種：直接滋擾生境／海洋生物而造成的直接影響，以及在進行沖噴，挖泥和鋪設電纜等工作時，產生沉積物捲流而影響水質所造成的間接影響。

B1.6.1　*施工期間的直接影響*

了哥岩和白沙頭咀的岸端挖泥工程(珊瑚區外圍)，都需要在兩條電纜走線的中軸線兩側，有各闊 4 米所形成的工地，因為需要考慮工程躉船的大小，以及躉船所需要的錨固點，甚至挖泥工程亦須限制在纜槽內進行。雖然”岩石切割”工程將需要一條位於岸端登陸部分大約 1.0 米（寬）X 0.6M（深度）的纜槽（位於了哥岩和白沙頭咀的都不超過 50m，但只有 10-20m 部分記錄到珊瑚群落）。下列各項影響，是假設在工地範圍內的潮間帶和底棲生物群落，都沒法避免地受到各種建築工程的直接影響。這種情形被稱作“最壞的假設情況”。

潮間帶生境：預測在了哥岩和白沙頭咀進行的岸端建築工程，會對當地的潮間帶生境造成短期影響。在電纜鋪設工程完成後，會分別為了哥岩和白沙頭咀的潮間帶礫石海岸生境和沙質海岸生境進行復原工作。預計在有關的海事工程完成後，受影響地區的海洋生態資源會逐漸復原，因為潮間帶的動物會在相關的生境中重新聚集。因此，擬議建築工程對了哥岩和白沙頭咀的潮間帶生境，不會造成顯著的直接影響。

潮下軟底生境：根據預測，挖泥工程和電纜鋪設工程都會造成短期影響，但在這些海事工程停止後，受影響地區的海洋生態資源會逐漸復原，因為底棲生物會在海床上重新聚集。沖噴法會對長約 880 米的電纜走線沿途的低生態價值潮下軟底生境造成短暫滋擾。在完成沖噴工程後，整條電纜走線（包括需要加上保護層的纜段）都會有自然回填的情況出現，並會在短期內將海床恢復至原來水平。由於有關地區的生態價值不高，因此，工程對潮下軟底生境所造成的短期直接影響不會顯著。

潮下生境：

*了哥岩：*預計本工程項目會影響闊 5 米的"岩石切割" 工程工作走廊內(珊瑚區內) 的硬珊瑚群落。為了減少本工程項目對珊瑚群落可能造成的影響，是次研究沿著了哥岩的海岸線進行了詳細調查，務求找到珊瑚密度較低的地區作為登岸點。然後便根據調查結果選擇了珊瑚群落最少的地區作為電纜工作走廊。若能在展開建築工程前，把 104 個可以移植的珊瑚個體，從受影響地區移植至接收地點，便可以把電纜工作走廊內可能受影響的珊瑚群落，從 120 個個體大幅減少至 16 個個體（*表 B12*、*圖 B12*）。在 16 個珊瑚個體中，一共有 6 個硬珊瑚個體將受到岩石切割工程的直接影響（在一米寬的岩石切割施工區內）。 10 個受影響的硬珊瑚個體（在隔泥幕包圍下寬 5 米的工作走廊內）可能受到潛水員的動作和擾動珊瑚區內水質時的間接干擾。未能移植的珊瑚群落屬於 *Leptastrea purpurea*，都是香港東北面和東部海域常見的種類。此外，這些珊瑚群落一般都比較小，其直徑通常都小於 15 厘米。因此，損失小量在工程地區附近海域較常見的細小珊瑚群落所造成的剩餘影響，屬於可以接受的情況。應予注意的是，按照實地觀察，珊瑚群落在受到滋擾後，可以成功地重新聚集於硬基質上，即現有的電纜表面。

*白沙頭咀：*預計本工程項目會影響位於擬議電纜走線兩側，共闊 5 米的"岩石切割" 工程 (珊瑚區內)工作走廊內的硬珊瑚群落。為了減少本工程項目對珊瑚群落可能造成的影響，是次研究沿著白沙頭咀的海岸線進行了詳細調查，務求找到珊瑚密度較低的地區作為登岸點。然後便根據調查結果選擇了珊瑚群落最少的地區作為電纜工作走廊。若能在展開建築工程前，把 83 個可以移植的珊瑚個體，從受影響地區移植至接收地點，便可以把電纜工作走廊內可能受影響的珊瑚群落，從 108 個個體大幅減少至 25 個個體（表 B14、圖 B13）。在 25 個珊瑚個體中，一共有 7 個硬珊瑚個體將受到岩石切割工程的直接影響（在一米寬的岩石切割施工區內）。 10 個受影響的硬珊瑚個體（在隔泥幕包圍下寬 5 米的工作走廊內）可能受到潛水員的動作和擾動珊瑚區內水質時的間接干擾。未能移植的珊瑚群落屬於 *Leptastrea purpurea* 和 *Oulastrea crispata* 兩個類別，都是香港東北面和東部海域常見的種類。這些珊瑚群落也很細小，特別是 *Oulastrea crispate* 的群落，其直徑全都小於 10 厘米。至於被認為不適宜移植的 *Leptastrea purpurea* 群落，其直徑通常都小於 15 厘米。由於電纜登岸工程只會導致小量在工程地區附近海域較常見而且細小的珊瑚群落遭受損失，因此，工程直接滋擾珊瑚生境所造成的剩餘影響，屬於可以接受的情況。應予注意的是，按照實地觀察，珊瑚群落在受到滋擾後，可以成功地重新聚集於硬基質上，即現有的電纜表面。

B1.6.2 施工期間的間接影響

在施工階段對海洋生態資源可能造成的間接影響包括在珊瑚區外由沖噴法和挖泥工程釋放的沉積物。應該指出的是，岩石切割只會產生最小和局部的水質影響。因沖噴及挖泥被揚起的沉積物對水質的潛在影響包括：

- 懸浮固體的濃度增加（於下文細述）；
- 令溶解氧濃度下降（根據水質評估，預計不會造成顯著影響）；及
- 水體的營養濃度增加（根據水質評估，預計不會造成顯著影響）。

懸浮固體

潮間帶生境：在評估區內可能會受挖泥工程影響的潮間帶生境包括：在登岸地點附近海岸線一帶的沙質和礫石海岸生境。由於了哥岩和白沙頭咀的沙質和礫石海岸的生態價值都偏低，而且施工期亦較短，因此，預計不會造成不可接受的影響。

潮下軟底生物：海底的固著生物會受到水中沉積物含量增加的影響。這些影響對海底固著生物來說可以是致命或近乎致命的（例如：由於不斷要把沉澱物質沖出而造成的壓力令生殖能力下降）。沉積物對生物的影響亦取決於其他因素，例如生物本身的承受力、固著生物的生長方向和水流情況等。香港的底內動物群落都位於軟泥和海沙中。這些沙泥經常受到風浪、海床洋流和不斷的拖網活動滋擾，沉積物受到攪動，令水中的懸浮沉積物濃度偏高。因此，底棲的無脊椎動物不會因為沖噴法和挖泥工程令沉積物揚起和再沉澱而受到不良影響。

預計在挖泥／沖噴工程區外，但貼近工程區的底棲群落所受到的影響會很短暫。受影響的範圍會較小，因為沉積物會在離沖噴工程一段短距離內沉澱。根據預測的沉澱速度，位於了哥岩和白沙頭咀的小量天然底棲生物和底內動物群落，都不會受到影響。該兩個地區的生物都已適應各種海床滋擾，而且據報該兩區只有零星的生物存在。由於受影響的地區會由該區的典型動物重新聚集，因此，暫時損失這些生態價值偏低的生物群落屬於可以接受的情況。

潮下硬底生境：在了哥岩和白沙頭咀登岸點的電纜，會被鋪設在一條由抓斗挖出的纜槽內。抓斗挖泥工程會在由隔泥幕圍繞的範圍內進行，藉以控制沉積物擴散。在實施這項緩解措施後，預計電纜的登岸工程不會對珊瑚造成不可接受的間接影響。

工程躉船的移動和作業，都可能揚起海底的沉積物，令它們重新進入懸浮狀態，因而影響了哥岩和白沙頭咀附近的珊瑚群落，特別是在退潮期間。工程躉船若能實施良好的操作方法（即不要超載，以及避免在退潮時移動，特別是在淺水區附近），便不會對珊瑚群落造成任何不可接受的不良影響。

雖然預期珊瑚不會受到不良的間接影響，但在進行電纜鋪設工程時仍會進行珊瑚監察，藉此證實本工程項目不會對珊瑚造成不良的生態影響。有關這項監察計劃，請參閱*附件 E*。

印洲塘海岸公園和荔枝窩海灘具特殊科學價值地點：本工程項目令水質變化而對印洲塘海岸公園（該公園最近的一點距離擬議電纜登岸地點和電纜路線大約 430 米）和荔枝窩海灘具特殊科學價值地點（距離擬議電纜登岸地點和電纜鋪設路線超過 1.5 公里）所造成的間接影響都不顯著，因為本工程項目的規模細小，所造成的影響都維時短暫，而且沉積物捲流的擴散亦有限。

B1.6.3 運營階段

擬議電纜在運營時不會滋擾海床上的沉積物，因此，預計電纜在運營期間不會對海洋生態資源造成直接影響，也不會令水質改變而造成間接影響。

B1.7　　在鋪設電纜期間的緩解措施

《環評技術備忘錄》附件 16 指出：緩解顯著生態影響的一般政策，按優先次序排列是：

避免產生： 透過採用適當的替代方法來盡量避免產生潛在影響；

減少產生： 透過採用適當和可行的措施，例如限制工程的強度或工程的時間安排等，來盡量減少產生無可避免的影響；及

作出補償： 對於受損失的重要物種和生境，盡可能在其他地方提供補償。此外，還應該盡可能改善這些政策和採取其他保育措施。

B1.7.1　　避免產生

連接了哥岩和吉澳白沙頭咀的現有 11 千伏海底電纜已使用超過 30 年，正在日漸老化，需要更換。因此，作為替換的新電纜會大致上沿著現有 11 千伏海底電纜的走線，並使用現有登岸地點來連接現有的 11 千伏架空電纜系統。電纜登岸點和走線的篩選是基於以下考慮：

- 避開各個海岸公園。
- 避開各個魚類養殖區。
- 選擇技術上可行的地區（即軟泥和沙質），以減少建築上的困難。
- 沿用現有 11 千伏海底電纜的走線，並使用在過去已受滋擾的現有登岸地點，藉此避開天然和未受滋擾的地區。
- 利用現有 11 千伏的架空電纜系統，以避免安裝新的架空電纜系統。

B1.7.2　　減少產生

在規劃階段的初期，關鍵考慮因素之一是選擇最短的電纜走線，盡量減少對環境的潛在不良影響。據當時的了解，珊瑚覆蓋率較高的地區，通常都在香港東北面海域的海岸線。為了減少本工程項目對珊瑚群落可能造成的影響，是次研究沿著了哥岩和白沙頭咀的海岸線進行了詳細調查，務求找到珊瑚密度較低的地區作為登岸點。然後便根據調查結果，選擇了珊瑚群落最少的地區作為電纜工作走廊。

除了選擇電纜路線和登岸點之外，也考慮了各種能夠盡量減少影響珊瑚的施工方法。在考慮上述各項因素後，根據技術可行性和環境影響方面的準則，“岩石切削法”（在珊瑚區）加上“挖掘法”（在非珊瑚區）是最適合岸端建築工程採用的方法。

同時，亦建議在鋪設電纜時，實施下列各項緩解措施，藉以減少工程對四周生境和海洋生物群落的影響和滋擾。

- 在岸端工程地點的四周裝設隔泥幕，務求在鋪設電纜期間，減少沉積物擴散。為免對環境和附近海洋生物造成任何影響，在拆除隔泥幕時，應該按

照下列步驟：(1) 檢查清楚隔泥幕內沒有任何明顯的沉積物捲流；(2) 慢慢地提起隔泥幕的底部；及 (3) 慢慢地把隔泥幕拉出水面。

- 為了盡量減少珊瑚群落所受到的影響（這些影響並非不可接受），建議把可能會受影響和可以移動（即可以移植）的珊瑚群落/個體加以移植。根據本地在"重建西貢北丫碼頭"工程中成功移植珊瑚的經驗，移植的重要因素包括：

  (1) 來源地和接收地之間距離須短；

  (2) 珊瑚群落本身須屬可以移動的種類；及

  (3) 採用影響較少和人手操作的方法進行珊瑚移植。

本工程項目在動工前進行了一項詳細的珊瑚調查，藉以確定珊瑚群落在工地範圍內的具體位置，並確定隔泥幕不會直接影響任何珊瑚和電纜路線，而且在有需要時會設置隔泥幕，務求盡量減少對珊瑚造成的影響。把工程區內記錄到的可移動珊瑚群落進行移植是最後的辦法。若有必要進行珊瑚移植工作，便應該在工程動工前兩個星期進行。被移植的珊瑚應該呈現良好的健康狀況（沒有受壓力的蹟象）。移植珊瑚的方法於*表 B15* 闡述。在實際進行珊瑚調查和移植前，應該先把詳細的調查和移植方法提交予漁護署批准。珊瑚調查和移植工作必須由持有與生態學有關的研究院學位，並具有相關實踐經驗的合資格人士負責進行

表 B15　　建議珊瑚移植方法

工序	詳情
在移植前評估珊瑚的狀況	在進行移植前應該找出在建議工程地點內的每個珊瑚群落。珊瑚群落的狀況，包括部份死亡、白化或病變，以及珊瑚所附著的基質種類和大小等，都應該加以記錄。應該為每個記錄到的珊瑚群落拍攝具代表性的照片。
移植珊瑚	應該用手提起被移植的珊瑚。為能取得顯著較高的珊瑚存活率，在整個移植過程中，所有被移植的珊瑚群落在任何時候都應該浸在水中（而不應暴露在空氣或風中，或受陽光直接照射）。採用人手水下移植法，可以確保被移植的珊瑚會被小心收集和遷移，並按照正確的方向放置。 對於已有識別資料的珊瑚群落，應該連同其附著的基質（例如礫石）一起遷移至接收地點。當珊瑚群落的識別工作展開後，便應由一隊潛水員攜同水下起重機跟隨，並以一致的方式把已作記錄的群落遷移。細小的可移動群落可以用水下起重機來運送。水下起重機是由一個 1 平方米的平台懸掛在一個 200 公斤的浮力袋下而組成。各個珊瑚群落可以由戴上手套的潛水員放置於平台上。應該設法令潛水員與被運送的珊瑚群落的接觸範圍和接觸時間都盡量減小。在每次使用平台和拿起珊瑚群落時都應該小心，盡量避免接觸珊瑚的組織。 可以把放置珊瑚群落的起重機連繫在潛水船上，以便把珊瑚運送至晨曦島西的北面（靠近現有碼頭）。潛水船應該以固定的慢速行駛（低於每小時 2 海浬）。在遷移過程中，每個珊瑚群落都應該一直保持其垂直定位。 當起重機到達接收地點後，潛水員便應該把載有珊瑚的平台放置在一片沒有任何珊瑚群落的海床上。然後把每個珊瑚群落逐一從平台上拿起，並小心地放置於海床上，盡量減少滋擾海床上的沉積物。各個群落之間的距離應盡量依照原來的珊瑚分佈，以免各個品種之間互相競爭。
評估移植後的	在進行移植後，應該馬上再次評估每個被移植的珊瑚群落。珊瑚群落的狀況，

工序	詳情
珊瑚群落	包括部份死亡、白化或病變，以及珊瑚所附著的基質種類和大小等，都應該加以記錄。應該為每個記錄到的已移植珊瑚群落拍攝具代表性的照片。

雖然預期珊瑚不會受到不良的剩餘影響，但在進行電纜鋪設工程時仍會進行水質和珊瑚監察，藉此證實本工程項目不會對珊瑚和海洋環境造成不良的生態影響。

B1.8 總結

是次研究檢視了在海底電纜走線和登岸地點附近的了哥岩和白沙頭咀的海洋生態基線情況。

結果顯示，該區的軟底底棲動物的生態價值屬偏低。雖然這些軟底生物群落在鋪設電纜時會受到滋擾，但相近的群落會在一段短時間內重新聚集於這些生境。故此，有關的影響並非不可接受。

根據最近的實地調查所得，在擬議電纜登岸地點的沙質和巨礫海岸潮間帶所發現的生物，無論是數量或種類都偏少。這些物種中，大部份都是在香港其他類似的海岸所常見和廣泛分佈，因此都屬於生態價值較低的種類。所以這些群落所受到的影響並非不可接受。

在了哥岩和白沙頭咀登岸地點所進行的珊瑚地圖調查，分別記錄到 18 和 16 種硬珊瑚。一般而言，在這兩個調查區內所記錄到的珊瑚種類，都是在香港東部和東北部海域經常發現的品種。兩個登岸地點所發現的珊瑚密度都偏低，每平方米只有少於 1.3 個個體。大部份群落的直徑都小於 15 毫米

預計電纜鋪設工程會令了哥岩和白沙頭咀登岸地點，分別有 16 個和 25 個硬珊瑚個體受到影響。受影響的珊瑚群落通常都較小，而且是普遍分佈於香港東北部和東部的海域。因此，預計本工程項目不會對珊瑚群落造成不可接受的剩餘影響。

本工程項目因水質變化而對有記錄的珊瑚群落、印洲塘海岸公園和荔枝窩海灘具特殊科學價值地點所造成的間接影響都不顯著，因為本工程項目的規模細小，所造成的影響都維時短暫，而且沉積物捲流的擴散亦有限。

本工程項目篩選了可以盡量減少影響珊瑚群落的登岸地點和電纜走線，也採用了可以減少干擾海洋環境的電纜鋪設技術，從而避免了對海洋生態資源可能造成的大部份影響。

預計是次研究為減少水質影響而建議的緩解措施，也可以控制海洋生態資源所受到的影響，特別是在電纜走線附近的硬珊瑚群落。這些緩解措施包括在工程地點四周裝設隔泥幕、限制電纜鋪設機的最高速度和挖泥的速度，以及在進行陸地工程時實施良好的工地管理方法。此外，亦建議進行珊瑚移植，藉此減少電纜登岸工程對了哥岩和白沙頭咀兩個電纜登岸地點的珊瑚所造成的損失。

Annex B2
附錄乙2

Terrestrial Ecological Survey Data
陸地生態調查數據

Table B2.1 *Plant species recorded within the Terrestrial Study Area (March 2011)*

表乙2.1 *在研究範圍內錄得之植物品種（2011年3月）*

Species name 品種名稱	Chinese name 中文名稱	Growth form 生長形式	Status 狀況*	Liu Ko Ngam				Pak Sha Tau Tsui		
				Works Area 工程地點	Shrubby grassland 灌木草地	Young woodland 尚未成熟的樹林	Coastal vegetation 海岸植物	Works Area 工程地點	Shrubland 灌木	Coastal vegetation 海岸植物
Sageretia thea	雀梅藤	Shrub 灌木	Very Common 十分常見		2	2	2	1	4	2
Psychotria asiatica	山大刀	Shrub 灌木/Tree 喬木	Very Common 十分常見	1		3	1	1	3	1
Rhaphiolepis indica	車輪梅	Shrub 灌木/Tree 喬木	Very Common 十分常見	1	2	2	2		3	
Millettia nitida	亮葉崖豆藤	Climber 攀爬類	Very Common 十分常見	3		4	1		1	
Schefflera heptaphylla	鵝掌柴	Tree 喬木	Very Common 十分常見	2		4			3	
Clerodendrum inerme	苦郎樹	Shrub 灌木	Common 常見				4			4
Caesalpinia crista	華南雲實	Climber 攀爬類	Very Common 十分常見	3		4				
Pandanus tectorius	露兜樹	Tree 喬木	Very Common 十分常見				2	2		3
Cassytha filiformis	無根藤	Climber 攀爬類	Very Common 十分常見		3			1	2	
Hibiscus tiliaceus	黃槿	Tree 喬木	Very Common 十分常見				2	2		2
Paliurus ramosissimus	馬甲子	Tree 喬木	Common 常見				3			3
Rhus succedanea	野漆	Shrub 灌木/Tree 喬木	Common 常見			3			2	1
Sterculia lanceolata	假蘋婆	Tree 喬木	Very Common 十分常見			3		1	2	
Vitex rotundifolia	單葉蔓荊	Shrub 灌木	Common 常見				2			4
Cerbera manghas	海杧果	Tree 喬木	Common 常見				2			3
Dalbergia benthamii	兩廣黃檀	Climber 攀爬類	Common 常見		1	2			2	
Microcos paniculata	布渣葉	Shrub 灌木/Tree 喬木	Common 常見		1	2			2	
Tetracera asiatica	錫葉藤	Climber 攀爬類	Very Common 十分常見	2		3				
Ampelopsis cantoniensis	廣東蛇葡萄	Climber 攀爬類	Very Common 十分常見	1		3				
Cratoxylum cochinchinense	黃牛木	Shrub 灌木/Tree 喬木	Very Common 十分常見						4	
Lantana camara	馬纓丹	Shrub 灌木	Very Common 十分常見					2		2
Miscanthus sinensis	芒	Herb 草本	Very Common 十分常見		4					
Phyllanthus cochinchinensis	越南葉下珠	Shrub 灌木	Very Common 十分常見			2	2			
Rhodomyrtus tomentosa	崗稔	Shrub 灌木	Very Common 十分常見						2	2
Baeckea frutescens	崗松	Shrub 灌木	Very Common 十分常見		3					
Byttneria aspera	刺果藤	Climber 攀爬類	Very Common 十分常見			2			1	
Gnetum luofuense	羅浮買麻藤	Climber 攀爬類	Very Common 十分常見	1		2				
Ilex asprella	梅葉冬青	Shrub 灌木	Very Common 十分常見	1		2				
Litsea rotundifolia	豺皮樟	Shrub 灌木	Very Common 十分常見		1	2				
Mallotus paniculatus	白楸	Tree 喬木	Very Common 十分常見		1	2				
Syzygium hancei	韓氏蒲桃	Tree 喬木	Common 常見						2	1
Vitex negundo	黃荊	Shrub 灌木	Common 常見					1		2
Acronychia pedunculata	山油柑	Tree 喬木	Very Common 十分常見			2				
Aporusa dioica	銀柴	Tree 喬木	Very Common 十分常見			2				
Bauhinia glauca	羊蹄甲藤	Climber 攀爬類	Very Common 十分常見			2				
Breynia fruticosa	黑面神	Shrub 灌木	Very Common 十分常見				1		1	
Bridelia tomentosa	土蜜樹	Shrub 灌木/Tree 喬木	Very Common 十分常見						2	
Dicranopteris pedata	芒萁	Fern 蕨類	Very Common 十分常見						1	1
Diospyros eriantha	烏柿	Tree 喬木	Very Common 十分常見			1	1			
Elaeocarpus sylvestris	山杜英	Tree 喬木	Very Common 十分常見	1		1				

Species name 品種名稱	Chinese name 中文名稱	Growth form 生長形式	Status 狀況*	Liu Ko Ngam				Pak Sha Tau Tsui		
				Works Area 工程地點	Shrubby grassland 灌木草地	Young woodland 尚未樹林	Coastal vegetation 海岸植物	Works Area 工程地點	Shrubland 灌木	Coastal vegetation 海岸植物
Embelia ribes	白花酸藤子	Climber 攀爬類	Common 常見						2	
Excoecaria agallocha	海漆	Tree 喬木	Common 常見				2			
Gymnema sylvestre	匙羹藤	Climber 攀爬類	Very Common 十分常見			2				
Loeseneriella concinna	希藤	Climber 攀爬類	Common 常見			1	1			
Melastoma sanguineum	毛稔	Shrub 灌木	Very Common 十分常見						2	
Millettia speciosa	美麗崖豆藤	Climber 攀爬類	Common 常見	1		1				
Photinia benthamiana	閩粵石楠	Tree 喬木	Common 常見			1	1			
Phyllanthus reticulatus	小果葉下珠	Shrub 灌木	Common 常見					1		1
Pinus massoniana	馬尾松	Tree 喬木	Common 常見						2	
Scolopia chinensis	刺柊	Tree 喬木	Common 常見			1				1
Cymbopogon hamatulus	扭鞘香茅	Herb 草本 草本	Very Common 十分常見							2
Smilax glabra	土茯苓	Climber 攀爬類	Very Common 十分常見	1		1				
Viburnum odoratissimum	珊瑚樹	Tree 喬木	Very Common 十分常見					1	1	
Wikstroemia indica	了哥王	Shrub 灌木	Common 常見				1			1
Zanthoxylum avicennae	簕欓花椒	Tree 喬木	Common 常見	1		1				
Zanthoxylum nitidum	兩面針	Climber 攀爬類	Very Common 十分常見						2	
Albizia corniculata	天香藤	Climber 攀爬類	Common 常見						1	
Archidendron lucidum	亮葉猴耳環	Tree 喬木	Common 常見			1				
Atalantia buxifolia	酒餅簕	Shrub 灌木	Common 常見		1					
Berchemia floribunda	多花勾兒茶	Climber 攀爬類	Common 常見			1				
Caryopteris incana	蘭香草	Herb 草本 草本	Common 常見				1			
Cinnamomum camphora	樟	Tree 喬木	Common 常見			1				
Croton lachnocarpus	毛果巴豆	Shrub 灌木	Very Common 十分常見			1				
Dalbergia hancei	藤黃檀	Climber 攀爬類	Common 常見						1	
Daphniphyllum calycinum	牛耳楓	Tree 喬木	Common 常見			1				
Derris alborubra	白花魚藤	Climber 攀爬類	Common 常見							1
Thuja orientalis	側柏	Tree 喬木	不適用							1
Diospyros vaccinioides	小果柿	Shrub 灌木	Very Common 十分常見			1				
Diplospora dubia	狗骨柴	Shrub 灌木/Tree 喬木	Common 常見			1				
Embelia laeta	酸藤子	Climber 攀爬類	Very Common 十分常見		1					
Euonymus nitidus	中華衛矛	Shrub 灌木	Very Common 十分常見			1				
Ficus hirta	粗葉榕	Shrub 灌木	Common 常見			1				
Ficus microcarpa	細葉榕	Tree 喬木	Common 常見						1	
Ficus subpisocarpa	筆管榕	Tree 喬木	不適用				1			
Garcinia oblongifolia	黃牙果	Tree 喬木	Very Common 十分常見			1				
Glochidion lanceolarium	艾膠算盤子	Shrub 灌木	Common 常見							1
Heterosmilax japonica	肖菝葜	Climber 攀爬類	Common 常見						1	
Lespedeza chinensis	中華胡枝子	Shrub 灌木	Restricted 受局限				1			
Liriope spicata	山麥冬	Herb 草本	不適用				1			
Litsea glutinosa	潺槁樹	Tree 喬木	Very Common 十分常見						1	
Lygodium japonicum	海金沙	Fern 蕨類	Very Common 十分常見						1	
Machilus chekiangensis	浙江潤楠	Tree 喬木	Very Common 十分常見						1	
Machilus velutina	絨毛潤楠	Tree 喬木	Common 常見			1				

Species name 品種名稱	Chinese name 中文名稱	Growth form 生長形式	Status 狀況*	Liu Ko Ngam				Pak Sha Tau Tsui		
				Works Area 工程地點	**Shrubby grassland** 灌木草地	**Young woodland** 尚未成熟的樹林	**Coastal vegetation** 海岸植物	**Works Area** 工程地點	**Shrubland** 灌木	**Coastal vegetation** 海岸植物
Maclura cochinchinensis	構棘	Climber 攀爬類	Common 常見				1			
Melodinus suaveolens	山橙	Climber 攀爬類	Common 常見			1				
Merremia umbellata	山豬菜	Climber 攀爬類	Common 常見			1				
Clausena lansium	黃皮	Tree 喬木	不適用							1
Psidium guajava	番石榴	Tree 喬木	不適用							1
Phyllanthus emblica	油甘子	Tree 喬木	Very Common 十分常見						1	
Psychotria serpens	蔓九節	Climber 攀爬類	Very Common 十分常見							1
Rourea microphylla	小葉紅葉藤	Climber 攀爬類	Common 常見			1				
Sapium discolor	山烏桕	Tree 喬木	Very Common 十分常見			1				
Asparagus cochinchinensis	天門冬	Herb 草本	Common 常見							1
Centella asiatica	崩大碗	Herb 草本	Very Common 十分常見							1
Symplocos glauca	羊舌樹	Tree 喬木	Common 常見			1				

Notes 註：

* Status according to Corlett, R., Xing, F. W., Ng, S. C., Lawrence, Chau K. C. & Laura, Wong M. Y. (2000). *Hong Kong vascular plants: distribution and status*. Memoirs of the Hong Kong Natural History Society. 23: 1-147.

