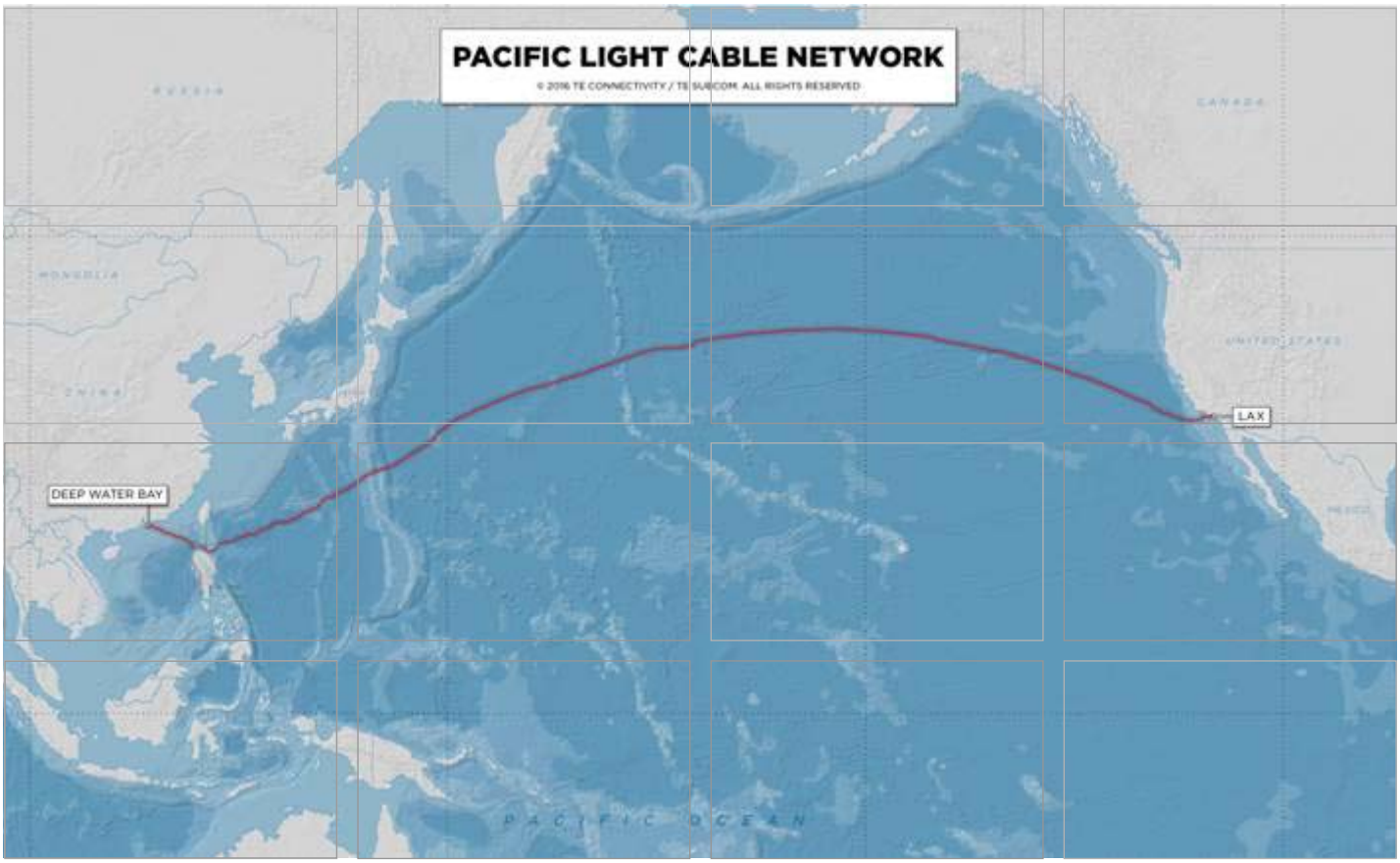

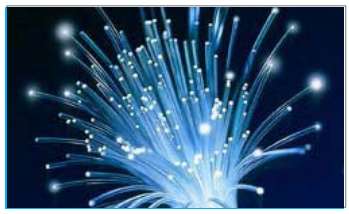

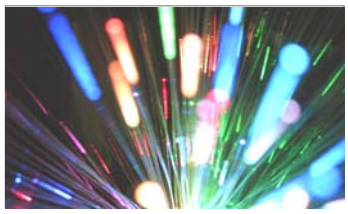

PCCW Global®

Pacific Light Cable Network (PLCN) – Deep Water Bay

Project Profile

April 2017

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ERM

Pacific Light Cable Network (PLCN) – Deep Water Bay

PLCN 海底光纜系統 – 深水灣

Project Profile
工程項目簡介

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ERM Document Code: 0335723.doc
環境資源管理顧問有限公司文件編號：0335723.doc

Client 客戶: PCCW Global (HK) Limited	Proposal No 項目編號 ： 0335723
Summary綜述: This is the Project Profile prepared by Environmental Resource Management – Hong Kong (ERM), for the permitting process under the Environmental Impact Assessment Ordinance (EIAO), for the proposed Pacific Light Cable Network submarine cable in Hong Kong Special Administrative Region, landing at Deep Water Bay. 本工程項目簡介是由環境資源管理顧問有限公司按照「環境影響評估條例」的規定，為於香港特別特政區內深水灣登陸的 PLCN 海底光纜系統工程項目進行許可證申請程序而編製。	Date: 25th April 2017 日期：2017 年 04 月 25 日 Approved by 批核:  *Terence Fong* *方靜威* *Partner* *合夥人*

Revision	Description	By	Checked	Approved	Date
v0	Project Profile for Formal Submission	FZ	TF	TF	25/04/17

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Annex B Assessment of Potential Impacts to Marine Ecology Resources

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Annex D Assessment of Potential Noise Impacts

Annex E Assessment of Potential Impacts to Marine Archaeological Resources

Annex F Tree Survey

Annex G Environmental Monitoring and Audit

1 BASIC INFORMATION

1.1 PROJECT TITLE

The title of the project is 'Pacific Light Cable Network (PLCN) – Deep Water Bay' (hereafter referred to as the Project).

1.2 PURPOSE AND NATURE OF THE PROJECT

In order to help meet the tremendous telecommunication services requirements between Asia and North America, the **PLCN Consortium** has decided to build a submarine telecommunication cable system, which will be approximately 12,800 km in length, connecting Hong Kong and the United States.

The cable will connect to Deep Water Bay (DWB) within the HKSAR. **PCCW Global (HK) Limited** is providing the cable landing point and the associated cable landing service in Hong Kong for the PLCN Consortium.

This Project Profile includes an assessment of the potential environmental impacts associated with the installation and operation of the submarine telecommunications cable system within HKSAR, including the connection to land at DWB. The assessment has been based on information compiled by the Project Proponent describing the expected construction and operation activities, as well as potential maintenance work, ie repair operations.

1.3 NAME OF PROJECT PROPONENT

As the landing service provider, **PCCW Global (HK) Limited (PCCWG)** is responsible for the cable landing issue within HKSAR and is therefore the Project proponent. Contact details are:

PCCW Global (HK) Limited
34th Floor, PCCW Tower
Taikoo Place, Quarry Bay, Hong Kong

1.4 LOCATION AND SCALE OF THE PROJECT AND HISTORY OF THE SITE

1.4.1 *Location*

The route of the proposed PLCN submarine cable system is depicted in *Figure 1.1.* The proposed cable would land at an existing manhole location at DWB (further details in *Section 1.5*) and the location of the landing site is presented in *Figure 1.2a.* It should be noted that DWB is currently the landing site for a number of submarine cables.

The cable will travel from DWB southward approaching the East Lamma Channel. Near to Round Island, the cable is approximately parallel to the

East Lamma Channel until the south of Stanley Peninsula. The cable will then travel eastward along the boundary of HKSAR waters and will enter the South China Sea.

1.4.2 Scale of Project

The PLCN submarine cable in HKSAR waters has an intended burial depth of up to 5 m below the sea bed in HKSAR waters. The total length of the submarine cable within HKSAR waters is approximately 40 km.

The cable laying process will only require minor works within the marine environment which are not expected to adversely affect water quality or marine ecological and fisheries uses of the area. The landing is situated to the far northwest end of the Deepwater Bay, away from the shark preventive net swimming area. Only small scale construction works are required at the cable landing site to enable the cable to enter the existing Beach Manhole (BMH) system.

During operation, the cable is not expected to result in any impact to the environment.

1.5 CABLE ROUTE SELECTION PROCESS

1.5.1 Landing Site Selection

Deep Water Bay (DWB) is one of the main cable landing locations in Hong Kong. The PLCN Purchaser has considered a number of constraints and benefits when selecting the landing site, including commercial factors such as availability of existing Beach Manholes (BMHs) to minimise land works and connectivity to the nearest available Cable Landing Station (CLS), as well as physical and environmental factors. Deep Water Bay was selected due to the following reasons:

- With existing BMH operated by PCCWG;
- With existing CLS operated by PCCWG;
- With well connected conduits, underneath and along the existing roads, between the BMH and CLS. No additional disturbance to the terrestrial environment after the submarine cable landed and connected to the existing BMH;
- DWB is a sandy beach with very gentle slope which is considered as a preferred cable landing location and therefore the cable installation is expected to be completed quickly;

The existing BMH and CLS facilities at DWB are already operated by PCCWG, and they have backhaul from there to their facilities in Hong Kong, all of which are advantageous reasons for PLCN Consortium selecting DWB as the landing site. The PLCN cable system Contractor, TE SubCom, also

successfully landed the TATA-IA cable at DWB in 2008 according to the requirement of Environmental Permit (EP -294/2007) and is therefore familiar with the site.

In addition, landing at the existing BMH at DWB allows the PLCN cable system to take advantage of existing infrastructure thus avoiding cutting the roads and verges to install new ducts and manholes, so avoiding big disruptions to local traffic as well as the terrestrial environment that this would cause. In addition, the nature of the bay with its gently shelving seabed and a soft bottom, provides shelter from waves and wind, with adequate depth of water for vessels to come reasonably close to shore and minimum currents, making it at an ideal location at which to land a cable, as evidenced by the fact that it has been a landing point for international submarine cables for many years.

DWB is located on the southwest side of Hong Kong and is currently the landing site for a number of telecommunication submarine cables including SEA-ME-WE3 S1 & S3, TATA Intra-Asia (IA), Thailand-Vietnam-Hong Kong (TVH), Hong Kong-Japan-Korea (HJK), Singapore-Hong Kong-Taiwan (SHT) A and B, and Okinawa-Luzon-Hong Kong (OLUHO). The PLCN cable will closely parallel existing cables to minimize land disturbance. For more details of the land cable installation see *Section 2.1.1*.

Due to all these considerations the site shown in *Figure 1.2a* at DWB is the selected landing site for the PLCN cable system in HKSAR, with further detail on the landing point locations considered within DWB itself, provided in *Section 1.5.2*, *Table 1.1*. *Figure 1.2b* and *Figure 1.2c* help to illustrate the advantages and disadvantages of the options considered.

1.5.2 Marine Route Planning Considerations

There are several existing environmental and physical constraints to the PLCN cable route (*Figure 1.3*), which have influenced the alignment of the cable. The following issues have been taken into consideration in finalising the route.

Other Submarine Cables and Pipelines

Minimize disturbance to existing submarine cables and pipelines, thereby ensuring that the PLCN cable laying operations do not compromise the operation or integrity of other cables. This includes minimising crossings with other submarine cables and pipeline infrastructure situated along the proposed PLCN cable route. Hong Kong waters have a number of existing cables and therefore crossings are unavoidable. Crossings have been minimised to route between existing cables and pipelines but given the congested nature of Hong Kong waters, some are unavoidable (see *Section 2.1.5*).

Other recommendations to maintain existing cable integrity will also be adhered to, with reference to the International Cable Protection

Committee(ICPC)[1], European Subsea Cables Association (ESCA)[2] and North American Submarine Cable Association (NASCA)[3], in particular aiming to adopting a default minimum separation distance between cables of three times water depth from in service cables.

Avoiding Major Marine Vessel Fairways

Major Marine Vessel Fairways have Traffic Separation Schemes (TSSs) and should be avoided where possible, so as to minimise impacts on marine traffic and maximise the safety of the PLCN cable laying operations. In particular for the PLCN Route landing at DWB, the East Lamma Channel should be avoided.

To avoid crossing existing telecommunication cables with shallow burial depth and maintain the PLCN cable's intended burial depth, consideration was made to re-route, running along the northern boundary of East Lamma Channel (see *Figure 1.4a*). However given this is a major shipping channel the potential disruption to marine traffic and safety means this alternative route has not been selected and the original route in this area will be followed.

To avoid proximity to environmental sensitive receivers, particularly for coral and the coastline along north Beaufort Island and Sung Kong Islet, a route north of the islands but south of existing telecommunication cables was explored. Given the deep waters in this area however and the need to maintain a suitable distance between the existing telecommunication cables , which is calculated as a multiple of water depth (refer to *Other Submarine Cables and Pipelines* above), a route north of the existing telecommunication cables was selected, as outlined in *Figure 1.4b.* A route to the south of Po Toi was also considered but not deemed feasible due to high congestion of other submarine cable in the area (see *Figure 1.3*), a rocky seabed limiting the route running close to Po Toi and the Traffic Separation Scheme/ Inshore Traffic Zone just outside Hong Kong's boundary limiting the route going further south-east.

The finalised alignment crosses and then runs parallel to a vessel traffic stream north of the Beaufort Island and although this is not termed one of major marine vessel fairways in Hong Kong, nevertheless vessel traffic is reasonably high and therefore an initial Marine Traffic Impact Assessment is being conducted to review any potential impacts and recommend mitigation measure if needed.

Environmental Sensitive Receivers

The route should preferably avoid all known key environmental sensitive receivers/ areas, such as Fish Culture Zones (FCZs), Coral Communities of High Ecological Value, and Coastal Protection Areas (CPAs) as shown in

(1) International Cable Protection Committee website available at https://www.iscpc.org/ [Accessed Dec 2016]

(2) European Subsea Cables Association website available at http://www.escaeu.org/ [Accessed Dec 2016]

(3) North American Submarine Cable Association website available at https://www.n-a-s-c-a.org/ [Accessed Dec 2016]

Figure 1.3, and maintain a suitable distance from such receivers/ areas. In addition, the proposed route must aim to minimize disturbance to the existing sea bottom.

With regards the Coral Communities of High Ecological Value near Sung Kong and natural coastlines along Beaufort Island, the original routing which maintained standard safety distance from other existing cables, was first slightly altered to maximise the distance from these Coral Communities of High Ecological Value and natural coastlines while still maintaining a suitable distance (refer to *Other Submarine Cables and Pipelines* above) from the existing cables immediately north. A further update to the alignment was made in this area to increase the distance between the alignment and sensitive receivers even further, and as shown in *Figure 1.4b* means the alignment now runs to the north of most other submarine cables in the area where the water depth is slightly shallower.

Minimize Disturbance to Known Marine Archaeological Resources

Avoid impact and minimize disturbance to any marine archaeological resources.

Other Physical Constraints

Avoid the anchorage areas south of Lamma Island and the deep water and old spoil ground between Po Toi and Beaufort Islands.

In addition, the cable should ideally avoid rocky outcrops on the seabed as cable installation in outcrop areas will require the cable to be surface laid or shallow burial, increasing the risk of cable damage due to vessel anchors and fishing activity during operation.

Gazetted Bathing Beaches

Direct routing to gazetted bathing beaches should be avoided insofar as practical. The swimming area (within the shark net) of the gazetted bathing beach at Deep Water Bay has been avoided with the landing site situated to the west.

Minimize Disturbance at Landing Site

To minimize disturbance at the DWB landing site, the PLCN cable will closely follow the route of the existing submarine cable shore ends.

Consideration of Alternative Landing Points

Several landing points at DWB were considered, as illustrated in *Figure 1.2a* and outlined in *Table 1.1*. Landing points were ruled out:

- along the south of Nam Long Shan as this area is designated as Coastal Protection Zone; and

- that traversed the shark protection nets in the gazetted beach area, as this would require removal of the nets which is not considered feasible.

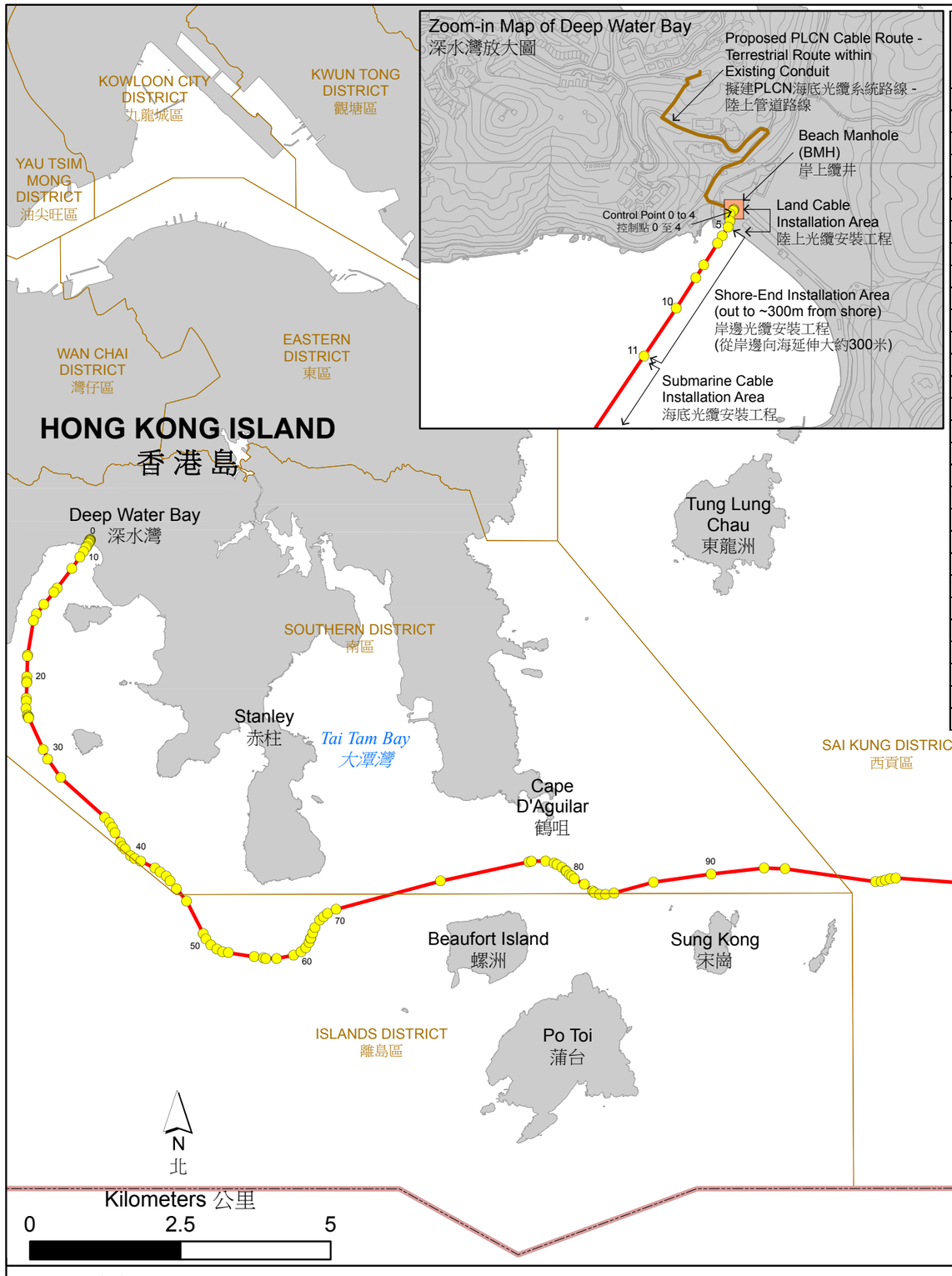
Landing site *Options 1* and *2* require the alignment to pass through the gazetted DWB bathing beach area, while *Options 3* and *4* do not; however all are within 500 m of the bathing beach and/or Coastal Protection Zones either along the south of Nam Long Shan or at Middle Island. Given the extent of the bathing beach and/or CPAs on the south side of Hong Kong Island, it is not possible to find a landing point nearby that does not pass within 500 m of a bathing beach/ CPA.

Given the considerations outlined in *Table 1.1 Option 2* has been selected as the landing site location, to the west of the gazette beach shark preventive nets, where there is existing infrastructure nearby and it is considered there will be minimal disruption to both bathers and traffic, as well as no adverse environmental impacts, as detailed further in *Section 4*.

Table 1.1 Cable Landing Site Selection at DWB

Option	Advantages	Disadvantages	Conclusion/ Recommendation
1. Far West of Gazetted Beach Shark Nets near land leased to Private Members' Club	• Furthest option from key bathing area (within the shark preventive nets) within gazetted beach boundary	• Still within gazetted beach area boundary • Less beach and more rocky shoreline not optimal for cable landing • Rock breaking (potentially more noise disturbance) may be required during the cable installation • Longer route to connect to the existing BMH • Route would need to pass over stream mouth of the Ecologically Important Stream to reach proposed BMH • Route from Landing Point to BMH would require trenching along public areas and footpaths, causing more disruption and likely leading to longer construction period • Route from Landing Point to BMH passes through land currently leased to Private Members' Club and would require additional liaison time and agreements	Not recommended as direct impact on stream mouth of the Ecologically Important Stream and additional environmental impacts particularly noise will likely be resulted due to the trenching and installation of land cable.
2. To the West of the Gazetted Beach Shark Nets	• Avoids key bathing area (within shark preventive nets) of gazetted beach boundary • Shallow beach shoreline ideal for cable landing • Shortest route to existing BMH facility • Existing conduit from BMH to CLS->minimal disturbance to traffic • Maximises separation distance from stream mouth of the Ecologically Important Stream to the west and from Shark Preventive Nets to the east	• Still within gazetted beach area boundary • Goes through an area of existing trees, but tree felling will not be required	Recommended as the option has the least environmental impacts and shortest works duration.
3. To the East, just outside Gazetted Beach Boundary	• Avoids gazetted beach boundary, hence avoids directly disturbing bathers there	• No existing BMH available • A new BMH will be required, increasing construction time and increasing disruption • Construction of a new section of conduit	Not recommended as additional environmental impacts particularly noise will likely be resulted due to the

Option	Advantages	Disadvantages	Conclusion/ Recommendation
		connecting to the existing conduits, increasing construction time and increasing disruption • Less beach and more rocky shoreline not optimal for cable landing • Rock breaking (potentially more noise disturbance) may be required during the cable installation • Construction of a BMH and conduit would be along busy main road and parking area, potentially causing heavy congestion • Close to several residential houses	construction of new BMH, trenching and installation of land cable.
4. South-east, outside Gazetted Beach Boundary	• Would not directly disturb bathers in the Gazetted Beach area • Furthest from Ecologically Sensitive Stream outflow	• Rocky shoreline not optimal for cable landing • Rock breaking (potentially more noise disturbance) may be required during the cable installation • No existing BMH available • A new BMH will be required, increasing construction time and increasing disruption • No existing conduit to haul cable to CLS. • Construction of a new section of conduit connecting to the existing conduits, increasing construction time and increasing disruption • Construction of a BMH and conduit would be along busy main road with limited passing points, potentially causing heavy congestion • Close to a number of residential houses	Not recommended as additional environmental impacts particularly noise will likely be resulted due to the construction of new BMH, trenching and installation of land cable.



Working Limit Control Point 工作工程控制點	Coordinate System (HK Grid 1980) 香港1980方格網坐標		Chainage Distance 測量距離	Working Limit Control Point 工作工程控制點	Coordinate System (HK Grid 1980) 香港1980方格網坐標		Chainage Distance 測量距離	Working Limit Control Point 工作工程控制點	Coordinate System (HK Grid 1980) 香港1980方格網坐標		Chainage Distance 測量距離	Working Limit Control Point 工作工程控制點	Coordinate System (HK Grid 1980) 香港1980方格網坐標		Chainage Distance 測量距離
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2	837229.32	811906	0.003	31	836522.74	808260	4.051	60	840735.25	805062	9.816	89	846597.69	806215	16.358
3	837223.82	811899	0.012	32	836738.08	807951	4.428	61	840812.92	805128	9.919	90	847556.1	806350	17.328
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6	837208.19	811857	0.058	35	837595.16	807121	5.629	64	840897.78	805283	10.097	93	850288.9	806222	20.089
7	837198.74	811842	0.076	36	837641.74	807036	5.727	65	840931.1	805373	10.193	94	850382.39	806229	20.183
8	837172.11	811801	0.126	37	837729.57	806874	5.912	66	840965.45	805465	10.291	95	850454.55	806251	20.258
9	837156.48	811776	0.155	38	837763.44	806812	5.983	67	841046.88	805583	10.435	96	850531.36	806275	20.339
10	837118.34	811716	0.226	39	837809.33	806760	6.052	68	841110.98	805638	10.520	97	850624.33	806284	20.433
11	837055.12	811622	0.339	40	837900.6	806658	6.189	69	841177.64	805695	10.608	98	858725.33	805691	28.576
12	836923.7	811428	0.575	41	837970.38	806612	6.273	70	841319.93	805764	10.767	99	858880.21	805680	28.731
13	836678.36	811108	0.979	42	838071.27	806562	6.386	71	843055.3	806234	12.569	100	863088.39	805889	32.955
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15	836459.3	810831	1.333	44	838393.37	806384	6.756	73	844570.83	806563	14.124	102	865321.36	805805	35.195
16	836331.99	810671	1.538	45	838490.83	806313	6.877	74	844800.96	806568	14.355	103	865441.32	805812	35.316
17	836284.22	810566	1.654	46	838557.18	806233	6.981	75	844945	806533	14.503	104	865562.24	805851	35.443
18	836186.45	809988	2.242	47	838659.97	806108	7.143	76	844991.07	806508	14.556	105	865660.44	805911	35.559
19	836186.11	809974	2.255	48	838831.53	805900	7.414	77	845074.62	806463	14.651	106	865735.92	805991	35.668
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22	836173.56	809535	2.696	51	839234.71	805173	8.249	80	845200.84	806343	14.826	109	865913.47	806261	35.995
23	836165.83	809267	2.964	52	839335.1	805096	8.376	81	845234.72	806311	14.873	110	866000.33	806315	36.098
24	836164.62	809227	3.005	53	839429.13	805055	8.479	82	845279.43	806269	14.934	111	866111.29	806350	36.214
25	836161.02	809105	3.127	54	839527.45	805040	8.579	83	845447.74	806176	15.127	112	867081.39	806403	37.188
26	836185.59	808992	3.242	55	839955.45	804974	9.013	84	845585.99	806066	15.304	113	869751.57	806549	39.869
27	836198.13	808965	3.273	56	840106.71	804951	9.166	85	845613.5	806045	15.339	114	869840.61	806545	39.958
28	836202.77	808955	3.284	57	840148.99	804945	9.209	86	845700.31	806015	15.431				

Legend 圖例

- Working Limit Control Point 工作限制工程點
- Proposed PLCN Cable Route 擬建PLCN海底光纜系統路線
- Boundary of HKSAR 香港特別行政區邊界

Figure 1.1
圖 1.1

Proposed PLCN Cable Route
擬建PLCN海底光纜系統路線

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Date: 29/3/2017

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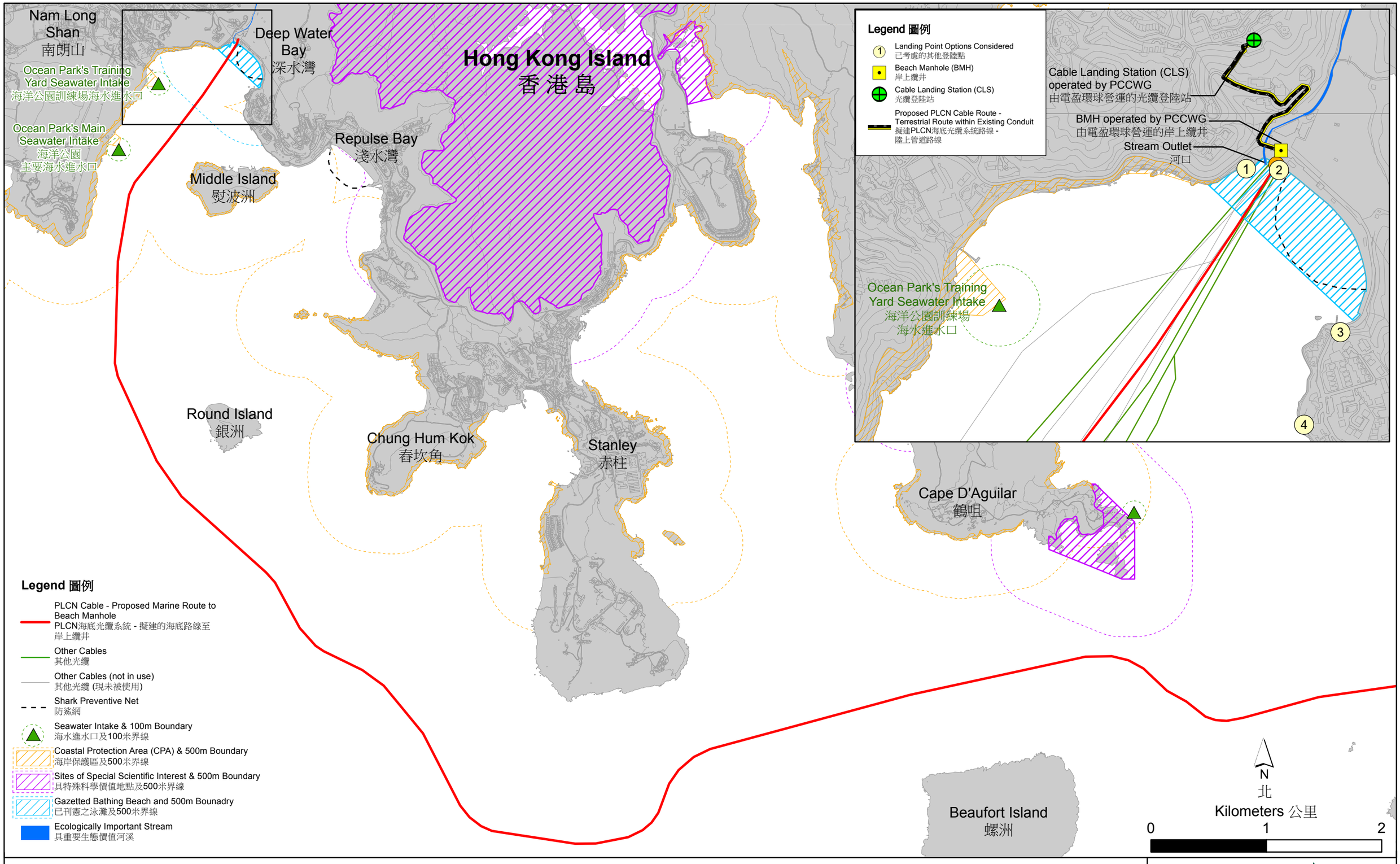

Figure 1.2a
圖 1.2a

Proposed PLCN Cable Route Landing at Deepwater Bay - Designated Project Elements
擬建PLCN海底光纜系統路線於深水灣的登陸點 - 指定工程項目的元素

File: T:\GIS\CONTRACT\0335723\Mxd\0335723_Proposed_PLCN_Cable_Landing_dredging_operation_v2_bil.mxd
Date: 29/3/2017

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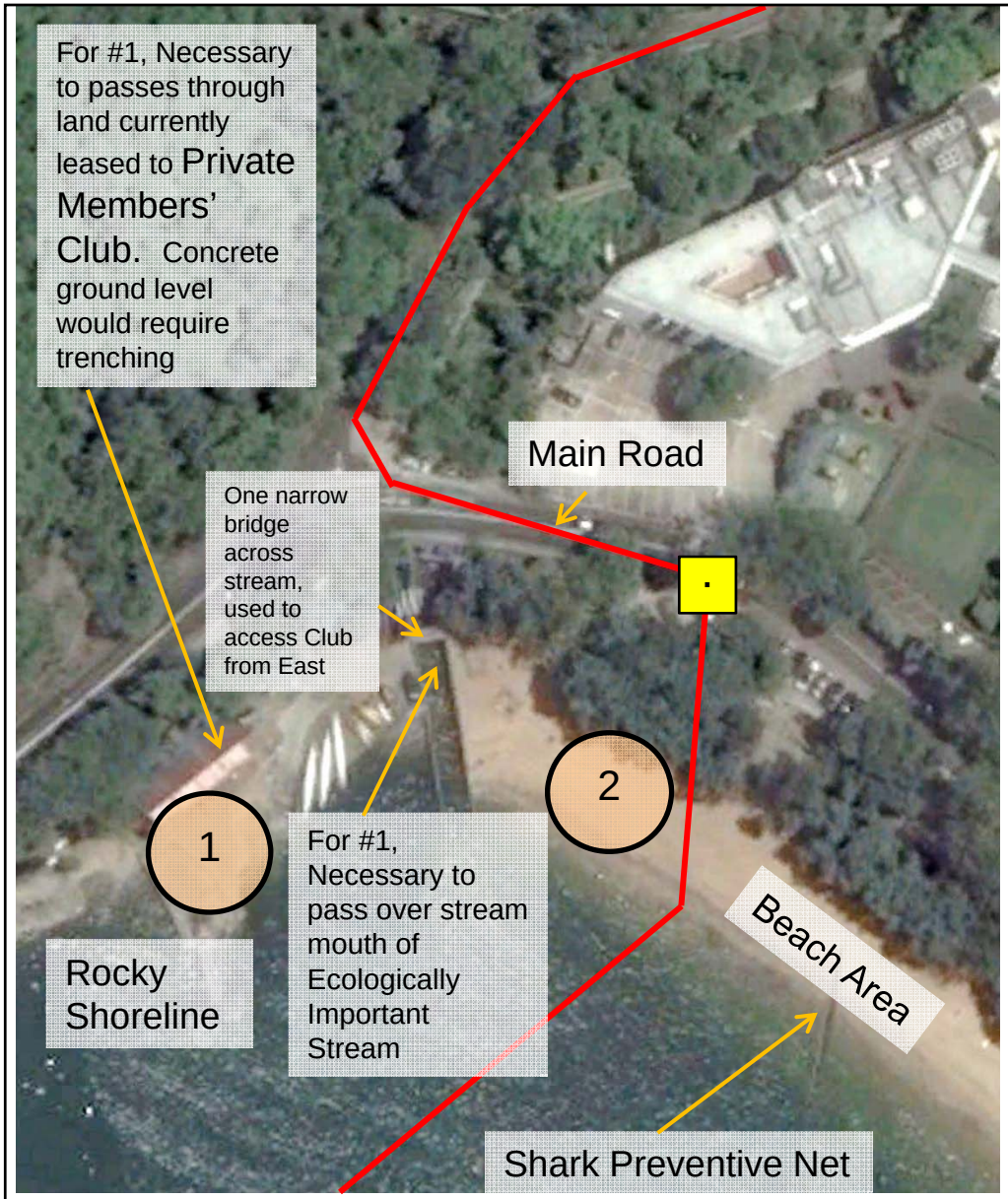

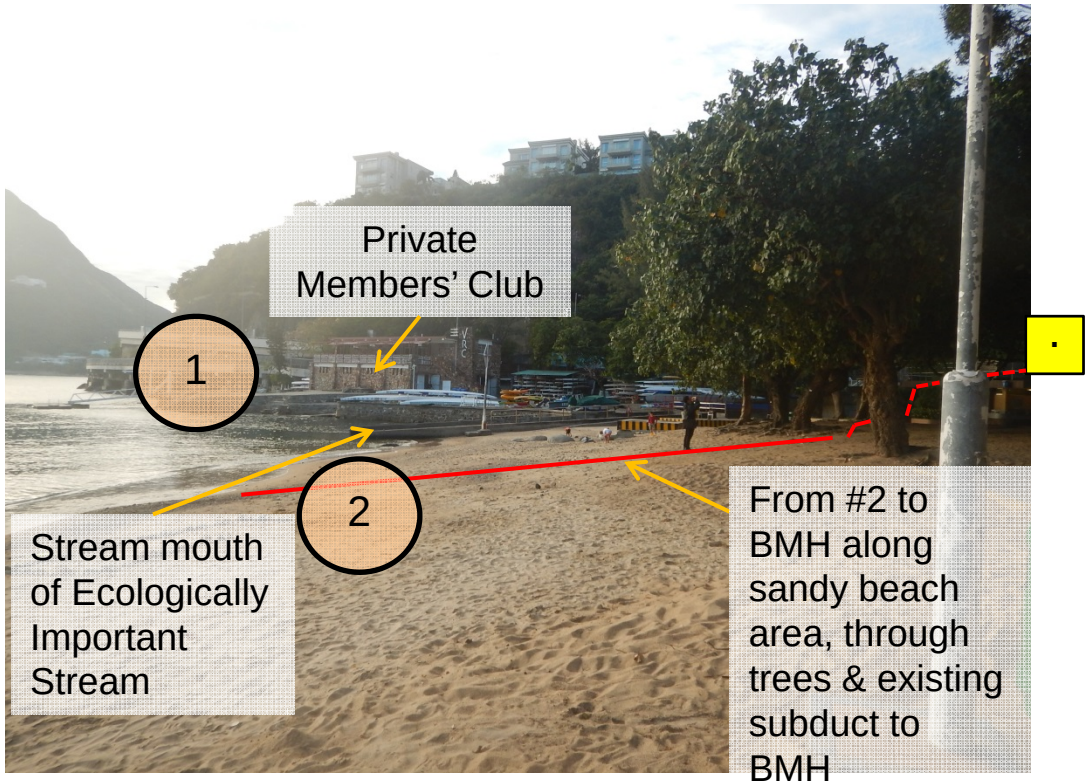

Landing Point Options Considered

Beach Manhole (BHM)

Proposed PLCN Cable

Figure 1.2b

DATE: 15/03/2017

Proposed PLCN Cable Rout Landing at Deepwater Bay -
Illustrations supporting Landing Point Options Considered

(Sheet 1 of 2)

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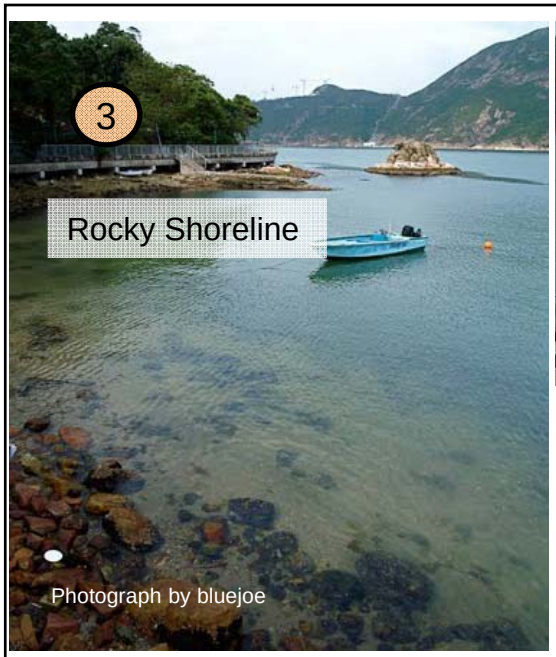

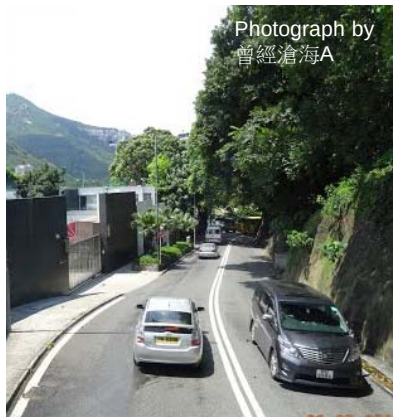

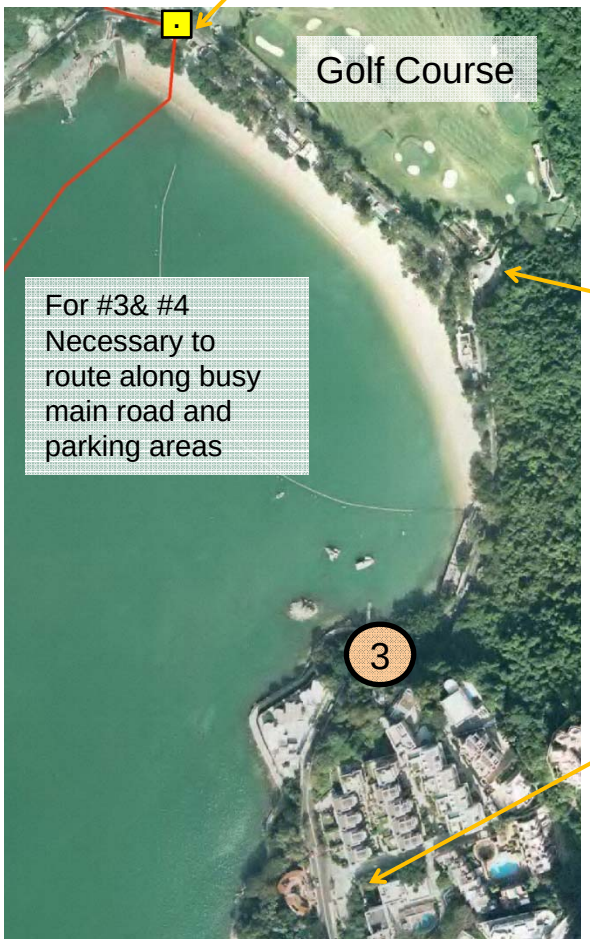

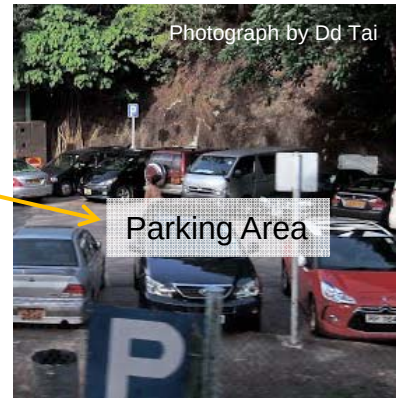

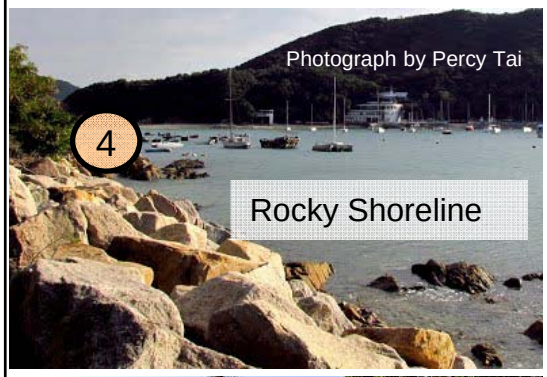

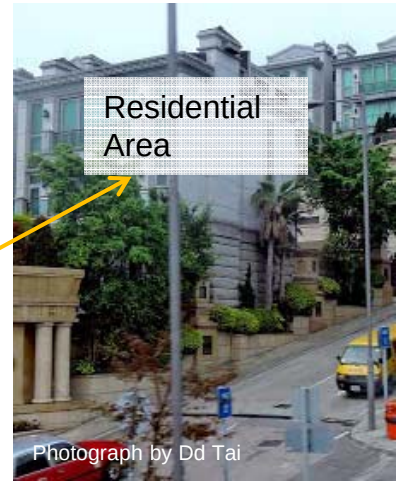

Figure 1.2c

DATE: 12/01/2017

Proposed PLCN Cable Rout Landing at Deepwater Bay -
Illustrations supporting Landing Point Options Considered

