Member of the Surbana Jurong Group

Project Profile

Hong Kong – Guam Submarine Cable Project (HK-G)

March 2019

Project/Deliverable No.	7076521 | D03/01 – Revision 2.8
Project Name	Hong Kong – Guam Submarine Cable Project (HK-G)
Report Name	Project Profile
Report Date	March 2019
Report for	NTT Com Asia Limited

PREPARATION, REVIEW AND AUTHORISATION

Revision#	Date	Prepared by	Reviewed by	Approved by
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1.1 (Revised Draft)	September 2017	Michelle PANG	Fred NG	Alexi BHANJA
1.2 (Revised Draft)	November 2017	Michelle PANG	Fred NG	Alexi BHANJA
2.0 (Draft Final)	March 2018	Joanne PONG	Fred NG	Alexi BHANJA
2.1 (Draft Final)	July 2018	Joanne PONG	Fred NG	Alexi BHANJA
2.2 (Final)	September 2018	Joanne PONG	Fred NG	Alexi BHANJA
2.3 (Revised Final)	October 2018	Joanne PONG	Fred NG	Alexi BHANJA
2.5 (Revised Final)	November 2018	Joanne PONG	Fred NG	Alexi BHANJA
2.6 (Revised Final)	December 2018	Joanne PONG	Fred NG	Alexi BHANJA
2.7 (Revised Final)	February 2019	Joanne PONG	Fred NG	Alexi BHANJA
2.8 (Revised Final)	March 2019	Joanne PONG	Fred NG	Alexi BHANJA

ISSUE REGISTER

Distribution List	Date Issued	Number of Copies
NTT Com Asia Limited	March 2019	1 soft copy
Environmental Protection Department	March 2019	1 soft copy
SMEC Project File:		1 electronic

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1 BASIC INFORMATION

1.1 Project Title

1.1.1 The title of the Project is "Hong Kong – Guam Submarine Cable Project (HK-G)".

1.2 Purpose and Nature of the Project

1.2.1 The HK-G Cable is a 38mm diameter submarine telecommunications cable, with a total length of 3700 km, linking the island of Guam, in the western Pacific Ocean, and Hong Kong. This Project contributes to the expansion of communications networks between China, Hong Kong and the United States, in addition to those between Southeast Asia and the United States. Buried below the seabed, the HK-G Cable enters the eastern waters of Hong Kong and terminates at the Tseung Kwan O Industrial Estate (TKOIE). It will provide Hong Kong with faster and more diverse international telecommunications services and will help to meet the growing demand for greater bandwidth. Installation of the HK-G Cable is scheduled to be completed in Q3 2019 and the system to be in service by the end of 2019.

1.2.2 Tseung Kwan O is a strategically important telecommunications and media hub in Hong Kong. Within TKOIE there are several high-tier data centres, such as Hong Kong Stock Exchange, HKColo, NTT, Digital Realty, China Mobile, HSBC, China Unicom, etc. There are also more data centres under construction within TKOIE, including Global Switch data centre, and at designated sites elsewhere in Tseung Kwan O, such as SUNeVision MEGA Plus data centre, which opened in October 2017.

1.2.3 TKOIE has purpose-designed landing points (ducts) for submarine cables built into the existing Harbour seawall that connect into a Beach Manhole (BMH) behind the seawall. These ducts and BMH are currently used by several local and international telecommunication cable systems, including the *East Asia Crossing ("EAC") Cable System*, *Asia Submarine-cable Express ("ASE") System*, *Asia Pacific Gateway ("APG") System*, *TKO Express – Cable System ("TKOE")* and the planned *Ultra Express Link ("UEL")*. Further cables are also planned to use these ducts.

1.2.4 An assessment of the potential environmental impacts associated with the Project has been provided in this Project Profile. The construction and installation of the HK-G Cable is virtually identical to other telecommunication cable systems that have been installed at TKOIE and within other areas of Hong Kong, all of which have been given permission to apply directly ("Direct Application") for the required Environmental Permit (EP).

1.3 Name of Project Proponent

NTT Com Asia Limited
6 Chun Kwong Street
Tseung Kwan O Industrial Estate
Hong Kong

1.4 Location and Scale of Project

Location of Project

1.4.1 The Project comprises of the installation of a high capacity network cable system between the eastern boundary of Hong Kong Waters and the cable landing point at TKOIE.

1.4.2 The alignment of HK-G Cable between the eastern boundary of Hong Kong and TKOIE is shown in ***Figures 1-1*** and ***1-2***. Entering Hong Kong waters in the east, the Cable follows the established "east-west cable corridor" to the north of Sung Kong island. The Cable then turns to the north and enters the existing "north-south cable corridor". The Cable enters Tathong Channel and terminates at the landing point at TKOIE, which is an existing duct in the Harbour seawall. The duct leads to the BMH within the reclaimed land of TKOIE and ultimately connects to a Cable Landing Station within TKOIE.

1.4.3 TKOIE is zoned as "Other Specified Uses (Industrial Estate)" in the approved Tseung Kwan O Outline Zoning Plan (OZP) No. S/TKO/24. The surrounding areas are zoned as Green Belt (GB), Open Space, Government, Institution or Community and Comprehensive Development Area.

1.4.4 The seabed where the Cable will be laid has been used over the years for fishing, material extraction, public utilities and for the laying of other cables. The seabed in the vicinity of the cable alignment has been significantly disturbed from its previous use as a designated Marine Borrow Area. Based on geophysical survey data, the seabed along the cable alignment shows scattered trawl scars and numerous dumped materials.

Scale of Project

1.4.5 As shown in ***Figure 1-1***, within Hong Kong waters the length of the HK-G Cable will be about 33.6km. No seabed dredging will be required for the cable laying or maintenance works, including repair works – see ***Paragraph.1.6.15***.

1.4.6 At the TKOIE landing point, the Cable emerges from the sea, enters an existing duct in the seawall and is then secured in the BMH. This shore-end installation process (up to around 20m from the seawall) will be performed by divers using jetting techniques to form a narrow trench in the seabed, approximately 0.5m wide and 5m deep. After the Cable is laid, the trench will naturally re-fill in a short space of time and the seabed will return to its original profile.

1.4.7 The remaining length of the Cable to the eastern boundary of Hong Kong will be buried by an "Injector Burial Tool" or "Sledge Tool" operated from a cable-laying vessel. The cable burial tool uses localised high-pressure jets directly around the Cable to fluidise a narrow trench in the seabed to the desired depth into which the cable is simultaneously laid and buried. The maximum width of the seabed fluidised by the burial tool is 0.5m and the Cable is buried to a depth of 5m. After the Cable is laid, the trench will naturally re-fill in a short space of time and the seabed will return to its original profile.

1.4.8 The intended burial depth for the Cable within Hong Kong waters will be 5m below seabed, except when crossing over existing cables, where the depth will be reduced, or when crossing the Hong Kong Electric (HKE) Gas Pipeline in eastern waters, in which case the Cable will be either the burial tool or divers at a depth possible/agreed, over the top of the Gas Pipeline and additional cable protection will be used to minimise the chance of future damage by vessel anchors and dropped objects.

1.5 Cable Route Selection Process

1.5.1 There are several sensitive receivers in the vicinity of the HK-G cable alignment, shown in ***Figure 1-3***, that have helped to define the route alignment and cable-laying process. The Cable route selection has considered seabed characteristics; the landing site; physical constraints; planning issues; and environmentally sensitive receivers:

Seabed Characteristics

- **Marine Sediments.** Cables need to be installed within soft marine sediment of a sufficient depth above bedrock to provide protection to the cable and to achieve a burial depth of 5m. The geophysical survey indicated that the seabed of the proposed cable alignment will primarily be composed of fine sediment, predominantly clay or silt.

Landing Site

- **Direct Path.** Considering all other constraints, the most direct path has been selected, thus allowing for efficiency in installation, material procurement, minimising environmental impacts and achieving operational targets.
- **Existing Facilities.** The HK-G Cable will use an existing duct in the TKOIE seawall, the existing BMH and the existing land-side cable duct network. No new construction is required for the landing of the HK-G Cable at TKOIE.
- **Auxiliary Facilities**: Numerous other cables, such as EAC, ASE, APG and TKOE, etc. have landed in TKOIE and the many high-tier data centres within TKOIE favour this location for cable landing.

Physical Constraints

- **Drainage Services Department (DSD) Sewage Pipeline.** Since the Harbour Area Treatment Scheme (HATS) has been implemented, the sewage pipeline is now a reserve outfall. The HK-G Cable avoids crossing this pipeline to minimise potential disturbance to DSD's infrastructure.
- **Water Supplies Department (WSD) Seawater Intake at Siu Sai Wan for Toilet Flushing.** The intake is located along the western portion of the Siu Sai Wan Promenade at Chai Wan. This area has been avoided and the closest point to the pumping station from HK-G Cable is approximately 420m.
- **Pamela Youde Nethersole Eastern Hospital Seawater Intake for Cooling.** The intake is located approximately 1.1km from the nearest point of the HK-G Cable.
- **Other Telecommunication Cables.** While the preferred HK-G cable alignment minimises the number of cable crossings as far as practicable, it will inevitably need to cross other submarine cables. There will be ten crossings along the alignment within Hong Kong waters, including EAC, ASE, APG, TKOE and UEL. In the eastern waters, the HK-G Cable will also need cross the HKE Gas Pipeline. At all these crossings, the HK-G Cable will be surface laid or with shallow burial.

Planning Issues

- **Marine Traffic.** The HK-G Cable cross the Tathong Channel Traffic Separation Scheme (TCTSS) in the waters offshore from Siu Sai Wan Promenade, however, the affected area is limited in extent. For most of its remaining length, the Cable will be laid outside the southern edges of the TCTSS. Such routing will minimise the disturbance to marine traffic within the Tathong Channel.
- **Marine Sand Borrow Area**. The marine seabed area near Siu Sai Wan Promenade was used as a sand borrow area between 1990 and the end of 2003. As a result, the seabed in this area has variable topography and, based on the marine survey, the preferred route avoids unsuitable areas of seabed such as this.
- **Other Projects.** The following projects are planned for the area:

– Desalination Plant at Tseung Kwan O
– Tseung Kwan O – Lam Tin Tunnel and Associated Works
– Cross Bay Link
– Hong Kong Offshore Wind Farm in South-eastern Waters
– Ultra Express Link
– Pacific Light Cable Network (PLCN) – Deep Water Bay

Environmentally Sensitive Receivers

- **Environmentally Sensitive Areas.** The Project avoids sensitive areas, such as gazetted bathing beaches, marine parks, areas of known coastal ecology, corals and fish culture zones.

1.5.2 The preferred alignment of the HK-G Cable has taken into account the above engineering, planning, environmental, operational considerations, as well as the existing cables, and follows a narrow corridor in order to either avoid or reduce these constraints and impacts at sensitive receivers as far as practicable.

1.6 Project Details

1.6.1 The Project will be constructed in the following stages:

- Shore-end Cable installation at TKOIE
- Offshore Cable installation with protection over cable/pipeline crossing points

1.6.2 There are no activities after installation of the Cable unless the Cable becomes damaged, in which case emergency cable repair works will be required.

Shore-end Cable Installation at TKOIE

1.6.3 The TKOIE landing point with the existing ducts in the seawall, the BMH and the landside cable duct network are shown in ***Figure 1-4***. All of this infrastructure is already in place and no new construction is required for the HK-G Cable.

1.6.4 In the immediate vicinity of the seawall at TKOIE the seabed is rocky and there are many other cables entering the ducts, so care will be taken when installing the HK-G Cable. Because of this, the Cable will be installed by divers to a depth appropriate to the site conditions on a “best endeavour” basis. Thereafter, cable protection, such as Articulated Pipe (AP) shown in ***Figure 1-5***, will be installed by divers.

1.6.5 The Cable will be pulled through the seawall duct by a winch into the BMH, where it will be secured. Thereafter, the Cable will be pulled through the existing landside cable duct network within TKOIE to the data centre.

Offshore Cable Installation

1.6.6 The offshore works will include route clearance, burial using a cable-laying vessel and cable burial tool, and shallow-burial at crossings and provision of cable protection:

Route Clearance

1.6.7 Prior to cable installation by barge, a Route Clearance Operation (RC) and Pre-lay Grapnel Run (PLGR) will be conducted, in which a grapnel is dragged along the seafloor to remove large objects from the cable path. Typical grapnels anchors used are shown in ***Figure 1-6***. Such processes are intended to remove out of service cables and any debris or obstacles that may pose threat to the cable laying. Any old cables or debris recovered will be retained on board the RC and PLGR vessel(s) for proper disposal ashore.

1.6.8 Whenever other seabed debris is encountered this shall, as far as practicable and reasonable, be cleared to ensure that a safe corridor exists for the cable laying. In all circumstances, no towed equipment (e.g. grapnels) shall be used within 50m of any pipeline or in-use submarine cable system identified by the Tone/Magnet Detector survey (shown in ***Figure 1-5***). Recovery/re-launch of towed equipment 50m before/after any crossing point is the industry standard practice and so will be followed.

Burial Using a Cable-laying vessel and Cable Burial Tool

1.6.9 The Cable to the eastern boundary of Hong Kong (after the first 20m of shore-end installation) will be buried using jetting techniques to a depth of 5m by an “Injector Burial Tool” or “Sledge Tool” towed behind a cable-laying vessel. These burial tools are shown in ***Figure 1-6***.

1.6.10 On board the cable-laying vessel, the Cable will be fed into the burial tool, which will lay the Cable into the seabed at the target depth. The target burial depth within Hong Kong waters is approximately 5m below the seabed, except when crossing obstructions and in transient zones, such as between launch positions of burial tool, the end of APs, and reaching the target burial depth on an incline.

1.6.11 The cable burial tool uses localised high-pressure jets directly around the Cable to fluidise a narrow trench in the seabed to the desired depth into which the cable is simultaneously laid and buried. The maximum width of the seabed fluidised by the burial tool is 0.5m and the disturbed area of the seabed will be limited to this width.

1.6.12 A dive team on the cable-laying vessel will be on standby during cable laying to ensure proper functioning and positioning of the burial tool. The cable-laying vessel towing the burial tool will travel at a speed of around 1km per hour or less along the cable alignment.

Shallow Burial at Crossings and Provision of Cable Protection

1.6.13 Where the HK-G Cable needs to cross existing cables, the burial tool will be re-adjusted about 50m from the crossing location to a depth sufficient to allow a cushion of seabed material to remain above the cable or pipeline to be crossed. Additional protection for the Cable will be provided by “Uraduct” (shown in ***Figure 1-5***), if needed. Crossings will be agreed with other cable owners in advance of installation. Once the cable has been crossed, the burial tool will be re-adjusted to achieve the target burial depth.

1.6.14 To avoid any interference with the Gas Pipeline, around 50-75m from the Gas Pipeline the HK-G Cable will be laid by either the burial tool or divers at a depth possible/agreed, over the top of the Gas Pipeline, as shown in ***Figure 1-5***. Since the cable is laid with shallow burial, it may be susceptible to anchor damage, additional cable protection by "Uraduct" will be needed for this 100-150m section.

Emergency Cable Repair Works

1.6.15 If a cable installed under the seabed is damaged by dropped objects or anchoring activities, cable repair works shall be required. These comprise route clearance prior to repair works; exposing the damaged cable section by diver jetting tool; reconnecting the damaged cable; and reburial of the repaired cable section by diver jetting tool. The seabed can be expected to naturally reinstate to before-work level and conditions shortly after completion of the repair works. No dredging will be required for cable repair works.

Consideration of Alternative Methods

1.6.16 Alternative methods such as Horizontal Directional Drilling (HDD) have been considered. However, HDD is normally adopted to avoid a specific obstacle when a direct impact cannot be avoided, e.g. the coral communities within 300m of the shore for the AAE-1 Cable Project. In the case of the AAE-1 Project, the HDD equipment was located on a temporary platform constructed on the beach. For locations that are not adjacent to land, such as this project, HDD would require the construction of temporary platforms at sea, the installation of which could cause significant water quality impacts. Since the alignment of the HK-G cable avoids direct impacts on coral communities, and is also more than 180m from any coral communities of significance, HDD is not considered to be a better alternative than cable laying by burial tool, which is currently proposed.

1.7 Designated Projects to be Covered by the Project Profile

1.7.1 The shore-end cable laying works at TKOIE are within 500m of a Declared Monument (Site of Chinese Customs Station) and three Sites of Archaeological Interest (Fat Tau Chau Site of Archaeological Interest, Fat Tau Chau Qing Dynasty Gravestone and Fat Tau Chau House Ruin), all of which are located on Fat Tau Chau. The cable alignment also passes within 500m of Coastal Protection Areas (CPA) along the coastline from Cape Collinson to Tso Tui Wan and at Tai Tau Chau, as shown in ***Figure 1-7***.

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

- **Schedule 2, Part I, Item C.12.** This refers to a dredging operation which (a) is less than 500m from the nearest boundary of an existing or planned (ii) Site of Cultural Heritage – this includes Declared Monuments and Sites of Archaeological Interest; or (vii) Coastal Protection Area.

1.7.3 As a DP, the HK-G Cable requires an EP prior to commencement of cable installation works. This Project Profile has been prepared to support an application for permission to apply directly for the EP under Section 5(1)(b) of the EIAO.

1.8 Name and Telephone Number of Contact Person

1.8.1 The contact for the Project Proponent is:

Global Network Business Division
NTT Com Asia Limited
Telephone +852 3793 0149

1.8.2 SMEC Asia Limited (SMEC) has been appointed to prepare this Project Profile. All queries can be addressed to SMEC at:

Mr Fred NG
Principal Environmental Consultant
SMEC Asia Limited
Telephone +852 3995 8100
Facsimile +852 3995 8101

Figure 1-1 Preferred Alignment of HK-G Cable

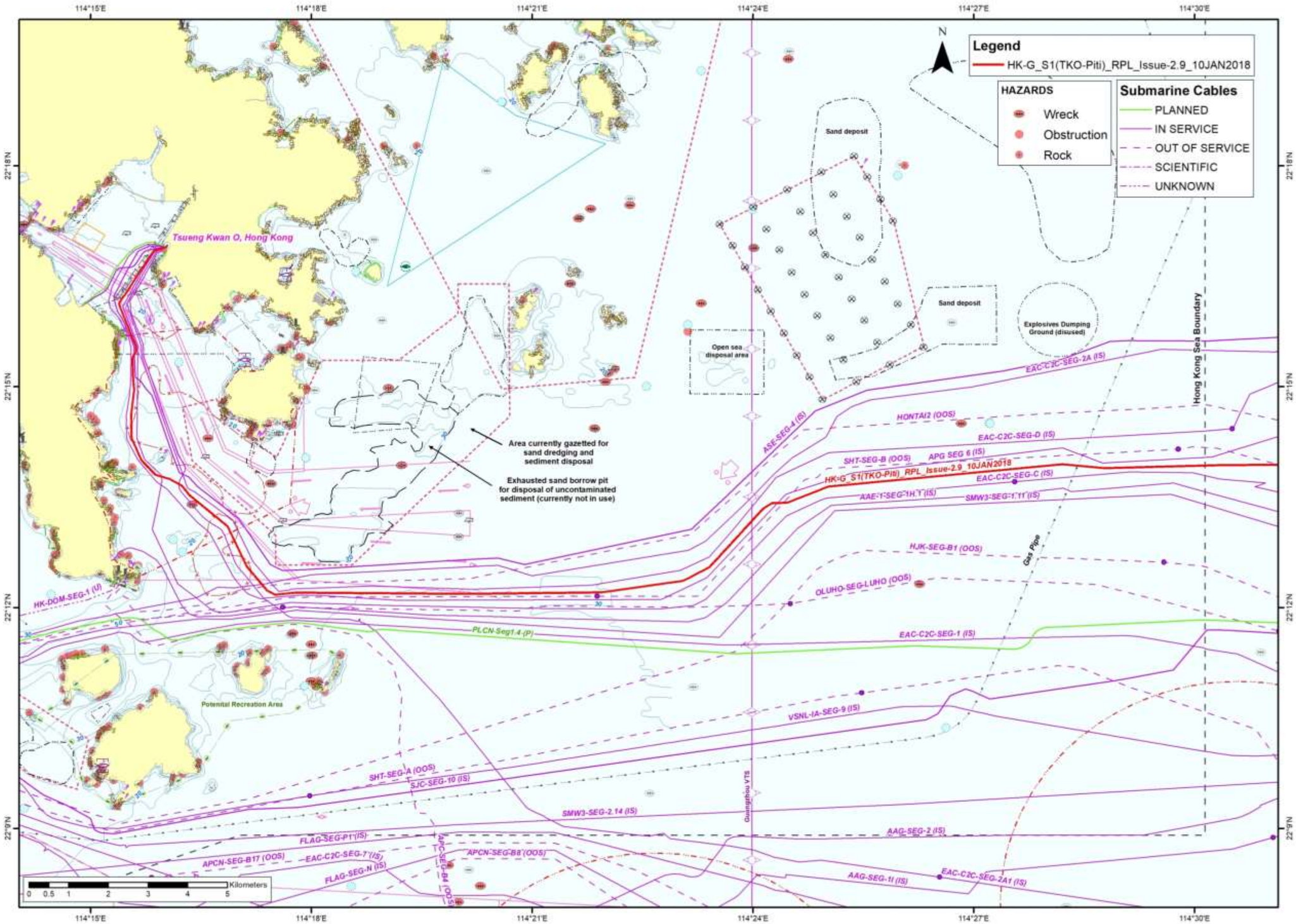


Figure 1-2 Alignment of HK-G Cable with Work Limit Control Points and Co-ordinates

WLCP	Easting	Northing	WLCP	Easting	Northing	WLCP	Easting	Northing	WLCP	Easting	Northing
1	845597.462	815901.629	21	844858.144	813201.690	41	847076.166	808703.773	61	853809.570	807193.203
2	845584.592	815882.242	22	844838.040	813181.063	42	847163.943	808506.544	62	853936.400	807194.822
3	845576.698	815870.057	23	844828.269	813171.037	43	847350.346	808087.550	63	854054.636	807196.248
4	845484.999	815832.537	24	844798.222	813140.199	44	847447.080	807870.027	64	855759.099	807218.213
5	845389.509	815816.055	25	844784.003	813067.476	45	847549.770	807738.882	65	855941.233	807246.125
6	845277.380	815760.623	26	844796.803	812594.096	46	847722.642	807518.464	66	857653.780	807509.337
7	845263.824	815739.022	27	844823.947	812280.918	47	847807.274	807410.561	67	858265.787	807853.831
8	844874.265	815116.291	28	844756.762	811670.185	48	847816.563	807398.757	68	858989.935	808703.644
9	844858.133	815090.444	29	844759.753	811473.845	49	847848.558	807357.809	69	859249.484	809008.173
10	844717.070	814845.460	30	844766.027	811061.893	50	847932.160	807251.013	70	859524.633	809331.186
11	844678.801	814778.814	31	844794.530	810993.602	51	847989.928	807219.313	71	859730.636	809463.268
12	844569.297	814614.499	32	844991.751	810521.083	52	848118.015	807149.279	72	859854.010	809465.299
13	844536.685	814565.574	33	845322.377	810152.344	53	848603.814	807204.837	73	859974.462	809467.512
14	844488.626	814493.572	34	845455.222	810110.343	54	850338.211	807193.014	74	860073.952	809469.140
15	844474.573	814430.631	35	845656.296	810046.975	55	852317.341	807179.419	75	860224.552	809532.673
16	844473.374	814425.093	36	845872.189	809918.471	56	852399.318	807178.949	76	861025.274	809871.109
17	844510.368	814308.842	37	845942.836	809876.436	57	852589.222	807177.670	77	866501.076	810441.625
18	844755.507	813658.596	38	846112.747	809646.586	58	852964.555	807182.496	78	866854.070	810407.247
19	844868.364	813358.938	39	846713.647	809119.516	59	853485.107	807188.966	79	867497.163	810344.848
20	844868.754	813274.964	40	847004.914	808864.288	60	853658.853	807191.189	80	869832.291	810415.582

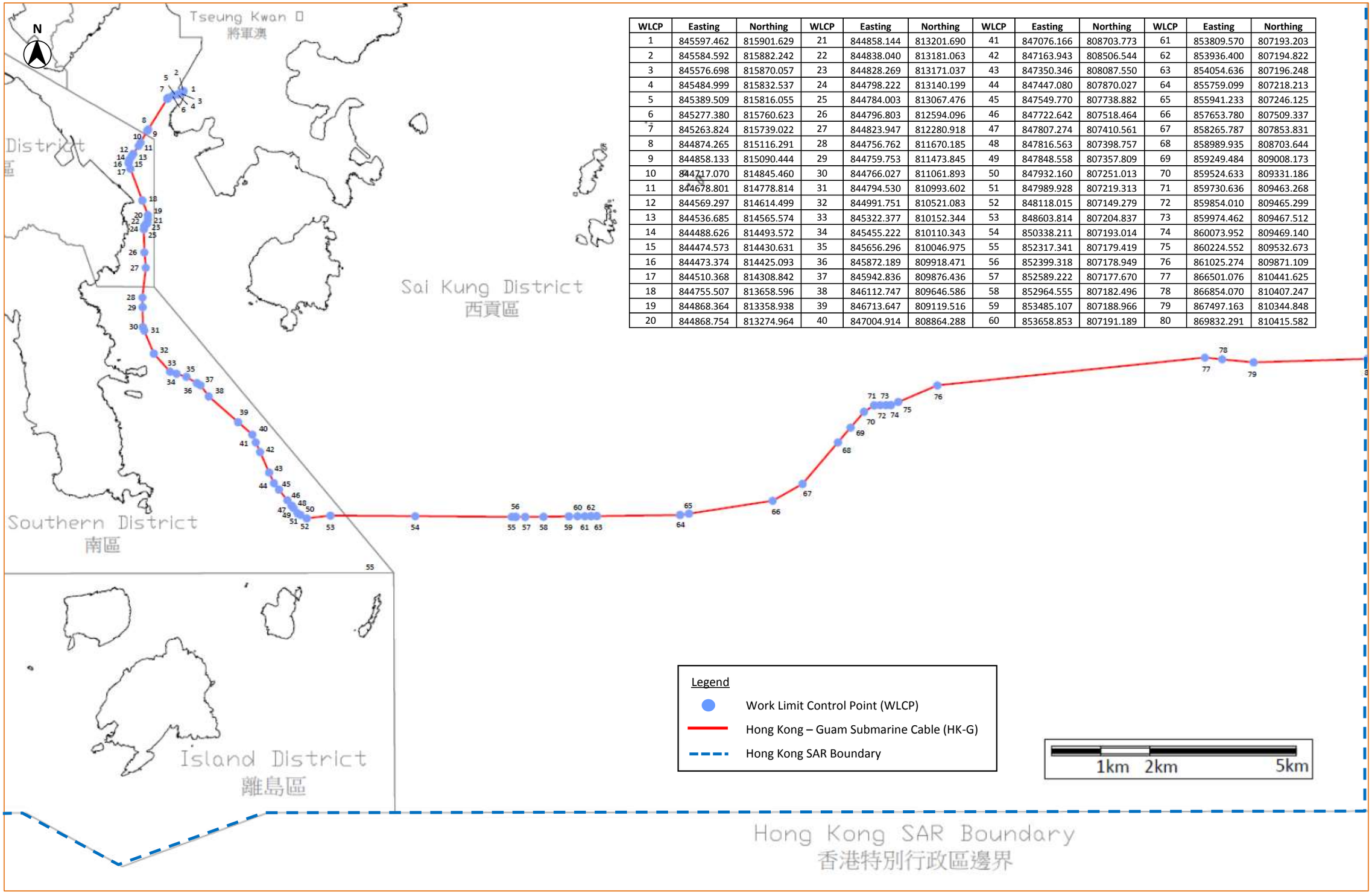


Figure 1-3 Sensitive Receivers

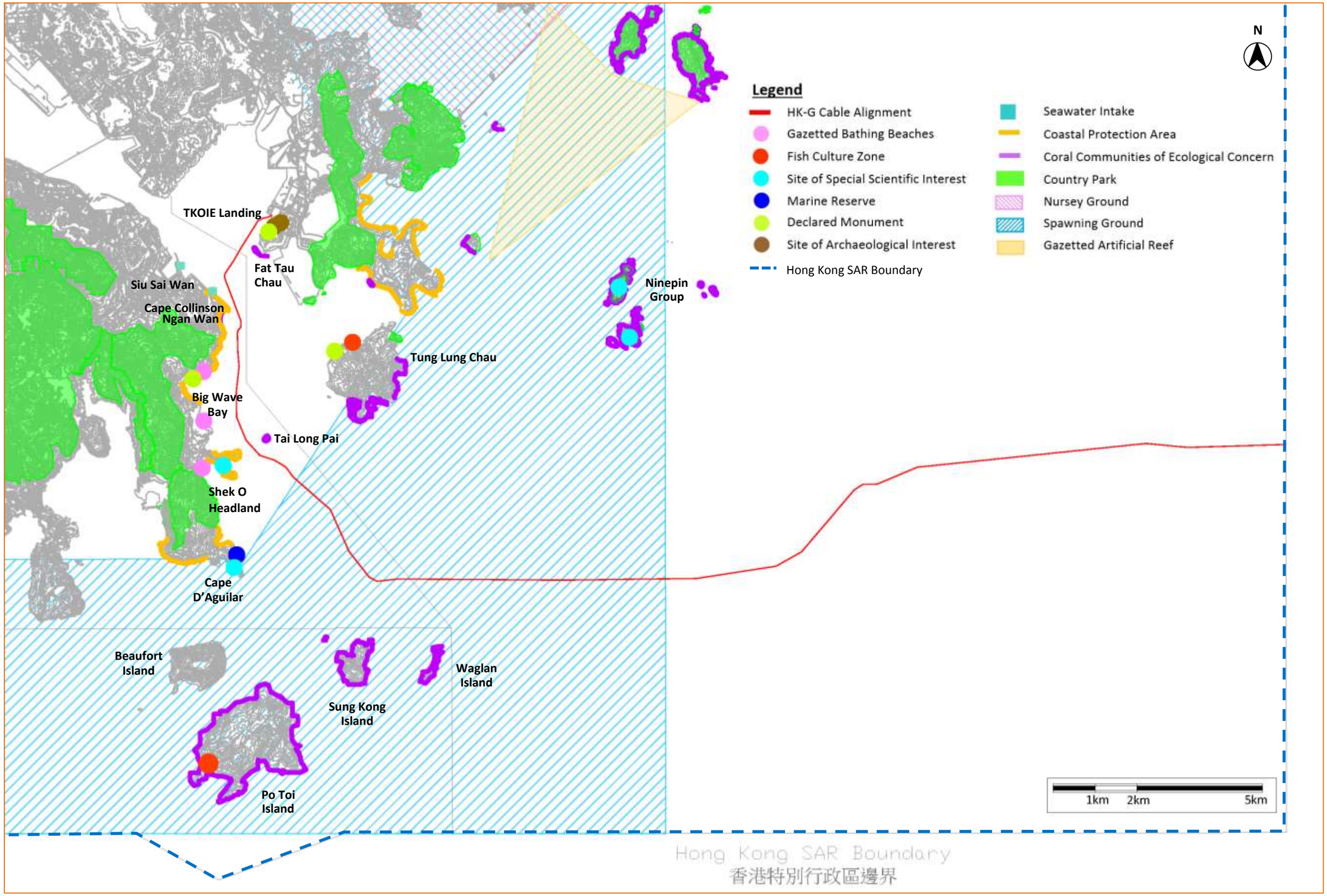
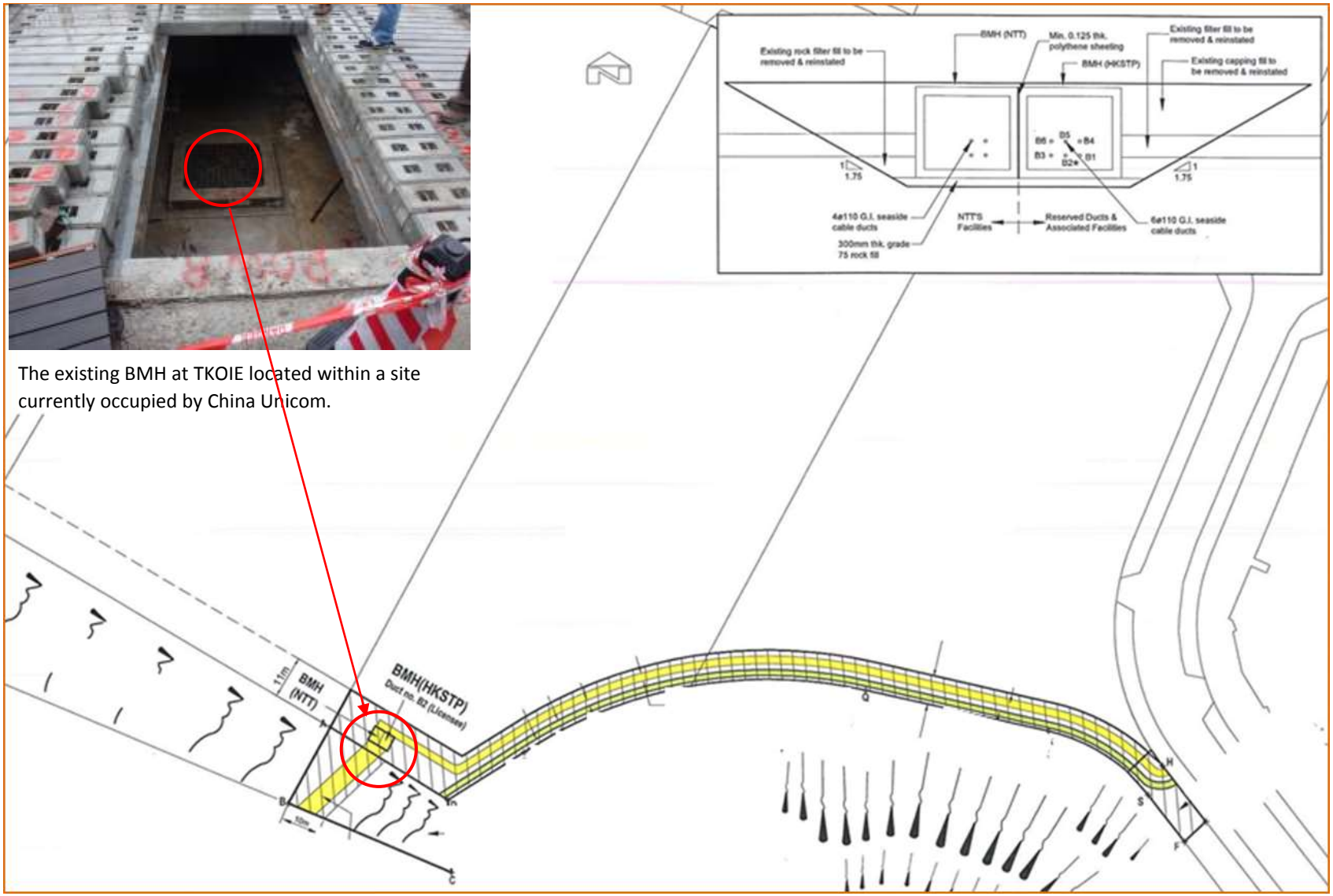


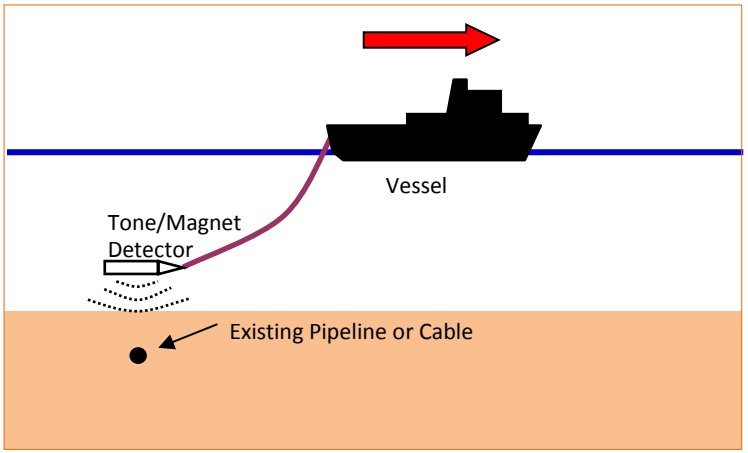
Figure 1-4 TKOIE Cable Landing Area with Existing Seawall Ducts and BMH



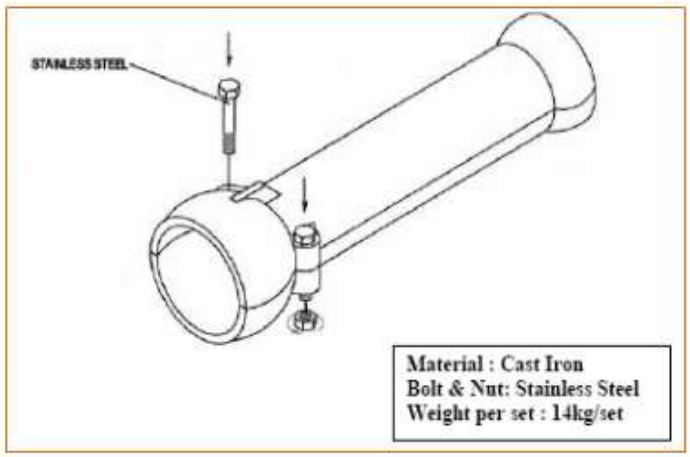
The existing BMH at TKOIE located within a site currently occupied by China Unicom.