* 表中所列狀況，是根據 Corlett, R., Xing, F. W., Ng, S. C., Lawrence, Chau K. C. & Laura, Wong M. Y. (2000). 「香港維管植物：分佈和狀況」。香港自然史學會紀念集。 23: 1-147.

† Origin according to AFCD website. Available at http://www.afcd.gov.hk/english/conservation/hkbiodiversity/database/search.asp?lang=en&refine=1 [Accessed May 2010]

† 根據漁農自然護理署網頁所述原生地。有關資料，可於以下網址取得： http://www.afcd.gov.hk/english/conservation/hkbiodiversity/database/search.asp?lang=en&refine=1 〔於 2010 年 5 月瀏覽〕

Relative abundance: 1 = Scarce; 2 = Occasional; 3 = Frequent; 4 = Abundant

相對數量： 1 = 稀少； 2 = 偶有發現； 3 = 經常發現； 4 = 數量豐富

附件 C

漁業評估

C1 漁業評估

C1.1 引言

本附件闡述在擬建的電纜走廊之內及其附近的現有漁業資源和捕漁作業的相關資料，並評估本工程項目對這些資源的直接和間接潛在影響。在海底電纜的運營期間，預計不會對這些資源造成任何影響。因為大部份纜段都會被掩埋在海床下不少於 5 米的深度，電纜不會受到捕漁活動破壞，而海床在短時間內亦會被復原至施工前的水平和狀況。因此，本附件不再探討有關電纜在運營期間對漁業資源的影響。

C1.2 相關的立法、指引和評估準則

評估漁業影響的準則，均於《環評技術備忘錄》附件 17 中闡述，而附件 9 則建議了一些可以用於評估漁業影響的一般準則。其他適用於漁業的法例包括：《漁業保護條例》（第 171 章）是有關保護魚類和其他水中生物，並規管捕漁方法；以及《海魚養殖條例》（第 353 章）（1983 年），是要對海魚養殖和其他相關活動加以規管和提供保護。

C1.3 基線情況和敏感受體

香港的商業海魚業可以分為捕撈和養殖漁業兩部份。因此，下文所述的基線資料會分別環繞兩個標題闡述："捕撈漁業"和"養殖漁業"。這些基線情況，都是根據最新的香港漁業資料[(1)] 整理所成。是次研究為了調查擬議電纜走廊所經過的海域是否存在商業漁業的重要繁殖地或育幼區，也檢視了其他相關的研究 [(2)]。有關水產養殖的資料取自漁農自然護理署（以下簡稱"漁護署"）年報 [(3)]。

C1.3.1 捕撈漁業

捕撈作業

圖 C1 展示了 2005 年於香港海域作業的漁船數目和作業地區 [(4)]。在 2005 年時，有中等數目的漁船（100 - 400 艘）在擬議電纜系統附近海域作業，大多是圍網漁船和舢舨。這些漁船的長度都少於 15 米，是電纜路線上的主要作業漁船（*圖 C2*）。

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(1) 漁農自然護理署 (2006) 《2006 年捕魚作業及生產調查》。香港特別行政區政府。

(2) 香港環境資源管理顧問有限公司 (1998) 《香港海域的漁業資源和作業》。向香港特別行政區漁農自然護理署提交的最後報告。

(3) 漁農自然護理署 2011 -2012 年報。 [*http://www.afcd.gov.hk/misc/download/annualreport2012/index.html*] 於 2013 年 5 月瀏覽。

(4) 漁農自然護理署 (2012) 漁業：捕撈漁業概況。於 2012 年 5 月瀏覽。 [*http://www.afcd.gov.hk/tc_chi/fisheries/fish_cap/fish_cap_latest/fish_cap_latest.html*]

圖 C1 *漁護署 2006 年捕漁作業及生產調查所記錄的香港海域捕漁作業（所有漁船）分佈圖*

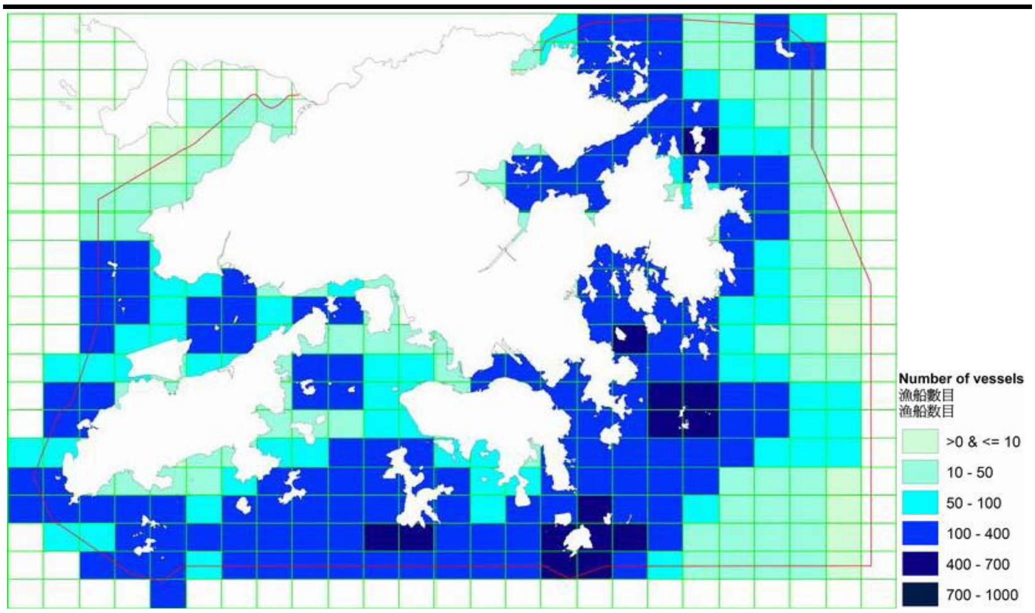
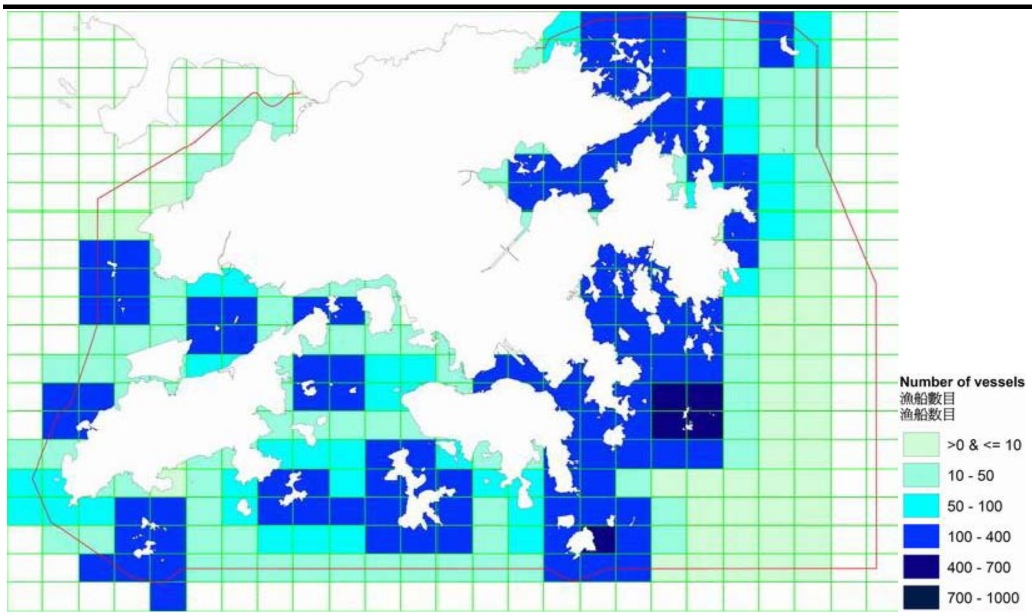


圖 C2 *漁護署 2006 年捕漁作業及生產調查所記錄的香港海域捕漁作業（超過 15 米長的漁船）分佈圖*



漁獲

雖然沒有香港海域內個別地點的數字，但估計 2012 年全港的漁獲量共達 155,230 公噸 [5]。

根據漁護署的《2006 年捕漁作業及生產調查》的數據，在 2005 年時，位於吉澳海域的擬議電纜系統附近海域的漁獲量屬於中等，每公頃約有 200 - 400 公斤的已成長魚類和少於 50 條的魚苗，每公頃的漁獲價值約為港幣 5,000 至 10,000 元（*圖 C3 - C5*）[6]。

(5) 漁農自然護理署 (2013) 漁業：養殖漁業概況。於 2013 年 5 月瀏覽。[*http://www.afcd.gov.hk/tc_chi/fisheries/fish_aqu/fish_aqu_mpo/fish_aqu_mpo.html*]

(6) 漁農自然護理署 (2013) *同上*。

在印洲塘海域的已成長魚類漁獲量屬偏低（每公頃 100 – 200 公斤），而魚苗產量則屬中等（每公頃 50 – 100 條），每公頃漁獲約值港幣 2,000 – 5,000（*圖 C3 - C5*）。

圖 C3 ***漁護署 2006 年捕漁作業及生產調查所記錄的香港海域內按重量（每公頃公斤數）計算的漁獲量（已成長魚類）的分佈圖***

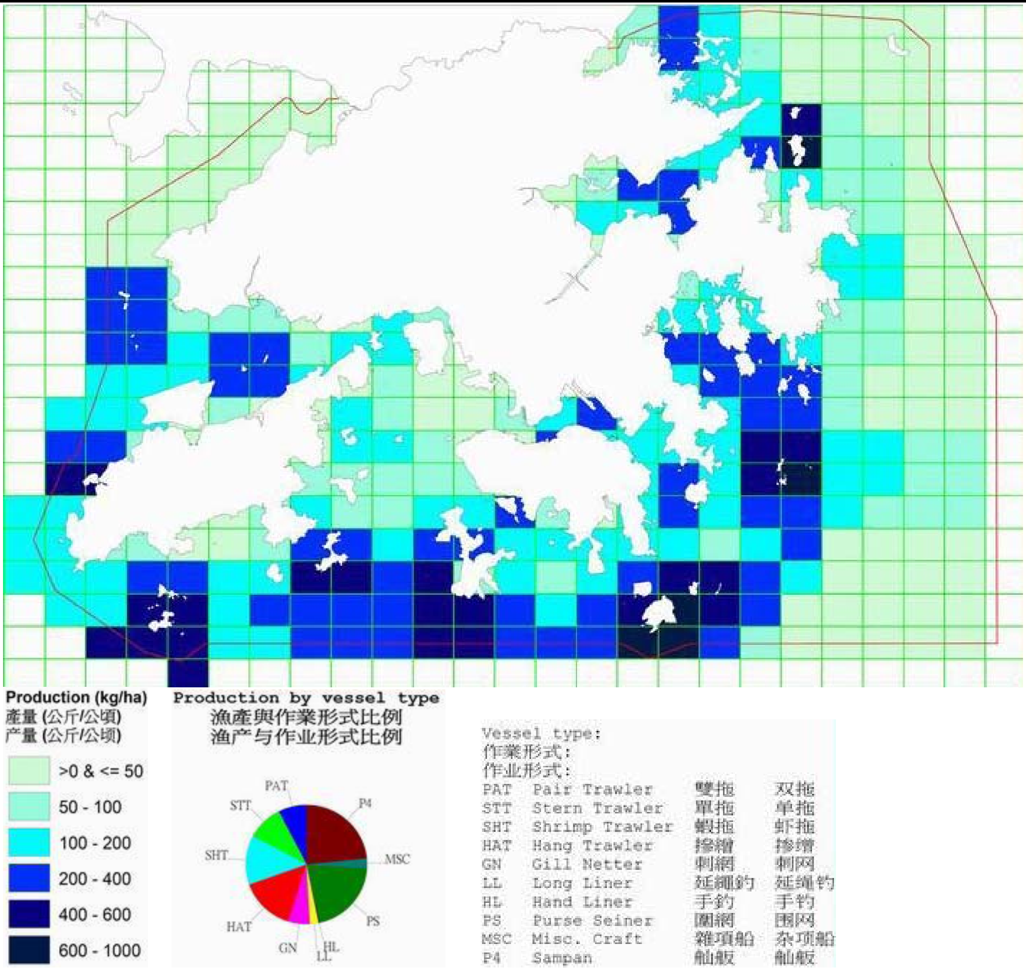


圖 C4 ***漁護署 2006 年捕漁作業及生產調查所記錄的香港海域內按每公頃條數計算的漁獲量（魚苗）的分佈圖***

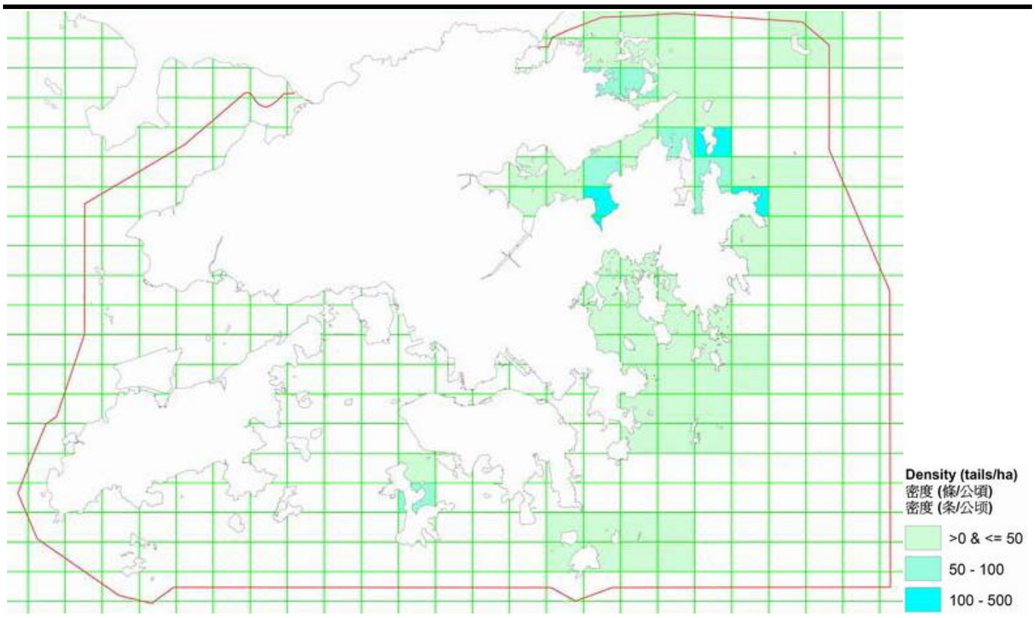
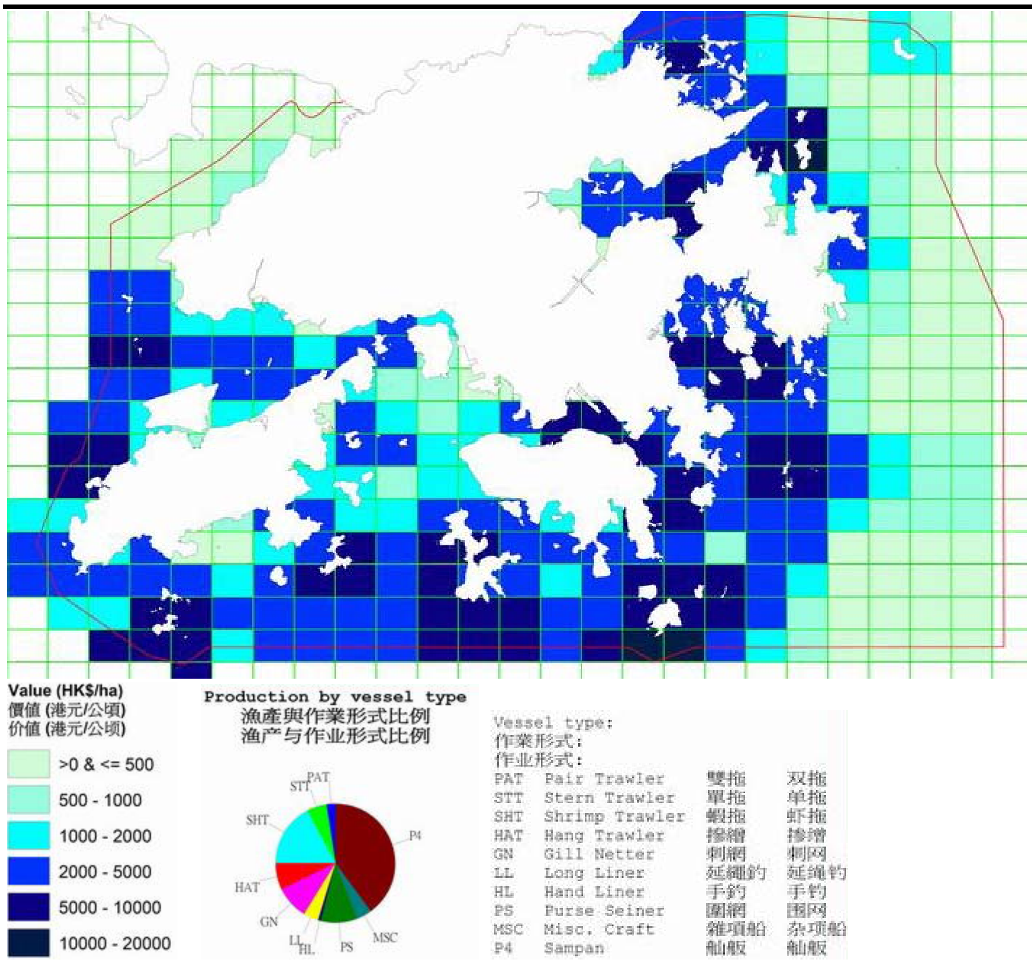


圖 C5 *漁護署 2006 年捕漁作業及生產調查所記錄的香港海域內按價值（每公頃港元）計算的漁獲量（已成長魚及魚苗）的分佈圖*



C1.3.2 *養殖漁業*

與擬議海底電纜最接近的魚類養殖區位於西流江，是在電纜路線東南面約 510 米。 其他魚類養殖區，包括澳背塘、吉澳和鴨洲，全都距離擬議海底電纜路線超過 1.5 公里（請參閱正文的*圖 1.2*）。

雖然沒有這些魚類養殖區的個別產量數字，但 2012 年全港的魚類養殖區總產量共達 1,299 公噸 (7)。所養殖的魚類大多是高商業價值的種類，包括龍躉（*Epinephelus lanceolatus*）、紅鮪（*Lutjanus argentimaculatus*）和黃鱲鯧（*Trachinotus blochii*）。

C1.3.3 *商業漁業資源的育幼區和繁殖場*

在先前的調查中，電纜走線穿過的地區已被識別為商業漁業資源的育幼和繁殖場 (8)（請參閱正文的*圖 1.2*）。香港海域內大部份魚類的繁殖期似乎都集中在 6 月至 9 月期間，因此，假定這地區的魚類繁殖期也集中在這段時間。如上文所述，電纜路線經過地區的魚苗產量屬於中等，每公頃約有 50-100 條（*圖 C4*）。

(7) 漁農自然護理署 (2013) 漁業：養殖漁業概況。於 2013 年 5 月瀏覽。[*http://www.afcd.gov.hk/tc_chi/fisheries/fish_aqu/fish_aqu_mpo/fish_aqu_mpo.html*]

C1.3.4 *人工魚礁*

漁護署的人工魚礁計劃，是要透過在適當地方建造和佈置人工魚礁來改善現有的海洋生境和漁業資源。一般而言，人工魚礁能夠為沒有天然掩護物的地區，提供硬底和高大的生境，而且可以成為促進漁業發展的裝置。印洲塘海岸公園和澳背塘人工魚礁的設置，都是以改善海洋生境質素和漁業資源為主要目的（請參閱正文的*圖 1.2*）。在 1998 至 2003 年間，在印洲塘海岸公園內共佈置了 19,820 立方米的人工魚礁， 由船隻、輪胎、混凝土塗層輪胎、粗石、預製混凝土構件和生物過濾器濾芯等組成。在澳背塘方面，於 2000 年共佈置了體積達 200 立方米的 4 個輪胎模組。它們距離擬議電纜鋪設路線最少 1 公里，由於相距很遠，因此不會受到本工程項目的施工和運營影響。水質模擬的結果也支持這個結論（*附件 A*）。

C1.4 *漁業的重要性*

根據上文所述的資料檢閱結果，研究區內的捕漁場與香港其他捕漁場相比，其價值和重要性都屬中等。

C1.5 *敏感受體*

根據先前檢閱有關擬議電纜系統附近海域的捕撈漁業和養殖漁業資料，下列敏感受體可能會受本工程項目影響：

- 西流江、澳背塘、吉澳和鴨洲的魚類養殖區；
- 已知的商業漁業資源的育幼區和繁殖場；
- 印洲塘海岸公園和澳背塘的人工魚礁。

C1.6 *影響評估*

C1.6.1 *潛在漁業影響的識別*

直接影響

擬議鋪設的電纜會以沖噴法掩埋於海床下 5 米深的地方。這種掩埋方法，令海床可以因為受滋擾的沉積物重新沉澱，以及自然侵蝕的效果而回復原貌。因此，預料海底的底棲動物會重新聚集在這些沉積物上，並為底棲漁業資源提供食物。預計本工程項目只會在鋪設電纜的階段對捕漁作業造成輕微干擾。因為電纜鋪設工程只需約 4 個星期完成，因此所造成的干擾極為輕微。在這些建築工程竣工後，海床會透過自然回填效果而回復原有狀態。因此，除了毗鄰電纜鋪設工程的海床會受到短期的輕微滋擾外，漁業資源或捕漁作業都不會受到任何長遠的直接影響。根據預測，這些短期滋擾亦不會影響漁業資源或捕漁作業。

(8) 香港環境資源管理顧問有限公司 (1998) 《香港海域的漁業資源和作業》。*同上*。

間接影響

電纜掩埋工程可以因為滋擾海床令懸浮固體含量增加而造成間接影響。然而，兩個登岸地點的挖泥工程所導致的懸浮固體增加，都會局限在小範圍內（在電纜走線的 60 米範圍內，以及在兩個登岸地點挖泥工程的 100 米範圍內），而且，其水平也不足以影響位於工程毗鄰地區以外的漁業資源。與擬議海底電纜和登岸地點最接近的魚類養殖區位於西流江，在電纜路線東南面約 500 米。其他魚類養殖區，包括澳背塘、吉澳和鴨洲，全都距離擬議海底電纜路線和登岸地點超過 1.5 公里。受本工程項目滋擾而呈懸浮狀態的沉積物，大都會保留在水體的底部，並會在短時間內沉澱回海床。預計在近岸海域進行電纜鋪設和掩埋工程不會對水質造成不可接受的影響，因此，亦不會對漁業造成不可接受的影響。所以，預計本工程項目只會對漁業資源造成極輕微的間接影響。

C1.6.2 影響評估

根據上述各項資料，本工程項目所造成的漁業影響屬偏低。以下是按照《環評技術備忘錄》附件 9 的要求進行的影響評估結果：

- *影響性質：*由於電纜鋪設工程的規模細小，而且對海床的滋擾屬局部性質，因此，無論是在電纜鋪設過程或在電纜運營期間，都不會對漁業資源和捕漁作業造成不可接受的影響。

- *受影響地區的大小：*在香港海域的電纜總長度約為 880 米。本工程項目不會令研究區內的漁業生境受到直接損失。沖噴工程和挖泥工程都會令研究區內的漁業生境／捕漁場受到暫時損失，然而，由於受影響地區範圍細小，而且受影響的時間很短，因此預測不會造成不可接受的影響。根據水質評估，由於本工程項目地點與大部份敏感受體之間的距離較遠，而且有關的建築工程規模細小，所以預計本工程項目對漁業的影響屬于輕微。預計挖泥工程所導致的懸浮固體增加會局限在小範圍內（在電纜走線的 60 米範圍內，以及在兩個登岸地點挖泥工程的 100 米範圍內）。沖噴工程會對海床造成輕微滋擾。

- *漁業資源／產量的大小：*在擬議電纜系統附近的捕漁區，其已成長魚類產量在香港海域中的排名是中等。由於受直接影響的地區範圍細小，而且影響時間短暫，因此，對漁業資源／產量的影響應屬輕微且可以接受。

- *繁殖場和育幼場所受的破壞和滋擾：*擬議電纜鋪設路線所經過的海域，已被識別為育幼和繁殖場。電纜鋪設工程需時較短，而且受滋擾的沉積物，最多只會擴散至距離電纜沖噴工程 60 米，或者距離兩個登岸地點挖泥工程 100 米的地方，因此，擬議海底電纜系統的施工和運營，都不會對香港海域內的育幼場和繁殖場造成不可接受的影響。

- *對捕漁活動的影響：*由於受影響範圍細小，而且海床的特點也沒有出現任何足以影響捕漁作業的改變；再加上有關的建築工程只會局限於了哥岩和白沙頭咀的前濱和擬議鋪設的電纜（約長 880 米），所以，預料本工程項目對捕漁活動的影響，只屬輕微。

- *對水產養殖活動的影響：*鑑於沖噴工程和挖泥工程所造成的懸浮固體增加只會局限在一個小範圍，而且程度極之輕微，所以魚類養殖區不會受到影響。

C1.7 *緩解措施*

本報告在“水質評估”（見*附件 A*）內所建議的良好施工方法和其他相關措施，已經避免了本工程項目對漁業資源和捕漁作業可能造成的大部份影響。因此，在鋪設海底電纜期間，無需為漁業實施特別的緩解措施。

C1.8 *總結*

是次研究檢閱了有關評估區內商業漁業資源和捕漁作業的現有資料。根據一項有關香港捕漁作業研究的資料，以及最新的漁護署《捕漁作業及生產調查》，在評估區附近的漁業產值雖然有變化，但大致上屬中等。

此外，亦已找出育幼區、人工魚礁和魚類養殖區等敏感受體，然而，有關水質影響的評估顯示，這些地區不會受到影響。

在鋪設電纜期間，預測該區的懸浮沉積物只會有輕微的增加。同樣地，挖泥工程所引起的懸浮固體含量增加只會局限在很小的範圍，因此不會影響工程附近的商業漁業資源。電纜鋪設工程雖然會滋擾海床，但不會對捕漁場造成暫時或永久的損失。此外，電纜鋪設工程竣工後，海床會恢復至原貌，因此不會影響漁業的營運。

本次工程項目無需為漁業資源實施特定的緩解措施。為減少水質影響而建議的緩解措施，也可以緩解漁業資源可能受到的影響。在實施各項為控制水質影響而建議的緩解措施後，海底電纜的施工便不會造成任何不良的剩餘影響。在施工期間進行的環境監察與審核程序，亦應該檢查在本報告“水質評估”部份所闡述的水質緩解措施的執行情況。除此之外，無需再為漁業實施其他特別措施。

附件D

水下考古調查

附件 D1

水下考古調查

目錄

D1 水下考古調查

D1.1 引言

本附件闡述了對本工程項目地點（包括11千伏的海底電纜）所進行的水下考古調查。是次水下考古調查包括了桌面研究、地球物理調查，以及評定有關地點的考古潛質，並評估工程可能對這些資源造成的直接和間接不良影響。

《水下考古調查報告》已於2010年11月18日獨立提交予古物古蹟辦事處，並於2010年12月17日及2011年2月8日收到該處的意見。

D1.2 法定要求及評估準則

下列法例和指引都適用於評估香港的水下考古遺址：

- 《環境影響評估條例（499 章）》及其附屬的《環境影響評估程序技術備忘錄》（環評技術備忘錄）；
- 《古物及古蹟條例（53 章）》；
- 《土地（雜項條文）條例（28 章）》；
- 《香港規劃標準與準則》；及
- 由古物古蹟辦事處釐訂的《水下考古調查指引》。

D1.2.1 環境影響評估程序技術備忘錄

《環評技術備忘錄》闡述了為水下考古遺址進行調查和評估時所需依循的方法。《環評技術備忘錄》的下列章節適用於本項目：

> *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，具有獨特考古歷史價值或建築學上的價值的地點，會視為非常重要。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上、考古學上及歷史上價值的地方、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。"*

《環評技術備忘錄》也闡述了文化遺產地點的影響評估準則：

> *附件10："評估對文化遺產地點影響的準則包括：(a) 一般假設為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。"

《環評技術備忘錄》也闡述了整體保存和部份保存文化資源的方法：

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。"

D1.2.2 古物及古蹟條例（53章）

《古物及古蹟條例（53章）》所提供的法律保護，可以防止法定古蹟、歷史建築和具考古研究價值的地點受到發展威脅，讓它們得以保存，供子孫後代享用。這條例的下列聲明也確立了須予遵循的法定程序。

"本條例旨在就保存具有歷史、考古及古生物學價值的物體…訂定條文。"