(Sheet 2 of 2)

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KOWLOON
九龍

HONG KONG ISLAND
香港島

Tseung Kwan O
將軍澳

Deep Water Bay
深水灣

Repulse Bay
淺水灣

Chung Hom Kok
春坎角

Stanley
赤柱

Tai Tam Bay
大潭灣

Shek O
石澳

Big Wave Bay
大浪灣

Tung Lung Chau
東龍洲

East Lamma Channel
東博寮海峽

Sheung Sze Mun
雙四門

Beaufort Island
螺洲

Sung Kong
宋崗

Po Toi
蒲台

Legend 圖例

- Boundary of HKSAR 香港特別行政區邊界
- Proposed PLCN Cable Landing Site 擬建PLCN海底光纜系統登岸地點
- Proposed PLCN Cable Route 擬建PLCN海底光纜系統路線

Environmental Constraints 環境限制

- Declared Monument 法定古蹟
- Seawater Intake 海水進水口
- Gazetted Beach 已刊憲之泳灘
- Gazetted Artificial Reef 已刊憲之人工魚礁
- Fish Culture Zone 魚類養殖區
- Sites of Special Scientific Interest 具特殊科學價值地點
- Country Park 郊野公園
- Special Area 特別地區
- Coastal Protection Area (CPA) 海岸保護區 (土地用途地帶)
- Conservation Area (CA) 自然保育區 (土地用途地帶)
- Intertidal Mudflat 潮間帶泥灘
- Mangrove 紅樹林
- Seagrass 海草床
- Coral Communities of High Ecological Value 高生態價值的珊瑚群落
- GeoPark Boundary 地質公園邊界
- Proposed Marine Parks 擬訂的海岸公園
- Designated Marine Reserve 指定的海岸保護區

Others 其他

- Nursery Area of Commercial Fisheries Resources 商業魚類資源哺育場
- Spawning Ground of Commercial Fisheries Resources 商業魚類資源產卵場

Physical Constraints 實質限制

- Anchorages 碇泊處
- Marina 遊艇會
- Gazetted Typhoon Shelter 已刊憲之避風塘
- Marine Vessel Fairway 船隻航道
- Planned Cable Routes 擬建的電纜路線
- Existing Cable 現存的電纜
- Existing Pipeline 現存的管道
- Existing Pipeline Area 現存的管道位置
- Existing Cable Area 現存的電纜位置
- GeoPark Boundary 地質公園界線
- Upcoming Projects 擬訂的項目
- Area Currently Gazetted for Sand Dredging and Sediment Disposal 已刊憲的挖沙或卸泥區
- Open Sea Disposal Area for Disposal of Uncontaminated Sediment 非污染海泥的開放式海洋棄置區
- Exhausted Sand Borrow Pit for Disposal of Uncontaminated Sediment 已填滿及封頂的非污染沉澱物棄置坑
- Sand Deposit - Extent Prior to Dredging 海沙沉積區 - 挖沙前範圍
- Sand Deposit - With Constraints on Dredging 海沙沉積區 - 挖沙限制
- Sand Deposit - Not Being Used on Environmental or Other Grounds 海沙沉積區 - 因以環境或其他考慮而不予使用

Others 其他

- Restricted High Traffic Volume 受限制並具高交通流量
- Restricted Low Traffic Volume 受限制並具低交通流量
- Unrestricted High Traffic Volume 不受限制並具高交通流量

N
北

Kilometers 公里
0 2.5 5

Figure 1.3
圖 1.3

Physical & Environmental Constraints for the Potential PLCN Cable System
擬建PLCN海底光纜系統的實質及環境限制

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Date: 17/3/2017

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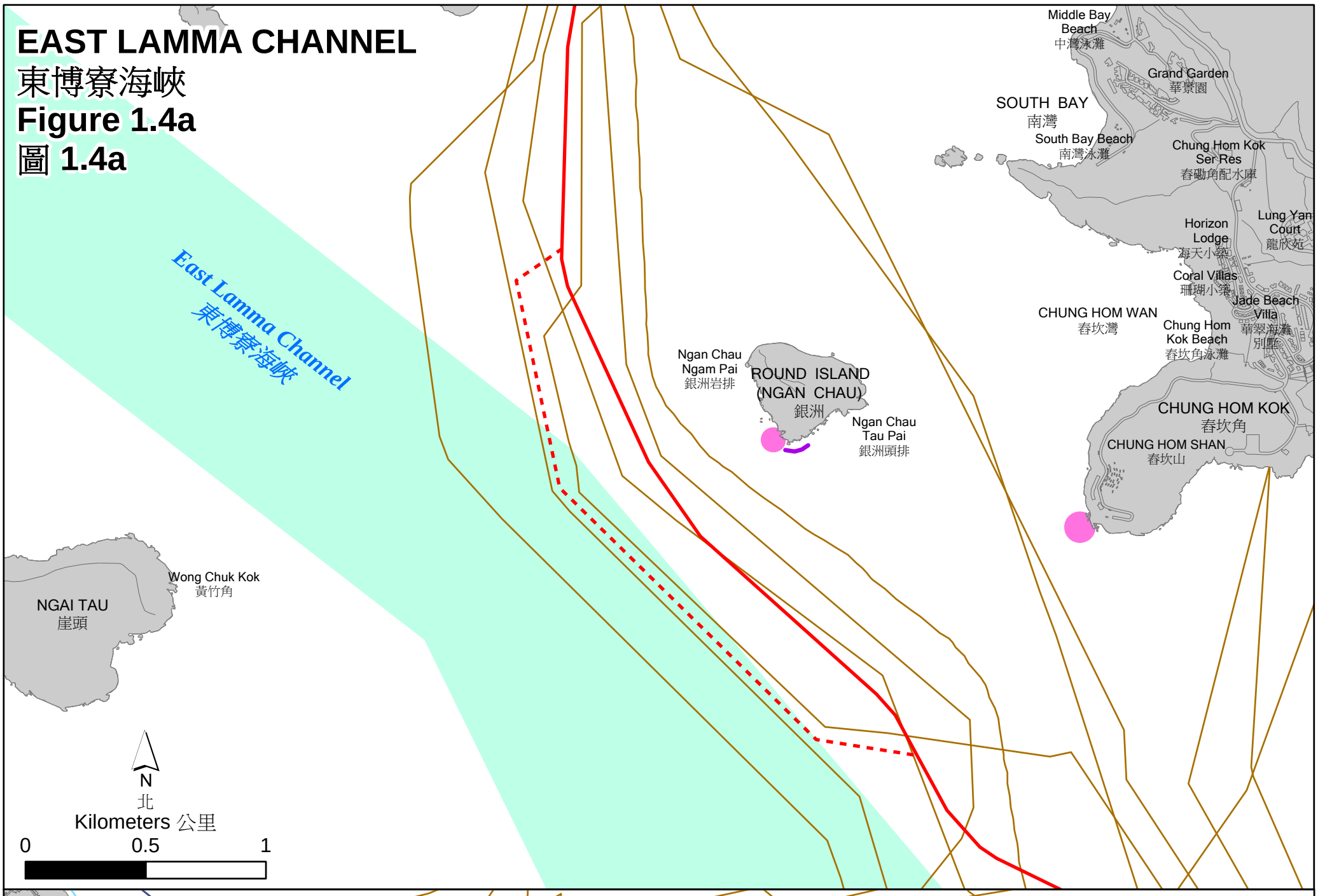
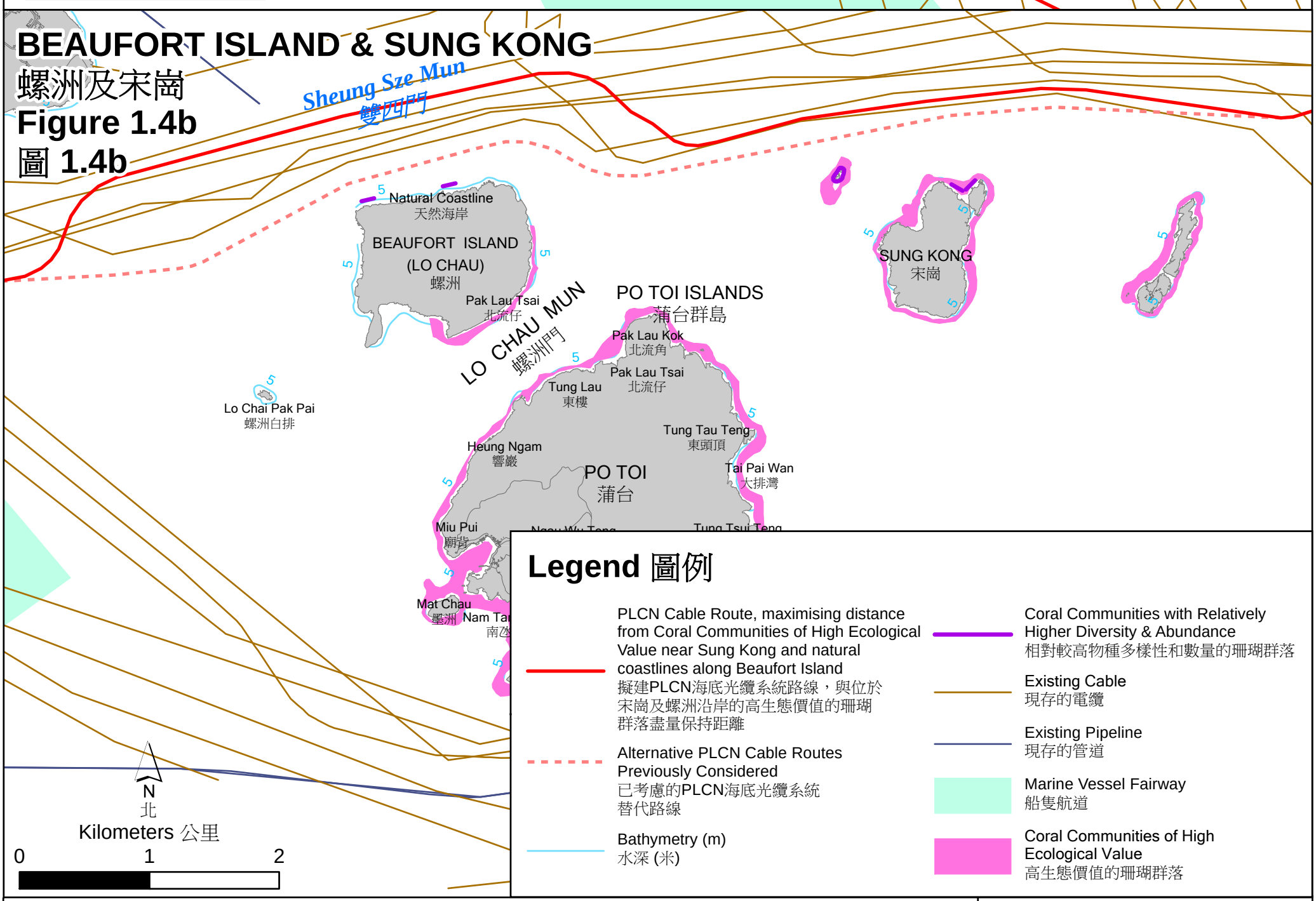
EAST LAMMA CHANNEL
東博寮海峽
Figure 1.4a
圖 1.4a



BEAUFORT ISLAND & SUNG KONG
螺洲及宋崗
Figure 1.4b
圖 1.4b



Legend 圖例

- PLCN Cable Route, maximising distance from Coral Communities of High Ecological Value near Sung Kong and natural coastlines along Beaufort Island
  擬建PLCN海底光纜系統路線，與位於宋崗及螺洲沿岸的高生態價值的珊瑚群落盡量保持距離
- Alternative PLCN Cable Routes Previously Considered
  已考慮的PLCN海底光纜系統替代路線
- Bathymetry (m)
  水深 (米)
- Coral Communities with Relatively Higher Diversity & Abundance
  相對較高物種多樣性和數量的珊瑚群落
- Existing Cable
  現存的電纜
- Existing Pipeline
  現存的管道
- Marine Vessel Fairway
  船隻航道
- Coral Communities of High Ecological Value
  高生態價值的珊瑚群落

Figure 1.4
圖 1.4

Potential PLCN Route Alternatives
PLCN海底光纜系統的其他替代路線

File: T:\GIS\CONTRACT\0335723\Mxd\0335723_Potential_Alternative_PLCN_Route_DWB2_bil.mxd
Date: 24/4/2017

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

The project is classified as a Designated Project (DP) under the *Environmental Impact Assessment Ordinance (EIAO)* as specified below:

- Schedule 2 (Part I), C.12 - A dredging operation which (a) is less than 500 metres from the nearest boundary of an existing or planned (iii) bathing beach; and (vii) coastal protection area.

1.7 NAME AND TELEPHONE NUMBER OF CONTACT PERSON

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

All queries regarding the project can be addressed to:

Environmental Resources Management
16/F Berkshire House
25 Westlands Road
Quarry Bay, Hong Kong
Attention: Partner (Landscape and Ecology)
Telephone: (852) 2271 3000
Fax: (852) 2723 5660
and

PCCW Global (HK) Limited
34th Floor, PCCW Tower
Taikoo Place
Quarry Bay
Hong Kong
Attention: Joseph Chan, Vice President, Cable Planning
Telephone: (852) 2883 7515
Fax: (852) 2565 0881

2 OUTLINE OF PLANNING AND IMPLEMENTATION PROGRAMME

2.1 PROJECT PLANNING AND IMPLEMENTATION

The Project will be led and managed by PCCWG. Planning and construction of the submarine cable system will be undertaken by TE Subcom on behalf of PLCN Consortium. The cable will be operated by PLCN Consortium.

The Project is not expected to interact with any other projects and will include the following stages:

1. Land Cable Installation (between BMH & LWM; and between BMH & CLS)

2. Shore-End Cable Installation (from LWM out to DWB beach's seaward boundary)

3. Submarine Cable Installation (from seaward boundary of DWB beach to boundary of HKSAR waters)

Prior to cable installation, route clearance will be undertaken. At cable operation (after installation), there may be a potential requirement for maintenance work (ie cable repair at particular fault location due to unexpected damage) to be carried out.

2.1.1 *Land Cable Installation*

Low Water Mark (LWM) - Beach Manhole (BMH)

The Applicant, PCCWG, is the Landing Party for Hong Kong, and will provide the BMH, ducts linking the BMH with the Cable Landing Station (CLS) and space within the CLS for the PLCN system.

The PLCN cable segment between the Beach Man Hole (BMH) on land and Low Water Mark (LWM) will be buried to a target of -2 m below the soil level, transitioning to -1 m below seabed at the LWM.

On land (beach area up to BMH), the construction activities will include trench excavation, exposing the BHM entry duct, cable laying and back filling. Typically the excavation will be carried out using small tracked diggers (see *Figure 2.6*). In order to minimize the risk to the existing systems and the services in the area, as well as the roots of trees in the vicinity, only hand tools will be used in the vicinity of trees and exposing the BHM entry duct. For other areas on the beach (without trees), small tracked diggers will be used in order to complete the excavation quicker so as to minimise the nuisance to the beach users. A silt curtain will be set up at the water line surrounding the works area on the beach to provide protection to surrounding water from sediment during the works between LWM and BMH (See *Figure 4.1*). The cable will pass via the duct into the BMH, typically by small winch or hand pulling. The existing structures and paving surrounding the BMH will not be affected during the works.

Figure 2.1 shows the proposed land routing of the PLCN cable at DWB from the landing point to the BMH, through the existing trees. The beach works safety zone boundary from the duct to the LWM will be no more than 10 m wide and 50 m long, with the width of the hand dug trench through the existing trees being approximately 1.5 m wide and approximately 20 m long. After the cable has been laid, the trench will be back filled by the original materials and reinstated to the original condition.

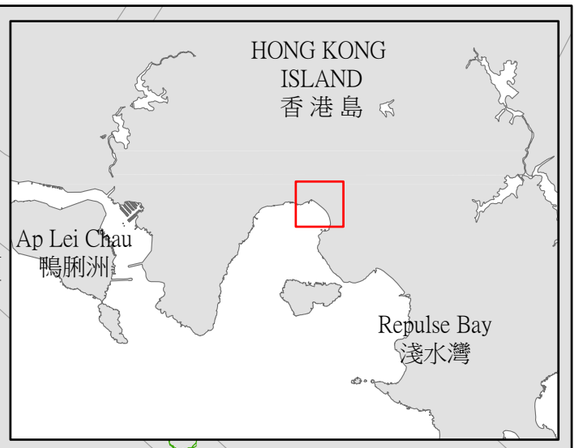
With reference to previous cable landings at Deep Water Bay, in particular that of the *TATA (VSNL) Intra Asia Submarine Cable System*, care will be taken to minimize disturbance to the existing trees and users of the gazette beach area.

Tree surveys were undertaken in July and December 2016 (See *Annex F*) and the route from landing point to proposed BMH is proposed to minimize impacts to the existing trees. *Figures 2.2, 2.3* and *2.4* help illustrate the proposed route through the trees. From the BMH, there is a duct/ conduit that passes below the pavement and the small retaining wall to reach the beach area. The seaward ducting is thought to extend past the toe of the retaining wall. *Figure 2.5* helps illustrate the route from BMH to beach area through the duct, under the pavement and retaining wall.

Figure 2.2 ***Proposed Route through Trees from BMH at DWB (Seaward)***

Legend 圖例

- Beach Manhole (BMH) 岸上纜井
- Landing Point 登陸點
- Trees 樹木
- Tree Protection Zone 樹木保護範圍
- Proposed PLCN Land Cable Route 擬建PLCN登岸光纜走線
- Existing Underground Duct 現存的地下管道
- Shark Preventive Net 防鯊網
- Beach Works Safety Zone Boundary during Construction 於工程進行時沙灘工作安全範圍
- Proposed Area of Hand Dig Trench 建議的手動挖掘範圍
- Conduct 管道



Name 名稱	Latitude 緯度	Longitude 經度
BMH operated by PCCWG 由電盈環球營運的岸上纜井	N22° 14.756'	E114° 11.173'
Landing Point 登陸點	N22° 14.738'	E114° 11.166'

BMH operated by PCCWG
由電盈環球營運的岸上纜井

Showers 更衣室

FB

Seawall

outfall 排水口

Deep Water Bay 深水灣

Winch 絞車

Haul Line 拖纜

Ramp 斜路

23m

36m

T1 T2 T3 T4 T5 T6 T7 T8 T9 T10 T11 T12 T13 T14 T15 T16 T17 T18 T19 T20 T21 T22 T23 T24

3.3 3.4 5.4 5.5 5.7

L H

N 北

Meters 米

0 5 10 20

Figure 2.1
圖 2.1

Tree Survey Plan and Proposed Cable Landing Route to Beach Man Hole
樹木調查圖及擬建光纜登陸至岸上纜井之路線

File: T:\GIS\CONTRACT\0335723\Mxd\0335723_Tree_Survey_Plan_Deep_Water_Bay_bil_v2.mxd
Date: 17/3/2017

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Figure 2.3 ***Key Area of Hand Dug Trench (Seaward) along Route to ensure Minimum Root Disturbance***

Figure 2.4 ***Proposed Route through Trees to BMH at DWB. Route to ensure Minimum Root Disturbance (Looking to Land)***

Figure 2.5 ***Underground Conduit Route from BMH to Beach Area***

The cable will be buried to a target depth of -2 m below the soil level, using hand tools only in the vicinity of the trees, to minimize the risk to the existing systems and the services in the area, as well as the roots of trees in the vicinity.

Figure 2.6 shows images of typical equipment required for this phase of work. *Figure 2.7* then shows the typical working conditions, including a hand dug trench near trees and an opened BMH. For trenching near existing trees, no root > 25 mm diameter will be severed and exposed roots >50 mm diameter will be protected by damp hessian or similar. It is expected that the construction activities on the beach (up to BMH) will be completed within 4 days. See *Section 2.2* for the full proposed schedule of works for all elements of the Project.

Figure 2.6 ***Typical Mechanical Equipment Required for Land Cable Installation***


5t Tracked Digger


2.5t Tracked Digger


3t Winch

Figure 2.7 ***Typical Onshore Works Conditions – Trench to duct/ conduit and Opened Beach Manhole***

Overall, in order to protect the existing trees and to keep Deep Water Bay beach in a safe and environmentally friendly condition for the general public, as well as ensuring no hazard to the public due to the Project, the precautionary measures listed below will be implemented.

Precautionary Measures

- Excavation works in the vicinity of the utilities or trees will be carried out by hand-held equipment only, with the utmost care to minimise the risks to their structure / roots. This will also protect the public's safety by ensuring the structural integrity of the trees.

- The Contractor should comply with conditions stipulated by LCSD for tree protection.

- On shore, the work area will be clearly demarcated using warning tape/ markers and marshals, and fenced off with barriers to ensure the public are kept clear.

- Trenching works will take place during the day-time period, ie 09:00 am to 6:00 pm, and restricted to weekdays, ie Monday to Friday. Security guards will stay overnight on site and the open section of trench will be clearly demarcated by means of warning tape and lights.

- Legible notices will be put on site to show the commencement and completion dates of the land and shore-end works, daily working hours and emergency contact person and number.

- The Project proponent will ensure there will be no sand lost during the construction. The beach will be photographed prior to the commencement of the works and after the restoration of the site in order to assure the beach will be reinstated to the pre-works conditions.

- The machinery employed will be inspected prior to work commencing on the beach then at least daily thereafter to ensure the waters and beach will not be polluted with oil/grease/fuel. Oil absorbent materials will be readily placed on site and will be applied immediately should any oil leakage incidents to make sure the swimming zone will not be affected.

- All diver hand jetting works will be conducted within silt curtain works area to provide protection to surrounding water from sediment. A silt curtain will be set up at the water line for land based works to provide additional protection to surrounding water from sediment (See *Figure 4.1*).

- In order to minimise the risk of disturbance to the existing utilities, the Contractor should confirm the location of all the utilities within the works area with the relevant departments, for example, but not limited to, Drainage Services Department, Architectural Services Department, Water Services Department and other departments/companies.

- Although the sand dust causing by strong wind during the trenching operation is unlikely to occur, water will be sprayed around the trenching areas to keep the "dust" down.

- Beaches usually comprise of soil ground (sand) and rock/hard ground. When the cable is installed in the soil ground (sand) or underlying non cohesive sediments, the cable will be buried with a target depth of -2m, transitioning to -1m at the LWM. If the cable is to be buried in hard (cohesive) ground, the cable will be installed inside a trench of 300mm wide and 400mm deep to ensure the cable will not be easily exposed by the tidal movements. The burial will ensure the public does not come into contact with or become concerned over the presence of the cable. It is worth noting that other existing cables are not trenched into the beach, but encased in iron articulated pipe and left on the surface. Note that iron articulated pipes are widely used in Hong Kong and overseas countries to protect submarine cables and they have proved over the past years to be non-problematic under either the soil or the seawater. If using smaller lighter concrete covers, they may become exposed, move around and pose a real problem due to the design constraints and such covers are not considered of any benefit. Removal of concrete covers at the end of system life would be problematic, whereas the articulated pipe encased cable can be easily pulled out. Articulated pipe is considered to corrode at 0.1mm per year, such that over a 25 year period it would lose only 2.5mm wall thickness and would therefore still be present at the end of the system life and in good condition for ease of removal.

- The cable will be protected by iron articulated pipe in order to prevent the public from touching the cable directly.

Beach Manhole (BMH) - Cable Landing Station (CLS)

In order to complete the link between the BMH and the CLS, the land cable will be installed in an existing terrestrial conduit passing between

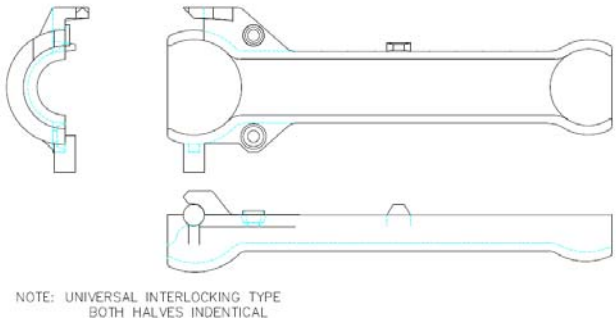
intermediate manholes, which generally follow the main Deepwater Bay Road (locations indicated in *Annex D*, *Figure D2*). The method of installation will be by hand pulling at existing intermediate manholes from the BMH or CLS, with any equipment potentially needed to help with the hand pulling (air-compressor, generator) positioned at one mid-way point along the route. The road will not be disturbed during the land cable installation and no excavation will be required.

2.1.2 *Shore-End Cable Installation*

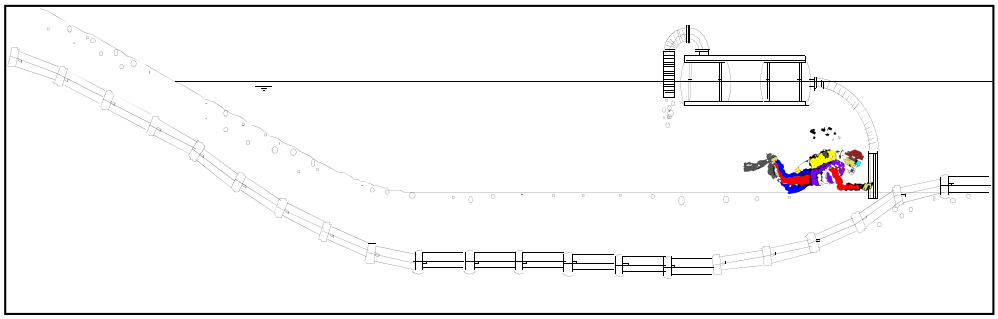
The shore-end works are defined as the route extending from the LWM seaward to Deep Water Bay until sufficient conditions for submarine cable installation (estimated as approximately 300 m seaward from the LWM).

First, the Cable installation barge will set up as close as possible to the shore in DWB for the cable landing and a work boat bring the cable ashore, attaching floats as it goes. Once the cable has been hauled ashore, is secure on the beach and the floats cut away, cable burial for the in-shore segment will be undertaken by divers using jet probes to sink the cable (with protection such URADUCT® or articulated pipe protection or other similar structures) into the sediment (*Figure 2.8* and *Figure 2.9*).

Figure 2.8 Typical Articulated pipe and Cable burial by Divers using Jet Probes



Typical Articulated pipe



Diver jetting burial

*Figure 2.9 Typical URADUCT® Details**

ITEM	SPECIFICATION
Color	Orange
Material Density	1108 kg/m^3
Cable Outer Diameter	DA 47 mm
Uraduct Inner Diameter	49 mm
Uraduct Outer Diameter	99 mm
Wall Thickness	25 mm
Uraduct Half Shell Length	2000 mm
Minimum bend radius	1.05 m
Individual half shell weight	6.5 kg
Wait in air	6.5 kg/m
Wait in water	0.5 kg/m

*Actual details may vary. For PLCN cable, the outer diameter of double armoured cable is around 50 mm and overall diameter of cable system (including protection) is around 100 mm.

From the LWM to approximately 300 m out from the LWM, the target burial depth of the cable is -1 m below the seabed. A sea earth cable and anodes (acting as grounding) will be laid in this section, and generally laid along the same alignment and to the same depth (target depth of -1m or reasonable endeavours) as the cable. The works area from the LWM to the position of the cable installation barge in DWB will be approximately 30 m either side along the cable route.

This shore-end cable installation work is expected to be completed within 5 working days with shallow burial by divers expected to take up to 4 working days. See *Section 2.2* for the full proposed schedule of works for all elements of the Project.

Given the public use of the shore-end marine environment of Deep Water Bay for swimming and recreational activities, the following precautionary measures (in addition to those discussed in *Section 2.1.1*) will be implemented to ensure no hazard to the public due to the Project.

Precautionary Measures

- In the shallows and offshore, marshals will ensure the public remains at a safe distance and outside the general works area. This will include security guards staying overnight on site as necessary eg to prevent night time/ early morning swimmers from entering the general works area.

- Legible notices will be put on site to show the commencement and completion dates of the land and shore-end works, daily working hours and emergency contact person and number.

- All diver hand jetting works will be conducted within silt curtain works area to provide protection to surrounding water from sediment. A silt curtain will also be set up at the water line for land based works to provide further protect from sediments possibly dispersing into the nearby water.

2.1.3 Submarine Cable Installation

Seaward of Deep Water Bay Beach, approximately 300 m from the LWM, the cable will be placed into a burial tool on a purpose built cable installation barge with cable burial tool. The barge will lower the cable burial tool to the target burial depth at the shore-end position.

Most of the marine cable burial works will be conducted using jet ploughing/ jetting technique. This method uses "Injector Burial Tool" or "Sledge Tool" which are designed to simultaneously lay and bury the cable (*Figure 2.10* and *Figure 2.11* with indicative photographs in *Figure 2.12*). Using these methods the injector fluidises a trench using high pressure water jets and the cable is immediately laid within the trench. The expected maximum width of the seabed fluidised by the injector is approximately 0.25 m either sides of the centre line of the proposed cable route (ie 0.5 m width) and the cable is buried to a maximum depth of 5 m. 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.

It is anticipated that the actual submarine cable installation, under normal weather conditions, will take around 15 days to complete.

Figure 2.10 Simultaneous Cable Lay and Burial Operation using "Injector Burial Tool"

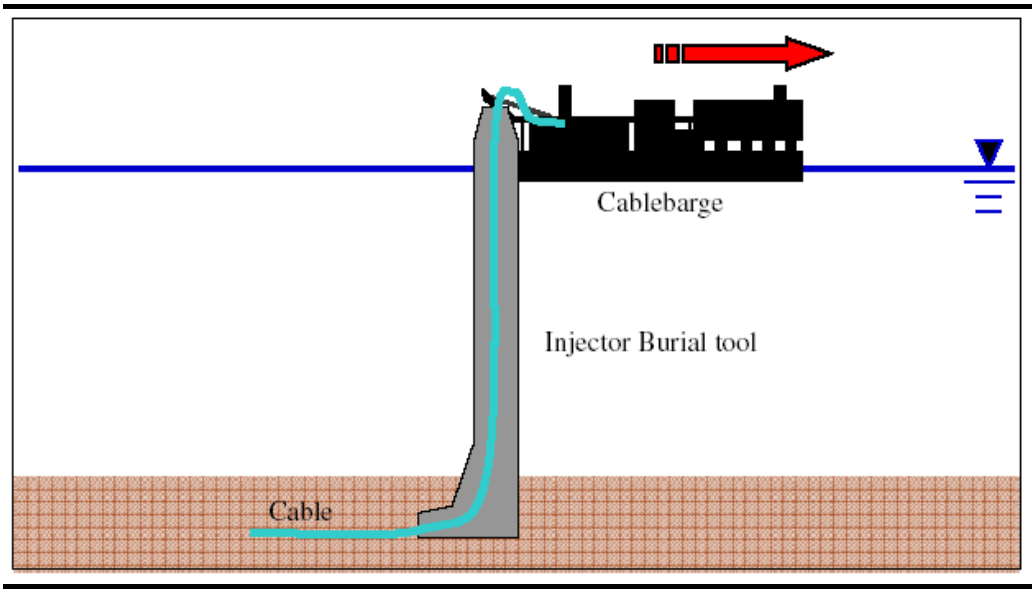


Figure 2.11 Simultaneous Cable Lay and Burial Operation using "Sledge Tool"

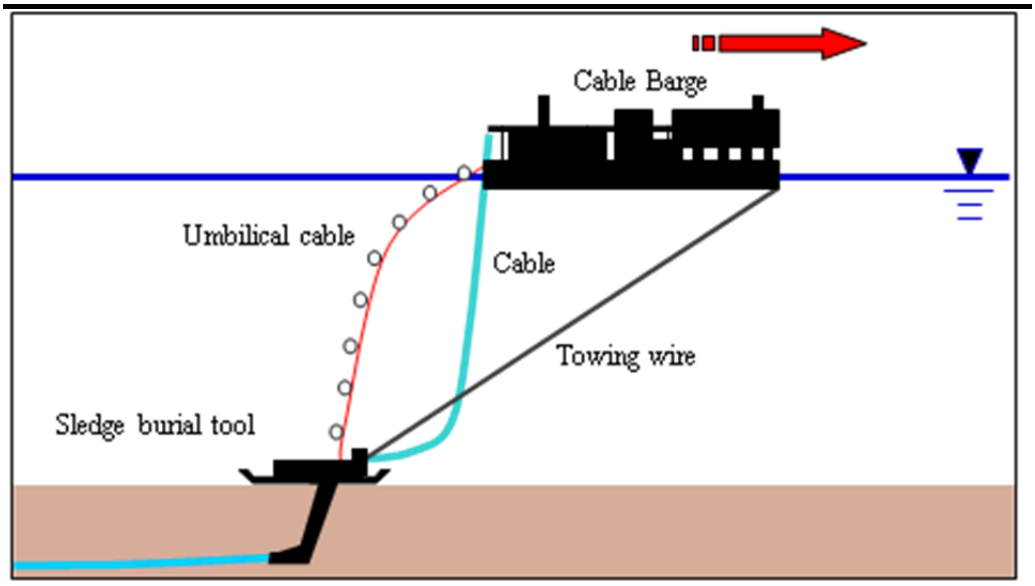


Figure 2.12 Equipment for Simultaneous Cable Lay and Burial Operation using "Sledge Tool" or "Injector Tool"

Typical Cable Installation Vessels/ Barge using Sledge Tool

Typical Sledge Tool

Typical Cable Installation Barge/ Vessel using Injector Burial Tool

Typical Injector Burial Tool

2.1.4 Route Clearance and Pre-Lay Grapnel Run

As part of the installation of the PLCN cable, Route Clearance (RC) and/or Pre-Lay Grapnel Run (PLGR) operation will be conducted over the proposed cable route. The RC will be conducted using jetting machine trial run while the PLGR will be conducted using tow of grapnel anchor, and these operations will be scheduled to take place before the actual cable laying operation. The aim of these operations is remove any Out of Service Cables (OSS), debris or obstacles deposited in the cable corridor, which may pose a threat to the cable or the burial tool. The RC jetting machine trial run will involve jet ploughing/ jetting technique as discussed in *Section 2.1.3*. The penetration of grapnel fluke during PLGR will not be more than 0.8 m, and the clearance area will cover 5 m on both sides of the cable (i.e. a total width of 10 m). All debris recovered from the seabed during PLGR will be disposed to the approved dumping ground. In all circumstances, no towed equipment shall be used within 500 m of any pipeline or in-service submarine cable system identified by the tone/magnet detector survey. RC/ PLGR operation(s) will be intended to carry out along the proposed cable route over a short period of time (ie less than a week) but the actual areas will likely be reduced and restricted to limited areas subject to the detailed findings of marine route survey (e.g. detailing rocky outcrops/ cable crossings which may prevent PLGR), and impacts to the marine environment are anticipated to be similar or less than those for cable installation.

A typical grapnel anchor is presented in *Figure 2.13.*

Figure 2.13 Typical "Grapnel Anchor"

2.1.5 Target Depth and Cable/ Pipeline Crossing

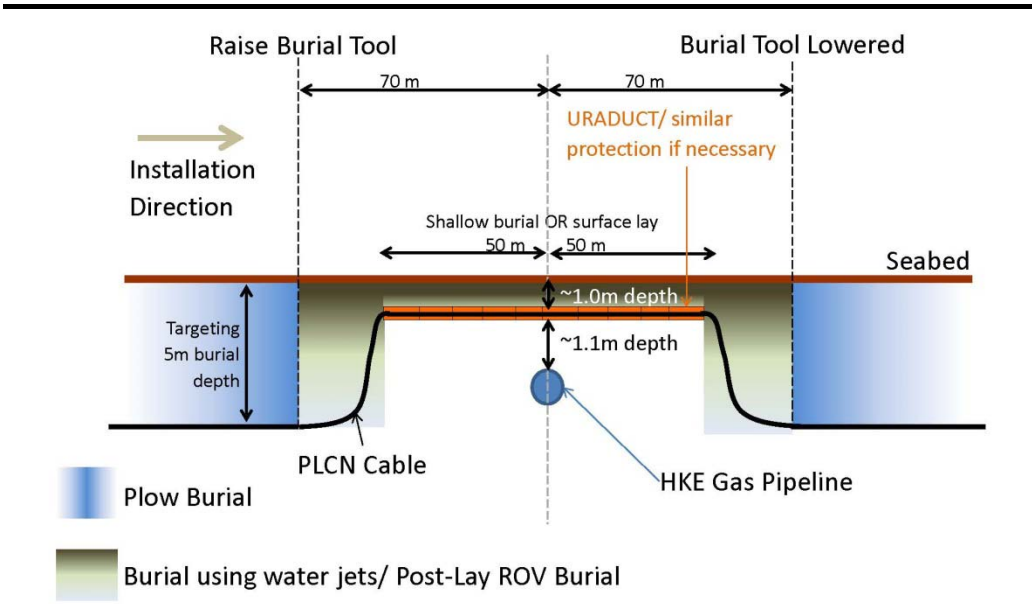
From the LWM to approximately 300 m seaward, target depth is -1 m. After this the target burial depth is -5 m below the seabed in HKSAR waters. It should be noted that the seabed will be reinstated to before-work level and condition very shortly. There are some areas where cable or pipelines will be crossed and cable depth will be shallower. Currently the PLCN cable route is anticipated to cross in-service cables 17 times and out-of-service cables 32 times, as well as one (1) utility gas pipeline.

Crossing existing telecommunication cables is expected to involve shallow burial, subject to the as-built burial depth of the existing cables. A cable localization operation will be performed at cable crossing points. To localize

the exact cable location, a tone/magnet detector survey (using vessel), a remotely operated vehicle (ROV) (See *Figure 2.16*) controlled at the vessel, or diver survey with localised hand jetting, will be conducted. The diver survey with localised hand jetting will only be conducted for existing cables that have been buried more than 2.5 m below the seabed. The localization operation will be scheduled to take place before the actual cable laying operation. To ensure a smooth operation, all cable crossing points will be confirmed before the start of the operation.

Where the cable crosses the Hongkong Electric Gas Pipeline, close to the boundary of HKSAR waters, it will have shallow burial/be surface laid for a distance of 100 m centred on the crossing point, with the burial tool raised when approximately 70 m before the pipeline crossing point and lowered again when approximately 50 m after the pipeline crossing, so that there is 5 m burial again from approximately 70 m after the pipeline crossing (*Figure 2.14*). The cable may be protected by URADUCT® (*Figure 2.9* above) if necessary or an optional cable protection using concrete mattress/ grout bags/ rock dumping of a maximum width of 20 m, which will not affect the existing seabed level or the utility that is crossed. The shallow burial section will be conducted either by water jetting from the raised burial tool or by ROV.

Figure 2.14 ***Indicative Section of the Gas Pipeline Crossing***



The broad areas of -1 m and -5 m burial below seabed are shown in *Figure 2.15* and *Figure 2.16* shows a typical ROV.