Figure 1-5 Possible Cable Protection Measures at Crossing Locations

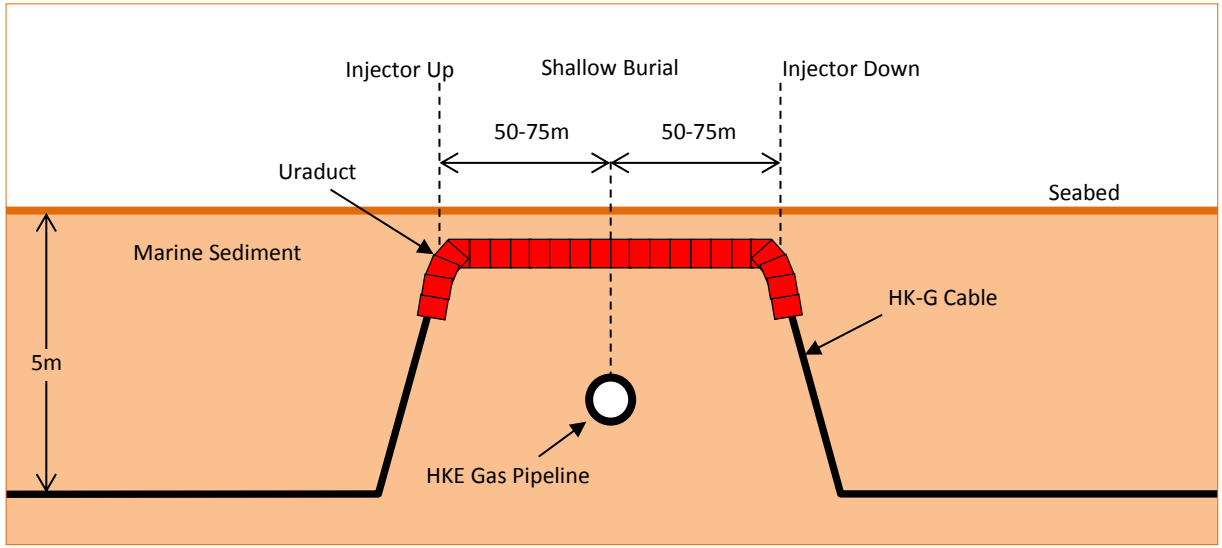
Detection of Existing Cables or Pipeline



Articulated Pipe (Typical Specifications)



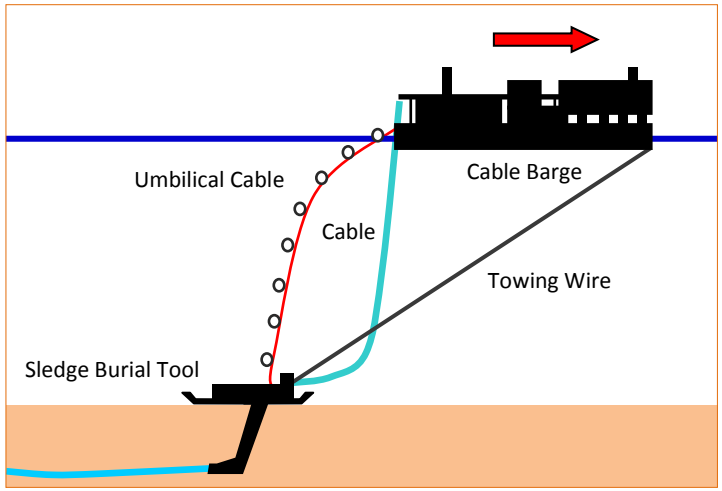
Typical Crossing Method for Hong Kong Electric Gas Pipeline



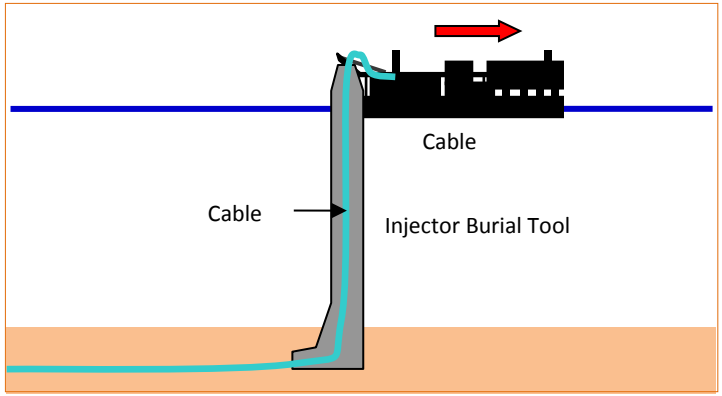
Uraduct

Figure 1-6 Examples of Cable-laying Vessels and Cable Burial Tools

Simultaneous Cable Laying and Burial Operation (Sledge Tool)



Simultaneous Cable Laying and Burial Operation (Injector Tool)



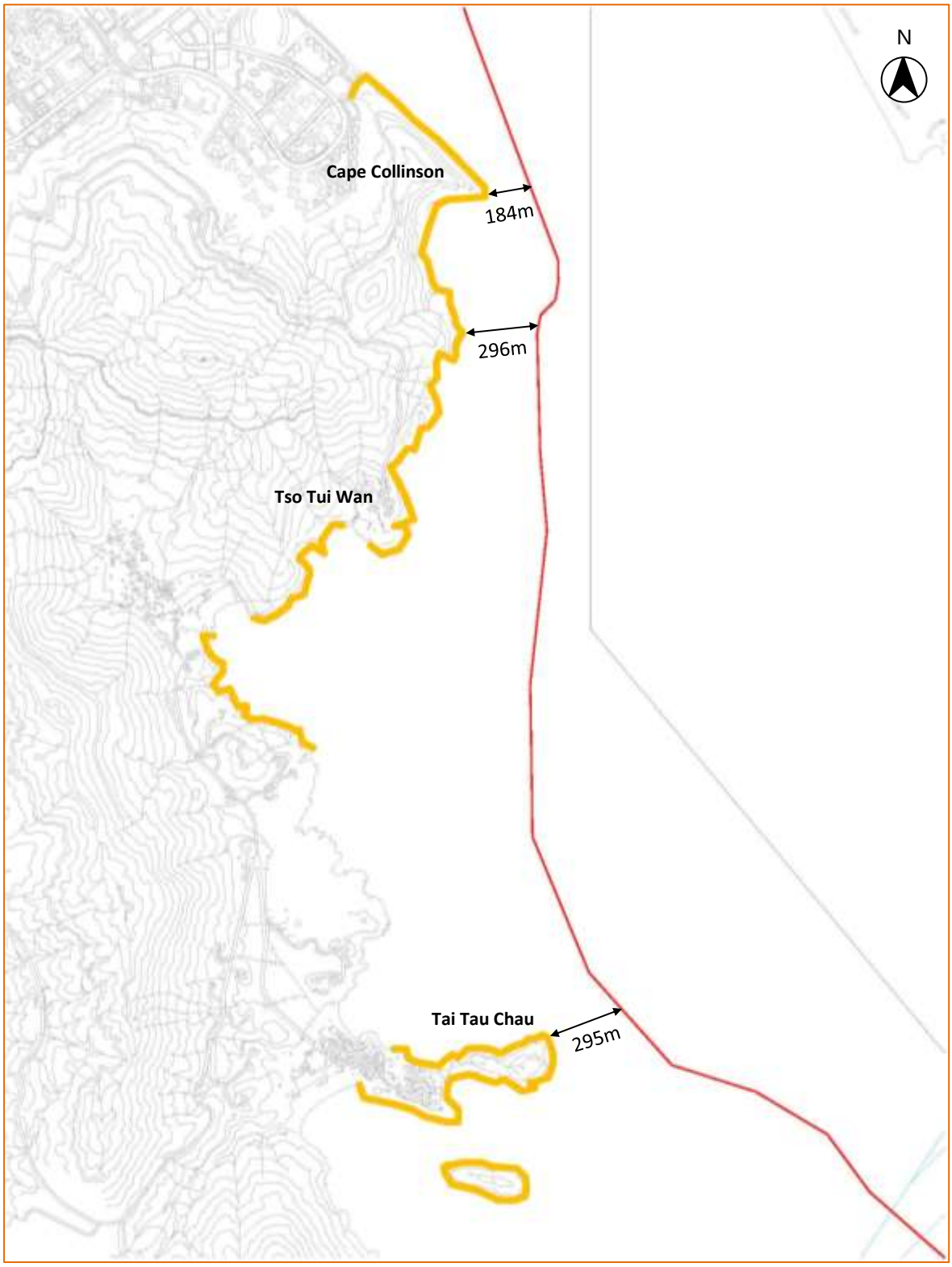
Typical Sledge Burial Tool

Typical Injector Burial Tool

Typical Cable Installation Barge

Typical Grapnel Anchors

Figure 1-7 CPAs within 500m of Cable Alignment



Legend

- Hong Kong – Guam Submarine Cable (HK-G)
- Coastal Protection Area (CPA)

2 OUTLINE OF PLANNING AND IMPLEMENTATION PROGRAMME

2.1 Project Planning and Implementation

2.1.1 The Project is to be led, planned and managed by the Project Proponent, NTT Com Asia Limited (NTTCA). To assist in project planning and implementation, NTTCA has engaged:

- Consultants to:
  - Obtain gazettal under the Seabed and Foreshore (Reclamation) Ordinance (FSRO) and liaise with Lands Department (LandsD) and District Councils (DCs)
  - Address marine traffic issues and liaise with Marine Department
- Contractors to:
  - Carry out the cable laying works

2.2 Project Programme

2.2.1 The HK-G Cable is provisionally scheduled to be landed and installed from June to September 2019. The expected installation schedule within Hong Kong is as follows:

• Shore-end Cable Installation at TKOIE	2 to 4 working days
• Offshore Cable Installation	up to 150 working days
– Route Clearance Operation (RC) and Pre-lay Grapnel Run (PLGR)	40 to 55 working days
– Cable Burial	30 to 40 working days
– Post Burial Checking	45 to 55 working days

2.2.2 The cable installation works near to the areas with coral communities at Fat Tau Chau, at Ngan Wan (Cape Collinson) and at Tai Long Pai will be completed in a matter of hours for each area.

2.3 Interactions with Other Projects

2.3.1 The following projects are planned in the vicinity of the HK-G Cable:

- **Ultra Express Link (UEL).** The UEL is a planned submarine cable owned by Hong Kong Telecommunications Limited, linking TKOIE and Siu Sai Wan in Chai Wan. Gazettal under FSRO was authorized in November 2018. As per our understanding from the Project Proponent of UEL, it is likely that the construction works for this project will commence in mid-2019, potentially at the same time as installation of HK-G Cable. To avoid any potential overlap, the cable laying works of HK-G will be planned to avoid overlapping with UEL works as far as practicable. However, should there be an unavoidable overlap of works for HK-G and UEL cables, the cumulative water quality impact at WSRs is still expected to be negligible – see ***Section 3.7***.

- **Tseung Kwan O – Lam Tin Tunnel and Associated Works**. Construction for this project commenced in mid-2016 and is expected to finish mid-2021. Construction of *Tseung Kwan O – Lam Tin Tunnel and Associated Works* will therefore be carried out at the same time as installation of the HK-G Cable – see ***Section 3.7***.
- **Desalination Plant at Tseung Kwan O.** This project is currently in the investigation review, design and tender preparation stage for the first phase of the plant. According to WSD, the only work currently (2019) being undertaken is the water mains laying works, whereas the associated marine works for the submarine intake and outfall pipeline installation are expected to begin later. Therefore, the marine works for this project are not likely to begin until after the HK-G Cable has been installed.
- **Cross Bay Link**. According to CEDD, the detailed design stage of the project was completed at the end of 2017. The main construction package was awarded mid-2018 and works commenced shortly after. The second works contract was awarded and commenced in late-2018. Construction of *Cross Bay Link* will therefore be carried out at the same time as installation of the HK-G Cable – see ***Section 3.7***
- **Hong Kong Offshore Wind Farm in Southeastern Waters**. CLP has extended the feasibility study stage of the project by a few years and postponed the construction stage. Since further economic viability and technical design studies are needed, there is still no firm date for the commencement of the project. The construction works for cable section of this project are therefore are not likely to begin until after the HK-G Cable has been installed.

3 MAJOR ELEMENTS OF THE SURROUNDING ENVIRONMENT

3.1 Marine Fairways and Traffic Separation Scheme

3.1.1 The HK-G Cable avoids all principal fairways in Hong Kong waters. It will, however, need to cross the TCTSS in the waters offshore from Siu Sai Wan Promenade, but the affected area is limited in extent. Other than this, the Cable will be laid outside the southern perimeter of the TCTSS and this alignment will minimise the disturbance to the marine traffic within the TCTSS as far as possible.

3.2 Cable, Pipelines, Outfalls and Intakes

3.2.1 There are a number of utilities located in the vicinity of the HK-G Cable and these include communications cables; electrical cables; pipelines and outfalls; and seawater intakes:

Communication Cables

3.2.2 TKOIE is a prime location for landing of submarine cables. One planned and six existing in-service cables have landed at the seawall ducts at TKOIE:

- EAC Cable – three in-service cables
- ASE Cable – one in-service cable
- APG Cable – one in-service cable
- TKOE – one in-service cable
- UEL – a planned cable system to be constructed in 2019

Electrical Cables

3.2.3 There are no existing electrical cables located in the vicinity of the HK-G cable alignment, but there may in future be a submarine electrical cable that is part of the proposed *Hong Kong Offshore Wind Farm in Southeastern Waters* project (FEP-01/34/2009). This marine electrical cable would deliver power from the offshore wind farm to the main grid near LOHAS Park, across from TKOIE. Based on discussions with CLP, any cable construction is expected to occur after the HK-G Cable is installed.

Pipelines and Outfalls

3.2.4 There is one pipeline and one outfall:

- **The DSD Sewer Outfall** is no longer in use since construction of HATS, but is still maintained by DSD for emergencies. However, the HK-G Cable will not cross the DSD Outfall and so there will be no impact.
- **The Hong Kong Electric Gas Pipeline** in eastern waters must be crossed by the HKG Cable (and is already crossed my most other cables).

Seawater Intakes

3.2.5 There are two seawater intakes:

- **WSD Seawater Intake at Siu Sai Wan for Toilet Flushing** – the HK-G cable alignment is around 420m from the seawater intake at the closest point and due to this distance the intake will not be affected by the Project.
- **Pamela Youde Nethersole Eastern Hospital Seawater Intake for Cooling**– the HK-G cable alignment is around 1,100m from the cooling water intake at the closest point and due to this distance the intake will not be affected by the Project.

3.3 Designated Areas

3.3.1 There are a number of areas with special planning designation in the vicinity of the HK-G cable alignment. These comprise Coastal Protection Areas (CPAs); Gazetted Bathing Beaches; Marine Reserves; Sites of Special Scientific Interest (SSSIs); and Sites of Cultural Heritage:

Coastal Protection Area (CPA)

3.3.2 CPAs are located on land along the shoreline, above the high water mark. Other than at the landing point, the Cable is installed below the seabed and no land-based construction is required. Therefore CPAs will not be affected by this Project.

3.3.3 However, for reference, there are CPAs within 500m of cable alignment along the coastline from Cape Collinson to Tso Tui Wan and at Tai Tau Chau. The closest point of the HK-G Cable to a CPA is 184m at Cape Collinson. Please refer to ***paragraph 3.4.3*** for details of corals in this area.

3.3.4 Other areas zoned as CPA include Big Wave Bay, the Shek O Headland and the coastline of Fat Tong Mun, Po Toi O and Clear Water Bay, all of which are more than 500m from the cable alignment and so will not be affected by this Project.

Gazetted Bathing Beaches

3.3.5 The closest Gazetted Bathing Beaches to the cable alignment are Shek O Beach, Rocky Bay Beach and Big Wave Bay Beach, which are 1,246m, 986m and 829m, respectively, from the closest alignment of the Cable. Given these large distances, the beaches will not be affected by this Project.

Cape D'Aguilar Marine Reserve

3.3.6 Cape D'Aguilar Marine Reserve occupies about 20ha of sea area around Cape D'Aguilar. The Marine Reserve is located 2,191m to the south of the cable alignment and the Cable does not enter the Marine Reserve at any point. As such, the Marine Reserve will not be affected by this Project.

Site of Special Scientific Interest (SSSI)

3.3.7 The closest SSSIs are the Shek O Headland, Hok Tsui (Cape D'Aguilar) and Ninepin Group SSSIs, which are 801m, 2,451m and 5,779m, respectively, from the closest alignment of the Cable. Given these large distances, and the small scale and localised water quality impacts as discussed in ***paragraph 4.2.2***, these SSSIs will not be affected by this Project.

Sites of Cultural Heritage

3.3.8 There are three Declared Monuments, namely the Site of Chinese Customs Station on Fat Tau Chau, Rock Carving at Big Wave Bay, and Rock Carving on Tung Lung Chau, situated approximately 244m, 1,102m and 2,351m from the HK-G Cable, respectively. According to the *List of Sites of Archaeological Interest in Hong Kong*, there are also three Sites of Archaeological Interest located near the HK-G Cable landing site, namely Fat Tau Chau Site of Archaeological Interest, Fat Tau Chau Qing Dynasty Gravestone and Fat Tau Chau House Ruin, which are all within 500m of the landing site.

3.3.9 As all of these cultural heritage sites are on land, and there are no land-based construction works associated with the Project, the Declared Monument and Sites of Archaeological Interest will not be affected by this Project.

3.3.10 For sites of archaeological interest in the marine environment, reference has been made to the APG in 2013, which follows a similar alignment to that proposed for the HK-G Cable, and to a new marine geophysical survey that was completed for the HK-G cable in 2017. The Project Profile for APG concluded that there was no site with marine archaeological value, and the MAI carried out for the HK-G Cable in 2018 also concluded that there was no site with marine archaeological value.

3.4 Coral Communities

3.4.1 Several coral communities of significance, i.e. locations where there are a large assembly of diverse, common coral species or a smaller assembly including rare species, have been identified in the vicinity of the cable alignment, including those identified at Ngan Wan (Cape Collinson), Junk Bay, Tung Lung Chau, Fat Tau Chau, Po Toi, Sung Kong, Ninepin Group, Waglan Island and Tai Long Pai.

3.4.2 As shown in ***Table A-7*** of ***Annex A***, three coral communities of significance are located within 500m of the cable alignment; those at Fat Tau Chau are 227m from the cable alignment and are the closest; those at Tai Long Pai are 319m from the cable alignment; and those at Ngan Wan (Cape Collinson) are 264m from the cable alignment. The remaining coral communities of significance are more than 1,000m from the cable alignment and given this distance will not be affected by this Project.

3.4.3 In addition to the coral communities of significance identified above, the *Baseline Coral Survey Monitoring Report* (May 2016) of the APG Project identified individual hard corals along various coastline, including those at Cape Collinson, but at less than 5% coverage these were considered to be individual corals, rather than “communities” and so were not considered to be of such significance. Individual corals were identified along the coastline of Cape Collinson, which is 184m from the cable alignment at its closest, but these are not considered to be of “coral communities of significance”.

3.5 Fish Culture Zones (FCZs)

3.5.1 The nearest FCZs are the Tung Lung Chau FCZ and Po Toi FCZ, located 2,736m and 5,924m, respectively, from the cable alignment. Given these distances, the FCZs will not be affected by this Project.

3.6 Spawning Grounds of Commercial Fisheries Resources

3.6.1 The HK-G Cable passes through a recognized Spawning Ground of commercial fisheries resources at south-eastern waters. ***Figure C-6*** of ***Annex C*** shows the location of the Spawning Grounds and the HK-G Cable Alignment.

3.7 Cumulative Impacts from Other Projects

3.7.1 ***Section 2.3*** identified potential interactions between the installation of the HK-G Cable and construction of other projects in the vicinity. The installation of the HK-G Cable may coincide with the following projects, and thereby cumulative impacts may be an issue:

- **Ultra Express Link (UEL).** As per our understanding from the Project Proponent of UEL, it is likely that the construction works for this project will commence in mid-2019, which may potentially overlap with the works for HK-G Cable. To avoid any potential overlap, the cable laying works of HK-G will be planned to avoid overlapping with UEL works as far as practicable. However, should there be an unavoidable overlap of works for HK-G and UEL cables, the cumulative water quality impact at WSRs is still expected to be negligible.

  The reason for this is due to the separation distance of some 573m between HK-G and UEL in the vicinity of the nearest WSR, the coral communities at Fat Tau Chau. For each cable, the maximum sediment plume extent is 180m and so there will be no overlap of the respective 180m maximum sediment plume extents for the two cables. As such, there is also no cumulative impact to water quality from the two cables if work is carried out concurrently. In terms of impact at WSRs, at its closest point HK-G is some 227m west of the coral communities at Fat Tau Chau. This is beyond the maximum sediment plume extent of 180m and so there will be negligible impact from HK-G at Fat Tau Chau, as has been assessed. At its closest point, UEL is some 800m west of Fat Tau Chau (and 573m west of HK-G), which is also well beyond the maximum sediment plume extent of 180m. As such, the cumulative impact at Fat Tau Chau from both HK-G and UEL, if carried out concurrently, will be no greater than the impact from HK-G alone, which has been assessed as negligible. Should any sediment plume from UEL extend further than predicted, it would be intercepted by the floating silt curtain to be deployed for HK-G in the vicinity of Fat Tau Chau.
- **Tseung Kwan O – Lam Tin Tunnel and Associated Works**. The marine works associated with the reclamation in Junk Bay will be around 2,250m to the northwest of the Cable landing point. According to the EP for that project (No. EP-458/2013/C), all reclamation shall be carried out within temporary steel cofferdam to ensure that any sediments released during reclamation are fully contained and do not enter Junk Bay. Given this full containment of reclamation works for the *Tseung Kwan O – Lam Tin Tunnel and Associated Works*, the 2,250m separation and the short installation time of shore-end works at TKOIE (just a few days), cumulative impacts will be negligible.
- **Cross Bay Link**. According to the approved EIA for that project (AEIAR-172/2013), no open sea dredging will be conducted and all marine works shall be carried out within a cofferdam to ensure that any sediments released during marine works are fully contained and do not enter Junk Bay. Given this full containment

of marine works for the *Cross Bay Link* and the short installation time of shore-end works at TKOIE (just a few days), cumulative impacts will be negligible.

4 POSSIBLE IMPACTS ON THE ENVIRONMENT

4.1 Summary of Potential Environmental Impacts

4.1.1 The potential environmental impacts associated with the Project are summarised in *Table 4-1* and likely impacts are assessed in the following sub-sections.

Table 4-1 Potential Sources of Environment Impacts

Potential Installation Impacts	Construction	Operation	Remarks
Gaseous Emissions	✗	✗	No significant emissions
Dust	✗	✗	No significant emissions
Odour	✗	✗	No significant emissions
Noisy Operations	✗	✗	No noise sensitive receivers within 300m of the works
Night-time Operations	✗	✗	Not required
Traffic Generation	✗	✗	None (all works are marine)
Liquid Effluents, Discharges, or Contaminated Runoff	✓	✗	Surface water runoff at landing site, but will not be muddy
Generation of Waste or By-products	✗	✗	Not anticipated
Manufacturing, Storage, Use, Handling, Transport, or Disposal of Dangerous Goods, Hazardous Materials or Wastes	✗	✗	Not anticipated
Risk of Accidents Which Result in Pollution or Hazard	✗	✗	Not anticipated
Disposal of Spoil Material, Including Potentially Contaminated Materials	✗	✗	No dredging required; no contaminated mud and no disposal of spoil anticipated
Disruption of Water Movement or Bottom Sediment	✓	✗	Cable laying will disturb the bottom sediment
Unsightly Visual Appearance	✗	✗	Works are mainly under water
Ecological Impacts:			
- Terrestrial	✗	✗	No new construction on land
- Inter-tidal	✓	✗	Habitat at TKOIE may be affected by the Cable as it approaches the landing site
- Marine	✓	✗	Corals in vicinity of the cable alignment may be affected
- Fisheries	✓	✗	Potential impacts along the alignment
Cultural Heritage	✓	✗	Potential impacts on marine archaeological resources. No impact on terrestrial sites.

Key: ✓ = Potential to result in adverse impacts.
✗ = Not expected to result in adverse impacts.

4.1.2 No environmental impacts are expected to occur during normal operation of the Cable, however, there may be a future requirement for maintenance work (i.e. cable repair at particularly fault location due to unexpected damage) to be carried out.

4.1.3 The following assessments therefore relate only to the installation of the Cable and any potential repair works that may be needed in the future during the operation stage.

4.2 Water Quality Assessment

4.2.1 A water quality assessment is provided in ***Annex A***. A summary is provided below.

4.2.2 There is potential for small scale and localised water quality impacts to occur from cable installation works. Based on the assumption that the forward speed of the cable-laying vessel is limit to a maximum of 1 km per hour, sediments disturbed during use of the cable burial tool will settle back to the seabed within a maximum of 180m of the cable alignment within about 3.5 minutes.

4.2.3 The recently installed APG Cable follows a similar alignment to the HK-G Cable and has similar distance separation from WSRs. Monitoring results from the installation of the APG Cable indicated that there was no deterioration of water quality at WSRs in the vicinity of the cable alignment and that water quality impact caused by installation of the APG Cable was negligible.

4.2.4 A total of 21 no. Water Sensitive Receivers (WSRs) have been identified, comprising gazetted bathing beaches, FCZs, SSSIs, a Marine Reserve, Fish Spawning Grounds and coral communities of ecological concern.

4.2.5 For the Fish Spawning Grounds through which the alignment of this Cable (and the majority of previous cables) passes, there may be a short-term impact. None of the other WSRs are located within the maximum 180m extent of any plume from the cable trench and five WSRs are located within 500m (the distance typically adopted for EIA studies for water quality impacts) and therefore might possibly be affected by the marine works. The remaining 16 no. WSRs are located more than 500m from the cable alignment and so would not be affected. Monitoring to represent the Tung Lung Chau FCZ, which is >500m from the cable trench, has been included as a precautionary measure.

4.2.6 Given that the similar distance separation from WSRs for APG and HK-G Cables, and the fact that none of the WSRs for HK-G Cable are within the maximum 180m extent of any plume from the cable trench. The closest WSR – coral communities at Fat Tau Chau – are 227m distant and so no adverse water quality impact is expected to arise from the installation of the HK-G Cable.

4.2.7 Nevertheless, precautionary measures/good site practices have been recommended during the marine installation; for example, the speed of the installation barge will be further reduced to a maximum of 0.5km per hour and a mobile silt curtain will be deployed when the cable is being installed in proximity to south of Cape Collinson and north of Ngan Wan, and west of Fat Tau Chau. Furthermore, it is recommended that water quality monitoring is carried out at a total of six WSRs to demonstrate, as has been demonstrated for other cable laying projects, that no adverse water quality impacts are caused by cable laying – details of proposed Environmental Monitoring and Audit (EM&A) are given in ***Annex E***.

4.2.8 For cable repair works, diver-operated jetting tools would be adopted. It have a much smaller water jetting strength and seabed fluidization ability (about 2m depth) compared to the cable burial tool used for cable installation (about 5m depth). Considering diver repair will be only for short sections of cable, will be carried out in a matter of hours, and will use less powerful jetting equipment, the sediment release is considered to be minimal. The seabed can therefore be expected to naturally reinstate to before-work levels and conditions shortly after completion of the works. As such, no significant water quality impact is anticipated for sections of cable repaired by divers.

4.2.9 Overall, with the recommended precautionary measures/good site practices in place, no adverse water quality impacts are anticipated from the cable installation works and cable repair works.

4.3 Marine Ecology Assessment

4.3.1 A marine ecological assessment is provided in ***Annex B***. A summary is provided below.

4.3.2 The review of the existing information on the marine ecological resources in the vicinity of the cable landing point at TKOIE and the cable alignment in Hong Kong waters has identified the area where the Cable is to be laid to be of generally low ecological value.

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

4.3.4 The rocky shores in the vicinity of the cable landing point off Fat Tau Chau and near Cape Collinson support low abundance and diversity of intertidal organisms. Most of these species are common and widespread on the similar shores in Hong Kong and as such, are considered to be of low ecological value. Impacts to these assemblages are, therefore, not regarded as significant.

4.3.5 The coral communities at Fat Tau Chau, at Ngan Wan (Cape Collinson) and at Tai Long Pai that are within 500m of the cable alignment may experience indirect disturbance through minor changes in water quality. Due to the small scale of the works, the short duration of impacts and the limited dispersion of sediment plume, however, any potential impacts are not considered to be significant.

4.3.6 The eastern waters of Hong Kong are not considered to represent an important habitat for the Indo-pacific Humpbacked Dolphin and so disturbance to these marine mammal species is not expected. Finless Porpoise is present in the south-eastern waters during the wet season (June to November). As a precautionary measure, a marine mammal exclusion zone is recommended (see ***Section 5.4***).

4.3.7 Impacts to marine ecological resources have largely been avoided during cable laying through the selection of a landing site, careful consideration for cable alignment, and use of cable laying techniques that result in little disruption to the marine environment. Due to the small scale of the works, the short duration of impacts and the limited dispersion of sediment plumes, adverse impacts to marine ecology are not expected to be significant and will be minimised during the cable installation and cable repair works.

4.3.8 Precautionary measures/good site practices recommended to minimise impacts to water quality will also minimise impacts to marine ecological resources. Water quality monitoring will be carried out during marine works to demonstrate that no adverse impact has occurred.

4.4 Fisheries Assessment

4.4.1 A fisheries assessment is provided in ***Annex C***. A summary is provided below.

4.4.2 A review of existing information on the fisheries resources and fishing operations along the alignment of the HK-G Cable has found the majority of the area supports fisheries resources with low to moderate fisheries production. The composition of the commercially important fisheries resources in the study area is: Shrimp, Crab, Flathead, Tongue Sole, Croaker, Golden thread, Pomfret, Cardinal fish, Hairtail, Markerel, Fry, Seabream, Squid, Grouper, Rock fish, Lizard fish, Rabbit fish, Scad, Thryssa and Sardine [Ref#1]. There are no Nursery Grounds, FCZs or Artificial Reefs in the area that would be directly affected by the Project. There is, however, a recognized Spawning Ground of commercial fisheries resources at south-eastern waters through which the HK-G Cable passes. The composition of the spawning grounds of commercially important fisheries resources[Ref. #2] in the study area are:

- Southeast Hong Kong: *Cynoglossus Macrolepidotus, Pseudosciaena Crocea*
- Eastern Waters: *Apogon Quadrifasciatus, Parapristipoma Trilineatum, Sebastiscus Marmoratus, Trichiurus Haumela, Upeneus Sulphureus, Upeneus Tragula*

4.4.3 Fisheries production in the affected area ranges from >0 to 50 kg/ha to >200 to 300 kg/ha in terms of catch weight of adult fish, in which more than half of the grids show no greater than 50kg/ha. Fisheries production of adult fish was highest (>200 to 300 kg/ha) east of D'Aguilar Peninsula and the value decreases (>0 to 50 kg/ha) east of the Ninepin Group. Fishing activities along the cable alignment are of low to moderate commercial value.

4.4.4 In terms of fishing activity, the areas through which the cable is laid are also used by fishing vessels – around 43% of the alignment is used by 1 to 50 vessels; 7% by 51 to 100 vessels; 43% by 201 to 400; and 7% by 401 to 600. For small fishing vessels (sampans), around 14% of the alignment is not used; 36% is used by 1 to 50 vessels; 29% by 101 to 200 vessels; and 21% by 201 to 400 vessels. For larger fishing vessels (other than sampans), around 50% of the alignment is used by 1 to 50 vessels; 14% by 51 to 100 vessels; and 36% by 101 to 200 vessels.