該條例把"古物"界定為一項古代遺物（在1800年以前人為製成的可移動物體）及在1800年前人為建立、闢設或建造的地方、建築物、地點或構築物。該條例亦指定：發現任何古物都必須向當局（發展局局長）報告；在1976年之後發現的古代遺物的擁有權屬於政府；當局可以宣佈一個地方、建築物、地點或構築物為一項古蹟、歷史建築物、考古或古生物地點或構築物（並因此為這些地點引入額外控制）；及可以就挖掘和其他工作發出執照和許可證。

多年來，香港進行過很多調查，務求找出具考古研究價值的地點。古物古蹟辦事處已經為已知的地點定立邊界和行政程序，藉此保護已知的具考古研究價值地點。然而，目前有關具考古研究價值地點的記錄尚不完整，因為有很多地區仍未進行調查。因此，有必要確保一個項目在規劃初期便能找出和實施適當的程序和機制，來讓先前未知，但在進行項目評估或施工時可能被發現的考古資源得以保存，或作出正式通知。

《古物及古蹟條例》第11條規定，任何人發現古物或假定古物，須向古物事務監督報告。據此推論，當一個項目在進行評估或施工時若發現考古資源，便必須正式知會古物事務監督和古物諮詢委員會(1)。

D1.2.3 土地（雜項條文）條例（28章）

根據這*條例*，若要在政府土地上進行挖掘，便必須在動工前領取許可證。

(1) 古物古蹟辦事處是向古物諮詢委員會傳遞資訊的門戶。古物諮詢委員會是一個法定機構，由各個相關界別的專門人材組成，向政府提供有關古物和古蹟事項的意見。

D1.2.4 *香港規劃標準與準則*

《香港規劃標準與準則》"第十章：自然保育及文物保護"為保護歷史建築、具考古研究價值的地點和其他古物，提供了一般指引和措施。

D1.2.5 *水下考古調查指引*

*附件D1-1*闡述了有關水下考古調查的指引，當中詳述了在決定水下考古潛質、考古文物的存在和界定適當緩解措施時必須依循的標準做法、程序和方法。水下考古調查的第一階段工作包括：基線情況檢閱、地球物理調查和確定考古潛質。視乎第一階段的結果而定，可能需要或不需要再作深入調查

D1.3 *評估方法*

D1.3.1 *水下考古調查指引*

在評估水下考古潛質，是否存在考古文物及決定適合的緩解措施時必需按照古物古蹟辦事處之《水下考古調查指引》解釋了水下考古調查的標準做法、程序和方法進行。文獻檢閱、地球物理調查及確定水下考古潛質是水下考古調查的第一階段工作。根據第一階段的結果，可能需要或不需要進一步的調查。

D1.3.2 *調查範圍*

水下考古調查的調查範圍定為可能發展的範圍並可見於圖*D1-1*。水下考古調查的調查範圍應包括在吉澳相距擬鋪設的11kV海底電纜297米至380米的範圍。

D1.3.3 *桌面研究*

調查已為沿電纜走廊的範圍進行了一個桌面研究，制定了詳細的考古資源清單。桌面研究包括檢閱過一些考古刊物以及英國海道測量部的沉船檔案，以評估擬鋪設的電纜走廊之水域的考古潛質。此外，亦檢閱了在評估適合的電纜走線而進行的地球物理調查結果，以確定可能具有考古潛質的物質。

D1.3.4 *地球物理調查*

EGS (Asia) Limited在2010年7月2日至7日期間，在調查範圍進行了地球物理調查，以了解海床和海床之下有否水下考古遺址及其位置。

地球物理調查使用的儀器包括地震剖面儀、多波束聲納、回聲探測器、磁動計和旁測聲納，並使用兩艘船隻，以配合所用的儀器和調查地點。見*圖D1-2*）調查是以擬鋪設的初期電纜路線為中心的走廊進行，其闊度為700米。主要的測量導線採用東北及西南走向，相隔20米，並附以相隔

100米並橫跨主要導線的測量進行。共完成長達136公里的測量導線。在2010年7月26日至27日期間，亦使用了另一船，沿擬鋪設的電纜路線進行了九個鑽探孔。這些調查及鑽探孔資料有助完整地調查海床及海床下的狀況。調查範圍水深在0.3米至13.2米間（見*圖D1-3*）。

地球物理調查所用的設備如下：

- C-Nav GcGPS （全球校正式全球定位系統）
- Odom DF 3200 MKIII-P 回聲探測器
- Reson 8125多波束聲納系統
- Edgetech Sonarlink1旁測聲納系統
- 高解像度地震剖面儀
- Knudsen 320M回聲探測器
- Seaspy (GSM-19MD) 海洋磁動計系統

D1.3.5 確定水下考古潛質

地球物理調查資料已被詳細分析，其結果亦整合在海床特徵及考古潛在物質位置的地圖中。這樣有助設計調查及評估的策略。若有發現文化遺留，可能需要進行步調查。然而，其需要性亦要根據檢閱對有關水域的考古潛質之結果而決定。若沒有發現文化遺留或其考古潛質檢閱結果顯示該處沒有考古潛質的存在性，便不會建議進一步工作。

D1.3.6 評估影響及作出建議

根據基線情況分析結果及評估了水下考古潛質後，進行了影響評估以評估擬議之發展對水下考古資源或遺址的潛在影響，並建議所需之水下考古工作或緩解措施以避免及減低其影響。

是項評估根據《環評技術備忘錄》附件10第2.1項及附件19第2.6至2.14項進行評估，並以整體原址保留為首要考慮。

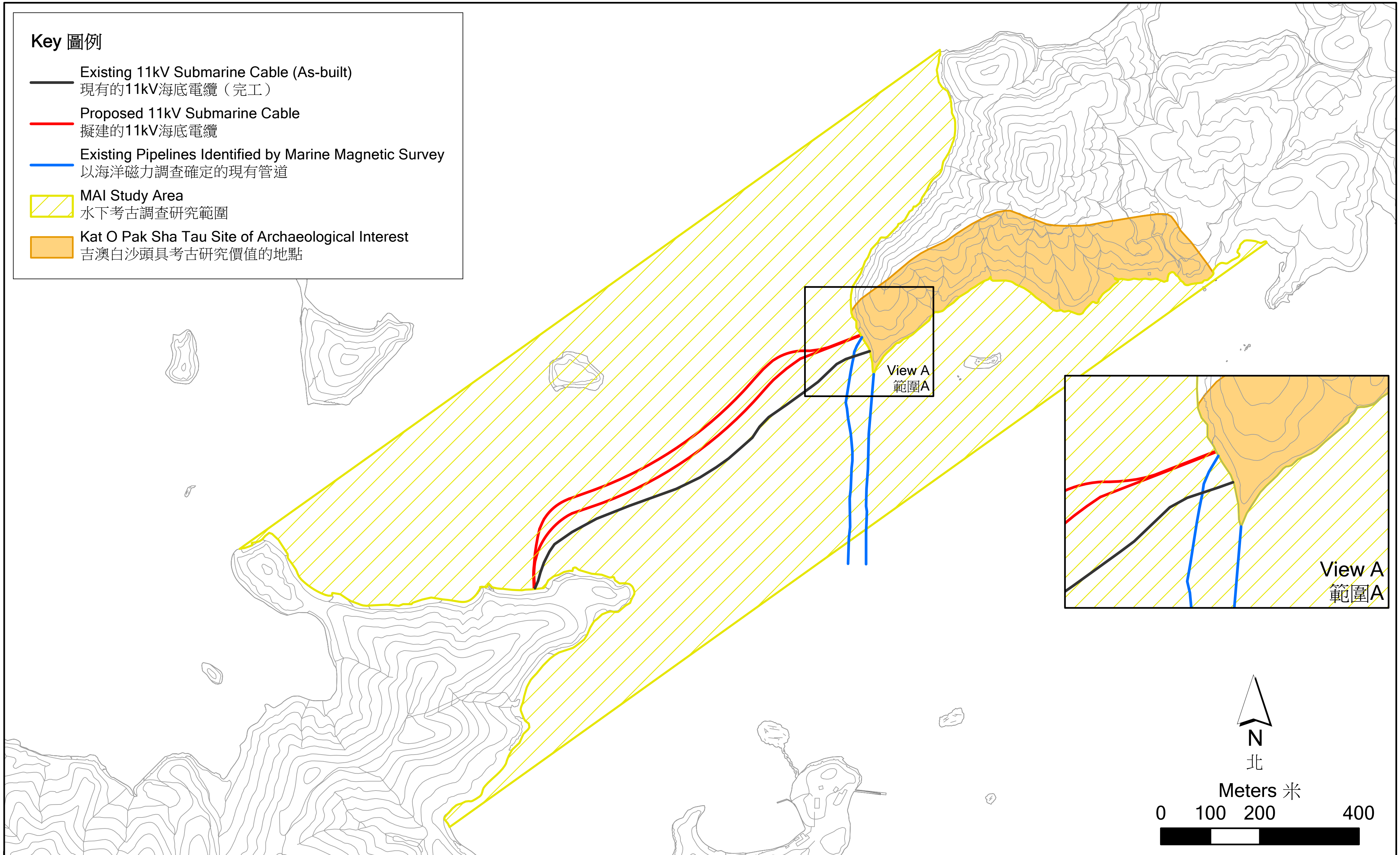


Figure D1-1
圖D1-1

File: 0114462_MAI study area.mxd
Date: 17-Oct-2012

MAI Study Area

水下考古調查研究範圍

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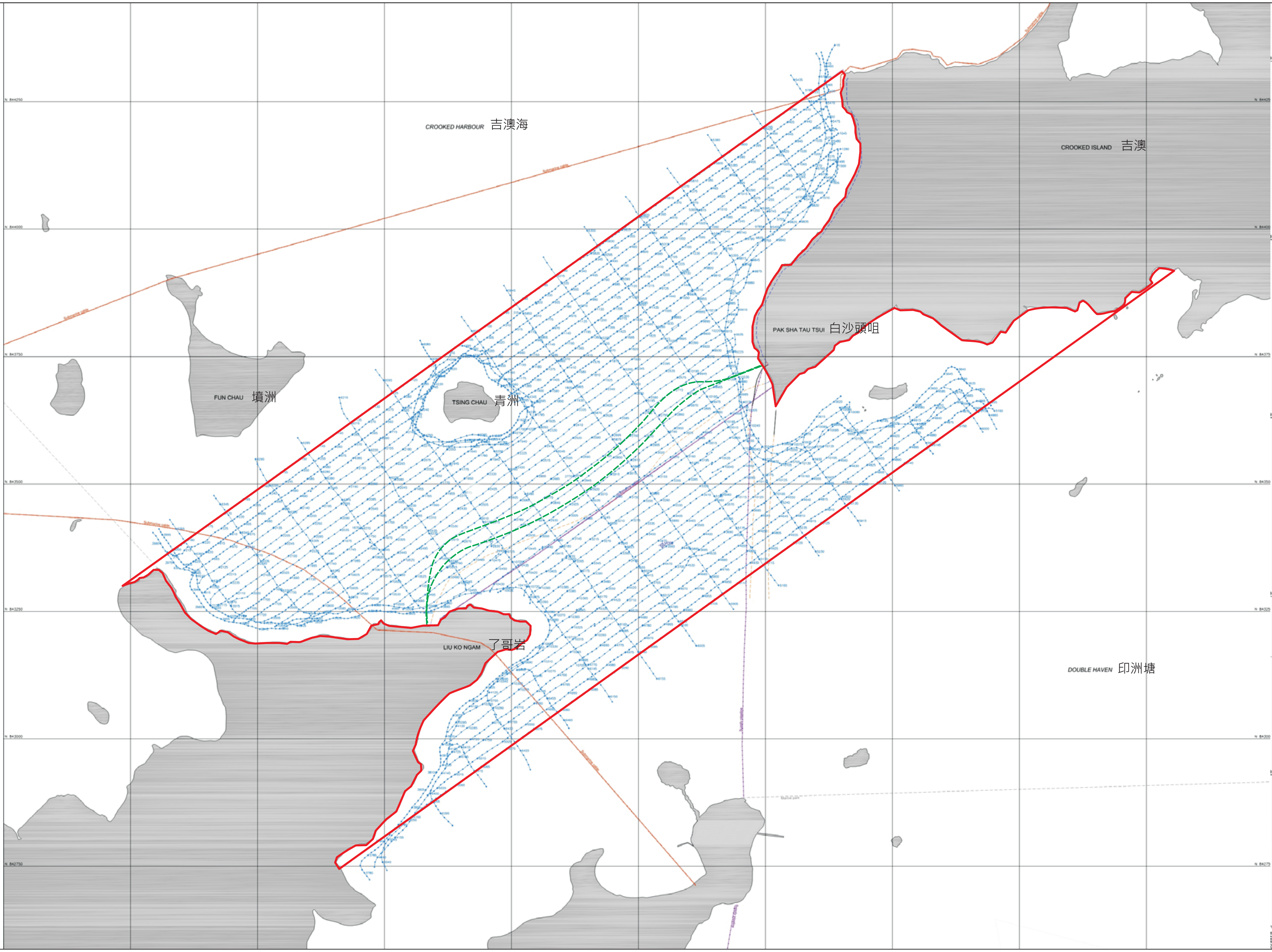
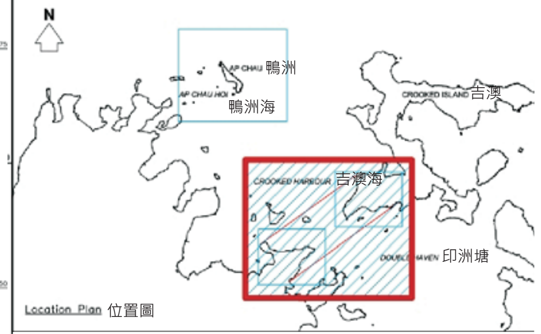


Legend 圖示:

- Vibrocore locations 鑽探位置
- Hydrophone track with fix positions 有定位的水中測音器航跡
- MAI Study Area 水下考古調查研究範圍
- Proposed 11kV Submarine Cable 擬建的11千伏海底電纜
- Pipeline from EGS database EGS資料庫記錄的管道
- Cable from EGS database EGS資料庫記錄的電纜
- PCCW cables (from client) 由項目倡議者提供的PCCW電纜
- Interpreted existing cable/pipeline position by magnetometer 根據磁力儀調查結果而確定的現有電纜/管道位置
- Interpreted existing cable/pipeline position by land topographic survey 根據地貌調查結果而確定的現有電纜/管道位置
- Concrete surround for water pipe 包圍水管的石屎



Notes :

1. Survey Date 測量日期 : 02-07,26-27/07/2010
2. Survey Grid 測量方格網 : Hong Kong 1980 Grid System 香港1980方格網系
3. Survey Datum 測量基準 : Hong Kong Principal Datum 香港高程數值
4. Positioning 位置 : C-Nav GcGPS (Globally corrected GPS)(全球校正式全球定位系統)
5. Equipment 儀器 : Odom DF3200 MKIII - P Dual Frequencies Echo Sounder 回聲探測器
   Edgetech Sonarlink1 Side Scan Sonar System 旁測聲納系統
   Knudsen 320M Echo Sounder 回聲探測器
   Reson 8125 Multibeam System 多波束聲納系統
   Seaspy (GSM-19MD) Magnetometer 海洋磁動計系統
6. Coastline taken from 1:1,000 Survey Sheets, Survey and Mapping Office, Lands Department 海岸線取自地政總署1:1000比例測量圖

Revision No.	Date	Drawn by	Checked by	Approved by	Remarks
0	13/07/2010	Clarence Siu	Margie Chen	Matthew Lai	Preliminary
1	19/08/2010	Clarence Siu	Peter Chu	Matthew Lai	Final

METRIC SCALE 1:2,500 比例尺

125 100 75 50 25 0 125 250

Client : CLP 中電

Surveyor : EGS (ASIA) LIMITED

JOB NO. : HK220310

Figure D1-2

圖D1-2

Hydrophone Track Plot 水中測音器航跡圖

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FILE: 0114462a-chi
DATE: 16/10/2012

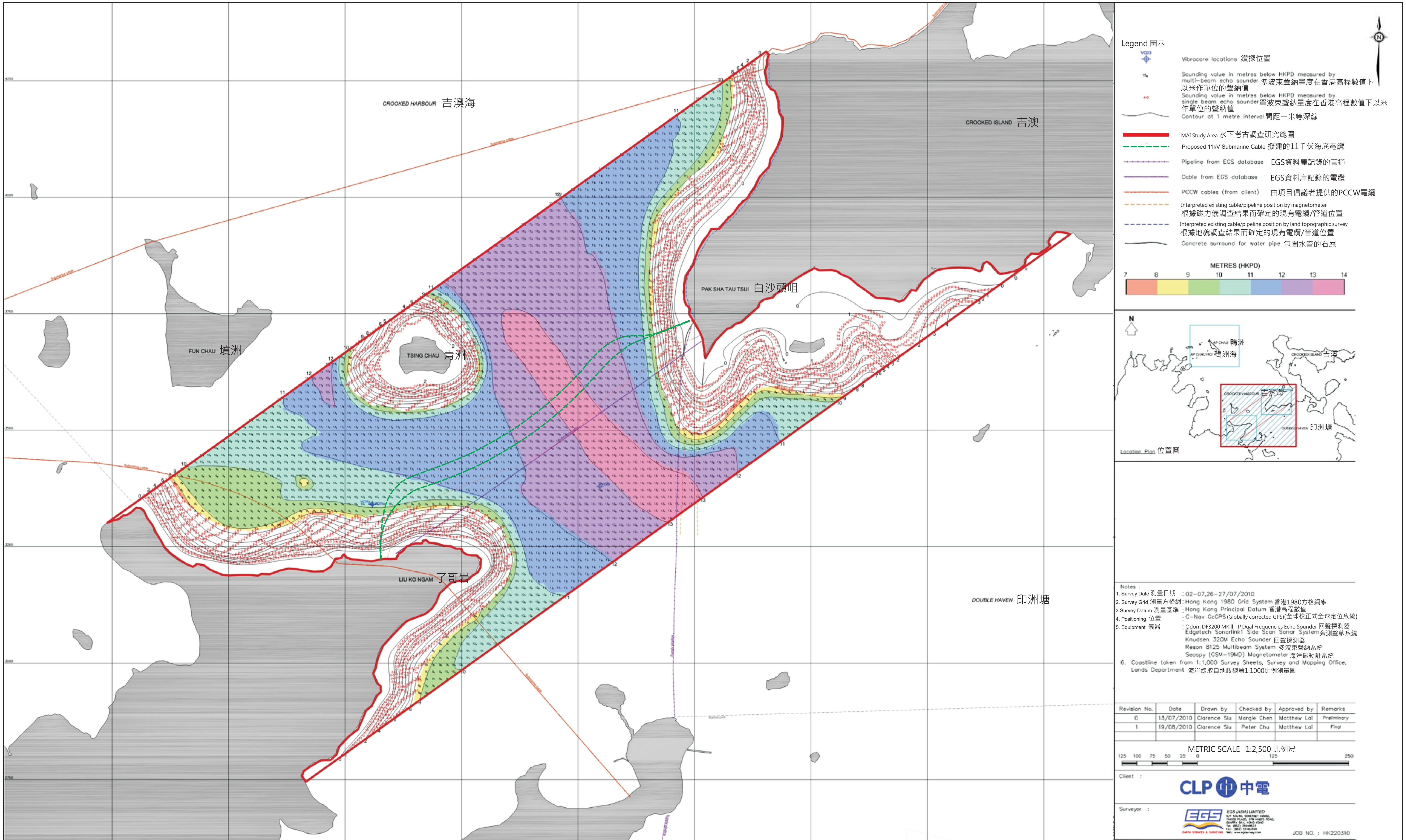

Figure D1-3

圖 D1-3

Seabed Levels 海床標高

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FILE: 0114462b-chi
DATE: 16/10/2012

D1.4 基線情況

D1.4.1 桌面研究結果

土力背景

香港地區的海相沉積物可以分成兩個地層組：赤鱲角組和覆蓋在上面的坑口組。赤鱲角組是在各個第四紀地層中最底的部份，屬於更新世的中期至晚期，是由崩積層、沖積層和湖泊沉積物組成（見Fyfe等人於2000年的著作）。在這個地層之上的海相沉積則屬全新世時期（約從距今13,000年至現在），並被稱為坑口組。它是由黏質粉土沉積物和砂（泥、砂質泥）組成。

在赤鱲角組和坑口組之間的是深屈組，屬於伊姆間冰期的沉積層，但年期未能確定。它是由柔軟至結實，並帶黃色班的粉質黏土形成。這個地層組分佈不廣，只發現於坑口組下露頭處（見Fyfe等人於2000年的著作）。

全新世晚期的沉積物一般都是由十分鬆軟至鬆軟程度的粉質黏土為主，成份比較均勻，含水量亦較高。相對於通常已受捕漁和其他航運活動滋擾的海床表面而言，這種沉積物地區，是最有可能埋藏一些保存完好的，與香港海域各島嶼的開發與使用相關的文物。其中可能會有沉船。

歷史背景

考古証據顯示，航海人員使用香港海域已有約6,000年（見Bard的1988年著作）。在Chau的1993年著作中有這樣的記載：

> *過去十年間，在沿岸沙洲發現多個史前遺址，都是早期移民開發這一帶海岸和離島的證明。在大約六千年前，新石器時代的人類已經在華南沿岸定居。*

在吉澳島上有一個位於研究範圍邊緣的具考古研究價值的地點，名叫吉澳白沙頭（見*圖D1-1*）。從該處出土的文物顯示，該島在新石器時代和從宋朝至清朝的時期，都有被居住和使用。其他已知的具考古研究價值的地點（吉澳島（北）、吉澳島（南）和吉澳上圍）都位於毗鄰的大陸上。在清朝時，吉澳島上主要是客家人。島上的天后宮、宗祠和水月宮都可以上溯至清朝中葉。有一種說法認為，該島以“吉”字為名，是因為過去該島為眾多漁船提供良好的避風港，意為繁榮昌盛、逢凶化吉。而英文島名用 "Crooked" 一字，有彎曲之意，應是以該島的形狀取名。

在1960年代，約有3,000人居於吉澳，更有數百艘漁船停泊該島。到2006年時，估計只有約300人仍居於島上。根據記載，在十九世紀中葉有約2,000名海盜聚居於吉澳，吉澳和沙頭角一帶，是香港東面最大的海盜巢穴（見龍康琪的2001年著作第346頁）。

島上亦有發現三尊十九世紀的大炮，相信是源自歐洲。

當代情況

是次研究範圍位於新界東北部的吉澳和了哥岩之間（見*圖D1-1*）。Glibbery在其著作中（1994年第47-48頁）對吉澳西南面地區，以及該島與大陸之間一帶地區的當代情況，有這樣的描述：

> *在轉至〔吉澳的〕西岸時，該島的西南角（白沙頭）便成了一個寬闊的碼頭，其原因可以在該島的名字中找到。倘若深入西岸，在海灣入口的盡頭處，是一個深受蔭蔽的海灣：深涌。這裏有寬闊的水域可供碇泊，良好泥底亦能吃住船錨，但要盯住回聲探測器，因四周有乾涸的泥灘。島上居民大都聚居於吉澳灣西北岸。*
>
> *吉澳的西岸、新界的東岸從了哥岩至沙頭角海一帶，合組成吉澳海。青洲位於了哥岩北面，四周被岩石環繞，其北岸有巨石落於海中。西面是另一個較大的島嶼墳洲，其南端是一個沙咀。*

英國海道測量部沉船檔案

位於湯頓市的英國海道測量部和香港政府海事處的海道測量部都有香港特別行政區的已知沉船數據庫。

是次研究搜尋了這些數據庫，都沒有發現研究範圍內有任何沉船地點。

總結

雖然有關研究範圍的文獻檢閱其基線情況發現該區有可能有水下文化遺產，然而，無論從文獻上或數據庫裏，都沒有發現研究範圍內有任何具歷史或考古研究價值的地點。

D1.4.2 地球物理調查結果

為了確定研究範圍的水下考古潛質，並評估擬議工程項目可能造成的水下考古影響，是次地球物理調查首先界定最具考古潛質的地區和地點，其中包括評估海床沉積物的深度和性質，並會在地圖上標出海床上和海床下的異常變化，因為那是可能具考古研究價值的物品。下文闡述了有關的資料。

研究人員使用旁測聲納調查來製作海床地圖，上面提供了有關海床性質的詳情，以及各類海事活動（如捕漁、拖網和錨碇）對海床的影響，還會顯示海床上的特色（見*圖D1-4*和*D1-5*）。

海床的性質包含以淤泥／土為主的地質至砂／礫地質，也混雜了低地勢的石塊／珊瑚和砂／礫。一般而言，研究範圍的沉積物比香港特別行政區（特別是香港島西面）的沉積物較粗糙（見*圖D1-6*）。研究範圍的海床也有受船錨和拖網影響的痕跡，但較香港島西面少（見*圖D7*）。

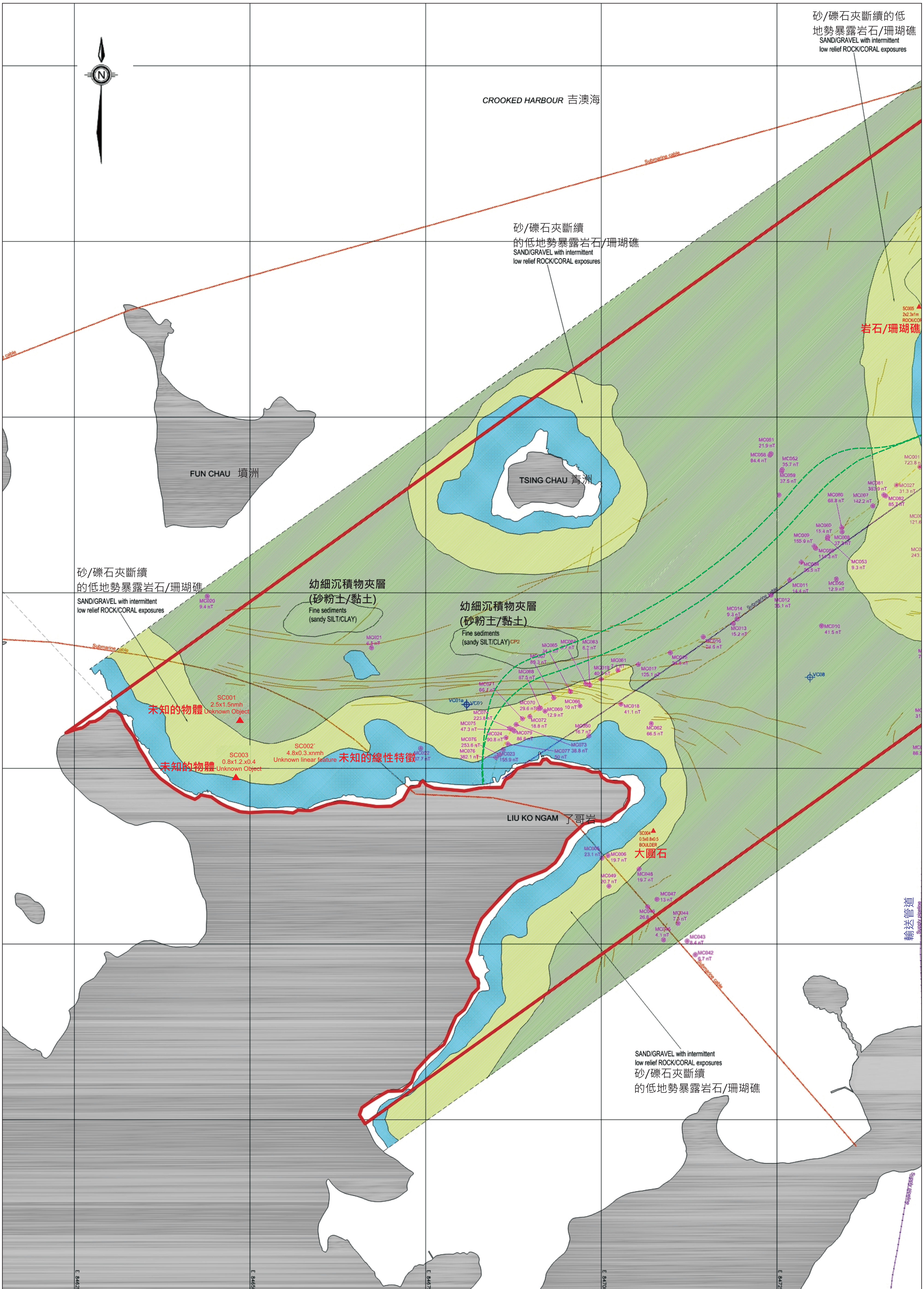

Figure D1-4 圖D1-4

Seabed Features (Sheet 1 of 2)
(Refer to Figure D1-5 for Legend)
海床特色（第1頁，共2頁）（有關圖例說明，請參閱圖D1-5）

FILE: 0114462c_1-chi
DATE: 16/10/2012

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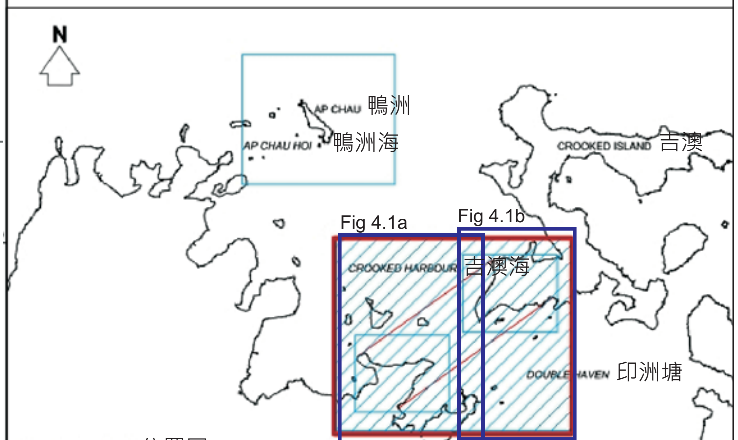
Legend :

VC03	Vibrocore locations 鑽探位置
	MAI Study Area 水下考古調查研究範圍
	Proposed 11kV Submarine Cable 擬建的11千伏海底電纜
	Pipeline from EGS database EGS資料庫記錄的管道
	Cable from EGS database EGS資料庫記錄的電纜
	PCCW cables (from client) 由項目倡議者提供的PCCW電纜
	Sonar contact (LxWxH) 聲納接觸位置 (長 寬 高)
	Linear features 線性特徵
MC_022 157.9nT	Magnetic contacts 磁力接觸位置
	Anchor / trawl marks 錨/拖網拖痕
	Fine sediments (SILT/CLAY) 幼細沉積物夾層 (粉土/黏土)
	CORAL with SAND/GRAVEL matrix 珊瑚礁夾砂/礫石陣
	Boulder 大圓石
	SAND/GRAVEL 砂/礫石
	Concrete surround for water pipe 包圍水管的石屎
	Interpreted existing cable/pipeline position by magnetometer 根據磁力儀調查結果而確定的現有電纜/管道位置
	Interpreted existing cable/pipeline position by land topographic survey 根據地貌調查結果而確定的現有電纜/管道位置



Location Plan 位置圖

Notes :
1. Survey Date 測量日期 : 02-07,26-27/07/2010
2. Survey Grid 測量方格網 : Hong Kong 1980 Grid System 香港1980方格網系
3. Survey Datum 測量基準 : Hong Kong Principal Datum 香港高程數值
4. Positioning 位置 : C-Nav GcGPS (Globally corrected GPS)(全球校正式全球定位系統)
5. Equipment 儀器 : Odom DF3200 MKIII - P Dual Frequencies Echo Sounder 回聲探測器
Edgetech Sonarlink1 Side Scan Sonar System 旁測聲納系統
Knudsen 320M Echo Sounder 回聲探測器
Reson 8125 Multibeam System 多波束聲納系統
Seaspy (GSM-19MD) Magnetometer 海洋磁動計系統
6. Coastline taken from 1:1,000 Survey Sheets, Survey and Mapping Office, Lands Department 海岸線取自地政總署1:1000比例測量圖

Revision No.	Date	Drawn by	Checked by	Approved by	Remarks
0	13/07/2010	Clarence Siu	Margie Chen	Matthew Lai	Preliminary
1	19/08/2010	Clarence Siu	Peter Chu	Matthew Lai	Final

METRIC SCALE 1:2,500 比例尺
125 100 75 50 25 0 125 2...