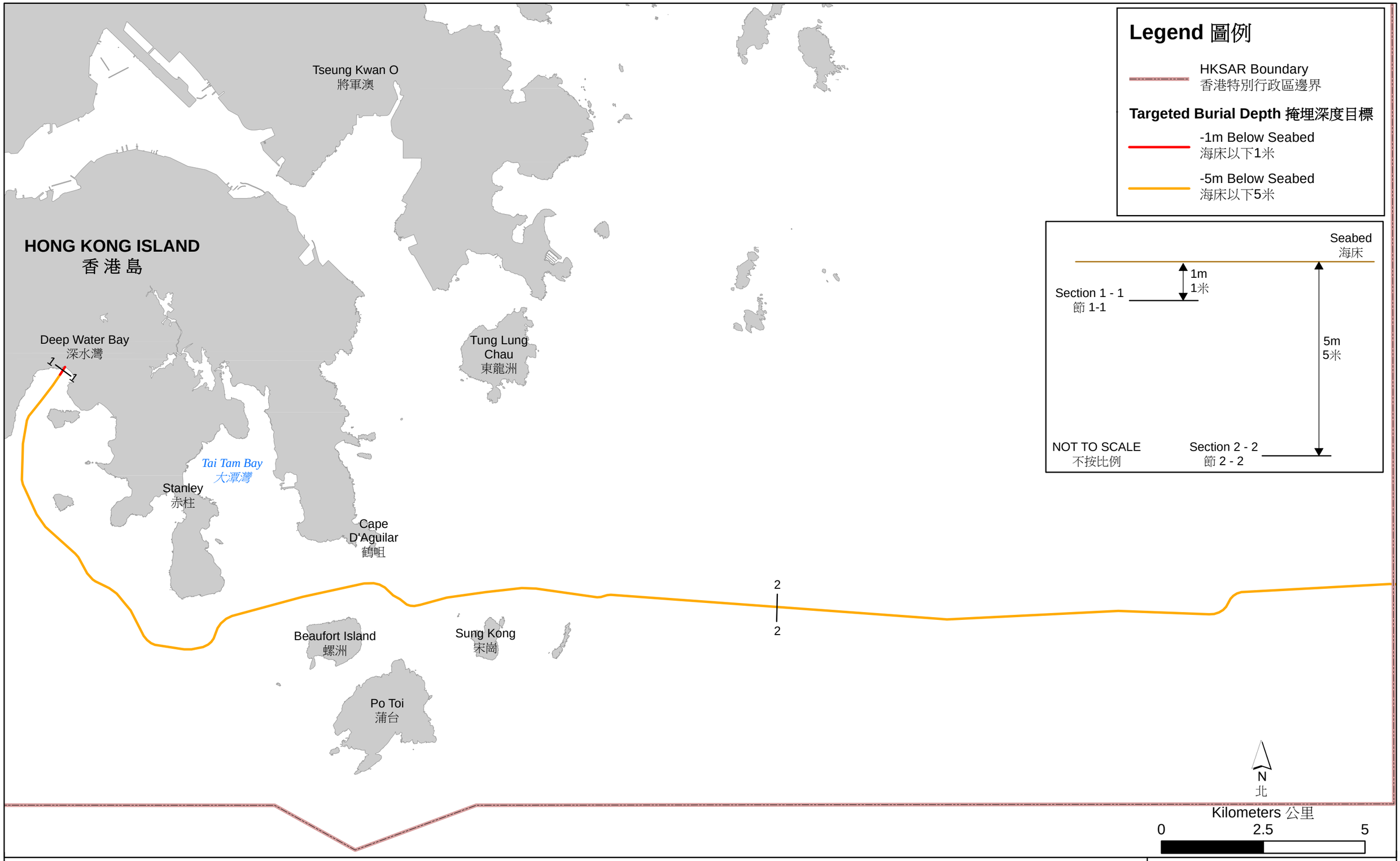


Figure 2.15
圖 2.15

Indicative Burial Depths of the Proposed PLCN Cable System
擬建PLCN海底光纜系統的掩埋深度示意圖

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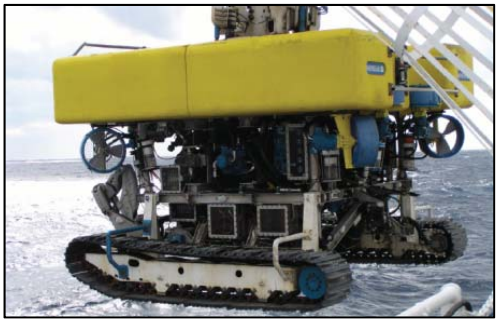
Figure 2.16 Typical "Remotely Operated Vehicle (ROV)"



2.1.6 Cable Operation (After Installation), including Maintenance and Repair.

During operation there may be a potential requirement for maintenance work (ie cable repair at particular fault location due to unexpected damage) to be carried out. These works will be similar in nature to cable installation works described in *Section 2.1.2 -5*. Should repair operation be required, mitigation measures proposed for the construction phase will be implemented as outlined further in *Section 5.1*

For land based repairs, the equipment and methods will be the same as for cable installation works, as outlined in *Section 2.1.1*.

For shore-end and submarine cable repairs, equipment and methods would again be similar to those outlined in *Section 2.1.2-5* but not along the full alignment, ie of smaller scale, with the potential to use smaller equipment such as Remotely Operated Vehicles (ROVs) equipped with injector tool (as shown in *Figure 2.16*) and divers with hand held tools (as shown in *Figure 2.8*).

The repair works process for shore end and marine works is outlined below:

- **Terminal Testing**: Testing from cable station terminal, to try and determine fault location as precisely as possible using optical or electrical characteristics of the submarine cable;

- **Initial Inspection**: Cable will be inspected using ROV or divers where appropriate to determine the precise fault location and nature if unknown. If the cable is buried, tracking equipment will be used;

- **Cut Faulty cable, Buoy off, Recover to vessel:** If necessary to cut the cable at the fault area, either an ROV or grapnels will be used, or if feasible, divers. Divers use hand-jetting and ROV use jetting technique to uncover buried cable. Grapnels penetrate the seabed without jetting to pick up the cable and *Figure 2.17* shows typical grapnels used to penetrate the seabed, and grip, cut and recover cables. The cable ends will be recovered to the vessel, using diver, ROV or gripper grapnels. While one cable end is repaired on the vessel, the other cable end will be attached to a rope that is lowered to seabed and this rope will be attached to a buoy to mark its location. Typical buoys are shown in *Figure 2.18*.

- **Cable Splice and Repair:** Damaged cable section will be cut out. First one end will be spliced to the spare repair cable section and electrical and optical testing conducted to ensure the integrity of the splice and cables. Then the second cable end will be picked up and spliced back to the repair cable section. Upon completion, the cable integrity will be confirmed through end-to-end electrical and optical testing.

- **Replacement of Repaired Cable:** Once the cable has been fully repaired and connected, it will be lowered onto the seabed, along the 'as-laid' cable route. Any protective measures, such as articulated piping, URADUCT® or other means would be added to the cable prior to re-laying. Once the repaired cable is in the 'as-laid' cable route alignment, a diver or ROV will perform an inspection of the repair area, including determining the beginning and ending of unburied cable.

- **Post Repair Inspection and Burial (PRIB):** Should burial at the repair area be necessary, it will be carried out to best endeavour or pre-determined target depth, using diver or ROV jetting up to 3 m or burial tool if deeper. If burial is not possible, other means of protection may be considered such as articulated piping, URADUCT® or other means. Once completed one final diver or ROV inspection will be carried out before repair works are completed.

Figure 2.17 *Typical grapnels used to penetrate seabed, grip, cut and recover cable*

Figure 2.18 *Typical buoy types used for connecting to cable end by rope*

2.2 *PROJECT PROGRAMME*

The PLCN cable system is provisionally scheduled to be landed and installed at DWB commencing in the first quarter of 2018. The expected construction schedule within the HKSAR is as follows:

• Land Cable Installation during Construction (As shown in *Figure 1.1*).	Within 13 working days
– Works on the beach (*Between BMH & LWM: chainage distance 0 m to ~ 59 m* [(1)]) expected to be completed within 4 days.	
– Works between BMH and CLS (~794 m) expected to be completed within 9 days.	
• Shore-End Installation during Construction (As shown in *Figure 1.1*) (*From the LWM to ~300 m out from the LWM: chain age distance ~59 m to ~359 m*)	Within ~5 working days
– Surface lay is expected to take up to 1 working day	
– Shallow burial by divers is expected to take up to 4 working days and can take place concurrently with surface lay	
• Submarine Cable Installation during Construction (As shown in *Figure 1.1*) *(~300 m from the LWM until east boundary of Hong Kong waters: chainage distance ~359 m to 17.120 km*) including: detection of existing cables, route clearance, deep burial cable installation by injector/ sledge, and contingency (such as bad weather, faulty vessel etc which require works to be intermittent) for which an additional 40 days added as precaution).	Within ~60 days
- The **actual cable installation during Construction** (not including the route clearance or post-lay works or any weather downtime) is expected to be **around 15 working days**.	
- Route Clearance (RC) and/or Pre-Lay Grapnel Run (PLGR) operation, if necessary, may only up to 5 working days subject to the detailed findings of marine route survey.	

All cable installation/ repair works are expected to be undertaken during non-restricted working hours, i.e. between 0700 and 1900 hours on any day not being a general holiday including Sundays. If works during restricted hours

(1) Chainage distance starts from BMH at 0 m and extend towards sea

are later found to be necessary, a Construction Noise Permit (CNP) will be applied for.

The cable is expected to be operational for a minimum of 25 years. Duration of any cable repair work during operation is anticipated to be of shorter duration than cable installation during construction.

3 MAJOR ELEMENTS OF THE SURROUNDING ENVIRONMENT

3.1 MAJOR VESSEL FAIRWAYS

The East Lamma Channel is a major vessel fairway and hence the proposed cable corridor has avoided crossing it.

3.2 GAZETTED MARINE FACILITIES

There are no gazetted marine facilities in the proposed cable corridor.

3.3 CABLE, PIPELINES AND OUTFALLS

There are a number of existing submarine tele-communication cables located at the cable landing site at DWB. The proposed routing of the cable corridor aims to reduce the number of crossings of existing cables and minimize crossing any of the existing pipelines and outfalls.

3.4 OTHER PROPOSED FACILITIES OR AMENITIES

At present, there are no proposed marine facilities or amenities that the cable corridor will cross.

3.5 GAZETTED BATHING BEACHES

The landing site is situated at the north-western edge of the DWB Bathing Beach. Further away are the beaches at Repulse Bay, Middle Bay, South Bay, Chung Hom Kok Beach and St. Stephen's Beach which are all over 1 km away from the cable landing site and the cable alignment. The works are inside the DWB beach boundary but are outside the area of the shark preventive nets.

3.6 COASTAL PROTECTION AREA

The PLCN cable route includes a landing point at DWB, which is approximately 150 m from a Coastal Protection Area (CPA) designated by the *Town Planning Ordinance, Hong Kong Town Planning Board Hong Kong Planning Area No. 17 – Shouson Hill and Repulse Bay Outline Zoning Plan No. S/H17/13*, as shown in *Figure 3.1*. The CPA zone covers a virtually undeveloped coastal area along Deep Water Bay, South Bay, Middle Island and three smaller islands, which are mainly below the 20-metre contour. As stipulated in the Explanatory Statements attached to the statutory notes for the CPA, the intention of such zoning is "*to conserve, protect and retain the natural coastlines and the sensitive coastal natural environment, including attractive geological features, physical landform or area of high landscape, scenic or ecological value, with a minimum of built development*". It should be noted that the CPA zone allows uses such as a telecommunications cable, and other cable systems have landed

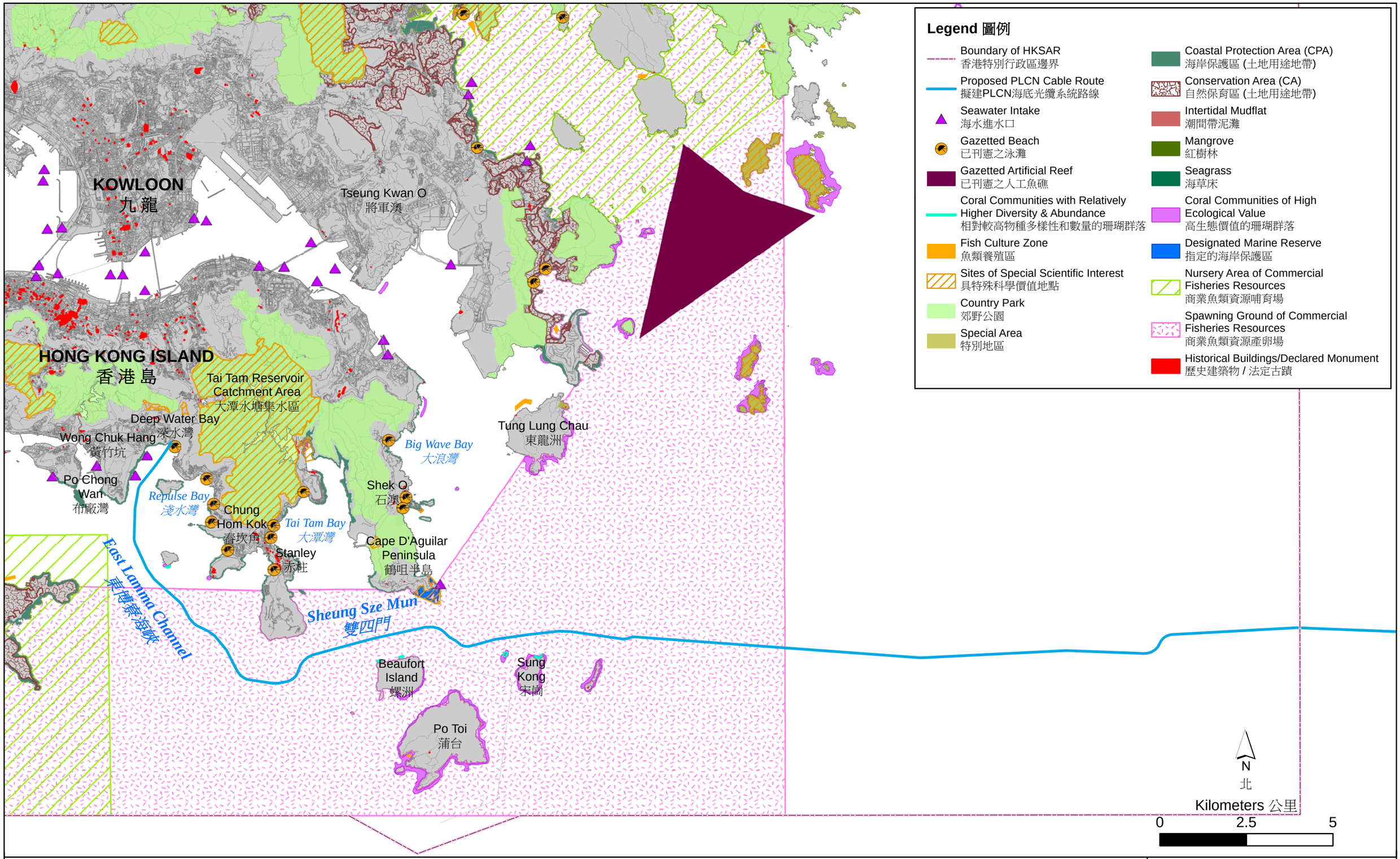


Figure 3.1
圖 3.1

Major Elements in the Surrounding of the Proposed Cable System
鄰近擬建PLCN海底光纜系統的環境要素

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at DWB. It should be noted that there are no works associated with this Project within the Coastal Protection Area.

3.7 SEAWATER INTAKE

Two seawater intakes for Ocean Park are located approximately 1.5 km and 0.7 km from the cable landing site and between 290-370 m from the cable alignment (*Figure 1.2a* and *Figure A2a* in *Annex A*).

3.8 SITES OF SPECIAL SCIENTIFIC INTEREST

The closest Sites of Special Scientific Interest (SSSI) are the Tai Tam Reservoir Catchment Area SSSI, Nam Fung Road Woodland SSSI and Deep Water Bay Valley SSSI, located approximately 0.75 km, 1 km and 1 km respectively away from the cable landing site. These SSSIs are terrestrial in nature and hence will not be affected in any way by the Project. There is also a Tai Tam Harbour (Inner Bay) SSSI as discussed in *Section 3.11*.

For the submarine cable alignment running in parallel with the Lamma Channel and Sheung Sze Mun, the closest coastal SSSI are the Tai Tam Harbour (Inner Bay) SSSI, Hok Tsui (Cape D'Aguilar) SSSI and Sham Wan SSSI, located ~5.4 km, ~690 m and ~5.0 km respectively away from the cable alignment route. These sites are all located more than 500 m away from cable alignment route and hence no anticipated impact would be foreseen.

3.9 CORAL COMMUNITIES

There are coral communities of ecological importance at the south of Round Island, along the south-eastern coast and north of Beaufort Island, at Sung Kong Islet and the northern coast of Sung Kong as well, as along the entire coast of Po Toi which is further from the proposed alignment (*Figure 3.1*). The shortest distances from the cable alignment to the closest coral communities near Round Island, Beaufort, Sung Kong Islet, and Sung Kong are approximately 450 m, 670 m, 330 m and 560 m respectively.

3.10 CULTURAL HERITAGE

No declared monuments, proposed monuments, graded historic sites/buildings, sites of archaeological interest and Government historic sites identified by Antiquities and Monuments Office are located in the vicinity of the proposed cable alignment or in the area surrounding the cable landing site. The closest cultural heritage to the cable landing site is the historic building Residence of Financial Secretary locating 700m away; the closest site of archeological interest is the Wong Chuk Hang Rock Carving Site located 1.4 km away (*Figure 3.1*). These sites of cultural heritage are land-based and hence will not be affected in any way by the Project.

3.11 *TAI TAM HARBOUR (INNER BAY) MUDFLAT*

The mudflat at Tai Tam is well-protected from strong oceanic waves and occupies an area of ~ 0.2 km^2 (*Figure 3.1*). The soft, sheltered, nature of the intertidal mudflat, together with the accumulation of organic detritus, has encouraged a rich diversity of inhabitants. The landward side of the mudflat is fringed by sparse mangrove stands. The environment is relatively intact and the area is only occasionally visited by study groups and tourists. The mudflat is of high conservation value and hence it was designated as a Site of Special Scientific Interest (SSSI). The western edge of the Tai Tam mudflat is over 5 km from the landing site and cable alignment and too remote to be affected by the Project works.

3.12 *ECOLOGICALLY IMPORTANT STREAM*

The Ecologically important stream at Deep Water Bay is 900m in length and is one of the few natural streams in Hong Kong Island that run from the upland to lowland without fragmentation. This stream is particularly diverse in both freshwater and estuarine fish species. A locally rare brackish fish species Largesnout goby *Awaous melanocephalus* was recorded in the estuary of the stream around 1999 (*Figure 3.2* shows the estuary area in 2016). Noting that the estuarine section of the steam flows out to the sea through a man-made channel (See *Figure 2.1*), the closest point between the estuarine section of the stream and the near shore cable laying point would be approximately 23 m away.

Figure 3.2 Estuary area of the ecologically important stream at Deep Water Bay

To further control any potential loss of sediment into the water column from jetting works in the 300 m area close to the beach at DWB and the ecologically important stream, divers will work within a silt curtain enclosed area, to control fine dispersion, if any, as well as a silt curtain being installed at the water line to mitigate the potential water quality impact due to surface runoff from the land based works. A typical arrangement for the silt curtains at the water line and for diver working is shown in *Figure 4.1*.

4 POSSIBLE IMPACTS ON THE ENVIRONMENT

4.1 SUMMARY OF POTENTIAL ENVIRONMENTAL IMPACTS

The cable installation/repair process will only require minor works within the marine environment and only small scale construction works are required at the cable landing site to enable the cable to enter the existing BMH and connect to the Cable Landing Station at Deep Water Bay. The potential construction, normal operation and potential repair during operation impacts associated with the proposed PLCN cable system are summarised in *Table 4.1* and are described in further detail in the following sections.

No environmental impacts are expected to occur during the normal operation of the submarine cable system. During operation however, there may be a potential requirement for maintenance work (ie cable repair at particular fault location due to unexpected damage) to be carried out and *Section 4.9* addresses the potential impacts associated with these works.

Table 4.1 Potential Sources of Environmental Impacts

Potential Impact	Construction	Normal Operation	Potential Repair during Operation*
• Liquid Effluents, Discharges, or Contaminated Runoff	×	×	×
• Disruption of Water Movement or Bottom Sediment	✓	×	✓
• Generation of Waste or By-products	×	×	×
• Unsightly Visual Appearance	×	×	×
• Ecological Impacts:			
- Terrestrial	×	×	×
- Marine	✓	×	✓
- Fisheries	✓	×	✓
• Dust	×	×	×
• Noise	✓	×	✓
• Cultural Heritage	×	×	×
• Gaseous Emissions	×	×	×
• Odour	×	×	×
• Night-time Operations	×	×	×
• Traffic Generation	×	×	×
• Manufacturing, Storage, Use, Handling, Transport, or Disposal of Dangerous Goods	×	×	×
• Hazardous Materials or Wastes	×	×	×

Potential Impact	Construction	Normal Operation	Potential Repair during Operation*
• Risk of Accidents Which Result in Pollution or Hazard	×	×	×
• Disposal of Spoil Material, Including Potentially Contaminated Materials	×	×	×

Notes: ✓ = Potential to result in adverse impacts

× = Not expected to result in adverse impacts

* = Potential adverse impacts are expected to be less than during construction due to duration of any cable repair work during operation anticipated to be of shorter duration than cable installation during construction, repair work generally covering point location rather than full cable alignment within HK SAR waters, and potential to use smaller or less powerful equipment e.g. ROV rather than Injector Tool (see *Section 4.9*)

4.2 WATER QUALITY

4.2.1 Land Based Activities

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

- The machinery employed will be inspected prior to work commencing on the beach then at least daily thereafter to ensure the waters and beach will not be polluted with oil/grease/fuel. No machinery maintenance will be carried out onsite. Oil absorbent materials will be readily placed on site and will be applied immediately should any oil leakage incidents occur, to ensure the swimming zone would not be affected; and

- All construction waste and drainage will be handled and disposed in accordance with the *Waste Disposal Ordinance* and *Practice Note for Professional Persons*, *Construction Site Drainage* (*ProPECC PN1/94*) and in particular the following measures adhered to:

  - 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. A water line silt curtain will also be installed for mitigating the potential water quality impact due to surface runoff from the land base work on the beach (See *Figure 4.1*). Silt curtain has been used extensively in marine construction works projects in Hong Kong and has demonstrated its ability to confine sediment dispersion effectively [(1)].

(1) The sediment reduction rate by silt curtain systems may vary:
e.g. sediment reduction rate of 75% achieved using single-layered curtain (EIA for SCL Hung Hom to Admiralty section).
e.g. sediment reduction rates between 61% to 87% achieved using two-layered silt curtain, according to EIA for Hong Kong - Zhuhai - Macao Bridge Hong Kong Boundary Crossing Facilities.

For small scale marine works with limited and localized sediment disturbance under this Project, a floating or frame type silt curtain would be appropriate and sufficient for the control of the potential sediment dispersion (1); and

- Best Management Practices (BMPs) will be applied to avoid and minimise contaminated runoff from work sites, marine plants and vessels, including wastewater being properly treated and discharged to storm drain.

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

During normal operation, no land based activities as anticipated and no water quality impacts are expected.

4.2.2 Marine Based Activities

The marine based construction activities include the shore-end works, Route Clearance (RC) and/or Pre-Lay Grapnel Run (PLGR) operation and submarine cable installation and involve burying the cables below the existing seabed. The cable will be buried to a depth of 5 m below the seabed using a barge mounted injection tool along most of the route. The shore end section will be buried 1m below the seabed. The burial depth is necessary to provide protection to the cable. The injection jetting tool utilises water injection technology to fluidise the sediments, which enables the tool to penetrate the seabed to the desired depth and so to lay the cable. The cable is expected to be installed in an approximately 15 day period. The maximum speed during cable laying will be approximately 1 km hour^{-1}. *Section 2.1.4* provides full details of RC and PLGR and the RC will be conducted using jetting machine trial run while the PLGR will be conducted using tow of grapnel anchor. These operations will be scheduled to take place before the actual cable laying operation. RC/ PLGR operation(s) will be carried out over a short period of time (ie less than a week) and restricted to limited areas, wherever necessary.

Cable laying, as well as RC/ PLGR operation(s), will result in the temporary formation of an area of high suspended sediment concentrations around the injection tool or grapnel anchor, 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; analysis of the potential transport of fine sediments suspended in the water column was undertaken and it was determined that the sediments would settle onto the seabed in less than 4 minutes (see *Annex A* for details). Hence the potential for the release of any

(1) EM&A for other similar projects have indicated that deterioration of water quality from burying works by divers (with frame-type/screen silt curtain) are negligible such as:
- VSNL Intra Asia Submarine Cable System – Deep Water Bay (EP-294/2007)
- Replacement of the Existing 11KV Submarine Cable Circuit Connecting Liu Ko Ngam and Pak Sha Tau Tsui at Kat O (EP-461/2013)

contaminants from sediments and exertion of an oxygen demand on the receiving waters will be very limited and are not expected to cause adverse impacts to water quality. The maximum distance of transport for the suspended sediments would be 180 m (see *Annex A*). It is hence expected that the sediment plume will not reach the Ocean Park's seawater intakes or coral colonies along the coast of Round Island, Beaufort Island, Sung Kong, Waglan and Po Toi. While the burial of cable with jetting would be conducted within 180 m of the gazetted boundary of DWB bathing beach, the potential sediment plume would stay within 1 m above the seabed, which is sufficient separation from general swimmers vertically (See *Annex A* for details). It is also predicted that no unacceptable adverse impacts will be posed to DWB Bathing Beach from the shore-end cable section which requires relatively shallow buried depth, ie small amount of sediment will be disturbed, and the works will be completed within a short duration (within 4 days). In addition, the cable installation works will be carried out outside the designated swimming area, ie outside the shark preventive net, and will be completed outside the peak bathing season (ie outside of 1st April to 30th October) (See *Annex A* for details). To further control any the potential loss of sediment into the water column from diver jetting works in the 300 m close to the beach at DWB, divers will work within a silt curtain enclosed area, to control fine dispersion, if any, as well as silt curtain being installed at the water line to mitigate the potential water quality impact due to surface runoff from the land base work on the beach. A typical arrangement for silt curtains at the water line and for diver working is shown in *Figure 4.1*.

No long term disruption of bottom sediment will occur and no disruption 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 and no water quality impacts are anticipated.

Figure 4.1 ***Example of silt curtains for burial works at water line and off-shore diver working area for land base work on the beach and marine based activities near shore respectively***

4.3 DISRUPTION OF WATER MOVEMENT OR BOTTOM SEDIMENT

There will be small scale temporary displacement of bottom sediment during the laying of the PLCN cable using the cable burial tool. Once the cable is installed, the bottom sediment will naturally resettle (see *Section A4.2* of *Annex A*).

4.4 MARINE ECOLOGY

The closest marine SSSIs of the Project are the Hok Tsui (Cape d'Aguilar) SSSI, Sham Wan SSSI and Tai Tam Harbour (Inner Bay) SSSI, which are located about ~690 m, ~5.0 km and ~5.4 km from the closest cable segment, respectively. Given the mentioned marine SSSIs are more than 600 m from the closest cable segment, no direct or indirect impacts are anticipated (see *Annex B*).

A review of the existing information on the marine ecological resources surrounding the cable route has identified the area as supporting benthic fauna which can be considered as typical for Hong Kong waters and thus of low ecological value (see *Annex B*). Although these soft bottom assemblages will be disturbed during the cable laying works, the area of disturbance is small and rapid reinstatement of the seabed will result in the area being available for prompt recolonization. Hence, no permanent impacts are likely to occur.

No coral communities of high ecological importance have been identified within the cable corridor (see *Annex B* and *Figure B1*). Coral assemblages of high ecological value have been identified around Round Island, Beaufort Island, Sung Kong Islet, Sung Kong, Po Toi and Waglan Island which are all

more than 300 m from the proposed cable route (see *Figure A2b*). As the dispersion of the sediment plume is predicted to be no more than 180 m from the cable injector, the coral communities are not expected to be affected by the Project (see *Annexes A* and *B*).

The south-eastern waters of Hong Kong are not considered to be a frequently used habitat for the Chinese White Dolphin (CWD). Sightings of the Finless Porpoises (FPs) were also found to be infrequent along the proposed cable corridor. It is expected that the cable installation works will last for a short duration (approximately 15 working days for the cable laying) and will involve one main cable installation barge. Cable laying works using injector burial tools are not expected to cause unacceptable elevations in underwater sounds to marine mammals as the water jets will be located within marine sediments which will dampen down sounds generated during the works. Significant disturbance to the FP and CWD, in terms of underwater noise, marine traffic and food sources, is therefore not expected (*Annex B*).

Based on this, and the predicted localised and very short term impacts to water quality, no unacceptable impacts are predicted to occur to marine mammals.

Impacts to marine ecological resources have largely been avoided during cable laying, as well as RC/ PLGR operation(s), through the selection of a landing site and cable corridor that reduce 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 reduce impacts to water quality are also expected to control impacts to marine ecological resources, particularly for coral communities in the vicinity of the cable alignment. These mitigation measures include limiting the maximum speed of the cable laying machine and implementing good house-keeping practices during land based activities. In addition, a marine mammal exclusion zone during cable installation works is recommended to be implemented as a precautionary measure to reduce disturbance to marine mammals, especially the FPs.

During normal operation, the cable will be below the seabed and no impacts on marine ecology are anticipated.

4.5 FISHERIES

A review of the existing information on the fisheries resources and fishing operations traversed by the proposed cable route has identified waters north of Sung Kong and Waglan Island as the highest fisheries production areas in terms of weight of adult fish (400-600 kg of adult fish per hectare) and waters north of Beaufort Island, Sung Kong and Waglan Island in terms of value of adult fish and fish fry ($5,000 - $10,000 of adult fish and fish fry per hectare). Fisheries production then decreases as the cable moves away from this area, with the majority portion of the cable route traversing production grids of > 0 kg to 200 kg adult fish per hectare and > $0 to $5,000 of adult fish and fish

fry per hectare. In addition, the increase in suspended solids (SS) concentrations will be localised, occurring within 180 m of the cable alignment, and the marine works will last for a short period of time (ie about 15 working days for cable laying). It is expected that the sediments 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 and fishing vessels could continue to operate in nearby waters during the construction the Project (see *Annexes A* and *C*). 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 and fishing ground/spawning ground of commercial fisheries resources in the immediate vicinity of cable laying activities, as well as RC/ PLGR operation(s), and short-term displacement of fishing activities from the works area. The seabed will be reinstated to before-work level and condition very shortly. Hence the works are not expected to result in any unacceptable impacts to water quality and consequently fisheries resources or fishing operations (see *Annex C*).

There are no AFCD gazetted Fish Culture Zones within 500 m of the proposed cable route. The Po Toi Fish Culture Zone is located about 3,040 m away from the cable route. No specific mitigation measures have been recommended as no impacts to fisheries resources have been identified.

During normal operation, the cable will be below the seabed and no impacts on fisheries are anticipated.

4.6 NOISE

A noise assessment was undertaken to describe and evaluate the potential noise impacts arising from the onshore and offshore works associated with submarine cable installation. The results of this assessment are presented in *Annex D*. No noise exceedances would occur at the identified Noise Sensitive Receivers.

Cable laying and burial is at present expected to take place during non-restricted hours i.e. to take place between 0700 and 1900 hours on any day not being a Sunday or a general holidays. If works during restricted hours are later found to be necessary, a Construction Noise Permit (CNP) will be applied for.

During operation, no adverse noise impacts are anticipated.

4.7 CULTURAL HERITAGE

The cable landing site is located 1.3 km away from the closest culture heritage site which, as discussed in *Section 3* is land-based. Therefore no impacts to cultural heritage on land would be expected.

An assessment of the potential marine archaeological resources of the area has been conducted based on a review of historical records and admiralty charts

(*Annex E*). One live shipwreck site (no. 68338) is located in the MAI Study Area but adverse impact to it is considered minimal due to the large separation distance (i.e. 294.30 m) from the cable route. For the remaining MAI Study Area, since the proposed cable will be laid in the proximity of the existing cables or pipelines, it is not expected to impinge upon resources of high marine archaeological importance. Based on this, no adverse impacts to marine archaeological resources are expected to occur as a result of the Project during installation or at operation.

4.8 OTHERS

Waste Management: During the cable landing work, the materials excavated during trenching will be used for *in-situ* backfilling and therefore no waste material for disposal will be generated at the site. There will be no waste generated during operation of the cable.

Terrestrial Ecology: No impacts to terrestrial ecology will arise from the construction and operation of the submarine cable. During land cable installation at the beach (requires up to 4 days) and shore-end installation (requires up to 5 days), mitigation measures as set out in *Annex A4.3* will be implemented, including best management practices. The nearest works boundary will be located at least 23 m from the lower watercourse of the Ecological Important Stream. Site runoff would not be expected but a silt curtain will be set up at the water line for land based works and all diver hand jetting works in the area will be conducted within silt curtain works area to provide additional protection to surrounding water from sediment (See *Figure 4.1*). Therefore no unacceptable impact during the construction phase is anticipated to the Ecologically Important Stream and associated fauna at Deep Water Bay Valley. Potential impacts on trees at DWB beach are detailed in *Section 4.8* above.

Landscape and Visual: Since the cable conduit is laid under the sea-shore and the submarine cable is buried in the seabed, it will not cause any visual obstruction or inconvenience to the public. Protective measures for landing the cable at Deep Water Bay are already proposed, as set out in *Section 2.1.1* including protection of existing trees and of the gazetted beach. The proposed works would not incur any long term adverse impact on existing landscape resources or existing landscape character. Therefore no adverse landscape, tree or visual impact is anticipated during either construction or operation.

Dust: There will not be significant dust impacts during construction as the construction works will be short-term and small in scale and thus no unacceptable impacts are predicted to occur. Appropriate dust control measures as stipulated under the *Air Pollution Control (Construction Dust) Regulation* should be implemented where applicable. No dust will be generated during operation.

Gaseous Emissions: Only a small amount of gaseous emissions (SO_2 and NO_x) from diesel-powered equipment would be generated during trenching for the cable landing site. Requirements stipulated in the *Air Pollution Control (Non-road Mobile Machinery) (Emission) Regulation* will be followed to control potential gaseous emissions from any non-road mobile machinery during construction phase. These emissions will not impact Air Sensitive Receivers. During operation, no gaseous emissions are anticipated.

Odour: No odour impacts are expected during either the construction or operation phases of the proposed project.

Night-time Operations: It is expected that all cable laying and burial work will be performed during non-restricted working hours, i.e. between 0700 and 1900 hours on any day not being a Sunday or general holiday. If works are proposed during restricted hours, a Construction Noise Permit will be applied for.

Traffic Generation: Only short term, minimum increase in traffic movements is expected to be generated as a result of the Project during construction and this will not generate significant noise or gaseous emissions. During operation the Project is not expected to generate vehicular traffic.

Dangerous Goods: No dangerous goods will be involved in this project in either the construction or operation phases.

Hazardous Materials or Wastes: No hazardous materials or wastes will be generated by this Project at either construction or operation phases.

Risk of Accidents Resulting in Pollution or Hazard: No pollution or hazard generating accidents will result from this Project at either construction or operation phases.

Disposal of Spoil or Contaminated Material: There will be no disposal of spoil or contaminated materials during construction or operation; hence no impacts are expected to result from this Project.

4.9 MAINTENANCE AND REPAIR

It is considered unlikely that the submarine cable will require maintenance during operation, however should an occasion of cable fault arise that necessitates this, emergency repair operation will be required. Methods used for cable maintenance and repair at any location along the submarine cable route are anticipated to be as per those used for cable installation during construction, with the potential to use smaller equipment such as Remotely Operated Vehicles (ROVs) equipped with injector tool. More details are provided in *Section 2.1.6* as to the general repair methodology and sequence.

Repair works will be conducted along the same proposed alignment as installed cable but duration of any cable repair work is anticipated to be of shorter duration than cable installation during construction, since repair work

will generally be conducted at point fault location(s) rather than along the whole cable alignment. ROVs generally have reduced jetting power compared to installation injector tools (typical injector tools jet around eight times (x8) more litres of water per minute than typical ROVs) and diver hand jetting is even less powerful (ROVs jet around four times (x4) more litres of water per minute than typical diver jetting). Grapnels on the other hand do not use jetting but simply penetrate the sea bed and are therefore not expected to cause significant sediment plumes. The recovery of any faulty cable using diver, ROV or gripper grapnel is expected to cause sediment plume that would be no greater than sediment plume generated during installation, ie the maximum distance of transport for the suspended sediments would be 180 m.

Therefore overall, potential impacts are anticipated to be less during cable maintenance and repair works than those for cable installation during construction. Since cable installation during construction is not considered to cause adverse environmental impacts, therefore no adverse environmental impacts are considered likely should maintenance and repair be required.

5 PROTECTION MEASURES AND ANY FURTHER IMPLICATIONS

5.1 ENVIRONMENTAL PROTECTION MEASURES

5.1.1 Construction Phase

Potential water quality impacts associated with the Project during the construction phase may involve minimal disturbances to the nearest coral communities near Round Island, north Beaufort Island, Sung Kong Islet and Sung Kong, (concerning the area with relatively higher coral diversity; see *Section B1.2.7* in *Annex B*, approximately over 450 m, 670 m, 330 m and 560 m to the closest section of the proposed cable alignment respectively). Potential water quality impacts may also lead to potential disturbance to SSSI at Cape D'Aguilar Headland (approximately 690 m to the closest section of the proposed cable alignment). The sediment plume calculation indicates that the corals and the SSSI are not expected to be affected by the cable laying activities (it is anticipated that the amount of suspended sediments in the water column would be back to the natural background level at 180m away from the nearest cable alignment).

Specific measures have been proposed to minimise the impacts to water quality and marine ecology during the construction phase (refer to *Annexes A* and *Annex B* as well as *Annex G Environmental Monitoring & Audit*).

In addition, precautionary measures have been proposed for the land and shore-end cable installation as listed above in *Sections 2.1.1 and 2.1.2* and detailed again in *Annex G Environmental Monitoring & Audit*

5.1.2 Operation Phase

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

Should repair operation be required, protection and mitigation measures proposed during construction phase will be put in place. For the land and shore-end cable installation, measures as listed above in *Sections 2.1.1 and 2.1.2* (and detailed again in *Annex G Environmental Monitoring & Audit*) would be implemented as well as those regarding noise listed in *Annex D* and detailed again in *Annex G*. For off-shore submarine cable repair operations, specific measures as proposed to minimise the impacts to water quality and marine ecology during the construction phase would be implemented (refer to *Annexes A* and *Annex B* as well as *Annex G Environmental Monitoring & Audit*).

5.2 POSSIBLE SEVERITY, DISTRIBUTION AND DURATION OF ENVIRONMENTAL EFFECTS

The actual installation of the submarine cable system in Hong Kong SAR waters (not including the route clearance or post-lay works or any weather downtime) is expected to take approximately 15 days. The residual

environmental impacts of the works activities are predicted to be localised to the immediate vicinity of the cable alignment, of low severity and acceptable.

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

5.3 CUMULATIVE IMPACTS

At present there is one planned submarine cable projects in vicinity of the proposed cable route, the Asia-Africa-Europe-1 (AAE-1) Cable System (EP 508/2016) due to land at Cape D'Aguilar and travel east on a similar trajectory to the PLCN cable, approximately 450-550 m north, for approximately 10 km before turning further north. This AAE-1 cable system is provisionally scheduled to be landed and installed in the first quarter of 2017, upon completion of the HDD works in Lap Sap Wan and is expected to take approximately six to eight weeks to complete, excluding works related to Horizontal Directional Drilling (HDD) (AAE-1 Project Profile, PP-533/2016 of January 2016). Since the current PLCN Project is due to start installation in 2018, no cumulative impact is expected during the construction and operation of the Project.

5.4 FURTHER IMPLICATIONS

As DWB is already the landing site of a number of submarine cable systems, the geotechnical environment at the proposed landing point is considered to be suitable for submarine cable installation. The site has already been used for other systems under Environmental Permit, which indicates there are no adverse effects to the surrounding environment from the operation of the submarine cables.

The methods used for burying the PLCN cable, as described above, have been used in Hong Kong and around the world for many years and are widely accepted to have very little impact on the surrounding marine 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.

Although no unacceptable environmental impacts have been identified, it is recommended to carry out water quality monitoring, coral monitoring, and site inspection, including inspection of trees, and to implement a marine mammal exclusion zone during construction, to verify and ensure that the project works will not result in any unacceptable impacts to water quality, marine ecology and fisheries or to the terrestrial environment and general public during construction. Should repair works be necessary during operation of the cable system, mitigation measures proposed for the construction phase will be implemented.

The Project Proponent will engage an Environmental Team (ET) to carry out the Environmental Monitoring & Audit (EM&A) requirements as set out fully in *Annex G*. The ET shall not be in an associated body of the Project Proponent, any works contractors or the Independent Environmental Checker (IEC). The ET shall be headed by an ET Leader who has at least 7 years of experience in EM&A or environmental management.

In addition to the ET, the Project Proponent will engage an IEC. The IEC shall not be an associated body of the Permit Holder, the works contractors or the ET. The IEC shall have at least 7 years of experience in EM&A or environmental management. The IEC shall audit the overall EM&A performance of the Project, including the Contractor's implementation of all environmental mitigation measures.

Deep Water Bay is already the landing site of several submarine cable systems, which provide connectivity between major countries in Asia Pacific. EIA Reports were not prepared under the EIAO for these cable systems, with the exception of the *SEA-ME-WE 3 Fibre Optic Submarine Cable System* and the *TATA (VSNL) Intra Asia (IA) Submarine Cable System*. It is assumed that permissions for the majority of the other cable systems were given before the *EIAO* process was instigated in 1997.

The project profile of the Videsh Sanchar Nigam Ltd (VSNL)'s project, entitled "*VSNL Intra Asia Submarine Cable System – Deep Water Bay: Project Profile´* was submitted to the EPD in August 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 November 2007 (EP-294/2007)).

The project profile of the Hong Kong Telecom International Limited's project, entitled *Cable Landing Work in Deep Water Bay for SEA-ME-WE 3 Fibre Optic Submarine Cable System*", was submitted to the EPD in May 1998 (AEP-001/1998). The study concluded that there would be no adverse long term or cumulative effects/impacts to the environment and the Environmental Permit was granted on 27 July 1998 (EP-001/1998).

Another Project Profile for the Hongkong Electric Co., Ltd., entitled "*132kV Submarine Cable Installation for Wong Chuk Hang - Chung Hom Kok 132kV Circuits*", was submitted to the EPD in January 2002 (AEP-132-2002). The landing site for the 132kV submarine cable was also in Deep Water Bay. The study concluded that no unacceptable environmental impacts were predicted during the installation of the submarine cables and no environmental monitoring and audit measures were recommended as being necessary for the project. The Environmental Permit was granted on 16 April 2002 (EP 132/2002).