4.4.5 There are no nursery grounds in the vicinity of the HK-G Cable alignment. The south-eastern and eastern waters have been recognised as spawning grounds for commercial fisheries resources, however, fish fry production from the area traversed by the HK-G Cable is very low.

4.4.6 The fishing operations and fisheries resources in the vicinity of the HK-G Cable are of low to moderate commercial value. Furthermore, the area that will be temporarily occupied by the cable installation vessel as it traverses through Hong Kong waters is considered to be small. Due to the small area occupied by the cable-laying vessel and short duration required for the cable installation in any one location, potential impacts on fishing vessel transit and fishing activities along the cable alignment will not be significant.

4.4.7 Based on a number of assumptions that are commonly adopted for many cable projects (see ***Appendix A to Annex A***), including the forward speed of the cable-laying vessel being limit to a maximum of 1 km per hour, calculations in ***Annex A*** show that sediments

1. Hong Kong Offshore Wind Farm in Southeastern Waters Environmental Impact Assessment (2009), Figure 8.7, Table 8.8 and Figure 8.19.
2. Fisheries Resources and Operations in Hong Kong Waters Final Report, ERM-Hong Kong, Ltd (1998)

disturbed during use of the cable burial tool will settle back to the seabed within a maximum of 180m of the trench within about 3.5 minutes. Thus, the maximum extent of any plume generated by cable laying works will be 180m.

4.4.8 The recently installed APG Cable follows a similar alignment to the HK-G Cable and has similar distance separation from WSRs. Monitoring results from the installation of the APG Cable indicated that there was no deterioration of water quality at WSRs in the vicinity of the cable alignment and that water quality impact caused by installation of the APG Cable was negligible. As such, indirect impacts will not be significant.

4.4.9 Given the above, adverse impacts are not expected to arise from the cable laying works. Overall, no unacceptable impacts are predicted to occur to fisheries resources or fishing operations as a result of this Project.

4.5 Cultural Heritage Assessment

4.5.1 A cultural heritage assessment is provided in ***Annex D***, which includes a MAI carried out by a qualified marine archaeologist. A summary is provided below.

4.5.2 There will be no threat to terrestrial heritage form marine works. At the TKOIE landing point, the only works will be pulling the Cable through the existing seawall duct – no new construction is required – and so there is also no threat to the Declared Monument or the three Sites of Archaeological Interest on Fat Tau Chau. Hence no mitigation measures need to be put in place.

4.5.3 The geophysical surveys carried out for other cables following similar alignments to HK-G Cable and the geophysical survey for carried out for the HK-G Cable in 2017 were interpreted by a qualified marine archaeologist. The geophysical surveys reveal that seabed along the HK-G cable alignment has been heavily impacted from trawling and the dumping of materials. They also reveal that the nature of the sediments to be soft silt or sandy clay in the area of the Tathong Channel and Study Area.

4.5.4 The MAI for the HK-G Cable, carried out by a qualified marine archaeologist, identified six sonar contacts within a 50m corridor centred on the alignment, but all of these are classified as debris. Nine magnetic contacts were identified within the 50m corridor but all of these are regarded as unknown objects. Other magnetic contacts and sub-bottom anomalies that were found during the geophysical surveys have been identified as related to the ASE and APG cables, DSD's sewage pipeline, and dumped materials/debris. A review of the UK Hydrographic Office database of known shipwrecks and other underwater obstructions in Hong Kong waters identified two wrecks within 100m of the cable alignment.

4.5.5 The MAI established that none of the above constitute a site with marine archaeological value and hence no marine archaeological impacts are expected. No mitigation measures shall therefore be required.

4.6 Others

4.6.1 The following impacts are not anticipated from the installation of the Cable and have not been in this Project Profile:

- **Gaseous Emissions.** Exhaust emissions from the installation plant will be insignificant and will not cause adverse impacts on air local quality.
- **Dust.** The Project is the installation of a submarine cable and no construction work is required at the cable landing point. No dust will be generated.
- **Odour**. No odour impacts will arise from the Project. No marine sediments will be brought to the surface.
- **Noisy Operations.** There are no noise sensitive receivers in proximity to the cable installation works that could be affected by noise.
- **Night-time Operations.** Cable laying will be carried out during normal working hours. If works are proposed during evening or night-time, application of a Construction Noise Permit may be necessary.
- **Traffic Generation.** Only minimal or short-term marine traffic movement within TKOIE related to the shore-end installation is expected, which will not generate significant noise or gaseous emission.
- **Liquid Effluents, Discharges, or Contaminated Runoff.** The Project is the installation of a submarine cable. As such there will be no effluents, discharge or contaminated run-off entering the marine environment.
- **Generation of Waste or By-products.** No waste materials are anticipated to be generated as a result of cable installation. Any old cables or debris recovered during the RC and PLGR will be retained on board the RC and PLGR vessel(s) for proper disposal ashore.
- **Manufacturing, Storage, Use, Handling, Transport or Disposal of Dangerous Goods, Hazardous Materials or Wastes.** No dangerous goods or hazardous materials will be used or generated by this Project. No waste will be generated during this Project other than old cables or debris that may possibly recovered during the RC and PLGR, which shall properly be disposed of ashore.
- **Risk of Accidents Resulting in Pollution or Hazard.** Laying of submarine cables is an established process in Hong Kong and there is only a minimal risk of accident. Given that no dangerous goods or hazardous materials will be used or generated by this Project, the risk of any accident resulting in pollution or hazard is negligible.
- **Disposal of Spoil Material, Including Potentially Contaminated Materials.** No spoil or dredged material will be generated by the Project and so there is no need for disposal of such. There are no contaminated mud pits in the vicinity of the cable alignment and there is no reason to suspect any contaminated materials will be encountered.
- **Unsightly Visual Appearance.** Since the cable will be buried in the seabed, its installation will not cause any visual obstruction or inconvenience to the public.
- **Ecological Impacts – Terrestrial.** No impacts to terrestrial ecology will arise from the installation of the submarine cable below the seabed. The cable landing point above water at TKIOE comprises a rubble mound seawall and concrete structures.

5 ENVIRONMENTAL PROTECTION MEASURES TO BE INCORPORATED INTO THE DESIGN AND ANY FURTHER IMPLICATIONS

5.1 Measures to Minimise Environmental Impacts

5.1.1 This environmental assessment has identified that the Project may result in a localised temporary elevation of suspended solids at the seabed during cable installation.

5.1.2 Based on a number of assumptions that are commonly adopted for many cable projects (see ***Appendix A to Annex A***), including the forward speed of the cable-laying vessel being limit to a maximum of 1 km per hour, calculations in ***Annex A*** show that sediments disturbed during use of the cable burial tool will settle back to the seabed within a maximum of 180m of the trench within about 3.5 minutes. Thus, the maximum extent of any plume generated by cable laying works will be 180m.

5.1.3 Previous assessments and monitoring results from similar projects (listed in ***Section 6***) have similar findings. For example, the recently installed APG Cable follows a similar alignment to the HK-G Cable and has similar distance separation from WSRs. Monitoring results from the installation of the APG Cable indicated that there was no deterioration of water quality at WSRs in the vicinity of the cable alignment and that water quality impact caused by installation of the APG Cable was negligible. As such, indirect impacts will not be significant.

5.1.4 There are three WSRs – all coral communities – at Ngan Wan (Cape Collinson), at Fat Tau Chau and at Tai Long Pai, that are beyond the 180m maximum settlement distance of any plume but within 500m of the cable trench and, as such, might indirectly be affected by the cable installation works.

5.1.5 A review of water quality monitoring data from previous cable laying projects close to the HK-G Cable, such as APG, have demonstrated that there was no deterioration of water quality at the WSRs in the vicinity of the cable alignment and water quality impact caused by the cable installation works was negligible. According to the *Post Project Coral Survey Report* (July 2016) of the APG Project, comparison of the Baseline and Post Project Coral Survey results did not indicate any detectable changes in coral conditions. As such, no adverse water quality impacts at WSRs are expected from the installation of the HK-G Cable and so, based on past experience, no further mitigation measures are considered necessary.

5.1.6 Having said that, as a precautionary measure, it is recommended that water quality monitoring is carried out at six WSRs to demonstrate, as has been demonstrated for other cable laying projects, that no adverse water quality impacts are caused by cable laying. Details of the proposed EM&A are given in ***Annex E***.

5.1.7 The following precautionary measures/good site practices shall be implemented as far as possible:

- 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 to avoid any spillage of materials to the adjacent marine waters and to ensure that any spoil materials are not discharged into adjacent waters.
- All construction waste and drainage will be handled and disposed of in accordance with the *Waste Disposal Ordinance* and *Practice Note for Professional Persons, Construction Site Drainage* (ProPECC PN1/94).
- Best Management Practices (BMPs) will be applied to avoid and minimise contaminated runoff from work sites, marine plant and vessels.

5.1.8 No adverse impacts are expected to occur during marine installation of the Cable with the cable burial tool, but the following precautionary measures will be followed:

- The crane barge used for the transport of any debris recovered from the seabed during route clearance shall be fitted with tight bottom seals in order to prevent leakage of material during loading and transport to the disposal site.
- The crane barge shall be filled to a level that ensures that material does not spill over during loading and transport and that adequate freeboard is maintained to ensure that the decks are not washed by wave action.
- The speed of the installation barge will be limited to a maximum of 1km per hour. This will be further reduced to 0.5km per hour when the cable is being installed in proximity to south of Cape Collinson and north of Ngan Wan, and west of Fat Tau Chau.

5.1.9 In addition to the above, and as a precautionary measure, a mobile silt curtain with an estimated silt removal efficiency of 85% will be deployed when the cable is being installed in proximity to south of Cape Collinson and north of Ngan Wan, and west of Fat Tau Chau. An indicative arrangement of the proposed mobile silt curtain is shown on ***Figure A-6*** and ***Figure A-7*** in ***Annex A***. Water quality monitoring inside and outside of the mobile silt curtain will also be carried out, as detailed in ***Annex E***.

5.1.10 There will be no environmental impacts from the normal operation of the HK-G Cable. However, if the Cable is damaged by dropped objects or anchoring activities, then cable repair works shall be required. These comprise route clearance prior to repair works; exposing the damaged cable section by diver jetting tool; reconnecting the damaged cable; and reburial of the repaired cable section by diver jetting tool. The seabed can be expected to naturally reinstate to before-work level and conditions shortly after completion of the repair works. No dredging will be required for cable repair works and no adverse environmental impacts are anticipated.

5.2 Possible Severity, Distribution and Duration of Environmental Effects

5.2.1 The duration of the Project will be approximately five months. This is a short period of time and no residual environmental impacts are anticipated.

5.2.2 Potential environmental impacts have been assessed in this Project Profile. No adverse environmental effects have been identified. There are no environmental impacts from the operation of the Project.

5.2.3 No secondary or induced effects have been identified. There are unlikely to be any cumulative effects as the only concurrent project – *Tseung Kwan O – Lam Tin Tunnel and*

Associated Works – will be provided full containment of reclamation works, is 2,250m from the shore-end works for the Cable, and the time overlap will be just a few days.

5.2.4 In terms of benefits, HK-G Cable will help meeting the growing demand for high speed internet access services and greatly increase bandwidth capacity within Hong Kong. The Project will provide telecommunication infrastructure to support industries (such as financial, trading, logistics, media, and other data intensive industries) that have a far-reaching effect on the economy of Hong Kong. Without this Project, these benefits may not be realized. Without the submarine alignment proposed in this Project Profile, HK-G Cable would need to follow a terrestrial route that would be much longer and would generate over much longer period significant disturbances to traffic; disrupt land-based activities; and would generate greater terrestrial environmental impacts.

5.3 Further Implications

5.3.1 TKOIE has been used by several other cable systems and no records of adverse impacts to the environment have been identified from the installation or operations of these systems – see ***Section 6.1*** for details of other similar projects.

5.3.2 Obtaining the EP for HK-G Cable is just one of the requirements. No objection in principle for the Project has already been obtained from the Office of the Communications Authority (OFCA). Approvals from other government departments, including Marine Department and Lands Department, must also be obtained, and these departments have already been contacted.

5.4 Environmental Monitoring and Auditing (EM&A)

5.4.1 Based on the findings of the water quality assessment in ***Annex A*** and the ecological assessment in ***Annex B***, a total of six monitoring locations are proposed including coral colonies of significance and WSRs that might be affected by the cable installation works.

5.4.2 Water sampling in these locations will be conducted prior to cable laying (Baseline Monitoring), during cable laying (Impact Monitoring) and, if needed, after cable laying (Post-Project Monitoring) to verify the predictions in the water quality assessment and to ensure that the installation of the HK-G Cable is conducted in a careful manner and that appropriate action is undertaken promptly in the event that impacts are identified to WSRs and are found to be caused by the cable installation works.

5.4.3 When cable laying is being carried out in south-eastern waters where Finless Porpoises may be present, a marine mammal exclusion zone within a radius of 250m from the cable installation barge will be implemented during day-time hours to avoid potential direct impacts on Finless Porpoises.

5.4.4 Full details of the EM&A requirements are given in ***Annex E***.

5.4.5 The Permit Holder shall engage an Environmental Team (ET) to implement the EM&A programme specified in ***Annex E.*** The ET shall be headed by an ET Leader who has at least 7 years of experience in EM&A or environmental management, and shall have suitably qualified staff included in the ET. The ET shall not be in any way an associated body of the Project Proponent, any of its contractors or the Independent Environmental Checker (IEC)/Independent Consultant (IC).

5.4.6 In addition to the ET, the Permit Holder shall also engage an IEC/IC to advise on environmental issues related to the Project. The IEC/IC shall have at least 7 years of

experience in EM&A or environmental management, and shall have suitably qualified staff included in the IEC/IC team. The IEC/IC shall not be in any way an associated body of the Permit Holder, the works contractors or the ET.

6 USE OF PREVIOUSLY APPROVED EIA REPORTS

6.1.1 To-date, all cable laying projects that are DPs have secured EPs via Direct Application upon submission of a detailed Project Profile. It is the intention of the Project Proponent to also apply for permission to apply directly for the EP under Section 5(1)(b) of the EIAO for this Project.

6.1.2 All previous cable laying projects have applied directly for EPs using detailed Project Profiles, no EIA Reports have been submitted. However, the following (generally more recent) Project Profiles have been referenced in the preparation of this Project Profile:

- **Ultra Express Link (UEL), Tseung Kwan O/Chai Wan (Hong Kong Telecommunications (HKT) Ltd).** The Project Profile was submitted on 29 June 2017 (PP-553/2017). The length of cable in Hong Kong waters was around 2.7km. The study concluded that there would be no adverse long-term or cumulative effects/impacts to the environment. The EP was granted on 14 September 2017 (EP-543/2017).
- **Asia-Africa-Europe-1 (AAE-1) Cable System, Cape D'Aguilar (PCCW Global (HK) Ltd).** The Project Profile was submitted on 1 February 2016 (PP-533/2016). The length of cable in Hong Kong waters was around 27.65km. The study concluded that there would be no adverse long-term or cumulative effects /impacts to the environment. The EP was granted on 20 Apr 2016 (EP-508/2016).
- **Tseung Kwan O Express – Cable System (TKO-E_, Tseung Kwan O/Chai Wan (Superloop (Hong Kong) Ltd).** The Project Profile was submitted on 16 December 2015 (PP-532/2015). The length of cable in Hong Kong waters was around 2.7km. The study concluded that there would be no adverse long-term or cumulative effects/impacts to the environment. The EP was granted on 15 January 2016 (EP-509/2016).
- **Asia Pacific Gateway (APG), Tseung Kwan O (China Mobile International Ltd).** The Project Profile was submitted on 9 October 2013 (PP-496/2013). The length of cable in Hong Kong waters was around 35km. 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).
- **Asia Submarine-cable Express (ASE), Tseung Kwan O (NTT Com Asia Ltd).** The Project Profile was submitted on 7 October 2011 (PP-452/2011). The length of cable in Hong Kong waters was around 33.5 km. The study concluded that there would be no adverse long-term or cumulative effects/impacts to the environment. The EP was granted on 20 December 2011 (EP-433/2011).
- **East Asian Crossing (EAC) Cable System, Tseung Kwan O (Asia Global Crossing Ltd).** Two Project Profiles for this project were submitted, one on 30 June 2000 (PP-094/2000) and the other on 11 Aug 2000 (PP-101/2000). The length of each of the two cables in Hong Kong waters was around 25 km. The studies concluded that there would be no adverse long-term or cumulative effects/impacts on the environment. The EPs were granted on 6 September 2000 (EP-79/2000) and on 4 October 2000 (EP-081/2000).

ANNEX A

Water Quality Assessment

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A WATER QUALITY ASSESSMENT

A.1 Introduction

A.1.1 This Annex provides an assessment of water quality impacts associated with the installation of the HK-G Cable and may be read in conjunction with the marine ecology assessment in ***Annex B***.

A.2 Relevant Legislation and Assessment Criteria

A.2.1 The following legislation and associated guidance or non-statuary guidelines are applicable to the evaluation of water quality impacts:

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

Water Pollution Control Ordinance (WPCO)

A.2.2 The WPCO is the primary legislation for the control of water pollution and water quality in Hong Kong. There are a total of ten Water Control Zones (WCZ) and four supplementary WCZs in Hong Kong. Each WCZ has its own set of Water Quality Objectives (WQOs).

A.2.3 The alignment of the HK-G Cable passes through the Junk Bay, Eastern Buffer, Southern and Mirs Bay WCZs, as shown in ***Figure A-1***. A summary of the WQOs for these WCZs are presented in ***Table A-1***. These WQOs are applicable as evaluation criteria for assessing the compliance of any discharge during the installation of the submarine cable system.

Table A-1 Summary of Water Quality Objectives for the Junk Bay, Eastern Buffer, Southern and Mirs Bay WCZs

Parameter	Junk Bay, Eastern Buffer, Southern and Mirs Bay WCZ
Temperature	Change not to exceed 2°C
Salinity	Change not to exceed 10% of natural ambient level
pH	To be in the range 6.5 to 8.5, change not to exceed 0.2
Suspended Solids (SS)	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 2mg/L for 90% samples Depth-averaged: Not less than 4mg/L for 90% samples
Nutrients (measured as total inorganic nitrogen)	Junk Bay WCZ and Mirs Bay WCZ: Not to exceed 0.3 mg/L (annual mean depth-averaged) Eastern Buffer WCZ: Not to exceed 0.4 mg/L (annual mean depth-averaged Southern WCZ: Not to exceed 0.1 mg/L (annual mean depth-averaged)
Unionised Ammonia	Not to exceed 0.021mg/L (annual mean)

Parameter	Junk Bay, Eastern Buffer, Southern and Mirs Bay WCZ
Chlorophyll-a	No criteria established for Junk Bay, Eastern Buffer, Southern and Mirs Bay WCZs
Toxicants	Not to be present at levels producing significant toxic effect
E. coli	Annual geometric mean not to exceed 610cfu/100mL (secondary contact recreation subzones in Southern and Mirs Bay WCZ and fish culture subzones in Junk Bay, Eastern Buffer, Southern and Mirs Bay WCZs)

EIAO-TM

A.2.4 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 all WQOs at the point of discharge as there are areas subjected to greater impacts (termed by the Environmental Protection Department (EPD) as "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.

TM-ICW

A.2.5 Under Section 21 of WPCO, all discharges during the installation of the submarine cable are required to comply with the TM-ICW. Effluents discharged into the drainage and sewerage systems, inshore and coastal waters of the WCZs are subject to pollutant concentration standards for particular volumes of discharge. These are defined by EPD and specified in licence conditions for any new discharge within a WCZ.

Seawater Intakes

A.2.6 Quality of seawater at intake points should comply with relevant water quality criteria shown in ***Table A-2***.

Table A-2 WSD's Water Quality Criteria for Seawater for Flushing Supply at Intake Point

Parameter	Target
Colour (HU)	<20
Turbidity (NTU)	<10
Threshold Odour No. (TON)	<100
Ammoniacal Nitrogen (mg/L)	<1
Suspended Solids (mg/L)	<10
Dissolved Oxygen (mg/L)	>2
Biochemical Oxygen Demand (mg/L)	<10
Synthetic Detergents (mg/L)	<5
E.coli (cfu per 100mL)	<20,000

ProPECC PN 1/94

A.2.7 Apart from the above statutory requirements, the *Practice Notes for Professional Persons, Construction Site Drainage* (ProPECC PN 1/94), issued by the Environmental Protection Department in 1994, also provides useful guidelines on water pollution associated with construction activities.

A.3 Description of the Environment

Hydrodynamics

A.3.1 The shore-end part of the HK-G Cable in TKOIE lies within Junk Bay WCZ. Further to the south, the Cable passes the Eastern Buffer WCZ and continues along the edge of Southern WCZ. The remainder of the Cable lies within the Mirs Bay WCZ as it heads toward the eastern boundary of Hong Kong. As the Cable exits Hong Kong waters, the main influence will be the oceanic waters of the South China Sea.

Routine Water Quality Monitoring Results

A.3.2 There are seven EPD routine water quality monitoring stations (JM3, JM4, EM1, EM2, EM3, MM8 and MM13) in the vicinity of the Cable alignment, as shown on ***Figure A-2***. Water quality data from these stations between 2012 and 2016 has been collected and is summarised in ***Table A-3***, below.

A.3.3 The data shows that the annual mean for both depth-averaged and bottom dissolved oxygen complied with the WQO during 2012 to 2016. Full compliance (100%) was achieved with the WQOs for total inorganic nitrogen and unionised ammonia at all stations. The suspended solid concentrations were within a range from 1.8 to 5.7mg/L at all monitoring stations. *E.coli* levels also stayed in compliance with the WQOs at all stations between 2012 and 2016.

Routine Sediment Quality Monitoring Results

A.3.4 There are six EPD routine sediment quality monitoring stations (JS2, ES4, ES1, ES2, MS8 and ES13) in the vicinity of the Cable alignment, as shown on ***Figure A-3***. Sediment quality data from these stations between 2012 and 2016 has been collected and is summarised in ***Table A-4***, below

A.3.5 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 sediment quality data (mean values) show that there were no exceedances of the LCEL and UCEL at all stations, from which can be concluded that the sediment in the vicinity of the Cable alignment is not contaminated based on the existing sediment classification guidelines.

Table A-3 Summary of EPD Routine Water Quality Monitoring Data between 2012 and 2016 (JM3, JM4, EM1, EM2, EM3, MM8 and MM13)

Water Quality Parameter	Junk Bay JM3			Junk Bay JM4			Chai Wan EM1		
	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Temperature (°C)	23.04	22.8	23.2	22.8	22.7	23.0	20.7	12.0	23.0
Salinity	32	31.5	32.7	32.2	31.7	32.9	32.1	31.6	32.8
Dissolved Oxygen – Averaged Depth (mg/L)	6.48	6	6.9	6.3	5.9	6.9	6.3	5.9	6.7
Dissolved Oxygen – Bottom (mg/L)	6.24	5.8	6.8	6.1	5.8	6.8	6.1	5.9	6.7
Dissolved Oxygen – Averaged Depth (% Saturation)	89.8	84	96	87	82	94	88	83	93
Dissolved Oxygen – Bottom (% Saturation)	86.8	81	93	85	80	93	85	81	93
pH	7.9	7.8	8	7.9	7.8	8.0	7.9	7.8	8.0
Suspended Solid (mg/L)	3.14	1.8	4.9	3.5	2.4	4.7	3.9	2.7	6.7
5-day Biochemical Oxygen Demand (mg/L)	0.96	0.5	1.3	0.8	0.4	1.0	0.7	0.5	0.8
Unionised Ammonia (mg/L)	0.0018	0.001	0.002	0.002	0.002	0.002	0.002	0.001	0.003
Total Inorganic Nitrogen (mg/L)	0.172	0.15	0.24	0.16	0.13	0.22	0.17	0.13	0.23
Total Nitrogen (mg/L)	0.388	0.3	0.55	0.39	0.29	0.56	0.38	0.29	0.55
Chlorophyll-a (µg/L)	3.94	2.2	5.1	3.2	1.8	4.4	3.1	1.6	4.4
Escherichia coli (cfu/100mL)	59.8	22	92	71	55	100	61	24	93

Source: Compiled from Appendix B of *Marine Water Quality in Hong Kong in 2012 to 2016*, EPD.

Notes:

1. Data presented is the depth-averaged value averaged over 5 years, unless stated otherwise.
2. Total Inorganic Nitrogen and Unionised Ammonia is presented as the depth averaged annual mean over 5 years and the depth averaged annual range.
3. *E.coli* is presented as depth averaged annual geometric mean.

Table A-3 Summary of EPD Routine Water Quality Monitoring Data between 2012 and 2016 (JM3, JM4, EM1, EM2, EM3, MM8 and MM13) (continued)

Water Quality Parameter	Tathong Channel EM2			Tathong Channel EM3			Waglan Island MM8			Mirs Bay North MM13		
	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Temperature (°C)	22.8	22.7	23.0	22.8	22.7	22.9	22.7	22.4	23.0	22.9	22.3	23.5
Salinity	32.2	31.8	32.9	32.4	31.9	33.0	32.4	31.7	33.0	32.1	31.8	32.5
Dissolved Oxygen – Averaged Depth (mg/L)	6.4	6.1	7.0	6.5	6.2	7.0	6.4	6.2	6.8	6.5	6.0	7.1
Dissolved Oxygen – Bottom (mg/L)	6.1	5.9	6.8	6.2	5.9	6.6	5.8	5.6	6.2	5.8	5.2	6.1
Dissolved Oxygen – Averaged Depth (% Saturation)	89	85	97	91	86	97	89	86	95	91	84	99
Dissolved Oxygen – Bottom (% Saturation)	85	81	93	85	80	91	80	76	85	79	72	83
pH	7.9	7.8	8.0	8.0	7.9	8.0	8.0	7.8	8.1	8.0	7.8	8.1
Suspended Solid (mg/L)	4.2	2.6	6.8	3.9	2.3	5.6	4.3	2.7	7.1	4.4	2.7	6.6
5-day Biochemical Oxygen Demand (mg/L)	0.8	0.5	1.1	0.8	0.4	1.0	0.5	0.3	0.6	0.8	0.6	1.2
Unionised Ammonia (mg/L)	0.002	0.001	0.002	0.001	0.001	0.002	0.001	0.001	0.001	0.002	0.001	0.002
Total Inorganic Nitrogen (mg/L)	0.14	0.12	0.19	0.11	0.09	0.17	0.11	0.08	0.14	0.09	0.07	0.12
Total Nitrogen (mg/L)	0.35	0.27	0.56	0.32	0.23	0.55	0.31	0.24	0.54	0.32	0.20	0.58
Chlorophyll-a (µg/L)	2.8	1.8	3.8	2.6	1.6	3.3	2.0	1.2	3.2	2.8	1.9	3.3
Escherichia coli (cfu/100mL)	20	10	29	4	2	7	1	1	1	1	1	2

Source: Compiled from Appendix B of *Marine Water Quality in Hong Kong in 2012 to 2016*, EPD.

Notes:

1. Data presented is the depth-averaged value averaged over 5 years, unless stated otherwise.
2. Total Inorganic Nitrogen and Unionised Ammonia is presented as the depth averaged annual mean over 5 years and the depth averaged annual range.
3. *E.coli* is presented as depth averaged annual geometric mean.

Table A-4 Summary of EPD Routine Sediment Quality Monitoring Data between 2012 and 2016 (JS2, ES4, ES1, ES2, MS8 and MS13)

Sediment Quality Parameter	LCEL	UCEL	Junk Bay			Tathong Channel			Tathong Channel		
			JS2			ES4			ES2		
			Mean	Min	Max	Mean	Mean	Max	Mean	Min	Max
Chemical Oxygen Demand (mg/kg)	-	-	13,590	8,900	17,000	13,030	9,300	24,000	9,770	7,300	13,000
Total Kjeldahl Nitrogen (mg/kg)	-	-	570	480	660	490	390	560	480	400	650
Arsenic (mg/kg)	12	42	7.6	0.8	8.6	6.2	4.2	8.6	6.1	4.5	9.5
Cadmium (mg/kg)	1.5	4	0.1	0.1	0.2	0.1	0.1	0.4	<0.1	<0.1	<0.1
Chromium (mg/kg)	80	160	41	29	47	33	24	42	28	19	49
Copper (mg/kg)	65	110	67	55	78	57	35	100	18	12	32
Lead (mg/kg)	75	110	47	31	55	39	25	66	28	18	42
Mercury (mg/kg)	0.5	1	0.22	0.18	0.3	0.21	0.09	0.5	0.08	<0.05	0.13
Nickel (mg/kg)	40	40	20	15	23	17	13	23	18	12	31
Silver (mg/kg)	1	2	1.2	0.9	1.6	1.4	0.6	4.2	0.2	<0.2	0.4
Zinc (mg/kg)	200	270	140	97	160	120	73	260	75	48	110

Source: Compiled from Appendix E of *Marine Water Quality in Hong Kong in 2016*, EPD.

Notes:

1. Data presented are arithmetic mean (except if specified differently)
2. Data is based on Government laboratory analysis of bulk samples collected twice per year.
3. LCEL – Lower Chemical Exceedance Level, UCEL – Upper Chemical Exceedance Level.
4. If concentrations are below the limit of detection, results are taken as half of the reporting limit.

Table A-4 Summary of EPD Routine Sediment Quality Monitoring Data between 2012 and 2016 (JS2, ES4, ES1, ES2, MS8 and MS13) (continued)

Sediment Quality Parameter	LCEL	UCEL	Chai Wan			Mirs Bay (North)			Mirs Bay (South)		
			ES1			MS8			MS13		
			Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Chemical Oxygen Demand (mg/kg)	-	-	10,090	7,200	15,000	10,140	8,600	12,000	8,260	6,400	10,000
Total Kjeldahl Nitrogen (mg/kg)	-	-	430	350	500	490	400	550	490	430	550
Arsenic (mg/kg)	12	42	5.6	3.6	8.7	7.4	6.6	8.7	7.7	6.3	8.7
Cadmium (mg/kg)	1.5	4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium (mg/kg)	80	160	23	14	36	31	28	33	30	24	34
Copper (mg/kg)	65	110	26	15	38	14	10	18	12	10	17
Lead (mg/kg)	75	110	29	15	43	33	30	37	31	25	35
Mercury (mg/kg)	0.5	1	0.14	0.08	0.31	0.05	<0.05	0.06	0.05	<0.05	0.07
Nickel (mg/kg)	40	40	14	9	21	22	20	24	22	19	24
Silver (mg/kg)	1	2	0.4	0.2	0.6	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Zinc (mg/kg)	200	270	74	48	120	79	72	89	77	62	86

Source: Compiled from Appendix E of *Marine Water Quality in Hong Kong in 2016*, EPD.

Notes:

1. Data presented are arithmetic mean (except if specified differently)
2. Data is based on Government laboratory analysis of bulk samples collected twice per year.
3. LCEL – Lower Chemical Exceedance Level, UCEL – Upper Chemical Exceedance Level.
4. If concentrations are below the limit of detection, results are taken as half of the reporting limit.

Water Sensitive Receivers

A.3.6 There are 21 no. Water Sensitive Receivers (WSRs) in the vicinity of the Cable alignment, comprising:

- Gazetted Bathing Beaches
- Fisheries
- Sites of Special Scientific Interest (SSSI)
- Marine Reserve
- Coral Communities of Ecological Concern
- Seawater Intakes

A.3.7 WSRs are shown on ***Figure A-4a*** and ***Figure A-4b*** and are summarised in ***Table A-5***, which also indicates the distance between the WSR and the closest alignment of the Cable.

Table A-5 Closest Distances of WSRs to the Cable Alignment

Category	ID	Water Sensitive Receivers	Closest Distance from Cable Alignment (m)
Gazetted Bathing Beaches	B1	Shek O Beach	1,246
	B2	Rocky Bay Beach	986
	B3	Big Wave Bay Beach	829
Fish Culture Zones (FCZ)	F1	Tung Lung Chau FCZ	2,736
	F2	Po Toi FCZ	5,924
Fish Spawning Grounds	F3	The south-eastern waters through which the cable alignment passes	0
Sites of Special Scientific Interest (SSSI)	S1	Shek O Headland	801
	S2	Hok Tsui (Cape D'Aguilar)	2,556
	S3	Ninepin Group	5,779
Marine Reserve	M1	Cape D'Aguilar Marine Reserve	2,191
Coral Communities of Ecological Concern	C1	Coral communities at Ngan Wan (Cape Collinson)	264
	C2	Coral communities along Junk Bay	3,200
	C3	Coral communities along Tung Lung Chau	2,000
	C4	Coral communities at Fat Tau Chau	227
	C5	Coral communities along coast of Po Toi	3,529
	C6	Coral communities along coast of Sung Kong	1,400
	C7	Coral communities along coast of Ninepin Group	5,518
	C8	Coral communities along coast of Waglan Island	1,600
	C9	Coral communities at Tai Long Pai	319
Seawater Intakes	W1	WSD Siu Sai Wan Seawater Intake	377
	W2	Pamela Youde Nethersole Eastern Hospital Cooling Seawater Intake	1,077

A.4 Potential Sources of Impact

A.4.1 Cable installation will involve the following activities that have the potential to generate suspended solids:

- **Route Clearance**. Removal of obstacles along the cable route by grapnel.
- **Shore-end Cable Installation at TKOIE.** Pulling the Cable through a duct in the seawall and securing in the BMH.
- **Off-shore Cable Installation**. Cable burial by cable burial tool, and shallow burial at cable and pipeline crossings.
- **Cable Repair Works.** Bring a cable to the surface to effect repairs due to accidental damage, e.g. from anchors.

A.4.2 The potential for any adverse direct and indirect impacts to water quality from the installation of the Cable are discussed below. There will be no adverse impacts to water quality from the operation of the Cable and so these have not been assessed.

Route Clearance

A.4.3 For the majority of the alignment, the Cable will be buried by an "Injector Burial Tool" or "Sledge Tool". Prior to this, a Route Clearance Operation (RC) and Pre-lay Grapnel Run (PLGR) will be conducted, in which a grapnel is dragged on the seafloor to remove large objects from the cable path. Such processes are intended to remove out of service cables and any debris or obstacles that may pose threat to cable laying.

A.4.4 RC and PLGR are carried out for all cable burial projects and in none of the previous Project Profiles submitted for these projects has the PLGR been predicted to cause unacceptable water quality impacts. As exactly the same methods are to be used for this Project, unacceptable water quality impacts are also not anticipated.

Shore-end Cable Installation at TKOIE

A.4.5 At the TKOIE landing point, the Cable emerges from the sea and enters an existing duct in the Harbour seawall. The Cable will be pulled through the seawall duct by a winch into the Beach Manhole (BMH), where it will be secured. Here, the seabed is rocky and there are many other cables entering the ducts, so the cable will be laid by divers to a depth appropriate to the site conditions on a "best endeavour" basis. Thereafter, cable protection, such as Articulated Pipe (AP) will be installed.