Client : CLP 中電

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
Web: www.egssurvey.com
EARTH SCIENCES & SURVEYING

JOB NO. : HK22031...

Figure D1-5 圖D1-5

Seabed Features (Sheet 2 of 2)
海床特色 (第2頁 · 共2頁)

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FILE: 0114462c_2-chi
DATE: 09/05/2013

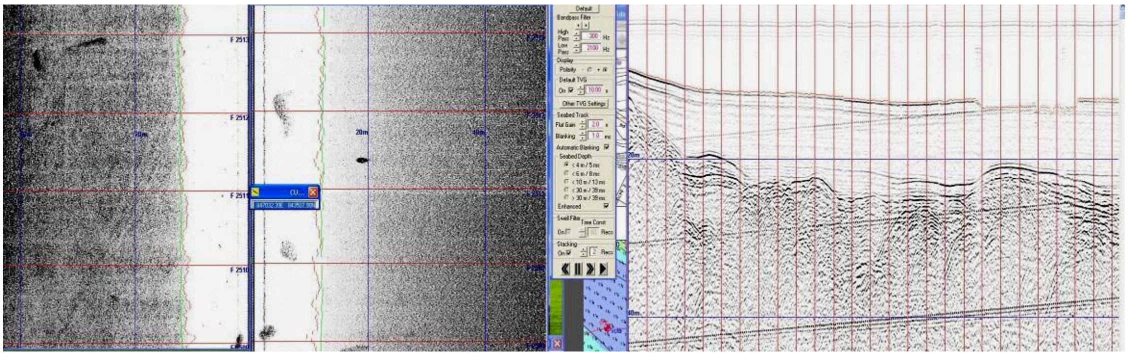
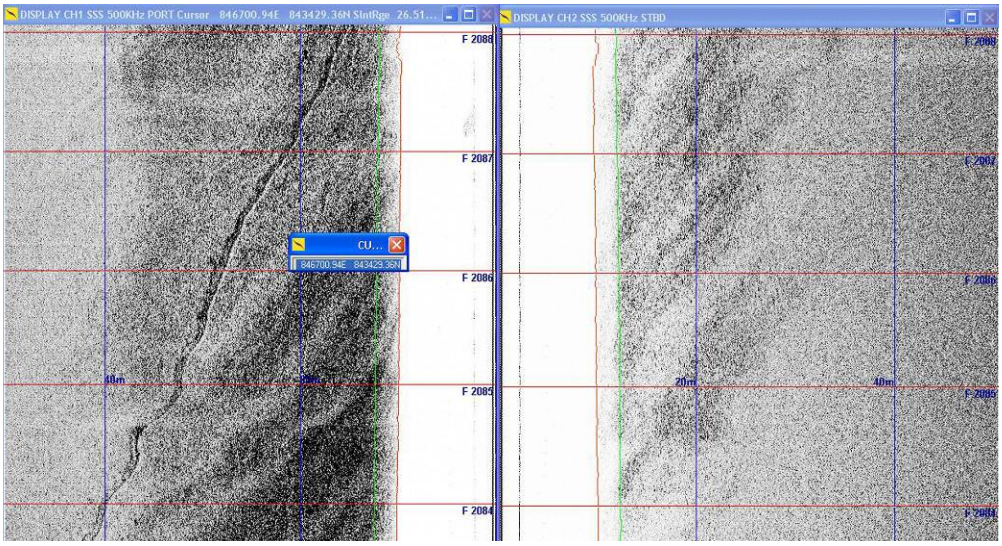


圖 D1-6 *從旁測聲納影像（左）和地震聲納影像（右）可以見到在“幼細沉積物”地區發現的粗糙海床沉積物（見圖D1-4和D1-5）*



圖D1-7 *海床上由錨碇造成的拖痕*

在進行旁測聲納調查時，發現了七個海床特色（聲納接觸點）。一如*表D1*所示，其中四個的來源不明，其餘三個則是石塊和一條管道，都距離擬議電纜鋪設路線不少於180米（見*圖D1-8*）。有關不明的聲納接觸點的位置，請參閱*圖D1-4*和*D1-5*。

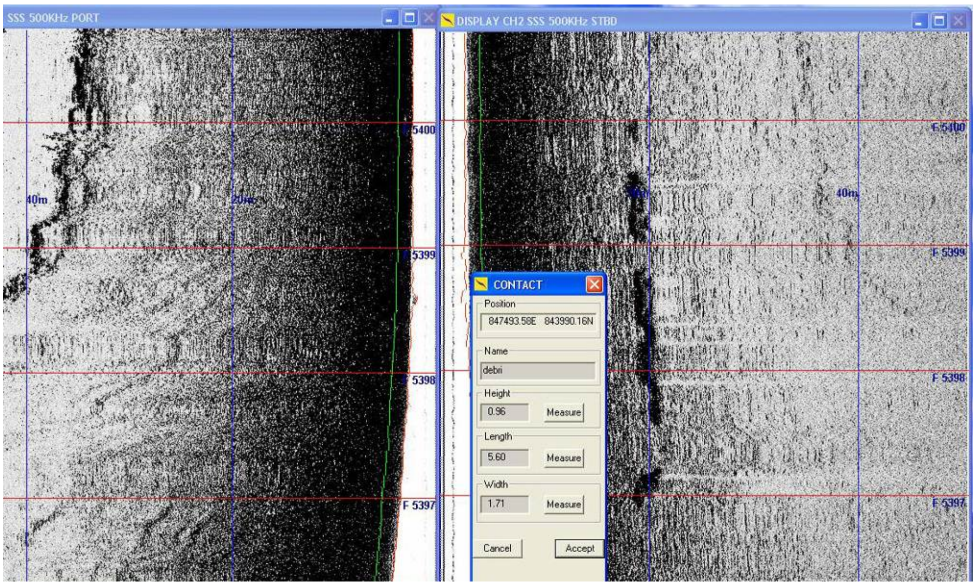


圖 D1-8　旁測聲納調查所發現的石塊或碎物（編號為SC005，見圖D1-4和D1-5）

表D1　不明的聲納接觸點

聲納接觸點編號	大小	與擬議電纜鋪設路線的距離（米）	座標
SC001	2.5 x 1.6 x 沒有量度高度	353	846486 東, 843318 北
SC002	4.8 x 0.3 x 沒有量度高度	289	846547 東, 843277 北
SC003	0.8 x 1.2 x 0.4 米	355	846480 東, 843237 北
SC007	1.2 x 0.5 x 0.9 米	202	847608 東, 843564 北

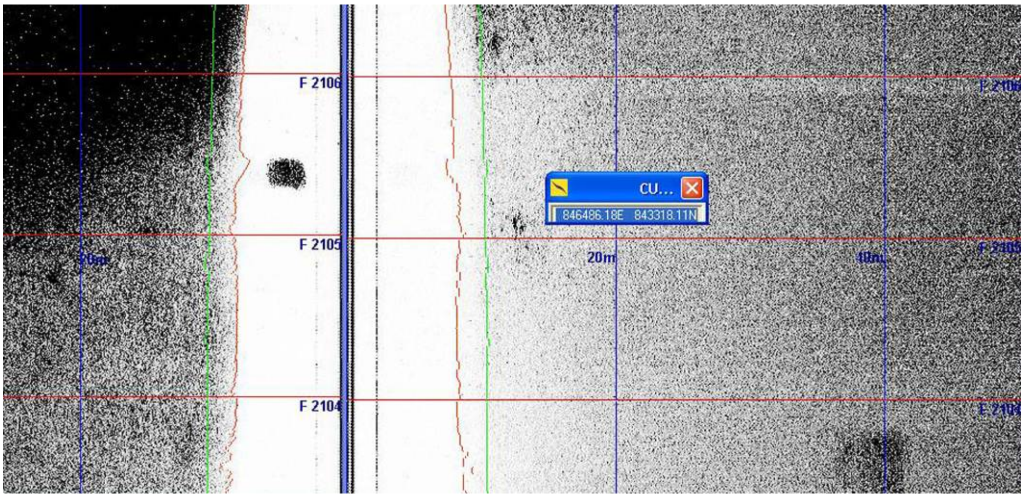


圖 D1-9　SC001

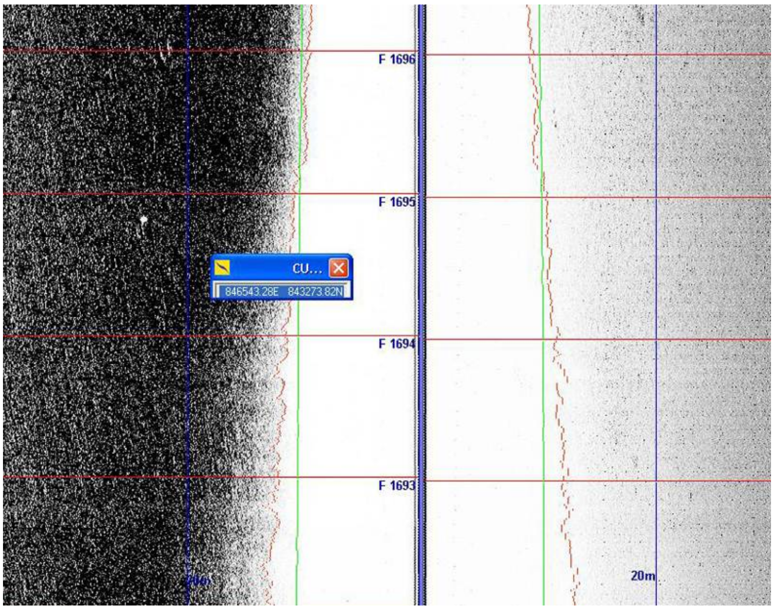


圖 D1-10　　SC002

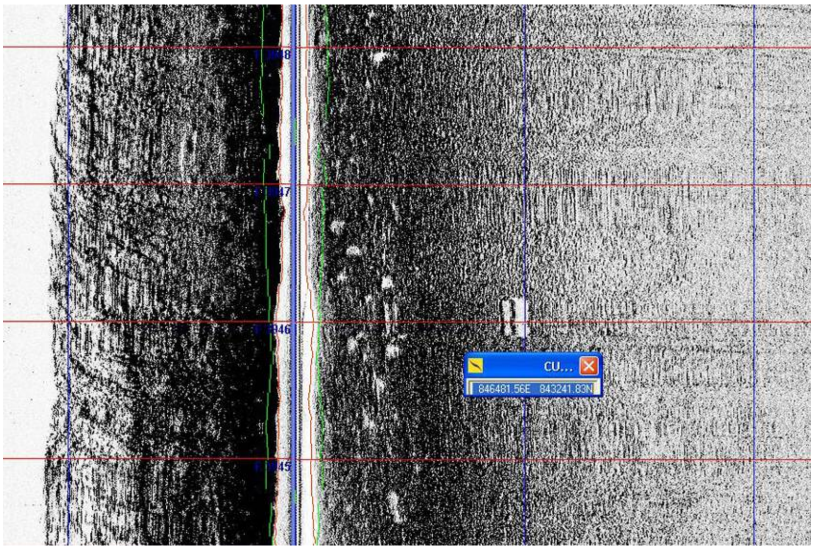


圖 D1-11　　SC003

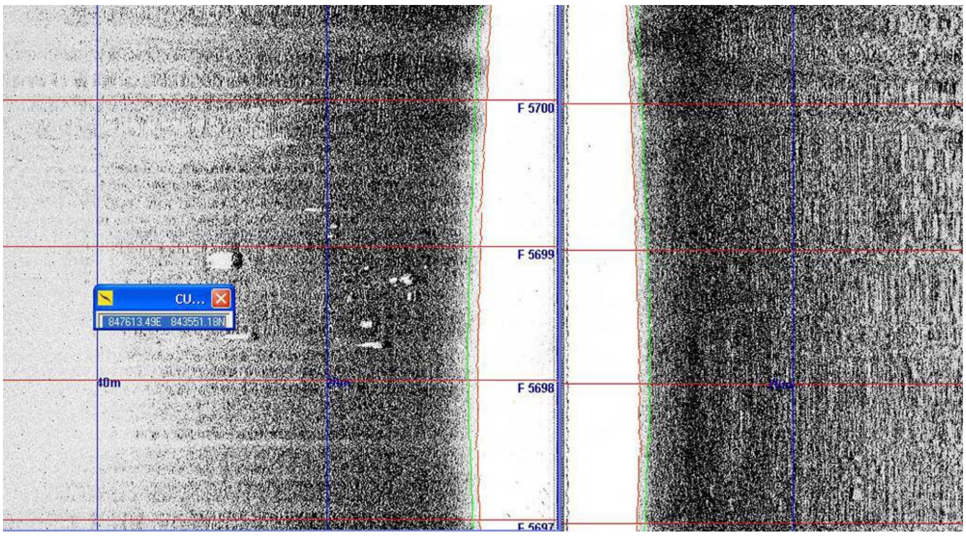


圖 D1-12　　SC007

四個不明的聲納接觸點SC001、002、003和007應為自然界物質，例如石塊。他們全都貼近有很多其他石塊的岸邊。

磁動計調查結果

磁力調查是要找出現有電纜和管道的位置。是次調查共發現五條電纜和一條管道。此外，亦發現多個與電纜和管道無關的異常情況，其詳情羅列於*表D2*，而位置則展示於*圖D1-4*和*D1-5*。這些未明的磁力異常地點在距離擬議電纜路線17米至436米的地方發現。

表D2　　未明的磁力接觸點

磁力接觸點編號	強度	與擬議電纜鋪設路線的距離（米）	座標
MC010	41.5 毫微	128	847313 東, 843452 北
MC018	41.1 毫微	70	847 028 東, 843341 北
MC020	9.4 毫微	436	846439 東, 843495 北
MC021	6.5 毫微	192	846672 東, 843421 北
MC022	37.7 毫微	95	846742 東, 843278 北
MC050	16.7 毫微	96	846982 東, 843296 北
MC051	21.9 毫微	64	847241 東, 843697 北
MC052	35.7 毫微	37	847257 東, 843675 北
MC057	5.2 毫微	17	847252 東, 843639 北
MC058	84.4 毫微	64	847239 東, 843695 北
MC059	37.5 毫微	37	847256 東, 843673 北
MC062	66.5 毫微	112	847071 東, 843313 北

雖然這些異常地點不會受到擬議電纜鋪設路線影響，但是次調查仍然加以探討。這些異常地點都沒有可以辨識的海床特色，亦沒有任何明顯的海床下特色。由於磁動計的感應器是在距離海床只有二至五米的位置拖行，由於它所記錄到的地球磁場僅有輕微變化，說明有關的鐵質物件都很細小，可能是被傾倒的物料，或者是被完全覆蓋或無法分辨的天然物料。以下圖像是這類磁力異常現象中最接近擬議電纜鋪設路線的例子（*圖D1-13*至*D1-16*）。

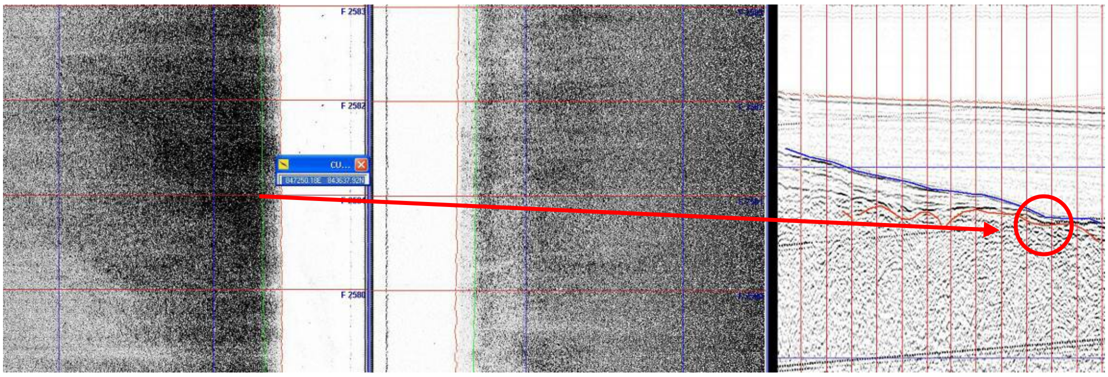


圖 D1-13　　MC 057

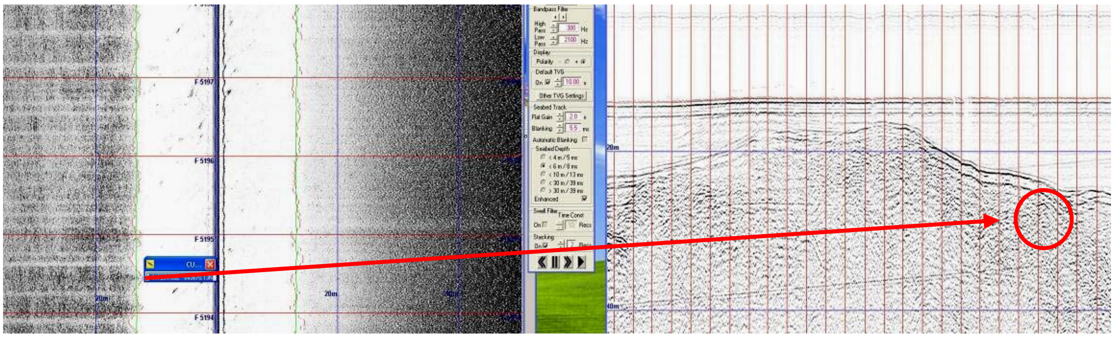


圖 D1-14　　MC 052 and 059

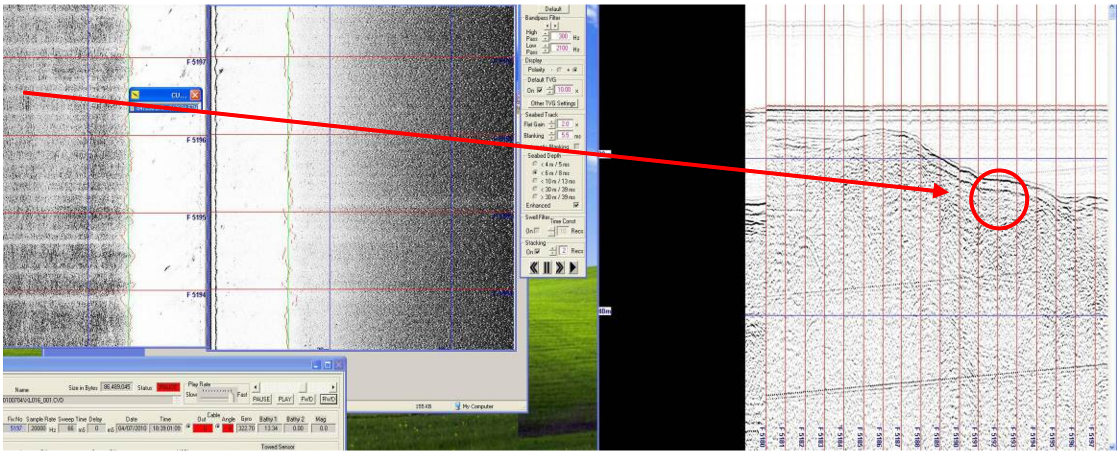


圖 D1-15　　MC 051 and 058

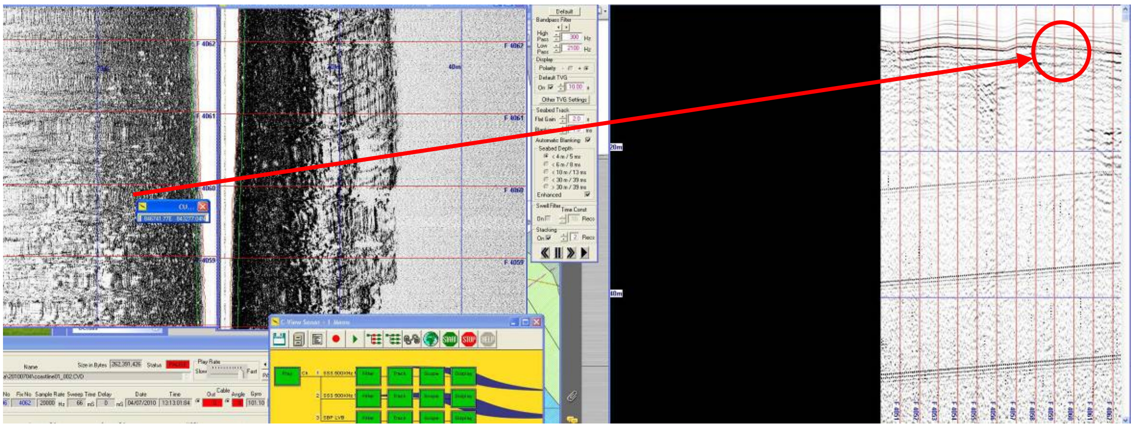


圖 D1-16　　MC022

淺層地底調查結果

是次調查沒有發現任何淺層地底的異常情況。雖然在研究範圍內的海床沉積物含有坑口組的成份（在該區中央從數米至19米不等），但在擬議電纜鋪設路線上以振動取樣法取得的沉積物當中，卻發現沉積物是砂和黏土的混合物，亦偶有碎石。這些成份並不如香港島西面的泥質沉積物般，是完好地保存文物的理想沉積物。

D1.5 水下考古潛質

D1.5.1 基線情況檢閱和及地球物理調查

根據歷史檔案和文獻記載顯示，研究範圍附近在新石器時代已有人居住，但大部份聚居地和有形及無形遺產都是源自十八世紀初期至中期。特別在十九世紀，該區曾經是漁民和海盜的活動範圍。然而，該區遠離主要貿易路線，因此，研究範圍的考古及文化遺產潛質，主要與本地用途和本土貿易相關。

無論是對相關數據庫或文獻的檢閱，都沒有找到關於研究範圍的重要考古或歷史資料。地球物理調查除了找到現有的電纜和一條管道之外，只找到小量以石塊為主的天然物料，以及小量鐵質物品或天然存在的磁性物料。這個地區曾經受到船錨和拖網的影響。由於這區的沉積物比較粗糙，因此能夠藏有完好文物的機會不大。

D1.6 影響評估

是次水下考古調查的結果認為，研究範圍內沒有任何水下文化遺產／具考古研究價值的地點，因此，擬議電纜鋪設路線不會對這類地點造成任何影響。所以，本工程項目在施工和營運期間，都不會對水下文化遺產和具考古研究價值的地點造成影響。

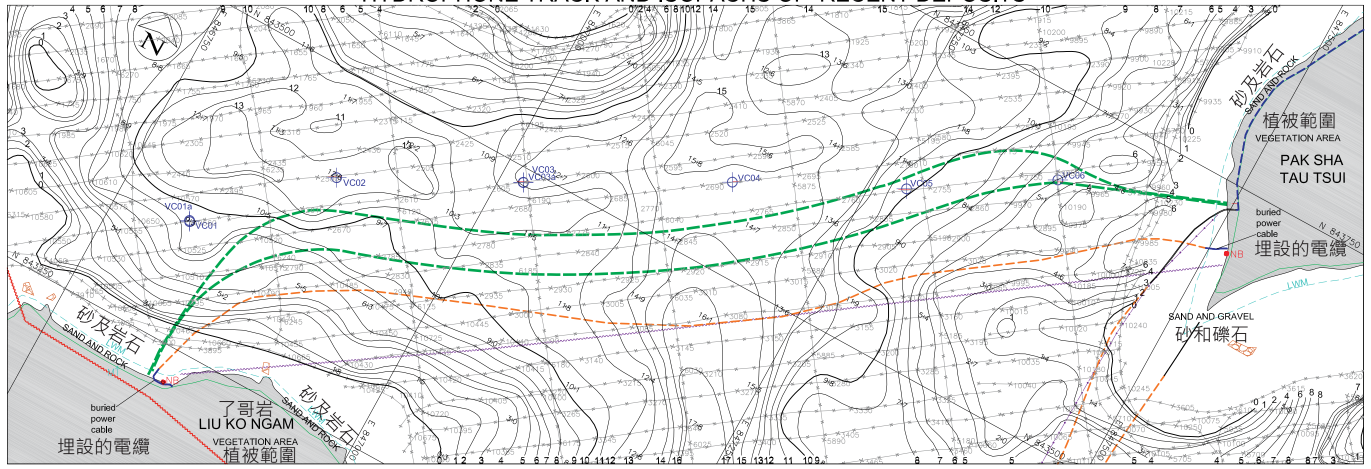
D1.7 緩解措施

研究範圍內沒有任何已知的水下文化遺產／具考古研究價值的地點，因此無需實施任何緩解措施。

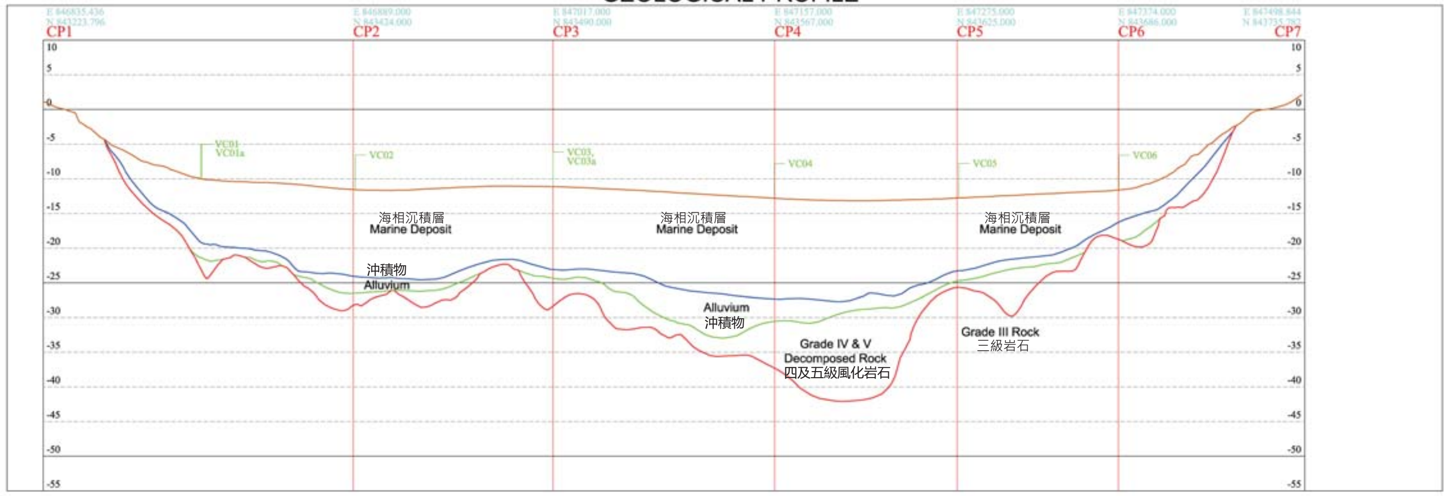
D1.8 總結

本工程項目所涉及範圍的考古潛質評估是根據擬議電纜走線區的歷史記錄、英國沉船數據庫，以及海道測量及地球物理調查結果的研究總結所得。評估結果認為該範圍沒有任何水下考古特色，因此，擬議海底電纜鋪設工程無論在施工或營運期間，都不會對該範圍內的水下考古資源造成任何影響。