Other similar projects that have been conducted in the HKSAR include the following:

- *Asia-Africa-Europe-1 (AAE-1) Cable System,* PCCW Global (HK) Limited. The Project Profile for this study was submitted to EPD in January 2016 (AEP-508/2016). The approximate length of the cable in HKSAR waters is approximately 27.7 km and involves installation using HDD, surface laying by diver and cable burial tool techniques. The study concluded that there would be no unacceptable, adverse impacts to the environment and the Environmental Permit was granted in April 2016 (EP-508/2016).

- *Tseung Kwan O Express – Cable System,* PCCW Global (HK) Limited. The Project Profile for this study was submitted to EPD on 16 December 2015 (AEP-243/2015). The approximate length of the cable in HKSAR waters is approximately 2.7 km and involves installation using HDD and direct

burial techniques (by a cable laying vessel and cable burial tool). The study concluded that there would be no unacceptable, adverse impacts to the environment and the Environmental Permit was granted on 20 May 2016 (EP-509/2016).

- *Asia Pacific Gateway (APG) – Tseung Kwan O*, China Mobile International Ltd. The Project Profile was submitted to EPD on 9 October 2013 (PP-496/2013). The length of cable in Hong Kong waters is around 35 km. The study concluded that there would be no adverse long-term or cumulative effects/impacts to the environment. The EP was granted on 18 February 2014 (EP-485/2014).

- *Replacement of the Existing 11KV Submarine Cable Circuit Connecting Liu Ko Ngam and Pak Sha Tau Tsui at Kat O,* CLP Hong Kong Limited. The Project Profile for this study was submitted to EPD on 30 May 2013 (AEP-461/2013). The approximate length of the cable in HKSAR waters was around 880m. 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 27 August 2013 (EP-461/2013).

- *Asia Submarine-cable Express (ASE) - Tseung Kwan O*, NTT Com Asia Limited. The Project Profile for this study was submitted to EPD on 29 November 2011 (AEP-433/2011). The approximate length of the cable in HKSAR waters was around 33.5 km. 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 20 December 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 28 September 2011 (AEP-423/2011). The approximate length of the cable in HKSAR waters was around 37 km. 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 24 October 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 October 2007 (AEP-298/2007). The length of cable in Hong Kong waters is around 10 km. 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 December 2007 (EP-298/2007).

- *Proposed 132kV Submarine Cable Route for Airport "A" to Castle Peak Power Station Cable Circuit*, CLP Power (AEP 267/2007). The approximate length of the cable in HKSAR 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).

- *HGC Optical Fibre Submarine Cable System between Tuen Mun and Chek Lap Kok,* Hutchison Global Crossing Ltd. The Project Profile was submitted on 19 April 2001 (PP-127/2001). The length of the cable in Hong Kong waters is around 500 m. The study concluded that there would be no adverse long-term or cumulative effects/impacts on the environment. The EP was granted on 9 June 2001 (EP-106/2001).

- *FLAG North Asian Loop,* FLAG Telecom Asia Limited. The Project Profile for this Study was submitted to EPD in March 2001 (AEP-099/2001). The total length of the cable in HKSAR waters was approximately 10 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 18 June 2001 (EP-099/2001).

- *C2C Cable Network - Hong Kong Section: Chung Hom Kok,* GB21, Hong Kong Limited. The Project Profile for this Study was submitted to EPD in December 2000 (AEP-087/2001). The approximate length of each cable in HKSAR waters was around 30 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 16 February 2001 (EP-087/2001).

- *New T&T Hong Kong Limited: Domestic Cable Route,* New T&T. The Project Profile for this Study was submitted to EPD in December 2000 (AEP-086/2001). The total length of the Chung Hom Kok to Cheung Sha cable was approximately 37 km and the Chung Hom Kok to Sandy Bay cable was approximately 32 km in length. The Study concluded that there would be no adverse long term or cumulative effects/impacts on the environment and the Environmental Permit was granted on 16 February 2001 (EP-086/2001).

- *East Asian Crossing (EAC) Cable System (TKO),* Asia Global Crossing Limited (AGC). The Project Profile for this Study was submitted to EPD in July 2000 (AEP-081/2000). The total length of the cable in HKSAR waters was approximately 25 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 4 October 2000 (EP-081/2000).

- *East Asian Crossing (EAC) Cable System*, Asia Global Crossing Limited (AGC). The Project Profile for this Study was submitted to EPD on 21 June 2000 (AEP-079/2000). The total length of the cable within HKSAR waters was approximately 25 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 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,* Cable and

Wireless HKT International Ltd. The Project Profile for this Study was submitted to EPD in May 2000 (AEP-069/2000). The total length of the cables in HKSAR waters was approximately 9 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 26 July 2000 (EP-069/2000).

- *Telecommunication Installation at Lot 591SA in DD328, 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*, Level 3 Communications Ltd. The Project Profile for this Study was submitted to EPD in March 2000 (AEP-064/2000). The total length of the cable in HKSAR waters was approximately 10 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 in June 2000 (EP-064/2000).

Annex A

Assessment of Potential Impacts to Water Quality

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A1 INTRODUCTION

This *Annex* presents an evaluation of the potential water quality impacts associated with the construction of the proposed Pacific Light Cable Network (PLCN) – Deep Water Bay submarine cable system. The cable will travel from Deep Water Bay (DWB) southward approaching the East Lamma Channel. Near to Round Island, the cable is approximately parallel to the East Lamma Channel until the south of Stanley Peninsula. The cable will then travel eastward along the boundary of HKSAR waters and will enter the South China Sea. Once installed, the cable is not expected to result in any water quality impacts during operation and hence the focus of this water quality assessment is on the potential impacts during the construction (ie cable laying and burial) phase.

A2 RELEVANT LEGISLATION AND ASSESSMENT CRITERIA

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

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

A2.1 WPCO

The *WPCO* is the primary legislation for the control of water pollution and water quality in Hong Kong. Under the *WPCO*, HKSAR waters are divided into 10 Water Control Zones (WCZs). Each WCZ has a designated set of statutory Water Quality Objectives (WQOs). The route for the proposed submarine cable system passes through the Southern and Mirs Bay WCZs (*Figure A1*) while the 7 km Study Area also covers the Eastern Buffer WCZ. A summary of the WQOs for these WCZs is presented in *Table A1*, and the WQOs are applicable as evaluation criteria for assessing the compliance of any discharge during the construction phase of the proposed PLCN submarine cable system.

Table A1 Summary of Water Quality Objectives for the Eastern Buffer, Southern and Mirs Bay WCZs

Parameter	Eastern Buffer, Southern and Mirs Bay WCZs*
Temperature	Change due to waste discharge not to exceed 2°C
Salinity	Change due to waste discharge not to exceed 10% of natural ambient level
pH	To be in the range 6.5 - 8.5, change due to waste discharge not to exceed 0.2
Suspended Solids (SS)	Waste discharge not to raise the natural ambient level by 30% nor cause the accumulation of suspended solids which may adversely affect aquatic communities
Dissolved Oxygen (DO)	
• Bottom	Not less than 2 mg L^{-1} for 90% samples
• Depth-averaged	Not less than 4 mg L^{-1} for 90% samples

Parameter	Eastern Buffer, Southern and Mirs Bay WCZs*
Nutrients (measured as total inorganic nitrogen)	Eastern Buffer WCZ: Not to exceed 0.4 mg L^{-1} (annual mean depth-averaged)
	Mirs Bay WCZs: Not to exceed 0.3 mg L^{-1} (annual mean depth-averaged)
	Southern WCZ: Not to exceed 0.1 mg L^{-1} (annual mean depth-averaged)
Unionised Ammonia	Not to exceed 0.021 mg L^{-1} (annual mean)
Toxicants	Not to be present at levels producing significant toxic effect
E.coli	Annual geometric mean not to exceed 610 cfu/100mL (secondary contact recreation subzones in Mirs Bay WCZ and fish culture subzones in Mirs Bay, Southern and Eastern Buffer WCZs)

* Unless specified, Water Quality Objectives for each parameter are the same for Eastern Buffer, Southern and Mirs Bay WCZs

A2.2 EIAO - TM

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

A2.3 WSD SEAWATER INTAKES

Quality of seawater intake should comply with the relevant Water Quality Objectives instituted by the Water Supply Department (*Table A2*).

Ocean Park confirmed in previous Direct-to-Permit application (1) that the WQO for Southern WCZ should apply as the water quality criteria for their extracted water through the seawater intakes, ie the SS elevation caused by the Project works should not exceed 30% of the ambient levels.

(1) VSNL Intra Asia Submarine Cable System – Deep Water Bay (AEP-294/2007)

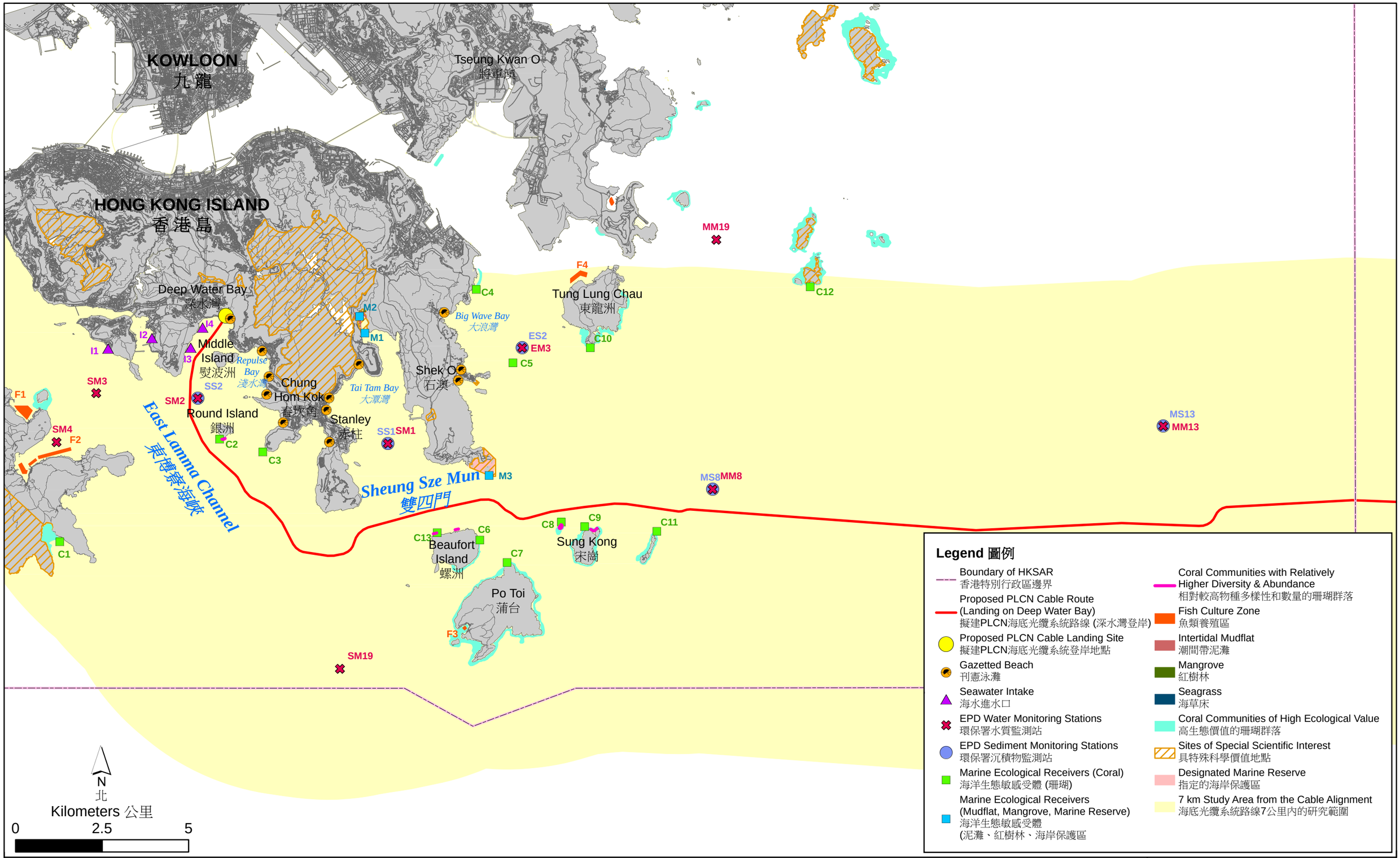
Table A2 ***WSD Water Quality Objectives for Seawater for Flushing Supply at Intake Point***

Parameter	Target*
Colour (H.U.)	<20
Turbidity (N.T.U.)	<10
Threshold Odour No. (T.O.N.)	<100
Ammonical N	<1
Suspended Solids	<10
Dissolved Oxygen	>2
Biochemical Oxygen Demand	<10
Synthetic Detergents	<5
E.coli / 100 mL	<20,000

Notes:
***:** Chemical values are expressed in mg/L (parts per million).

A2.4 PROPECC PN 1/94

Apart from the above statutory requirements, the *Professional Persons Environmental Consultative Committee Practice Notes*, *Construction Site Drainage* (*ProPECC PN 1/94*), issued by EPD in 1994, shall also be followed to prevent water pollution associated with construction activities. The applicable measures from *ProPECC PN 1/94* are listed in *Section A4.3*.



Legend 圖例

- Boundary of HKSAR 香港特別行政區邊界
- Proposed PLCN Cable Route (Landing on Deep Water Bay) 擬建PLCN海底光纜系統路線 (深水灣登岸)
- Proposed PLCN Cable Landing Site 擬建PLCN海底光纜系統登岸地點
- Gazetted Beach 刊憲泳灘
- Seawater Intake 海水進水口
- EPD Water Monitoring Stations 環保署水質監測站
- EPD Sediment Monitoring Stations 環保署沉積物監測站
- Marine Ecological Receivers (Coral) 海洋生態敏感受體 (珊瑚)
- Marine Ecological Receivers (Mudflat, Mangrove, Marine Reserve) 海洋生態敏感受體 (泥灘、紅樹林、海岸保護區
- Coral Communities with Relatively Higher Diversity & Abundance 相對較高物種多樣性和數量的珊瑚群落
- Fish Culture Zone 魚類養殖區
- Intertidal Mudflat 潮間帶泥灘
- Mangrove 紅樹林
- Seagrass 海草床
- Coral Communities of High Ecological Value 高生態價值的珊瑚群落
- Sites of Special Scientific Interest 具特殊科學價值地點
- Designated Marine Reserve 指定的海岸保護區
- 7 km Study Area from the Cable Alignment 海底光纜系統路線7公里內的研究範圍

Figure A1
圖 A1

Representative Marine Water Sensitive Receivers in the surrounding of the Proposed Pacific Light Cable Network
在擬建PLCN海底光纜系統附近具代表性的海洋水質敏感受體

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Date: 15/3/2017

Environmental Resources Management

ERM

A3 DESCRIPTION OF THE ENVIRONMENT

A3.1 HYDRODYNAMICS

The first part of the proposed cable system is sheltered from tidal currents as it lies within the Deep Water Bay. The cable which lies beyond Round Island and beside the East Lamma Channel is mainly affected by the relatively strong tidal currents since the East Lamma Channel forms one of the main flow paths for waters into and out of the Western Harbour. The cable which is located in the south-eastern waters is mainly influenced by the oceanic water from South China Sea.

A3.2 WATER QUALITY

The proposed route for the submarine cable system passes through the Southern and Mirs Bay WCZs. There are seven EPD routine water quality monitoring stations in the vicinity of the cable route, including (from west to east) SM4, SM3, SM2, SM19, SM1, EM3, MM8 and MM13. Water quality data for these stations, which were collected between 2011 and 2015 (1) and are the most up to date published data, and are summarised in *Table A3.* The locations of the stations are shown in *Figure A1.*

(1) EPD, Marine Water Quality in Hong Kong in 2010 - 2014.

Table A3 EPD Routine Water Quality Monitoring Data along the Cable Route (2011 - 2015)

WQ Parameter	SM4	SM3	SM2	SM19	SM1	MM8	MM13	EM3
	East Lamma Channel		Hong Kong Island (South)			Waglan Island	Mirs Bay (South)	Tathong Channel
Temperature (°C)	23.2 (15.0-28.8)	22.7 (14.9-28.8)	23.0 (15.1-28.8)	22.8 (14.7-28.8)	22.9 (14.7-28.8)	22.7 (14.9-28.9)	22.9 (14.5-28.9)	22.8 (14.9-28.9)
Salinity (ppt)	31.6 (27.5-33.5)	32.2 (29.8-33.7)	31.9 (27.9-33.9)	32.3 (29.8-34.1)	32.2 (30.0-34.0)	32.6 (29.9-34.2)	32.8 (30.8-34.3)	32.5 (30.9-33.9)
pH	7.9 (7.5-8.3)	7.9 (7.5-8.3)	8.0 (7.6-8.3)	8.0 (7.6-8.3)	8.0 (7.5-8.3)	8.0 (7.6-8.3)	8.0 (7.6-8.3)	8.0 (7.5-8.3)
Dissolved Oxygen – Depth-averaged (mg L^{-1})	6.5 (3.1-9.0)	6.2 (3.2-8.5)	6.5 (3.7-8.5)	6.5 (3.8-8.4)	6.7 (4.0-8.6)	6.5 (3.3-8.4)	6.5 (3.7-8.2)	6.6 (4.1-9.7)
Dissolved Oxygen - Bottom (mg L^{-1})	6.2 (2.6-8.7)	5.9 (1.3-8.5)	6.1 (1.6-8.4)	6.0 (0.9-8.3)	6.2 (2.2-8.5)	5.9 (2.4-8.1)	6.0 (2.2-8.0)	6.2 (3.0-9.7)
BOD_5 (mg L^{-1})	0.8 (0.2-2.0)	0.7 (0.2-3.7)	0.7 (0.2-2.2)	0.6 (0.1-1.6)	0.7 (0.2-2.0)	0.5 (0.1-1.3)	0.5 (0.1-2.0)	0.8 (0.2-4.9)
Suspended Solids (mg L^{-1})	2.7 (0.7-7.4)	3.5 (0.7-7.0)	3.6 (0.7-12.9)	3.4 (0.8-9.9)	2.9 (0.5-8.6)	3.3 (0.8-10.0)	3.0 (0.8-9.6)	3.3 (0.6-10.5)
Total Inorganic Nitrogen (mg L^{-1})	0.21 (0.02-0.55)	0.17 (0.01-0.40)	0.17 (0.03-0.54)	0.13 (0.02-0.33)	0.13 (0.02-0.40)	0.11 (0.01-0.31)	0.09 (0.01-0.27)	0.12 (0.02-0.28)
Unionised Ammonia (mg L^{-1})	0.002 (0.001-0.009)	0.002 (0.001-0.007)	0.002 (0.001-0.006)	0.002 (0.001-0.007)	0.002 (0.001-0.004)	0.001 (0.001-0.003)	0.002 (0.001-0.006)	0.002 (0.001-0.005)
Chlorophyll-*a* (microgram L^{-1})	3.7 (0.3-17.9)	2.7 (0.4-9.7)	3.3 (0.4-16.5)	2.3 (0.5-10.5)	2.7 (0.4-12.5)	1.9 (0.4-10.7)	1.8 (0.3-12.7)	2.6 (0.4-12.8)
Escherichia coli (cfu $100mL^{-1}$)	14 (<1 - 3800)	40 (<1 - 3800)	40 (<1 - 5000)	1 (<1 - 22)	2 (<1 - 70)	1 (<1 - 16)	1 (<1 - 40)	3 (<1 - 1600)

The data showed that the annual mean for both depth-averaged and bottom dissolved oxygen complied with the WQO during 2011 – 2015. Compliance of total inorganic nitrogen remains low for the Southern WCZ during these five recent years with decreasing Total Inorganic Nitrogen (TIN) level from the west side to the east side. On the other hand, compliance of unionised ammonia is observed at all stations throughout the period. The SS concentrations were within a wide range from 0.5 mg/L at SM1 to 12.9 mg/L at SM2. *E.coli* levels also stayed in compliance with the WQO at all stations between 2011 and 2015. The maximum *E.coli* level could be up to 5000 cfu/100 mL^{-1} (at SM2) and 3800 cfu/100 mL^{-1} (at SM3 and SM4).

A3.3 SEDIMENT QUALITY

There are five (5) EPD routine sediment quality monitoring stations in the vicinity of the cable corridor: (from west to east) SS2, SS1, MS8, MS13 and ES2. Sediment quality data for these stations are available for 2011-2015 (1) and are summarised in *Table A4*. The locations of the sediment quality monitoring stations are shown on *Figure A1*.

(1) EPD. Marine Water Quality for Hong Kong in 2014.

Table A4 ***EPD Routine Sediment Quality Monitoring Data in the Vicinity of the Cable Route (2011 – 2015)***

Parameter	LCEL	UCEL	SS2	SS1	MS8	MS13	ES2
COD (mg kg-1)	-	-	11490 (9100 - 15000)	9250 (7700 - 11000)	10130 (8600 - 12000)	8500 (6400 - 10000)	9190 (7100 - 13000)
TKN (mg kg-1)	-	-	515 (360 - 600)	420 (340 - 500)	499 (400 - 550)	484 (320 - 550)	481 (350 - 650)
Cadmium (mg kg-1)	1.5	4	<0.1 (<0.1-0.1)	<0.1 (<0.1-<0.1)	<0.1 (<0.1-<0.1)	<0.1 (<0.1-<0.1)	<0.1 <0.1
Chromium (mg kg-1)	80	160	29 (27-32)	21 (18-23)	32 (28-33)	30 (24-34)	27 (19 - 49)
Copper (mg kg-1)	65	110	18 (15-21)	9 (8-11)	13 (10-18)	12 (9-17)	17 (12 - 32)
Mercury (mg kg-1)	0.5	1	0.09 (0.05-0.13)	0.05 (<0.05-0.07)	0.03 (<0.05-0.06)	0.03 (<0.05-0.07)	0.07 (<0.05-0.13)
Nickel (mg kg-1)	40	40	19 (17-22)	15 (14-17)	22 (20-24)	22 (20-23)	18 (12 - 31)
Lead (mg kg-1)	75	110	32 (20-37)	25 (22-28)	33 (30-37)	31 (25-35)	27 (18 - 42)
Silver (mg kg-1)	1	2	0.2 (<0.2-0.3)	<0.2 (<0.2-<0.2)	<0.2 (<0.2-<0.2)	<0.2 (<0.2-<0.2)	<0.2 (<0.2-<0.2)
Zinc (mg kg-1)	200	270	90 (82-98)	61 (51-68)	79 (72-89)	77 (62-86)	71 (48 - 110)
Arsenic (mg kg-1)	12	42	8.3 (6.6-10.0)	6.6 (5.9 - 7.0)	7.3 (6.6 - 7.9)	7.7 (6.3 - 8.7)	6.1 (4.5 - 9.5)
Low Molecular Weight PAHs (µg kg-1)	550	3160	100 (90-150)	100 (90-180)	130 (90-260)	140 (90-330)	100 (90 - 150)
High Molecular Weight PAHs (µg kg-1)	1700	9600	92 (27-280)	51 (20-230)	70 (27-310)	44 (27-91)	74 (38 - 190)
Total PCBs (µg kg-1)	23	180	18 (18-18)	18 (18-18)	18 (18-18)	18 (18-18)	18 (18-18)

Sediment quality, management and classification specified under *Works Bureau Technical Circular (Works) No. 34/2002 Management of Dredged/Excavated Sediment* comprise two criteria for a broad range of Contaminants of Concern. The lower criterion is referred to as the Lower Chemical Exceedance Limit (LCEL) and the upper criterion is referred to as the Upper Chemical Exceedance Limit (UCEL). The above data (mean values) show that there were no exceedances of the LCEL at the above sediment quality monitoring stations and the sediment in the vicinity of the proposed cable route was not contaminated based on the existing sediment classification guidelines.

A3.4 WATER QUALITY SENSITIVE RECEIVERS

Water quality sensitive receivers (WSRs) within the 7 km Study Area of the cable corridor and the landing site have been identified under the broad designations of gazetted bathing beaches, coral sites, intertidal mudflat, fish culture zones, designated marine reserve and seawater intakes.

The identified WSRs in these categories, shown on *Figure A1* are summarised as follows. *Figure A2a* and *A2b* provide the zoom-in view for the locations of the sensitive receivers lying in the close vicinity to the cable alignment.

- **Gazetted Bathing Beaches:** Deep Water Bay, Repulse Bay, Middle Bay, South Bay, Chung Hom Kok, Saint Stephen's Beach, Stanley Main Beach, Hairpin Bay, Turtle Cove, Big Wave Bay, Rocky Bay, and Shek O;
- **Fisheries:** Lo Tik Wan (F1), Sok Kwu Wan (F2), Po Toi (F3) and Tung Lung Chau (F4) Fish Culture Zones;
- **Sites of High Ecological Importance:** Cape d'Aguilar Marine Reserve (M3);
- **Coral Communities:** coral sites along the coast of Sham Wan of Lamma Island (C1), Round Island (C2), Chung Hom Kok (C3), Cape Collinson (C4), Tai Long Pai (C5), Beaufort Island (C6), Po Toi Island (C7), Sung Kong (C8, C9, 13), Tung Long Chau (C10), Waglan Island (C11), Ninepin Group (C12);
- **Intertidal Mudflat and Mangrove at Tai Tam** (M1 & M2)**;** and
- **Seawater Intakes:** WSD Flushing Intake of Ap Lei Chau (I1), WSD Flushing Intake of Aberdeen (I2), Ocean Park's Main Seawater Intake (I3), Ocean Park's Training Yard Seawater Intake (I4).

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

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

ID	Water Quality Sensitive Receivers	Approximate Geodesic Distance ^ to Proposed Cable Alignment (m)
DWB	Deep Water Bay	In the immediate vicinity
RB	Repulse Bay	1,200
MB	Middle Bay	1,920
SB	South Bay	2,240
CHK	Chung Hom Kok	1,990
SSB	Saint Stephen's Beach	2,480
SMB	Stanley Main Beach	2,300
HB	Hairpin Bay	3,510
TC	Turtle Cove	4,130
BWB	Big Wave Bay	5,420
RKB	Rocky Bay	3,780
SO	Shek O	3,400

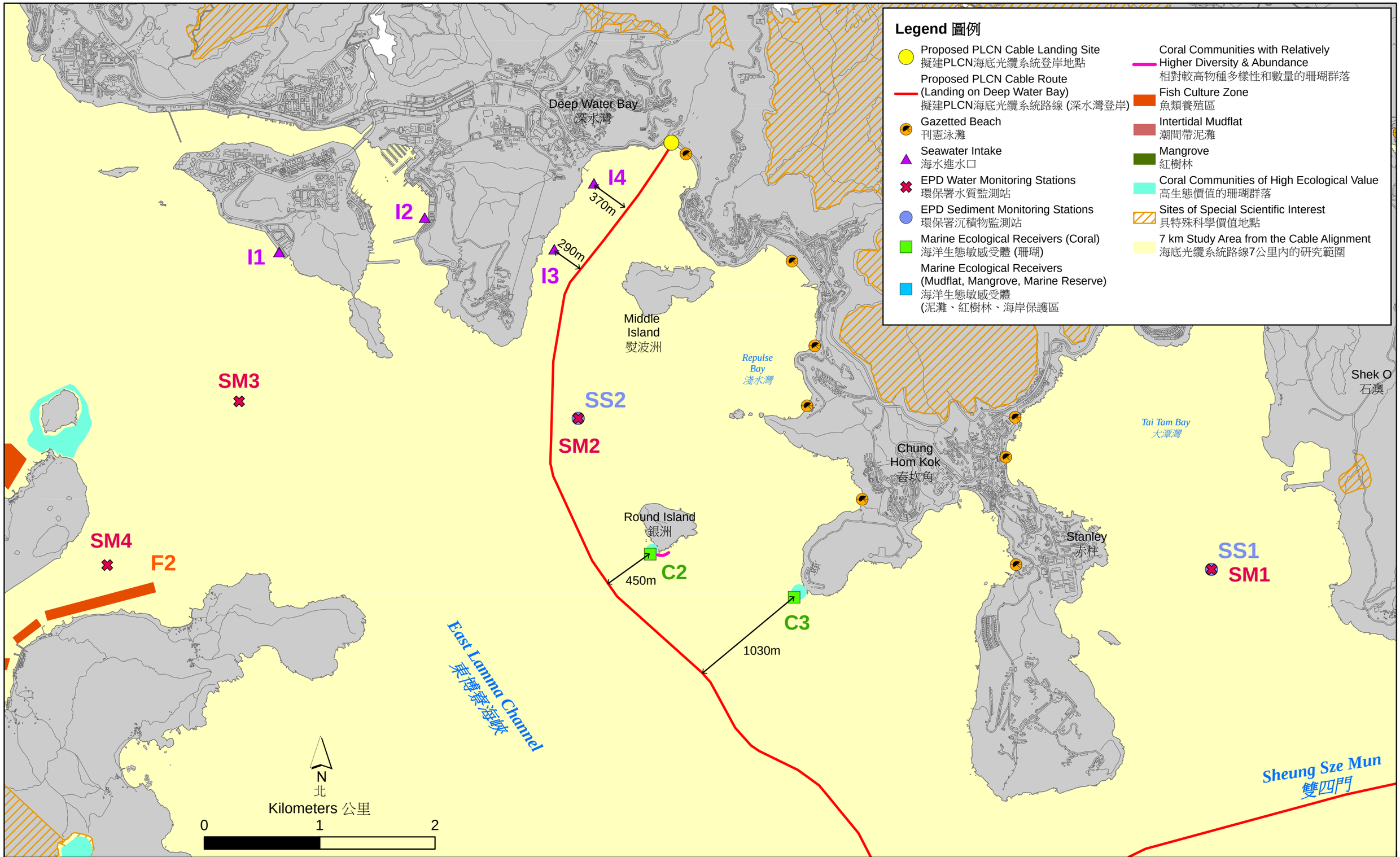

Figure A2a
圖 A2a

Representative Marine Water Sensitive Receivers in the surrounding of the Proposed Pacific Light Cable Network - Zoom in (Part I)
在擬建PLCN海底光纜系統附近具代表性的海洋水質敏感受體 - 放大圖 (部分I)

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Date: 9/3/2017

Environmental
Resources
Management

ERM

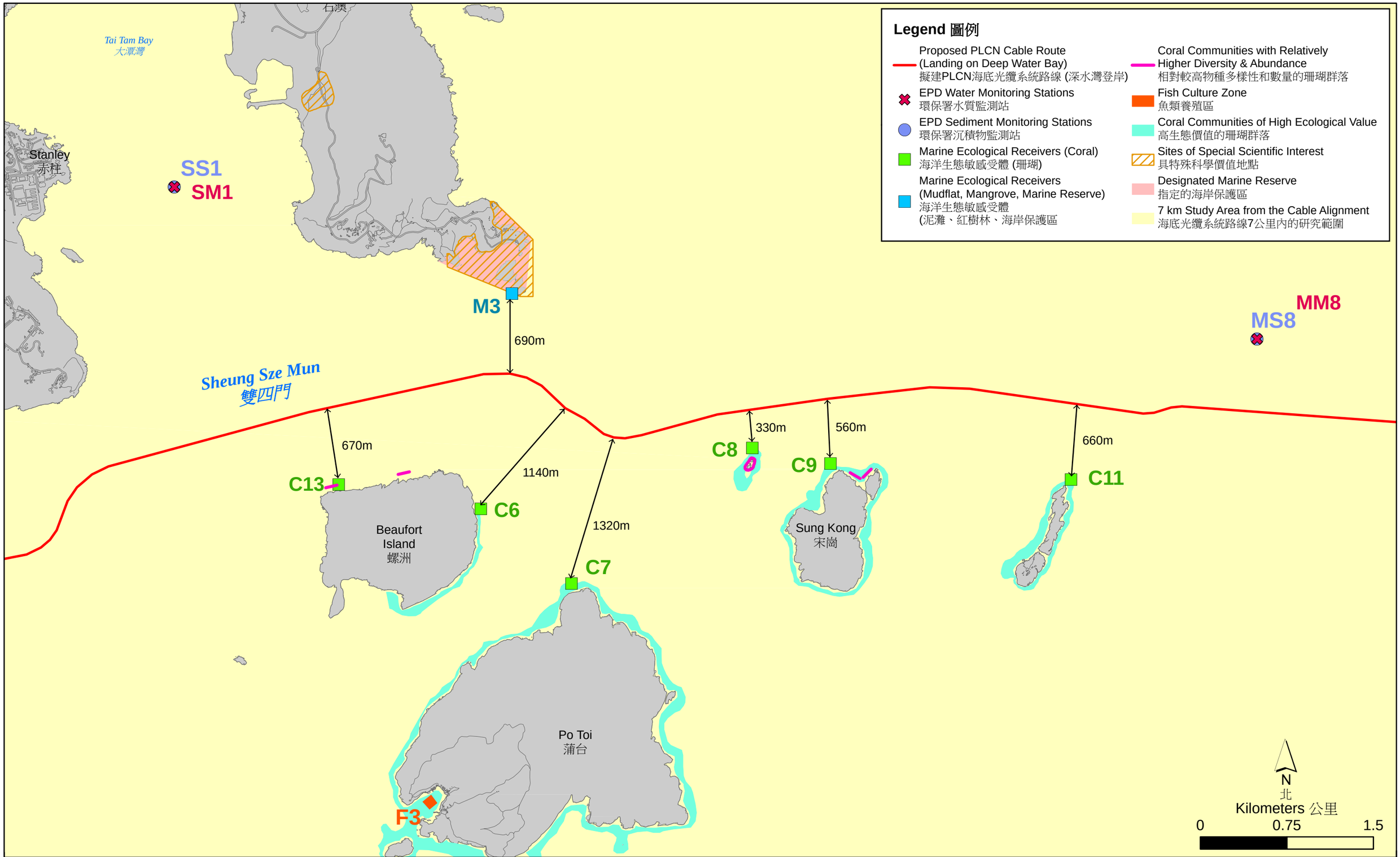

Figure A2b
圖 A2b Representative Marine Water Sensitive Receivers in the surrounding of the Proposed Pacific Light Cable Network - Zoom in (Part II)
在擬建PLCN海底光纜系統附近具代表性的海洋水質敏感受體 - 放大圖 (部分II)

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Date: 17/3/2017

Environmental Resources Management

ERM

ID	Water Quality Sensitive Receivers	Approximate Geodesic Distance ^ to Proposed Cable Alignment (m)
C1	Coral sites along the coast of Sham Wan of Lamma Island	5,040
C2	Coral sites along the coast of Round Island	450
C3	Coral sites along the coast of Chung Hom Kok	1030
C4	Coral sites along the coast of Cape Collinson	6,080
C5	Coral sites along the coast of Tai Long Pai	4,010
C6	Coral sites along the coast of south & east Beaufort Island	1,140
C7	Coral sites along the coast of Po Toi Island	1,320
C8	Coral sites along the coast of Sung Kong Islet	330
C9	Coral sites along the coast of Sung Kong	560
C10	Coral sites along the coast of Tung Long Chau	4,550
C11	Coral sites along the coast of Waglan Island	660
C12	Coral sites along the coast of Ninepin Group;	6,660
C13	Coral site along the coast of north Beaufort Island	670
M1	Tai Tam Intertidal Mudflat	5,440
M2	Tai Tam Mangrove Stand	5,950
M3	Cape d'Aguilar Marine Reserve	690
F1	Lo Tik Wan Fish Culture Zones;	4,540
F2	Sok Kwu Wan Fish Culture Zones;	3,600
F3	Po Toi Fish Culture Zones;	3,550
F4	Tung Lung Chau Fish Culture Zones;	6,470
I1	WSD Flushing Intake of Ap Lei Chau	2,500
I2	WSD Flushing Intake of Aberdeen	1,380
I3	Ocean Park's Main Seawater Intake	290
I4	Ocean Park's Training Yard Seawater Intake	370

Note: ^ Geodesic distance refers to the shortest straight line distance between two locations, without regard on the physical obstacles in between.

A4 IMPACT ASSESSMENT

There will be no impacts to water quality from the normal operation of the proposed fibre optic submarine cable system. The potential for any adverse direct and indirect impacts to water quality from the construction of the submarine cable system or from maintenance and repair work during operation have been assessed below.

The cable alignment has been reviewed and optimized taking into consideration existing environmental and physical constraints, in particular noting other submarine cables and pipelines, avoiding major marine vessel fairways, maximising its distance from the environmental sensitive receivers (eg corals), minimising disturbance to known marine archaeological resources, and avoiding anchorage areas and rocky outcrop areas, as detailed further in the Main Report *Section 1.5.2*. The effect of the optimized alignment has been taken into account in the assessment in the following section.

A4.1 CABLE AT THE LANDING SITE

The potential impacts to water quality during trenching works on land primarily relate to surface water run-off and the discharge of pumped water, both of which may be readily controlled through the measures discussed in *Section A4.3*.

A4.2 MARINE SECTIONS OF THE CABLE

Marine sections of the cable will be installed in two ways. From the low water mark (LWM) to approximately 300 m out from the LWM, the cable will be buried by divers using jet probes to target burial depth of -1 m below the seabed (shore-end cable installation). Beyond this segment up to the HKSAR boundary (submarine cable installation), the cable will be buried by an "Injector Burial Tool" or "Sledge Tool" to a target burial depth of 5 m below the seabed using jetting technique.

A4.2.1 Shore-end Cable Installation

It is anticipated that the burying by divers will not cause significant water quality impacts as only a small area will be disturbed; the length is short (approximately 300 m) and the burial depth is shallow (approximately 1 m). To further control any the potential loss of sediment into the water column for jetting works of the 300 m length close the DWB shore, divers will work within an area enclosed by silt curtain, to control fine sediment dispersion, if any (Also see *Section A4.3*).

A4.2.2 Submarine Cable Installation

The works involving jetting by an injector have been assessed in a quantitative manner. 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-Africa-Europe-1 (AAE-1) Cable System* (AEP-508/2016). *Environmental Permit* was granted on 20 Apr 2016 (EP-508/2016).

- *Tseung Kwan O Express – Cable System* (AEP-243/2015). E*nvironmental Permit* was granted on 20 May 2016 (EP-509/2016).

- *Asia Pacific Gateway (APG) - Tseung Kwan O* (AEP-485/2014). *Environmental Permit* was granted on 18 Feb 2014 (EP-485/2014).

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

- *South-East Asia Japan Cable System (SJC) Hong Kong Segment* (AEP-423/2011). *Environmental Permit* was granted on 24 October 2011 (EP-423/2011).

- *VSNL Intra Asia Submarine Cable System – Deep Water Bay* (AEP-294/2007). *Environmental Permit* was granted on 23 November 2007 (EP-294/2007).

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

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

- *FLAG North Asian Loop* (AEP 099/2001). *Environmental Permit* was granted on 18 June 2001 (EP-099/2001).

- *New T&T Hong Kong Limited: Domestic Cable Route* (AEP-086/2001). *Environmental Permit* was granted on 16 February 2001 (EP-086/2001).

- *C2C Cable Network - Hong Kong Section: Chung Hom Kok* (AEP-087/2001). *Environmental Permit* was granted on 16 February 2001 (EP-087/2001).

- *East Asian Crossing (EAC) Cable System (TKO)* (AEP-081/2000). *Environmental Permit* was granted on 4 October 2000 (EP-081/2000).

- *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* was granted in June 2000 (EP-064/2000).

- *Black Point to Shekou Submarine Cable System, CLP Power.* Gazetted under *Foreshore Seabed (Reclamation) Ordinance* in 2005.

- *11kV Cable Circuits from Tai Mong Tsai to Kiu Tsui, CLP Power.* Gazetted under *Foreshore Seabed (Reclamation) Ordinance* in 2004.

In this method, the cable and injector are lowered to the seabed. The injector fluidises a trench using high pressure water jets and the cable is immediately laid within the trench. The sides of the trench slip around the cable, burying it and leaving a small depression in the seabed, which is infilled by natural sedimentation. The maximum width of the seabed fluidised by the injector is

0.5 m and while for this Project the cable will be buried to a maximum target depth of 5 m, other cables can be buried up to a maximum depth of 10 m.

During the jetting cable laying process, as well as Route Clearance (RC) and/or Pre-Lay Grapnel Run (PLGR) operation, 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 injector.

The analysis of the potential transport of fine sediments suspended into the water column during the cable laying process has been conducted and is presented in the following paragraphs.

Calculation of Sediment Transport

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

Release rate =	=	cross-sectional area of disturbed sediment × speed of cable laying machine × sediment dry density × percentage loss
depth of disturbance	=	5 m (maximum burial depth of cable)
width of disturbance	=	0.5 m (width of seabed disturbance as cable buried)
maximum cross sectional area	=	2.5 m^2
loss rate	=	20% (majority of sediment not disturbed)
speed of machine	=	0.278 m s^{-1} (1 km hr^{-1})
in-situ dry density	=	600 kg m^{-3} (typical of Hong Kong sediment)
Release Rate	=	**83.4 kg s^{-1}**

During cable laying works, as well as RC and/or PLGR operation, 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 sediments will tend to form large aggregations of sediment particles (the process of flocculation) which have a higher settling velocity than the individual sediment particles.

It is expected that the suspended sediments will remain within 1 m of the seabed, which is independent of the water depth, although the current velocities at the seabed are lower than those near the water surface, due to such effects as bottom friction. For the purposes of the assessment it is assumed that the current velocity is 0.9 m s^{-1}, which is an upper bound

estimate of bottom current velocities in the vicinity of the cable works area and conservative [1].

Similar impact assessment projects including those listed in *Section A3.2* above have been reviewed and a current velocity of 0.9 m s^{-1} is chosen based on estimated velocity values of currents from projects closest to the project area. [2] 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 injector. The suspended solids will tend to form around the cable laying works, however the potential impacts have been addressed using a conservative assumption that a cross-current carries the sediment towards the sensitive receivers.

Based on the above, and given the worst 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 × height of sediment × width of sediment)
release rate	=	83.4 kg s^{-1}
current velocity	=	0.9 m s^{-1}
height of sediment	=	1 m
width of sediment	=	6 m
Initial Concentration	=	**15.44 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 applies in HKSAR and typically, 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} [3]. As the predicted initial concentration exceeds this value for this project, a more conservative settling velocity of 10 mm s^{-1} has been adopted.