A.4.6 Shore-end installation in marine mud (up to around 20m from the seawall) will be performed by divers using jetting techniques to form a narrow trench in the seabed, approximately 0.5m wide and 5m deep. After the Cable is laid, the trench will naturally re-fill in a short space of time and the seabed will return to its original profile.

A.4.7 Burying by divers at the shore-end location is not expected to cause significant water quality impacts as only a small area will be disturbed. The potential impacts in terms of water quality during the shore-end cable installation would be mainly surface water runoff, which can be controlled and minimised with the implementation of precautionary measures/good site practices recommended in ***Section A.6***.

Off-shore Cable Installation

A.4.8 The Cable to the eastern boundary of Hong Kong (after the first 20m of shore-end installation) will be buried using jetting techniques to a depth of 5m by an "Injector Burial Tool" or "Sledge Tool" towed behind a cable-laying vessel.

A.4.9 On board the cable-laying vessel, the Cable will be fed into the burial tool, which will lay the Cable into the seabed at the target depth. The target burial depth within Hong Kong waters is approximately 5m below the seabed, except when crossing obstructions and in transient zones, such as between launch positions of burial tool, the end of APs, and reaching the target burial depth on an incline.

A.4.10 The cable burial tool uses localised high-pressure jets directly around the Cable to fluidise a narrow trench in the seabed to the desired depth into which the Cable is simultaneously laid and buried. The maximum width of the seabed fluidised by the burial tool is 0.5m and the disturbed area of the seabed will be limited to this width.

A.4.11 A dive team on the cable-laying vessel will be on standby during cable laying to ensure proper functioning and positioning of the burial tool. The cable-laying vessel towing the burial tool will travel at a speed of around 1km per hour or less along the cable alignment.

A.4.12 During the cable laying process, seabed sediments will be disturbed and a small percentage of sediment will be lost to suspension in the lower part of the water column in the immediate vicinity of the cable burial tool. The sediment along the trench area naturally slumps around the Cable, burying it, and leaving a small line in the seabed, which is then infilled by natural sedimentation. There are no materials that will be dredged or disposed of off-site.

A.4.13 Where the HK-G Cable needs to cross existing cables, the burial tool will be re-adjusted about 50m from the crossing location to a depth sufficient to allow a cushion of seabed material to remain above the cable or pipeline to be crossed. Additional protection for the Cable will be provided by Uraduct, if needed, and will be agreed with other cable owners in advance of installation. Once the cable has been crossed, the burial tool will be re-adjusted to achieve the target burial depth.

A.4.14 When crossing the Gas Pipeline, which is buried around 4m below the seabed, a shallower burial depth is required. To avoid any interference with the Gas Pipeline, around 50-75m from the Gas Pipeline the HK-G Cable will be laid by either the burial tool or divers at a depth possible/agreed, over the top of the Gas Pipeline. Since the cable is laid with shallow burial, it may be susceptible to anchor damage, additional cable protection by Uraduct will be needed for this 100-150m section. As cable laying will be carried out quickly, significant water quality impacts are not anticipated from shallow burial installation.

A.4.15 Some parts of the Cable will be installed by divers, such as the shore-end and the crossing of the Gas Pipeline. Diver-operated jetting tools have a much smaller water jetting strength and seabed fluidization ability (about 2m depth) compared to the cable burial tool used for the majority of cable installation (about 5m depth). Considering that diver installation will be only for short sections of cable, will be carried out in a matter of hours, and will use less powerful jetting equipment, the sediment release is considered to be minimal. The seabed can therefore be expected to naturally reinstate to before-work levels and conditions shortly after completion of the works. As such, no significant water quality impact is anticipated for sections of cable installed by divers.

A.4.16 The majority of the Cable alignment, however, will be laid using an "Injector Burial Tool" or "Sledge Tool" and the impacts from this have been assessed in a quantitative manner. To calculate the transportation of sediment in suspension the standard approach has been used, which is the same as for recently approved Project Profiles for similar cable burial projects for which EPs have been issued – these were listed in ***Section 6***.

Cable Repair Works

A.4.17 If a cable installed under the seabed is damaged by dropped objects or anchoring activities, cable repair works shall be required. These comprise route clearance prior to repair works; exposing the damaged cable section by diver jetting tool; reconnecting the damaged cable; and reburial of the repaired cable section by diver jetting tool. The seabed can be expected to naturally reinstate to before-work level and conditions shortly after completion of the repair works. No dredging will be required for cable repair works.

A.5 Impact Assessment

Calculations

A.5.1 In the following calculations, all of the values adopted for the HK-G Cable lie within the range of values adopted in other recently approved Project Profiles for similar cable laying projects; all of the formulae that have been used for the HK-G Cable are identical to those used in other recently approved Project Profiles for similar cable laying projects; and the approach for calculating settling velocity and settling time is the same as that used in other recently approved Project Profiles for similar cable laying projects, including AAE-1 and APG. A list of values adopted in these calculations has been provided in ***Appendix A*** for reference.

Calculation of Sediment Release Rate

A.5.2 Calculation of sediment transport is based on the following approach with appropriate reference to EAC, ASE, APG, TKOE and UEL. The upper limits for the parameters have been used in these studies for calculating the release rate, settling velocity and settling time and distance travelled for suspended sediments to account for a worst case scenario.

Release rate	= cross sectional area of disturbed sediment x speed of burial tool x sediment dry density x percentage loss
Depth of Disturbance	= 5m (burial depth of cable)
Width of Disturbance	= 0.5m (width of seabed disturbance as cable buried)
Max. Cross-sectional Area	= 2.5m^2
Loss Rate	= 20% (majority of sediment not disturbed)
Speed of Burial Tool	= 0.278m s^{-1} (1km per hour)
In-situ Dry Sediment Density	= 600kg m^{-3} (typical of Hong Kong sediment)
Release Rate	**= 83.4kg s^{-1}**

A.5.3 The width of temporary disturbance during cable installation is approximately 0.25m from either side the centre line of the cable alignment, which is 0.5m in total. With reference to recently completed cable projects, the maximum speed of the cable-laying vessel (and therefore the burial tool) will be 1km per hour, as adopted above.

Initial Concentration of Suspended Sediments

A.5.4 During cable laying works, 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. At high concentrations and within a localised area the suspended sediments will tend to form large aggregations of sediment particles (flocculation), which have a higher settling velocity than the individual particles.

A.5.5 It is expected that the suspended sediments will remain within 1m of the seabed, which is independent of the water depth. Current velocities at the seabed are lower than those near the water surface due to such effects as bottom friction. The current velocity has been chosen based on velocity values of cable projects with similar alignments to HK-G.

A.5.6 For the purpose of the assessment, a current velocity of 0.9m s^{-1} has been applied, which is an upper bound estimate of bottom current velocities in the vicinity of the Cable alignment and a conservative estimate. Based on recent data, this would be an absolute worst-case scenario.

A.5.7 It is expected that the sediment will initially spread to a maximum of 6m along the centre line of the trench, which represents the longitudinal dimension of the cable burial tool. Although the suspended solids are expected to form around the cable laying works, a conservative assumption has been used to allow for a cross-current to carry sediment towards the sensitive receivers.

A.5.8 Referring to the above, the worst case scenario is that the sediment initially mixes evenly over the lower 1m of the water column and over the initial length of spread of the sediment.

Initial concentration	= release rate ÷ (current speed x height of sediment x width of sediment)
Release Rate	= 83.4kg s^{-1}
Current Velocity	= 0.9 m s^{-1}
Height of Sediment	= 1m
Width of Sediment	= 6m
Initial Concentration	**= 15.44kg m^{-3}**

Settling Velocity and Settling Time

A.5.9 Typically, the settling velocity of suspended solids is determined by examining the relationship between the initial suspended solids concentrations and the cohesive nature of the sediment being disturbed. It is generally accepted that an increase in sediment concentrations also increases the settling velocity, a result of flocculation leading to gain in mass and therefore faster settlement. However, when initial concentrations exceed values such as 1kg m^{-3} [Ref#1], this is no longer true. As the initial concentrations for this Project are predicted to be greater than this value, a conservative settling velocity of 10mms^{-1} has been adopted.

A.5.10 As the sediment progressively settles onto the seabed, suspended sediment concentrations will gradually reduce. In order to account for the gradually reducing

1. HR Wallingford (1992) *Estuarine Muds Manual* Report SR 309, Her Majesty's Stationary Office, UK.

concentrations, the above settling velocity is halved, which gives a value of 5.0mm s^{-1}. This is the same approach as was adopted for the EAC, ASE, APG, TKOE and UEL and others.

A.5.11 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	= maximum height of sediment ÷ settling velocity
	= 1m/0.005m s^{-1}
Settling Time	**= 200s (3.3 minutes)**

Distance Travelled

A.5.12 Combining this settling time with the speed of the tidal currents allows an estimate of how far the sediment will spread during the cable laying process. In this case, a worst-case tidal current of 0.9 m s^{-1} has been assumed.

Distance Travelled	= Settling Time x Speed of Tidal Current
	= 200s x 0.9m s^{-1}
Distance Travelled	**= 180m**

A.5.13 The above calculation indicates that the sediments disturbed during cable laying works will settle onto the seabed within approximately 180m of the trench and will settle within about three and half minutes.

Potential Impacts to WSRs

A.5.14 ***Table A-6***, below, shows the 21 no. WSRs for the HK-G Cable and examines the potential impacts based on distance from cable laying activities. Based on the sediment plume distance calculated above, and with reference to the findings of the monitoring for APG, WSRs located within the 180m settlement distance from the cable trench would likely be affected by the Project; WSRs located more than 180m but within 500m (the distance typically adopted for EIA studies for water quality impacts) might possibly be affected; but WSRs located more than 500m would unlikely be affected (see ***Figure A-4a***).

A.5.15 For the Fish Spawning Grounds through which the alignment of this Cable (and the majority of previous cables) passes, there may be a short-term impact. None of the other WSRs are located within the maximum 180m extent of any plume from the cable trench, which means none will be directly affected by the Project. There are four WSRs that are within 500m of the cable alignment; the coral communities at Ngan Wan (Cape Collinson), at Fat Tau Chau and at Tai Long Pai; and the WSD Siu Sai Wan Seawater Intake, that might be indirectly affected by the cable installation works.

Reference to Past Water Quality Monitoring Data

A.5.16 A number of recently approved cable projects have already been constructed. The two most recent are TKOE, completed in early-2017, and APG, completed in mid-2016. APG has a very similar alignment to the HK-G Cable. As shown in ***Figure 1-1***, APG also has the same landing site at TKOIE as HK-G Cable, also runs along the Tathong Channel to the eastern waters, and then also exits Hong Kong at the eastern boundary. APG also has similar distance separation from WSRs.

A.5.17 Given these similarities, the results of the water quality monitoring carried out for APG have been reviewed to assess the likely water quality impacts that may result from the cable laying works for the HK-G Cable.

A.5.18 Water quality monitoring for the installation of APG was carried out at stations in three zones, designated Zones A, B and C, which are shown in ***Figure A-5***. The monitoring results for suspended solids and turbidity have been reviewed and are summarised in ***Table A-7***, below. These results demonstrate that there was no deterioration of water quality at WSRs in the vicinity of the cable alignment and that water quality impact caused by installation of the APG Cable was negligible. Given the similarities between the two cables, a similar result could be expected for installation of the HK-G Cable.

Table A-6 Water Quality Impact at Sensitive Receivers During Cable Burial Machine Installation

Category	ID	Sensitive Receivers	Closest Distance from Cable Alignment (m)	Potential for Adverse Impact
Gazetted Bathing Beaches	B1	Shek O Beach	1,246	None due to >500m distance between WSR and cable trench
	B2	Rocky Bay Beach	986	None due to >500m distance between WSR and cable trench
	B3	Big Wave Bay Beach	829	None due to >500m distance between WSR and cable trench
Fish Culture Zones (FCZ)	**F1**	**Tung Lung Chau FCZ ❶**	**2,736**	**None due to >500m distance between WSR and cable trench**
	F2	Po Toi FCZ	5,924	None due to >500m distance between WSR and cable trench
Fish Spawning Grounds	**F3**	**The south-eastern waters through which the cable alignment passes ❷**	**0**	**Possible due to <500m distance between WSR and cable trench**
Sites of Special Scientific Interest (SSSI)	S1	Shek O Headland	801	None due to >500m distance between WSR and cable trench
	S2	Hok Tsui (Cape D'Aguilar)	2,556	None due to >500m distance between WSR and cable trench
	S3	Ninepin Group	5,779	None due to >500m distance between WSR and cable trench
Marine Reserve	M1	Cape D'Aguilar Marine Reserve	2,191	None due to >500m distance between WSR and cable trench
Coral Communities of Ecological Concern	**C1**	**Coral communities at Ngan Wan (Cape Collinson) ❸**	**264**	**Possible due to <500m distance between WSR and cable trench**
	C2	Coral communities along Junk Bay	3,200	None due to >500m distance between WSR and cable trench
	C3	Coral communities along Tung Lung Chau	2,000	None due to >500m distance between WSR and cable trench
	C4	**Coral communities at Fat Tau Chau ❹**	**227**	**Possible due to <500m distance between WSR and cable trench**
	C5	Coral communities along coast of Po Toi	3,529	None due to >500m distance between WSR and cable trench
	C6	Coral communities along coast of Sung Kong	1,400	None due to >500m distance between WSR and cable trench
	C7	Coral communities along coast of Ninepin Group	5,518	None due to >500m distance between WSR and cable trench
	C8	Coral communities along coast of Waglan Island	1,600	None due to >500m distance between WSR and cable trench
	C9	**Coral communities at Tai Long Pai ❺**	**319**	**Possible due to <500m distance between WSR and cable trench**
Seawater Intakes	**W1**	**WSD Siu Sai Wan Seawater Intake ❻**	**377**	**Possible due to <500m distance between WSR and cable trench**
	W2	Pamela Youde Nethersole Eastern Hospital Cooling Water Intake	1,077	None due to >500m distance between WSR and cable trench

Notes: Other than the Fish Spawning Grounds, none of these WSRs are located within the 180m maximum extent of any plume generated by cable laying works, which means none will be directly affected by the Project.

Based on distance from the cable trench, WSRs within 500m, shown in **Bold** and identified as ❶ to ❻, might be indirectly affected by the cable installation works. Although the Tung Lung Chau FCZ is >500m from the cable trench, as a precautionary measure it has been included as one of the six WSRs at which water quality monitoring shall be carried out.

Table A-7 Summary of Past Water Quality Monitoring Data from APG Cable Installation

Duration	Activity	Exceedances	Conclusion
16 to 22 May 2016	Route Clearance	Exceedances of Action and Limit Levels were recorded on all six monitoring days despite the stable water quality in Zones A to C. However, **these exceedances were not considered to be caused by the route clearance works but reflected the natural background fluctuation of marine water quality**, as concluded in the project's *First Weekly Impact Water Quality Monitoring Report*.	There was no deterioration of water quality during the reporting week and hence the effect of the project route clearance works on water quality is considered to be negligible over this reporting week. **No impact on water quality from the Project.**
23 to 29 May 2016	Cable laying works in Zone A and Zone B	Exceedances of Action and Limit Levels were recorded on three out of five monitoring days despite the stable water quality in Zones A to C. However, **these exceedances were not caused by cable installation but reflected the natural background fluctuation of marine water quality**, as concluded in the project's *Second Weekly Impact Water Quality Monitoring Report*.	There was no deterioration of water quality during the reporting week and hence the effect of the project cable laying works on water quality is considered to be negligible over this reporting week. **No impact on water quality from the Project.**
30 May to 5 June 2016	Cable laying works and post lay inspection and burial (PLIB) works in Zone B and C	Exceedances of Action and Limit Levels were recorded on all seven monitoring days despite the stable water quality in Zones A to C. However, **these exceedances were not caused by cable installation but reflected the natural background fluctuation of marine water quality**, as concluded in the project's *Third Weekly Impact Water Quality Monitoring Report*.	There was no deterioration of water quality during the reporting week and hence the effect of the project cable laying works and PLIB on water quality in considered to be negligible over this reporting week. **No impact on water quality from the Project.**
6 to 12 June 2016	No project marine works	All marine works were completed on 5 June 2016, yet exceedances of Action and Limit Levels were recorded on two monitoring days. **These exceedances once again reflected the natural background fluctuation of marine water quality**.	Natural background fluctuations in water quality is more likely to have caused exceedances. **No impact on water quality from the Project.**

Implications for HK-G Cable

A.5.19 The assessment of water quality monitoring results for APG concluded that there was no deterioration of water quality at the WSRs in the vicinity of the cable alignment and water quality impact caused by the cable installation works was negligible.

A.5.20 Given that the similar distance separation from WSRs for APG and HK-G Cables, and the fact that none of the WSRs for HK-G Cable are within the 180m settlement distance from the cable trench – the closest, coral communities at Fat Tau Chau, are 227m distant – no adverse water quality impact is expected to arise from the installation of the HK-G Cable. The results of the EM&A programme for the APG Cable demonstrated that there were no adverse impacts in the vicinity of that cable that were attributed to its installation. Given the similar nature of the two projects, this same conclusion would also be reached for the HK-G Cable.

A.5.21 Nevertheless, as a precautionary measure, it is recommended that water quality monitoring is carried out at the five WSRs within 500m of the cable alignment plus the Tung Lung Chau FCZ to demonstrate, as has been demonstrated for other cable laying projects, that no adverse water quality impacts are caused by cable laying. Details of proposed Environmental Monitoring and Audit (EM&A) are given in ***Annex E***.

Cumulative Impacts

A.5.22 While there are five projects planned in the vicinity of the HK-G Cable, only one including reclamation – the *Tseung Kwan O – Lam Tin Tunnel and Associated Works* – will be constructed concurrently with the HK-G Cable. As discussed in ***Section 3.4***, given that there will be full containment of reclamation works, the 2,250m separation and the short installation time of shore-end works at TKOIE (just a few days), cumulative water quality impacts will be negligible.

A.6 Precautionary Measures/Good Site Practices

Shore-end Cable Installation

A.6.1 No adverse impacts are expected to occur during shore-end cable installation at TKOIE, but the following precautionary measures/good site practices will nevertheless be followed:

- Stockpiles of any materials will be covered with tarpaulin or similar fabric to minimise runoff during the rainy season.
- Care will be taken during the cable landing to avoid any spillage of materials to the adjacent marine waters and to ensure that any spoil materials are not discharged into adjacent waters.
- All construction waste and drainage will be handled and disposed of in accordance with the Waste Disposal Ordinance and Practice Note for Professional Persons, Construction Site Drainage (ProPECC PN1/94).
- Best Management Practices (BMPs) will be applied to avoid and minimise any contaminated runoff from work sites, marine plant and vessels.

Marine Installation with Cable Burial Machine

A.6.2 No adverse impacts are expected to occur during marine installation of the Cable with the cable burial tool, but the following precautionary measures will be followed:

- The crane barge used for the transport of any debris recovered from the seabed during route clearance shall be fitted with tight bottom seals in order to prevent leakage of material during loading and transport to the disposal site.
- The crane barge shall be filled to a level that ensures that material does not spill over during loading and transport and that adequate freeboard is maintained to ensure that the decks are not washed by wave action.
- The speed of the installation barge will be limited to a maximum of 1km per hour. It will be further reduced to 0.5km per hour when the cable is being installed in proximity to south of Cape Collinson and north of Ngan Wan, and west of Fat Tau Chau.

A.6.3 In addition to the above, and as a precautionary measure, a mobile silt curtain with an estimated silt removal efficiency of 85% will be deployed when the cable is being installed in proximity to south of Cape Collinson and north of Ngan Wan, and Fat Tau Chau. Details of the mobile silt curtain shall be checked and verified by the Independent Environmental Checker/Independent Consultant (IEC/IC) before deployment.

A.6.4 The silt curtain will be suspended from a silt curtain barge that moves in parallel with the cable laying barge at a close but sufficiently safe distance (to be confirmed by the barge operator). The silt curtain will be 3x the length of the cable burial tool (i.e. around 18m in total length) and will be positioned such that the cable burial tool is always in the middle (horizontally) of the silt curtain. The silt curtain will be 3x the height of the suspended sediment (i.e. 3m in height) and will be positioned to hang from the silt curtain barge just above the seabed without actually touching the seabed (which would cause further sediment release). The silt curtain barge will have an accurate water depth detector and the silt curtain shall be raised or lowered as required to follow the undulations of the seabed without touching the seabed. Note that this is the same arrangement that was proposed in the approved Project Profile for the AAE-1 Cable.

A.6.5 An indicative arrangement of the proposed the silt curtain is shown on ***Figure A-6*** and ***Figure A-7***. The cross-section view of the arrangement is shown on ***Figure A-8***. Water quality monitoring inside and outside of the silt curtain will also be carried out, as detailed in ***Annex E***.

A.6.6 EM&A will be carried out at the six water quality monitoring locations that are likely to be affected or may possibly be affected by the cable installation works to demonstrate that the Project will not result in adverse impacts to water quality. Details of monitoring locations are provided in ***Annex E***.

Cable Repair Works

A.6.7 No adverse impacts are anticipated to result from the potential cable repair works, thus no mitigation measures are required.

A.7 Conclusion

A.7.1 An assessment of sediment dispersion impacts associated cable laying works along the proposed cable alignment has been undertaken. There is potential for small scale and localised water quality impacts to occur from cable installation works. The calculation of sediment transport from the cable laying works indicates that sediments disturbed during use of the cable burial tool will settle back to the seabed within a maximum of 180m from the cable trench within about three and half minutes.

A.7.2 For the Fish Spawning Grounds through which the alignment of this Cable (and the majority of previous cables) passes, there may be a short-term impact. None of the other WSRs are located within the 180m maximum extent of any plume from the cable trench and five WSRs are located within 500m (the distance typically adopted for EIA studies for water quality impacts) and therefore might possibly be affected by the marine works. The remaining 16 no. WSRs are located more than 500m from the cable alignment and so would not be affected. Monitoring to represent the Tung Lung Chau FCZ, which is >500m from the cable trench, has been included as a precautionary measure.

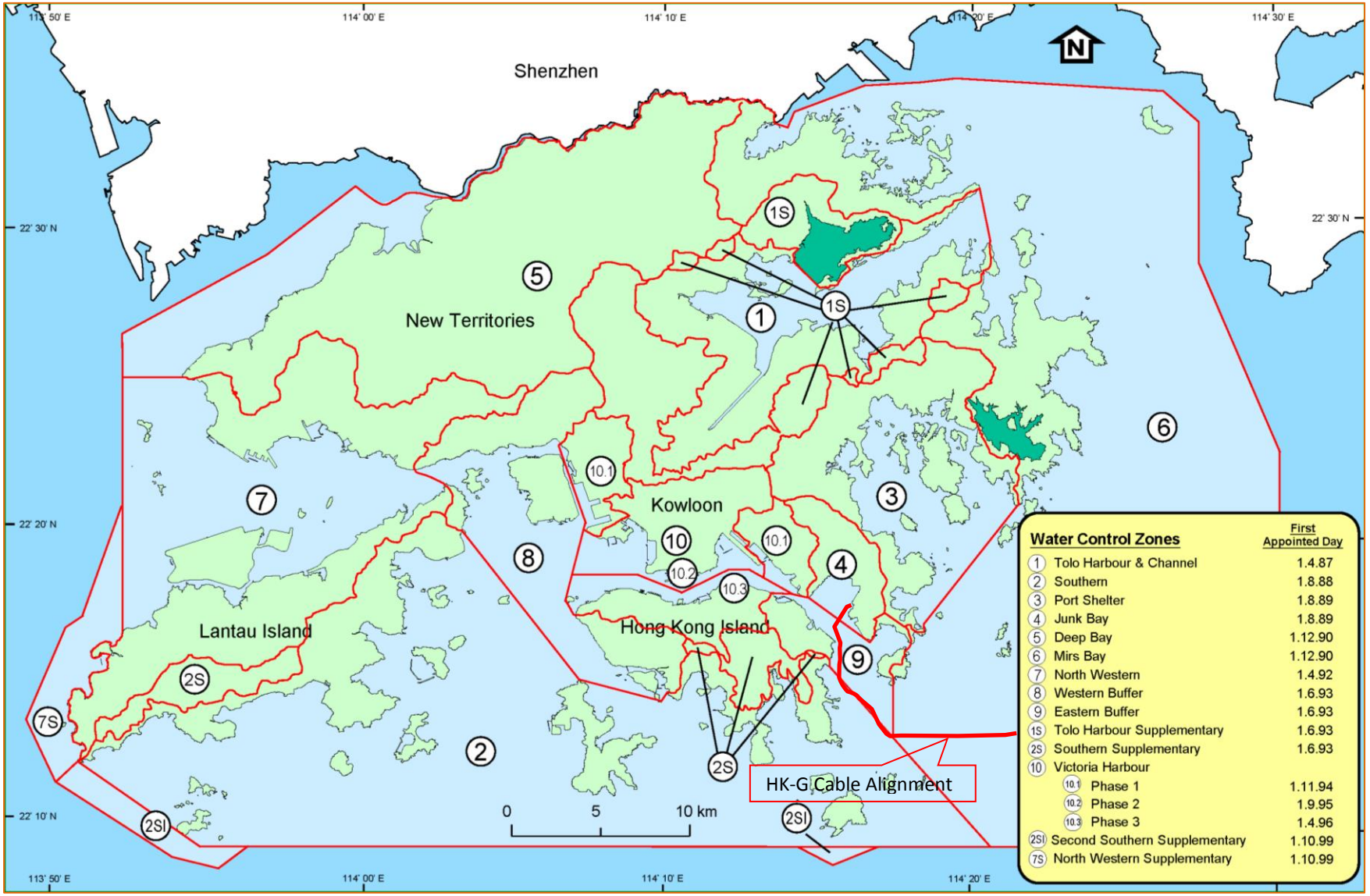
A.7.3 The water quality monitoring results for APG demonstrated that there was no deterioration of water quality at the WSRs in the vicinity of the cable alignment and water quality impact caused by the cable installation works was negligible. As such none are expected to arise from the installation of the HK-G Cable.

A.7.4 Nevertheless it is recommended that water quality monitoring is carried out at five WSRs within 500m of the cable alignment; the three coral communities at Ngan Wan (Cape Collinson), Fat Tau Chau and Tai Long Pai; Fish Spawning Grounds at south-eastern waters; and the WSD Siu Sai Wan Seawater Intake, to demonstrate, as has been demonstrated for other cable laying projects, that no adverse water quality impacts are caused by cable laying. Monitoring to represent the Tung Lung Chau FCZ, which is >500m from the cable trench, has been included as a precautionary measure.

A.7.5 Precautionary measures/good site practices have been recommended during the marine installation; for example, the speed of the installation barge will be set to a maximum of 1km per hour along the majority of the cable length, but further reduced to 0.5km per hour when the cable is being installed in proximity to south of Cape Collinson and north of Ngan Wan, and west of Fat Tau Chau; and implementation of EM&A at the WSRs that might be affected.

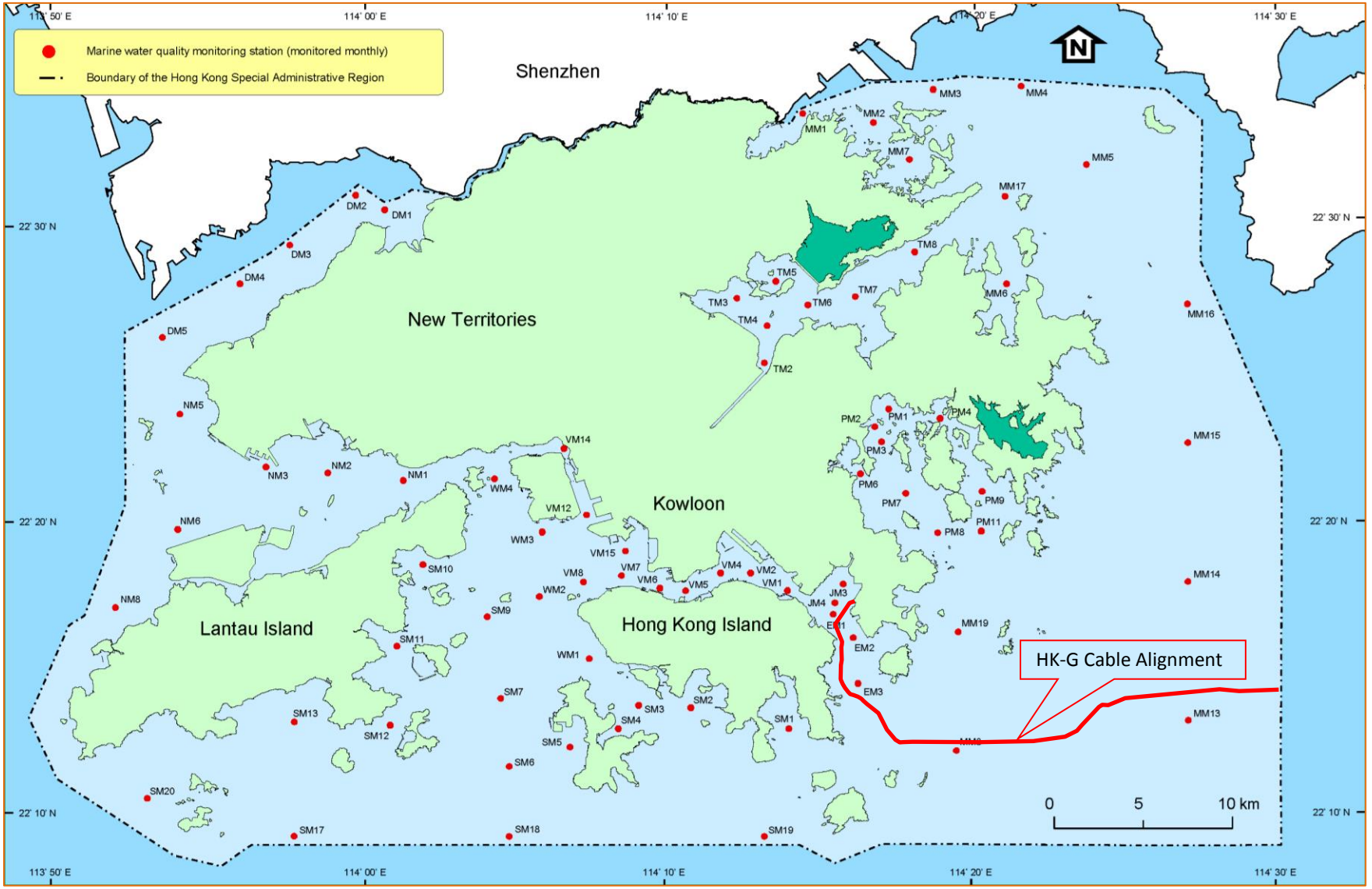
A.7.6 Overall, with the recommended precautionary measures/good site practices in place, no adverse water quality impacts are anticipated from the cable installation works.