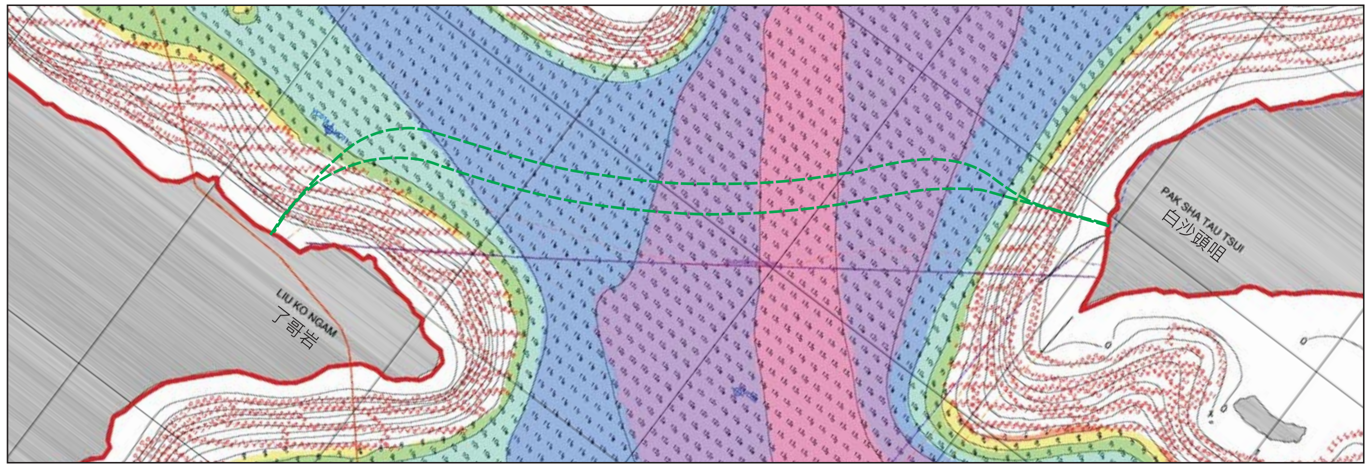
新近沉積物的水聽器追蹤及等原線
HYDROPHONE TRACK AND ISOPACHS OF RECENT DEPOSITS



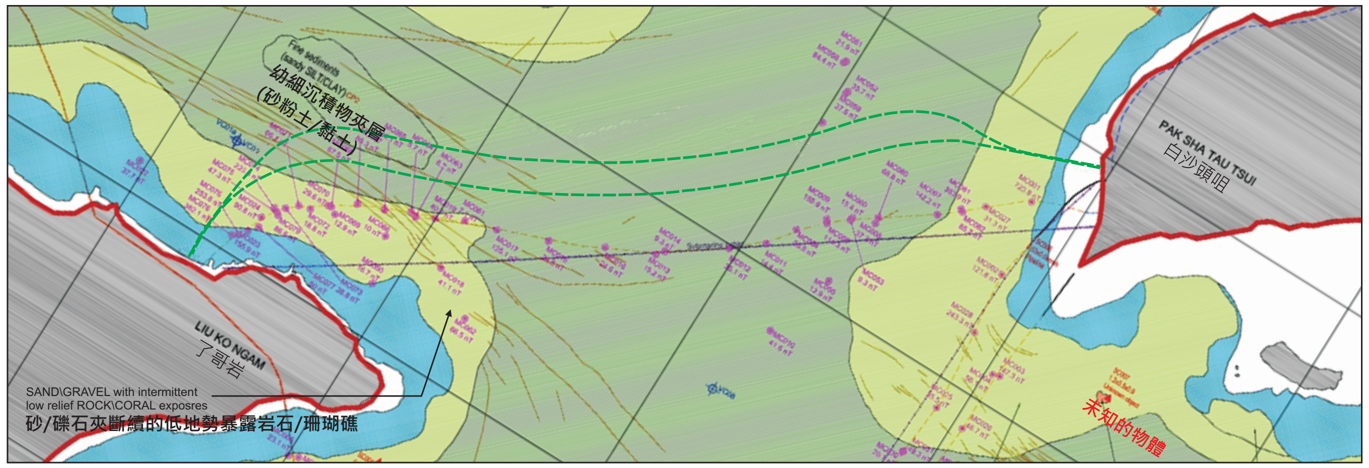
地質概況
GEOLOGICAL PROFILE



條帶式測深系統
SWATH BATHYMETRY



海床特色
SEABED FEATURES



LEGEND 圖示

General 一般

- Vibrocore locations 鑽探位置
- Proposed 11kV Submarine Cable 擬建的11千伏海底電纜
- Pipeline from EGS database EGS資料庫記錄的管道
- Cable from EGS database EGS資料庫記錄的電纜
- PCCW cables (from client) 由項目倡議者提供的PCCW電纜
- Interpreted existing cable/pipeline position by magnetometer 根據磁力儀調查結果而確定的現有電纜/管道位置
- Interpreted existing cable/pipeline position by land topographic survey 根據地貌調查結果而確定的現有電纜/管道位置
- Concrete surround for water pipe 包圍水管的石屎

First Panel - Hydrophone Track and Isopachs of recent deposits
面板一-新近沉積物的水聽器追蹤及等原線

- Isopachs value in metres (Thickness of the layer) 等原線值以米為單位 (夾層厚度)
- Contour at 1 metre interval 間距一米等深線
- Hydrophone track with fix positions 固定位置的水聽器追蹤
- Manhole (telecom) 沙井(電信)
- Notice Board 告示板
- Low Water Mark 低水位標記
- Vegetation Boundary 植被範圍
- Boulders 大圓石

Second Panel - Swath Bathymetry
面板二-條帶式測深系統

- Sounding value in metres below HKPD measured by multi-beam echo sounder 多波束聲納量度在香港高程數值下以米作單位的聲納值
- Sounding value in metres below HKPD measured by single beam echo sounder 單波束聲納量度在香港高程數值下以米作單位的聲納值
- Contour at 1 metre interval 間距一米等深線

METRES (HKPD)

7 8 9 10 11 12 13 14

Third Panel - SeaBed Features
面板三-海床特色

- Sonar contact (LxWxH) 聲納接觸位置 (長x寬x高)
- Linear features 線性特徵
- Magnetic contacts 磁力接觸位置
- Anchor / trawl marks 錨/拖網拖痕
- Fine sediments (SILT/CLAY) 幼細沉積物夾層 (粉土/黏土)
- Low relief ROCK/CORAL with SAND/GRAVEL matrix 砂/礫石夾斷續的低地勢暴露岩石/珊瑚礁
- Boulder 大圓石
- SAND/GRAVEL 砂/礫石
- Concrete surround for water pipe 包圍水管的石屎

Fourth Panel - Geological Profile
面板四- 地質概況

- Seabed 海床
- Base of Marine Deposits 海洋沉積物基線
- Top of Grade IV – V Rock 四及五級岩石的表面
- Top of Grade III Rock 三級岩石的表面
- Vibrocore Locations 鑽探位置

Fifth Panel - Pipeline Engineering
面板五- 管道工程

Location Plan 位置圖

Notes :
1. Survey Date 測量日期 : 02-07,26-27/07/2010
2. Survey Grid 測量方格網 : Hong Kong 1980 Grid System 香港1980方格網系
3. Survey Datum 測量基準 : Hong Kong Principal Datum 香港高程數值
4. Positioning 位置 : C-Nav GcGPS (Globally corrected GPS)(全球校正式全球定位系統)
5. Equipment 儀器 : Odom DF3200 MKIII - P Dual Frequencies Echo Sounder 回聲探測器
   Edgetech Sonarlink1 Side Scan Sonar System 旁測聲納系統
   Knudsen 320M Echo Sounder 回聲探測器
   Reson 8125 Multibeam System 多波束聲納系統
   Seaspy (GSM-19MD) Magnetometer 海洋磁動計系統
6. Coastline taken from 1:1,000 Survey Sheets, Survey and Mapping Office, Lands Department 海岸線取自地政總署1:1000比例測量圖
7. Horizontal Scale for Section : 1:2500 橫向截面比例: 1: 2500
   Vertical Scale for Section : 1:500 縱向截面比例: 1: 500

Revision No.	Date	Drawn by	Checked by	Approved by	Remarks
0	13/07/2010	Clarence Siu	Margie Chen	Matthew Lai	Preliminary
1	19/08/2010	Clarence Siu	Peter Chu	Matthew Lai	Final

METRIC SCALE 1:2,500 比例尺

125 100 75 50 25 0 125 250

Client : CLP 中電

Surveyor : EGS (ASIA) LIMITED

JOB NO. : HK220310

Figure D1-17 圖D1-17

Geological Profile 地質概況

Environmental Resources Management

ERM

F1-ILE: 0114462d-chi(2)
DATE: 16/10/2012

D2 参考

D2.1 英文文獻

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Chau, Hing-wah, (ed) 1993, *Collected essays on the culture of the Ancient Yue People in South China.* Hong Kong Museum of History. Hong Kong.

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Lung Hong Kay, 2001, *Britain and the Suppression of Piracy on the Coast of China, with Special Reference to the Vicinity of Hong Kong 1842-1870.* Master's Thesis, University of Hong Kong.

D2.2 網絡資料

Government of the Hong Kong Special Administrative Region, *The Geographical Information System on Hong Kong Heritage – Archaeological Site* (accessed on 6 May 2011) [http://www5.lcsd.gov.hk/gishinter/html/viewer_en.htm].

附件 D1-1

水下考古調查指引

D1-1 水下考古調查指引

標準的水下考古調查方法應包括四項工作，即 (1) 檢閱基線情況；(2) 地球物理調查；(3) 確定考古潛質及 (4) 以遙控載具或潛水員進行目視調查或從旁監察。

(1) 檢閱基線情況

1.1 應該進行基線檢閱，務求搜集現有資料，以便找出可能存在的考古資源，以及它們的特點、範圍、質量和價值。

1.2 基線檢閱會集中於已知的數據來源，其中包括

a. 土力工程處 – 該處保存大量過去地質研究所搜集的海床調查數據。

b. 海事署海道測量部 – 該署保存大量水文數據和海圖。

c. 英國海軍海道測量署 – 該署保存了所有由海軍海道測量師搜集的調查數據。

1.3 上述數據來源會就各項可能已被近期沉積物和碎物掩蓋的海底特徵，提供相關的歷史記錄和詳細地質分析。

(2) 地球物理調查

2.1 在對研究範圍進行廣泛的地球物理調查時，應該配備高解像度探測器、旁測聲納和回聲測深儀。這項調查所收集到的數據會被詳細分析，以便提供下列資料：

a. 具有最大考古潛質的位置的確實範圍。

b. 評估海床沉積物的深度和性質，以便界定有合適的物質可以掩埋和保存考古物品的地區。

c. 詳細檢閱探測器和旁測聲納的記錄，以便在地圖上標出海床上可能是考古物品的異常地點。

(3) 確定考古潛質

3.1 對於項目1和2檢閱過的數據加以分析，以便就研究區的考古資源提供有關其性質和範圍的指標。這樣會有助於擬訂調查策略。

3.2 有關的結果都應該以書面報告和圖表的形式表達。倘若沒有任何指標顯示區內有考古物品，便無需進行進一步工作。

(4) 遙控載具／潛水員目測調查／從旁監察

4.1 視乎前三項工作的結果而定，一般獲接受的水下考古方法會計劃進行實地評估，以便對那些被認為具有考古潛質的地區搜集更詳細的數據。具考古價值的地區可以由遙控載具或潛水員予以調查。無論是遙控載具或潛水隊，都會配備照相機和錄影機，以便記錄所有具考古價值的海床特色。

4.2 然而，香港的海上交通繁忙，無論是使用遙控載具或潛水員目測調查可能都不是可行的做法。倘若真的如此，最適當的方法便是進行旁觀式的考古監察，以監察具高潛力的地區的挖掘工作來取得實地考古資料。

4.3 這樣便應該根據前三項工作的結果，擬訂考古監察的採樣策略，以便把工作重點集中於具有最高考古潛力的地區。若能小心監察各項挖掘工作，便可以馬上發現和搶救考古物品。倘若發現考古物品，便應該立即聯絡古物古蹟辦事處，並尋求有關該等發現的重要性的指引，以便擬訂適當的緩解措施。

4.4 倘若進行了項目4，便應把有關的結果以書面報告和圖表的形式表達。

附件 D2

考古調查報告

目錄

1 *引言*

1.1 *工程項目背景*

中華電力有限公司（中電）現正計劃改善吉澳供電的可靠性。現時，在了哥岩與吉澳之間，只有一組 11 千伏的海底電纜連接。該組電纜已使用超過 30 年，正在老化。為了確保能夠向吉澳島持續供電，中電計劃更換連接了哥岩與吉澳白沙頭咀的現有 11 千伏海底電纜（見*圖 1.1*）。

根據《環境影響評估條例技術備忘錄》附表 2 第 I 部的 C 類 C.12 條的規定，“連接了哥岩與吉澳白沙頭咀之現有 11 千伏海底電纜更換工程”，屬於距離二一個海岸公園的最近界線少於 500 米的挖泥作業，因此是一項指定工程項目。根據《環境影響評估條例》第 5 (11) 條的規定，本工程項目必須在施工和運作前，申請環境許可證。

擬議作為替換的新海底電纜走線，是介乎了哥岩和吉澳島上的白沙頭咀之間，毗鄰一些現有的公用設施，包括現有的 11 千伏海底電纜和兩條主輸水管（見*圖 1.1*）。在登岸後，擬議作為替換的 11 千伏海底電纜會連接至現有的架空電纜系統，並會在了哥岩盡量減少新增地下電纜和在白沙頭咀盡量減少新增電線桿。

白沙頭咀的登岸地點位於吉澳白沙頭具考古研究價值的地點。在先前的考古調查中，曾經在該處出土過新石器時代晚期的文物，以及宋、明和清朝的文物。因此，有必要進行考古調查，務求取得實地數據，以便稍後為將會受到本工程項目直接影響的白沙頭咀登岸地點（以下簡稱“考古地點”）進行考古影響評估。

為此，顧問公司制定了一份《考古調查計劃書》（以下簡稱“考古計劃書”），闡述準備進行的考古調查的範圍，然後提交予古物古蹟辦事處，以取得同意。有關當局根據《古物及古蹟條例》（香港法例第 53 章）的規定，於 2012 年 6 月（即考古調查展開前）發出“挖掘及搜尋古物牌照”（以下簡稱“考古牌照”）予金志偉博士。

是次考古調查於 2012 年 7 月 17 日至 2012 年 8 月 3 日在“考古地點”進行，其中包括地表踏查和遺物採集、七個鑽孔和三個探方。調查結果在此《考古調查報告》（以下簡稱“考古報告”）中闡述。

1.2 *擬於考古地點進行的施工*

在電纜登岸地點的岸上只需要進行小規模施工，以便把海底電纜連接至現有的架空電纜系統。

新地下電纜的長度約為 89 米。在登岸點的擬議鋪設電纜越過高水位線之後，便會鋪置在一條 0.75 米闊、1.0 米深的纜槽內，並連接至新的木製電線桿。為了建造每條木桿的地基，需要掘走約 1.8 米（闊）x 1.4 米（長）x 1.6 米（深）的泥土。然後，這些電纜會架空連接至現有的電線桿。有關的纜槽會以露天挖掘法施工。

1.3 考古小組成員

參與是次考古調查工作的人員如下：

金志偉博士	持牌考古學家
趙柏熹先生	助理考古學家
吳震霖先生	助理考古學家
王珮琪小姐	文化遺產專家
廖潔盈小姐	文化遺產專家

除了上述小組成員外，是次考古調查亦僱用了三名工人。田野記錄及其處理工作由金志偉博士領導，並由趙柏熹先生、吳震霖先生和廖潔盈小姐執行。地圖和圖則的製作由趙柏熹先生及香港環境資源管理顧問有限公司的地理資訊系統及圖像組負責。文物處理工作由趙柏熹先生、吳震霖先生和廖潔盈小姐負責。文物攝影由趙柏熹先生負責。

本報告的撰寫者包括：金志偉博士、王珮琪小姐、趙柏熹先生、吳震霖先生和廖潔盈小姐。

1.4 報告結構

在本章引言之後，報告的其餘部份分為以下各章：

第 2 章　闡述"考古地點"的背景；

第 3 章　闡述是次考古調查的目的和方法；

第 4 章　闡述是次考古調查的結果；

第 5 章　作出結論；及

第 6 章　羅列參考書及文獻目錄。

此外，亦包括下列附件：

附件 A　闡述鑽孔記錄；

附件 B　闡述探方記錄；

附件 C　羅列各項重要文物和一般文物；

附件 D　闡述重要文物的說明；

附件 E　展示一般文物的攝影記錄；及

附件 F　闡述土地測量記錄。

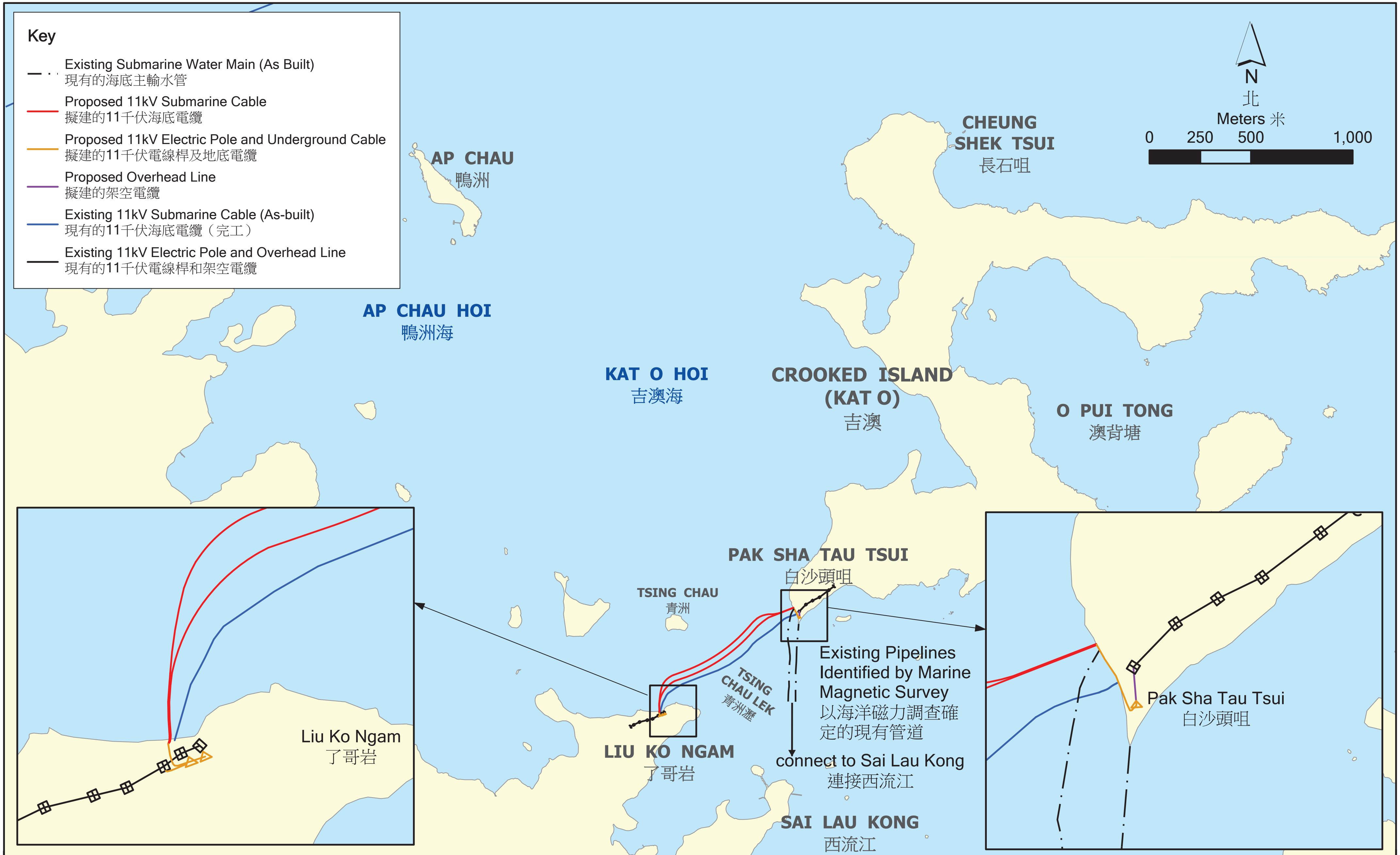

Figure D2-1.1
圖 D2-1.1

Alignment of the Proposed 11kV Submarine Cable Circuit from Liu Ko Ngam to Pak Sha Tau Tsui

了哥岩至白沙頭咀的擬建11kV海底電纜路線

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2 *考古調查範圍的背景*

2.1 *歷史及地形背景*

"考古地點"位於吉澳島西南端的白沙頭山咀的底部。該山咀是從東北面的矮山向西南伸延，其高度亦逐漸下降。"考古地點"的西南正對青洲瀝海峽，而東南面則是印洲塘。吉澳島位於香港東北部，靠近香港北面與深圳接壤的邊界。該島是生態旅遊景點之一，可以遠眺深圳鹽田港。吉澳島上的村民是在明朝末年從廣東省的龍崗、新會和鹽田等地移居當地。在 1950 和 60 年代，島上有超過 4,000 名居民。

時至今日，年輕一代多遷入城市工作，仍於島上生活的約有 200 戶。他們全都是客家人和蜑家人。由於人口減少，島上唯一的學校已於 2005 關閉。(1)

白沙頭咀是一個岬角，伸延進一個名為青洲瀝的海峽。青洲瀝的北面連接吉澳海，東南面則通往印洲塘。在白沙頭咀西南面的青洲瀝對岸，是一個名叫了哥岩的岬角（電纜的另一個登岸地點）。白沙頭咀以東是一個小島，名叫筆架洲*圖 2.1* 展示了白沙頭咀四周的地形和格局。

印洲塘有三個主要島嶼和新界東北的陸地圍繞，因此不受風浪沖擊。該區的海水十分平靜，是極佳的天然避風躲浪之處。

2.2 *地質背景*

"考古地點"是位於第四紀的後灘沉積層和海灘沉積層的表土沉積層上；亦是在大帽山組的固體地質上（GEO1992）。請參閱*圖 2.2* 的地質地圖。

2.3 *考古背景*

"考古地點"位於古物古蹟辦事處記錄中的吉澳白沙頭具考古研究價值的地點範圍內。該地點於 2000 年曾進行考古調查，並進行了地表踏查和遺物採集及鑽探了兩個鑽孔和挖掘了六個探方（詳見書目所列之"古物古蹟辦事處(2000)"）。有關它們的位置，請參閱*圖 2.3*。

據報在 T2 和 T3 位置離地面大概 42 至 74 厘米處曾發現新石器時代晚期的文化層，並出土了一些十分零碎的粗砂陶片。然而，這些陶片太小，難以分辨類型。此外，亦曾在 T1 和 T3 出土清朝建築物的地基遺物。在地表採集和各個探方的已受擾亂的地層中，發現了新石器時代晚期的粗砂陶片、陶片、石器，以及宋、明和清等朝代的陶瓷碎片。

(1) 吉澳〔在線資料〕；可於互聯網取得，網址如下：http://zh.wikipedia.org/wiki/%E5%90%89%E6%BE%B3.