As the sediment progressively settles onto the seabed, however, suspended sediment concentrations will gradually reduce. In order to account for the

(1) ERM- Hong Kong Ltd (2007). VSNL Intra Asia Submarine Cable System – Deep Water Bay. For VSNL International Pte Ltd.

(2) The bottom current velocity along the proposed cable alignment is examined based on the Update Model (developed, calibrated and verified by EPD in 1998) and for a typical tidal cycle in the dry and wet season respectively. The current velocity from DWB to Middle Island is smaller in magnitude than those in the open waters. The Model indicates that maximum bottom current velocity along the proposed cable from DWB to Middle Island is would be about 0.3 m/s in both seasons. The maximum bottom current velocity in the open waters (proposed cable alignment from Middle Island until east boundary of Hong Kong) would be below 0.6 m/s. If taking these velocities to estimate the sediment travel distance, the travel distance will be generally < 60 m from DWB to Middle Island and < 110 m from Middle Island until east boundary of Hong Kong. Therefore taking bottom current velocity of 0.9 m/s (sediment travel distance 180 m accordingly) is valid for the entire cable route and a rather conservative assumption.

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

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 (1).

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

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

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

Distance Travelled = 200 s x 0.9 m s^{-1} **= 180 m**

The above calculation indicates that the sediments disturbed during cable laying works will settle onto the seabed within approximately **180 m** of the cable alignment.

Using the same calculation for 2 m burial depth, the initial concentration is predicted to be 2.3 kg m^{-3} exceeding 1 kg m^{-3} and hence 10 mm s^{-1} settling velocity was used. Therefore, the distance travelled by the disturbed sediments will also be 180 m from the cable alignment.

Table A6 shows that all WSRs except the bathing beach of DWB are located beyond the above predicted distance, it is hence expected that the suspended solid in water column will be back to background level before reaching of these WSRs. No significant elevation is therefore expected at these WSRs and hence no unacceptable change in water quality is expected at these WSRs.

As stated in *Section 2.1.2* of the main text, the installation of the cable from the LWM to 300 m out of the LWM would be conducted by diver jet burial method. Suspended solids generated by diver jet burial method are expected to be localised and short term in duration. Furthermore divers will work within a silt curtain enclosed area, to control fine dispersion, if any, as well as a silt curtain being installed at the water line for land based works.

For jetting with injector burial tool starting from 300 m out from LWM as described in *Section 2.1.3*, since the predicted maximum distance travelled by the disturbed sediments is 180 m and the gazetted boundary of the DWB beach extend for about 150 m from the LWM, there could be a 30-m of overlapping of the gazetted beach and extent the disturbed sediment could travel to. It should be noted that while the disturbed sediment could potentially travel into the gazetted boundary of the DWB bathing beach, any disturbed sediment would stay close to the seabed (i.e. initial height of sediment is 1 m above seabed and would be settled within 200 s). Based on the *Chart of Local Vessels* (2), the water depth exceeds 5 m at about 150 m off the LWM of the DWB bathing beach. Given that swimmers generally make use

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

(2) The Hydrographic Office, Marine Department, 2011.

of the top 2-m of water of the water column, suspended sediment within 1 m above seabed would unlikely result in any notable deterioration of beneficial use. Furthermore, the above result of 30 m overlapping assumes swimmer could make use of the whole gazetted boundary of the Deep Water Bay beach. In fact, swimmers do not in general make use of the bathing beach beyond the installed shark net, which further increases the separation of the swimmers from the point where jetting by cable burial tool starts. The cable tool jetting works would also be sufficiently far away from the DWB beach, starting from approximately 300 m out and considering its 1 km/hr forward speed the. cable burial tool would be over 1 km away from DWB area after one hour, so any disturbed sediment encroaching into DWB would last for less than one hour. Given that the Project Proponent committed no work would be conducted near the DWB beach during peak bathing season (1st April to 30th October), as well as other consideration above, no unacceptable water quality impact to DWB beach and other WSRs is expected.

Generally, it is anticipated that the cable installation works will not cause unacceptable adverse impacts to water quality at the WSRs. For areas of high ecological importance and the nursery area of commercial fisheries resources, assessment of associated impacts to marine ecology and fisheries are presented in *Annex B* and *Annex C* respectively.

A4.2.3 Cable Operation

It should be noted that in case cable repair work is required during project operation, the recovery of any faulty cable section to the surface would involve similar equipment for fluidizing the mud that covers the cable. Therefore, the calculation for maximum distance travelled by disturbed sediment above still applies. Since only a short section of faulty cable would need to be removed, the potential extend of impact would be smaller than that of the construction phase and the duration of impact would also be shorter. No unacceptable water quality impact to DWB beach and other WSRs is expected from the potential cable repair works.

Table A6 Evaluation of Impacts with respect to the Extension of the Sediment Plume

ID	Water Quality Sensitive Receiver	Approx. Distance to Proposed Cable Corridor/ Landing Point (m)	Sediment may reach the WSR?	Likelihood of Adverse Impact	Reason
DWB	Deep Water Bay	In the immediate vicinity	Yes	No	Disturbed sediment within the bottom 1 m would not affect the beneficial use of bathing beach by swimmers within the top 2 m of the water column.
RB	Repulse Bay	1,200	No	No	Sediment would not reach WSR.
MB	Middle Bay	1,920	No	No	Sediment would not reach WSR.
SB	South Bay	2,240	No	No	Sediment would not reach WSR.
CHK	Chung Hom Kok	1,990	No	No	Sediment would not reach WSR.
SSB	Saint Stephen's Beach	2,480	No	No	Sediment would not reach WSR.
SMB	Stanley Main Beach	2,300	No	No	Sediment would not reach WSR.
HB	Hairpin Bay	3,510	No	No	Sediment would not reach WSR.
TC	Turtle Cove	4,130	No	No	Sediment would not reach WSR.
BWB	Big Wave Bay	5,420	No	No	Sediment would not reach WSR.
RB	Rocky Bay	3,780	No	No	Sediment would not reach WSR.
SO	Shek O	3,400	No	No	Sediment would not reach WSR.
C1	Coral sites along the coast of Sham Wan of Lamma Island	5,040	No	No	Sediment would not reach WSR.
C2	Coral sites along the coast of Round Island	450	No	No	Sediment would not reach WSR.
C3	Coral sites along the coast of Chung Hom Kok	1,030	No	No	Sediment would not reach WSR.
C4	Coral sites along the coast of Cape Colinson	6,080	No	No	Sediment would not reach WSR.
C5	Coral sites along the coast of Tai Long Pai	4,010	No	No	Sediment would not reach WSR.
C6	Coral sites along the coast of south & east Beaufort Island	1,140	No	No	Sediment would not reach WSR.
C7	Coral sites along the coast of Po Toi Island	1,320	No	No	Sediment would not reach WSR.
C8	Coral sites along the coast of Sung Kong Islet	330	No	No	Sediment would not reach WSR.
C9	Coral sites along the coast of Sung Kong	560	No	No	Sediment would not reach WSR.

ID	Water Quality Sensitive Receiver	Approx. Distance to Proposed Cable Corridor/ Landing Point (m)	Sediment may reach the WSR?	Likelihood of Adverse Impact	Reason
C10	Coral sites along the coast of Tung Long Chau	4,550	No	No	Sediment would not reach WSR.
C11	Coral sites along the coast of Waglan Island	660	No	No	Sediment would not reach WSR.
C12	Coral sites along the coast of Ninepin Group;	6,660	No	No	Sediment would not reach WSR.
C13	Coral site along the coast of north Beaufort Island	670	No	No	Sediment would not reach WSR.
M1	Tai Tam Intertidal Mudflat	5,440	No	No	Sediment would not reach WSR.
M2	Tai Tam Mangrove Stand	5,950	No	No	Sediment would not reach WSR.
M3	Cape d'Aguilar Marine Reserve	690	No	No	Sediment would not reach WSR.
F1	Lo Tik Wan Fish Culture Zones;	4,540	No	No	Sediment would not reach WSR.
F2	Sok Kwu Wan Fish Culture Zones;	3,600	No	No	Sediment would not reach WSR.
F3	Po Toi Fish Culture Zones;	3,550	No	No	Sediment would not reach WSR.
F4	Tung Lung Chau Fish Culture Zones;	6,470	No	No	Sediment would not reach WSR.
I1	WSD Flushing Intake of Ap Lei Chau	2,500	No	No	Sediment would not reach WSR.
I2	WSD Flushing Intake of Aberdeen	1,380	No	No	Sediment would not reach WSR.
I3	Ocean Park's Main Seawater Intake	290	No	No	Sediment would not reach WSR.
I4	Ocean Park's Training Yard Seawater Intake	370	No	No	Sediment would not reach WSR.

A4.3 MITIGATION MEASURES

A4.3.1 Shore-end Cable Works

During shore-end marine based cable laying activities the following mitigation measures will be undertaken:

- No works would be conducted during peak bathing season (1st April to 30th October) within 300 m from the nearest boundary of Deep Water Bay bathing beach;
- Jet probe would be used by divers from the LWM of the DWB beach to approximately 300 m to sea. Divers will work within area enclosed within silt curtain to control fine dispersion for jetting works of the 300 m stretch close to the DWB beach.
- The forward speed of the cable installation barge will be limited to a maximum of 1 km hr^{-1}; and
- Water quality monitoring will be carried out to verify that the Project works will not result in any impacts to water quality, and consequently to marine ecology and fisheries. In case of any Limit Level exceedances, cable installation/ repair operations will be suspended immediately (until the cause of non-compliance is detected and the situation rectified) and appropriate methods of reducing impacts will be discussed including, but not limited to: reduction of speed of cable installation barge; and reduction in jetting water pressure.

Disturbed sediment from hand jet probe is not expected, however as precautionary measure, divers will work within a silt curtain enclosed area, to control fine dispersion from jetting works, if any, as well as a silt curtain being installed at the water line to mitigate the potential water quality impact due to surface runoff from the land based works on the beach. Silt curtain has been used extensively in marine construction works projects in Hong Kong and has demonstrated its ability to confine sediment dispersion effectively (1). For small scale marine works with limited and localized sediment disturbance under this Project, a floating or frame type silt curtain would be appropriate and sufficient for the control of the potential sediment dispersion. (2)

A4.3.2 Submarine Cable Works

- The crane barge used for the transport of debris recovered from the seabed during route clearance/ pre-lay grapnel run shall be fitted with tight

(1) The sediment reduction rate by silt curtain systems may vary:
e.g. sediment reduction rate of 75% achieved using single-layered curtain (EIA for SCL Hung Hom to Admiralty section).
e.g. sediment reduction rates between 61% to 87% achieved using two-layered silt curtain, according to EIA for Hong Kong - Zhuhai - Macao Bridge Hong Kong Boundary Crossing Facilities.

(2) EM&A for other similar projects have indicated that deterioration of water quality from burying works by divers (with frame-type/screen silt curtain) are negligible such as:
- VSNL Intra Asia Submarine Cable System – Deep Water Bay (EP-294/2007)
- Replacement of the Existing 11KV Submarine Cable Circuit Connecting Liu Ko Ngam and Pak Sha Tau Tsui at Kat O (EP-461/2013)

bottom seals in order to prevent leakage of material during loading and transport;

- The crane barge 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 actions;

- The forward speed of the cable installation barge will be limited to a maximum of 1 km hr^{-1}; and

- Water quality monitoring will be carried out to verify that the Project works will not result in any impacts to water quality, and consequently to marine ecology and fisheries. In case of any Limit Level exceedances, cable installation/ repair operations will be suspended immediately (until the cause of non-compliance is detected and the situation rectified) and appropriate methods of reducing impacts will be discussed including, but not limited to: reduction of speed of cable installation barge; and reduction in jetting water pressure.

Disturbed sediment from cable burial jetting may only encroach into the DWB beach within the first hour of the jetting works and the disturbed sediment would stay within 1 m from the seabed and therefore does not materially affect the use of bathing beach (See *Section 4.2.2*).

A4.3.3 Land Cable Works

The potential impacts to water quality during trenching works on land primarily relate to surface water run-off and the discharge of pumped water. These may be readily controlled through water quality protection measures incorporated as part of good working practices:

- The machinery employed will be inspected prior to work commencing on the beach then at least daily thereafter to ensure the waters and beach will not be polluted with oil/grease/fuel. No machinery maintenance will be carried out onsite. Oil absorbent materials will be readily placed on site and will be applied immediately should any oil leakage incident occur, to ensure the swimming zone would not be affected; and

- All construction waste and drainage will be handled and disposed in accordance with the *Waste Disposal Ordinance* and *Practice Note for Professional Persons*, *Construction Site Drainage* (*ProPECC PN1/94*) and in particular the following measures adhered to:

  - 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. A water

line silt curtain will also be installed for this purpose (See *Figure 4.1* in the Main Report text); and

- Best Management Practices (BMPs) will be applied to avoid and minimise contaminated runoff from work sites, marine plants and vessels, including wastewater being properly treated and discharged to storm drain.

A4.3.4 Cable Operation (After Installation), including Maintenance and Repair Phase

For any potential cable repair works, the mitigation measures listed above would also apply, according to where the fault was located ie mitigation measures proposed for shore-end cable works would apply if the repair operation was located in the shore-end area, etc.

A5 SUMMARY AND CONCLUSIONS

A review and assessment of water quality impacts associated with cable laying works and other working activities along the proposed cable alignment have been undertaken.

The calculation of sediment transport from the construction works indicates that the sediments disturbed during the cable laying works will settle onto the seabed within approximately 180 m from the cable alignment. WSRs have been identified and all of them are located at the distance greater than 180 m from the proposed cable route thus plume of suspended sediments would not reach these WSRs except DWB beach at the landing site. The potential disturbance to the DWB beach at the landing site is expected to be limited and transient given (1) disturbed sediment encroaching into DWB would last for less than 1 hour, (2) no work would be conducted near the DWB beach during peak bathing season (1st April to 30th October) and (3) swimmers generally make use of the top 2 m of water of the water column while the disturbed sediment would stay within 1 m above seabed. It is concluded that no unacceptable water quality impacts have been identified. Mitigation measures are recommended, for example, the speed of the installation barge will be limited to 1 km hr^{-1}, and a water quality monitoring programme will be carried out, in order to minimise the water quality impacts at the water sensitive receivers if any, and verify that the Project works will not result in any unacceptable adverse impacts to water quality at WSRs. Due to the physical separation of the water quality sensitive receivers from the cable laying works and the short duration of working period, the identified water quality sensitive receivers are unlikely to be affected by adverse changes in water quality within the assessment area and water quality is likely to comply with the WQOs.

Annex B

Assessment of Potential Impacts to Marine Ecology Resources

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Appendices

Appendix B1 Data of Intertidal Surveys

Appendix B2 Data of Subtidal Dive Surveys

B1 INTRODUCTION

This *Annex* presents the baseline conditions of marine ecological resources in the vicinity of the proposed cable corridor which is the footprint of the proposed routing for the Pacific Light Data Communication (PLCN) submarine cable system and evaluates the potential for direct and indirect impacts to them during construction of the Project. Baseline conditions are evaluated based on information from the literature and recent field verification conducted for the purposes of this assessment. Measures required to mitigate identified impacts are recommended, where appropriate.

B2 RELEVANT LEGISLATION AND ASSESSMENT CRITERIA

The criteria for evaluating marine ecological impact are laid out in the *EIAO-TM*. *Annex 16* describes the general approach and methodology for 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* sets out the criteria for evaluating such potential ecological impacts.

B3 EXISTING MARINE ECOLOGICAL RESOURCES

B3.1 SITES OF SPECIAL SCIENTIFIC INTEREST

The nearest marine Sites of Special Scientific Interest (SSSI) are at Cape d'Aguilar (both ecological and geological importance site at ~690 m away from the proposed cable corridor), Sham Wan (a green turtle nesting site at ~5.0 km away from the proposed cable corridor) and Tai Tam (mudflat at ~5.4 km away from the proposed cable corridor) (*Figure B1*).

B3.2 CAPE D'AGUILAR MARINE RESERVE

The Cape d' Aguilar Marine Reserve is designated to protect the diverse marine life and the ecologically important habitats such as coral communities.

B3.3 COASTAL PROTECTION AREAS

The coastline of Sham Shui Kok near Ocean Park and Middle Island (Tong Po Chau) is designated as "Coastal Protection Area (CPA)", and the shortest distance from the cable alignment to these CPA is around 300 m (*Figure B1* and also *Figure 1.2a* in the Main Report). Hence, the Project is classified as a DP under *EIAO Schedule 2 (Part I), C.12* - A dredging operation which (a) is less than 500 metres from the nearest boundary of an existing or planned (vii) coastal protection area.

Given that the designated CPAs are located on land, it is anticipated that no unacceptable impacts would occur to the CPAs at Sham Shui Kok near Ocean Park and Middle Island. The intertidal and subtidal hard bottom

assemblages below the CPA zone have been assessed in the following sections.

B3.4 INTERTIDAL SOFT BOTTOM ASSEMBLAGES

Within the Study Area, a sandy shore is located at Deep Water Bay (DWB), which is designated as a gazette bathing beach and frequently occupied by human activities. Sandy shores are, in general, known to be mobile and unstable environments that are subject to constant water movement and wave action. Since few intertidal organisms are able to tolerate these conditions, sandy shores in Hong Kong may appear devoid of intertidal life [1]. A qualitative walk-through survey was conducted in July 2016 along the sandy shore at DWB (Station T3 of *Figure B2*) and one (1) common ghost crab species, *Ocypode* sp., was recorded during the survey. Given the DWB sandy shore supports low diversity of fauna without any species of conservation importance, it is considered as a low ecological value habitat.

B3.5 INTERTIDAL HARD BOTTOM ASSEMBLAGES

Information on the intertidal rocky shore assemblages in the vicinity of the proposed cable landing site is summarized from two consultancy studies: *132kV Submarine Cable Installation for Wong Chuk Hang – Chung Hom Kok 132 kV Circuits* [2], and *Environmental Impact Assessment (EIA) Report for the Repositioning and Long Term Operation Plan of Ocean Park* [3]. Data extracted from these studies are considered to be representative of the assemblages within the proposed cable landing site at DWB.

Intertidal surveys were conducted in the vicinity of the proposed cable landing site in the submarine cable installation study in 2001[4]. The assemblage structure on the shores surveyed was considered to be typical of semi-exposed rocky shores in Hong Kong. Whilst the mean abundances of mobile organisms (limpets and snails) were 4.6 – 9.4 m^{-2}, the mean percentage coverage of sessile organisms (bivalves, barnacles and macroalgae) were 0.5 – 6.0 %. These results showed that the intertidal rocky shores near DWB supported relatively low abundances and densities of organisms. It is also noted that no species of conservation importance were recorded.

In another study in 2005 [5], intertidal surveys were conducted on the rocky shores along the western side of DWB Headland Area. Results of the surveys suggested that these shores comprised assemblages typical of other semi-exposed rocky shores of Hong Kong. The dominant species were the periwinkles *Echinolittorina* spp., the sea slater *Ligia exotica*, the limpet *Collisella*

(1) Morton B, Morton J (1983). The Sea Shore Ecology of Hong Kong.

(2) ERM (2002). 132kV Submarine Cable Installation for Wong Chuk Hang - Chung Hom Kok 132kV Circuits. Final Report for the Hong Kong Electric Co Ltd.

(3) Maunsell Environmental Management Consultants LTD. (2006). Environmental Impact Assessment (EIA) Report for the Repositioning and Long Term Operation Plan of Ocean Park (2006). Report for Ocean Park Corporation.

(4) ERM (2002). *Op cit*

(5) Maunsell Environmental Management Consultants LTD. (2006). *Op cit*

dorsuosa, the barnacle *Tetraclita japonica*, the mussels *Septifer virigatus* and *Perna viridis*, the whelk *Thais clavigera*, and the algae *Corallina sessilis*, *Hildenbrandia rubra* and *Gelidium pusillum*. These species are all common and widespread on Hong Kong semi-exposed shores.

An updated intertidal survey was conducted in July 2016 along the rocky shores adjacent to the landing site within the Study Area, i.e. DWB (Stations T1 and T2 of *Figure B2*). A total of 28 faunal taxa were encountered during the qualitative spot checks and quantitative surveys (see *Table B1.1* of *Appendix B1*). These species are all considered as common and widespread species on rocky shores of HKSAR. Dominant organisms recorded included the topshell *Monodonta labio*, the turban shell *Lunella coronata*, the whelk *Morula musiva* and the limpet *Cellana grata*. Sessile species including the oyster *Saccostrea cucullata* also presented in the mid to low-shore (0.5-1.0 mCD). Both the abundance/ density of mobile species and percentage cover of sessile species were considered to be low to moderate (mean of 54 – 65 m^{-2} and 7 – 14% m^{-2} respectively).

Overall, results from previous and updated intertidal surveys have shown that the intertidal rocky shores within the Study Area, including the area adjacent to the proposed cable landing site at DWB, supported generally low abundances and densities of organisms, and therefore of low ecological value. It is also noted that no species of conservation importance were recorded.

B3.6 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]. Twelve (12) sampling stations (Sampling Nos. 63-74) are close to the proposed cable corridor and data extracted from them can be considered to be representative of the assemblages within the corridor.

According to the findings of the *Consultancy Study*, the substratum of the 12 sampling stations was covered by very fine sand and/or silt/clay. Their benthic assemblages were typical of Hong Kong waters and similar to benthic assemblages in majority of other subtidal habitats in Hong Kong. In summer, the average number of species was medium (35 species per 0.5 m^2), while the average number of individuals (170 individuals per m^2) and average wet weight (41.7 g per m^2) were low when compared with average values of Hong Kong (33 species per 0.5 m^2, 540 individuals per m^2 and 71.2 g per m^2). In winter, the average number of species (29 species per 0.5 m^2) and average wet weight (32.0 g per m^2) were medium, while the average number of individuals (170 individuals per m^2) was low in comparison with 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). Concerning the species diversity in

(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.

summer, five (5) stations showed high diversity (> 3) while seven (7) of them showed only medium diversity (2 – 3) in comparison to other survey areas. Species diversity was lower in winter with only two (2) stations showing high diversity while others were of medium diversity. In both seasons, no species of conservation importance were found along the proposed cable corridor.

B3.7 SUBTIDAL HARD BOTTOM ASSEMBLAGES

Based on literature review, there are coral communities of high ecological value along the entire coast of Po Toi, Sung Kong and Waglan Island and along the south-eastern coast of Beaufort Island [1].

Subtidal marine ecological surveys employing the Rapid Ecological Assessment (REA) technique have been carried out at DWB in 2006 [2]. The survey sites were located at the eastern coast of the Brick Hill headland and were approximately 400 m from the proposed cable alignment. The survey results showed that up to 16 hard coral species were recorded. The hard coral cover was 5-10% at the shallow area (-2 to -5 mCD) and 1-5% at the mid-depth area (-6 to -8.5 mCD). No hard coral cover was found at the deep area (-9 to -12 mCD). A comparison to the results of underwater surveys in coastal waters of Hong Kong including Tung Ping Chau, Long Ke Wan, Chek Chau and Pak A [3] depicted that the abundance and diversity of the coral species at the eastern coast of the Brick Hill headland were relatively low. It was concluded in the Ocean Park EIA that the ecological value of the subtidal habitat along the headland of Ocean Park was classified as moderate.

In a post-construction survey for a cable system [4], the subtidal surveys in eastern DWB indicated that the hard coral cover was less than 5% with only seven (7) hard coral species recorded. All colonies found were small in size (maximum diameter was 30 cm) and they were not considered as rare species in Hong Kong. Therefore, the coral assemblage was considered to be of low ecological value.

Supplementary subtidal dive surveys were conducted in July 2016 for this Project to provide updated information on the status of subtidal hard bottom habitats in the vicinity of the proposed cable alignment and the proposed cable landing site (*Figure B2 and B3*). The dive surveys comprised qualitative spot dive surveys and semi-quantitative REA surveys in the vicinity of the proposed cable route at DWB (Stations C1 and C2), Middle Island (Tong Po Chau) (Station C3), Round Island (Station C4), Beaufort Island (Station C5), Sung Kong Islet (Station C6) and Sung Kong (Station C7). Data from the

(1) Chan, AKL, Chan, KK, Choi, CLS, McCorry, D, Lee, MW, Ang, P Jr, Li, SSF (2005). Field Guide to Hard Corals of Hong Kong. Friends of the Country Parks and Cosmos Books Ltd, Hong Kong.

(2) Maunsell Environmental Management Consultants LTD. (2006). *Op cit*

(3) Oceanway Corporation Ltd (2002). Underwater Survey in Coastal Waters of Hong Kong. Unpublished report submitted to the Hong Kong Agriculture, Fisheries and Conservation Department, Hong Kong SAR Government

(4) ERM (2007). Coral Survey after the Installation Works of the 132kV Submarine Cable for Wong Chuk Hang – Chung Hom Kok 132kV Circuits. May 2007. For the J-Power Systems Corporation.

qualitative spot dive checks are presented in *Table B2.1* of *Appendix B2* while data from the REA surveys are presented in *Table B2.2* in *Appendix B2*.

Results of qualitative spot dive checks revealed that corals were recorded at shallow depth zone (-2 to -5 mCD) of the monitoring stations C1-C3 while corals were recorded at both shallow (-2 to -6 mCD) and deep depth zone (-6 to -10 mCD) of the monitoring stations C4-C7. The coral species recorded during the qualitative spot dive reconnaissance check is presented in *Table B2.1* of *Appendix B2*. It is recorded that moderate numbers of coral species were recorded at stations C4-C7, with 20, 17, 17 and 31 coral species recorded at stations C4, C5, C6 and C7, respectively. All coral species recorded in the dive surveys are considered as common species and have a widespread distribution throughout HKSAR's nearshore waters. Semi-quantitative REA surveys were then conducted along the each depth zone of the monitoring stations where corals were recorded.

Results of REA surveys conducted near the proposed landing point at DWB and at Middle Island (Tong Po Chau) (i.e. Stations C1-C3; *Figure B3*) showed that the shallow depth zone (- 2 – 5 mCD) was dominated by sands, bedrocks and large boulders. The estimated hard coral covers were below 5% at shallow depth zone of stations C1, C2 and C3, respectively. Octocorals and black corals were not recorded at shallow depth zone during the REA surveys at stations C1, C2 and C3.

Results of REA surveys conducted at Round Island (i.e. Station C4; *Figure B3*) showed that both shallow (- 2 – 5 mCD) and deep (- 6 – 8 mCD) depth zones were dominated by bedrocks and large boulders. Both estimated hard and octocoral covers were 6-10% and less than 5% in shallow and deep depth zones, respectively. Black corals were recorded with less than 5% cover at deep depth zone of station C4.

Results of REA surveys conducted at Beaufort Island (i.e. Stations C5A and C5B; *Figure B3*) showed that shallow depth zone (- 2 – 5 mCD) was dominated by bedrocks, large boulders and rubbles while deep depth zone (- 6 – 10 mCD) was dominated by large boulders and sands. Hard coral was not recorded at shallow depth zone of station C5A while the estimated hard coral cover was less than 5% at shallow depth zone of station C5B. Octocorals were recorded at both shallow and deep depth zone of stations C5A and C5B with less than 5% covers. Black corals were recorded at deep depth zone of stations C5A and C5B with 6-10% covers.

Results of REA surveys conducted at Sung Kong Islet (i.e. Station C6; *Figure B3*) showed that both shallow (- 2 – 6 mCD) and deep (- 8 – 12 mCD) depth zones were dominated by bedrocks. Hard coral and octocoral covers were estimated to be less than 5% at both shallow and deep depth zones of station C6. Black corals were recorded at deep depth zone of station C6 with less than 5% cover.

Results of REA surveys conducted at Sung Kong (i.e. Stations C7A and C7B; *Figure B3*) showed that shallow depth zone (- 2 – 5 mCD) was dominated by bedrocks while deep depth zone (- 6 – 10 mCD) was dominated by sands. Hard coral covers were estimated to be 11-30% and 6-10% at shallow and deep depth zones, respectively. Octocoral covers were estimated to be less than 5% at both shallow and deep depth zones of station C7A and deep depth zone of station C7B. Black corals were recorded at deep depth zone of station C7A with less than 5% cover.

Overall, results of the supplementary dive surveys showed that sparse hard coral colonies of locally common, widely-distributed species were recorded in the vicinity of the proposed cable landing point and the proposed cable alignment. The abundance and diversity of hard corals were considered to be low in the context of subtidal hard bottom habitats in HKSAR except at Sung Kong (station C7). Octocoral and black coral coverage and diversity were generally considered to be low except at the deep depth zone of Round Island, Beaufort Island, Sung Kong Islet and Sung Kong (stations C4-C7) where higher abundance and diversity of octocorals were found.

KOWLOON
九龍

TSEUNG KWAN O
將軍澳

HONG KONG ISLAND
香港島

Deep Water Bay
深水灣

Middle Island
鰂波洲

Repulse Bay
淺水灣

Round Island
銀洲

Chung Hom Kok
春坎角

Stanley
赤柱

Tai Tam Bay
大潭灣

Big Wave Bay
大浪灣

Shek O
石澳

Tung Lung Chau
東龍洲

East Lamma Channel
東博寮海峽

Sheung Sze Mun
雙四門

Beaufort Island
螺洲

Sung Kong
宋崗

Po Toi
蒲台

Legend 圖例

- Boundary of HKSAR
  香港特別行政區邊界
- Proposed PLCN Cable Landing Site
  擬建PLCN海底光纜系統登岸地點
- Proposed PLCN Cable Route
  擬建PLCN海底光纜系統路線
- Coral Communities with Relatively Higher Diversity & Abundance
  相對較高物種多樣性和數量的珊瑚群落
- Sites of Special Scientific Interest
  具特殊科學價值地點
- Coastal Protection Area (CPA)
  海岸保護區 (土地用途地帶)
- Intertidal Mudflat
  潮間帶泥灘
- Mangrove
  紅樹林
- Coral Communities of High Ecological Value
  高生態價值的珊瑚群落
- Designated Marine Reserve
  指定的海岸保護區

N
北

Kilometers 公里
0 2.5 5

Figure B1
圖 B1

Major Marine Ecological Elements in the Surroundings of the Proposed Pacific Light Cable Network (PLCN)
鄰近擬建PLCN海底光纜系統的主要海洋生態要素

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Date: 17/3/2017

Environmental Resources Management

ERM

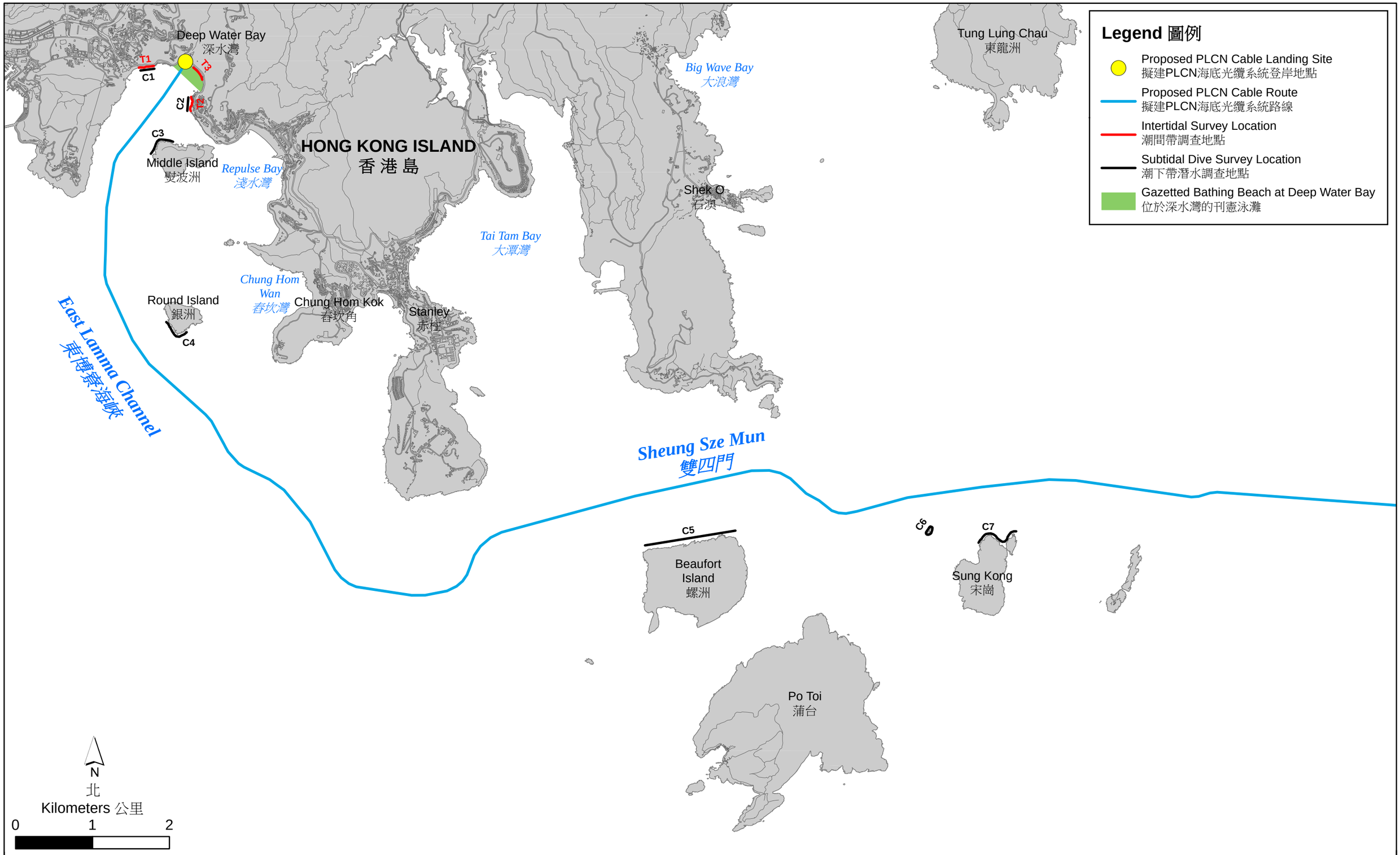

Figure B2
圖 B2

Marine Ecological Survey Locations
海洋生態調查地點

File: T:\GIS\CONTRACT\0335723\Mxd\0335723_Proposed_Location_for_Marine_Eco_Surveys_bil.mxd
Date: 17/3/2017

Environmental Resources Management

ERM

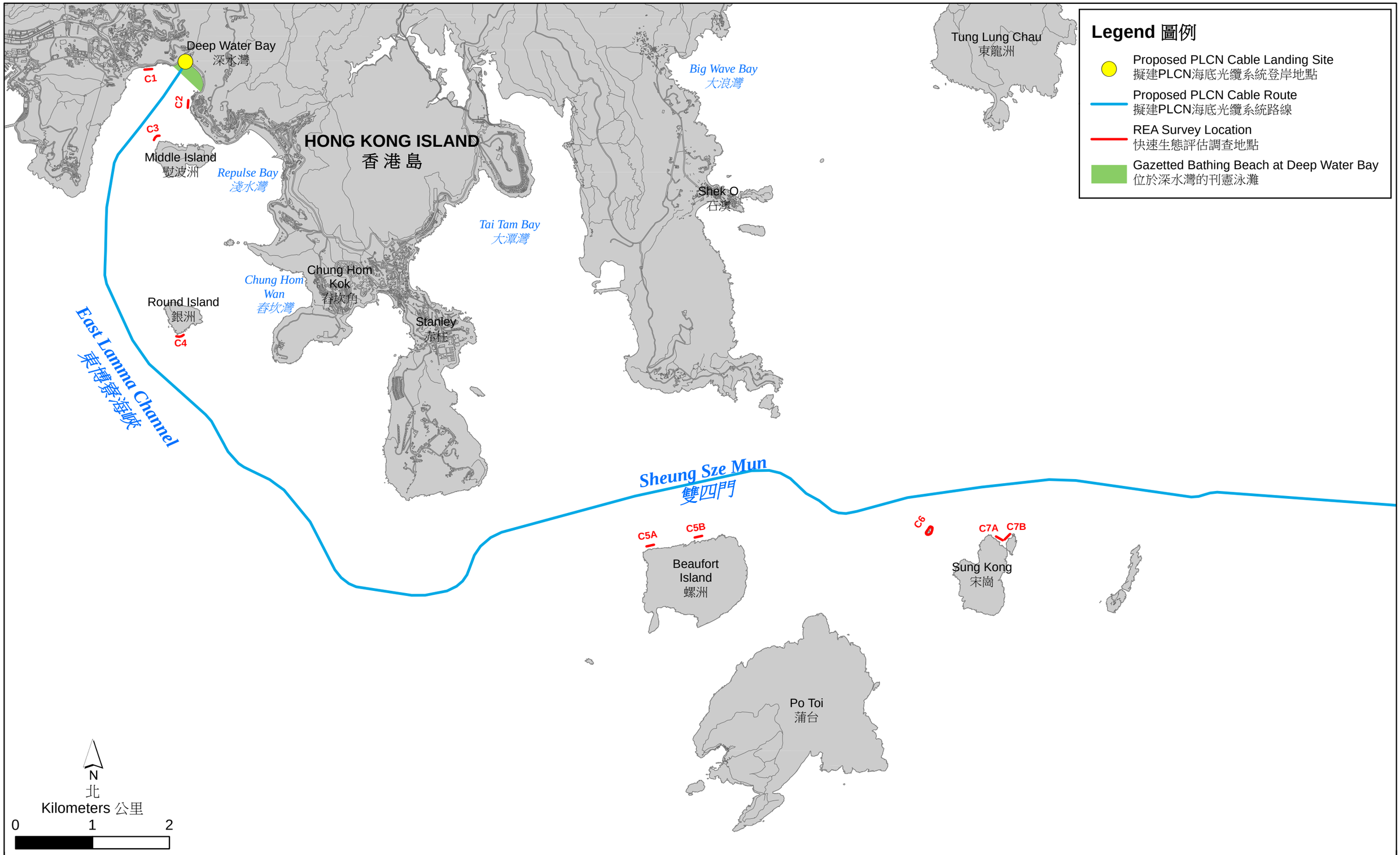

Figure B3
圖 B3

REA Survey Location
快速生態評估調查地點

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Date: 17/3/2017

Environmental Resources Management
ERM

B3.8 MARINE MAMMALS

The Chinese White Dolphin (CWD) (*Sousa chinensis*) and the Finless Porpoise (FP) (*Neophocaena phocaenoides*) are the two species of marine mammals that are regularly sighted in Hong Kong waters. Both species are highly mobile and utilise a wide range of areas seasonally.

The population of the CWD is mostly found near the Pearl River Estuary and the major distribution of the CWDs in Hong Kong waters is in West and Northwest Lantau [1]. Sightings are most frequent in the western part of these waters around the Sha Chau and Lung Kwu Chau Marine Park and the west coast of Lantau near Tai O. More CWD usage was found in Southwest Lantau areas in recent years [2]. The eastern waters of Hong Kong are not considered to represent an important habitat for CWD as only a small number of sightings have been recorded, mainly within the waters of Port Shelter.

The FP is a small cetacean endemic to southern and eastern Asia and is protected under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Appendix I. FPs are mostly found in the southern waters and occasionally in the eastern waters of Hong Kong. Their distribution and abundance appears to vary spatially and temporally. It was reported that they are mostly recorded during spring in southern waters near Lamma Island. It has been suggested that the important FP habitats are located to the south of Tai A Chau, southwest of Shek Kwu Chau, south of Cheung Chau and the waters between Shek Kwu Chau and Soko Islands in the dry season. FP generally moves eastwards in the wet season with important habitats around Po Toi Islands and at the juncture of Po Toi and Ninepins [3].

The above literature review suggests that sightings of FP are infrequent and seasonal along the proposed cable alignment in the eastern and southeastern HKSAR waters, whereas southeast Lantau is already the marginal habitat for the CWD. Therefore, the proposed cable alignment situated in the eastern and south-eastern HKSAR waters is not considered to be a major habitat for cetaceans in HKSAR.

(1) Hung, S.K.Y. (2016). Monitoring of Marine Mammals in Hong Kong Waters (2015-16). Report submitted to Agriculture, Fisheries and Conservation Department.

(2) Hung, S.K.Y. (2016). *Op cit*

(3) Hung, S.K.Y. (2016). *Op cit*

B4 IMPACT ASSESSMENT

B4.1 IMPACT ON SITES OF SPECIAL SCIENTIFIC INTEREST (SSSIS)

The Hok Tsui (Cape d'Aguilar) SSSI, Sham Wan SSSI and Tai Tam Harbour (Inner Bay) SSSI are located about ~690 m, ~5.0 km and ~5.4 km from the closest cable segment, respectively (*Figure B1*). Since the maximum distance of transport of suspended sediments generated by the construction of the Project would be approximately 180 m (see *Annex A*) and the mentioned marine SSSIs in the vicinity are more than 600 m from the closest cable segment, no direct or indirect impacts are anticipated.

B4.2 DIRECT IMPACTS DURING CONSTRUCTION

As part of the installation of the PLCN submarine cable system, Route Clearance (RC) and/or Pre-Lay Grapnel Run (PLGR) operation will be conducted over part of the proposed cable route where the cable will be buried. The RC / PLGR will be conducted using jetting machine trial run or tow of grapnel anchor and these operations will be scheduled to take place before the actual cable laying operation. The aim of these operations is remove any Out of Service Cables (OSS), debris or obstacles deposited in the cable corridor, which may pose a threat to the cable or the burial tool. The penetration of grapnel fluke or jetting machine tool will not be more than 0.8 m. The clearance area for these operations will cover 5 m on both sides of the cable (i.e. a total width of 10 m). Afterwards, the proposed cable will be laid beneath the seabed using injection jetting technique for the cable burial. Through this method, the cable is lowered to the seabed by "Injector Burial Tool" or "Sledge Tool" which are designed to simultaneously lay and bury the cable. Using these methods the injector fluidises a trench using high pressure water jets and the cable is immediately laid within the trench. The maximum width of the seabed fluidised by the injector is 0.5 m and the cable is buried to a maximum depth of 5 m. 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.