Figure A-1 Water Control Zones in Hong Kong



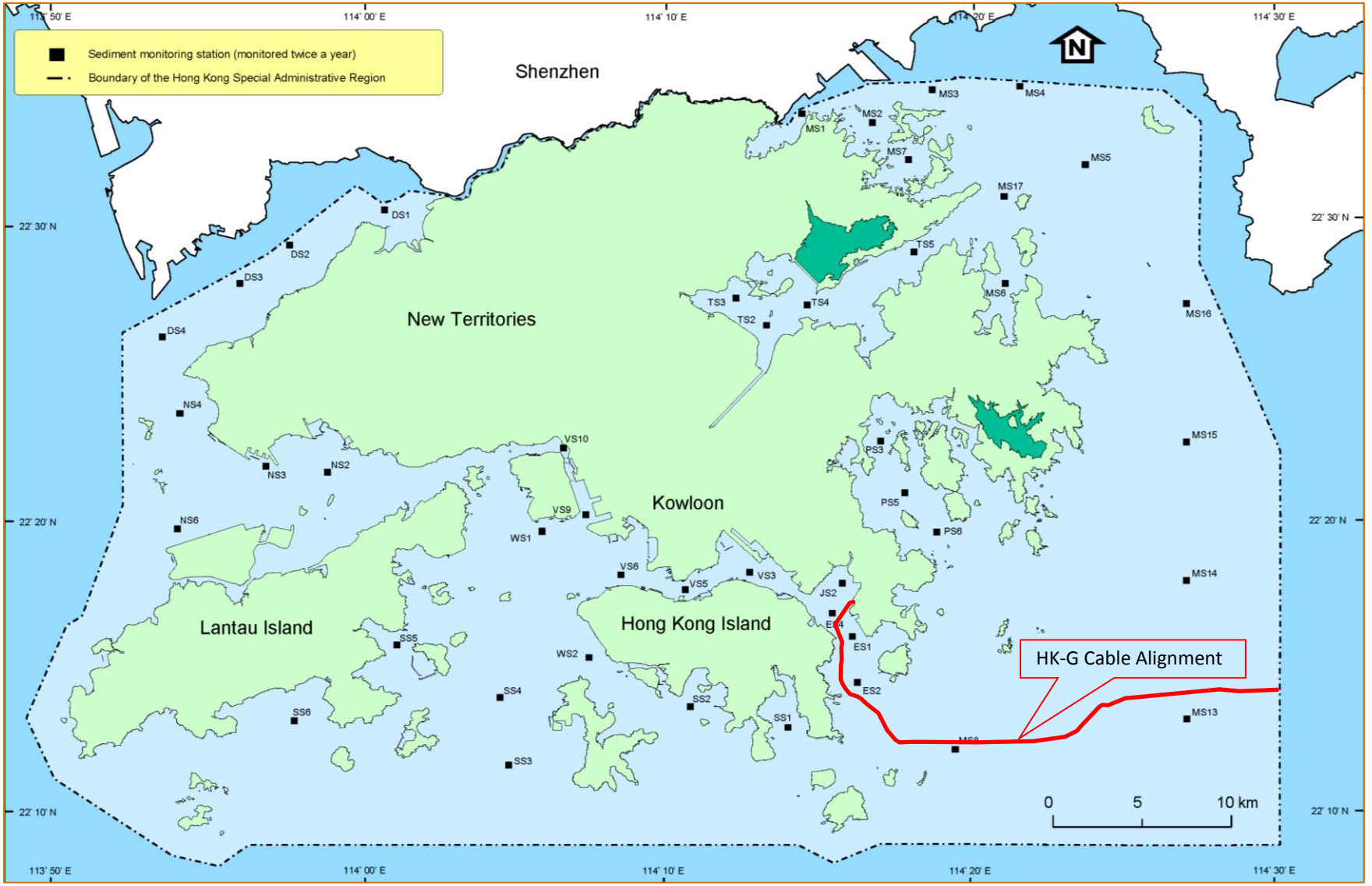
Source: *Marine Water Quality in Hong Kong in 2016*, EPD

Figure A-2 EPD's Marine Water Quality Monitoring Stations



Source: *Marine Water Quality in Hong Kong in 2016*, EPD

Figure A-3 EPD's Marine Sediment Monitoring Stations



Source: *Marine Water Quality in Hong Kong in 2016*, EPD

Figure A-4a WSRs and EPD Monitoring Stations in the Vicinity of the HK-G Cable Alignment

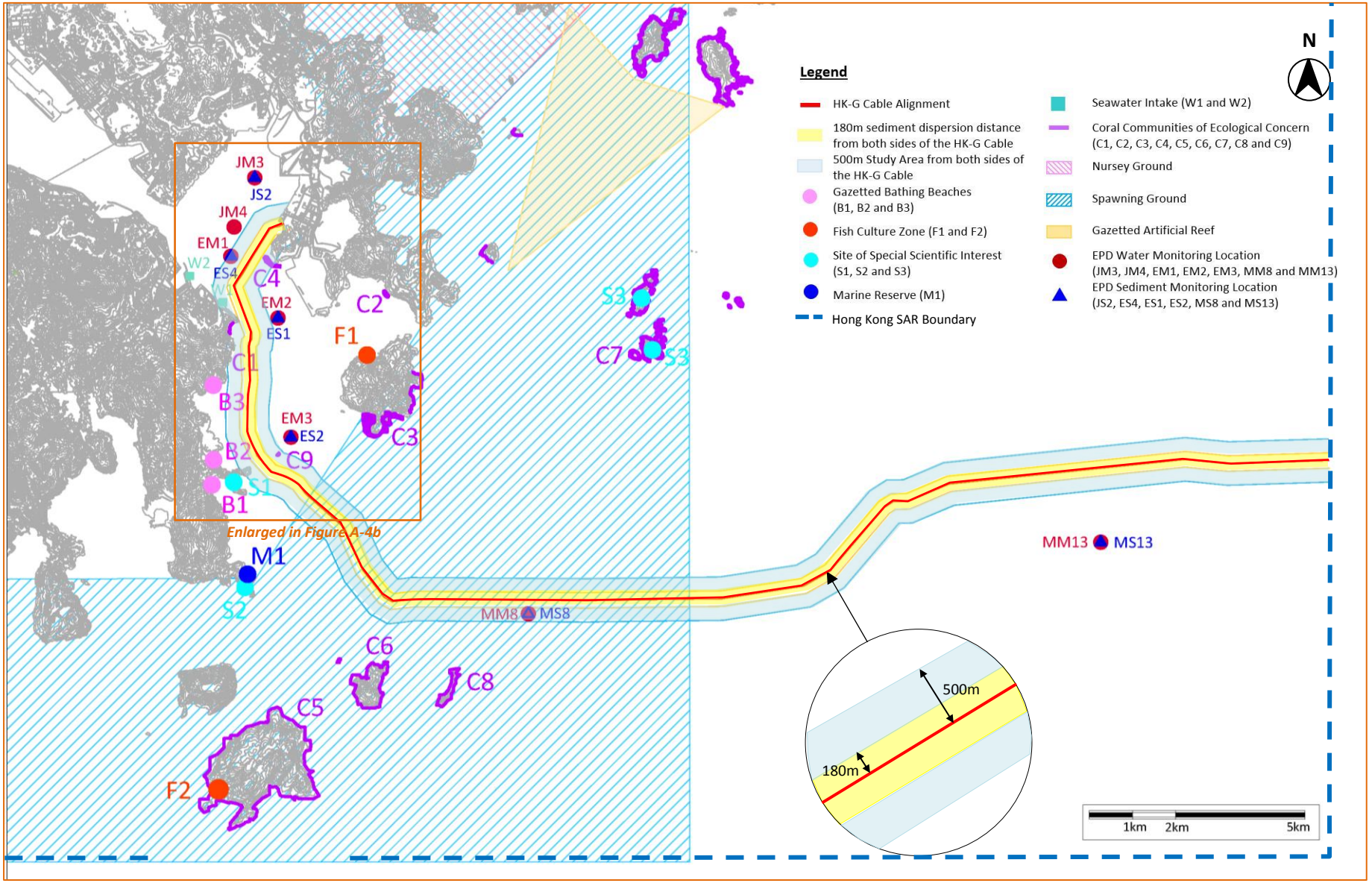
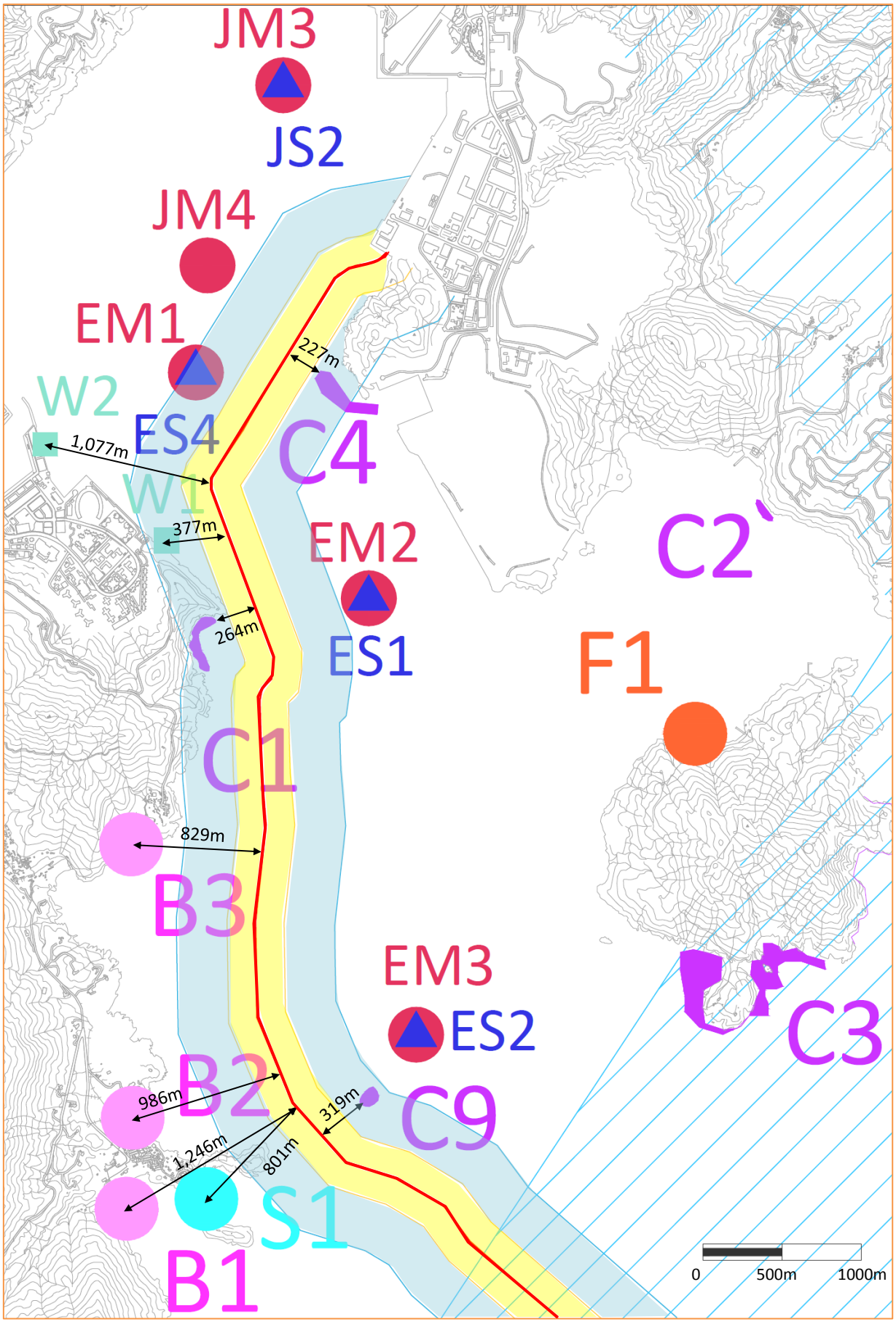
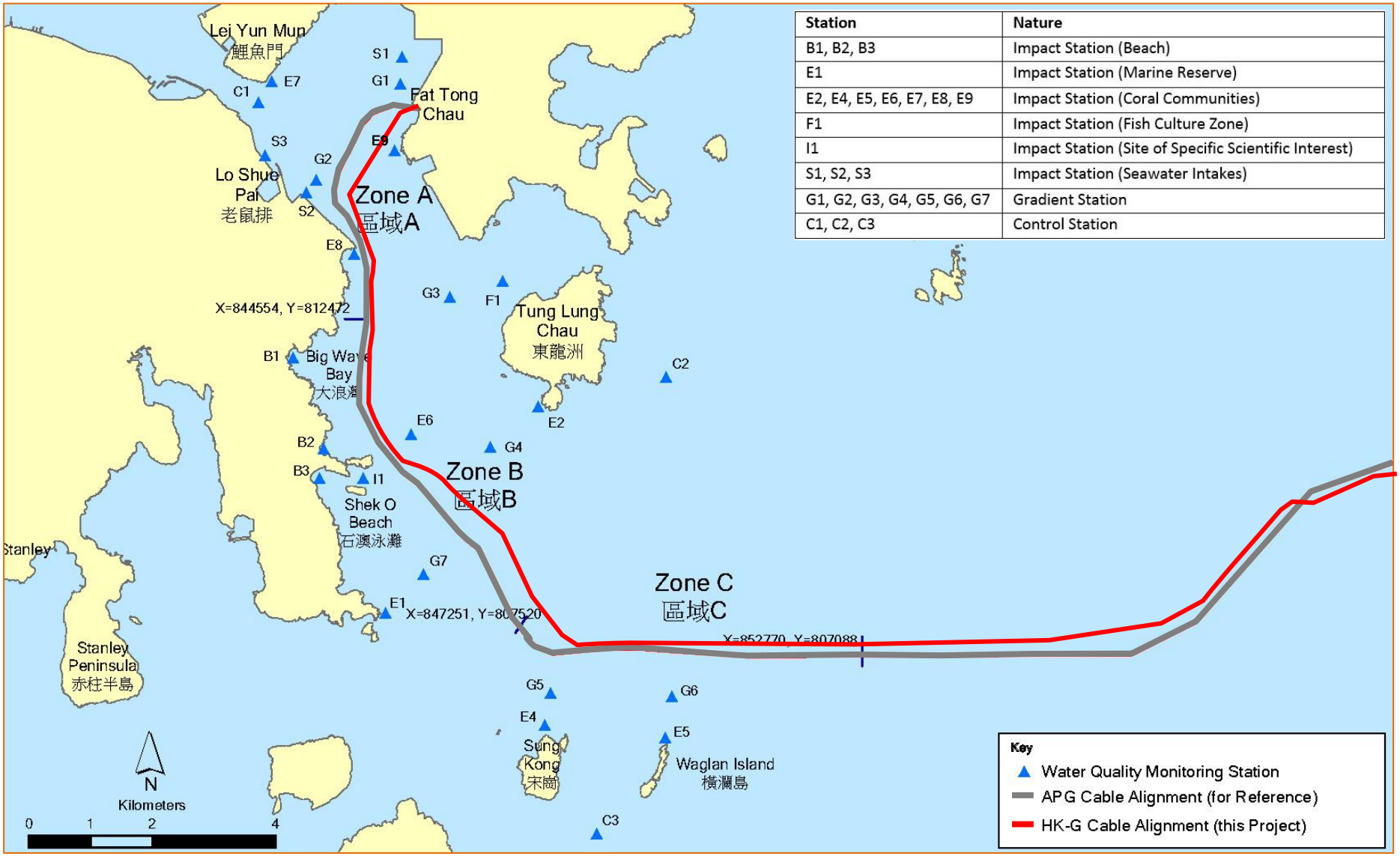


Figure A-4b Enlarged Plan Showing Location of WSRs and Cable Alignment



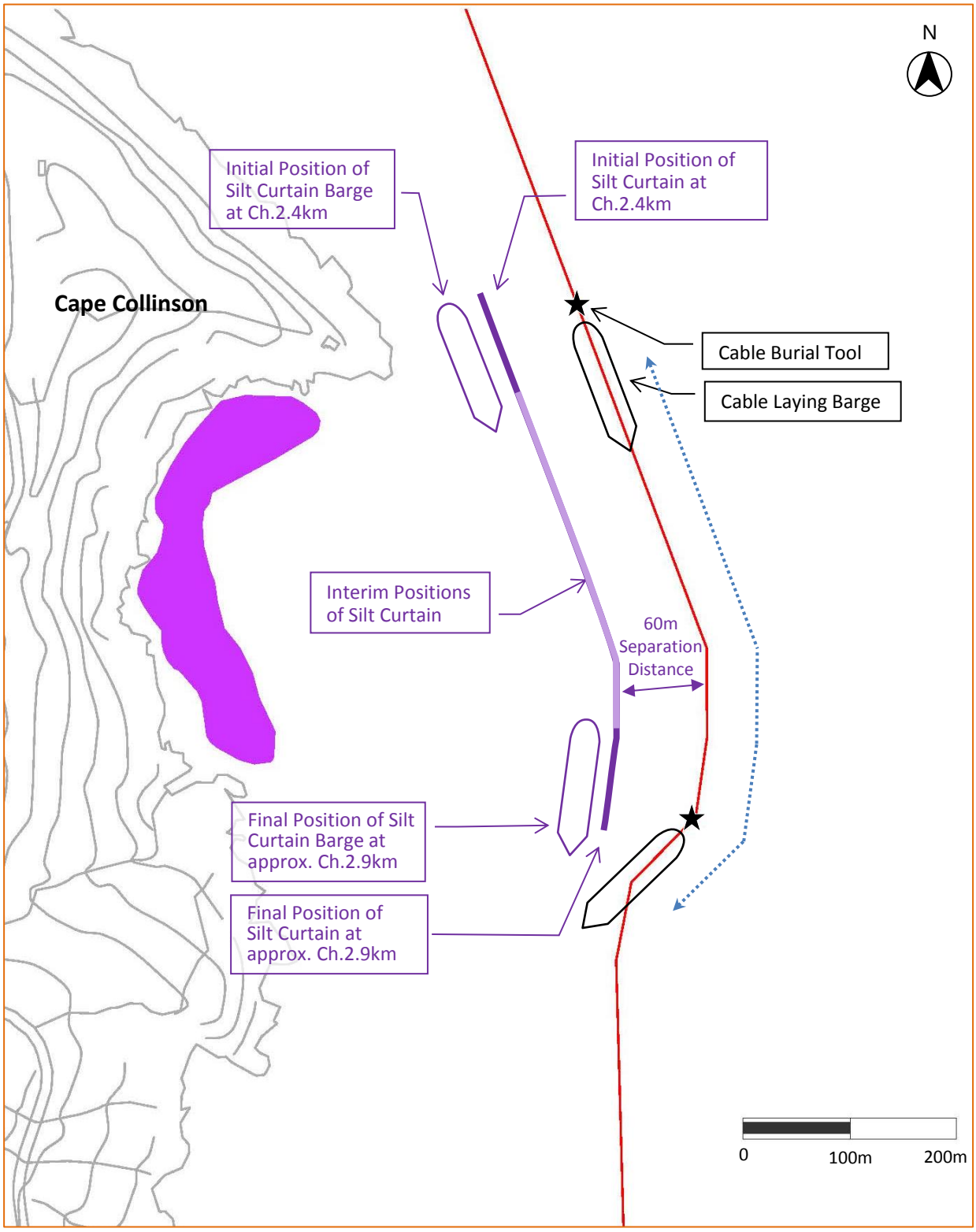
Note: See legend on ***Figure A-4a***.

Figure A-5 Water Quality Monitoring Stations Used for APG Cable Project (for Reference)



Source: EPD, modified from Project Profile for APG Cable, Figure E-1 available at http://www.epd.gov.hk/eia/register/profile/latest/dir233/dir233.pdf.

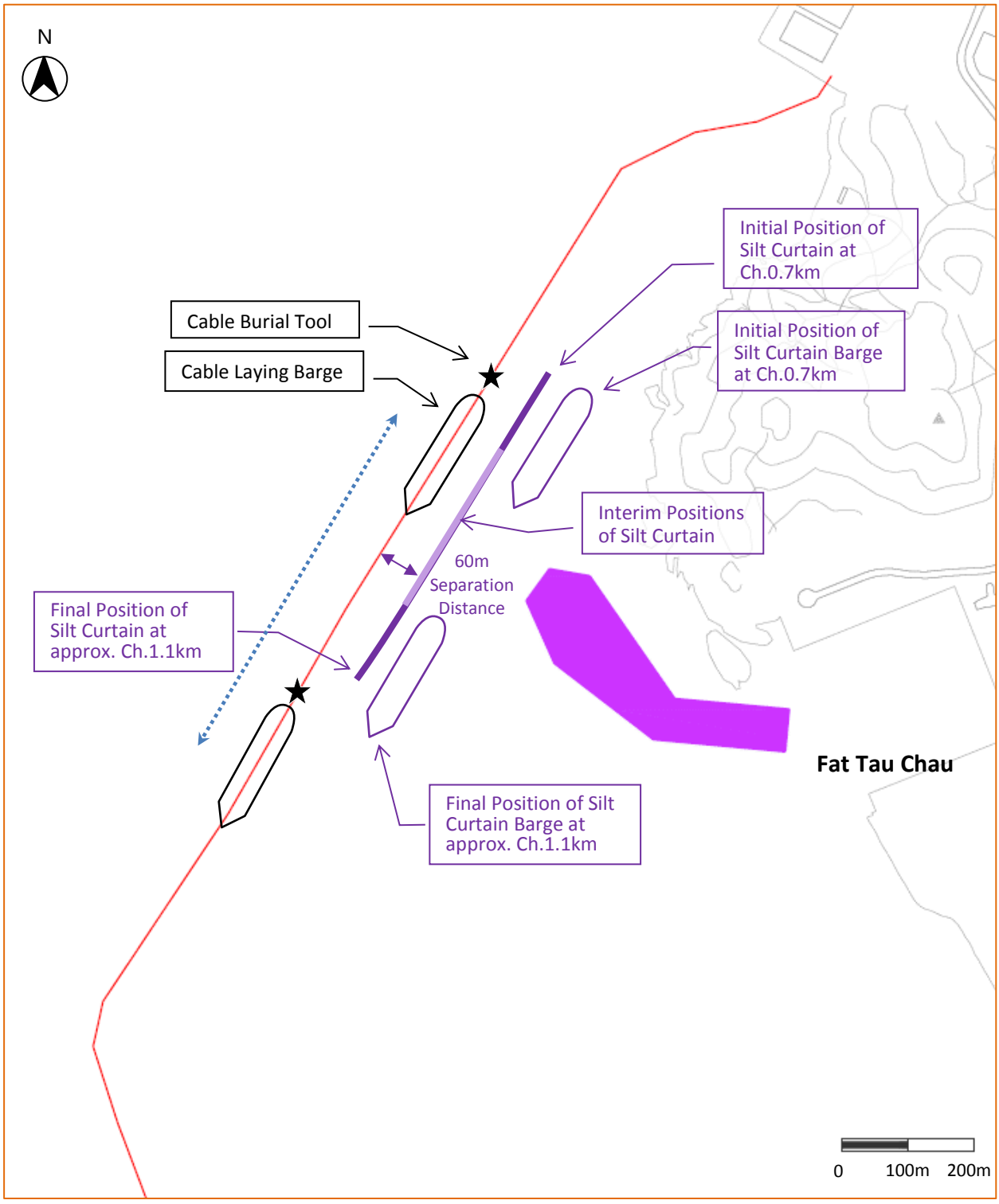
Figure A-6 Indicative Location of Mobile Silt Curtain in Proximity to South of Cape Collinson and North of Ngan Wan



Legend

- Proposed Hong Kong – Guam Submarine Cable (HK-G) (Ch.0km at TKO Landing Point)
- Speed of the barge reduced to 0.5km per hour along this section
- Coral Communities of Ecological Concern

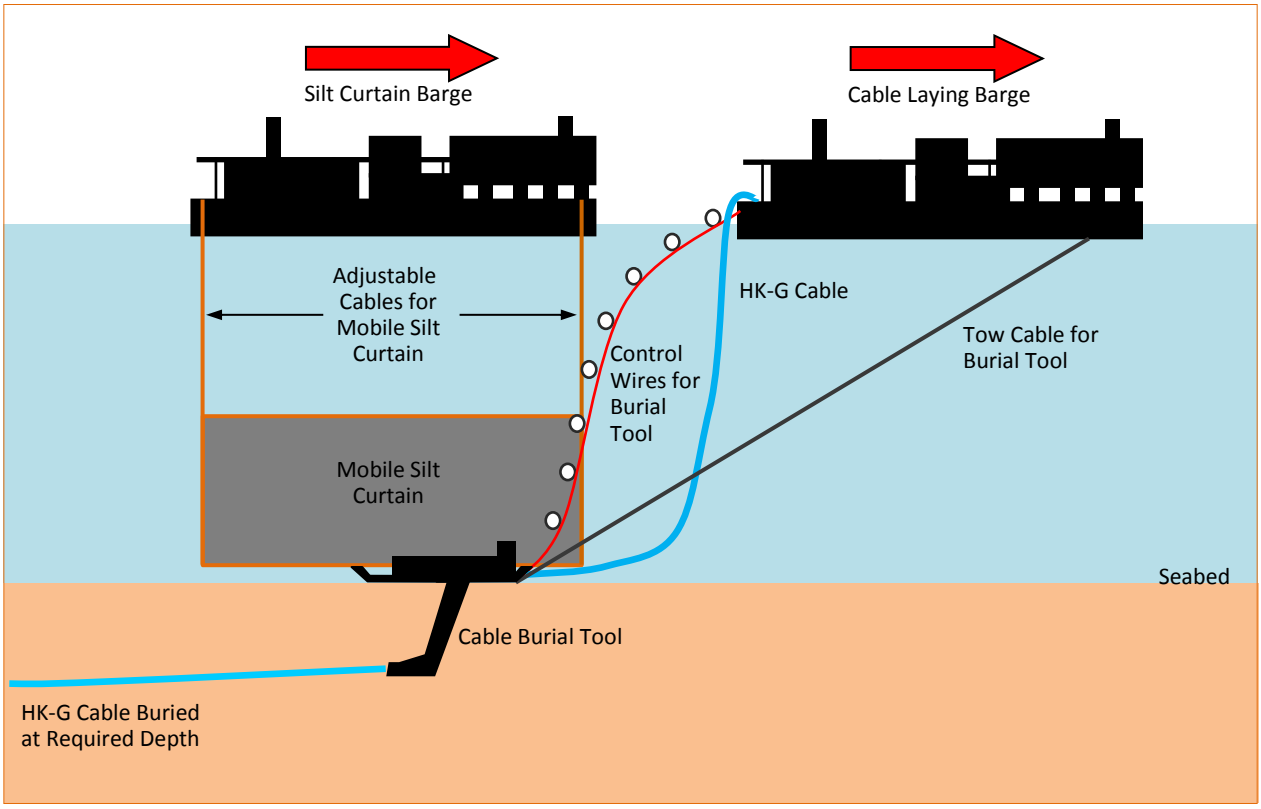
Figure A-7 Indicative Location of Mobile Silt Curtain in Proximity to Fat Tau Chau



Legend

- Proposed Hong Kong – Guam Submarine Cable (HK-G) (Ch.0km at TKO Landing Point)
- Speed of the barge reduced to 0.5km per hour along this section
- Coral Communities of Ecological Concern

Figure A-8 Cross-section View of Mobile Silt Curtain in Operation



APPENDIX A

Summary of Parameters Used in Sediment Plume Calculations for Other Selected Cable Projects

Project	Sediment Release Rate (kg/s)	Initial Concentration (kg/m^3)	Depth of Disturbance (m)	Width of Disturbance (m)	Maximum Cross-sectional Area (m^2)	Loss Rate (%)	Speed of Burial Tool (m/s)	In-situ Dry Density (kg/m^3)	Current Velocity (m/s)	Height of Sediment Plume (m)	Width of Sediment Plume (m)
HK-G Cable (this Project)	**83.4**	**15.44**	**5**	**0.5**	**2.5**	**20**	**0.278**	**600**	**0.9**	**1**	**6**
Justification for Value Adopted	*Standard formula*	*Standard formula*	*As required by project*	*As required by project*	*Standard formula*	*Worst case amongst PPs*	*Adopted in most other PPs*	*Adopted in all other PPs*	*Adopted in most other PPs*	*Adopted in most other PPs*	*Adopted in all other PPs*
Comparison with Parameters Used in Sediment Plume Calculations for Other Selected Cable Projects											
Ultra Express Link (UEL) – Tseung Kwan O/Chai Wan (AEP-543/2017)	83.4	15.44	5	0.5	2.5	20	0.278	600	0.9	1	6
Pacific Light Cable Network (PLCN), Deep Water Bay (AEP-539/2017)	83.4	15.44	5	0.5	2.5	20	0.278	600	0.9	1	6
AAE-1 Cable – Cape D'Aguilar (AEP-508/2016)	(i) 500m to 2.5km = 24.9 (ii) 2.5km to 27.65km = 83.4	(i) 500m to 2.5km = 14.88 (ii) 2.5km to 27.65km = 15.44	5	0.5	2.5	20	(i) 500m to2.5km = 0.083 (ii) 2.5km to 27.65km =0.278	600	(i) In vicinity of Cape D'Aguilar = 0.28 (ii) In existing cable corridor = 0.90	1	6
Tseung Kwan O Express – Cable System (TKO-E) – Tseung Kwan O /Chai Wan (AEP-509/2016)	83.4	15.44	5	0.5	2.5	20	0.278	600	0.9	1	6
Asia Pacific Gateway (APG) – Tseung Kwan O (AEP-485/2014)	83.4	15.44	5	0.5	2.5	20	0.278	600	0.9	1	6
Asia Submarine-cable Express (ASE) – Tseung Kwan O (AEP-433/2011)	83.4	15.44	5	0.5	2.5	20	0.278	600	0.9	1	6
South-East Asia Japan Cable System (SJC) Hong Kong Segment (AEP-423/2011)	33.0	6.11	5	0.5	2.5	10	0.220	600	0.9	1	6
VSNL Intra Asia Submarine Cable System – Deep Water Bay (AEP-294/2007)	41.7	7.72	5	0.5	2.5	10	0.278	600	0.9	1	6
Proposed 132kV Submarine Cable Route for Airport "A" to Castle Peak Power Station Cable Circuit (AEP 267/2007)	13.2	1.47	5	2.0	5.0	20	0.022	600	1.5	1	6
132 kV Submarine Cable Installation for Wong Chuk Hang – Chung Hom Kok 132 kV Circuits (AEP132/2002)	3.33	1.39	5	1.0	2.5	20	0.011	600	0.4	1	6
Flag North Asian Loop (AEP099/2001)	41.7	4.63	5	0.25	1.25	20	0.278	600	0.5	3	6
New T&T Hong Kong Limited: Domestic Cable Route (AEP-086/2001)	37.53	3.48	9	0.25	2.25	10	0.278	600	0.9	2	6
C2C Cable Network – Hong Kong Section: Chung Hom Kok (AEP-087/2001)	20.85	2.90	5	0.25	1.25	10	0.278	600	0.6	2	6

ANNEX B

Marine Ecology Assessment

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Figure B-2 Chinese White Dolphin Distribution Patterns in Hong Kong Waters (2012 to 2017)
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B. MARINE ECOLOGY ASSESSMENT

B.1 Introduction

B.1.1 This Annex provides an assessment of marine ecology impacts associated with the installation of the HK-G Cable, and may be read in conjunction with the water quality assessment in ***Annex A***.

B.2 Relevant Legislation and Assessment Criteria

B.2.1 The following legislation and associated guidance or non-statuary guidelines are applicable to the evaluation of ecological impacts:

- Environmental Impact Assessment Ordinance (Cap. 499. S.16) and the Technical Memorandum on EIA Process (EIAO-TM), Annexes 8 and 16
- Water Pollution Control Ordinance (WPCO)

EIAO-TM

B.2.2 Annexes 8 and 16 of the *EIAO-TM* provide general guidelines and criteria to be used in assessing ecological impacts. Besides magnitude and scale of impact, the EIAO-TM recognises that the significance of an ecological impact is also related to the asserted importance of the habitat or species affected – in general, the impact on an important habitat or species will be more significant in comparison to other less important ones.

Water Pollution Control Ordinance (WPCO)

B.2.3 The WPCO is the primary legislation for the control of water pollution and water quality in Hong Kong. There are a total of ten Water Control Zones (WCZ) and four supplementary WCZs in Hong Kong. Each WCZ has its own set of Water Quality Objectives (WQOs).

B.2.4 The WQOs recognise that marine waters need to be protected to ensure that they are fit for marine life growth and different human uses in a sustainable manner. In general, waters with more sensitive uses, including sanctuaries for important species such as the Chinese White Dolphin, require a higher level of protection (i.e. with more stringent WQOs) compared to water bodies with less sensitive uses, such as navigation. Sensitive water bodies are mostly found in the eastern and southern waters of Hong Kong.

B.3 Description of the Marine Environment

B.3.1 Calculations in ***Annex A*** indicate that the sediments disturbed during cable laying works will settle onto the seabed within approximately 180m of the cable alignment and will settle within about three and half minutes.

B.3.2 In ***Section 3.3***, three coral communities were identified in the vicinity of the cable alignment. Other marine sensitive areas, such as a marine reserve and SSSIs, are distant from the HK-G Cable and will not be affected by the Project. In addition to sensitive areas, marine mammals are also identified as a sensitive, mobile animal group.

Coral Communities

B.3.3 ***Figure B-1*** shows the coral communities of ecological concern identified along the HK-G Cable. The closest coral communities to the cable alignment include those at Fat Tau Chau (227m); at Ngan Wan (Cape Collinson) (264m); and at Tai Long Pai (319m). Other coral communities are more than 1,000m from the cable alignment and so will not be affected.

B.3.4 The following description is based on a review of previous marine ecological assessments carried out for similar projects in the same area, in particular APG, which has a similar alignment to the HK-G Cable, which are considered applicable to the HK-G Cable.

Intertidal Soft Bottom Assemblages

B.3.5 Based on the previous surveys conducted, a small area of sandy shore is located to the south of the seawall at TKOIE. 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[Ref #1].

Intertidal Hard Bottom Assemblages

B.3.6 The Project Profile for APG references two intertidal surveys that were previously been conducted at Harbour seawall at TKOIE, at the natural rocky shore of Fat Tau Chau near the landing site, as well as along Cape Collinson.

B.3.7 Findings from the intertidal survey undertaken in the wet season of 2008 indicated that the assemblage structure on the natural rocky shore at Fat Tau Chau and on the Harbour seawall at TKOIE was considered to be typical of sheltered to semi-exposed rocky shores and seawalls in Hong Kong. The seawall exhibited a low diversity of species. Those recorded were mainly the rock oyster *Saccostrea cucullata*, periwinkles *Echinolittorina radiata* and *E. trochoides*, and limpets *Nipponacmea concinna* and *Patelloida pygmaea*. Dominant species of the natural rocky shore recorded from the same survey included the rock oyster *Saccostrea cucullata*, periwinkles *Echinolittorina radiata* and *E. trochoides*, limpets *Nipponacmea concinna* and topshell *Monodonta labio*. These are all common species on natural rocky shores in Hong Kong.

B.3.8 In 2011, intertidal surveys were undertaken along the Harbour seawall at TKOIE and on the shorelines along the northwest side of Cape Collinson for APG, using qualitative spot checks and the standard quantitative belt transect method. Results of the 2011 intertidal surveys were similar to those obtained by the 2008 surveys, which revealed that the Harbour seawall exhibited a low diversity of species. A total of 14 faunal taxa and one encrusting alga were encountered during the qualitative spot checks. These species are all very common and widespread species on artificial shores/wharfs in Hong Kong. For natural rocky shores along Cape Collinson, dominant organism recorded included the periwinkles *Echinolittorina* spp. in the high-shore; the topshell *Monodonta labio* and the limpet *Siphonaria japonica* in the mid-shore; and the limpet *Cellana toreuma* and the chiton *Acanthopleura japonica* in the low-shore. Sessile species including the barnacle *Tetraclita* spp. were also present in the low-shore. Both the abundance/ density of mobile species and percentage cover of sessile species were considered to be low to moderate (mean of 65 – 80 m^{-2} and 2 – 42% m^{-2} ,respectively).

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

B.3.9 Overall, results from previous intertidal surveys have shown that the intertidal rocky shores and artificial seawall along the cable alignment, including the cable landing point at TKOIE, supported generally low abundances and densities of organisms, and therefore were of low ecological value. It is also noted that no species of conservation importance were recorded.

Subtidal Soft Bottom Assemblages

B.3.10 Information on the subtidal soft bottom assemblages in the vicinity of the HK-G Cable alignment is available from the *Consultancy Study on Marine Benthic Communities in Hong Kong*[Ref #2]. A number of sampling stations used in that study are in the vicinity of the HK-G Cable alignment and data extracted from them can be considered to be representative for this Project.

B.3.11 According to the findings of that study, the substratum of the sampling stations was covered by medium/fine/very fine sand. The benthic assemblages are 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 is higher (51 species per 0.5 m^2), while the average number of individuals (487 individuals per m^2) and average wet weight (32.3 g per m^2) are lower than the 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 (50 species per 0.5 m^2), average wet weight (33 g per m^2) and the average number of individuals (605 individuals per m^2) are higher than the average values of benthic assemblages in Hong Kong (34 species per 0.5 m^2, 28 g per m^2 and 450 individuals per m^2). The surveys carried out in both summer and winter did not identify any species of conservation concern along the cable alignment.

Subtidal Hard Bottom Assemblages

B.3.12 Several studies undertaken in the period from 2007 to 2013 provide relevant information on subtidal hard bottom habitats in the vicinity of the HK-G Cable and were referenced in the Project Profile for APG. The surveyed subtidal hard bottom habitats included those located at Fat Tau Chau and near to TKOIE in the vicinity of the cable landing site and near the cable alignment at Ngan Wan (Cape Collinson) and Tai Long Pai. Overall, results of these surveys showed that generally very sparse colonies of locally common, widespread hard coral species are present in the vicinity of the TKOIE, and their abundance and diversity were considered to be very low in the context of subtidal coral assemblages in Hong Kong. While cover and diversity of octocoral assemblages were low to moderate along the shoreline of Cape Collinson, high abundance and diversity of octocoral assemblages was found at depth at Tai Long Pai.