3 目的和方法

3.1 考古調查的目的

是次考古調查（以下簡稱“2012 年調查”）是要收集足夠數據，以便為本工程項目進行考古影響評估，其中需要在海底電纜與現有架空電纜系統連接的白沙頭咀登岸地點（亦即在“考古地點”）進行挖掘工程。

3.2 考古調查的範圍

是次考古調查的範圍包括：

- 在“考古地點”及周邊進行地表踏查和遺物採集；
- 挖掘 3 個探方，其大小介乎 1 米 x 1 米至 2 米 x 1.5 米不等；及
- 沿著擬議工程的走線，鑽探 7 個鑽孔[1]。

擬議電纜走線的確實位置，是由考古小組與本工程項目的倡議人代表一起，在現場根據實際情況大致標出。然後再視乎需要調整各個鑽孔和探方的位置。因此，預計是次考古調查不會對吉澳白沙頭具考古研究價值的地點之考古潛質造成負面的影響。

3.3 考古調查的方法

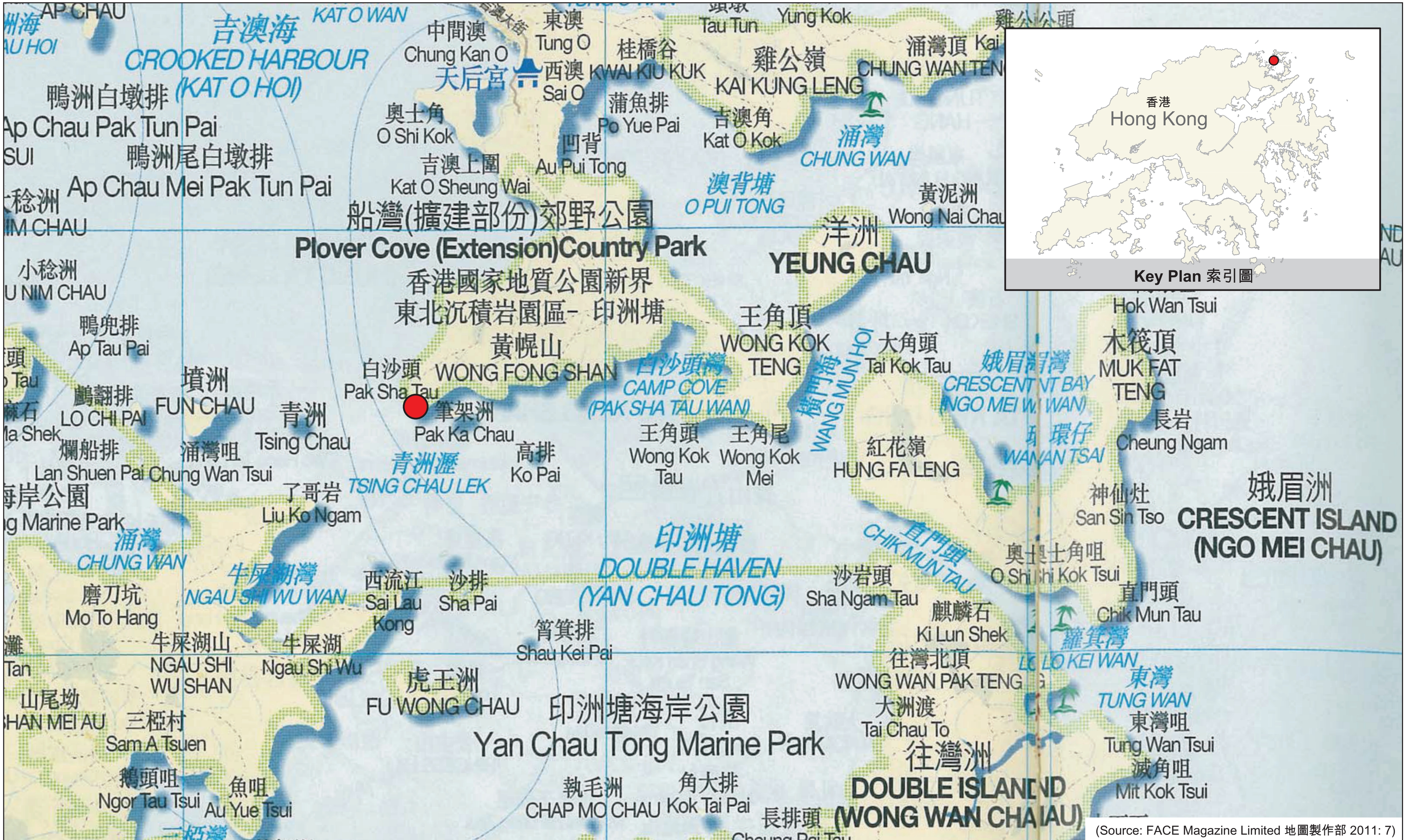
在“考古計劃書”獲得古物古蹟辦事處的同意後，即由一位合資格的考古學家金志偉博士根據《古物及古蹟條例》，申請並取得“挖掘及搜尋古物牌照”。由於“考古地點”位於郊野公園範圍內，因此亦向漁農自然護理署申領了進入許可證。

在取得各項相關的牌照和許可證後，便正式展開考古調查工作，其中包括下列各項任務。

3.3.1 任務 1 – 實地調查

是次考古調查由一位合資格的考古學家領導，而相關的田野工作包括下列各項任務：

(1) 在進行田野工作期間，當鑽挖第一個鑽孔（AH1）時，在地面以下 0.60 米處遇到大石。於是在 AH1 旁邊再鑽挖另一個鑽孔（AH2），試圖避開大石。 然而，在 AH2 的地面以下 0.52 米處也遇到大石。 因此假設沿岸地區都有一層大石。 基於上述原因，實際鑽挖的鑽孔共有七個，而不是考古建議書所建議的六個。



(Source: FACE Magazine Limited 地圖製作部 2011: 7)

Figure D2-2.1

圖D2-2.1

Topographic Setting around Pak Sha Tau Tsui 白沙頭咀的地形環境

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DATE: 16/10/2012

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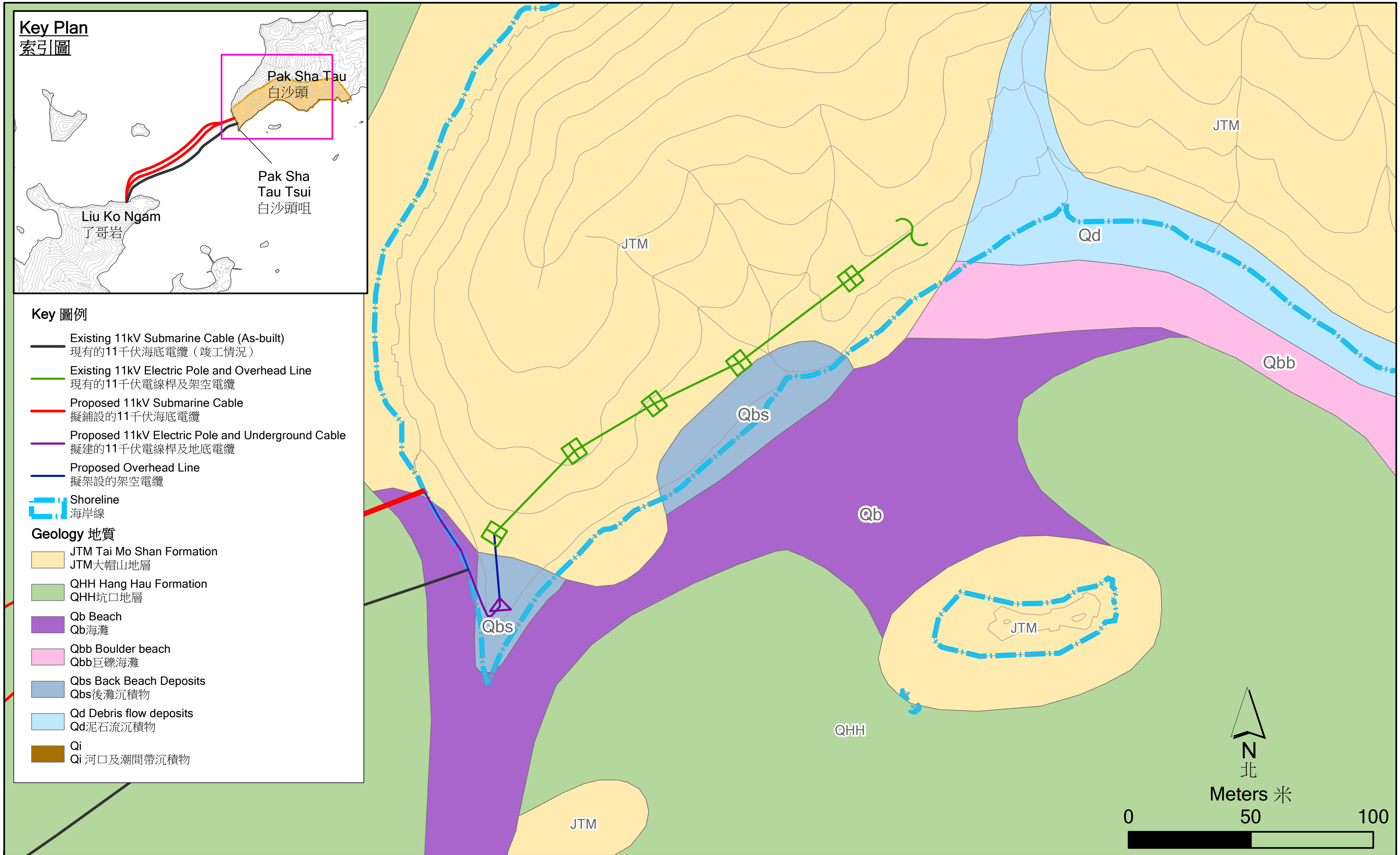

Figure D2-2.2
圖 D2-2.2

Geology

地質

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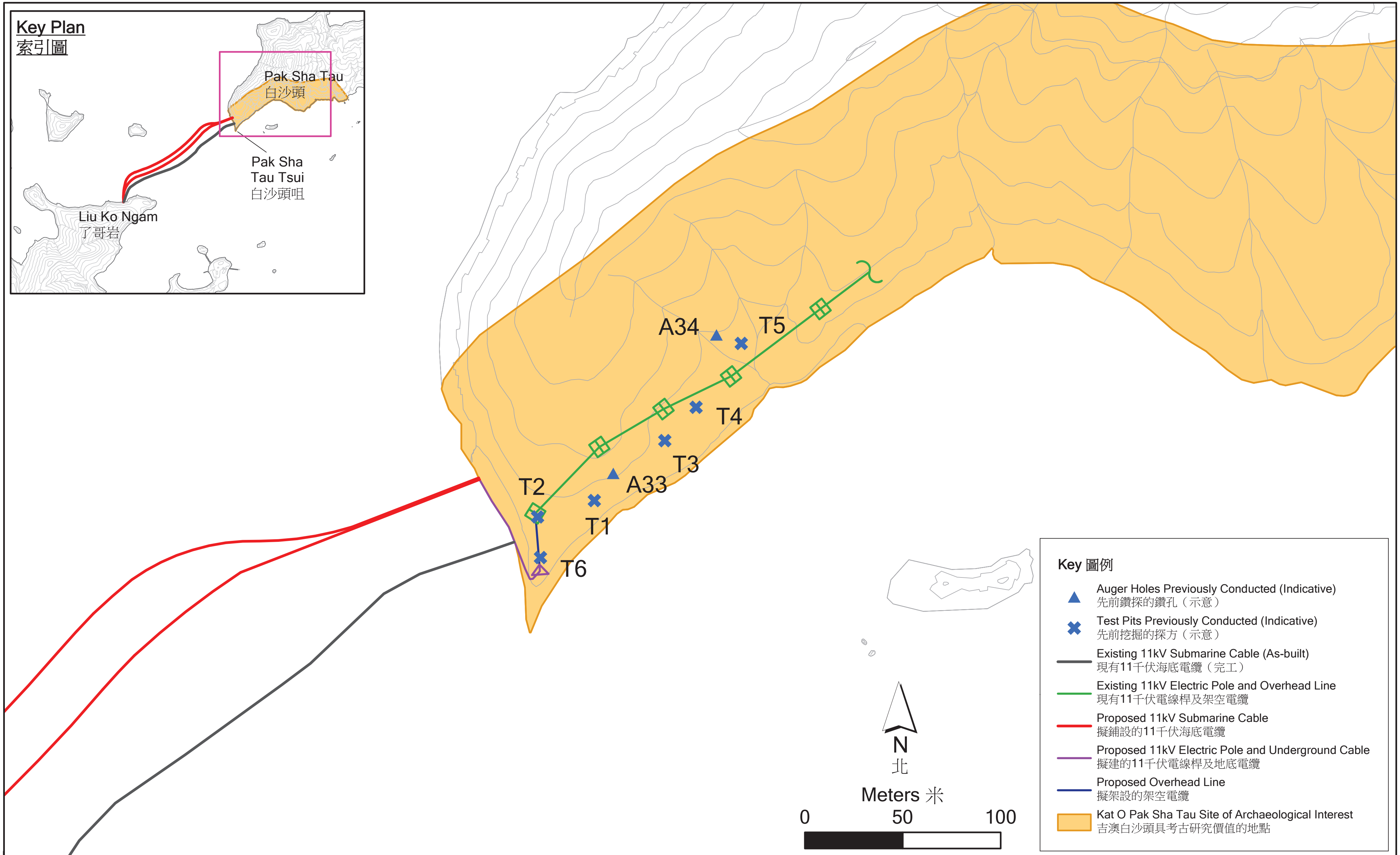

Figure D2-2.3
圖D2-2.3

Archaeological Background

考古背景

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任務 1a：地表踏查和遺物採集

在“考古地點”進行了地表踏查和遺物採集。採集的地區和地面收集點的位置均於*圖 3.1* 標示。

任務 1b：挖掘（鑽孔調查和探方挖掘）

是次考古調查共挖掘了 3 個探方，分別為一個 1.5 米 x 1.5 米和兩個 2 米 x 1.5 米的探方；亦鑽探了 7 個鑽孔，以便為考古影響評估收集實地數據。各個探方和鑽孔的位置，均展示於*圖 3.2*。探方的確實位置是根據考古小組與本工程項目的倡議人代表一起在現場根據實際情況而確定。這些探方都是在持牌考古學家的督導下，以人手挖掘。探方的挖掘工作在到達地下水位時（約在地面以下 1.1 至 1.2 米）即告停止，因為繼續挖掘可能會有危險。在現場收集到的實地數據，提供了足夠資料來確定受本工程項目影響的地區的考古潛質。考古小組在發現考古文物後，便馬上通知古物古蹟辦事處到場視察。

小組的有關人員亦準備了每日的田野記錄，其內容包括：

- 一份日程表，詳細列出每日完成的田野工作；
- 有關現場使用的資源和設備的報告；
- 有關現場發現的文物和考古遺蹟，以及相關的處理和保存方法；
- 天氣情況。

考古小組在進行田野工作的時候，都一直進行田野記錄。這些田野記錄均按照《考古文物及檔案的處理指引》（至 2011 年 11 月止）的要求處理。

各個已挖掘的探方的標高，都由一位土地測量師予以核證。有關的測量記錄，請參閱*附件 F*。

任務 1c：古代遺物及檔案的處理和記錄

所有出土的考古文物都加以收集、記錄、加上日期和分類；對於具代表性的考古文物則予以拍照。所有照片均為彩色，並附有日期、時間、團隊識別資料。照片是以 JPEG 格式儲存，其解析度最少達 400 萬像素。這些古代遺物和田野記錄，均按照古物及古蹟辦事處的《考古文物及典籍的處理指引》（至 2011 年 11 月止）的要求，進行處理和分析。

根據《古物及古蹟條例》第 10 條的規定，所有已發現的考古文物，均屬香港特區政府所有。在本報告的最終版本獲古物古蹟辦事處接受後，是次考古調查所收集到的所有文物、人工製品和文書典藉，都會按照牌照條件和《古物及古蹟條例》的規定，交予古物古蹟辦事處。

3.3.2 *任務 2 – 報告*

是次考古調查的所有結果，均按照古物古蹟辦事處的《考古報告指引》（至 2011 年 4 月止）的要求，於本《考古調查報告》中闡述。

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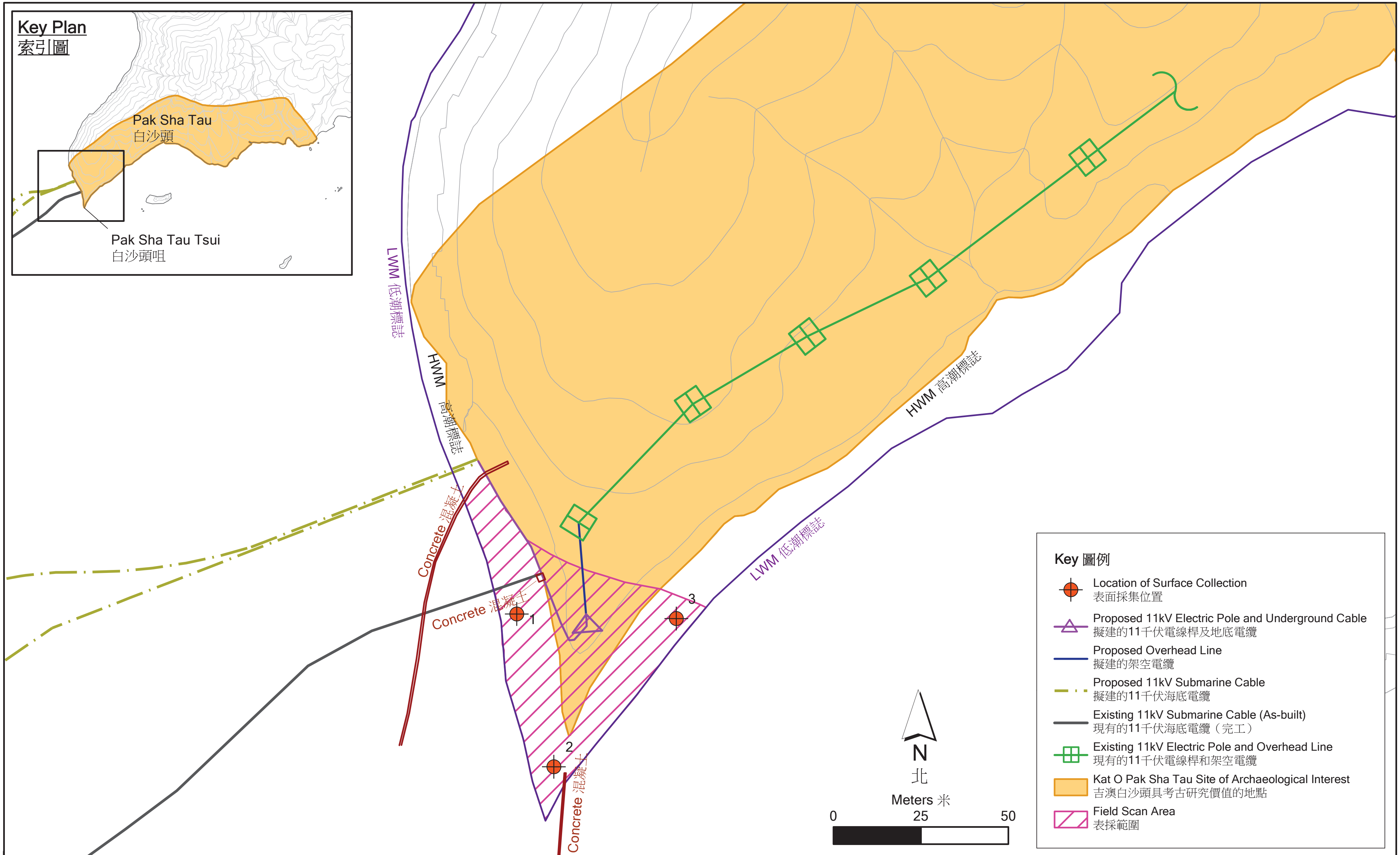

Figure D2-3.1
圖 D2-3.1

Field Scan Area

表採範圍

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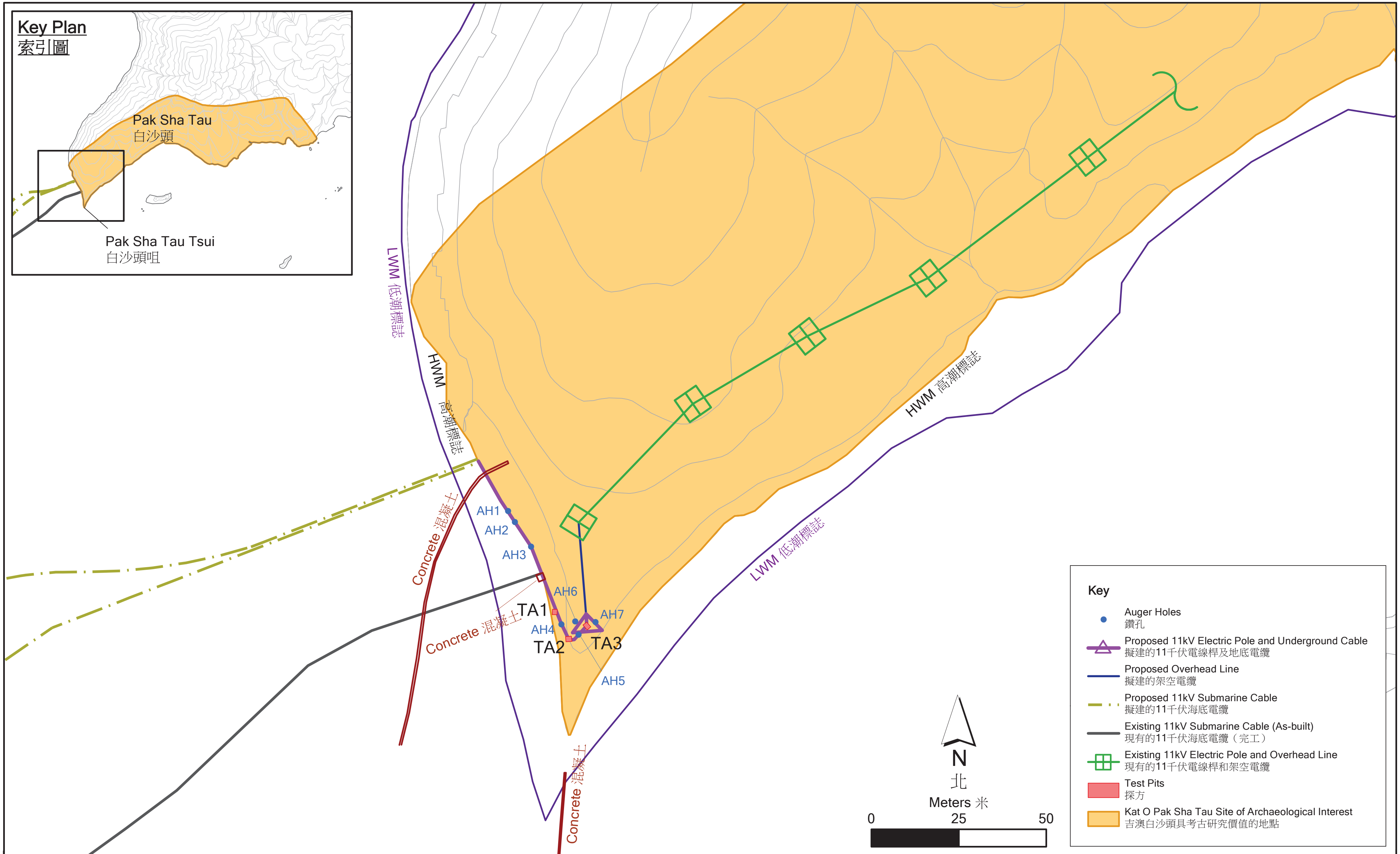

Figure D2-3.2
圖 D2-3.2

Locations of Conducted Test Pits and Auger Holes

已鑽探的鑽孔和探方位置

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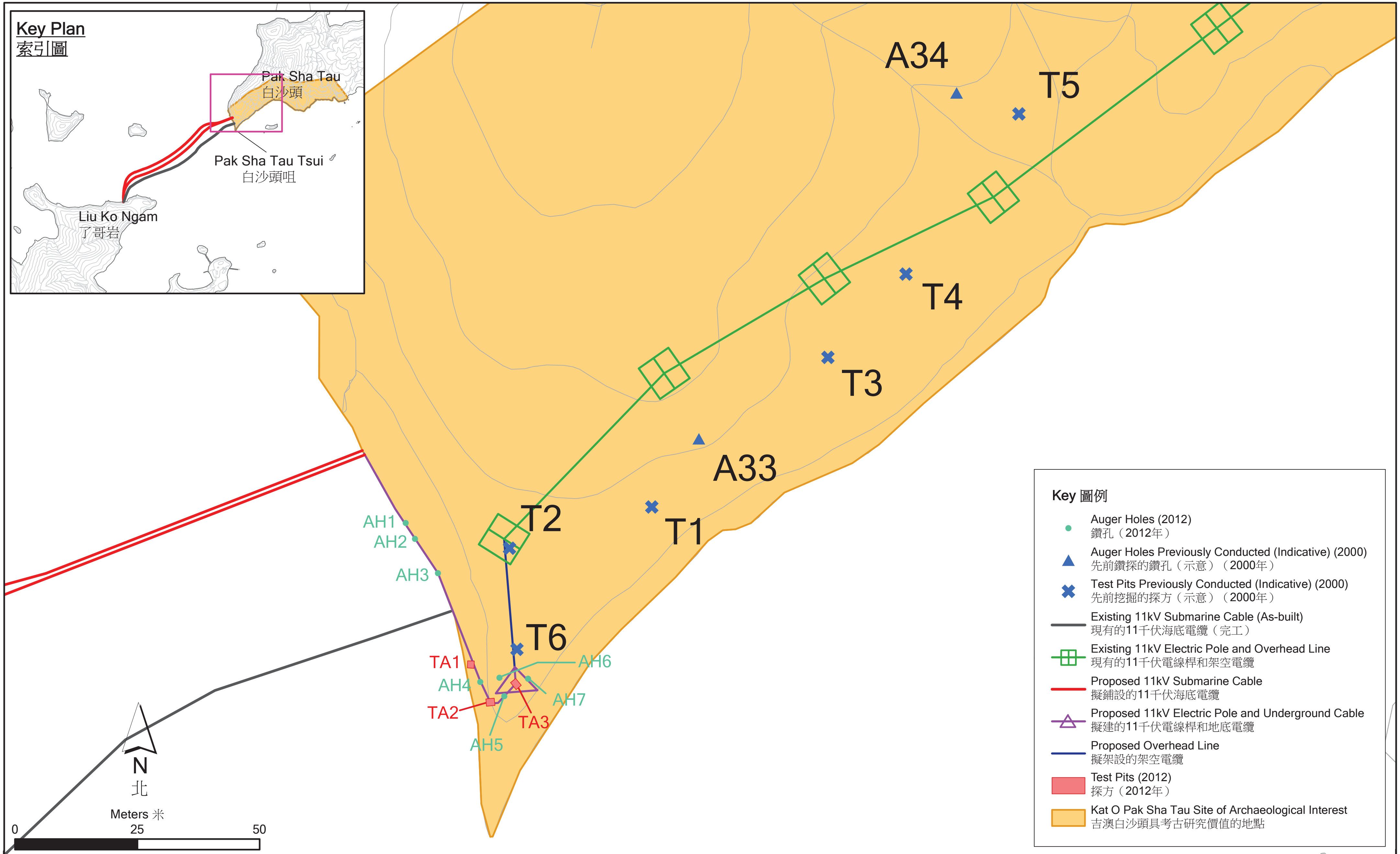

Figure D2-3.3
圖 D2-3.3

Site Plan Showing the Test Pit and Auger Hole Locations of 2000 and 2012 Surveys

展示2000年及2012年調查的探方及鑽孔位置的平面圖

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4　　考古調查結果

4.1　　引言

是次考古調查共踏查了 1,862 平方米的地方，鑽挖了七個鑽孔和挖掘了三個探方。有關的結果於下文闡述。

4.2　　地表踏查及遺物採集

地表踏查及遺物採集是在低潮期間於"考古地點"及周邊各處進行。有關地表踏查的地區以及地面遺物採點的位置，請參閱*圖 3.1*。地表遺物的收集工作是於白沙頭咀的三個方位進行，即：在 TA1 西面的沙質海灘的潮間區（位置 1）；南面岬角的沙質海灘的潮間區（位置 2）；在 TA3 東面的沙質海灘的潮間區（位置 3）。

地表採集到的遺物包括十三件一般文物，其中有鄉村器物、瓷片和瓦片，以及一件孤立發現的重要遺物（一件穿孔石製品）。它們大都磨圓程度較高，部份更有海貝黏附在表面。所有在地表收集到的文物，均羅列於*附件 C*。所有鄉村器物和瓦片都沒有明顯的年份特徵。

在所有瓷片當中，有一片青瓷可能為唐代生產。其它的包括青花、白瓷等則屬於明末清初至民國期間。

在位置 2 發現了一件穿孔石製品，器身扁平，平面形狀，略呈橢圓形。它的磨圓程度非非常高，在器身上部可以見到一個兩面對鑽的穿孔。它的年代應屬先秦時期。有關這件石製品的詳細討論和說明，請分別參閱*第 4.4 節*和*附件 D*。

4.3　　鑽孔和探方

是次調查共鑽探了七個鑽孔和挖掘了三個探方。所有位置都沒有發現任何重要的考古文物。下文闡述了是次調查結果的摘要，以及與 2000 年調查結果的比較。

4.3.1　　一般地層情況

根據鑽孔和探方的結果顯示，"考古地點"有灰白色的沙層。越往下的沙層，其顆粒越大。在地面以下 60 厘米處，開始有卵石出現，而且越往下，卵石越大，也越密集。大部份分層中都有海貝的碎片，但大都集中在表面的分層。越往下層，海貝碎片的數量便越少。在低潮的時候，在 TA1、TA2 和 TA3 三個地點的地底約 1.1 米處出現地下水。

這三個地點的分層情況與 2000 年調查時 T1 和 T6 地點的情況相似。它們都位於受潮汐變化影響的現有海岸旁，其沉積物是由貝殼碎片和沙質土組成，可以分為三類：表土、擾亂土和生土，還有少量二次堆積的人工製品。

4.3.2 *已出土的考古文物*

根據探方的觀察，所有探方的所有層位（即第 1、2、3 和 4 層）都有玻璃和塑膠等現代物料出土。在 TA2 的第 3 層還發現一塊混凝土磚。另外還出土有十八件一般文物，包括鄉村器物的碎片、瓷器碎片和瓦片。在 TA1 的第 3 層和 TA2 的第 4 層，都分別有一件鄉村器物，而且都與二十世紀初的鄉村容器相似。因此，TA1 第 3 層和 TA2 第 4 層的年代，都不會早於二十世紀。由於 TA1 的第 3 層和 TA2 的第 4 層都含有二十世紀初的人工製品和現代物料，因此，探方的所有層位的年代，都可以判別為二十世紀初至近代。在 TA3 內沒有發現考古遺物。

所有出土文物的磨圓程度屬中等，而且都與卵石混雜一起，顯示它們都經過水流的運送、移動和侵蝕。因此，它們都不是原生考古堆積。

4.4 *人工製品*

是次考古調查共收集到 32 件人工製品，其中 14 件是在地表採集時收集，另外 18 件是在挖掘探方時出土。在收集到的 32 件人工製品中，有 31 件被記錄為一般文物，其中包括：鄉村器物的碎片、瓷器碎和瓦片；另外還有在地表踏查採集的一件（一塊孤立的發現，有穿孔的石製品）被記錄為重要文物。縱使它是二次堆積文物，與其它發現的文物相比之下則較為特別，更有可能是一件石器。*附件 C* 羅列了各項重要文物和一般文物。

唯一一件重要文物是一塊孤立發現的穿孔石製品。它是在*圖 3.1* 標示為位置 2 的白沙頭咀南面岬角的沙質海灘的潮間區地面所收集到的文物。它的磨圓程度很高，說明它曾被水流運送，然後沉積於被發現的位置。在發現它時，還發現上面附有海貝的殼。