Intertidal Habitats: The rocky shore along the shoreline of DWB will not be affected as the cable will land via an existing beach manhole (BMH) and conduit under the seawall at the top of the beach. No direct impacts are therefore expected as a result of the shore-end construction activities.

Subtidal Soft Bottom Habitats: Short-term direct impacts will occur to soft bottom benthic assemblages present along the cable trench. It is, however, expected that once the cable laying operations are completed, the soft bottom habitats will be recolonised by benthic fauna which are expected to be similar to the assemblages presented before construction activities commenced. As a result, direct impacts to soft bottom benthic assemblages are not anticipated to be significant.

Subtidal Hard Bottom Habitats: The rocky shore along the coastline of DWB will not be affected as the cable will land via an existing BMH and

conduit under the seawall at the top of the beach. There will be no direct impact to the coral communities in the vicinity of the proposed cable alignment near DWB, Middle Island (Tong Po Chau), Round Island, Beaufort Island and Sung Kong.

Marine Mammals: In Hong Kong, there have been instances when dolphins have been killed or injured by vessel collisions [1] [2], and it is thought that this risk is mainly associated with high-speed vessels such as ferries. Given the marine vessel to be used for cable installation works is slow moving, the risk of vessel collision with marine mammals is considered to be very small. As such, direct impacts to marine mammals due to vessel collision are not anticipated to be significant.

B4.3 INDIRECT IMPACTS DURING CONSTRUCTION PHASE

The injection jetting cable laying process, as well as RC/ PLGR operation, will result in the formation of suspended sediment around the Injector Burial Tool or Sledge Tool, which can be expected to remain very close to the seabed and would thus settle rapidly. An analysis of the potential transport of fine sediments suspended into the water column during the cable laying process has been conducted (*Annex A*) and has determined that the maximum distance of transport for suspended sediments would be 180 m from the cable burial machine.

Based on the above, indirect impacts may occur through seabed disturbance, resulting in elevation of suspended solids in the water column. Such increase above background suspended solid levels may potentially cause impacts to filter feeders. As the cable installation works will be of a short duration, the increase is not predicted to be high except for in the immediate vicinity of the cable burial machine and are expected to settle rapidly back onto the seabed. As such, these impacts will be small scale and of a localised nature. Coral communities of high ecological values at Po Toi, Sung Kong, Waglan Island and north Beaufort Island are considered too remote (over 500 m) from the cable route to be adversely affected by the elevation of suspended solids and settlement of sediment due to the works. During cable laying it is expected that there will only be minimal disturbance to the coral communities at Round Island and Sung Kong Islet (concerning areas with relatively higher coral diversity and abundance; see *Section B3.7* above) which are located approximately 450 m and 330 m respectively, from the cable alignment. The distance of the cable from sensitive receivers such as these has been maximized, as detailed in *Section 1.5* of the Project Profile Main Text. Potential disturbance to corals are expected to be limited and transient given the short-term nature of the cable laying works which will only last for a total of 15 working days for the whole alignment. Marine mammals are highly

(1) Parsons ECM, Jefferson TA (2000) Post-mortem investigations on stranded dolphins and porpoises from Hong Kong waters. Journal of Wildlife Diseases 36: 342-356.

(2) Jefferson TA, Curry BE, Kinoshita R (2002) Mortality and morbidity of Hong Kong finless porpoises, with special emphasis on the role of environmental contaminants. Raffles Bulletin of Zoology (Supplement) 10: 161- 171.

mobile and are able to swim into open waters to avoid short term and localized seabed disturbance. In addition, they are air breathing and hence SS in the water column have no effect on their respiratory surfaces. Therefore, no unacceptable adverse impacts to marine ecological resources are predicted to occur.

Cable installation works may result in a minor and short-term increase in underwater sound from marine vessels. FP, which are the more abundant marine mammal species in this area, use high frequency ultrasonic clicks for foraging and communication. The low frequency underwater sound associated with vessels, injection jetting and cable laying would thus not be expected to interfere significantly with them. Similarly, although some vessel sounds may be within the audible range of CWD, this is generally for high speed vessels [1]. The cable installation works will be short-term and temporary and be carried out by one slow moving cable installation barge. Barge operation for cable laying works will take a total of approximately 15 working days in HKSAR waters and over this short timeframe is not expected to interfere significantly with this cetacean species either.

Therefore overall no unacceptable adverse impacts to FP and CWD from the Project (e.g. from underwater sounds or the cable laying vessel) are expected to occur.

B4.4 OPERATION PHASE

During normal operation of the proposed cable system, impacts to marine ecological resources are not expected to occur. During operation however, there may be a potential requirement for maintenance work (ie cable repair at particular fault location due to unexpected damage) to be carried out. For shore-end and submarine cable repairs, equipment and methods would be similar in nature to that used during cable installation works, but of smaller scale, with the potential to use smaller equipment such as Remotely Operated Vehicles (ROVs) equipped with injector tool and divers with hand held tools. The repair works process for shore end and marine works is therefore expected to have similar or reduced impact as compared to construction phase.

[1] Sims P, Hung S, Würsig B. (2012) High-speed vessel noises in West Hong Kong Waters and Their Contributions Relative to Indo-Pacific Humpback Dolphins (*Sousa chinesnis*). Journal of Marine Biology. Vol. 2012, ID169103, 11pp

B5 IMPACT ASSESSMENT

An evaluation of the impact in accordance with the *EIAO-TM Annex 8 Table 1* is presented below.

- *Habitat Quality*: Short-term direct impacts are predicted to occur to subtidal soft bottom habitats along the cable trench. Short-term indirect impacts are predicted to occur to intertidal/subtidal hard bottom habitats in the vicinity of the cable route such as DWB and Round Island, Beaufort Island, Sung Kong Islet and Sung Kong. The subtidal soft bottom habitats which may be directly affected are, however, considered to be of low ecological importance. Since the maximum distance of transport for suspended sediments would be 180 m from the cable burial machine and the short-term nature of the cable laying works (15 working days for the whole alignment), the potential indirect impacts on the intertidal/subtidal hard bottom habitats are not expected to be significant.

- *Species*: No species that are considered of high ecological value are expected to be directly affected. FP occurs in eastern waters with important habitats around Po Toi Islands and at the juncture of Po Toi and Ninepins. FPs are known to use high frequency ultrasonic clicks used by FPs for foraging and communication. Given the short timeframe of the Project as well as the cable installation barge is slow-moving and emit low frequency underwater sound, no unacceptable adverse impacts to FP from the Project are expected to occur. The coral communities at Round Island and Sung Kong Islet (concerning areas with relatively higher coral diversity; see *Section B3.7* above) are located within 500 m from the cable alignment and at least 150 m from the boundary of the dispersal range of suspended sediments generated from the injection jetting method, therefore no unacceptable adverse impacts to these coral communities are expected since the suspended sediment level in the water column is anticipated to be similar to the natural background level at the limit of the dispersal range and the potential impacts would be transient in nature.

- *Size*: The length of the cable will be approximately 40 km inside HKSAR waters. The cable will be buried using a cable burial machine and will fluidise approximately 0.5 m of the seabed in width along the alignment.

- *Duration*: The duration of the cable laying will be for a total of approximately 15 working days.

- *Reversibility*: Direct impacts to soft bottom marine community are expected to be short-term and re-colonisation of the sediments is expected to occur shortly. Indirect impact to hard bottom marine community is expected to be short-term and reversible.

- *Magnitude:* No unacceptable adverse impacts to ecologically important organisms or habitats are predicted to occur. The magnitude of impacts during the laying of the cables is expected to be of low severity and is

considered acceptable, given that the disturbances are of small scale, short-term and localised.

B5.1 MITIGATION MEASURES

In accordance with the guidelines in the *EIAO TM* on marine ecology impact assessment, the general policy for mitigating impacts to marine ecological resources, in order of priority, are:

- **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 (e.g. dredging rates) or timing or works operations.
- **Compensation:** The loss of important species and habitats may be provided for elsewhere as compensation. Enhancement and other conversation measures should always be considered whenever possible.

Based on the above, mitigation measures are discussed below.

B5.1.1 Avoidance of Impacts

Impacts to marine ecological resources have largely been avoided for the cable laying through the selection of a landing site and cable corridor that avoids impacts to coral communities with high ecological value and through the employment of cable laying techniques that result in little disruption to the marine environment. Due to the confined space along the proposed cable corridor, including due to existing cables, gazetted Sand Dredging and Sediment Disposal Area located at the west of Po Toi and the Major Marine Vessel Fairway in East Lamma Channel amongst other constraints, the PLCN submarine cable routing has been carefully considered (See *Section 1.5* in the Main Project Profile Report). The proposed cable alignment is located at the furthest distance from the known coral communities with relatively higher coral diversity as practicable, ie Round Island, and Sung Kong Islet as well as Beaufort Island and Sung Kong.

Coral monitoring works have been proposed to be carried out at Round Island which is in the vicinity of the cable alignment, at Sung Kong to represent the corals at Sung Kong Islet, and at a Control station (Po Toi) to ensure corals (ie hard corals, octocorals and black corals) will not be affected by the cable laying works. (See *Figure G3 of Annex G Environmental Monitoring & Audit*)

B5.1.2 Minimisation of Impacts

Mitigation measures that have been recommended to reduce impacts to water quality are also expected to control impacts to marine ecological resources (refer to *Annex A*, Section A4.3). In particular:, for all marine works (both shore-end and submarine):

- The maximum speed of the cable laying will not exceed 1 km hr^{-1} so that the amount of seabed sediment disturbed and dispersed during the cable laying process can be kept to a minimum.

- Furthermore, with the implementation of good house-keeping practices, no unacceptable impacts to either water quality or marine ecological resources are expected to occur from land based activities.

- Water quality monitoring will be carried out to verify that the Project works will not result in any unacceptable impacts to water quality, and consequently to marine ecology and fisheries (See *Annex A* for all water quality mitigation measures).

- Based on the above mitigation measures, no compensation will be required as no unacceptable residual impacts to marine ecological resources are predicted to occur, however, precautionary measures for marine mammals (marine mammal exclusion zone) will be implemented during the cable installation works.

These measures will ensure that no adverse impacts to the corals and marine mammals will result from cable installation works. The monitoring details for water quality, coral and marine mammals are presented in *Annex G*.

B6 SUMMARY AND CONCLUSIONS

The review of the existing information on the marine ecological resources in the vicinity of the proposed cable landing point and the proposed cable alignment have identified the area to be of generally low ecological value in terms of supporting marine fauna.

Although soft bottom assemblages will be disturbed during the cable laying works, the habitats will be reinstated by similar communities within a short time and thus the impacts are considered acceptable.

The rocky shores in the vicinity of the proposed cable landing site at DWB support low abundance and diversity of intertidal organisms. All of these species are common and widespread on the similar shores in HKSAR and as such, are considered to be of low ecological value. Impacts to these assemblages are, therefore, not regarded as significant.

A few hard coral species have been identified in the vicinity of the proposed cable landing site but in low abundance and diversity. The coral colonies along the shoreline of Round Island and Sung Kong Islet are within 500 m of the proposed cable alignment but at least 150 m from the boundary of the dispersal range of suspended sediments generated from the injection jetting method. Due to the small scale of the works, the short duration of impacts and the limited dispersion distance of sediment plume, any potential impacts are not considered to be significant.

The southeastern waters of HKSAR are not considered to be frequently used habitat by the CWD. Sightings of the FP were also found to be infrequent along the proposed cable corridor. It is expected that the cable laying works will last for a short duration (approximately 15 working days in total) and will involve one main cable installation barge. Significant disturbance to the FP and CWD, in terms of underwater noise, marine traffic and food sources, is therefore not expected.

Impacts to marine ecological resources have largely been avoided through the selection of a landing site and cable corridor that reduce impacts to coral communities and through the employment of techniques that result in little disruption to the marine environment.

Mitigation measures that have been recommended to reduce impacts to water quality are also expected to control any impacts to marine ecological resources, particularly the coral colonies in the vicinity of the cable alignment. These mitigation measures include limiting the maximum speed of the cable laying machine and implementing good house-keeping practices during land-based activities (full details in *Annex A*). A marine mammal exclusion zone will be implemented during cable works as a precautionary measure. All these measures will ensure that no adverse impacts to the corals and marine mammals will result from cable installation works or any future maintenance/ repair work that might be required. The monitoring details for water quality, coral and marine mammals are presented in *Annex G*.

Appendix B1

Data of Intertidal Surveys

Table B1.1 Faunal Species Recorded during the Qualitative and Quantitative Intertidal Surveys at the Rocky Shores in the vicinity of Deep Water Bay

Group	Species	T1-H	T1-M	T1-L	T2-H	T2-M	T2-L
Cyanobacteria	*Kyrtuthrix maculans*	✓	✓	✓	✓	×	✓
Sea squirts	*Styela plicata*	×	×	×	×	×	✓
Worm-snails	*Serpulorbis imbricatus*	×	×	×	×	✓	✓
Chitons	*Acanthopleura japonica*	×	✓	×	×	✓	×
Chitons	*Onithochiton hirasei*	×	✓	✓	✓	✓	×
Limpets	*Collisella dorauosa*	×	×	✓	×	×	×
Limpets	*Cellana grata*	✓	✓	✓	✓	×	✓
Limpets	*Cellana toreuma*	✓	×	×	×	×	×
Limpets	*Nipponacmea concinna*	×	×	✓	×	×	×
Limpets	*Patelloida saccharina*	×	✓	×	×	×	×
Nerites	*Nerita albicilla*	×	✓	✓	✓	✓	×
Periwinkles	*Nodilittorina vidua*	✓	×	×	×	×	×
Planaxid Snails	*Planaxis sulcatus*	✓	×	×	×	×	×
Turban Shells	*Lunella coronata*	×	✓	✓	✓	✓	✓
Topshells	*Monodonta labio*	✓	✓	✓	✓	✓	✓
Topshells	*Chlorostoma argyrostoma*	×	×	×	×	×	✓
Whelks	*Thais clavigera*	✓	×	×	×	×	✓
Whelks	*Morula musiva*	×	✓	✓	✓	✓	✓
Bivalves	*Saccostrea cucullata*	✓	✓	✓	✓	✓	×
Bivalves	*Barbatia virescens*	×	×	×	✓	✓	×
Bivalves	*Perna viridis*	×	✓	✓	×	✓	×
Bivalves	*Septifer virgatus*	✓	×	×	✓	✓	✓
Barnacles	*Capitulum mitella*	×	×	×	✓	×	×
Barnacles	*Balanus amphitrite*	✓	×	×	×	✓	✓
Barnacles	*Tetraclita japonica*	✓	✓	✓	✓	×	×
Hermit Crabs	*Hermit crabs*	×	×	×	✓	×	✓
True Crabs	*Hemigrapsus sanguineus*	✓	✓	×	×	×	✓
Sea Slaters	*Ligia exotica*	✓	✓	×	✓	×	×
Cowrie	*Cypraea arabicus*	×	×	×	×	×	✓

Appendix B2

Data of Subtidal Dive Surveys

Table B2.1 Coral Species Recorded during the Qualitative Spot Dive Reconnaissance Check in the vicinity of the Proposed Cable Alignment

Taxon	Family	Species	C1	C2	C3	C4	C5	C6	C7
	Acroporidae	*Acropora solitaryensis*					✓	✓	✓
	Acroporidae	*Montipora venosa*	✓			✓	✓	✓	✓
	Dendrophylliidae	*Turbinaria peltata*	✓	✓				✓	✓
	Incertae sedis	*Leptastrea pruinosa*					✓		✓
	Incertae sedis	*Leptastrea purpurea*							✓
	Incertae sedis	*Oulastrea crispata*	✓						
	Incertae sedis	*Plesiastrea versipora*				✓		✓	✓
	Lobophylliidae	*Acanthastrea hemprichii*				✓			✓
	Merulinidae	*Cyphastrea japonica*							✓
	Merulinidae	*Cyphastrea serailia*				✓	✓	✓	✓
	Merulinidae	*Dipsastraea speciosa*	✓	✓					✓
	Merulinidae	*Favites abdita*							✓
	Merulinidae	*Favites chinensis*			✓				✓
Hermatypic Hard Coral	Merulinidae	*Favites flexuosa*		✓		✓			✓
	Merulinidae	*Favites pentagona*			✓	✓			✓
	Merulinidae	*Goniastrea favulus*						✓	✓
	Merulinidae	*Hydnophora exesa*							✓
	Merulinidae	*Phymastrea curta*				✓		✓	✓
	Merulinidae	*Platygyra acuta*					✓		✓
	Merulinidae	*Platygyra carnosus*				✓			✓
	Merulinidae	*Platygyra verweyi*						✓	✓
	Poritidae	*Goniopora columna*							✓
	Poritidae	*Goniopora lobata*				✓			✓
	Poritidae	*Goniopora stutchburyi*				✓	✓	✓	✓
	Poritidae	*Porites* sp.				✓	✓		✓
	Psammocoridae	*Psammocora superficialis*						✓	✓
	Siderastreidae	*Coscinaraea* n sp.							✓
Ahermatypic Hard Coral	Dendrophyllidae	*Tubastrea/ Dendrophyllia* sp.				✓	✓	✓	✓

Taxon	Family	Species	C1	C2	C3	C4	C5	C6	C7
Octocoral	Acanthogorgiidae	*Muricella* sp.				✓	✓		
	Alcyoniidae	*Claidella* sp.						✓	
	Ellisellidae	*Verrucella* sp.				✓			
	Ellisellidae	*Viminella* sp.					✓		
	Nephtheidae	*Chromonephthya* sp.					✓	✓	
	Nephtheidae	*Dendronephthya* sp.				✓	✓	✓	✓
	Plexauridae	*Echinomuricea* sp.				✓	✓	✓	✓
	Plexauridae	*Euplexaura* sp.				✓			
	Plexauridae	*Menella* sp.				✓	✓		
	Plexauridae	*Paraplexaura* sp.				✓	✓		
Black Coral	Antipathidae	*Antipathes* sp.				✓	✓	✓	✓
	Antipathidae	*Cirripathes* sp.					✓	✓	✓
		Total Coral Species	**4**	**3**	**2**	**20**	**17**	**17**	**31**

Table B2.2 Ordinal Rank of Percentage Cover of Seabed Attributed recorded along the Semi-quantitative Rapid Ecological Assessment (REA) Survey Transects

Zone	C1	C2	C3	C4		C5A		C5B		C6		C7A		C7B	
Depth [a]	**S**	**S**	**S**	**S**	**D**	**S**	**D**	**S**	**D**	**S**	**D**	**S**	**D**	**S**	**D**
Depth (- mCD)	2-5	2-5	2-5	2-5	6-8	2-5	6-10	2-5	6-10	2-6	8-12	2-5	6-10	2-5	6-10
Seabed attributes [b]															
Bedrock	3	3	3	4	3	4	0	4	0	6	5	4	0	4	0
Continuous pavement	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rocks (<26 cm)	1	1	1	1	1	1	0	1	0	1	1	1	0	1	0
Large boulders (>50 cm)	3	3	3	3	5	3	4	3	4	0	2	2	2	3	3
Small boulders (<50 cm)	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0
Rubble	0	0	0	0	0	3	2	3	2	0	0	0	2	0	0
Sand	4	3	3	0	0	0	3	0	3	0	1	0	5	2	3
Mud/ Silt	1	1	2	0	1	0	1	0	1	0	0	0	1	0	3
Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ecological attributes [b]															
Hard coral	1	1	1	2	1	0	1	1	1	1	1	3	2	3	2
Dead standing coral	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Octocoral (Soft corals and Gorgonians)	0	0	0	1	1	1	1	1	1	1	1	1	1	0	1
Black coral	0	0	0	0	1	0	2	0	2	0	1	0	1	0	0
Macroalgae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Benthos (including sponges, zoanthids, ascidians and bryozoans)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Notes:

(a) S = shallow water; D=deep water

(b) 0 = none record; 1 = 1-5% Cover, 2= 6-10% Cover, 3 = 11-30% Cover, 4 = 31-50% Cover, 5 = 51-75% Cover, 6 = 76-100% Cover.

Annex C

Assessment of Potential Impacts to Fisheries Resources and Fishing Operations

CONTENTS

C1	*INTRODUCTION*	*1*
C2	*RELEVANT LEGISLATION AND ASSESSMENT CRITERIA*	*1*
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C1 INTRODUCTION

This *Annex* presents existing information on the fisheries resources and fishing operations within and adjacent to the proposed cable corridor and evaluates the potential for direct and indirect impacts to them during construction and operation of the Project. The cable is unlikely to be damaged by fishing activity as it will be buried to a target depth of up to 5 m under the seabed for the majority of the cable corridor, and the seabed will be reinstated to the before-work level and condition very shortly. During operation, there may be a potential requirement for maintenance work (ie cable repair at particular fault location due to unexpected damage) to be carried out. These works will be similar in nature to cable installation works, using similar, if not smaller scale, equipment and methods but for a shorter duration.

C2 RELEVANT LEGISLATION AND ASSESSMENT CRITERIA

The criteria for evaluating fisheries impacts are laid out in *Annex 17* of *Environmental Impact Assessment Ordinance (Cap. 499. S.16)* and the *Technical Memorandum on EIA Process (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)* 1987 which provides 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.

C3 DESCRIPTION OF THE ENVIRONMENT

In Hong Kong Special Administrative Region (HKSAR), the commercial marine fishing industry is divided into capture and culture fisheries. However, there are no gazetted Fish Culture Zones (FCZs) within 500 m of the proposed cable corridor. As such, culture fisheries are considered unlikely to be affected by the Project and they will thus only be discussed briefly. The following baseline information is focusing on capture fisheries and briefly describing the nearest culture fisheries. The baseline has been derived from the most up-to-date information on the HKSAR 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

(1) Agriculture, Fisheries and Conservation Department (2006) Port Survey for year 2005. Hong Kong SAR Government.

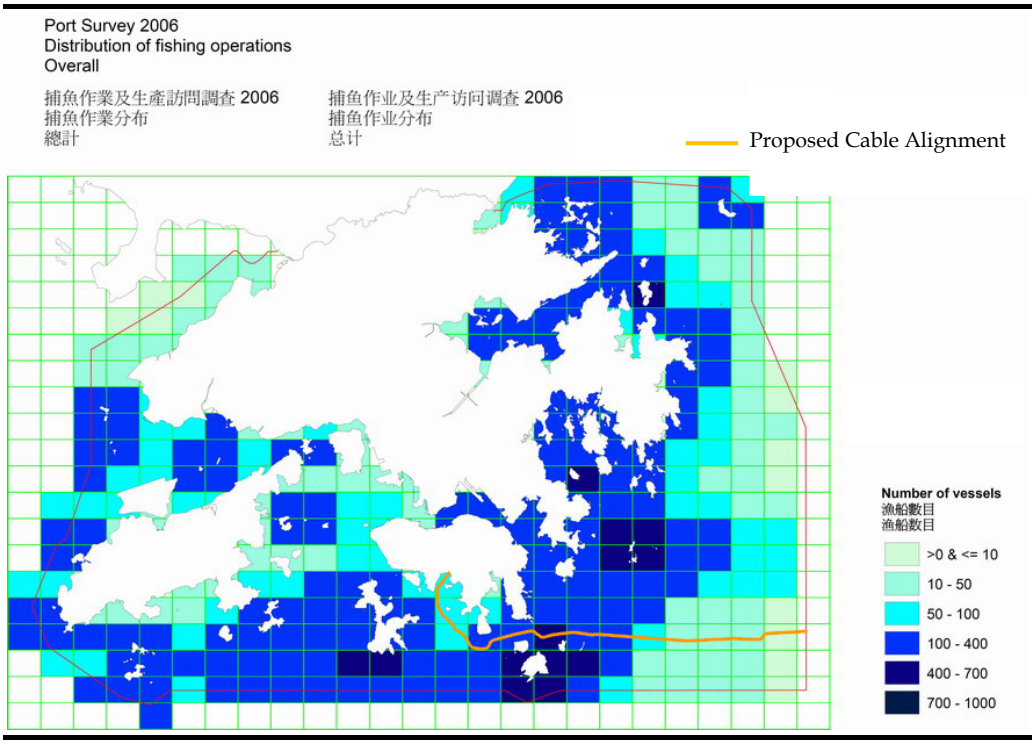
areas for commercial fisheries [1]. Mariculture information was obtained from the AFCD Annual Reports [2].

C3.1 FISHERIES

C3.1.1 Capture Fishing Operations

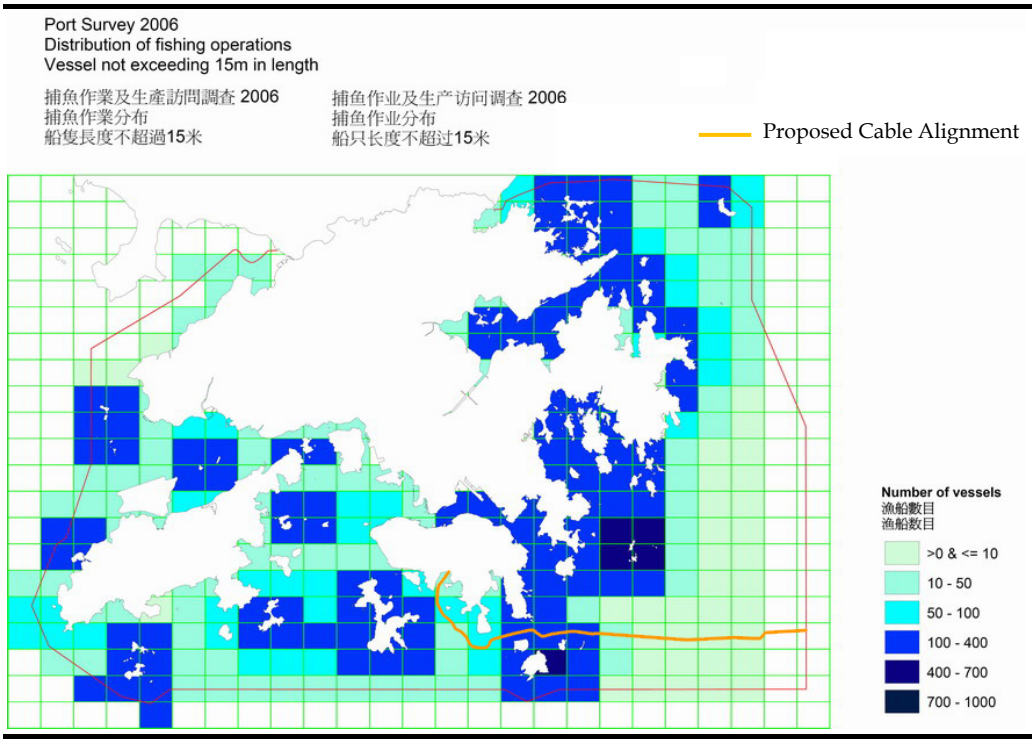
In 1989 - 1991 AFCD devised a system whereby the waters of HKSAR were divided up into individual Fishing Zones [3]. Data were gathered at that time on the catches of HKSAR fleet derived from these Fishing Zones. Since this first HKSAR wide survey, AFCD kept updating the information by performing similar Port Survey. The most updated Port Survey was carried out in 2005 - 2006 [4] in which grid analysis of fishing operations was performed, with each grid cover an area of 720 hectare. Generally moderate numbers of fishing vessels (100 – 400 vessels), except for one gird which had higher number of fishing vessels (400-700 vessels) operated in waters around the proposed cable route (*Figure C1*). These vessels of no longer than 15 m in length are the major type of fishing vessels along the cable route and are mostly sampans (*Figure C2*).

Figure C1 Distribution of Fishing Operations in HKSAR Waters and Locations of the Proposed Cable Corridor



(1) 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.
(2) Agriculture, Fisheries and Conservation Department Annual Report 2014 -2015. Hong Kong SAR Government.
(3) Agriculture, Fisheries and Conservation Department (1991) Port Survey 1989 - 1991. Hong Kong SAR Government.
(4) Agriculture, Fisheries and Conservation Department (2006) *Op cit*.

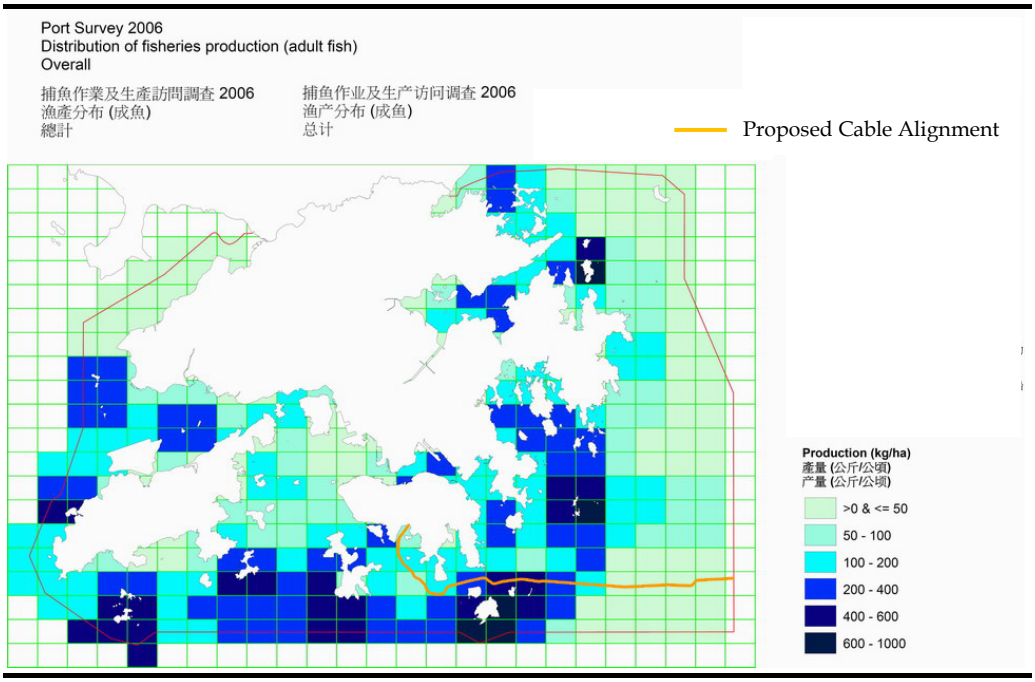
Figure C2 ***Distribution of Fishing Operations (vessel not exceeding 15 m in length) in HKSAR Waters***



C3.1.2 ***Capture Fisheries Resources***

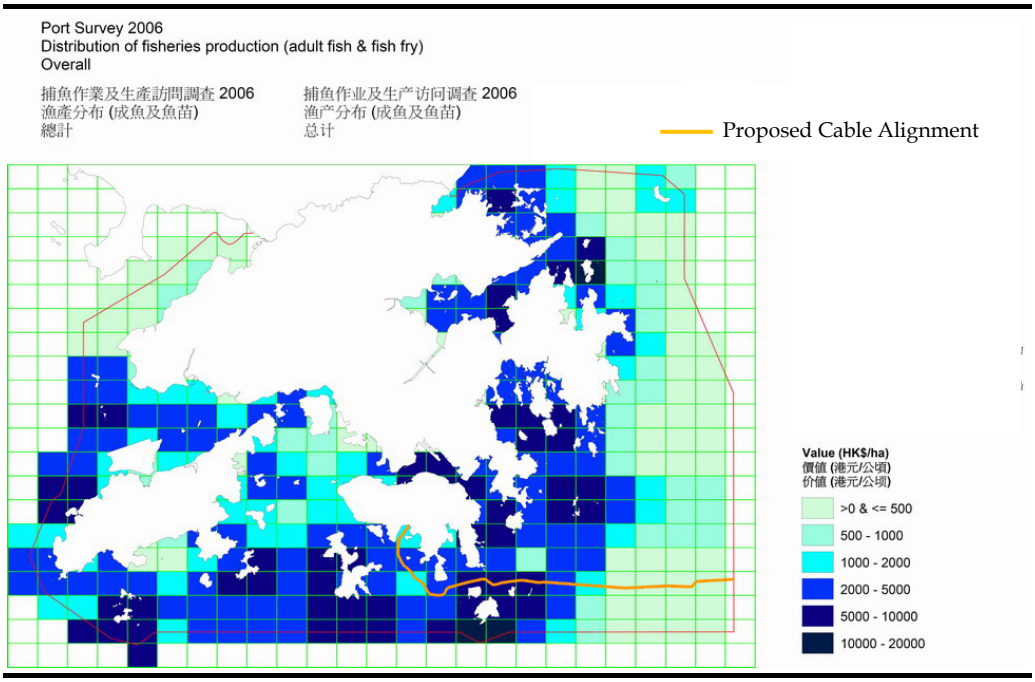
Fisheries production from the grids traversed by the cable corridor range from > 0 – 50 kg per hectare to 400 – 600 kg per hectare (*Figure C3*). Adult fish production was recorded as the highest (400 – 600 kg per hectare) in waters north to Sung Kong and Waglan Island with decreasing value in general when moving away from this area, in which majority of the grids showing >0 kg to 200 kg per hectare.

Figure C3 ***Distribution of Fisheries Production (Adult Fish) in HKSAR Waters and Location of the Proposed Cable Corridor***



Fisheries production values (adult fish and fish fry) from the grids traversed by the cable corridor range from > $0 – $500 per hectare to $5,000 – $10,000 per hectare (*Figure C4*). Production value of adult fish and fish fry was highest ($5,000 – $10,000 per hectare) in waters north of Beaufort Island, Sung Kong and Waglan Island with decreasing value when moving away from this area, in which majority of the grid was in the range of > $0 to $5,000 per hectare (*Figure C4*).

Figure C4 ***Distribution of Fisheries Production (Adult Fish and Fish Fry) in HKSAR Waters (in terms of value) and Location of the Proposed Cable Corridor***



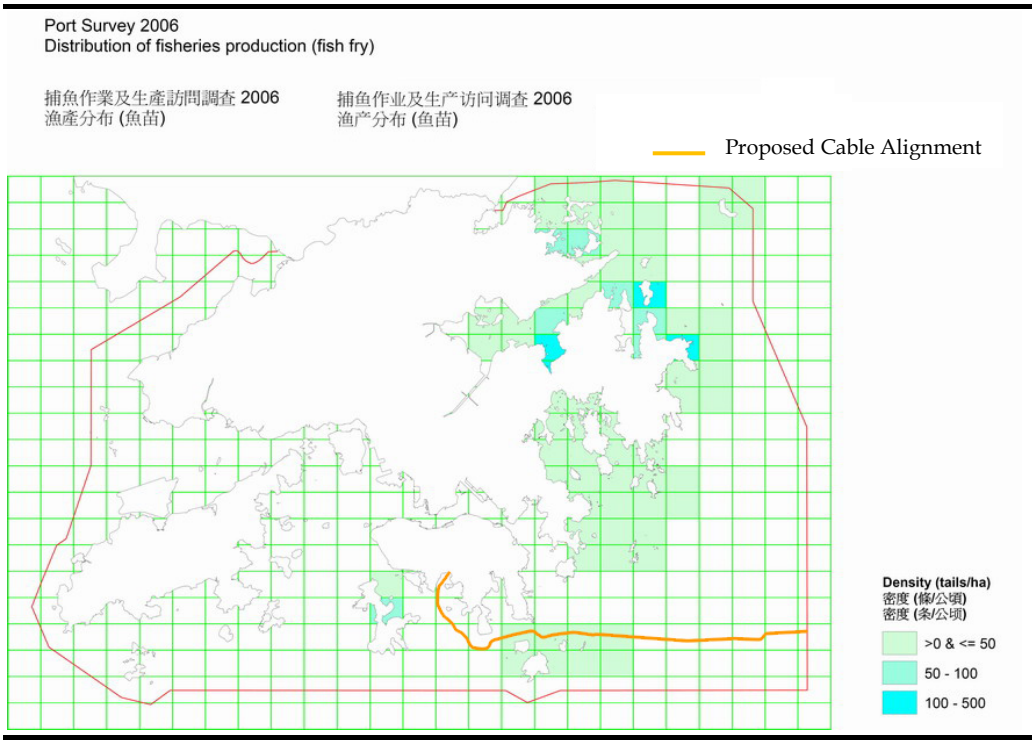
C3.1.3 Culture Fisheries

There are no AFCD gazetted Fish Culture Zone (FCZ) within 500 m of the proposed cable corridor. The closest FCZ is the Po Toi FCZ located just over 3.5 km away from the cable corridor at the closest point. According to the water quality impact assessment in *Annex A*, the maximum travel distance of the sediment plume generated during cable installation is 180 m. As such, no impact is expected on the Po Toi FCZs due to the cable installation/ operation works. As the Po Toi FCZs will not be affected by the proposed Project due to their relative remoteness from the alignment, they will not be discussed further.

C3.1.4 Spawning and Nursery Areas

The Port Survey 2006 (1) records fish fry production within grids and indicates that some grids with the lowest density (>0 – 50 tails per hectare) are traversed by the proposed cable corridor (*Figure C5*). The low density of fish fry agrees with the finding of another fisheries study in 1998 which showed that the area traversed by the cable corridor was not being considered as an important nursery area for commercial fish species (2). However, the cable route passes through waters identified as spawning grounds of commercial fisheries resources (refer to *Figure 3.1*) (2).

Figure C5 Distribution of Fisheries Production (Fish Fry) in HKSAR Waters and Location of the Proposed Cable Corridor



(1) Agriculture, Fisheries and Conservation Department (2006) *Op cit.*
(2) ERM - Hong Kong (1998) Fisheries Resources and Operations in Hong Kong Waters. *Op cit.*

C4 IMPACT ASSESSMENT

C4.1 DIRECT IMPACTS

The proposed cables will be submerged through the injection jetting technique to a maximum depth of 5 m under the seabed. Through the employment of this burial technique, the seabed will be reinstated by resettlement of disturbed sediments and natural erosion from nearby seabed. Recolonisation of the sediments by benthic infauna is expected to occur, therefore providing food for bottom dwelling fisheries resources. In addition, minor interruptions to fishing operations are expected to occur only during the cable installation and potential repair of the proposed Project. These disruptions are, however, expected to be minimal as the duration of time required for cable installation/ repair works will be short (ie approximately 15 working days for cable laying and 3 to 4 working days for RC/ PLGR operation and duration of any cable repair work during operation is anticipated to be of shorter duration) in HKSAR waters and fishing vessels could continue to operate in nearby waters. 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 and short-term displacement of fishing activities from the works area. These disturbances are not predicted to affect either fisheries resources or fishing operations in an unacceptable manner.

C4.2 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 and other marine work activities. However, the proposed injection jetting technique of burial will only lead to localized disturbance of seabed sediments, and expected to result in short-term SS elevations in the immediate vicinity (within 180 m from the cable alignment) (1). 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 (approximately 200 seconds). Cable laying and burial, as well as RC/ PLGR operation, and any repair work during operation, are thus not predicted to cause unacceptable impacts to water quality and consequently unacceptable impacts to fisheries will not occur.

(1) ERM - - Hong Kong (2016) Pacific Light Cable Network (PLCN) – Deep Water Bay. Project Profile. Annex A.

An evaluation of the impact in accordance with the *EIAO-TM Annex 9* is presented as follows:

- *Nature of Impac*t: The Project will involve the laying and operating of a submarine cable connect to Deep Water Bay to the offshore southeast water of the eastern boundary of HKSAR waters before entering the South China Sea. The cable will travel from Deep Water Bay southward approaching the East Lamma Channel. Near to Round Island, the cable is approximately parallel to the East Lamma Channel until the south of Stanley Peninsula. 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 HKSAR waters is approximately 40 km. The cable will be deployed using the injection jetting method and will not affect fisheries resources or fishing operations. In addition, the maximum works area occupied by the cable installation barge during normal operation will be approximately 30 m either side along the cable route. In view of the small area occupied by the cable installation barge during construction (cable laying works will last for a total of approximately 15 working days), potential impacts on vessel transit and fishing activities along the cable alignment are not expected.

- *Size of Fisheries Resources/Production*: Fisheries production of the affected areas ranges from > 0 – 50 kg per hectare to 400 – 600 kg per hectare, with the majority of them showing fisheries production between > 0 and 200 kg per hectare in terms of catch weight of adult fish. For fisheries production of adult fish and fish fry, the value ranges from > $0 – $500 per hectare to $5,000 – $10,000 per hectare, and the majority of the grids were in the range of > $0 to $5,000 per hectare. Fisheries production (in terms of weight of adult fish) in areas traversed by the cable corridor is highest in waters north of Sung Kong and Waglan Island. Fisheries production (in terms of value of adult fish and fish fry) traversed by cable corridor is highest in waters north of Beaufort Island, Sung Kong and Waglan Island. Fisheries production then decreases as the cable moves away from this area. Since the cable laying works will only last for approximately 15 working days, (for any repair works, less time) and the disturbance on seabed is localized, and the seabed will be reinstated by resettlement of disturbed sediments and natural erosion, no unacceptable impact on the fisheries resources/ production is expected

- *Destruction and Disturbance of Spawning and Nursery Grounds*: The proposed cable corridor passes through waters that have been identified as a nursery ground (>0 – 50 tails per hectare) which is not considered important, however, a section of the cable route passes through waters identified as

spawning grounds of commercial fisheries resources. The cable laying works are of relatively short duration in HKSAR (approximately 15 working days), and given that sediment will disperse a maximum of 180 m from the alignment, the construction and operation of the proposed submarine cables is not expected to result in unacceptable adverse impacts to nursery and spawning grounds in HKSAR waters.