B.3.13 Supplementary dive surveys conducted in September and October 2012 and in February 2013 for APG comprised qualitative spot dive surveys and semi-quantitative Rapid Ecological Assessment (REA) surveys at TKOIE and Fat Tau Chau (i.e. near the cable landing point), as well as at Ngan Wan (Cape Collinson) and Tai Long Pai (i.e. near the cable alignment). Baseline Coral Monitoring Survey and Post Project Coral Survey were also conducted before and after construction of APG in April and June 2016 respectively. Results of these surveys showed that both hard coral and octocoral covers were below 5% with five hermatypic hard coral species, one ahermatypic hard coral species and two octocoral species being recorded. All hard coral colonies recorded were less than 10cm

2. CityU Professional Services Limited (2002). *Consultancy Study on Marine Benthic Communities in Hong Kong*. Final Report for AFCD.

in diameter and octocoral colonies were about 10cm in height. All coral species recorded were considered as common and widespread in Hong Kong nearshore waters.

B.3.14 From Cape Collinson to Ngan Wan, results of the surveys confirmed that the seabed in these areas was mainly composed of hard bottom substrate (i.e. ~60% cover of bedrock). The estimated hard coral cover was less than 5% in the shallow depth zone (-3-5 m CD) with eight species recorded. Octocoral cover was between 6-10% with a total of six species recorded. According to the *Baseline Coral Survey Monitoring Report* (May 2016) of the APG Project, no coral communities, only individual corals, were found at Cape Collinson, which is 184m from the cable alignment at its closest point.

B.3.15 However, south of Cape Collinson in the northern part of Ngan Wan, more hard coral species and larger hard coral colonies were found. This area is considered as a coral community of relatively higher coral diversity although the estimated coral cover and number of octocoral species recorded were similar to the adjacent area.

B.3.16 At Shek O Headland, the seabed was observed to be mainly composed of boulders and rocks in the shallow depth zone (-3-5 m CD) while sand was the major abiotic benthic attribute covering the seabed in the deep depth zone (-5-10 m CD). Results also indicated that both hard coral and octocoral covers were very low (<1%) at both shallow and deep water zones. Three hermatypic hard coral species, one ahermatypic hard coral species and four octocorals species were recorded.

B.3.17 At Tai Long Pai, results of the dive surveys confirmed that the seabed was mainly composed of hard bottom substrates – mostly bedrock. Hard coral cover was very low (< 5%) with seven hermatypic hard coral species and one ahermatypic hard coral species recorded. A total of seven octocoral species and two black coral species were recorded along the shoreline of Tai Long Pai with an estimated cover of 5-10% in shallow depth zone (-2-5 m CD) and 11-30% in deep depth zone (beyond -5 m CD). All coral species recorded are common species and have a widespread distribution throughout Hong Kong's nearshore waters. Due to the relatively high octocoral abundance and diversity recorded at Tai Long Pai, it is considered as a significant coral habitat in the area.

B.3.18 Overall, results of the dive surveys carried out previously showed that sparse hard coral colonies of locally common, widely distributed species were recorded in the vicinity of the HK-G Cable landing point and alignment. The abundance and diversity of hard corals were considered to be very low in the context of subtidal hard bottom habitats in Hong Kong. Octocoral coverage and diversity were generally considered to be low, except at depth at Tai Long Pai, which showed higher abundance and diversity of octocorals.

Marine Mammals

B.3.19 The Indo-pacific Humpbacked Dolphin (*Sousa chinensis*), locally known as the Chinese White Dolphin, and the Indo-Pacific Finless Porpoise (*Neophocaena phocaenoides*) are the two species of marine mammals regularly sighted in Hong Kong waters. They are also the only two residential marine mammal species in Hong Kong.

B.3.20 Based on the latest research[Ref.#3], in 2017, important Chinese White Dolphin habitats are mostly located along the coastal waters of West Lantau, stretching from Tai O Peninsula, Kai Kung Shan, Fan Lau to Kau Ling Chung. In the past six years, Chinese White Dolphin habitat use patterns were mostly consistent in West Lantau, but their usage

3. *Monitoring of Marine Mammals in Hong Kong Waters (2017-18) Final Report (1 April 2017 to 31 March 2018)* dated 10 July 2018, Hong Kong Cetacean Research Project Ref. AFCD/SQ/174/16, published by AFCD.

there has slightly diminished in 2016 and 2017. In Southwest Lantau waters, Chinese White Dolphin usage was higher and more evenly spread in 2014-16 than in earlier years. In the North Lantau region, Chinese White Dolphin occurrence has greatly diminished in recent years, and was largely confined to the area around Lung Kwu Chau in 2016 and 2017. ***Figure B-2*** shows the distribution of Chinese White Dolphins in Hong Kong waters over the past six years.

B.3.21 The Finless Porpoise is the most common and important species of cetacean in the southern waters of Hong Kong. The distribution of this species appears to vary on both a temporal and spatial basis. Overall, abundance in Hong Kong appears to peak in spring and be lowest in the autumn[Ref #4]. Based on the latest research[Ref.#3], the important habitats for Finless Porpoises during 2014-17 were located to the south of Tai A Chau, west and southwest of Shek Kwu Chau, south of Cheung Chau, and at the offshore waters between Shek Kwu Chau and the Soko Islands during the dry season (December to May). On the contrary, Finless Porpoises densities were higher around the Po Toi Islands, and at the juncture of Po Toi and Ninepins survey areas during the wet season (June to November). ***Figure B-3*** shows the distribution of Finless Porpoises in Hong Kong waters over the past four years during the wet season and the dry season.

B.4 Impact Assessment

Direct Impact to Coral Communities

Intertidal Soft Bottom Assemblages

B.4.1 As concluded in the water quality assessment in ***Annex A***, with the recommended mitigation measures in place, no adverse water quality impacts are anticipated from the cable installation works. On this basis, no adverse impact to intertidal soft bottom assemblages from the installation of the HK-G Cable is expected.

Intertidal Hard Bottom Assemblages

B.4.2 As concluded in the water quality assessment in ***Annex A***, with the recommended mitigation measures in place, no adverse water quality impacts are anticipated from the cable installation works. On this basis, no adverse impact to intertidal hard bottom assemblages from the installation of HK-G is expected. The Harbour seawall at TKOIE will not be affected as the Cable will land via an existing duct in the seawall. No direct impact is therefore expected as a result of the shore-end construction activities.

Subtidal Soft Bottom Assemblages

B.4.3 Short term direct impacts will occur to soft bottom benthic assemblages present along the cable trench. However, once cable laying operations are completed, it is expected that 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. There will be no direct impact to the coral communities in the vicinity of the proposed cable alignment near Fat Tau Chau, Ngan Wan (Cape Collinson), Shek O Headland and Tai Long Pai.

4. Jefferson TA, Hung SK, Law L, Torey M, Tregenza N (2002) Distribution and Abundance of Finless Porpoises in Hong Kong and Adjacent Waters of China. *Raffles Bulletin of Zoology*, Supplement 10: 43-55 (cited in the Project Profile for the APG Cable System).

Subtidal Hard Bottom Assemblages

B.4.4 As concluded in the water quality assessment in ***Annex A***, with the recommended good site practices in place, no adverse water quality impacts are anticipated from the cable installation works. On this basis, no adverse impact to sub-tidal hard bottom assemblages from the installation of HK-G Cable is expected at the TKOIE landing point.

Indirect Impact to Coral Communities

B.4.5 Based on a number of assumptions that are commonly adopted for many cable projects (see ***Appendix A to Annex A***), including the forward speed of the cable-laying vessel being limit to a maximum of 1 km per hour, calculations in ***Annex A*** show that sediments disturbed during use of the cable burial tool will settle back to the seabed within a maximum of 180m of the trench within about 3.5 minutes. Thus, the maximum extent of any plume generated by cable laying works will be 180m.

B.4.6 Previous assessments and monitoring results from similar projects (listed in ***Section 6***) have similar findings. For example, the recently installed APG Cable follows a similar alignment to the HK-G Cable and has similar distance separation from WSRs. Monitoring results from the installation of the APG Cable indicated that there was no deterioration of water quality at WSRs in the vicinity of the cable alignment and that water quality impact caused by installation of the APG Cable was negligible.

B.4.7 Based on the above, indirect impacts may occur through seabed disturbance, resulting in increases in suspended solids in the water column. However, as cable installation works will be of a short duration the increases are not predicted to be high, except for in the immediate vicinity of the cable burial tool, and are expected to settle rapidly back onto the seabed. As such, these impacts will be small scale and of a localised nature.

B.4.8 At coral communities close to the cable alignment, i.e. Fat Tau Chau, Ngan Wan (Cape Collinson) and Tai Long Pai, which are located approximately 227m, 264m and 319m, respectively, from the cable alignment, potential disturbance is expected to be limited and short-term. Since the coral species at these locations are common throughout Hong Kong Waters, the severity of potential impact to the general habitat will be minimal. Given the short duration of disturbance from the cable burial tool at a single time at single location, the impact arising from the installation works would be insignificant.

Indirect Impact to Marine Mammals

B.4.9 An increase in underwater noise and vibration is anticipated to occur during the cable installation works, from both marine vessels and water jet. Marine mammals, in particular Finless Porpoises that frequent the south-eastern waters of Hong Kong during the wet season (June to November), are sensitive to the impacts of marine noise, because they use sonar clicks for communication, navigation and prey location.

B.4.10 Studies of the Finless Porpoise suggest that it produces sonar clicks at a peak frequency of 142 kHz[Ref.#5]. With regard to the potential construction phase impacts, marine jetting works and large marine vessels typically emit sound in the range of 0.02 to 1 kHz[Ref.#5,#6], which is generally below the hearing range of Finless Porpoises. Construction noise

5. Goold J.C. and Jefferson T.A. (2002). Acoustic signals from free-ranging finless porpoises (*Neophocaena phocaenoides*) in waters around Hong Kong. *The Raffles Bulletin of Zoology Supplement* 10:131-139.
6. Popper, A.N., Fay, R.R., Platt, C. and Sand, O. (2003). Sound Detection Mechanisms and Capabilities of Teleost Fishes. In: Collin, S.P. and Marshall, N.J. (eds.). *Sensory Processing in Aquatic Environments*. Springer Verlag, New York, 3-38.

levels are also generally below the 8 to 90 kHz hearing range of Chinese White Dolphins[Ref.#7], although this species is uncommon outside its preferred estuarine habitat in the western waters of Hong Kong.

B.4.11 The cable alignment is situated in the eastern and south-eastern Hong Kong waters. The anticipated timing for off-shore cable laying is June to September, as stated in ***paragraph 2.2.1***, with the cable laying in south-eastern waters occurring first, during June and July.

B.4.12 As shown in ***Figure B-2***, the cable is not located in areas frequented by the Chinese White Dolphin and so this species will not be adversely impacted by cable laying.

B.4.13 As shown in ***Figure B-3***, the Finless Porpoise frequents the area where the cable will be located at the time the cable is planned to be laid (which is during the wet season from June to November). However, the cable installation works will be short-term and be carried out by one slow moving cable installation barge. The cable laying works will only take about 30 to 40 working days in HKSAR waters. It is anticipated that this species will not be adversely impacted over the short-term period. Nevertheless, as a precautionary measure, a marine mammal exclusion zone will be implemented during cable laying in this area to mitigate potential indirect impacts on Finless Porpoises – this is discussed in more detail in ***Section B.6 and Annex E***.

B.4.14 Given the temporal and spatial distribution of Chinese White Dolphins and Finless Porpoises, and with the implementation of recommended mitigation measures as needed, it is not anticipated that there would be any significant adverse impact on marine mammals caused by the cable installation works, which will be temporary and carried out by one slow-moving cable installation barge.

Cumulative Impacts

B.4.15 While there are five projects planned in the vicinity of the HK-G Cable, only one including reclamation – the *Tseung Kwan O – Lam Tin Tunnel and Associated Works* –will be constructed concurrently with the HK-G Cable. As discussed in ***Section 3.4***, given that there will be full containment of reclamation works, the 2,250m separation and the short installation time of shore-end works at TKOIE (just a few days), cumulative ecological impacts are not anticipated.

Impact from Operation Phase

B.4.16 If a cable installed under the seabed is damaged by dropped objects or anchoring activities, cable repair works shall be required. These comprise route clearance prior to repair works; exposing the damaged cable section by diver jetting tool; reconnecting the damaged cable; and reburial of the repaired cable section by diver jetting tool.

B.4.17 Diver-operated jetting tools have a much smaller water jetting strength and seabed fluidization ability (about 2m depth) compared to the cable burial tool used for cable installation (about 5m depth). Considering diver repair will be only for short sections of cable, will be carried out in a matter of hours, and will use less powerful jetting equipment, the sediment release is considered to be minimal. The seabed can therefore be expected to naturally reinstate to before-work levels and conditions shortly after completion of the works. As such, no significant water quality impact is anticipated for sections of cable repaired by divers.

7. Richardson, W.J., Greene, C.R. Jr., Malme, C.I. and Thomson, D.H. (1995). *Marine Mammals and Noise*. Academic Press, San Diego, 576 pp

B.5 Impact Evaluation

B.5.1 An evaluation of the impact in accordance with the EIAO TM Annex 8 Table 1 is presented below.

Habitat Quality

B.5.2 Short-term direct impact are predicted to occur to subtidal soft bottom habitat along the cable trench and short-term indirect impacts to intertidal and subtidal hard bottom habitats in the vicinity of the cable route, such as TKOIE and Cape Collinson. Nevertheless, the habitats susceptible to direct impact are considered to be of low ecological importance and the indirect impact is not expected to be significant.

Species

B.5.3 No species considered to be of high ecological value have been identified within or in proximity to the cable alignment, and will not be directly affected. Although three coral communities are identified within 500m from the cable alignment, they are unlikely to be affected by the cable installation since they are located beyond the 180m sediment dispersion distance. Also considering the short disturbance time at a single location during cable laying, significant adverse impacts are not expected from the cable installation works.

B.5.4 The Chinese White Dolphin is not recorded as being present in the south-eastern waters where the HK-G Cable will be laid and so will not be directly or indirectly affected. The Finless Porpoise is present in the south-eastern waters during the wet season (June to November). The cable laying is anticipated to be carried out in south-eastern waters in June and July. As the cable installation works will be short-term, it is anticipated that this species will not be adversely impacted. However, as a precautionary measure, a marine mammal exclusion zone will be implemented to mitigate potential indirect impacts on Finless Porpoises during cable laying in the south-eastern waters.

Size/Abundance

B.5.5 Within Hong Kong waters, the length of the Cable will be about 33.6km and it has a diameter of 38mm. No seabed dredging will be required for the cable laying. Instead, it will be buried using a cable burial tool that will affect approximately 0.5m of the seabed in width along the alignment.

Duration

B.5.6 The duration of the cable installation will be for around four months.

Reversibility

B.5.7 Impacts to both the hard and soft bottom marine communities are expected to be short term and recolonization of the sediments and hard substrates is expected to occur.

Magnitude

B.5.8 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.

B.6 Mitigation Measures During Cable Installation

B.6.1 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.

B.6.2 Based on the above, mitigation measures are discussed below.

Avoidance of Impacts

B.6.3 Impacts to marine ecological resources during cable laying have been avoided through the selection of a landing site and cable alignment that avoids direct impacts to coral communities and through the use of cable laying techniques that result in minimal disruption to the marine environment. The HK-G Cable alignment has been carefully considered (see ***Section 1.5***) to maximise, as far as practicable, the distance to known coral communities of ecological concern, while also minimising the number of crossings of existing cables.

B.6.4 Nevertheless, as a precautionary measure, it is recommended that water quality monitoring is carried out at the closest coral communities to the cable alignment, i.e. those at Tai Long Pai, Ngan Wan (Cape Collinson) and at Fat Tau Chau, to demonstrate, as has been demonstrated for other cable laying projects, that no adverse water quality impacts are caused by cable laying – details of proposed EM&A are given in ***Annex E***.

B.6.5 Nevertheless, as a precautionary measure, when cable laying is being carried out in south-eastern waters where Finless Porpoises may be present, a marine mammal exclusion zone within a radius of 250m from the cable installation barge will be implemented during day-time hours to avoid potential direct impacts on Finless Porpoises – details of proposed EM&A are given in ***Annex E***.

Minimisation of Impacts

B.6.6 Mitigation measures have been recommended to minimise impacts to water quality to control potential impacts during marine installation to marine ecological resources. These are as stated in ***Section A.6 of Annex A***:

- The crane barge used for the transport of any debris recovered from the seabed during route clearance shall be fitted with tight bottom seals in order to prevent leakage of material during loading and transport to the disposal site.
- The crane barge shall be filled to a level which ensures that material does not spill over during loading and transport and that adequate freeboard is maintained to ensure that the decks are not washed by wave action.

- The speed of the installation barge will be limited to a maximum of 1km per hour. It will be further reduced to 0.5km per hour when the cable is being installed in proximity to south of Cape Collinson and north of Ngan Wan, and west of Fat Tau Chau.

B.6.7 With the implementation of the above mitigation measures, plus the proposed EM&A, no adverse ecological impacts are expected.

Compensation

B.6.8 Based on the above mitigation measures, no compensation will be required as no unacceptable residual impacts to marine ecological resources are predicted to occur.

B.7 Conclusion

B.7.1 The review of the existing information on the marine ecological resources in the vicinity of the cable landing point at TKOIE and the cable alignment in Hong Kong waters has identified the area where the Cable is to be laid to be of generally low ecological value.

B.7.2 Although soft bottom assemblages will be disturbed during cable laying, the habitat will be reinstated by similar communities within a short period of time and thus the impacts are considered acceptable.

B.7.3 The rocky shores in the vicinity of the cable landing point off Fat Tau Chau and near Cape Collinson support low abundance and diversity of intertidal organisms. Most of these species are common and widespread on the similar shores in Hong Kong and as such, are considered to be of low ecological value. Impacts to these assemblages are, therefore, not regarded as significant.

B.7.4 The coral communities at Fat Tau Chau, at Ngan Wan (Cape Collinson) and at Tai Long Pai are within 500m of the cable alignment may experience indirect disturbance through minor changes in water quality. Due to the small scale of the works, the short duration of impacts and the limited dispersion of sediment plume, any potential impacts are not considered to be significant.

B.7.5 The Chinese White Dolphin is not recorded as being present in the south-eastern waters where the HK-G Cable will be laid and so will not be affected. The Finless Porpoise is present in the south-eastern waters during the wet season (June to November). The cable laying is anticipated to be carried out in south-eastern waters in June and July. However, the cable installation works will be carried out by one slow moving cable installation barge. The cable laying works will only take about 30 to 40 working days in HKSAR waters. It is anticipated that this species will not be adversely impacted over the short-term period.

B.7.6 Impacts to marine ecological resources have largely been avoided during cable laying through the selection of a landing site, careful consideration for cable alignment, and use of cable laying techniques that result in little disturbance to the marine environment. Due to the small scale of the works, the short duration of impacts and the limited dispersion of sediment plumes, adverse impacts to marine ecology are not expected to be significant and will be minimised during the cable installation.

B.7.7 Mitigation measures recommended to minimise impacts to water quality will also minimise impacts to marine ecological resources. Water quality monitoring will be carried out during marine works to demonstrate that no adverse impact has occurred.

B.7.8 When cable laying is being carried out in south-eastern waters where Finless Porpoises may be present, as a precautionary measure a marine mammal exclusion zone will be implemented to mitigate and thereby minimise potential indirect impacts on Finless Porpoises.

Figure B-1 Coral Communities of Ecological Concern Along HK-G Alignment

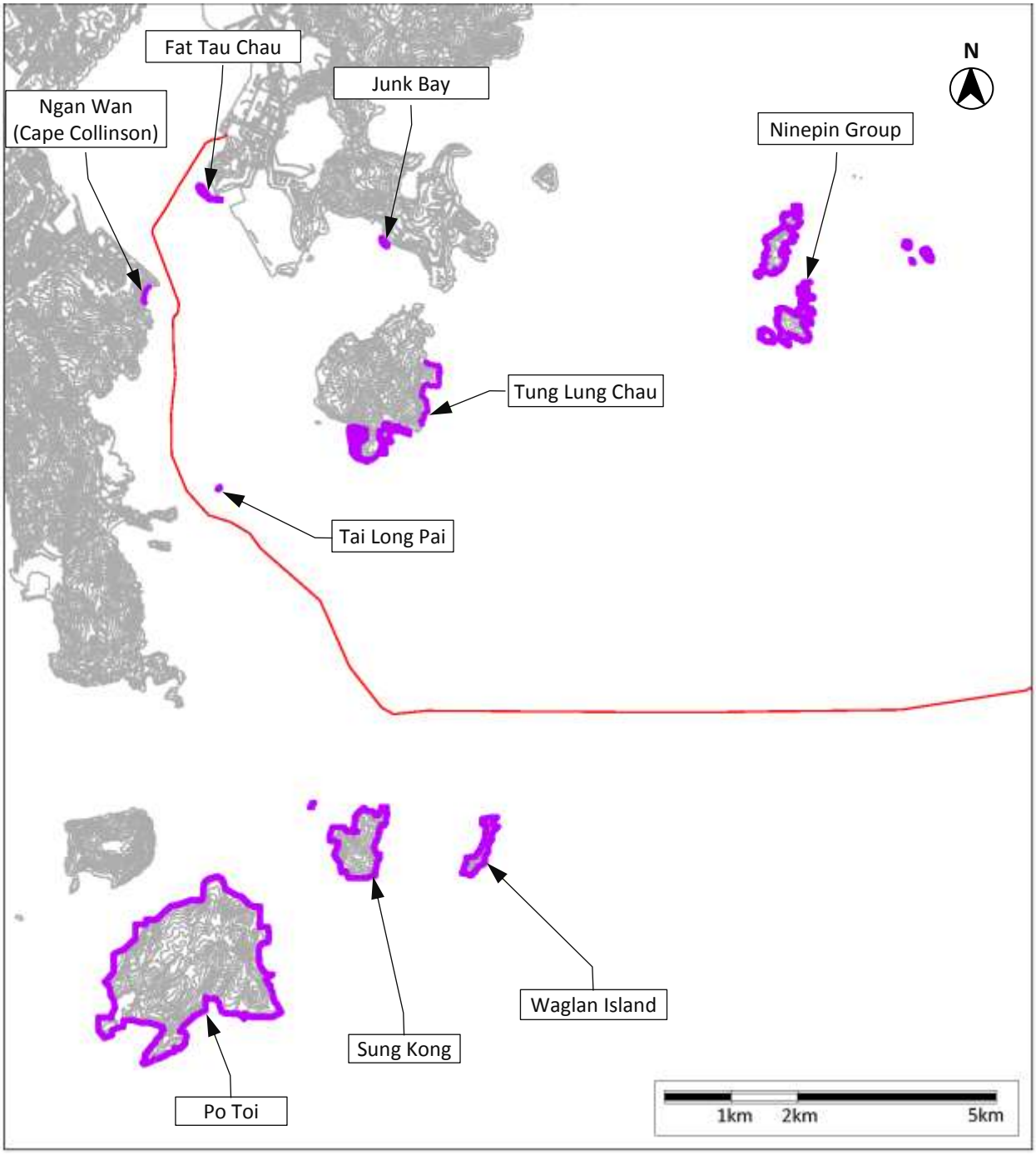
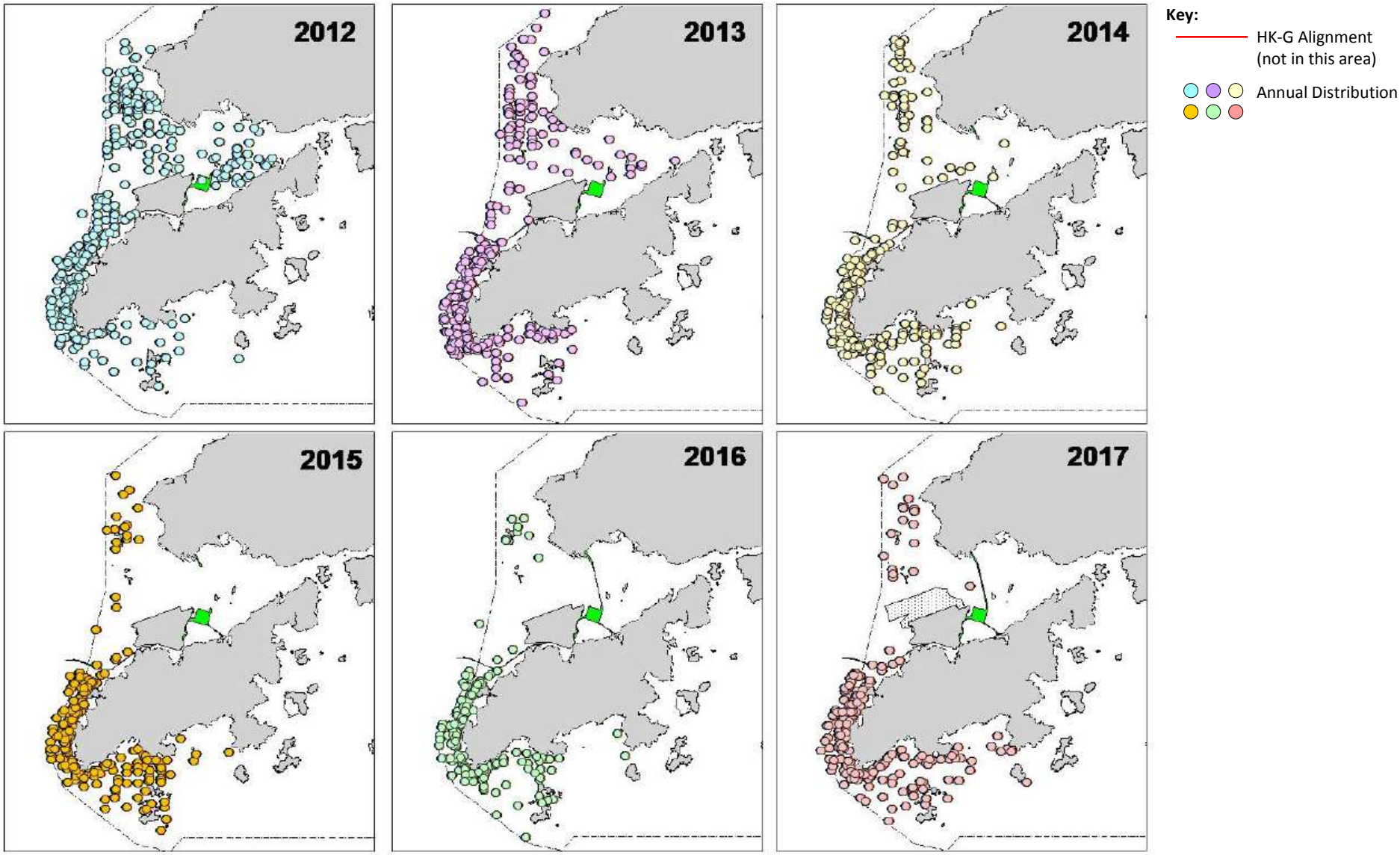
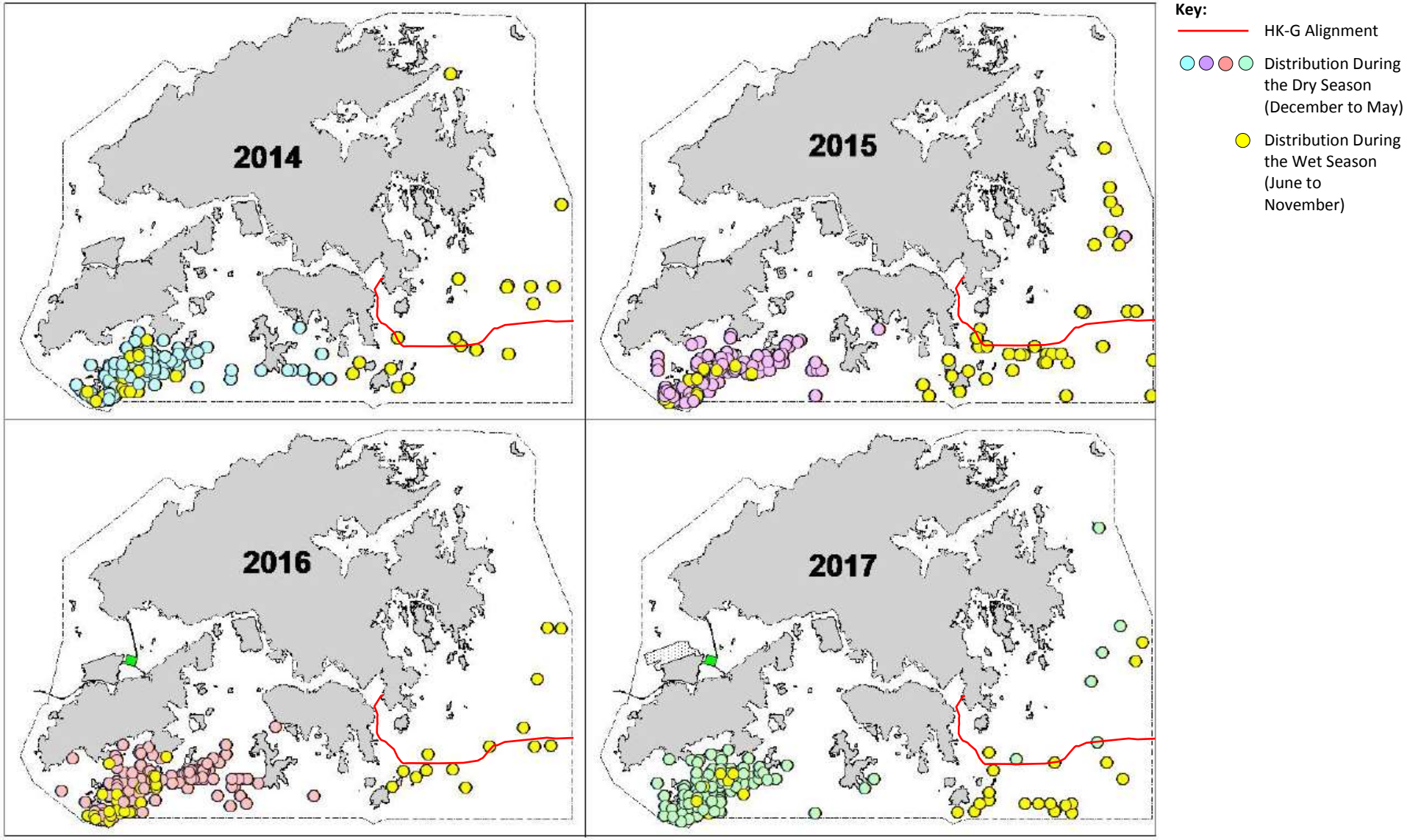


Figure B-2 Chinese White Dolphin Distribution Patterns in Hong Kong Waters (2012 to 2017)



Source: Figure 8 from *Monitoring of Marine Mammals in Hong Kong Waters (2017-18) Final Report (1 April 2017 to 31 March 2018)*.

Figure B-3 Finless Porpoise Distribution Patterns in Hong Kong Waters (2014 to 2017)



Source: Figure 10 from *Monitoring of Marine Mammals in Hong Kong Waters (2017-18) Final Report (1 April 2017 to 31 March 2018)*.

ANNEX C

Fisheries Assessment

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C FISHERIES ASSESSMENT

C.1 Introduction

C.1.1 This Annex provides an assessment of impacts to the existing fisheries resources and fishing operations within and adjacent to the proposed HK-G Cable alignment and evaluates the potential impacts to these resources.

C.1.2 Baseline information has been obtained from the AFCD website[Ref.#1] and from recent relevant studies in the vicinity of the HK-G Cable alignment to determine whether the waters surrounding the HK-G Cable are important spawning grounds or nursery areas for commercial fisheries – the most up-to-date Port Survey[Ref.#2] (the "*Port Survey 2016/17*") has been referenced, together with relevant studies, including the previous edition of the Port Survey (the "*Port Survey 2006*") [Ref.#3], the final report for *Fisheries Resources and Operations in Hong Kong Waters*[Ref.#4] and the *Updated Fisheries Survey* in June 2017 for the Tseung Kwan O Desalination Plant[Ref.#5] (the "2017 Survey"). Mariculture information was obtained from the latest AFCD *Annual Report 2016-2017*[Ref.#6].

C.1.3 There are no gazetted Fish Culture Zones (FCZs) within 500m of the cable alignment – the nearest are the Tung Lung Chau FCZ and Po Toi FCZ, located 2,736m and 5,924m, respectively, from the closest alignment of the Cable. Given these distances, the FCZs will not be affected by this Project. The cable alignment does not pass through any nursery grounds, although it does pass through spawning grounds of commercial fisheries resources.

C.1.4 The western part of the HK-G Cable near the landing point lies within Junk Bay Water Control Zone (WCZ). The HK-G Cable also passes through the Eastern Buffer, Southern and Mirs Bay WCZs. Special attention has been given to the fishing grounds, fishing activities and spawning grounds along the alignment, and to Po Toi FCZ and Tung Lung Chau FCZ, which are located further away.

C.2 Relevant Legislation

C.2.1 The following legislation and associated guidance or non-statuary guidelines are applicable to the evaluation of fisheries impacts and the regulation of fishing practices:

- Environmental Impact Assessment Ordinance (Cap. 499. S.16) and the Technical Memorandum on EIA Process (EIAO-TM), Annexes 9 and 17
- Fisheries Protection Ordinance (Cap 171)
- Marine Fish Culture Ordinance (Cap 353)

1. https://www.afcd.gov.hk/english/fisheries/fish_aqu/fish_aqu_mpo/fish_aqu_mpo.html
2. *Port Survey 2016/17*, AFCD (2018).
3. *Port Survey 2006*, AFCD (2007).
4. ERM-Hong Kong, Ltd (1998) *Fisheries Resources and Operations in Hong Kong Waters*. Final Report for the AFCD.
5. Agreement No. CE 8/2015 (WS) First Stage of Desalination Plant at Tseung Kwan O – Investigation, Design, Construction*, Updated Fisheries Survey*, June 2017.
6. *AFCD Annual Report 2016-2017.*

C.3 Existing Situation

Fishing Background

C.3.1 In 2017, Hong Kong fishermen provided an estimated 127,600 tonnes of produce. According to AFCD, the industry now consists of some 5,150 fishing vessels and some 10,600 local fishermen working aboard and provides employment in ancillary sectors servicing the fishing industry[Ref.#7].

C.3.2 The fisheries industry in Hong Kong comprises capture and culture fisheries. Combined production of these contributing to the steady supply of marine fish to local consumers.