這塊穿孔石製品是以暗紅色[(1)] 的沉積岩製成。石製品的一端有穿孔。穿孔位於石邊有輕微內凹的一端；而沒有穿孔的一端則有外彎的邊緣，而且有明顯的鑽痕。穿孔是從石製品的兩面，在同一位置施鑽而形成全圓形的孔洞。根據這種製作技巧，這塊穿石製品的年代應是屬於先秦時期。有關這件石製品的詳細說明，請參閱附件 D。收集到的其他人工製品，均以照片方式展示於*附件 E*。

至於在 TA1 和 TA2 出土的人工製品，它們都有貝殼附在表面，說明它們曾被水力運送，因此都是二次堆積。若把 2000 年調查時在 T2 和 T3 處的發現與這次 2012 年調查的發現比較，T2 和 T3 都在較高的位置，而且比較遠離潮間區。這種地點比較適合人類聚居。事實上，在 T1 和 T3 的位置亦確實找到建築物地基遺物。T2 和 T3 這兩個地點的地層分析也顯示有史前文化層存在（有關其位置，請參閱*圖 3.3*）。此外，T1 和 T6 位於水平線較低處，接近潮汐帶，因而在此兩個探方內發現擾亂層。

除了先秦時期的穿孔石製品之外，也在地面採收集到一塊唐代的青瓷。縱使那青瓷是二次堆積物，在吉澳白沙頭具考古研究價值地點內乃第一次發現唐代器物。結果顯示在吉澳白沙頭具考古研究價值地點內可能有唐代文化層，但有待日後調查來確定。其他被發現的一般文物主要是晚明至清代、二十世紀初或民

(1)蒙賽爾土壤色卡（2000 年可洗版）的暗紅色 (10R 5/3)。

國時期的人工製品，包括鄉村器物、瓦片和瓷片。這些文物中，很多都是十分細小的碎片，而且破損不堪，部份更附有貝殼碎片，因此沒法決定其類型。然而，這種情況亦表示這些人工製品都是由水力運送至調查區，因此全都屬於二次堆積。既然全部文物都是二次堆積，它們對了解這裡的原生堆積狀況的重要性便很低。

5　總結

中華電力有限公司（中電）現正計劃改善吉澳島供電的可靠性。為了確保能夠向吉澳島持續供電，中電計劃更換連接了哥岩與吉澳白沙頭咀的現有 11 千伏海底電纜。

由於白沙頭咀位於吉澳白沙頭具考古研究價值的地點範圍內，因此，有必要進行考古調查，務求取得實地數據，以便稍後為將會受到本項目的施工影響的“考古地點”進行考古影響評估。

顧問公司在展開考古調查前，先制定了一份《考古調查計劃書》，然後提交予古物古蹟辦事處，以便取得同意。有關當局根據《古物及古蹟條例》的規定，於 2012 年 6 月發出“挖掘及搜尋古物牌照”予金志偉博士。是次考古調查於 2012 年 7 月 17 日至 2012 年 8 月 3 日在“調查地點”進行。在調查期間，共對 1,862 平方米的地區進行了地表採集，也鑽挖了七個鑽孔和挖掘了三個探方。

是次考古調查發現，所有被找到的文化分層的年代都是近代。

調查期間共收集了 31 件一般文物和一件重要文物。這些一般文物包括：鄉村器物的碎片、瓷器碎片和瓦片。地表採集所找到的一件孤立發現的重要文物，是一塊屬於先秦時期的穿孔石製品，其性質是二次堆積的人工製品。由於全部文物都是二次堆積，因此，都沒有重要價值。

是次考古調查的地點，比 2000 年調查的 T6 位置較偏南和偏西，亦與 T2 和 T3 距離更遠。是次調查的地點十分接近現有海岸線，因此，沒有出土任何原生文化遺物。

基於是次考古調查的結果，在擬議進行本工程項目的地點發現重要考古遺存的可能性十分低。過去 2000 年的考古調查更亦已有提及原生的史前考古堆積主要位於離工程現處之現代海灘範圍以外的山坡上。

然而，由於是次調查發現了一件重要文物及一些考古遺物，建議項目倡議人在吉澳白沙頭具考古研究價值地點內進行挖掘工作前通知古物古蹟辦事處，以便該處安排監察工作。此外，在吉澳白沙頭具考古研究價值地點內進行挖掘期間，若有發現任何古物或疑似古物，應立即通知古物古蹟辦事處。

本頁留空

土力工程處《1992 年 1:20 000 地質地圖（HGM20 系列第 4 幅）》。香港：土木工程署轄下土力工程處。

蒙賽爾色卡 2000 年。蒙賽爾土壤色卡（2000 年修訂可洗版）。NY: GretagMacbeth.

FACE Magazine Limited 地圖製作部 (2011)，《地圖王》(香港：FACE Magazine Limited)。

古物古蹟辦事處 (2000)，《新界餘下偏僻村落供水計劃第二期考古調查工作報告》(未出版，現藏香港文物探知館參考圖書館，索書號：ND3)。

吉澳〔在線資料〕；可於互聯網取得，網址如下：
http://zh.wikipedia.org/wiki/%E5%90%89%E6%BE%B3

附件A

鑽孔記錄

詳細鑽探記錄

鑽孔編號	地層	深度（米）	厚度（米）	說明
AH1	1	0.60	0.60	灰白色沙質層，雜有少量貝殼碎片。無發現考古文物。
	鑽探深度	0.60		至岩石
AH2	1	0.52	0.52	灰白色沙質層，雜有少量貝殼碎片。無發現古文物。
	鑽探深度	0.52		至岩石
AH3	1	0.74	0.74	灰白色沙質層，雜有少量貝殼碎片。無發現考古文物。
	鑽探深度	0.74		至岩石
AH4	1	0.60	0.60	灰白色沙質層，雜有少量貝殼碎片。無發現考古文物。
	鑽探深度	0.60		至岩石
AH5	1	1.10	1.10	灰白色沙質層，雜有少量貝殼碎片。無發現考古文物。
	鑽探深度	1.10		至地下水位
AH6	1	1.17	1.17	灰白色沙質層，雜有少量貝殼碎片。無發現考古文物。
	鑽探深度	1.17		至地下水位
AH7	1	1.10	1.10	灰白色沙質層，雜有少量貝殼碎片。無發現考古文物。
	鑽探深度	1.10		至地下水位

註： (a) 深度是從地面量度至地層表面的距離。

附件B

探方記錄

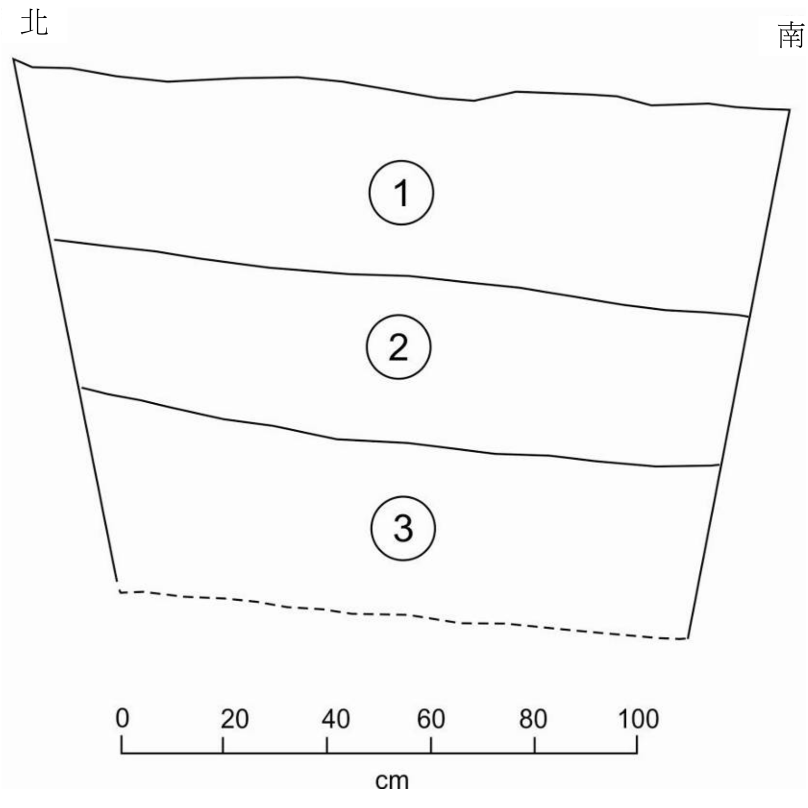
詳細探方記錄

地點代號	**KOPST2012**		探方代號	**TA1**
探方座標	E847516.972	N843689.772	探方尺寸	1.5米 x 1.5米
挖掘方法	人手挖掘		地面標高	主水平基準2.5-2.6米

地層情況

分層	說明	文物	測定年代	地面標高以下深度（米）	厚度（米）
1	灰白色海沙，雜有很多貝殼碎片和塑膠碎片		現代	0	0.35-0.40
2	比第1層粗糙的海沙，雜有少量貝殼碎片、塑膠碎塊和玻璃誶片	鄉村器物碎片、瓷器碎片、瓦片	現代	0.35-0.40	0.28-0.30
3	灰白色海沙、比第2層粗糙，雜有圓卵石	鄉村器物碎片、瓦片	不早於20世紀	0.65-0.70	>0.35-0.40

示意圖



東段

照片

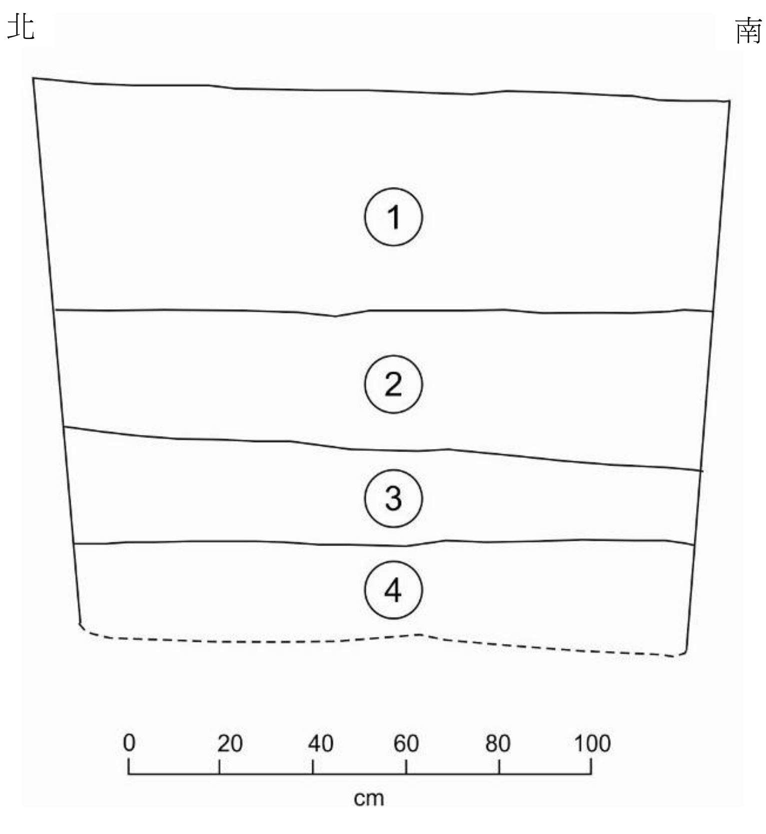
東段

地點代號	**KOPST2012**		探方代號	**TA2**
探方座標	E847520.905	N843681.966	探方尺寸	2米 x 1.5米
挖掘方法	人手挖掘		地面標高	主水平基準2.5-2.6米

地層情況

分層	說明	文物	測定年代	地面標高以下深度（米）	厚度（米）
1	灰白色海沙，雜有濃密的植物根，以及貝殼碎片和塑膠碎片		現代	0	0.45-0.50
2	灰白色海沙，比第1層粗糙，雜有貝殼碎片和塑膠誶片	瓷器碎片、瓦片	現代	0.45-0.50	0.25-0.35
3	灰白色海沙，比第2層粗糙，雜有較少的貝殼碎片和一塊混凝土	鄉村器物的碎片、瓦片	現代	0.75-0.80	0.15-0.25
4	灰白色海沙、比第3層粗糙，雜有碎石	鄉村器物碎片	不早於20世紀	0.95-100	>0.20-0.25

示意圖



東段

照片

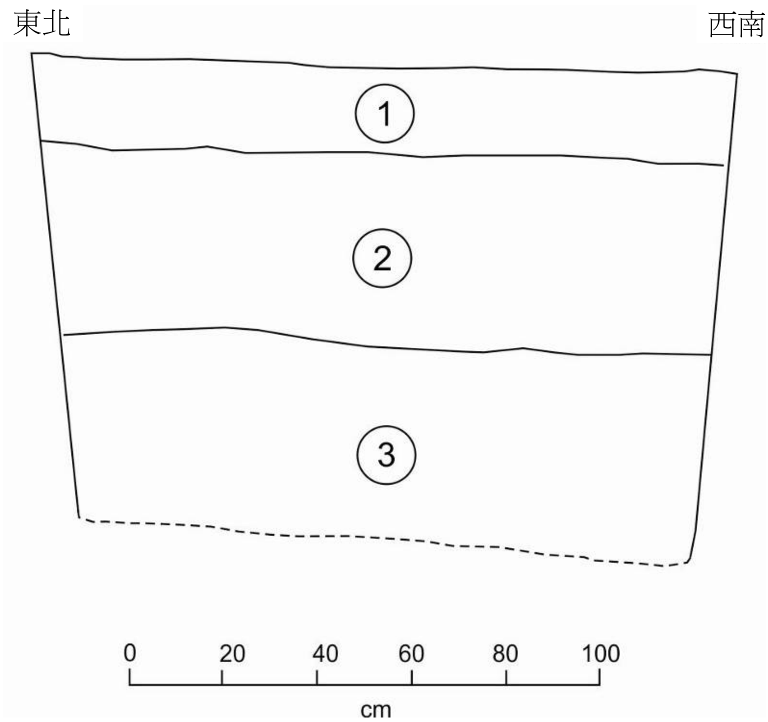
東段

地點代號	KOPST2012		探方代號	TA3
探方座標	E847525.792	N843686.775	探方尺寸	2米 x 1.5米
挖掘方法	人手挖掘		地面標高	主水平基準2.5米

地層情況

分層	說明	文物	測定年代	地面標高以下深度（米）	厚度（米）
1	灰白色細沙，雜有貝殼碎片和現代垃圾	沒有文物	現代	0	0.19-0.20
2	灰白色海沙，雜有一些貝殼碎片和玻璃酒瓶碎片	沒有文物	現代	0.19-0.20	0.40
3	灰白色海沙，比第2層粗糙，雜有一些貝殼碎片和玻璃酒瓶碎片	沒有文物	現代	0.60	>0.40

示意圖



東南段

照片

東南段

附件C

重要文物和一般文物一覽表

重要文物一覽表

重要文物編號	位置	地層	名稱	數量（件）
KOPST2012SC:SF01	在南面岬角的潮間帶沙灘（2號位置）	地面收集	穿孔石製品	1
			總數	1

一般文物一覽表

位置	袋	地層	物件		
			鄉村器物（陶器）	瓷器	磚瓦
在TA1西面的潮間帶沙灘（1號位置）	01	地面收集點	1	1	
在TA3東面的潮間帶沙灘（3號位置）	02	地面收集點	1	3	
在南面岬角的潮間帶沙灘（2號位置）	03	地面收集點	1		1
在南面岬角的潮間帶沙灘（2號位置）	04	地面收集點		5	
TA1	01	第2層	2	1	3
TA1	02	第3層	2		1
TA2	01	第2層		1	4
TA2	02	第3層	1		2
TA2	03	第4層	1		
		總數：	9	11	11

附件D

重要文物的說明

重要文物編號：KOPST2012SC: SF01
名稱：穿孔石製品
照片
  穿孔石製品的兩面
數量：1 件
物料：沉積岩
石料顏色：暗紅 (10R 5/3) [1]
大概尺寸：14厘米（長）；10厘米（闊）；0.2 - 1.7厘米（厚）
形狀：不規則
穿孔直徑：0.96厘米
穿孔形狀：圓形
穿孔技術：從兩面穿孔
年代測定：先秦時期

(1) 蒙賽爾土壤色卡（2000 年可洗版）的暗紅色 (10R 5/3)。

附件E

一般文物的攝影記錄

地面收集的文物

在TA1西面沙灘的潮間帶（1號地點）收集到的明末清初及民國期間的鄉村器物碎片（左）及白瓷片（右）。（01號袋）
（上方：外部；下方：內部）

地面收集的文物

在TA3東面沙灘的潮間帶（3號地點）收集到的明末清初及民國期間的碎片（02號袋）（上方：外部；下方：內部）：鄉村器物碎片（左下）、青瓷碎片（左上）和瓷碎片（右上、右下）。

地面收集的文物

在南面岬角沙灘的潮間帶（2號地點）收集到的明末清初及民國期間的碎片（03號袋）
（上方：外部；下方：內部）：鄉村器物碎片（左）和瓦片（右）。

地面收集的文物

在南面岬角沙灘的潮間帶（2號地點）收集到的唐代青瓷碎片（右上）及明末清初的青花瓷碎片（04號袋）
（上方：外部；下方：內部）。

地點TA1的一般文物

在TA1第2層出土的鄉村器物碎片（中上及右下）、瓦片（左上、左下及中下），以及明末清初的青花瓷碎片（右上）（01號袋）
（上方：外部；下方：內部）。

地點TA1的一般文物

在TA1第3層出土的20世紀初至現代的鄉村器物碎片（左）及瓦片（右）（02號袋）
（上方：外部；下方：內部）；左下角的鄉村器物碎片顯示內部有梳形刻紋。

地點TA2的一般文物

在TA2第2層出土的20世紀初至現代青瓷碎片（左上）及瓦片（中及右）（01號袋）
（上方：外部；下方：內部）。

地點TA2的一般文物

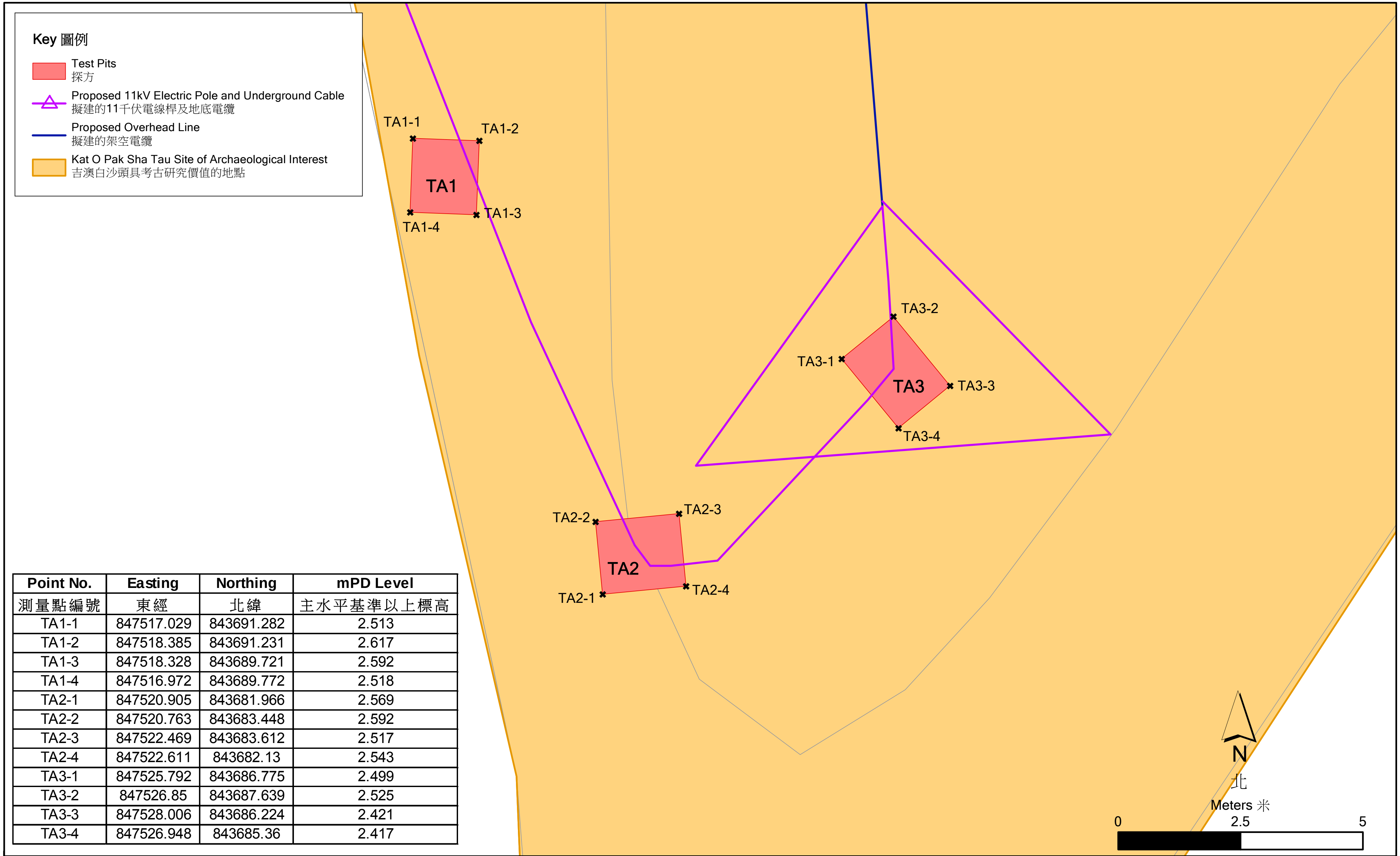
在TA2第3層出土的20世紀初至現代的鄉村器物碎片（左下）及瓦片（02號袋）
（上方：外部；下方：內部）。

地點TA2的一般文物

在TA2第4層出土的20世紀初至現代的鄉村器物碎片（03號袋）
（上方：外部；下方：內部）。

附件F

土地測量記錄



Point No.	Easting	Northing	mPD Level
測量點編號	東經	北緯	主水平基準以上標高
TA1-1	847517.029	843691.282	2.513
TA1-2	847518.385	843691.231	2.617
TA1-3	847518.328	843689.721	2.592
TA1-4	847516.972	843689.772	2.518
TA2-1	847520.905	843681.966	2.569
TA2-2	847520.763	843683.448	2.592
TA2-3	847522.469	843683.612	2.517
TA2-4	847522.611	843682.13	2.543
TA3-1	847525.792	843686.775	2.499
TA3-2	847526.85	843687.639	2.525
TA3-3	847528.006	843686.224	2.421
TA3-4	847526.948	843685.36	2.417

Annex F1
附件F1

Land Survey Record

土地測量記錄

File: 0114462_Land_Survey_Record_Aug2012.mxd
Date: 26/4/2013

Environmental
Resources
Management

ERM

附件E

環境監察與審核

目錄

E *引言*

這份《環境監察與審核》附件旨在：

- 監察在進行電纜鋪設工程時所採用的控制措施的有效程度；
- 核實本工程項目各項工程是否均與工程項目簡介中的預測情況相符，而且不會對附近的珊瑚群落造成不可接受的影響；
- 確保在鋪設電纜的過程中能夠偵測到工程可能造成的任何不良影響，並在發現有敏感受體受到電纜鋪設工程影響時，採取適當行動。

E.1 *水質採樣*

以下章節闡述了在 11 千伏海底電纜鋪設期間的水質監察細節。

E.1.1 *採樣方法*

需測量的參數

需於原地測量的參數有：

- 溶解氧（飽和度%及每公升毫克數）
- 溫度
- 混濁度（比濁法濁度單位 [NTU]）
- 鹽度（$^0/_{00}$）

需於實驗室測量的唯一參數是：

- 懸浮固體（每公升毫克數）

除了水質參數外，亦必須測量和記錄其他相關數據，包括：採樣站位置、水深、時間、天氣情況、海中情況（若適當）、潮汐情況（若適當）、在監察區和工程區附近發生的，可能會影響監察結果的特殊現象和工作。

設備

在進行水質監察時，環境承辦商必須提供和使用下列設備：

- ***溶解氧和溫度測量設備*** – 這項儀器必須是方便攜帶、不受天氣影響的溶解氧測量器，並須附有完整的電線、感應器和全部操作手冊，而且必須可以使用直流電操作。該儀器必須能夠測量：介乎每公升 0–20 毫克和 0-200% 飽和度的溶解氧，以及攝氏 0-45 度的溫度。

  此外，還必須配有能夠自動作出溫度補償的薄膜電極，以及不少於 35 米長的吊索。該儀器必須有足夠的備用電極和電線，以便必要時更換（例如

YSI59 型儀錶、YSI 5739 探頭、YSI 5795A 沉下攪拌器，連同捲盤和電線，或獲批准的相近儀器）。

- *混濁度測量設備* – 混濁度應該以懸浮固體樣本分拆的水樣本進行測量。而且，應該使用適當的套裝混濁度試劑來測量混濁度。

- *鹽度測量儀器* – 必須使用一個能夠測量 0-40ppm 鹽度的便攜式鹽度計來測量每個監察地點的海水鹽度。

- *水深儀* – 沒有為測量水深建議特定的設備。然而，應該優先採用附於水質監察設備底部的水深儀。環境承辦商在使用有關儀器前，必須先取得客戶的同意。

- *水流速度和方向* – 沒有為測量水流速度和方向建議任何特定設備。然而，環境承辦商必須就其建議採用的儀器，先取得客戶的同意，然後才正式使用。

- *定位設備* – 在進行監察時，必須使用全球定位系統（GPS）來確保能夠準確記錄監察船的位置，然後才開始進行測量工作。應該優先採用差分全球定位系統作為定位設備，並應在適當的檢查點（例如鰂魚涌測量釘）進行妥當校準。

- *水樣本採集設備* – 水樣本採集器應該有一個容量不少於兩公升的透明聚氯乙烯或玻璃容器，其兩端都可以有效地加蓋密封（例如 Kahlsico 13SWB203 型水樣本採集器，或獲批准的相近儀器）。水樣本採集器必須設有正向鎖扣來保持在開啟狀態，並防止其過早關上，務求設備在到達選定的水深時，才由適當的訊息指示關上。

採樣／測試程序

所有在原地監察時使用的儀器，都必須由一家經“香港實驗所認可計劃”或其他國際認可計劃認可的化驗所進行檢查、校準和認證，才可以使用，而且必須在進行水質監察的各個階段，都每月重新校準一次。這些設備在每次使用前，都必須以有認證的標準溶液檢測其感應器和電極。

需要在現場進行校準的野外設備，必須遵循《英國標準 1427 號：1993 – 水域分析的田野及現場測試方法指南》的要求進行校準。各項設備都必須保存足夠的備品，務求在有需要時可以更換。此外，亦必須提供後備的監察設備，以便正常的監察設備在進行保養、校準等的時候，仍能不間斷地進行監察。

用於測量懸浮固體的水樣本必須用高密度的聚乙烯瓶收集，並以冰包裹（冷凍至 4°C 而不凝固），然後盡快送至一所屬於香港實驗所認可計劃的實驗室進行相關分析。

實驗室分析

所有實驗室工作都必須在一所已獲香港實驗所認可計劃認可的實驗室內進行。為了進行相關的實驗室測定工作，必須在監察及控制站收集約 1,000 毫升的水樣本。有關的測定工作必須在收集水樣本後的下一個工作天內開始。懸浮固體的實驗室測量結果，必須在採樣後的 2 天（48 小時）內給予客戶。各項分析都必

須依照美國公共衛生協會的《水和廢水的標準檢驗方法（第 19 版）》所闡述的標準方法進行，除非另有說明（有關懸浮固體的 APHA 2540D 部份）。懸浮固體的規定報告下限是每公升 1 毫克。

需予呈交的資料應包括：預處理程序、所用儀器、質量保證／質量控制（質保／質控）詳情（例如空白樣本、加標回收、每批樣本的複製樣本數目等），檢測下限和準確度。質保／質控的詳情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。

E.1.2 監察地點

監察站的位置已經確定，以便監察本工程項目對*圖 E1* 所展示的水質敏感受體的潛在影響。

在電纜鋪設工程進行之前、進行期間和進行之後，都會在工程區四周的監察站進行水質採樣工作。在這些監察站進行的監察工作，是要確保本工程項目的建築工程不會影響附近的敏感地區（展示於*圖 E1*）。