- *Impact on Fishing Activity*: The proposed cable corridor passes through fisheries operation areas which mostly have moderate numbers of fishing vessels (100-400 vessels per hectare) and are mostly fished by vessels less than 15 m in length. The cable laying works will only last for approximately 15 working days with any repair works considered to take less time. In addition, the disturbance on seabed is localized and the seabed is expected to reinstate naturally to before-work level and condition very shortly. As such, impacts to fishing activities are not expected to occur. It should also be noted that the target burial depth of the cable after shore-end section is approximately 5 m below the seabed. Damages on the fishing gears /tools by the cable are not expected.

- *Impact on Aquaculture Activity*: Impacts to the closest Fish Culture Zone at Po Toi, which is approximately 3,040 m from the cable corridor at the closest point, are not predicted to occur.

C5.1 MITIGATION MEASURES

As no unacceptable impacts to water quality or fisheries resources are expected to occur, no mitigation measures specific to fisheries are required.

C6 CONCLUSION

A review of existing information on the fisheries resources and fishing operations in the vicinity of the proposed cable corridor has identified the majority of the area as supporting a fishery of low to medium ranking in terms of fisheries production. Given the short duration of works and localized sediment plume (within 180 m from the cable alignment) arising from the cable laying or repair works, no unacceptable impacts have been predicted to occur to fisheries resources or fishing operations as a result of the Project.

Annex D

Assessment of Potential Noise Impacts

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Appendix D1 Construction Noise Impact Assessment

D1 INTRODUCTION

This *Annex* describes and evaluates the potential noise impacts arising from the construction of the offshore works associated with submarine cable installation and onshore works (land and shore-end cable installation) for the proposed cable landing site at Deep Water Bay.

Noise emissions are not expected from the operation of the proposed submarine cable and, therefore, will not be considered further.

The principal legislation relating to the control of construction noise in daytime (ie 0700 to 1900 hours) on any day not being a Sunday or general holiday is the *Environmental Impact Assessment Ordinance* (*EIAO*) (*Cap. 499*). The *Technical Memorandum on Environmental Impact Assessment Process* (*EIAO-TM*), issued under the *EIAO*, provides guidelines and noise criteria for evaluating noise impacts.

The *Noise Control Ordinance* (*Cap. 400*) (*NCO*) also provides means to assess construction noise impacts. Various Technical Memoranda (*TMs*), which stipulate control approaches and criteria, have been issued under the *NCO*. The following TMs are applicable to the control of noise impacts from construction activities:

- *Technical Memorandum on Noise from Construction Work other than Percussive Piling* (*GW-TM*); and
- *Technical Memorandum on Noise from Construction Work in Designated Areas* (*DA-TM*).

The construction works associated with the onshore and offshore submarine cable installation is expected to occur during non-restricted hours, ie 0700 to 1900 hours on any day not being a Sunday or public holiday. If works during restricted hours are later found to be necessary, a Construction Noise Permit (CNP) will be applied for.

Under the *EIAO*, noise impact arising from general construction works during non-restricted hours at openable windows of buildings are to be assessed in accordance with the noise criteria given in *EIAO-TM*. With reference to the *EIAO-TM*, the daytime noise standard for domestic premises is $L_{eq,\ 30\ min}$ 75 dB(A).

The assessment of noise impact from the associated cable installation works was undertaken based on the procedure outlined in the *GW-TM*. In general, the procedure to undertake a construction noise assessment is as follows:

- locate representative noise sensitive receivers (NSRs) that may be affected by the works;
- determine construction plants for corresponding construction activities, based on available information;
- assign sound power level (SWL) to the powered mechanical equipment (PME) proposed based on the *GW-TM* or other sources;
- calculate the correction factors based on the distance between the NSRs and the notional noise source positions of the work sites;
- apply corrections such as potential screening effect and acoustic reflection, if any, in the calculations; and
- predict construction noise levels at NSRs.

In accordance with *Section 2* of the main body of text, major construction activities will be carried out in the following Works Areas (see *Figures D1* and *D2*):

- Onshore Cable (BMH to CLS) – cable laying by hand pulling using existing intermediate manholes between BMH and CLS that are generally along Deep Water Bay Road. Air compressor and generator may be used for clearing the existing ducts, if necessary and these would only be placed at one location, ie the manhole near N2 along Deep Water Bay Road as shown in *Figure D2*. They are not required to be used at other manhole locations;

- Onshore Cable (beach area) (from the beach landing point to BMH) - trench excavation, cable laying and back filling by small tracked diggers, winch, with hand digging and hand pulling near trees; and

- Offshore Submarine Cable (cable laying works from offshore to the landing point) – using cable installation barge and work boat.

D5 DESCRIPTION OF THE ENVIRONMENT & IDENTIFICATION OF NOISE SENSITIVE RECEIVERS

The existing noise environment of the proposed work site area is tranquil, reflecting the rural nature of the site and its coastal location. Low density housing developments are located along the low trafficked Deep Water Bay Road and Island Road. The Study Area for the noise impact assessment covers a distance of 300 m from the proposed alignment of the cable, as shown in *Figure D1*.

Only the first layer of NSRs having direct line of sight towards both of the onshore and offshore alignments have been included in the assessment as NSRs behind are located further away or are screened.

The identified representative NSRs, N1 and N2 (equivalent to ID 13 and 15 in *Figure D1),* are shown in *Figure D2*. Details of the identified representative NSRs are presented in *Table D1* with their photographs shown in *Figure D3*. *Table D1* provides distances between the NSRs and specific works areas where more noise may be generated according to the construction plant inventory described in *Section D6*.

Table D1 Representative Noise Sensitive Receivers (NSRs)

NSR	Description	Type of Use	Shortest Distance (m) between specific Works Areas and NSRs		
			Onshore Cable (BMH to CLS)	**Onshore Cable (beach area)**	**Offshore Submarine Cable**
N1	House 3, Deep Water Bay Road No. 72	Residential	H: 154 S: 154	H: 131 S: 137	H: 175 S: 180
N2	Deep Water Bay Road No. 77	Residential	H: 21 S: 22	H: 142 S: 147	H: 252 S: 255

Note:
H – Horizontal distance; S - Slant distance.

An assumed plant inventory has been established and is presented in *Table D2*. The plant inventory was reviewed by the Design Engineer and was confirmed to be suitable for completing the Assignment.

Table D2 Construction Plant Inventory

Item of PME	Identification Code [1]	No. of units	Sound Power Levels (SWL) (dB(A))
Onshore Cable – BMH to CLS (inventory at one location as indicated in Section D4)			
Air compressor, air flow <= 10m³/min	CNP 001	1	100
Generator, super silenced	CNP 103	1	95
		Sub-total	**101**
Onshore Cable – Beach area			
Winch	CNP 262	1	95
Generator, super silenced	CNP 103	1	95
Excavator, mini-robot mounted	Note [2]	2	97
		Sub-total	**101**
Offshore Submarine Cable			
Tug Boat	CNP 221	1	110
Mobile Crane	CNP 048	1	112
		Sub-total	**114**

Notes:

[1] PME Identification Codes and Sound Power Levels (SWLs) refer to those provided in EPD's 'Technical Memorandum on Noise from Construction Work other than Percussive Piling' (TM-GW).

[2] For PME not included in TM-GW, SWLs refer to those documented by EPD's Noise Control Authority within 'Sound Power Levels of Other Commonly Used PME' (http://www.epd.gov.hk/epd/english/application_for_licences/guidance/files/OtherSWLe.pdf).

Noise levels at the representative NSRs have been predicted based on the above construction plant inventory. The predicted noise levels at the representative NSRs are presented in *Table D3*. Details of the calculation on construction noise impact assessment are given in *Appendix D1*.

Table D3 Predicted Noise Levels at the Representative NSRs

NSR	Predicted Noise Levels (dB(A))	Noise Criterion (dB(A))	Compliance
Onshore cable – BMH to CLS			
N1	52	75	Yes
N2	69	75	Yes
Onshore cable – beach area			
N1	53	75	Yes
N2	52	75	Yes
Offshore submarine cable			
N1	64	75	Yes
N2	61	75	Yes

The construction noise levels for onshore and offshore submarine cable installation are predicted in the range of 52 to 69 dB(A) and comply with the noise criterion.

D6.1 MITIGATION MEASURES

The following mitigation measures are recommended to further reduce the construction noise levels during the onshore construction or maintenance and repair works. It is recommended that the Contractor be responsible for implementing these measures properly.

- Only well-maintained plant should be operated on-site and plant should be serviced regularly during the construction programme.
- Machines and plant (such as backhoe) that may be intermittently used should be shut down between work periods or should be throttled down to a minimum.
- Plant known to emit noise strongly in one direction, for example an air compressor, should, where possible, be oriented so that the noise is directed away from nearby NSRs.
- Mobile plant should be sited as far away from NSRs as possible.
- Silencers or mufflers on construction equipment should be utilised and should be properly maintained during the construction programme.
- Where necessary, movable noise barriers should be positioned within a few metres of noisy plant items.

D7 CONCLUSION

A noise assessment was undertaken to describe and evaluate the potential noise impacts arising from the onshore and offshore works associated with submarine cable installation and operation. It is predicted that noise exceedances would not occur at the identified noise sensitive receivers due to the minor activities for construction or operation.

Cable installation or maintenance and repair work at present is not expected to take place during restricted hours. If restricted hours works are later found to be necessary, a Construction Noise Permit (CNP) will be applied for.

Appendix D1

Construction Noise Assessment

Appendix D1 - Construction Noise Impact Assessment

A) Calculation of Façade Noise Levels at N1

	x	y
NSR: N1 - House 3, Deep Water Bay Road No. 72 (@ 45 mPD)	837099.9	811940.7
Notional Source Positions (nearest to the NSR):		
Onshore Cable (BMH to CLS)	837230.0	812022.7
Onshore Cable (beach area)	837222.5	811895.8
Offshore Submarine Cable	837134.8	811769.7

PME	Identification Code [1]	No. of PME	Unit SWL, dB(A)	Horizontal Distance	Slant Distance	Correction, dB(A)				CNL of individual PME, dB(A)	Overall CNL of each Group, dB(A)[3]	Criterion, dB(A)	Compliance
						No. of Plant	Cdist	Cfacade	Barrier				
Onshore Cable - BMH to CLS (@ 31 mPD)													
Air compressor, air flow <= 10m3/min	CNP 001	1	100	154	154	0	-51.8	3	0	51			
Generator, super silenced	CNP 103	1	95	154	154	0	-51.8	3	0	46	52	**75**	**Yes**
Onshore Cable - beach area (@ 3 mPD)													
Winch	CNP 262	1	95	131	137	0	-50.7	3	0	47			
Generator, super silenced	CNP 103	1	95	131	137	0	-50.7	3	0	47			
Excavator, mini-robot mounted	Note[2]	2	94	131	137	3	-50.7	3	0	49	53	**75**	**Yes**
Offshore Submarine Cable (@ 0 mPD)													
Tug Boat	CNP 221	1	110	175	180	0	-53.1	3	0	60			
Mobile Crane	CNP 048	1	112	175	180	0	-53.1	3	0	62	64	**75**	**Yes**

B) Calculation of Façade Noise Levels at N2

	x	y
NSR: N2 - Deep Water Bay Road No. 77 (@ 40 mPD)	837229.0	812043.2
Notional Source Positions (nearest to the NSR):		
Onshore Cable (BMH to CLS)	837230.0	812022.7
Onshore Cable (beach area)	837225.4	811900.8
Offshore Submarine Cable	837155.3	811802.1

PME	Identification Code [1]	No. of PME	Unit SWL, dB(A)	Horizontal Distance	Slant Distance	Correction, dB(A)				CNL of individual PME, dB(A)	Overall CNL of each Group, dB(A)[3]	Criterion, dB(A)	Compliance
						No. of Plant	Cdist	Cfacade	Barrier				
Onshore Cable - BMH to CLS (@ 31 mPD)													
Air compressor, air flow <= 10m3/min	CNP 001	1	100	21	22	0	-35.0	3	0	68			
Generator, super silenced	CNP 103	1	95	21	22	0	-35.0	3	0	63	69	**75**	**Yes**
Onshore Cable - beach area (@ 3 mPD)													
Winch	CNP 262	1	95	142	147	0	-51.3	3	0	47			
Generator, super silenced	CNP 103	1	95	142	147	0	-51.3	3	0	47			
Excavator, mini-robot mounted	Note[2]	2	94	142	147	3	-51.3	3	0	49	52	**75**	**Yes**
Offshore Submarine Cable (@ 0 mPD)													
Tug Boat	CNP 221	1	110	252	255	0	-56.1	3	0	57			
Mobile Crane	CNP 048	1	112	252	255	0	-56.1	3	0	59	61	**75**	**Yes**

Remarks:

(1) PME Identification Codes and Sound Power Levels (SWLs) refer to those provided in EPD's '*Technical Memorandum on Noise from Construction Work other than Percussive Piling (TM-GW)*'.

(2) For PME not included in TM-GW, SWLs refer to those documented by EPD's Noise Control Authority within '*Sound Power Leverls of Other Commonly Used PME*' (http://www.epd.gov.hk/epd/english/application_for_licences/guidance/files/OtherSWLe.pdf).

(3) Corrected Noise Level (CNL), dB(A) = SWL + No.of PME correction + barrier correction+ distance correction + façade correction.

Annex E

Assessment of Potential Impacts to Marine Archaeological Resources

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E1 INTRODUCTION

This *Annex* presents a Marine Archaeological Investigation (MAI) as part of the cultural heritage impact assessment of the environmental assessments associated with the installation and operation of the submarine telecommunications cable system within HKSAR, including the connection to land at Deep Water Bay (DWB). This MAI includes a desktop study, available geophysical surveys results and establishment of archaeological potential and evaluates the potential for direct and indirect adverse impacts to these resources. The MAI Study Area is defined as within 500 m of the proposed cable corridor.

E2 RELEVANT LEGISLATION AND ASSESSMENT CRITERIA

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

E2.1 ENVIRONMENTAL IMPACT ASSESSMENT ORDINANCE TECHNICAL MEMORANDUM ON THE EIA PROCESS

Annex 10 outlines the criteria for assessment of impact on sites of cultural heritage. The general presumption is in favour of the protection and conservation of all sites of cultural heritage. Also, adverse impacts on sites of cultural heritage shall be kept to the absolute minimum.

Annex 19 outlines the approaches required in investigating and assessing the impacts on marine archaeological sites. 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. Preservation in totality is preferred. If, due to site constraints and other factors, this must be fully justified with alternative proposals or layout designs, which confirm the impracticability of total preservation.

E2.2 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 to enable their preservation for posterity. The *AM Ordinance* also establishes the statutory procedures to be followed in making such a declaration.

Any person who discovers an antiquity, or supposed antiquity, is required to report the discovery to the Antiquities Authority.

E2.3 HONG KONG PLANNING STANDARDS AND GUIDELINES

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

E2.4 GUIDELINES FOR MARINE ARCHAEOLOGICAL INVESTIGATION (MAI)

Guidelines for MAI established by AMO 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. Baseline review, 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.

E3 ASSESSMENT METHODOLOGY

The methodology used in this assessment followed the Guidelines for MAIs established by AMO and comprised the following tasks.

E3.1 ESTABLISH BASELINE CONDITIONS

- Implement Desktop Research, comprising a review of geotechnical survey data, historical documents and United Kingdom Hydrographic Office (UKHO) 'Wreck' files to establish the potential for marine archaeological sites in the MAI Study Area;

- Examination of the seabed and below seabed using geophysical survey equipment in order to locate and define any sites of archaeological potential in the MAI Survey Area.

E3.2 ESTABLISHING ARCHAEOLOGICAL POTENTIAL

The synthesis and analysis of the baseline conditions were used to establish if there were any marine archaeological sites in the MAI Survey Area.

E3.3 ASSESS IMPACT AND MAKE RECOMMENDATION

Based on the findings and analysis of the baseline conditions, an assessment was made of the potential impact of the project on the marine archaeological sites, and recommendations made to mitigate any impact.

E4 DESKTOP RESEARCH

E4.1 TERRESTRIAL CULTURAL HERITAGE SITES

The submarine cable's landing site is at Deep Water Bay. No declared monuments, graded historic buildings, known terrestrial archaeological sites within 500 m of the proposed cable alignment is identified. The raised beach at Deep Water Bay is not expected to be of archaeological potential, as it is not natural, but artificially raised through sand borrowing activities.

E4.2 MARINE ARCHAEOLOGICAL RESOURCES

According to a database of United Kingdom's Hydrographic Office (UKHO), a total of three UKHO sites were found to be within the MAI Study Area (see *Figure E1*). One of these sites were reported as 'live' (to exist), and two were reported as 'dead' (not detected by repeated surveys, therefore considered not to exist) (see *Table E1.1*).

Table E4.1 UKHO Wreck Sites in the Survey Area

UKHO Wreck number	Description	Status (HK Marine Survey Date)	Geographical Coordinates	Distance from the cable route (m)
68338	A shipwreck located 12.6m underwater.	Live (8 July 2006)	22 13′.020 N 114 10′.830 E	294.30
68345	A shipwreck located 6.3m underwater.	Dead (14 October 2008)	22 14′.230 N 114 11′.080 E	415.30
72505	A cargo aircraft shipwreck, which sank on 2 September 1977.	Dead (15 October 2008)	22 11′.817 N 114 21′.167 E	486.48

The shipwreck site 68338 is a live site thus it is potentially of archaeological significance. For the dead sites 68345 and 72505, they have no archaeological significance.

E4.3 PREVIOUS REFERENCING PROJECTS

The baseline review makes reference to the previous projects in the vicinity, including: *132kV Submarine Cable Installation for Wong Chuk Hang - Chung Hom Kok 132kV Circuits* (Application No.: *DIR-063/2002*); *VSNL Intra Asia Submarine Cable System – Deep Water Bay* (Application No.: *DIR-155/2007*); *Asia Pacific Gateway (APG) - Tseung Kwan O* (Application No.: *DIR-233/2013*); and the proposed *Asia-Africa-Europe-1 (AAE-1) Cable System* (Application No.: *DIR-244/2016*). Their alignments are indicated in *Figure E1*.

Under application *DIR-063/2002*, the section of proposed cable route on the northwest and west of the Middle Island falls within the MAI Study Area. The results of geophysical surveys identified one anomaly, which was characterized as a potential wreck in the side scan sonar data. That anomaly was located within the MAI Study Area of the current Project; however, it was

KOWLOON CITY DISTRICT 九龍城區
KWUN TONG DISTRICT 觀塘區
SAI KUNG DISTRICT 西貢區
KOWLOON 九龍
YAU TSIM MONG DISTRICT 油尖旺區
HONG KONG ISLAND 香港島
WAN CHAI DISTRICT 灣仔區
EASTERN DISTRICT 東區
Tseung Kwan O Industrial Estate 將軍澳工業邨
Tung Lung Chau 東龍洲
Deep Water Bay 深水灣
SOUTHERN DISTRICT 南區
Big Wave Bay 大浪灣
Tai Long Pai 大浪排
Shek O 石澳
Tai Tau Chau 大頭洲
68345
Middle Island 鴨脷洲
68338
Round Island 銀洲
Chung Hom Kok 春坎角
Stanley Peninsula 赤柱半島
Proposed AAE-1 (DIR - 244/2016)
擬鋪設的AAE-1 (DIR - 244/2016)
72505
Sung Kong 宋崗
ISLANDS DISTRICT 離島區
Po Toi 蒲台

Legend

- Boundary of HKSAR 香港特別行政區邊界
- Ship Wrecks 沉船殘骸
- Proposed PLCN Cable Route 擬建PLCN海底光纜系統路線
- MAI Study Area 海洋考古調查研究範圍
- Planned Cables Routes 擬建的電纜路線
- Existing Cable 現存的電纜
- Existing Cable Route (DIR-063/2002) 現存的電纜路線 (DIR-063/2002)
- Existing Cable Route (DIR-155/2007) 現存的電纜路線 (DIR-155/2007)
- Existing Cable Route (DIR-233/2013) 現存的電纜路線 (DIR-233/2013)
- Existing Cable Area 現存的電纜位置
- Existing Pipeline 現存的管道
- Existing Pipeline Area 現存的管道位置
- Country Park 郊野公園
- Designated Marine Reserve 指定的海岸保護區
- District Council Boundary 區議會分區分界

N 北

Kilometers 公里

0 2.5 5

Figure E1
圖 E1

MAI Study Area
海洋考古調查研究範圍

File: T:\GIS\CONTRACT\0335723\Mxd\0335723_MAI_Study_Area_bil.mxd
Date: 29/3/2017

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not expected to have any archaeological significance due to the use of the surrounding waters as permanent mooring facilities for recreational vessels and the seabed being highly disturbed. As a result, the proposed cable route under application *DIR-63/2002* is not expected to have resources present that can be considered to be of archaeological importance.

Under application *DIR-155/2007*, *t*he section of proposed cable route between Deep Water Bay and the Stanley Peninsula is similar to the current Project. It was concluded that since the proposed cable under *DIR-155/2007* was laid in the proximity of the existing cables or pipelines, it was not expected to impinge upon resources of marine archaeological importance.

Under application *DIR-233/2013* and *DIR-244/2016*, the section of cable route at area above the Sung Kong Island is similar to the current Project. Results of geophysical surveys of both MAI had only identified modern debris. It was concluded that no marine archaeological resources were located.

Based on the MAI results of these applications, archaeological potential of MAI Study Area between Deep Water Bay and the Stanley Peninsula is considered minimal. In addition, existing cables are also laid in proximity to the remaining section of the MAI Study Area (see *Figure E1*). It was not expected to impinge upon resources of marine archaeological importance.

E5 IMPACT ASSESSMENT, CONCLUSION AND RECOMMENDATION

E5.1 IMPACT ASSESSMENT

The desktop review found no declared monuments, graded historic buildings and terrestrial archaeological sites within 500m of the landing Site. However, there is one live shipwreck site (no. 68338) located in the MAI Study Area, which is about 294 m away from the cable route. Adverse impact to the shipwreck site is considered minimal due to the large separation distance.

In addition, the MAI Study Area between Deep Water Bay and the Stanley Peninsula overlapped with previous referencing projects as discussed in *Section E1.4.3*, which archaeological potential and adverse impact of that area is concluded to be minimal. For the remaining MAI Study Area, since the proposed cable will be laid in the proximity of the existing cables, it is not expected to impinge upon resources of marine archaeological importance. Based on this, no adverse impacts to marine archaeological resources are expected to occur as a result of the Project.

ERM (2002), *132kV Submarine Cable Installation for Wong Chuk Hang- Chung Hom Kok 132kV Circuits* (*DIR 63/2002*).

ERM (2007), *VSNL Intra Asia Submarine Cable System – Deep Water Bay: Project Profile* (*DIR 155/2007*).

ERM (2013), *Asia Pacific Gateway (APG) – Tseung Kwan O* (DIR 233/2013)

SMEC Asia Limited (2016), *Asia-Africa-Europe-1 (AAE-1) Cable System* (DIR 244/2016)

Annex F

Tree Survey

CONTENTS

F1 *TREE SURVEY* *1*

Appendix F1 *Tree Schedule & Photographs*

F1 TREE SURVEY

A Tree Survey of the DWB beach area, in the vicinity of the proposed PLCN landing point, was conducted by qualified arborist in July and December 2016.

Figure 2.1 in the main Project Profile text shows the location of trees in the area. A Tree Schedule is provided as *Appendix F1* with photographs of each tree provided in *Figure F1*. There is a dominance of *Melaleuca leucadendron* and *Hibiscus tiliaceus* trees in this area. Heights of surveyed trees range from approximately 5-10 m with DBH ranging from 115 mm to 850 mm and crown spread from 2 m to 8 m. All trees were considered in fair health and form.

Appendix F1: Tree Survey Schedule

Project title **Deep Water Bay, Hong Kong** **Revision: 20161220**

Date of Surveys: **13 July and 19 December 2016**

Survey conducted by: **Kelvin Ip [ISA Certified Arborist HK0544A] and Jacob Ma**

Tree No.[1]	Species[2]		Measurements			Amenity value[4]	Form	Health	Structural condition	Suitability for Transplanting[5]		Conservation status[7]	Recommendation	Department to provide expert advice to LandsD	Additional remarks[8]
	Scientific Name	Chinese Name	Height	DBH[3]	Crown spead	Good/Fair/Low				High/Medium/Low	Remarks[6]		(Retain/ Transplant/ Fell)		
			(m)	(mm)	(m)										
T001	*Terminalia mantaly*	小葉欖仁	8	275	8	Fair	Fair	Fair	Fair	Medium	/	/	Retain		
T002	*Melaleuca cajuputi* subsp.	白千層	10	800	6	Fair	Fair	Fair	Fair	Medium	/	/	Retain		
T003	*Hibiscus tiliaceus*	黃槿	8	625	6	Fair	Fair	Fair	Poor	Medium	/	/	Retain		
T004	*Macaranga tanarius*	血桐	5	197	3	Fair	Fair	Fair	Fair	Low	/	/	Retain		
T005	*Hibiscus tiliaceus*	黃槿	8	310	8	Fair	Fair	Fair	Poor	Medium	/	/	Retain		
T006	*Hibiscus tiliaceus*	黃槿	10	475	10	Fair	Fair	Fair	Poor	Medium	/	/	Retain		
T007	*Albizia lebbeck*	大葉合歡	6	323	6	Fair	Fair	Fair	Poor	Medium	/	/	Retain		
T008	*Melaleuca cajuputi* subsp.	白千層	6	317	3	Fair	Fair	Fair	Poor	Medium	/	/	Retain		
T009	*Hibiscus tiliaceus*	黃槿	6	506	8	Fair	Fair	Fair	Poor	Medium	/	/	Retain		
T010	*Araucaria heterophylla*	異葉南洋杉	5	111	2	Fair	Fair	Fair	Fair	Medium	/	IUCN:VU	Retain		
T011	*Hibiscus tiliaceus*	黃槿	6	428	8	Fair	Fair	Fair	Poor	Medium	/	/	Retain		
T012	*Hibiscus tiliaceus*	黃槿	8	710	8	Fair	Fair	Fair	Poor	Medium	/	/	Retain		
T013	*Melaleuca cajuputi* subsp.	白千層	8	628	9	Fair	Fair	Fair	Fair	Medium	/	/	Retain		
T014	*Hibiscus tiliaceus*	黃槿	8	200	4	Fair	Fair	Fair	Fair	Medium	/	/	Retain		
T015	*Melaleuca cajuputi* subsp.	白千層	6	226	6	Fair	Fair	Fair	Fair	High	/	/	Retain		
T016	*Hibiscus tiliaceus*	黃槿	8	320	6	Fair	Fair	Fair	Poor	Medium	/	/	Retain		
T017	*Hibiscus tiliaceus*	黃槿	8	256	4	Fair	Fair	Fair	Poor	Medium	/	/	Retain		
T018	*Melaleuca cajuputi* subsp.	白千層	8	418	4	Fair	Fair	Fair	Fair	High	/	/	Retain		
T019	*Melaleuca cajuputi* subsp.	白千層	8	418	4	Fair	Fair	Fair	Fair	High	/	/	Retain		
T020	*Hibiscus tiliaceus*	黃槿	8	383	7	Fair	Fair	Fair	Fair	Medium	/	/	Retain		
T021	*Casuarina equisetifolia*	木麻黃	10	381	6	Fair	Fair	Fair	Fair	Medium	/	/	Retain		
T022	*Hibiscus tiliaceus*	黃槿	8	568	7	Fair	Fair	Fair	Poor	Medium	/	/	Retain		
T023	*Aleurites moluccana*	石栗	10	327	7	Fair	Fair	Fair	Fair	Medium	/	/	Retain		
T024	*Hibiscus tiliaceus*	黃槿	8	259	6	Fair	Fair	Fair	Poor	Medium	/	/	Retain		

Notes:

1 Tree(s) in the Register of Old and Valuable Trees should be highlighted with OVT number. No Registered OVTs recorded

2 Use of scientific name of plants follows Guidance given in the Agriculture, Fisheries and Conservation Department's Nature Conservation Practice Note No. 3, Available at http://www.afcd.gov.hk/english/conservation/con_tech/files/common/NCPC_No.03_The_use_of_plant_names_rev_2008_2.pdf

3 DBH = diameter at breast height of tree (i.e. measured at 1.3 m above ground level), following Guidance in AFCD's Nature Conservation Practice Note N Available at http://www.afcd.gov.hk/english/conservation/con_tech/files/common/NCPN_No.02_measurement_of_DBH_ver.2006.pdf

4 menity value of a tree assessed by its functional values for shade, shelter, screening, reduction of pollution and noise and also its fung shui significance, and classified into the following categories.
Good: important trees which should be retained by adjusting the design layout accordingly.
Fair: trees that are desirable to be retained in order to create a pleasant environment, which includes healthy specimens of lesser importance than "Good" trees.

5 Assessment takes into account conditions of an individual tree at the times of survey (including health, structure, age and root conditions), site conditions (including topography and accessibility), and intrinsic characters of tree species (survival rate after transplanting).

6 Major determining factors for the rating on suitability for transplanting where necessary.

7 Conservation status as per IUCN Red list version 2016-3. [http://www.iucnredlist.org/details/30497/0]
VU = Listed as "Vulnerable".

8 Any additional information deemed necessary for consideration of the proposed management recommendation.

T1

T2

T3

T4

Figure F1a
圖 F1a

DATE: 21/12/2016

Photographs of Surveyed Trees 已調查樹木的照片
(Sheet 1 of 6) 頁 1/6

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T5

T6

T7

T8

Figure F1b
圖 F1b

DATE: 21/12/2016

Photographs of Surveyed Trees 已調查樹木的照片
(Sheet 2 of 6) 頁 2/6

Environmental Resources Management

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T9

T10

T11

T12

Figure F1c
圖 F1c

DATE: 21/12/2016

Photographs of Surveyed Trees 已調查樹木的照片
(Sheet 3 of 6) 頁 3/6

Environmental Resources Management

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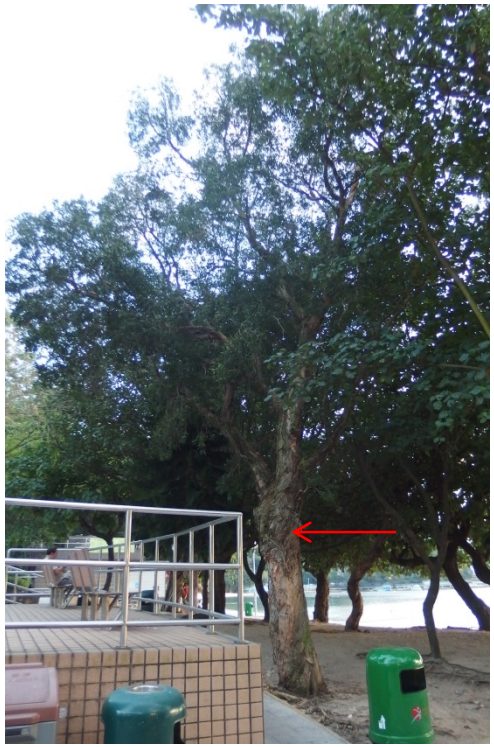
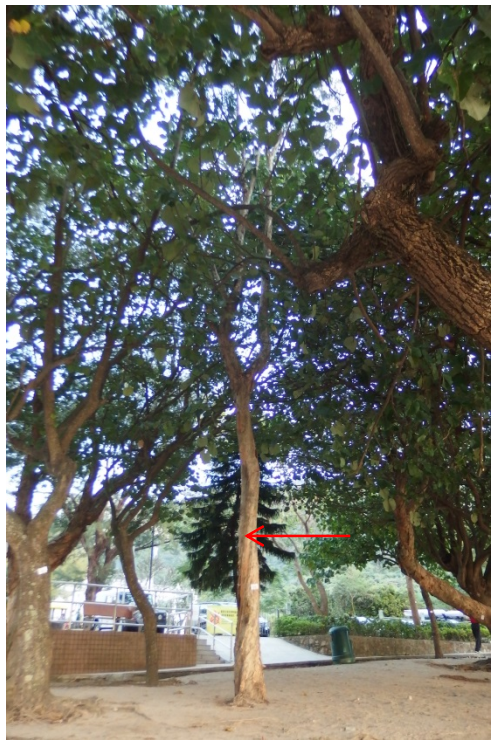


T13

T14



T15

T16

Figure F1d
圖 F1d

DATE: 21/12/2016

Photographs of Surveyed Trees 已調查樹木的照片
(Sheet 4 of 6) 頁 4/6

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T17

T18

T19

T20

Figure F1e
圖 F1e

DATE: 21/12/2016

Photographs of Surveyed Trees 已調查樹木的照片
(Sheet 5 of 6) 頁 5/6

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T21

T22

T23

T24

Figure F1f
圖 F1f

DATE: 21/12/2016

Photographs of Surveyed Trees 已調查樹木的照片
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Environmental Resources Management

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Annex G

Environmental Monitoring & Audit

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G1 EM&A MEASURES

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

- verify whether the monitoring results are in line with the predicted impact;
- monitor the effectiveness of the control measures employed during the cable laying works;
- verify that the Project works are not resulting in any impacts to water quality, especially at water sensitive receivers;
- ensure that any adverse impacts are detected during the cable laying process/ operation 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 works;
- carry out coral monitoring works at Impact stations which are in the vicinity of the cable alignment and at Control stations to ensure water quality and marine ecology such as corals (ie hard corals, octocorals and black corals) will not be affected by the cable laying works; and
- carry out site inspections at the land installation site at Deep Water Bay to ensure all suggested mitigation measures are being adhered to and that the Project works are not resulting in adverse impacts to the terrestrial environment, trees and beach users in the area.

G2 WATER QUALITY MONITORING

Potential impacts on water quality associated with the construction of the Project have been identified and mitigation measures have been recommended, including limiting the speed of the cable installation barge, using silt curtains where appropriate and undertaking a water quality monitoring programme. The following Section provides details of the water quality monitoring during the installation of the submarine cable. The necessity of implementing these measures should also be reviewed if repair operation of the cable system is carried out.

G2.1 SAMPLING AND TESTING METHODOLOGY

G2.1.1 Parameters Measured

The parameters to be measured *in situ* are:

- dissolved oxygen (DO) (% saturation and mgL^{-1})
- temperature (°C)
- turbidity (NTU)
- salinity (‰ or ppt)

The only parameter to be measured in the laboratory is:

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

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

G2.1.2 Equipment

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

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

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

- ***Turbidity Measurement Equipment*** - Turbidity 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 ppt 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.

G2.1.3 Sampling / Testing Protocols

All *in situ* monitoring instruments shall be checked, calibrated and certified by a laboratory accredited under HOKLAS or any other international accreditation scheme before use, and subsequently re-calibrated at-monthly intervals throughout all stages of the water quality monitoring. Responses of sensors and electrodes shall be checked with certified standard solutions before each use.

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.

At least two (2) replicate samples should be collected from each of the monitoring events for *in situ* measurement and lab analysis.

G2.1.4 Laboratory Analysis

All laboratory work shall be carried out in a HOKLAS accredited laboratory. Water samples of about 1,000 mL shall be collected at the monitoring, gradient 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 two (2) days of the sampling event (48 hours). The analyses shall follow the standard methods as described in *APHA Standard Methods for the Examination of Water and Wastewater, 19th Edition*, unless otherwise specified (APHA 2540D for SS).

The submitted information should include pre-treatment procedures, instrument use, Quality Assurance/Quality Control (QA/QC) details (such as blank, spike recovery, number of duplicate samples per-batch etc), detection limits and accuracy. The QA/QC details shall be in accordance with requirements of HOKLAS or another internationally accredited scheme.

G2.2 MONITORING LOCATIONS

The monitoring station locations have been established to identify potential impacts to water and ecological sensitive receivers.

Prior to, during, and after the installation of the cable, water quality sampling will be undertaken at stations situated around the cable laying works (shown in *Table G1*, and *Figures G1, G2a* and *G2b*). The monitoring at those stations is to ensure the construction works of the Project do not affect the sensitive area nearby. Similarly water quality sampling should be undertaken prior to, during and after any necessary repair operation.

The monitoring stations are divided into two areas based on their distance from the proposed cable alignment. A number of monitoring stations are located close to the cable alignment from Aberdeen to Chung Hom Kok. This area is defined as Area A, covering the cable alignment between Working

Limit Control Points 0 and 31, at 0 km and 5.851 km chainage, and is shown in *Figure G1*. The monitoring stations within Area A (see *Figure G1* and *Figure G2a*) should be monitored for all works between the landing point to the boundary of cable segment within Area A (HK Grid coordinate 837716.853E 806917.294N/ Working Limit Control Point 31 at 5.851km). Cable works from north of Beaufort Island to Waglan Island is also close to nearby monitoring stations and this works area is defined as Area B (shown in *Figure G1*), covering the cable alignment between Working Limit Control Points 58 and 78, at 11.117 km and 20.014 km chaingage. The monitoring stations within Area B (see *Figure G1* and *Figure G2b*) should be monitored for all cable works between the western end (HK Grid coordinate 842031.328E 805264.677N/ Working Limit Control Point 58 at 11.117 km) and the eastern end (HK Grid coordinate 850624.326E 806284.338N) of the cable alignment. Outside Area A and Area B, the cable works are considered too far away from any identified sensitive receivers for any potential impact, and water quality monitoring is not required. The contractor should inform the ET every day of the expected cable segment which would be installed/ repaired in the next working day to allow the ET to plan ahead the required extent of water quality survey.

The suggested co-ordinates of these monitoring stations are listed in *Table G1* below. The exact co-ordinates should be confirmed before commencement of Baseline Monitoring (prior to cable installation/ repair operation).

The monitoring stations shall be sampled for any marine (shore-end or offshore submarine) cable work, during Baseline Monitoring (prior to cable installation/ repair operation), Impact Monitoring (during any works related to the cable installation/repair operation) and Post Project Monitoring (after completion of the cable installation/repair operation).

Table G1 Co-ordinates of Sampling Stations (HK Grid)

Station	Nature	Approx. Geodesic Distance ^ to Proposed Cable Alignment (m)	Easting	Northing
Area A: The waters from Aberdeen to Chung Hom Kok where a number of sensitive receivers are located close to the cable alignment. Covers the cable alignment between Chainage 0 and 5.851 km.				
B1	Impact Station (Adjacent to Deep Water Bay Beach)	36	8371878	811783
I3	Impact Station (Ocean Park's Main Seawater Intake)	290	836195	810956
I4	Impact Station (Ocean Park's Training Yard Seawater Intake)	370	836539	811529
C2	Impact Station (Coral sites along the coast of Round Island)	450	847579	805787
C3	Impact Station (Coral sites along the coast of Chung Hom Kok)	1030	838275	807941
G1	Gradient Station (Between Ocean Park's Main Seawater Intake and cable alignment)	143	836306	810867
E1	Control Station for Area A in Ebb Tide	1,520	834695	808775
F1	Control Station for Area A in Flood Tide	1,330	838953	807607
Area B: The waters from Beaufort Island to Waglan Island where a number of sensitive receivers are located close to the cable alignment. Covers the cable alignment between Chainage 11.117 km and 20.014 km.				
C6	Impact Station (Coral sites along the coast of south & east Beaufort Island)	1,140	844548	805397
C7	Impact Station (Coral sites along the coast of Po Toi Island)	1,320	845334	804749
C8	Impact Station (Coral sites along the coast of Sung Kong Islet)	330	846901	805922
C9	Impact Station (Coral sites along the coast of Sung Kong)	560	837028	808316
C11	Impact Station (Coral sites along the coast of Waglan Island)	660	849664	805649
C13	Impact Station (Coral site along the coast of north Beaufort Island)	670	843316	805606
M3	Impact Station (Cape d'Aguilar Marine Reserve)	690	844817	807259
G2	Gradient Station (Between M3 Cape d'Aguilar Marine Reserve and cable alignment)	343	844824	806909
G3	Gradient Station (Between C8 Coral sites along the coast of Sung Kong Islet and cable alignment)	166	846878	806086
E2	Control Station for Area B in Ebb Tide	1580	841090	803463

Station	Nature	Approx. Geodesic Distance ^ to Proposed Cable Alignment (m)	Easting	Northing
F2	Control Station for Area B in Flood Tide	2570	849986	803673

Note: ^ Geodesic distance refers to the shortest straight line distance between two locations, without regard on the physical obstacles in between.