C.3.3 The latest comprehensive survey of fisheries was undertaken as part of the *Port Survey 2016/17*, which provided a grid analysis of fishing operations covering Hong Kong waters, with each grid cell representing 720ha. The study compiled information on fisheries production and fishing operations in Hong Kong and has been useful in setting out fisheries management strategies and assessing potential environmental impacts of marine development projects on fisheries.

C.3.4 The following assessment has been based on the *Port Survey 2016/17* and the *Port Survey* 2006, and from a review of information from AFCD's Annual Reports.

Capture Fisheries

C.3.5 Capture fishing activities for Hong Kong are mainly conducted in the waters adjacent to the continental shelf in the South China Sea. The majority of fishing vessels are family-operated businesses with the main fishing methods being long-lining, gill-netting and purse-seining.

Fisheries Operations

C.3.6 The HK-G Cable traverses 14 Port Survey Grids, in which six grids showed >0 to 50 vessels, one grid showed >50 to 100 vessels, six grids showed >200 to 400 vessels, and one grid showed >400 to 600 vessels, as shown on ***Figure C-1***.

C.3.7 The distribution of Fishing Operations with sampans is shown on ***Figure C-2***, where two grids showed 0 vessels, five grids showed >0 to 50 vessels, four grids showed >100 to 200 vessels, and three grids showed >200 to 400 vessels.

C.3.8 The distribution of fishing operations with other types of vessels is shown on ***Figure C-3***, where seven grids showed >0 to 50 vessels, two grid showed >50 to 100 vessels and five grids showed >100 to 200 vessels.

Fisheries Production

C.3.9 The *Port Survey 2016/17* shows that fisheries production from the grids traversed by the HK-G Cable range from >0 to 50kg/ha to >200 to 300kg/ha, in which the more than half of the grids show no greater than 50kg/ha, as shown on ***Figure C-4***.

C.3.10 Fisheries production was highest (>200 to 300 kg/ha) in the cable section east to D'Aguilar Peninsula and the value decreases (>0 to 50 kg/ha) in the cable section east to Ninepin Group.

7. AFCD website (http://www.afcd.gov.hk/english/fisheries/fish_cap/fish_cap_latest/fish_cap_latest.html)

Fish Fry Production / Spawning Grounds / Nursery Areas

C.3.11 The southern, south-eastern and eastern waters have been recognised[Ref.#3] as spawning grounds for commercial fisheries resources.

C.3.12 The *Port Survey 2006* shows that fish fry production from the area traversed by the HK-G Cable is low, as shown on ***Figure C-5***.

C.3.13 ***Figure C-6*** shows the location of the Spawning Grounds and the HK-G Cable Alignment.

C.3.14 Nursey areas in Hong Kong waters are important habitat area for a number of commercial juvenile fish and crustacean species, which have been previously identified across southern waters from Lantau Island to Lamma Island.

C.3.15 As shown on ***Figure C-6***, there are no nursery grounds in the vicinity of the HK-G Cable alignment.

Artificial Reef Deployment

C.3.16 An Artificial Reef Deployment programme has been in effect since 1998 to enhance existing marine habitats and fisheries resources through the siting, construction and deployment of Artificial Reefs. Artificial Reefs provide hard bottom, high profile habitat in areas without natural cover and may potentially act as fish enhancement devices. AFCD deployed a total of 103,270m^3 of Artificial Reefs on the seabed of the outer Port Shelter WCZ to prevent trawling and enhance habitat quality and marine resources.

C.3.17 As shown on ***Figure C-6***, there are no Artificial Reefs in the vicinity of the HK-G Cable alignment.

Culture Fisheries

C.3.18 Mariculture fisheries involve rearing marine fish in cages suspended by floating rafts in sheltered coastal areas. According to the AFCD website[Ref.#5] in 2016, there were 949 licensed operators in the 26 FCZs designated under the Marine Fish Culture Ordinance. These occupied a sea area of 209ha with an estimated production in 2016 of 1,031 tonnes, or about 5% of all locally consumed live marine fish.

C.3.19 The shortest navigation distances between the nearest FCZs to the HK-G Cable are Tung Lung Chau FCZ, located some 2.7km from the cable and Po Toi FCZ, located more than 5.9km from the cable, as shown on ***Figure C-6***. Given this distance, adverse impact from cable burial works is unlikely at either FCZ.

Fisheries Importance

C.3.20 Fisheries production in the vicinity of the HK-G Cable is low to moderate. Fisheries production was highest (>200 to 300 kg/ha) in the cable section east to D'Aguilar Peninsula and the value decreases (>0 to 50 kg/ha) in the cable section east to Ninepin Group. The area that will be temporarily occupied by the cable installation vessel as it traverses through Hong Kong waters is small and so should not adversely affect the routes taken by fishing vessels. On this basis, the Project is considered to be of low importance to the Hong Kong fishing industry.

Sensitive Receivers

C.3.21 The identified sensitive receivers are listed in ***Table C-1*** below.

Table C-1 Shortest Navigation Distances of Fisheries Sensitive Receivers to the Cable Alignment

Category	ID	Sensitive Receiver Description	Shortest Navigation Distance to HK-G Cable
Fish Culture Zone	F1	Tung Lung Chau FCZ	2.7km
	F2	Po Toi FCZ	5.9km
Nursery Grounds	--	To the north of the cable alignment	>11km
Spawning Grounds	--	The cable alignment passes through	0
Artificial Reefs	--	Artificial Reefs in Port Shelter WCZ	>7.6km

C.4 Impact Assessment

Direct Impacts

C.4.1 As indicated in ***Table C-1***, above, due to the large distance from the cable alignment, installation works will not have any direct impacts on FCZs, Nursery Grounds or Artificial Reefs. The only potential impacts may be on Spawning Grounds through which the Cable passes. The majority of the HK-G Cable alignment is located within areas identified in ***Paragraph C.3.11*** as Spawning Grounds of generally "low" fish fry production rate.

C.4.2 TKOIE, which is the landing point of the HK-G cable, is approximately 5km northwest of the recognised Spawning Ground in the South-eastern Waters WCZ. The seabed near the landing point is rocky and the area has been installed with many other cables. Therefore, the installation of the cable in TKOIE should have no significant impact on the Spawning Ground to the south and east, as well as on fisheries in general.

C.4.3 As the cable-laying vessel traverses across Hong Kong waters it will occupy part of the sea surface, which is thus unavailable for use by other marine vessels, including fishing vessels. However, this "temporary loss" of fishing grounds will be limited to 70m x 25m at any one time (i.e. the "footprint" of the vessel) and impacts from the presence of the cable-laying vessel are no different to those from any other marine vessel passing through Hong Kong waters. Other than area occupied by the cable-laying vessel, there is no other temporary loss of fishing grounds.

C.4.4 Although movement of the cable-laying vessel might be considered as an interruption to any fishing operations that may have been occurring, it is no different than any other marine vessel – from sampans to container ships – traversing Hong Kong waters. On the other hand, the cable burial tool – typically 6m x 1m – will occupy the seabed, not the surface, as it buries the cable that is fed down from the cable-laying vessel above. As such, there will be no interruption to any fishing activities due to the operation of the cable burial tool on the seabed.

C.4.5 The EIAO-TM states that Spawning Grounds can be regarded as an important habitat type as they are critical to the regeneration and long-term survival of many organisms and their populations. After the cable burial tool has buried the cable, the seabed will be reinstated naturally by resettlement of disturbed sediments, following which there will be immediate recolonization by benthic fauna that provide food for fish. Also, the

disturbed area at one time during cable installation shall be limited. Thus, there is only short-term and a minor disturbance to the seabed within the Spawning Grounds and this should not cause any significant impact to fisheries production.

C.4.6 Overall, no long-term direct impacts are expected to occur that would affect either fisheries resources or fishing operations, i.e. the direct impacts are not considered to be significant.

Indirect Impacts

C.4.7 As indicated in ***Table C-1***, above, due to the distinct navigation distance, any indirect impacts resulting from the installation of the HK-G Cable on FCZs, Nursery Grounds or Artificial Reefs are unlikely. The only potential indirect impacts may be on Spawning Grounds through which the Cable passes.

C.4.8 Indirect impacts may occur through elevation in suspended solids resulting from the disturbance of the seabed during the burial of the cable. However, this disturbance will be localised, temporary and of short duration.

C.4.9 Calculations in ***Annex A*** indicate that any sediments disturbed during cable burial works along the entire alignment will settle onto the seabed within 180m of the cable trench in less than 3.5 minutes. Burial of the HK-G Cable is therefore not expected to result in unacceptable impacts to water quality, particularly in terms of suspended sediments. As such, cable burial is not expected to result in any significant indirect impacts to fisheries.

Fisheries Impact Evaluation

C.4.10 An evaluation of the impact to fisheries is presented in ***Table C-2*** in accordance with EIAO-TM Annex 9:

Table C-2 Evaluation of Fisheries Impact

Aspect	Evaluation of Impact
Nature of Impact	Beyond shore-end cable installation in TKOIE, the Cable will be directly laid and buried using a cable burial tool, below the seabed. Direct impacts to the immediate seabed will result from cable laying and indirect impacts may result from elevation in suspended solids in the water column as a result of the burial process. The impact shall be localised as the maximum width of the seabed fluidised by the burial tool is 0.5m and the disturbed area of the seabed will be limited to this width. The impact shall also be short-term as cable laying will take around just 4 months for the entire alignment within Hong Kong including weather downtime. Making reference to the APG (a cable with similar alignment to this Project), the actual duration required for the marine works within Hong Kong waters was only about 3 weeks.
Size of Affected Area	The total length of the cable in Hong Kong waters is approximately 33.6km from TKOIE to the eastern boundary of Hong Kong. The temporary loss of fishing grounds, will be limited to the area occupied by the cable-laying vessel, i.e. approximately 70m x 25m at any one time, along 33.6km. As such, potential impacts on vessel transit and fishing activities along the cable alignment are not anticipated.
Loss of Fisheries Resources and Production	Fisheries production in the affected area ranges from >0 to 50 kg/ha to >200 to 300 kg/ha in terms of catch weight, in which more than half of the grids show no greater than 50kg/ha. Fisheries production was highest (>200 to 300 kg/ha) east of D'Aguilar Peninsula and the value decreases (>0 to 50 kg/ha) east of Ninepin Group. The fishing operations and fisheries resources

Aspect	Evaluation of Impact
	production in the vicinity of the HK-G Cable is low to moderate. Due to the small area occupied by the cable-laying vessel and short duration for cable installation in any one location, potential impacts on fishing vessel transit and fishing activities along the cable alignment will not be significant.
Destruction and Disturbance of Spawning and Nursery Grounds	The Cable does not pass through any recognised Nursery Grounds. The south-eastern and eastern waters through which the Cable will be laid have been recognised as spawning grounds for commercial fisheries resources. After the cable burial tool has buried the Cable, the seabed will be reinstated naturally by resettlement of disturbed sediments, following which there will be immediate recolonization by benthic fauna that provide food for fish. In terms of indirect impacts, the maximum predicted extent of suspended solids is expected to be 180m from the cable trench and would settle back onto the seabed within 3.5 minutes, based on worst case assumptions. Given the above, there is only short-term and a minor disturbance to the seabed within the Spawning Grounds.
Impact on Fishing Activities	Fishing activities along the cable alignment are of moderate commercial value and the size of the fishing areas that will be temporarily occupied by the cable-laying vessel as it traverses through Hong Kong waters is considered to be small. On this basis, the impacts arisen from the Project to the fishing industry is considered to be minimal.
Impact on Aquaculture Activity	The nearest FCZs are Tung Lung Chau FCZ, located at some 2.7km from the cable and Po Toi FCZ, at more than 5.9km from the cable. Given this distance, no impact from cable burial works is expected at either FCZ.

Cumulative Impacts

C.4.11 While there are five projects planned in the vicinity of the HK-G Cable, only one – the *Tseung Kwan O – Lam Tin Tunnel and Associated Works* – including reclamation will be constructed concurrently with the HK-G Cable. As discussed in ***Section 3.4***, given that there will be full containment of reclamation works, the 2,250m separation and the short installation time of shore-end works at TKOIE (just a few days), cumulative fisheries impacts are not anticipated.

C.5 Mitigation Measures

C.5.1 As no adverse impacts to fisheries resources are expected to occur, no specific mitigation measures to fisheries are required. However, the mitigation measures proposed in ***Annex A Section A.6*** to protect water quality shall also be of benefit to fisheries resources and shall be fully implemented.

C.6 Residual Impact

C.6.1 The residual impacts to fisheries resources, habitats and fishing operations during construction phase are considered to be within acceptable level and no specific fisheries monitoring programme is found to be necessary.

C.7 Conclusion

C.7.1 A review of existing information on the fisheries resources and fishing operations along the alignment of the HK-G Cable has found the majority of the area supports fisheries resources with low to moderate fisheries production. There are no Nursery Grounds, FCZs or Artificial Reefs in the area that would be affected by the Project. There is, however, a recognized Spawning Ground of commercial fisheries resources at south-eastern waters through which the HK-G Cable passes.

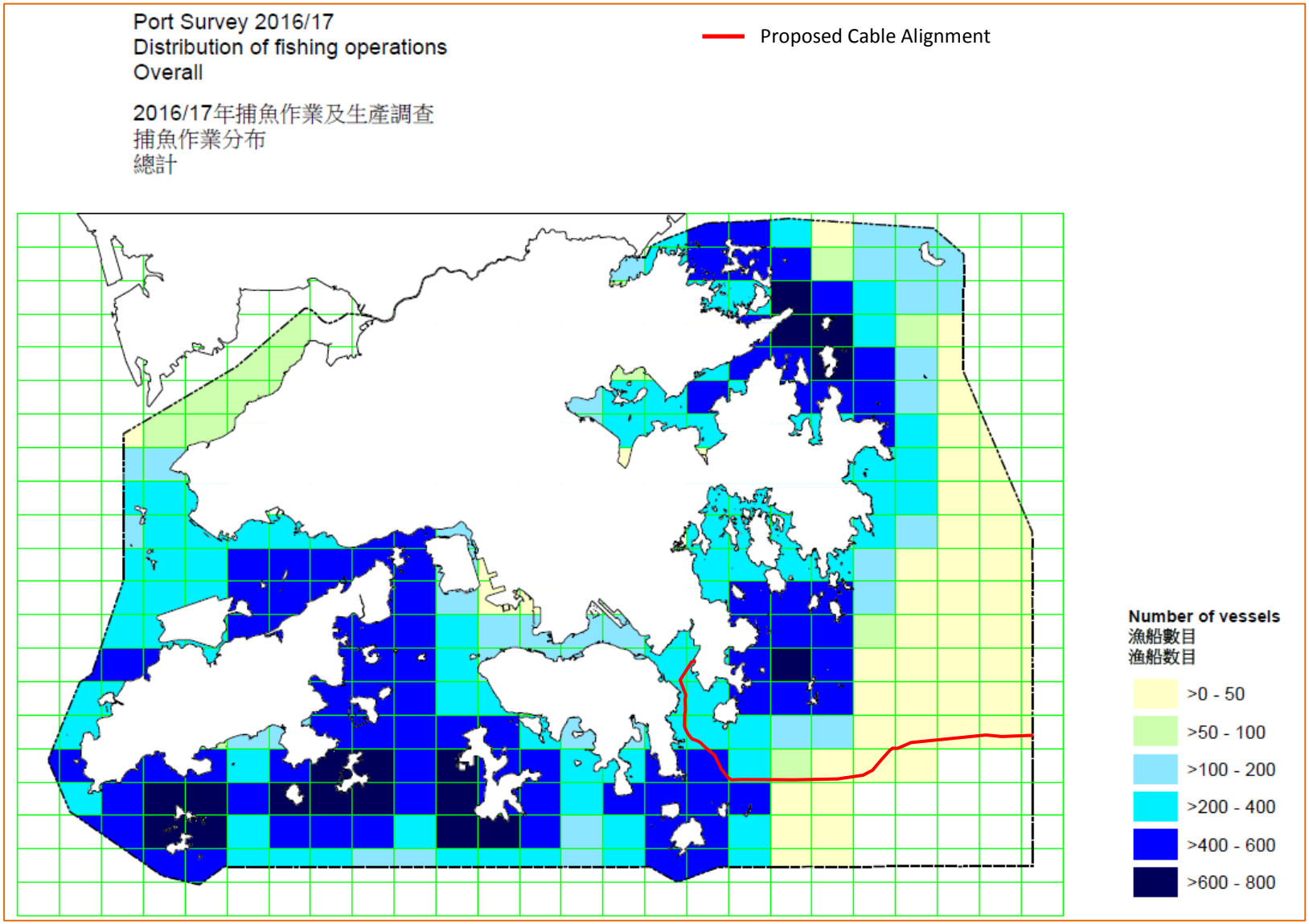
C.7.2 Fisheries production in the affected area ranges from >0 to 50 kg/ha to >200 to 300 kg/ha in terms of catch weight, in which more than half of the grids show no greater than 50kg/ha. Fisheries production was highest (>200 to 300 kg/ha) east of D'Aguilar Peninsula and the value decreases (>0 to 50 kg/ha) east of the Ninepin Group.

C.7.3 Due to the small area occupied by the cable-laying vessel and short duration required for the cable installation in any one location, potential impacts on fishing vessel transit and fishing activities along the cable alignment will not be significant.

C.7.4 In terms of indirect impacts, the maximum predicted extent of any plume is 180m from the cable trench, and would settle back onto the seabed within 3.5 minutes, based on worst case assumptions. Thus, the seabed will be reinstated naturally by resettlement of disturbed sediments, following which there will be immediate recolonization by benthic fauna that provide food for fish.

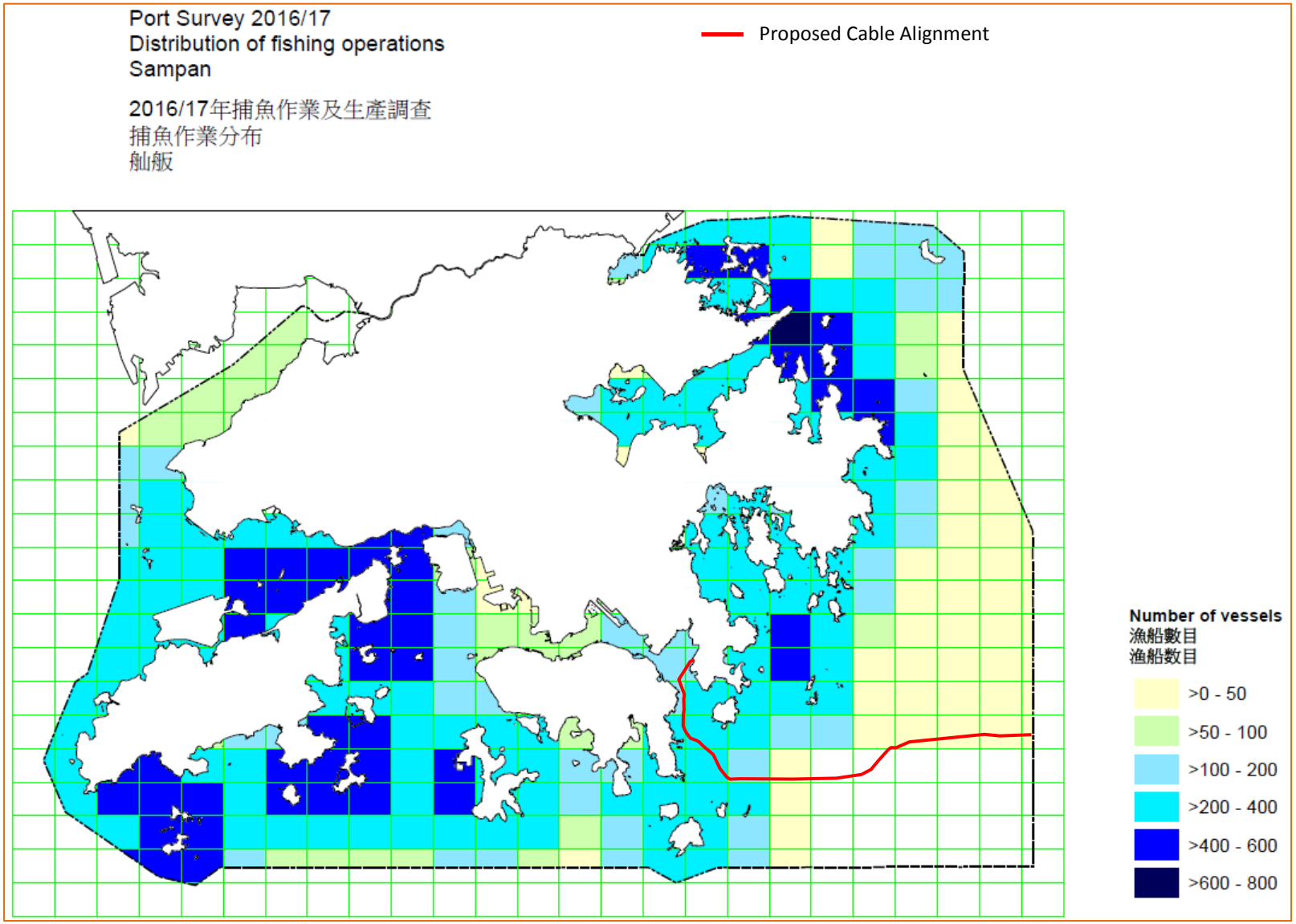
C.7.5 Given the above, adverse impacts are not expected to arise from the cable laying works. Overall, no unacceptable impacts are predicted to occur to fisheries resources or fishing operations as a result of this Project.

Figure C-1 Distribution of Fishing Operations in Hong Kong Waters and Location of the HK-G Cable



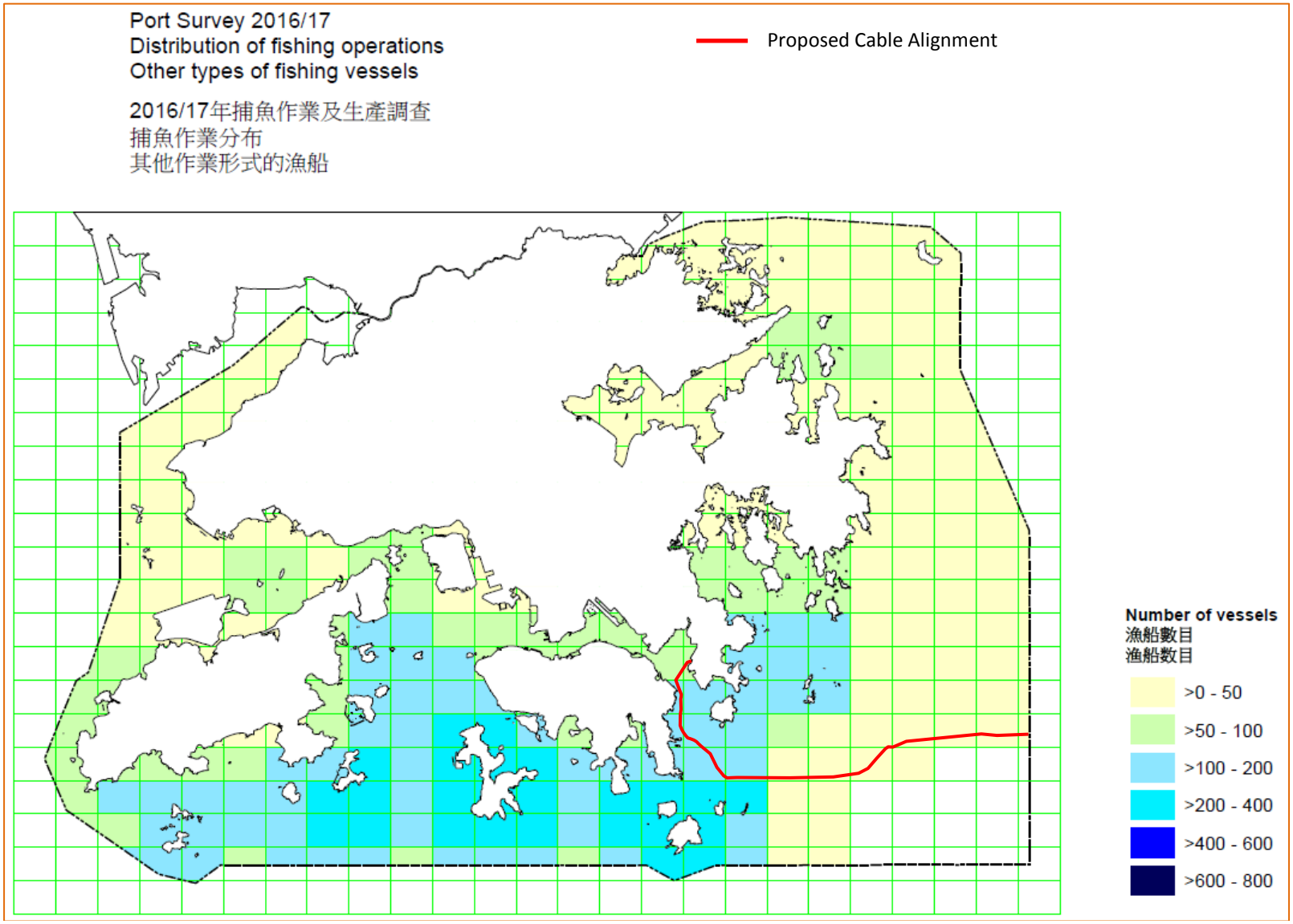
Source: Port Survey 2016/17, AFCD.

Figure C-2 Distribution of Fishing Operations (Sampan) and Location of the HK-G Cable



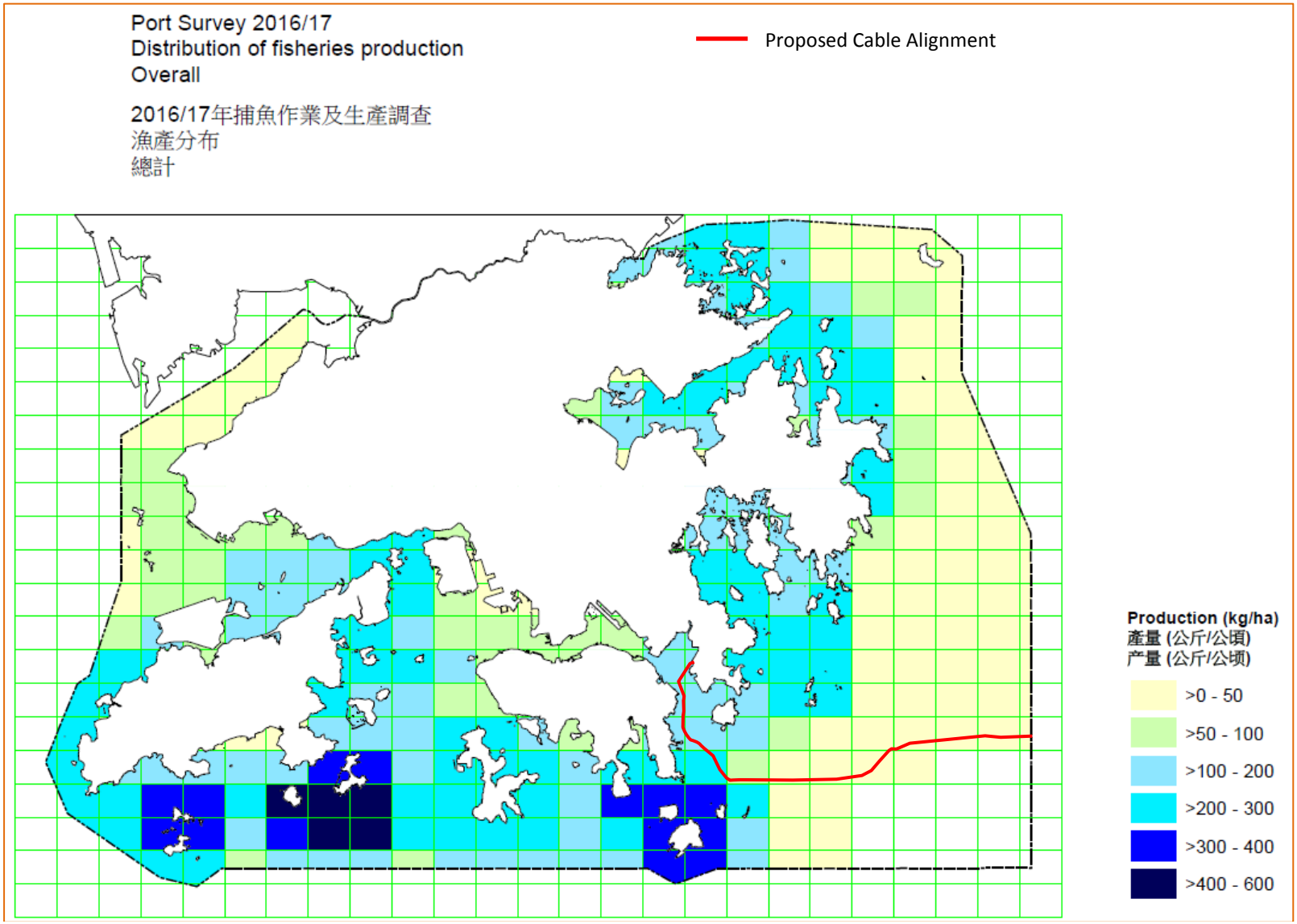
Source: Port Survey 2016/17, AFCD.

Figure C-3 Distribution of Fishing Operations (Other types) and Location of the HK-G Cable



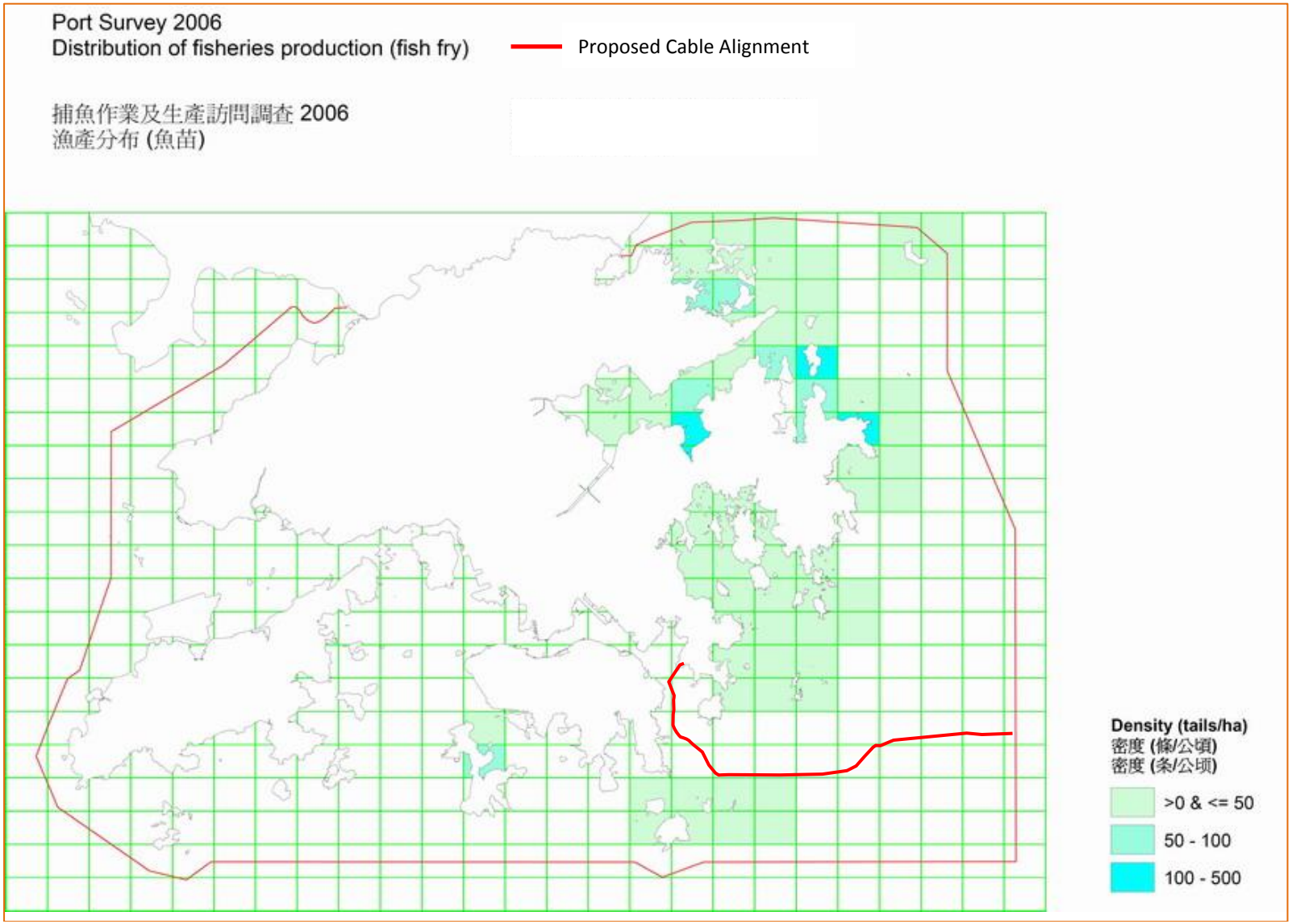
Source: Port Survey 2016/17, AFCD.