- C1 是一個“控制站”，位於電纜走線北面（相距約 1.4 公里），與環保署的例行監察站 MM2 的座標相同，而且，因為距離本項目地點較遠，應該不會受到相關的建築工程影響；
- C2 是一個“控制站”，位於電纜走線南面（相距超過 1.6 公里），與環保署的例行監察站 MM7 的座標相同，而且，因為距離本項目地點較遠，應該不會受到相關的建築工程影響；
- SR1 是一個“影響監察站”，用作監察電纜鋪設工程對位於青洲的高生態價值珊瑚群落的影響；
- SR2 是一個“影響監察站”，用作監察電纜鋪設工程對位於牛屎湖灣的高生態價值珊瑚群落的影響；
- SR3 是一個“影響監察站”，用作監察電纜鋪設工程對荔枝窩／印洲塘海岸公園（本工程項目地點以西）的影響；
- SR4 是一個“影響監察站”，用作監察電纜鋪設工程對印洲塘海岸公園（本工程項目地點以南）的影響；
- SR5 是一個“影響監察站”，用作監察電纜鋪設工程對西流江魚類養殖區的影響；
- G1 是作為位於“SR1 影響監察站”和建築工程走線之間的“漸變站”；
- G2 是位於 SR2、SR4 和 SR5 的“影響監察站”與建築工程走線之間的“漸變站”；及
- G3 是位於 SR3“影響監察站”與建築工程走線和了哥岩登岸點之間的“漸變站”。

這些監察站的建議座標均羅列於*表 E1*。

表 E1　　各監察站的座標（香港座標格）

監察站	性質	東經	北緯
C1	控制站	846615.32	844892.99
C2	控制站	848633.26	842648.35
SR1	影響監察站	846957.82	843601.61
SR2	影響監察站	847041.35	843125.56
SR3	影響監察站	846208.21	843365.71
SR4	影響監察站	847534.45	842914.89
SR5	影響監察站	847209.44	842883.44
G1	漸變站	846580.39	843334.26
G2	漸變站	847025.97	843218.44
G3	漸變站	847031.21	843538.70

E.1.3　　採樣程序

監察頻率

水質樣本會在基線監察、影響監察和項目後監察時進行收集。影響監察會在海床受到滋擾時進行，例如在進行電纜鋪設工程、水底挖槽、潛水員掩埋電纜、水底纜槽回填等工作時。項目後監察會在電纜鋪設工程完成後進行。

基線監察

基線監察會在電纜鋪設工程展開前進行三次（天）採樣，但不可在超過三個星期之前進行。監察採樣共會在十個地點進行（五個影響監察站、三個漸變監察站和兩個控制監察站），詳見*圖 E1*。每次採集樣本時，都會在漲潮中段和退潮中段的時間收集樣本。

影響監察

影響監察會在電纜鋪設工程進行期間，在基線監察站的位置，每星期收集樣本兩次。每次採集樣本時，都必須在漲潮中段和退潮中段的時間收集樣本。

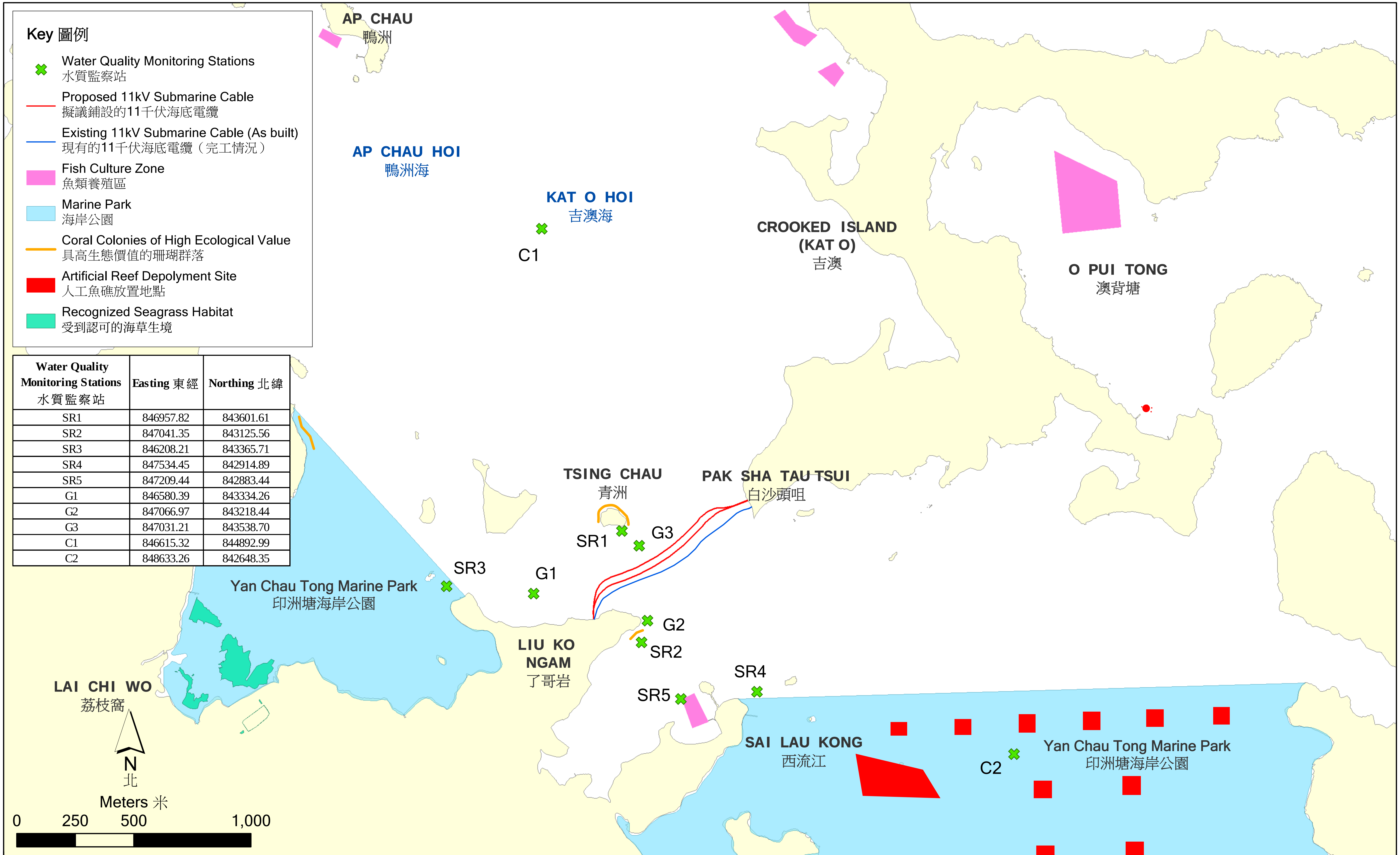
倘若影響監察因為某些原因而暫停，例如電纜鋪設工作沒有滋擾海床，或工程因為安全理由或不良天氣情況等原因而暫停超過一星期，承辦商便應在停止進行影響監察前的一個星期，向環保署和漁護署發出確認信。

項目後監察

項目後監察會在電纜鋪設工程完成後的一個星期內，在基線監察站的位置，收集樣本三次（天），每次均須在漲潮中段和退潮中段的時間進行。

時間

水質採樣工作會分別在漲潮中段和退潮中段之前的 1.5 小時和之後的 1.5 小時，合共 3 小時的時段內進行。環境承辦商會負責聯絡工程承建商，以確保在進行水質採樣時，鋪設工程也在進行。為了能夠記錄到具代表性的潮汐情況，潮水變化的幅度不應少於 0.5 米。此外，每兩次相連的監察工作之間，不可以相隔少於 36 小時進行，除非另有說明。



Water Quality Monitoring Stations 水質監察站	Easting 東經	Northing 北緯
SR1	846957.82	843601.61
SR2	847041.35	843125.56
SR3	846208.21	843365.71
SR4	847534.45	842914.89
SR5	847209.44	842883.44
G1	846580.39	843334.26
G2	847066.97	843218.44
G3	847031.21	843538.70
C1	846615.32	844892.99
C2	848633.26	842648.35

Figure E1
圖E1

Water Quality Monitoring Stations

水質監察站

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Date: 30-Oct-2012

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深度

每個站都會在三個不同深度進行採樣和測量，分別是在海面下 1 米（海面）、在半深處和在海床上 1 米（海底）。在水深不足 3 米的監察站，只會在半深處收集樣本。在水深不足 6 米的監察站，只會在海面和海底收集樣本。

E.1.4 合規事件／行動事件計劃

水質監察結果會根據*表 E2* 所羅列的行動水平和限制水平進行評估

表E.2 水質的行動水平和限制水平

參數	行動水平	限制水平
按每公升毫克數計算的溶解氧 [a]	海面和半深 海面層和半深層以基線數據的 5%百分位數為準；而且“影響監察站”的數值超過“控制站”相應數據的 20%。 海底 海面層和半深層以基線數據的 5%百分位數為準；而且“影響監察站”的數值超過“控制站”相應數據的 20%。	海面和半深 海面層和半深層 [d] 以每公升 4 毫克 [e] 或基線數據的 1%百分位數為準。 海底 海底層 [d] 以每公升 2 毫克 [e] 或基線數據的 1%百分位數為準。
按每公升毫克數計算的懸浮固體（深度平均 [b]）[c]	基線數據的 95%百分位數，以及任何“影響監察站”的數值超過“控制站”相應數據的 20%。	基線數據的 99%百分位數，以及任何“影響監察站”的數值超過“控制站”相應數據的 30%。
以 NTU 計算的混濁度（深度平均 [a]）[c]	基線數據的 95%百分位數，以及任何“影響監察站”的數值超過“控制站”相應數據的 20%。	基線數據的 99%百分位數，以及任何“影響監察站”的數值超過“控制站”相應數據的 30%。

註：

a. 在溶解氧方面，當監察結果低於限制水平，便是不符合水質限制。

b. “深度平均”是以三個深度（即在海面下 1 米處、半深處和在海床對上 1 米處，見*第 E.1.3 節*有關採樣水深的定義）的讀數計算其算術平均而得。

c. 在懸浮固體和混濁度方面，當監察結果高於限制水平，便是不符合水質限制。

d. 在完成基線監察後，其中一個（或兩個）會被選作“行動水平”和“限制水平”。

e. 溶解氧的限制水平是根據《水污染管制條例》（第 358I 章）所擬訂的“大鵬灣水質管制區水質指標”而釐訂。

表 E3 羅列了在有參數超出“行動水平”或“限制水平”時會採取的措施。

表 E3　　事件與行動計劃

事件	承辦商
超出行動水平	**第 1 步** – 重複採樣以確定結果。 **第 2 步** – 若結果獲得確定，便應與電纜鋪設工程的承建商探討以最適當的方法來減少鋪設電纜期間的懸浮固體（例如降低電纜鋪設速度、減少鋪設工程的用水量、提高隔泥幕的效率）。 **第 3 步** – 在實施緩解措施後，再次測量有關的參數，以確定是否符合要求。 **第 4 步** – 若不符合要求的情況持續，便應增加在第 2 步中所採取的措施，然後再重複第 3 步的測量工作。若不符合要求的情況第三度出現，便應暫時停止電纜鋪設工作。
超出限制水平	在錄得參數超出限制水平後，須立即通知環保署和漁護署，並在 24 小時內以書面確認該項不符合要求的事件。 馬上採取上述的**第 1-3 步**。如果不符合要求的情況持續，便應暫時停止電纜鋪設工作，直至找到有效的解決方法為止。

E.1.5　　報告

負責監察工作的環境承辦商應該在展開監察工作前最少一個星期，把“影響監察”的時間表提交予環保署和漁護署，以便取得同意。在進行有關的監察工作時，必須以書函形式，向環保署和漁護署報告監察結果及對這些結果的詮釋。有關的監察數據應該以圖表形式，展示“控制站”、“漸變站”和“影響監察站”之間的關係，以及各項“行動水平”和“限制水平”的符合或不符合情況。

環境承辦商所提供的報告必須包括：一份《基線監察報告》、《影響監察每周報告》，以及《項目後監察報告》。《基線監察報告》須於電纜鋪設工程展開前提交。在展開影響監察後的首三星期，必須在每周的監察調查完成後的一星期內提交該星期的《影響監察每周報告》。倘若在首三星期都沒有錄得任何超出規定的情況，便必須在每完成兩次每周監察調查後的一星期內，提交該兩星期的《影響監察雙周報告》。《項目後監察報告》則須於完成項目後調查的一個星期內提交。

E.2 珊瑚監察與遷移計劃

根據最近的潮下帶潛水和珊瑚地圖調查結果，在了哥岩和白沙頭咀的電纜施工走廊內分別錄得 18 和 16 種硬珊瑚。

擬議電纜鋪設路線的登岸位置已經避開了珊瑚密集區。若能在建築工程動工前，把受影響地區內可以移動的珊瑚群落（了哥岩有 104 個個體、白沙頭咀有 83 個個體）都遷移至接收地點，便可以令電纜施工走廊內可能受影響的硬珊瑚群落數目大幅減少（了哥岩的 120 個個體減少至 16 個，以及白沙頭咀的 108 個個體減少至 25 個）。根據預測，在實施這些措施後，珊瑚群落便不會受到不可接受的影響。

在了哥岩和白沙頭咀兩個登岸地點的岩石切削工作，會在闊 5 米的隔泥幕內進行，藉以控制沉積物擴散。這項緩解措施亦可以令珊瑚在電纜登岸工程進行期間，不會受到不可接受的間接影響。雖然預測珊瑚不會受到不良影響，仍會在鋪設電纜期間進行珊瑚監察，藉以核實本工程項目不會對珊瑚造成任何不良生態影響。

E.2.1 監察和遷移目的

在電纜鋪設工程期間進行珊瑚監察的目的，是要偵測工程對附近珊瑚所造成的不良影響，並在發現由電纜鋪設工程造成的影響時，確保有關方面採取適當行動來有效減少影響。

對珊瑚情況的監察結果，會與水質監察結果一起檢視，因為後者可以提供有關電纜鋪設其間的懸浮固體濃度。

為了再減少珊瑚群落所受影響（該影響並非不可接受），會在施工前把位於了哥岩和白沙頭咀工程區內可能受影響而又可以移動的珊瑚進行遷移。珊瑚調查和遷移工作必須由一位持有相關的生態學研究院學位，以及最少三年相關工作經驗的合資格人士進行。

E.2.2 珊瑚遷移計劃

在有關工程動工前，會先進行詳細的珊瑚調查，以探明工程區內的珊瑚群落。這項調查也會用作指示隔泥幕的安裝位置。珊瑚遷移工作應該在有關工程動工前兩星期，當將被遷移的珊瑚健康狀況良好（沒有受壓力的蹟象）的時候進行。遷移珊瑚的方法闡述如下。

在遷移前的珊瑚狀況評估

在進行遷移前，應該找出在建議工程地點內的每個珊瑚群落。珊瑚群落的狀況，包括部份死亡、白化或病變，以及珊瑚所附著的基質種類和大小等，都應該加以記錄；並應該為每個記錄到的珊瑚群落拍攝具代表性的照片。

遷移珊瑚

應該用手提起被遷移的珊瑚。為能取得顯著較高的珊瑚存活率，在整個遷移過程中，所有被遷移的珊瑚群落在任何時候都應該浸在水中（而不應暴露在空氣或風中，或受陽光直接照射）。採用人手在水下遷移的方法，可以確保被遷移的珊瑚會被小心收集和遷移，並按照正確的方向放置。

對於已有識別資料的珊瑚群落，應該連同其附著的基質（例如礫石）一起遷移至接收地點。細小的可移動群落可以用水下起重機來運送。水下起重機是由一個 1 平方米的平台懸掛在一個 200 公斤的浮力袋下而組成。各個珊瑚群落可以由戴上手套的潛水員放置於平台上。當珊瑚群落的識別工作展開後，便應由一隊潛水員攜同水下起重機跟隨，並以一致的方式把已作記錄的群落遷移。應該設法令潛水員與被運送的珊瑚群落的接觸範圍和接觸時間都盡量減小。在每次使用平台和拿起珊瑚群落時都應該小心，盡量避免接觸珊瑚的組織。

建議把起重機拴附於潛水船上，藉此把珊瑚運送至青洲北面，即在*圖 E2* 和*第 E.2.3* 節中稱為“控制地點”的地方。潛水船應該以固定的慢速行駛（低於每小時 2 海浬）。在遷移過程中，每個珊瑚群落都應該一直保持其垂直定位。

當起重機到達接收地點後，潛水員便應該把載有珊瑚的平台放置在一片沒有任何珊瑚群落的海床上。然後把每個珊瑚群落逐一從平台上拿起，並小心地放置於海床上，盡量減少滋擾海床上的沉積物。各個群落之間的距離應盡量依照原來的珊瑚分佈，以免各個品種之間互相競爭。

評估遷移後的珊瑚群落

每個被遷移的珊瑚群落都應該在被遷移後，以及在進行項目後監察時，進行再次評估。珊瑚群落的狀況，包括部份死亡、白化或病變，以及珊瑚所附著的基質種類和大小等，都應該加以記錄。此外，亦應該為每個被遷移的珊瑚群落拍攝具代表性的照片，以便比較這些珊瑚在遷移前和遷移後的健康狀況。

E.2.3 珊瑚監察計劃

監察地點

對於可能會受間接影響的珊瑚群落，將會實施監察計劃，其中包括在“影響監察站”和“控制站”進行潛水調查。因此，電纜鋪設工程對珊瑚的影響，可以透過比較這兩個站和水質監察結果來加以推斷。

在了哥岩和白沙頭咀的“影響監察站”，會包括位於海灣內和最接近電纜鋪設工程施工走廊的具代表性珊瑚群落；而“控制站”則會包括位於青洲北面的具代表性珊瑚群落。在進行珊瑚監察時，安全是首要考慮，因此，絕不可以在建築工程的機器運營時，在毗鄰地方進行監察工作。環境承辦商在進行珊瑚監察時，必須與電纜鋪設工程承建商保持良好溝通，並須於展開監察工作前，把監察時間和計劃通知電纜鋪設工程承建商，以便能安排適當時間進行監察。

在青洲北面設置“控制站”比較適合，因為該處的珊瑚群落與“影響監察站”相近。而且，該處的群落與可能受影響的地區有合理的距離，預計不會受到電纜鋪設工程影響。所以，“控制站”所受到的任何影響，都是由其他環境因素造成，因此可以在檢查“影響監察站”所受到的影響時作為比較對象。

將會在“影響監察站”和“控制站”加以監察的珊瑚數目和位置（會加上標籤的珊瑚），都必須在現場予以識別。每個地點（受影響地點和控制地點）都必須最少選出 20 個珊瑚群落，以便進行統計評估。在每個地點的珊瑚都必須隨機地選定並加上標籤，而且，在“控制站”的受監察珊瑚群落都必須與“影響監察站”所選定的監察對象具有相似的特點和位於相近的深度。

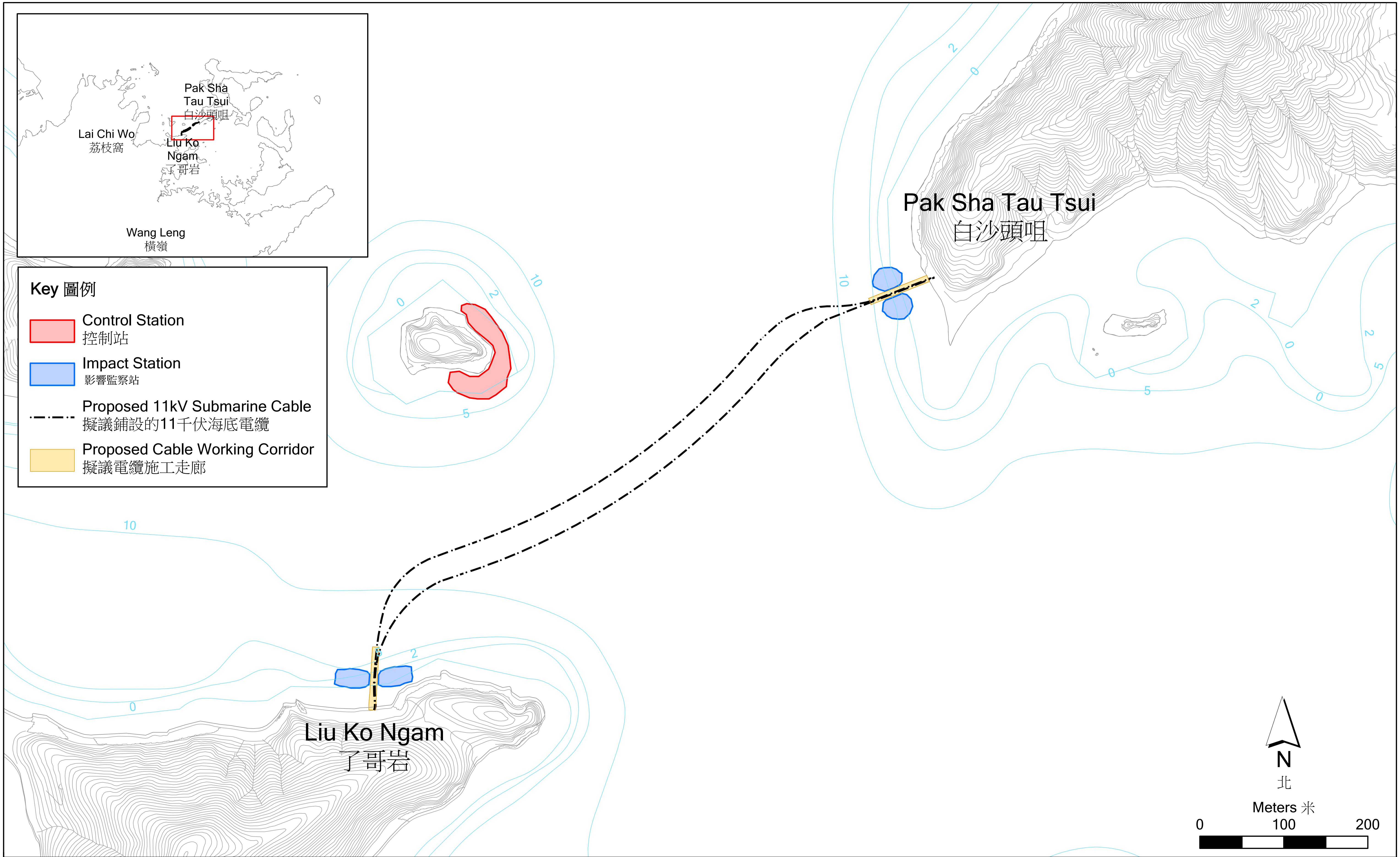

Figure E2
圖E2

Coral Monitoring Stations

珊瑚監察站

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File: T:\GIS\CONTRACT\0114462\mxd\0114462_Coral Monitoring Station.mxd
Date: 30-Oct-2012

珊瑚監察方法

珊瑚監察工作必須由具有實地識別座生底棲生物類別經驗的觀察員，以水肺潛水方式進行。這些觀察員必須是對珊瑚具有專門知識的合資格海洋生物學家，並須具有海洋生物學碩士或以上學位。每次潛水調查都應由同一位珊瑚專家進行，以保持珊瑚狀況記錄的前後一致。有關的專家在進行監察工作前，必須先經漁護署批准。環境承辦商必須為潛水工作執行一套安全工作制度。該套制度必須依循適用的工作守則（《工業潛水的工作安全與健康》）。

需要進行的珊瑚調查包括：在電纜鋪設工程動工前進行一次調查（以便完成基線調查和為珊瑚加上標籤）；在電纜鋪設工程施工期間每星期進行兩次監察（影響監察）；以及在工程竣工後進行一次調查（項目後監察）。執行這些工作的方式如下。

<u>基線調查／為珊瑚加標籤</u>

在電纜鋪設工程動工前，會先在“影響監察站”和“控制站”的地區進行潛水調查。這次潛水調查會包括對該區的一般勘察，藉此取得區內珊瑚數目的資料，以便找出需加標籤的珊瑚群落數目。此外，亦會提供有關該區珊瑚的種類多樣性、數目多寡和健康狀況（白化、活珊瑚／死珊瑚的比率和粉泥覆蓋率）等一般資料。將會加上標籤和予以監察的珊瑚，都必須按下述方法在現場實地找出。

應該優先選擇最接近電纜鋪設區的最大和未受破壞的珊瑚群落作為標籤對象，因為這些珊瑚是最容受到沉積物破壞的群落，而且，在先前未受破壞的珊瑚中，會較容易識別出這些珊瑚來進行狀況記錄。

在進行基線監察時，必須對每個已被標籤的珊瑚群落進行種類識別，其細緻程度須達“屬”或“種”一級，而且必須為每個已標籤的群落進行拍照記錄，並記錄其相關資料，包括位置、大小和四周環境的一般情況。此外，還須記錄其他相關資料，例如：調查日期、調查時間、天氣情況、海中情況和潮汐情況等。

每個已標籤珊瑚群落被沉積物覆蓋的情況也必須加以記錄，包括沉積物的覆蓋百分比、顏色和質感，以及在珊瑚群落上及毗鄰的基岩或礫石基質上的沉積物大概厚度。對於毗鄰的任何覆蓋率超過 10%的成片沉積物，都必須予以點算。每個已標籤珊瑚群落的健康狀況，包括白化效果和活／死比率等，都必須加以記錄。

此外，還必須為“受影響區”和“控制區”內的每一個已標籤珊瑚群落及其附近地形拍照。

<u>影響監察</u>

“影響監察”的焦點，在於確定有關的珊瑚在電纜鋪設工程進行期間是否受到影響，以及這些影響是否由電纜鋪設工程造成。這些珊瑚監察結果會與水質監察結果一併檢視。在進行任何電纜鋪設工程時，包括登岸地點準備工程、電纜鋪設和登岸工程，及回填工程等，都必須進行“影響監察”。

在每次“影響監察”中，都必須收集與“基線調查”相若的資料，其中包括：珊瑚的健康狀況、牠們的環境狀況、調查日期和時間、調查期間的大氣情況、海水情況和潮汐情況，以及沉積物的覆蓋率和大約厚度。每個珊瑚群落都必須予以拍照。

項目後監察

“項目後監察”是在電纜鋪設工程完成後兩個星期內進行的一次調查。這項監察必須取得的資料與“影響監察”所須取得的資料一樣。

E.2.4 合規事件／行動事件計劃

珊瑚監察的結果會按照“行動水平”和“限制水平”進行評估，並會參考電纜鋪設工程在進行中和進行前的珊瑚狀況及沉積物覆蓋率。*表 E4* 羅列了進行珊瑚監察的“行動水平”和“限制水平”。

表 E4 珊瑚監察的行動水平和限制水平

水平	說明
行動水平	倘若在進行“影響監察”期間，在“影響監察站”內的已標籤珊瑚群落中，有超過 20%的群落，其沉積物覆蓋率增加了 15%或以上，而且“控制監察站”又未有錄得這種情況，該“影響監察站”便是超過了“行動水平”。
限制水平	倘若在進行“影響監察”期間，在“影響監察站”內的已標籤珊瑚群落中，有超過 20%的群落，其沉積物覆蓋率增加了 25%或以上，而且“控制監察站”又未有錄得這種情況，該“影響監察站”便是超過了“限制水平”。

表 E5 羅列了在有參數超出“行動水平”或“限制水平”時會採取的措施。

表 E5 珊瑚監察的行動水平和限制水平

事件	承辦商
超出行動水平	**第 1 步** – 將監察結果與水質監察結果比較，並在兩天內再次進行採樣。倘若仍然超過行動水平，便須通知漁護署。
	第 2 步 – 與電纜鋪設工程的承建商探討以最適當的方法來減少鋪設電纜期間的懸浮固體（例如降低電纜鋪設速度、減少鋪設工程的用水量、提高隔泥幕的效用）。
	第 3 步 – 在實施緩解措施後，再次測量有關的參數，以確定是否符合要求。
	第 4 步 – 若不符合要求的情況持續，便應增加第 2 步中的相關措施，然後再進行第 3 步的測量工作。倘若第三次出現不符合要求的情況，便須暫停電纜鋪設工作。
超出限制水平	馬上採取上述的**第 1-3 步**。如果不符合要求的情況持續，便應暫時停止電纜鋪設工作，直至找到有效的解決方法為止。

E.2.5 報告

承辦商必須向漁護署提交書函式報告，其內容須包括相關的監察結果，連同在採樣期間的挖泥工程和電纜掩埋工程的運營方法（包括位置、電纜掩埋深度等），以及對電纜鋪設工程和珊瑚狀況監察結果的詮釋。

報告內的數據必須包括調查的扼要資料，最少須包括地點說明（包括調查期間的天氣情況和各地點的地理特色）、每個地點的生物環境描述，以及每個地點的珊瑚狀況，包括沉積物覆蓋率和照片證明。

此外，必須提交下列報告：

- 一份《珊瑚遷移調查和基線監察調查報告》；
- 在電纜鋪設期間的《影響監察每周調查報告》；及
- 《項目後調查報告》。

《珊瑚遷移調查和基線監察調查報告》須於電纜鋪設工程動工前提交，而各份影響監察報告則須於每周監察調查完成後的一個星期內提交。《項目後監察報告》須於完成項目後調查的一個星期內提交。

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