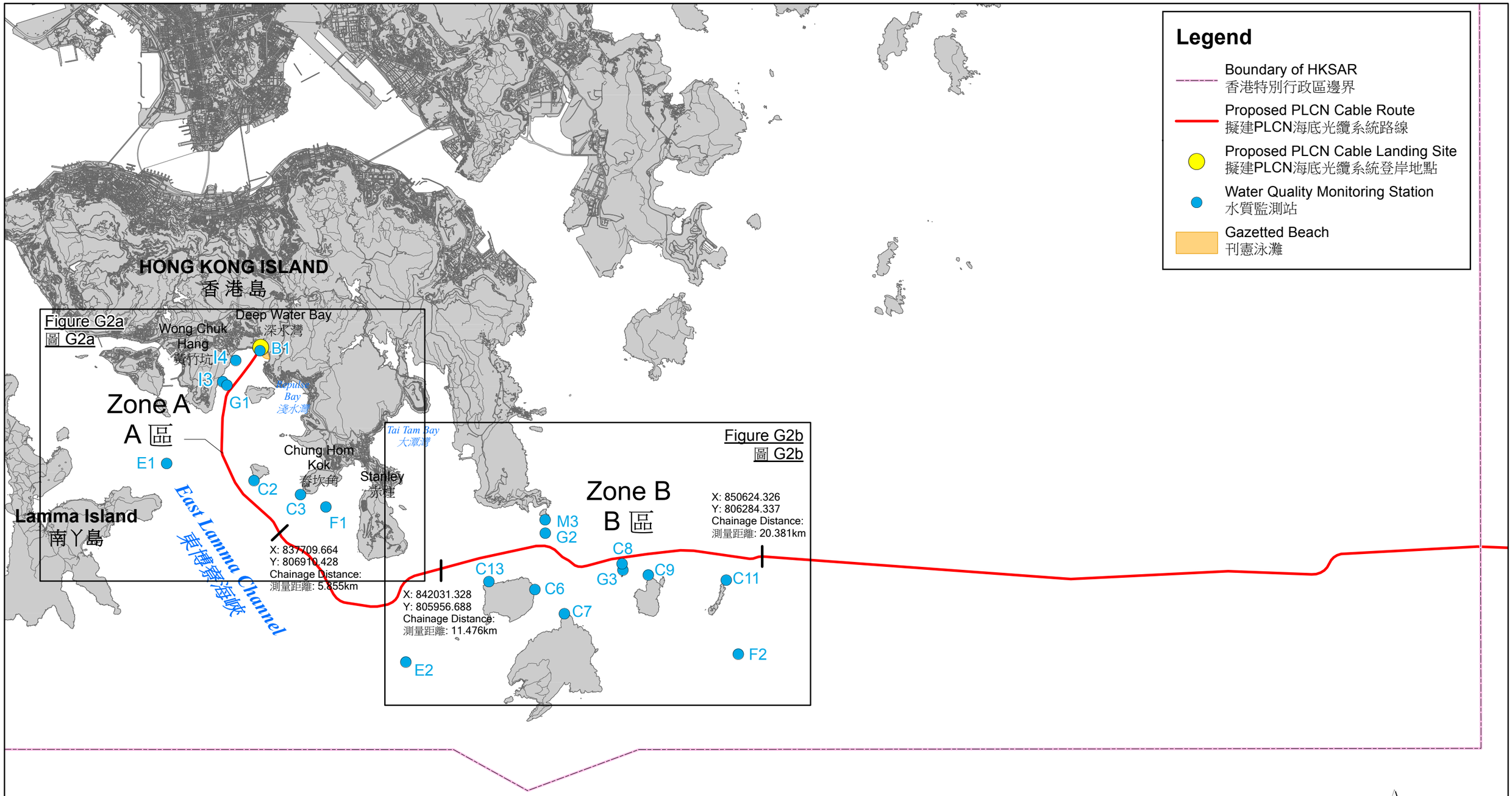

Figure G1
圖 G1

Water Quality Monitoring Stations - Overview
水質監測圖 - 概覽

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Environmental Resources Management

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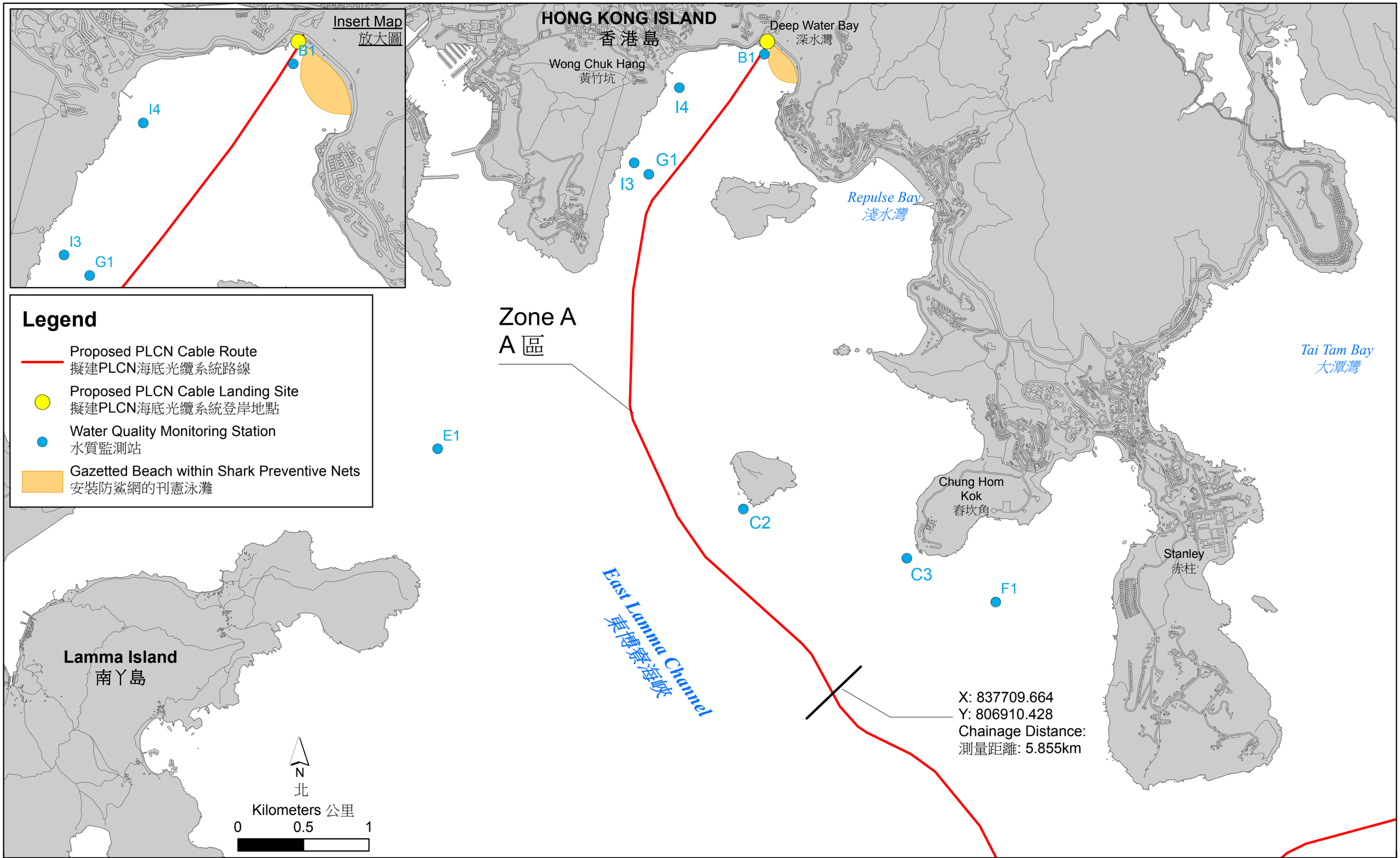

Figure G2a
圖 G2a

Water Quality Monitoring Stations - Zone A
水質監測站 - A 區

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HONG KONG ISLAND
香港島

Tai Tam Bay
大潭灣

Sheung Sze Mun
雙四門

X: 842031.328
Y: 805956.688
Chainage Distance:
測量距離: 11.476km

X: 850624.326
Y: 806284.337
Chainage Distance:
測量距離: 20.381km

M3
G2
G3
C8
C9
C11
C13
C6
C7
E2
F2

Beaufort Island
螺洲

Sung Kong
宋崗

Waglan Island
橫瀾島

Po Toi
蒲台

Legend

- Water Quality Monitoring Station
  水質監測站
- Proposed PLCN Cable Route
  擬建PLCN海底光纜系統路線

N
北

Kilometers 公里
0 1 2

Figure G2b
圖 G2b

Water Quality Monitoring Stations - Zone B
水質監測站 - B 區

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G2.3 SAMPLING PROCEDURES

G2.3.1 Monitoring Frequency

Baseline Monitoring

Baseline Monitoring will comprise sampling on three occasions (days) prior to, but no more than six weeks before, cable installation/ repair operation work. The interval between two sets of monitoring shall not be less than 36 hours. The monitoring will be undertaken at all (i.e. seventeen (17) monitoring stations, as shown in *Table G1* for cable installation works. For any cable repair works monitoring will be undertaken in the area where repair works will be carried out at all eight (8) monitoring stations of Area A if located within Area A, all eleven (11) monitoring stations of Area B if located within Area B, and all seventeen (17) monitoring stations if located across both Areas A and B. Samples will be taken during mid-flood and mid-ebb tidal state on each sampling occasion.

Impact Monitoring

The impact monitoring works shall cover all monitoring stations within the same area (Area A or Area B as shown in *Figure G1*, *G2a and G2b*) as the works being undertaken for the cable installation/ repair operation. Monitoring should be conducted at all monitoring stations in Area A on the working day if cable installation/ repair operation works would be conducted within Area A on that day. Similarly for any cable installation/ repair operation works within Area B, works would be conducted within Area B on that day. *In-situ* data and SS data will be collected at monitoring stations (actual time interval subject to the sampling vessel travelling time among stations) during the cable installation/ repair operation works.

Post Project Monitoring

Post Project Monitoring will comprise sampling on three occasions (days) within three weeks after completion of the cable installation/ repair operation works at the same stations as Baseline Monitoring, during mid-flood and mid-ebb tides. The interval between two sets of monitoring shall not be less than 36 hours.

G2.3.2 Timing

For Baseline and Post Project Monitoring, water quality sampling will be undertaken within a 4 hour window of 2 hours before and 2 hours after mid flood and mid-ebb tides.

For Impact Monitoring, *in-situ* data and SS data will be collected at 2-hour intervals (actual time interval subject to the sampling vessel travelling time among stations) during the cable installation/ repair operation works.

The environmental contractor will be responsible for liaison with the engineering contractor to ensure installation/ repair operation works are being undertaken during the water quality sampling. Tidal range for flood and ebb tides should not be less than 0.5 m for capturing representative tides.

Table G2 summarizes the monitoring frequency and timing for baseline, impact and post monitoring.

Table G2 ***Summary of Monitoring Frequency***

Zone	Baseline	Impact	Post
Zone A: Impact stations B1, I3, I4, C2 and C3; Gradient station G1, and Control stations E1 and F1.	Three (3) occasions (days), twice (a 4 hour window of 2 hours before and 2 hours after mid flood and mid-ebb tides) at each occasion.	2-hour intervals when cable installation/repair works is in Zone A. (actual time interval subject to the sampling vessel travelling time among stations)	Three (3) occasions (days), twice (a 4 hour window of 2 hours before and 2 hours after mid flood and mid-ebb tides) at each occasion.
Zone B: Impact stations C6-C9, C11, C13 and M3; Gradient stations G2 and G3, and Control stations E2 and F2.		2-hour intervals when cable installation/repair works is in Zone B. (actual time interval subject to the sampling vessel travelling time among stations)	

G2.3.3 ***Depths***

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

G2.4 ***COMPLIANCE/ACTION EVENT PLAN***

Water quality monitoring results will be evaluated against Action and Limit levels shown in *Table G3*.

Table G3 ***Action and Limit Level for Water Quality (based on the result of the Baseline Report)***

Parameter	Action Level	Limit Level
SS in mgL^{-1} (Depth-averaged)	95%-ile of baseline data, or 20% exceedance of value at any impact station compared with corresponding data from control station	99%-ile of baseline data, or 30% exceedance of value at any impact station compared with corresponding data from control station

Parameter	Action Level	Limit Level
DO in mgL^{-1}	Surface and Middle	Surface and Middle
	5%-ile of baseline data for surface and middle layer	4mg/L or 1%-ile of baseline for surface and middle layer
	Bottom	Bottom
	5%-ile of baseline data for bottom layers	2mg/L or 1%-ile of baseline data for bottom layer
Turbidity in NTU (Depth-averaged)	95%-ile of baseline data, or 20% exceedance of value at any impact station compared with corresponding data from control station	99%-ile of baseline data, or 30% exceedance of value at any impact station compared with corresponding data from control station

Notes:

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

b. "Depth-averaged" is calculated by taking the arithmetic means of reading of all sampled depths.

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

d. Limit level for DO was derived from the Water Quality Objectives (WQO) for Junk Bay, Eastern Buffer, and Mirs Bay Water Control Zones under the Water Pollution Control Ordinance (WPCO) Chapters 358L, 358Y, and 358I respectively.

The measures that will be undertaken in the event that the Action or Limit Levels are exceeded are shown in *Table G4*.

Table G4 Event Action Plan for Water Quality

Event	Contractor
Action Level Exceedance	**Step 1** - repeat sampling event. Where applicable, review results of gradient station(s) to confirm the source of impact. **Step 2 –** Inform EPD and AFCD and confirm notification of the non-compliance in writing; **Step 3** - discuss with cable installation/ repair operation contractor the most appropriate method of reducing suspended solids during cable installation/ repair operation (e.g. reduce cable laying speed/pressure in jetting water) and agree with EPD. **Step 4** - repeat measurements after implementation of mitigation for confirmation of compliance. **Step 5** - if non-compliance continues - increase measures in Step 3 and repeat measurements in Step 3. If non-compliance occurs a third time, suspend cable installation/ repair operations.

Event	Contractor
Limit Level Exceedance	**Step 1** - Suspend cable installation/repair operations immediately (until the cause of the non-compliance is detected and the situation is rectified).
	Step 2 - repeat sampling event. Where applicable, review results of gradient station(s) to confirm the source of impact.
	Step 3 – Inform EPD and AFCD and confirm notification of the non-compliance in writing
	Step 4 - discuss immediately with cable installation/ repair operation contractor the most appropriate method of reducing suspended solids during cable installation/ repair operation (e.g. reduce cable laying speed/pressure in jetting water) and agree with EPD.
	Step 5 - repeat measurements after implementation of mitigation or suitable time has elapsed since suspension of cable installation/ repair operations, for confirmation of compliance.
	Step 6 -. Repeat Step5 until measurements show compliance.

G2.5 REPORTING

Schedule for baseline and impact monitoring should be submitted to the Environmental Protection Department (EPD) at least 2 weeks before commencement of the monitoring works for agreement.

The reports to be provided shall include:

- Baseline Monitoring Report;
- Weekly Impact Monitoring Reports; and
- Post Project Monitoring Report.

The Baseline Monitoring Report shall be provided no later than two weeks before the cable installation/ repair operation work and the report should be submitted to EPD for agreement on the Action/Limit Levels. The Impact Monitoring Report will be provided weekly within three days after the relevant monitoring data are collected or become available during the cable installation/ repair operation work. The Post Project Monitoring Report to review the environmental status after cable installation/ repair operation and compare with the results as presented in the Baseline Monitoring Report shall be provided within one month after completion of the marine works.

The Baseline Monitoring Report shall include the following details:

- brief project background information;
- drawings showing locations of the baseline monitoring stations;

- an updated construction/ repair operation programme with milestones of environmental protection/mitigation activities annotated;

- monitoring results together with the information including monitoring methodology, parameters monitored, monitoring locations (and depth), monitoring date, time, frequency and duration;

- details on influencing factors, including major activities, if any, being carried out on the Site during the period, weather conditions during the period and other factors which might affect the results;

- determination of the Action and Limit Levels (AL levels) for each monitoring parameter and statistical analysis of the baseline data, the analysis shall conclude if there is any significant difference between control and impact stations for the parameters monitored; and

- comments and conclusions.

The Weekly Impact Monitoring shall include, but not limited to, the following details:

- Basic Project Information - construction/ repair operation programme with fine tuning of activities showing the inter-relationship with environmental protection/mitigation measures for the week and works undertaken during the week;

- Operating practices of the cable installation/ repair machinery during sampling (including: position, speed, cable burial depth during installation and repair operations where relevant) and an interpretation of monitoring results; and

- The monitoring data should be provided graphically to show the relationship between the Control and the Impact monitoring stations and compliance or non-compliance with respect to the Action/Limit Levels.

The Post Project Monitoring Report shall include the following details:

- brief project background information;

- drawings showing locations of the baseline monitoring stations;

- full construction/ repair operation programme with milestones of environmental protection/mitigation activities annotated;

- monitoring results together with the information including monitoring methodology, parameters monitored, monitoring locations (and depth), monitoring date, time, frequency and duration. Monitoring results should show relationship between Control and Impact monitoring stations

and compliance or non-compliance with respect to the Action/Limit Levels;

- review the environmental status after the cable installation/ repair operation and compare with the results as presented in the Baseline Monitoring Report; and
- comments and conclusions.

G3 CORAL MONITORING

Coral communities at Round Island and Sung Kong Islet, which are in the vicinity of the proposed cable alignment, may have the potential to be indirectly disturbed through impact on water quality during cable installation/ repair operation works. However, no unacceptable indirect impacts on coral communities are expected to occur due to the following reasons.

- Firstly, the coral communities at Round Island and Sung Kong Islet are within 500 m of the proposed cable alignment but at least 150 m from the boundary of the dispersal range of suspended sediment generated from the injection jetting method. The sediment plume calculation indicated that the disturbed sediments would have settled onto the seabed in less than 4 minutes before they can travel to the coral communities at Round Island and Sung Kong Islet.

- Secondly, the cable installation/ repair operation works will be of small-scale, short-term and temporary (approximately 15 working days for the installation along the whole cable alignment, less time for repair operations, and only several workings hours for the sections near Round Island, and Sung Kong Islet).

Nevertheless, coral monitoring is recommended to verify that the cable installation/ repair operation works will not result in any unacceptable impacts to the coral communities at Round Island and Sung Kong Islet. Coral monitoring is not recommended to be undertaken at DWB which is in close vicinity to the proposed cable landing site, and Middle Island which is near to the proposed cable alignment, given that low abundance and diversity of corals were recorded at the subtidal hard bottom habitat of these areas. In addition, Sung Kong Islet is exposed and coral monitoring at this site is considered not feasible in terms of health and safety most of the time. Since the proposed coral monitoring site at Sung Kong is close to Sung Kong Islet and has a relatively higher coral abundance and diversity than Sung Kong Islet, it is considered that monitoring at Sung Kong is sufficient to reflect the coral conditions at both Sung Kong and Sung Kong Islet. As such, it is not recommended to conduct coral monitoring at Sung Kong Islet.

The following section provides details of the coral monitoring programme for the installation/ repair operation of the submarine cable.

G3.1 OBJECTIVES AND APPROACH

The objective of the coral monitoring programme is to verify whether any unacceptable impacts to coral communities at Round Island and Sung Kong Islet occur as a result of the cable installation/ repair operation works in the

marine environment ie during near-shore of offshore submarine cable works. Coral monitoring will be required if cable installation/ repair operation works will take place within 500 m of coral communities of High Ecological Value or Coral Communities with Relatively Higher Diversity and Abundance, as identified in *Annex B*, *Figure B1*.

The coral monitoring programme comprises the following two surveys:

1. Baseline Survey will be conducted within two weeks before any jetting works for the cable installation/ repair operation commence. The objective of the Baseline Survey is to identify suitable coral monitoring locations and to collect baseline monitoring data of corals at those locations for comparison with data collected during the Post Project Survey.

2. Post Project Survey will be conducted within one month after completion of the cable installation/ repair operation works of the Project. During the Post Project Survey, data will be collected at the same locations and using the same methodology as the Baseline Survey. The Post Project Survey data will be used to compare with the baseline data in order to determine any detectable changes in coral conditions after cable installation/ repair operation works.

Coral monitoring will not be undertaken during jetting works as any works near Round Island and Sung Kong will only last for several hours which will not allow adequate time for completion of the coral monitoring surveys at the monitoring locations.

Coral monitoring data will be reviewed in conjunction with the relevant water quality monitoring data which will measure the levels of suspended solids generated during jetting works.

G3.2 MONITORING LOCATIONS

Coral monitoring will be undertaken at Round Island and Sung Kong (Monitoring Stations), and a Control Station at Po Toi which is located more than 1 km from the cable alignment and thus unlikely to be impacted by cable works. The monitoring locations are shown in *Figure G3* and detailed below:

Monitoring Stations:

- Zone A: Round Island; and
- Zone B: Sung Kong.

Control Station:

- Zone C: Po Toi.

Deep Water Bay
深水灣

HONG KONG ISLAND
香港島

Middle Island
(Tong Po Chau)
雙洲

Repulse Bay
淺水灣

Big Wave Bay
大浪灣

Tung Lung Chau
東龍洲

Shek O
石澳

Tai Tam Bay
大潭灣

Chung Hom Wan
春坎灣

Round Island
銀洲

Zone A

Chung Hom Kok
春坎角

Stanley
赤柱

East Lamma Channel
東博寮海峽

Sheung Sze Mun
雙四門

Zone B

Beaufort Island
螺洲

Sung Kong
宋崗

Zone C

Po Toi
蒲台

Legend 圖例

- Proposed PLCN Cable Landing Site
  擬建PLCN海底光纜系統登岸地點
- Proposed PLCN Cable Route
  擬建PLCN海底光纜系統路線
- Monitoring Station
  監測站
- Control Station
  參考站
- Gazetted Bathing Beach at Deep Water Bay
  位於深水灣的刊憲泳灘

N
北

Kilometers 公里

0 1 2

Figure G3
圖 G3

Proposed Monitoring Locations for the Baseline and Post Project Coral Monitoring
擬議基線及工程項目完成後珊瑚監測地點

File: T:\GIS\CONTRACT\0335723\Mxd\0335723_Proposed_Coral_Monitoring_Location_bil.mxd
Date: 21/3/2017

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At each monitoring station, coral monitoring will be undertaken in two depth zones (ie shallow water: -2 to -5 mCD and deep water: -5 to -15 mCD). The depth ranges may be revised based on observations of coral distribution during the Baseline Survey.

G3.3 MONITORING METHODOLOGY

G3.3.1 Monitoring Personnel

The coral monitoring works should be undertaken by a qualified coral specialist hired by the ET. The qualified coral specialist should be a degree holder in marine sciences with at least three years of post-graduate experience in the field of marine ecology and undertaking coral surveys. The same coral specialist should be used for each dive survey to maintain consistency in the documentation of the coral condition and should be approved by AFCD in advance of undertaking the monitoring work.

G3.3.2 Survey Methodology

The Baseline Survey comprises the following three components:

- Qualitative spot dive survey;
- Semi-quantitative Rapid Ecological Assessment (REA) survey; and
- Coral Colony Monitoring.

The Post Project Survey comprises the same components as the Baseline Survey, except that the qualitative spot dive survey will not be undertaken. Survey methodology of the three components is described below.

Qualitative Spot Dive Survey

The qualitative spot dive survey will be undertaken as part of the Baseline Survey only to identify suitable coral monitoring locations at Round Island, Sung Kong and Po Toi. During the survey, spot dive reconnaissance checks will be conducted within the designated Monitoring and Control Stations by SCUBA to collect qualitative information including coral composition, abundance and distribution. Based on the information collected, locations with relatively higher coral abundance and number of species/genus will be selected for each station for the subsequent REA survey and coral colony monitoring during the Baseline and Post Project Surveys. The depth range (shallow and deep) to be monitored will also be finalised based on observed coral distribution.

Rapid Ecological Assessment (REA) Survey Method

A standardised semi-quantitative REA survey technique will be used to investigate the general conditions of the coral communities (hard, soft and

black corals) associated with subtidal hard bottom habitats at the Monitoring and Control Stations. The collection of REA data during the Baseline and Post Project Surveys would allow for a comparison of coral conditions before and after cable installation/ repair operation works in order to determine any changes in conditions due to the works.

The REA technique allows semi-quantitative information on the ecological attributes of the subtidal habitat to be obtained in a relatively simple way without compromising scientific rigour. This technique is the standard practices for EIA marine baseline surveys in Hong Kong and has been modified from the standardised REA survey technique established for the assessment of coral communities on the Great Barrier Reef (1) for marine environment of Hong Kong (2).

A series of REA surveys will be conducted by qualified coral specialist by SCUBA at the Monitoring stations (Round Island and Sung Kong; *Figure G3*) and Control Station (Po Toi; *Figure G3*) with the aim to record the condition of substratum, estimate the diversity and relative abundance of coral assemblages (ie hard corals, octocorals and black corals) and with all hard coral colonies identified to species level while octocorals and black corals recorded to genus level. The survey will be undertaken on REA transects laid onto the seabed, each of which measure 100 m in length, at the following two depth zones of each station:

- Shallow depth region: -2 to -5 m CD (typically the depth range of hard coral colonies associated with subtidal hard bottom habitat); and
- Deep depth region: -5 to -15 m CD.

The location of the REA transects as well as the depth ranges of the monitored depth zones will be determined based on findings from the qualitative spot dive survey. A total of two (2) REA transects will be monitored at each depth region of Round Island, Sung Kong and Po Toi.

Following the laying of the transect line, the coral specialist will swim along the transect slowly and conduct the REA survey. The REA methodology will encompass 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. The belt transect width was dependent on underwater visibility and might be adjusted to a swathe ~ 2 m wide, 1 m either side of each transect in case of reduced visibility. An explanation of the two assessment categories (Tiers) used in the survey is presented below.

(1) DeVantier, L.M., G.De'Ath, T.J. Done and E. Turak (1998). *Ecological assessment of a complaex 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 octocoral communities and benthic cover along a water quality gradient in reefs of Hong Kong.* Marine Pollution Bulletin 52: 22-23.

Tier I – Categorisation of Benthic Cover

Upon the completion of each survey transect, ecological and substratum attributes will be assigned to standard ranked (ordinal) categories (*Tables G5a* and *G5b*).

Table G5a ***Tier I Benthic Attribute Categories***

Ecological Attributes	**Substratum Attributes**
Hard coral	Bedrock
Dead standing coral	Continuous pavement
Octocoral (Soft corals and Gorgonians)	Rocks (<26 cm)
Black coral	Large boulders (>50 cm)
Macroalgae	Small boulders (<50 cm)
Other Benthos (including sponges, zoanthids, ascidians and bryozoans)	Rubble
	Sand
	Mud/ Silt
	Other

Table G5b ***Tier I Ordinal Ranks of Percentage Cover of Benthic Attributes***

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 be compiled for each transect. Taxa will be identified *in situ* to the following levels:

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

Following the completion of the survey of each transect, each taxon in the inventory will be ranked in terms of abundance in the community (*Table G6*). 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. Representative photos of organisms will be taken.

Table G6 ***Ordinal Ranks of Taxon Abundance***

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

Note:

(a) The classification of "sparse" 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 will also be recorded for each REA transect as follows:

(A) The degree of exposure to prevailing wave energy will be 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 (experiences the full force of prevailing wave energy).

(B) Sediment deposition on the reef 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 cleaned 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 coastline on SCUBA from haphazardly-chosen starting points. REA surveys will be carried out using 100 m long transect with the transect tapes laid out within a single ecological

zone - habitat - depth range. A suite of representative photographs will be captured for each REA transect.

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

Once the transect photographs have been reviewed and REA data checked all data will be inputted and stored in Excel spreadsheets. Two spreadsheets will be used and data will be separated into:

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

Coral Colony Monitoring

Coral colony monitoring will be undertaken during the Baseline and Post Project Surveys to identify any evidence of sediment stress to corals before and after cable installation/ repair operation works. At each coral monitoring station, a total of fifteen (15) hard coral colonies and fifteen (15) octocoral/black coral colonies will be selected for monitoring. Due to limited hard coral colonies recorded at Round Island (Zone A of *Figure G3*), only fifteen (15) octocoral/ black coral colonies will be selected for monitoring at this Monitoring Station. Priority will be given to selecting colonies of horizontal plate-like and massive growth forms which present large stable surfaces for the interception and retention of settling solids. Each of the selected corals will be identified to species or genus levels and photographed. The following data will be collected:

- Maximum diameter of the identified hard coral and soft coral colonies;
- Maximum height and width of the identified gorgonians and black corals;
- Percentage of sediment cover on the identified colonies and the colouration, texture and approximate thickness of sediment on the coral colonies and adjacent substrate. Any contiguous patches of sediment cover >10 % were recorded;
- Percentage of bleached area on the identified colonies of which two categories were recorded: a. blanched (ie pale) and b. bleached (ie whitened);
- Percentage of colony area showing partiality mortality; and

- Physical damage to colonies, tissue distension, mucous production and any other factors relevant will be noted in the field.

Other information such as the survey date, time, weather, sea and tidal conditions should also be recorded. The coral colony monitoring exercise will be undertaken to ensure colonies of similar growth forms and size will be selected for the Baseline and Post Project Monitoring. Although coral tagging is a common practice for repeated monitoring of individual colony, this technique will not be employed in this monitoring programme due to difficulties in locating the tagged corals given the generally low visibility in the area and low light conditions in deep water.

G3.4 REPORTING

Schedule for Baseline and Post Project Survey should be submitted to the Environmental Protection Department (EPD) at least one week before commencement of the monitoring works for agreement.

The reports to be provided should include the Baseline Monitoring Report and Post Project Monitoring Report.

The Baseline Monitoring Survey Report should be submitted within two weeks after the completion of the baseline monitoring and the report should include the following details:

- Brief project background information;
- Monitoring results together with the information including monitoring methodology, parameters monitored, monitoring locations (and depth), monitoring date, time, frequency and duration; and
- Comments and conclusions.

Post Project Survey Report should be submitted within one month after the completion of the post monitoring and the report should include, but not limited to, the following details:

- Basic Project information;
- Review of the coral conditions at the monitoring stations and the health status of the corals after the cable installation/ repair operation and compare with the results as presented in Baseline Monitoring Report; and
- Discussion of any detected adverse impacts to coral communities as a result of the cable installation/ repair operation works.

G4 MARINE MAMMAL OBSERVATION

Cable installation/ repair operation works may result in a minor and short term increase in underwater sound from marine vessels. Given that Finless Porpoises and Chinese White Dolphins use high frequency ultrasonic clicks for foraging and communication, the low frequency underwater sound associated with vessels, jetting and cable laying are not expected to interfere significantly with these two species of cetaceans. No unacceptable adverse impacts to Finless Porpoises and Chinese White Dolphins from underwater sounds are expected to occur during either cable installation or repair operations. The cable installation works will be short-term and temporary, and be carried by one cable installation barge within a total of approximately 15 working days in HKSAR waters. The Finless Porpoises and Chinese White Dolphins are hence not expected to be disturbed by the cable laying vessel. Any cable repair works are expected to of shorter-term than initial cable installation works and therefore also not expected to disturb Finless Porpoise or Chinese White Dolphins

However, additional precautionary measure will be implemented for marine mammals during the cable installation works and as required during cable repair operations.

A marine mammal exclusion zone within a radius of 250 m from the cable installation/repair operation vessel will be implemented during the cable installation/repair operation works taking place in daylight hours along the section outside Area A (location refer to *Figure G1*). The marine mammal exclusion zone will be monitored by qualified observer(s)(1) with an unobstructed, elevated view of the area. The view will be undertaken from the cable installation/repair operation vessel. The viewpoint will be proposed by the Independent Checker.

Qualified observer(s) will stand on the open upper decks of the vessel, allowing for observer eye heights of 4 to 5 m above water level and relatively unobstructed 180° visibility. Vessel-based observation by the observer(s) shall be conducted by searching an 180° swath where the installation/repair works are being conducted at the centre, with appropriate marine binoculars, scanning the same area with the naked eyes and occasional binocular check.

Qualified observer(s) will scan the 250 m exclusion zone for at least 30 minutes prior to the start of cable installation/repair works. If marine mammals are observed in the exclusion zone, cable installation/repair works will be

(1) The qualification and experience of the qualified observer(s) shall be to the satisfaction of the Director of Agriculture, Fisheries and Conservation (DAFC). The qualified observer(s) for the marine mammal monitoring must be suitably trained to conduct the visual monitoring works. CVs of the qualified observer(s) will be provided to the DAFC prior to commencement of monitoring surveys.

delayed until they have left the area. This measure will confirm that the area in the vicinity of the cable installation/repair work is clear of marine mammals prior to the commencement of works and will serve to reduce any disturbance to marine mammals. As per previous practice in HKSAR, should cetaceans move into the works area during cable installation/repair operation vessel, it is considered that cetaceans will have acclimatised themselves to the works therefore cessation of cable installation is not required (1).

The marine mammal exclusion zone monitoring will be required during periods when there are cable installation works or repair operation works as necessary. Daily monitoring will be conducted until the completion of cable installation works or repair operation works as agreed.

(1) This precautionary measure is consistent with conditions for grab dredging works inside the Sha Chau and Lung Kwu Chau Marine Park included in the issued Environmental Permit for the Permanent Aviation Fuel Facility for Hong Kong International Airport project

G5 SITE INSPECTIONS

Daily site inspection will be undertaken at the landing point (ie from LWM to Beach Manhole (BMH) at Deep Water Bay (DWB) during cable installation/ repair operations in this area (ie during Land cable works) to ensure that appropriate environmental protection and precautionary measures outlined in the Project Profile Main Text, are properly implemented, in particular regarding protection of the existing trees and to keep Deep Water Bay beach in a safe and environmentally friendly condition for the general public, as well as ensuring no hazard to the public due to the Project.

G5.1 PRIOR TO CABLE INSTALLATION/ REPAIR AT LAND AND SHORE-END

- In order to minimise the risk of disturbance to the existing utilities, the Contractor should confirm the location of all the utilities within the works area with the relevant departments, for example, but not limited to, Drainage Services Department, Architectural Services Department, Water Services Department and other departments/companies.

- The Project proponent will ensure there will be no sand lost during the construction/ repair works here. The beach will be photographed prior to the commencement of the works (and after the restoration of the site) in order to assure the beach will be reinstated to the pre-works conditions.

- Legible notices will be put on site to show the commencement and completion dates of the land and shore-end works, daily working hours and emergency contact person and number.

G5.2 LAND AND SHORE-END CABLE INSTALLATION/ REPAIR PERIOD

G5.2.1 Works Area Demarcation, Marshalling & Notices

- On shore, the work area will be clearly demarcated using warning tape/ markers and marshals, and fenced off with barriers to ensure the public are kept clear.

- Security guards will stay overnight on site and ensure the public remains at a safe distance and outside the general works area. On land the open section of trench will be clearly demarcated by means of warning tape and lights. In the shallows and offshore, marshals will also ensure the public remains clear of the works area eg for night time/ early morning swimmers.

G5.2.2 ***Working Hours***

- Trenching works will take place during the day-time period, ie 09:00 am to 6:00 pm, and restricted to weekdays, ie Monday to Friday. Security guards will stay overnight on site and the open section of trench will be clearly demarcated by means of warning tape and lights.

G5.2.3 ***Precautionary Measures Concerning Trees***

- The Contractor should comply with conditions stipulated by LCSD for tree protection.

- Excavation works in the vicinity of the utilities or trees will be carried out by hand-held equipment only, with the utmost care to minimise the risks to their structure / roots.

- The machinery employed will be inspected prior to work commencing on the beach then at least daily thereafter to ensure the waters and beach will not be polluted with oil/grease/fuel. Oil absorbent materials will be readily placed on site and will be applied immediately during oil leakage incidents to make sure the swimming zone will not be affected.

G5.2.4 ***Precautionary Measures Concerning Noise***

- Only well-maintained plant should be operated on-site and plant should be serviced regularly during the construction programme.

- Machines and plant (such as backhoe) that may be intermittently used should be shut down between work periods or should be throttled down to a minimum.

- Plant known to emit noise strongly in one direction, for example an air compressor, should, where possible, be oriented so that the noise is directed away from nearby Noise Sensitive Receivers (NSRs) identified in *Annex D*..

- Mobile plant should be sited as far away from NSRs as possible.

- Silencers or mufflers on construction equipment should be utilised and should be properly maintained during the construction programme.

- Where necessary, movable noise barriers should be positioned within a few metres of noisy plant items.

G5.2.5 ***Other Precautionary Measures***

- All diver hand jetting works will be conducted within silt curtain works area for shore-end installation/ repair works, to provide protection to surrounding water from sediment. A silt curtain will also be set up at the

water line for land based works to provide further protect from sediments possibly dispersing into the nearby water.

- Beaches usually comprise of soil ground (sand) and rock/hard ground. When the cable is installed in the soil ground (sand) or underlying non cohesive sediments, the cable will be buried with a target depth of -2m, transitioning to 1m at the LWM. If the cable is to be buried in hard (cohesive) ground, the cable will be installed inside a trench of 300mm wide and 400mm deep to ensure the cable will not be easily exposed by the tidal movements. The burial will ensure the public does not come into contact with or become concerned over the presence of the cable.

- Within the shore-end section (approximately 300 m from LWM), the cable will be protected by a cast iron articulated pipe in order to prevent the public from touching the cable directly.

- Although the sand dust causing by strong wind during the trenching operation is unlikely to occur, water will be sprayed around the trenching areas to keep the "dust" down.

Site inspections will ensure the measures outlined in *Annex A* for water quality pollution prevention from land and shore-end cable installation/ repair works are implemented.

G5.3 POST-CABLE INSTALLATION/ REPAIR AT LAND AND SHORE-END

- The Project proponent will ensure there will be no sand lost during the cable installation/ repair works. The beach will be photographed (prior to the commencement of the works and) after the restoration of the site in order to assure the beach will be reinstated to the pre-works conditions.

G5.4 REPORTING

Site inspection results should be submitted to the Project Proponent and the Contractor(s) within 72 hours. Should actions be necessary, the Environmental Team will follow up with recommendations on improvements and will submit these recommendations in a timely manner to the Project Proponent and the Contractor(s). They will also be presented, along with the remedial actions taken, in an overall EM&A report for the Project. The Contractor(s) will follow the procedures and time frame stipulated in the environmental site inspection for the implementation of mitigation proposal and the resolution of deficiencies. An action reporting system shall be formulated and implemented to report on any remedial measures implemented subsequent to the site inspections.

G6 ENVIRONMENTAL COMPLAINTS

An Environmental Team (ET) will undertake the following procedures (*Figure G4*) upon receipt of a complaint:

i. log complaint and date of receipt into the complaint database;

ii. investigate the complaint and discuss with the Contractor(s) and Project Proponent to determine its validity and to assess whether the source of the issue is due to works activities;

iii. if a complaint is considered valid due to the works , the ET will identify mitigation measures in consultation with the Contractor(s) and Project Proponent;

iv. if mitigation measures are required, the ET will advise the Contractor(s) accordingly;

v. review the Contractor(s)'s response on the identified mitigation measures and the updated situation;

vi. if the complaint is transferred from EPD, an interim report will be submitted to EPD on the status of the complaint investigation and follow-up action within the time frame assigned by EPD;

vii. undertake additional monitoring and audit to verify the situation if necessary and ensure that any valid reason for complaint does not recur;

viii. report the investigation results and the subsequent actions on the source of the complaint for responding to complainant. If the source of complaint is EPD, the results should be reported within the time frame assigned by EPD; and

ix. record the complaint, investigation, the subsequent actions and the results in the EM&A report.

During the complaint investigation work, the Contractor(s) and Project Proponent will cooperate with the ET in providing the necessary information and assistance for completion of the investigation. If mitigation measures are identified in the investigation, the Contractor(s) will promptly carry out the mitigation measures. The Project Proponent will approve the proposed mitigation measures and the ET will check that the measures have been carried out by the Contractor(s).

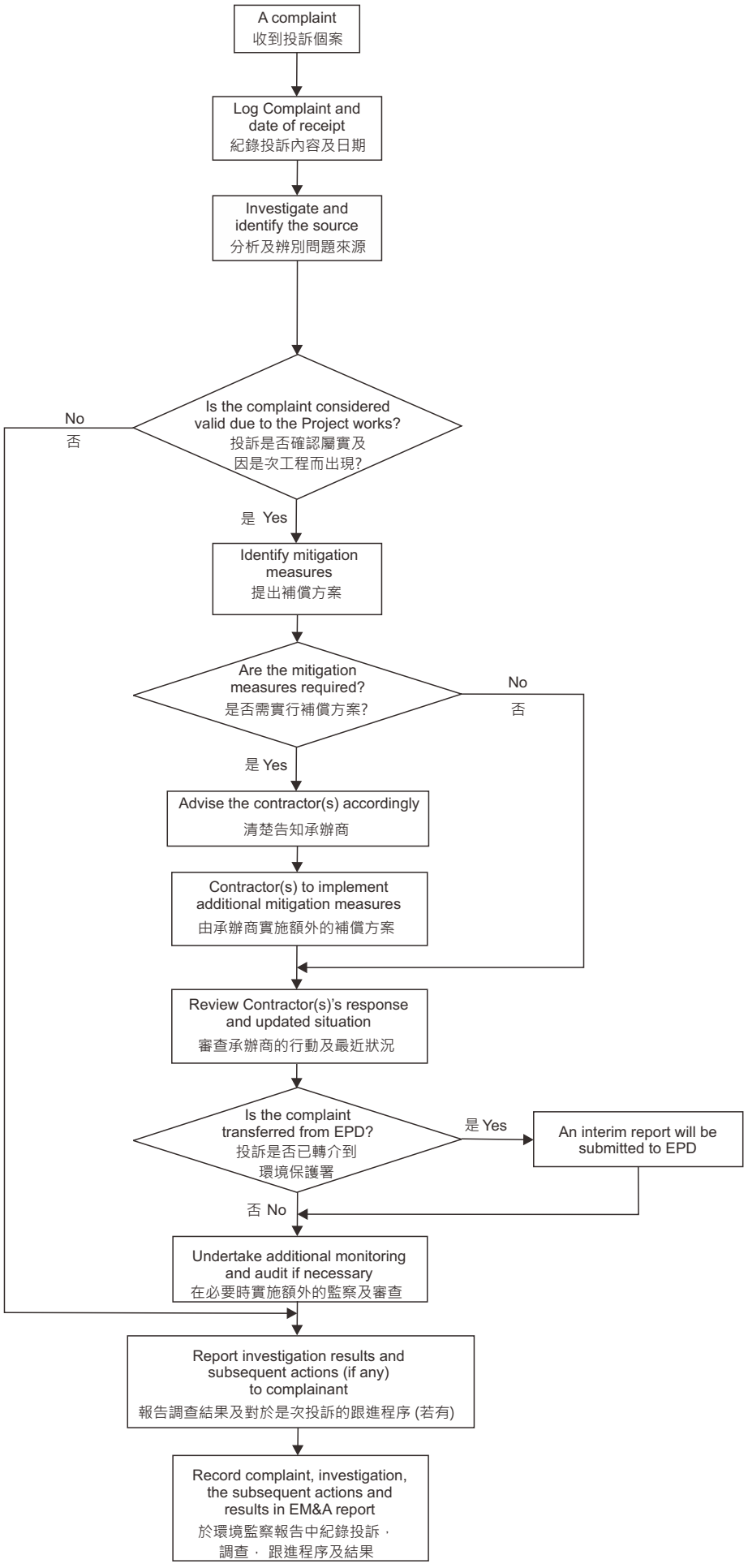

Figure G4
圖 G4

Flow Chart for Handling Environmental Complaints
處理環境問題投訴之流程圖

FILE: 0122859c3-chi
DATE: 19/10/2016

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