Figure C-4 Distribution of Fisheries Production (Overall) and Location of the HK-G Cable



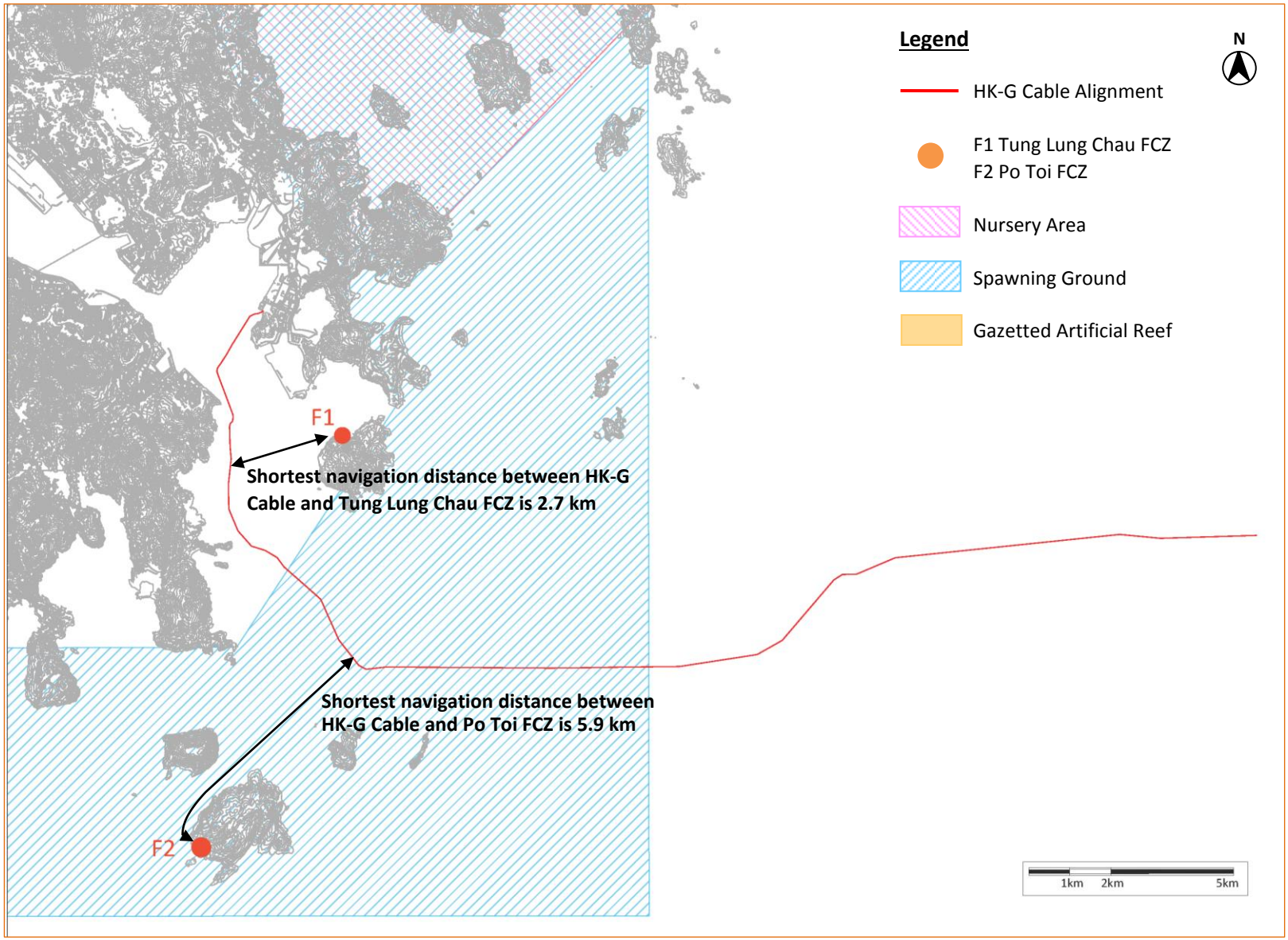
Source: Port Survey 2016/17, AFCD.

Figure C-5 Distribution of Fisheries Production (Fish Fry) and Location of the HK-G Cable



Source: Port Survey 2006, AFCD.

Figure C-6 Fisheries Sensitive Receivers



ANNEX D

Cultural Heritage Assessment

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D CULTURAL HERITAGE ASSESSMENT

D.1 Introduction

D.1.1 This Annex contains an assessment of cultural heritage associated with the Project.

D.2 Relevant Legislation and Guidelines

D.2.1 The following legislation and guidelines are applicable to the assessment of cultural heritage impact in Hong Kong:

- Environmental Impact Assessment Ordinance (Cap 499) and the associated Technical Memorandum on the EIAO Process (EIAO-TM), Annexes 10 and 19
- Antiquities and Monuments Ordinance (Cap. 53)
- Hong Kong Planning Standards and Guidelines (HKPSG)
- Guidelines for Marine Archaeological Investigation (MAI) prepared by the Antiquities and Monuments Office (AMO)

EIAO-TM

D.2.2 The EIAO-TM outlines the approach and criteria for assessment of impact on Sites of Cultural Heritage.

D.2.3 Annex 10 provides the criteria for evaluating impact on sites of cultural heritage and also notes the general presumption in favour of the protection and conservation of sites of cultural heritage and that adverse impacts on sites of cultural heritage shall be kept to the absolute minimum.

D.2.4 Annex 19 notes that preservation is the preferred solution and if full preservation is not feasible, 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.

Antiquities and Monuments Ordinance, Cap 53

D.2.5 The Antiquities and Monuments Ordinance (Cap. 53) provides statutory protection against the threat of development on declared and proposed Monuments, to enable their preservation for posterity. The Ordinance also establishes statutory procedures to be followed in making such a declaration.

Hong Kong Planning Standards and Guidelines

D.2.6 Chapter 10 of the HKPSG on Conservation provides general guidelines and measures for the conservation of historic buildings, sites of archaeological interest and other antiquities.

MAI Guidelines

D.2.7 The objectives of the MAI are to conduct a phased review/investigation of a Study Area in accordance with the *MAI Guidelines for Marine Archaeological Investigation*. The Study Area refers to the assessment corridor along the cable alignment with 25m width

on both sides. The MAI shall include a Phase I Assessment, which shall determine if a Phase II Assessment is required.

D.2.8 During a Phase I Assessment, the following shall be undertaken by a qualified marine archaeologist:

- Baseline review of the Study Area
- Review of Geophysical Survey data
- Establish marine archaeological potential
- Conduct marine archaeological impact assessment

D.2.9 Based on the results of the first stage MAI, further investigation may or may not be required. Should a Phase II Assessment be required, the following shall be undertaken:

- Remote Operated Vehicle/Visual Diver Survey/Watching Brief if potential sites are identified during Phase I work.
- Provide a Report on these aspects.

D.3 Baseline Study

D.3.1 The HK-G Cable alignment and landing site at TKOIE is within the same assessment corridor as the previous MAIs of several other submarine cables systems. These include EAC, ASE, APG, TKOE and the planned UEL. Information from these recent MAIs has been extracted to describe and support the existing conditions and findings within the Study Area.

Inventory of Heritage within Study Area

D.3.2 At TKO, there is a Declared Monument, the Site of Chinese Customs Station at Fat Tau Chau, located approximately 244m from the landing site at TKOIE. At areas farther away from the Cable, there are two more Declared Monuments, namely Rock Carving at Big Wave Bay and Rock Carving on Tung Lung Chau, which are approximately 1,473m and 2,013m away from the Cable alignment. On the other hand, there are three Sites of Archaeological Interest located near the HK-G cable alignment, namely Fat Tau Chau Site of Archaeological Interest (approximately 103m), Fat Tau Chau Qing Dynasty Gravestone (approximately 215m) and Fat Tau Chau House Ruin (approximately 500m).

D.3.3 ***Figure D-1*** shows the location of the declared Monument and the three Sites of Archaeological Interest.

D.3.4 In terms of marine archaeological resources, HK-G Cable is in the vicinity of several other submarine cable systems that have landed at TKOIE and have been subject to previous MAIs, as shown in ***Figure 1-1 of the Project Profile***. These MAIs did not identify any previously known marine archaeological resources, or seabed features with marine archaeological potential. It is therefore possible to conclude that no marine archaeological resources, fall within the Study Area of the MAI for this Project. The closest object, UKHO 65708 is located 52m from the HK-G Cable, as shown in ***Figure D-2***, and is outside the Study Area.

Possible Threats to Terrestrial Heritage

D.3.5 There will be no threat to terrestrial heritage form marine works. At the TKOIE landing point, the only works will be pulling the Cable through the existing seawall duct – no new construction is required – and so there is also no threat to the Declared Monuments or the three Sites of Archaeological Interest. As such, the remainder of this assessment will focus on marine heritage.

Possible Threats to Marine Heritage

D.3.6 The distances between the cable alignment and the identified potential marine archaeological objects in the previous MAIs are shown in ***Figure D-2***. To ascertain whether any of these objects are marine archaeological resources, a MAI has been carried out for the HK-G Cable, provided in ***Section D.5***.

D.3.7 Installation of the first 20m of the cable from the seawall will be achieved by divers using jetting. The remainder of the cable will be installed using an injector burial tool which fluidizes the seabed 0.5m width to a depth of 5m. The Study Area is set at 25m either side of the cable alignment to allow a buffer zone for the installation work

D.4 Baseline Review

Geotechnical Data

D.4.1 Thick marine sediments have been deposited along the South China coast during quaternary fluctuations in sea level. Mean sea level has risen some 120m since the end of the last ice age when the shoreline was further out from the present coastline and close to the edge of the continental shelf. This rise in sea level has formed drowned coastline topography. The deposits that now occupy this topography throughout Hong Kong waters (and PRC waters south of Hong Kong) are characterised by two main sedimentary facies; marine sediments of the Hang Hau Formation overlying older sediments of the Sham Wat and Chek Lap Kok formations[Ref #1].

D.4.2 The upper-most geological unit is the “Marine Deposits” of the Holocene Hang Hau Formation. This comprises very soft to soft homogenous sediments deposited shortly after the rise in sea level at the end of the last ice age, 10,000 to 6,000 years ago. It typically consists of greenish grey silty clay that has a variable thickness up to 30m. Undrained shear strengths vary from <3kPa to 20kPa. The sediment generally becomes coarser to the base of the formation[Ref #1]. The Hang Hau Formation would provide an excellent preservation environment for marine archaeological resources.

D.4.3 Underlying the Hang Hau Formation is the laterally impersistent late Pleistocene marginal marine to estuarine Sham Wat Formation and the Chek Lap Kok Formation. The Sham Wat Formation consists of similar source material to the Holocene sediment, but is firmer as it has been exposed to subaerial weathering when sea levels have been lowered during previous glacial/inter-glacial cycles. The Sham Wat Formation generally comprises firm (40-60kPa) grey silty clay with occasional leached soft shell fragments. The Chek Lap Kok Formation comprises a heterogeneous, poorly sorted mix of sediments ranging in size from boulders to clay. The clay tends to be firmer than the

1. Project Profile for Ultra Express Link, 14 September 2017 (PP-553/2017) and Project Profile for Tseung Kwan O Express – Cable System, 20 May 2015 (PP-532/2015)

overlying formations with an unconfined compressive strength of between 30 to 90kPa. The thickness of these combined formations is up to 30m[Ref #1].

D.4.4 Close to the coast, where wave action has removed the fine sediment, the Chek Lap Kok Formation includes colluvial sand, gravel and boulders. Away from the coastline, the formation tends to a poorly sorted soil, mostly sand and silt but with clay and gravel in places [Ref #1].

D.4.5 Below the Chek Lap Kok formation is the solid rock geology of Hong Kong, mostly tuff and granite, often with a thick highly weathered horizon above the unweathered rock, with some sedimentary rocks[Ref #1].

Review of Historical Documents

D.4.6 The following has been extracted from previous marine archaeological Baseline studies (APG Cable System) which covered the same Study Area.

TKOIE Landing Point

D.4.7 Archaeological evidence indicates that seafarers have used the waters of Hong Kong for around 6,000 years[Ref#2] and it is reported[Ref #3] that in the past decade a great number of prehistoric sites have been discovered in the coastal sandbars which represent the opening up of the coastal and offshore island areas by the early settlers. Around 6,000 years ago, the Neolithic peoples had already settled in the coastal area of South China.

D.4.8 The TKOIE landing point is located in what is now called Junk Bay (formerly known as Fat Tong Mun) due to the many junks that previously took shelter within in the bay, as reported by Aijmer[Ref #4]. Junk Bay and Tathong Channel (which the HK-G Cable will need to cross) were used from the Song Dynasty during trading activities that connected Guangzhou and northern China. This waterway forms the eastern entrance to Victoria Harbour and has continued to the present day to be an important waterway for many vessels of all sizes.

Site of Chinese Customs Station

D.4.9 The former Site of Chinese Customs Station at TKO is a Declared Monument only 244m from the cable landing point. While it will not be impacted at all by the cable installation it is an important indicator of historic maritime activity in this vicinity.

D.4.10 In the Qing Dynasty (1644-1911), vessels passing through Fat Tong Mun and Tathong Channels stopped at a customs station on Fat Tau Chau or Junk Island, before proceeding west to the Pearl River delta. It is located with strategic significance at the eastern exit of the harbour. In April 1979, following the recovery of pieces of a broken pillar, the AMO undertook a brief survey of the area (Bard, 1980). Broken stones, rubble, tiles and grey bricks were found and granite-slab steps with remains of door hinges were uncovered. At the south end two column bases were discovered. This material indicated that an imposing structure had stood on the site. Large boulders, clearly deliberately aligned, were observed at low tide about the centre of the beach. It was suggested that these could be the remains of a large wooden pier or slipway.

2. Bard, S. 1988. *In Search of the Past: A Guide to the Antiquities of Hong Kong*. Hong Kong Urban Council
3. Chau, Hing-wah, (ed) 1993. *Collected essays on the culture of the Ancient Yue People in South China*. Hong Kong Museum of History
4. Aijmer, 1984, cited in Maunsell Consultants Asia Ltd., 2005, *Further Development of Tseung Kwan O, Feasibility Study*, Environmental Impact Assessment, Impact on Cultural Heritage. Civil Engineering and Development Department. Hong Kong

D.4.11 After the Kowloon Peninsula was ceded to the British following the 'arrow' or Second Opium War in 1857-60 and the signing of the Treaty of Tientsin in 1860, Chinese Customs Stations were established at Ma Wan, Cheung Chau, Lai Chi Kok and at Junk Island. Armed Maritime Customs cruisers regularly patrolled the waters nearby looking for contraband (Sayer, 1975). The Chinese Customs Station was closed, along with the others in the immediate vicinity of Hong Kong, after the Convention of Peking in 1898 leased what subsequently became the New Territories to Great Britain. The Chinese Customs Station buildings gradually fell into disrepair after they were abandoned.

D.4.12 The coastline of Junk Bay now extends much further seaward as a large amount of the seabed has been reclaimed from the 1970s onwards, thus pushing coastal villages back inland and covering evidence of early coastal use and settlement. Tseung Kwan O Village, originally located on the north eastern coastline of Junk Bay, is one of the oldest settlements in the region, dating back to the early Ming Dynasty.

United Kingdom's Hydrographic Office

D.4.13 The UK Hydrographic Office (UKHO) in Taunton maintains a database of known shipwrecks and other underwater obstructions in the HKSAR.

D.4.14 As the HK-G Cable follows the same alignment as *APG*, information has been obtained from the *APG* with regard to the assessment of marine archaeological resources. ***Figures D-3 and D-4*** provide a detailed information about the two shipwreck sites closest to the HK-G cable alignment. UKHO shipwreck number 57736 is located 76m from the alignment and shipwreck number 65708 is located 52m from the alignment. Neither of them is located within the Study Area.

Geophysical Surveys

D.4.15 The following MAIs were undertaken in Project Profiles for previous cables in the vicinity of the HK-G Cable:

- MAI in the Project Profile for TKOE, dated 16 December 2015. The geophysical survey was carried out between 16 and 30 November 2015 and covered a 500m wide corridor, which included the Study Area for the HK-G Cable.
- MAI in the Project Profile for the ASE, dated 7 October 2011. The survey covered a 1,000m wide corridor, including the Study Area for the HK-G Cable. The survey period was between 14 March and 4 May 2011.
- MAI in the Project Profile for the APG, dated 8 October 2013, using the same type of survey as for ASE. The geophysical survey was carried out between 11 and 24 October 2012 and covered a 650m wide corridor, which included the Study Area for the HK-G Cable.

D.4.16 A geophysical survey for HK-G Cable was undertaken in mid-2017, which encompassed an assessment of the depth and nature of the seabed sediments and any seabed and sub bottom anomalies. Information was extracted from earlier surveys for the HK-G Cable as it has a similar alignment to other submarine cable projects.

D.4.17 The following equipment was employed during the earlier and 2017 HK-G geophysical surveys:

- C-Nav GcGPS (Globally corrected GPS)
- Single-beam Echo Sounder
- Multi-beam Echo Sounder
- Side Scan Sonar System
- Sub-bottom Profiler
- Marine Magnetometer System

D.4.18 Dumped materials were found by the side scan sonar survey along the length of HK-G Cable alignment. The seabed in the Study Area is covered by thick sediment, comprising very soft silt or sandy clay. The amount of dumped materials decreases when the cable get further away from the shore in TKOIE and the area around Tathong Channel. The seabed is characterized by scattered scars but becomes clear of features as it approaches the eastern end.

D.5 Marine Archaeological Investigation

D.5.1 Geophysical survey data was provided by local marine surveying company EGS (Asia) Ltd (EGS) for other cable projects along the cable route alignment, namely the ASE, APG and TKOE. This data was processed by in-house geophysicists and reviewed by a qualified marine archaeologist Ms Sarah HEAVER of Marine Ltd. In addition to this, EGS has also carried out a geophysical survey for this Project, in mid-2017. However, once the cable alignment was changed the HK-G geophysical survey no longer provided 100% coverage of the route. As this was covered by the 2013 geophysical survey for the APG this data was analysed for the realigned section as shown on drawing D-2.

D.5.2 The survey findings for ASE, APG and TKOE did not identify any objects with marine archaeological potential within the vicinity of the HK-G Cable. The surveys found that the seabed comprised coarse sediment for most of the Study Area with a number of areas of rock/boulders and low relief dumped materials. The surveys found that part of the area along the Cable alignment was heavily impacted from historical trawling and dumping of material.

D.5.3 The geophysical survey of the HK-G Cable alignment revealed that the seabed has scattered trawling scars and numerous dumped materials, concentrated on the western half of the alignment. The Cable section along the east coast of Hong Kong Island passes through an area of declared minefield and suspended Marine Borrow Area (1990-2003). These activities would have significantly reduced the archaeological potential of the seabed. To the eastern half of the alignment patches of dumped materials became less frequent and the seabed becomes less disturbed and more featureless. Further to the east, the seabed is flat with isolated dumped material. Toward the east end of the alignment within Hong Kong Waters, the seabed is clear of any features or obstructions. The survey results are in accordance with the findings of previous surveys, i.e. no evidence of any marine archaeological resources.

D.5.4 A list of sonar contacts from the HK-G geophysical survey of the HK-G Cable alignment is provided below in ***Table D-1a*** and shown on ***Figure D-2***. Six sonar contacts are located within the 50m corridor and all of them are classified as debris. Copies of the data are included in ***Appendix D***.

D.5.5 A list of sonar contacts from the APG geophysical survey for the realigned section of HK-G Cable is provided below in ***Table D-1b*** and shown on ***Figure D-2***. There are five sonar contacts and all of them are more than 128m from the alignment and classified as debris. They require no further investigation.

Table D-1a Sonar Contacts Identified in the HK-G 2017 Geophysical Survey

Ref	Survey Reference	Latitude Longitude	Size (m)*	Description
A-**SC005**	HK-G	22° 16.256' N 114° 15.476' E	3x2xnmh	Debris
SC003	HK-G	22° 16.843' N 114° 15.844' E	3x1xnmh	Debris
SC023	HK-G	22° 16.287' N 114° 15.497' E	4x2xnmh	Debris
SC032	HK-G	22° 16.208' N 114° 15.442' E	2x2x1.3	Debris
SC034	HK-G	22° 16.200' N 114° 15.444' E	2x1x1.4	Debris
SC082	HK-G	22° 12.404' N 114° 17.248' E	5x5xnmh	Debris

Note: * nmh stands for no measurable height

Table D-1b Sonar Contacts from the 2013 APG Geophysical Survey

Ref	Survey Reference	Latitude Longitude	Size (m)*	Description
SC001	APG	22° 17.017' N 114° 15.994' E	62xnmwxnmh	Unknown Linear
SC002	APG	22° 17.001' N 114° 15.977' E	80xnmwxnmh	Unknown Linear
SC003	APG	22° 17.017' N 114° 15.978' E	20xnmwxnmh	Unknown Linear
SC004	APG	22° 13.404' N 114° 16.381' E	19x7x7	Shipwreck
SC005	APG	22° 12.266' N 114° 18.837' E	5.9x4.5xnmh	Dumped materials
SC006	APG	22° 13.946' N 114° 25.624' E	4.6x2.7x0.7	Dumped materials
SC007	APG	22° 14.211' N 114° 29.359' E	1.5x1.3x<0.5	Tyre

D.5.6 Magnetic surveys were carried out to locate existing cables and pipelines along the alignment, which are listed in ***Table D-2a*** and shown on ***Figure D-2***. Nine magnetic contacts are located within the 50m corridor and all of them are regarded as unknown objects.

D.5.7 A list of magnetic contacts from the APG geophysical survey for the realigned section of HK-G Cable is provided below in ***Table D-2b*** and shown on ***Figure D-2***. There are seven magnetic contacts are located within the 50m corridor and all of them are regarded as unknown objects.

Table D-2a Magnetic Contacts from 2017 HK-G Geophysical Survey

Ref	Survey Reference	Latitude Longitude	Magnetic Anomaly (nT)	Description
A-MC003	HK-G	22° 16.398' N 114° 15.577' E	83.8	Unknown
MC007	HK-G	22° 16.878' N 114° 15.948' E	169.6	Unknown
MC085	HK-G	22° 16.100' N 114° 15.394' E	43.8	Unknown
MC102	HK-G	22° 15.662' N 114° 15.570' E	131.3	Unknown
MC151	HK-G	22° 14.945' N 114° 15.813' E	27.1	Unknown
MC206	HK-G	22° 12.496' N 114° 17.166' E	37.9	Unknown
MC207	HK-G	22° 12.486' N 114° 17.167' E	34.6	Unknown
MC277	HK-G	22° 12.186' N 114° 19.449' E	11.8	Unknown
MC307	HK-G	22° 12.266' N 114° 22.360' E	13	Unknown

Table D-2b Magnetic Contacts from 2013 APG geophysical survey

Ref	Survey Reference	Latitude Longitude	Magnetic Anomaly (nT)	Description
MC041	APG	22° 15.842' N 114° 15.434' E	185.3	Unknown
MC042	APG	22° 15.839' N 114° 15.427' E	84.9	Unknown
MC046	APG	22° 15.823' N 114° 15.460' E	74.9	Unknown
MC061	APG	22° 15.222' N 114° 15.500' E	43.5	Unknown
MC064	APG	22° 15.223' N 114° 15.542' E	73.6	Unknown
MC065	APG	22° 15.220' N 114° 15.490' E	36.1	Unknown
MC133	APG	22° 12.159' N 114° 17.681' E	23.8	Unknown

D.5.8 Other magnetic contacts and sub-bottom anomalies that were found during the geophysical surveys have been identified as related to the ASE and APG cables, DSD's sewage pipeline, and dumped materials/debris given their association with these types of seabed features. Copies of the magnetic data are included in ***Appendix D***.

D.5.9 A review of the UKHO wrecks database found the following, shown in ***Table D-3***, to be located within 100m of the Cable alignment. There were a total of 15 wreck sites found in the wider area where the cable route runs as shown in ***Figure D-2***, and only two of the UKHO sites were found to be within the 100m Study Area but outside the 25m Study Area for the HK-G cable.

Table D-3 Wrecks Record from United Kingdom's Hydrographic Office

Wreck No.	Latitude Longitude	Classification	Description
57736	22° 16'.910 N 114° 16'.150 E	Undefined Origin	Undefined
65708	22° 16'.083 N 114° 15'.433 E	Undefined Origin	Dangerous Wreck

D.6 Conclusion

D.6.1 There will be no threat to terrestrial heritage from marine works. At the TKOIE landing point, the only works will be pulling the Cable through the existing seawall duct – no new construction is required – and so there is also no threat to the Declared Monument or the three Sites of Archaeological Interest. Hence no mitigation measures need to be put in place.

D.6.2 The geophysical surveys of previous MAIs and the one carried out for the HK-G Cable in mid-2017 reveal that seabed along the HK-G Cable alignment has been heavily impacted from trawling and the dumping of materials and installation of the previous 5 cables. It also found the nature of the sediments to be soft silt or sandy clay in the area of the Tathong Channel and Study Area. The previous seabed disturbance would have significantly reduced the archaeological potential of the seabed in the Study Area.

D.6.3 The geophysical survey carried out for the Project identified six sonar contacts within the 50m corridor, but all of these are classified as debris based on previous experience of data interpretation in the vicinity. Nine magnetic contacts were identified within the 50m corridor but all of these are regarded as unknown objects and most likely associated with the existing cables and their installation. Other magnetic contacts and sub-bottom anomalies that were found during the geophysical surveys have been identified as related to the ASE and APG cables, DSD's sewage pipeline, and dumped materials/debris. A review of the UKHO wrecks database identified two wrecks within 100m of the cable alignment but the closest one is 52m away and outside the Study Area.

D.6.4 The MAI established that there is no evidence for marine archaeological resources and hence no marine archaeological impacts are expected. No mitigation measures or further action will therefore be required.

D.7 References

Aijmer, 1984, cited in Maunsell Consultants Asia Ltd., 2005, Further *Development of Tseung Kwan O, Feasibility Study, Environmental Impact Assessment*, Impact on Cultural Heritage. Civil Engineering and Development Department. Hong Kong.

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Figure D-1 Location of Declared Monument and Sites of Archaeological Interest near TKOIE Landing Point

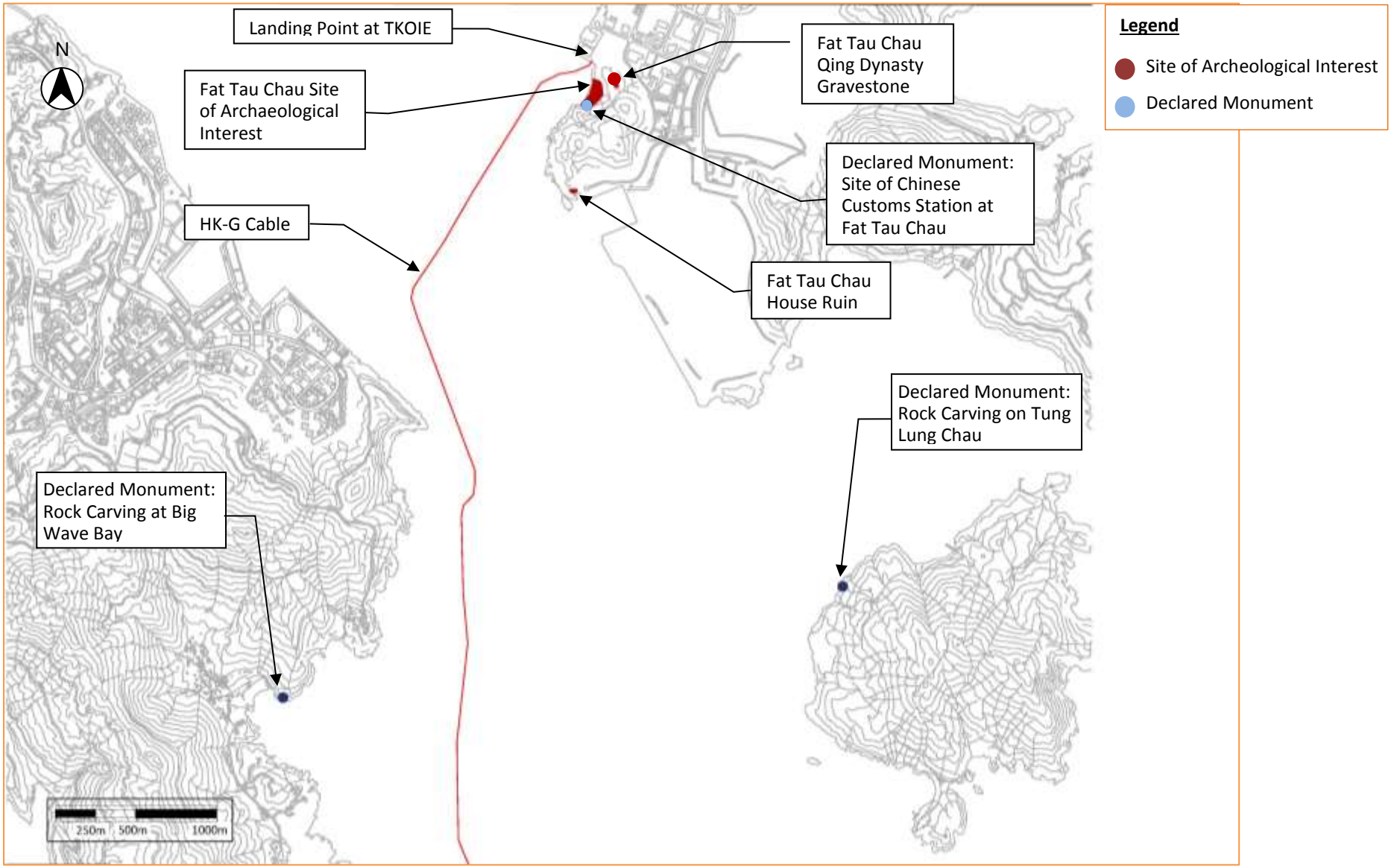

Figure D-2 Locations of Potential Marine Archaeological Resources

Source: EGS

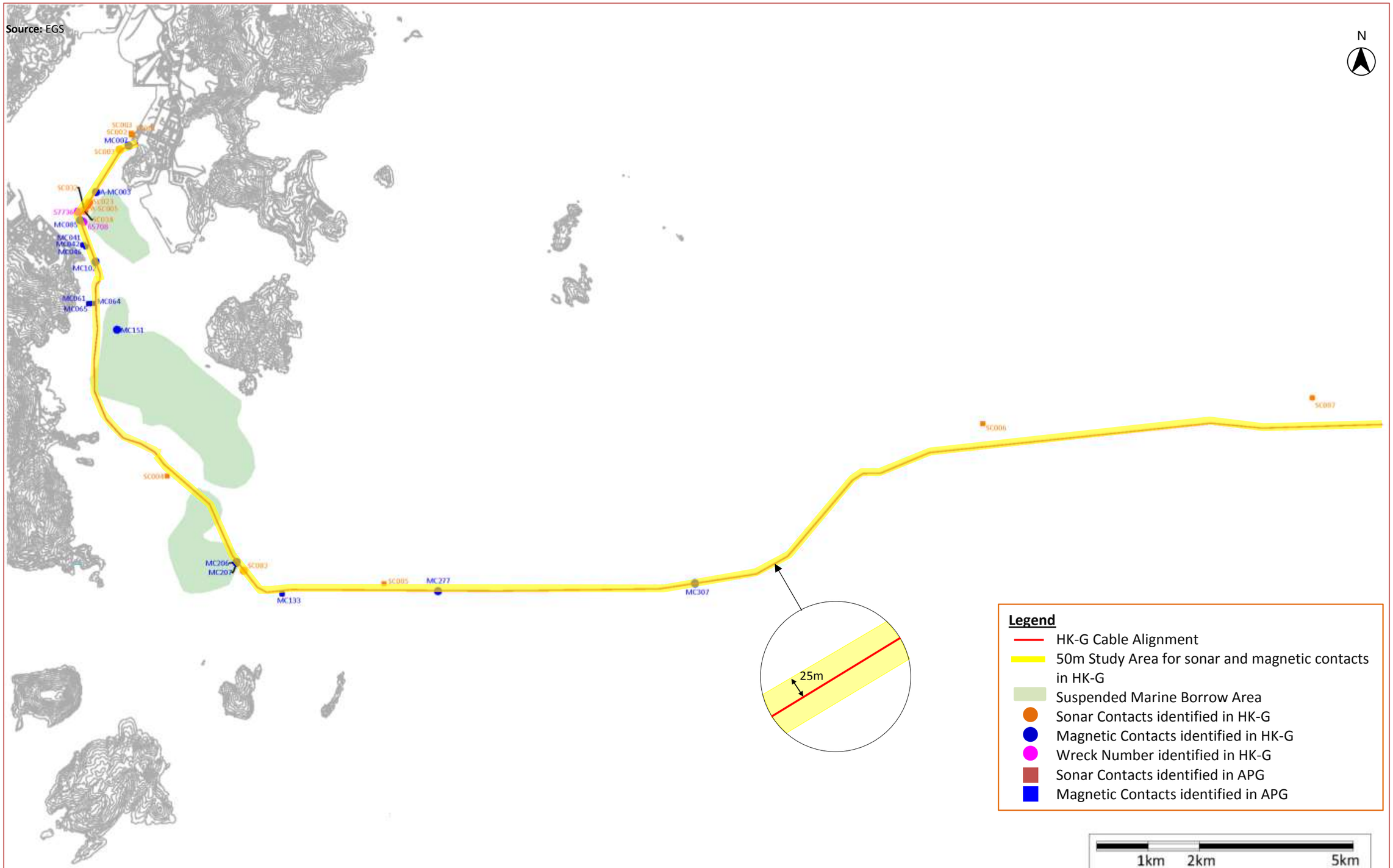

Figure D-3 United Kingdom Hydrographic Office Wreck Database for Wreck No. 57736

Latitude = 22 16'.190 N **Longitude** = 114 15'.370 E [UND] **Square Number** = 1113
State = DEAD

Wreck Number	57736	**Classification**	=
Unclassified			
Symbol	OB	**Largest Scale Chart** =	4117
Charting Comments			
Old Number			
Category	Undefined		
WGS84 Position	**Latitude** = 22 16'.190 N	**Longitude** = 114 15'.370 E	
WGS84 Origin	Undefined		
Horizontal Datum	UND UNDETERMINED		
Position Method			
Position Quality	Precisely known		
Position Accuracy			
Area at Largest Scale	No		
Depth			
Drying Height			
Height			
General Depth	14 metres		
Vertical Datum	Approximate lowest astronomical tide		
Depth Method			
Depth Quality	Depth unknown		
Depth Accuracy			
Conspic Visual	NO	**Conspic Radar**	NO
Historic	NO	**Military** NO	**Existence**
Doubtful NO			
Non Sub Contact	NO		
Last Amended	04/10/1999		
Position Last Amended			
Position Last	**Latitude** =	**Longitude** =	
Name			
Type			
Flag			
Dimensions	**Length** =	**Beam** =	**Draught** =
Tonnage			
Cargo			
Date Sunk			
Sonar Dimensions	**Length** =	**Width** =	**Shadow**
Height =			
Orientation			
Magnetic Anomaly			
Debris Field			
Scour	**Depth** =	**Length** =	**Orientation**
=			
Markers			
General Comments			
Circumstances of Loss			

Surveying Details
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Figure D-4 United Kingdom Hydrographic Office Wreck Database for Wreck No. 65708

Latitude = 22 16'.083 N **Longitude** = 114 15'.433 E [UND] **Square Number** = 1113
State = DEAD

Wreck Number	65708	**Classification**	=
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Charting Comments			
Old Number			
Category	Dangerous wreck		
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WGS84 Origin	Undefined		
Horizontal Datum	UND UNDETERMINED		
Position Method			
Position Quality			
Position Accuracy			
Area at Largest Scale	No		
Depth	11.9 metres		
Drying Height			
Height			
General Depth	20 metres		
Vertical Datum	Approximate lowest astronomical tide		
Depth Method			
Depth Quality	Depth known		
Depth Accuracy			
Conspic Visual	NO	**Conspic Radar**	NO
Historic	NO	**Military** NO	**Existence**
Doubtful NO			
Non Sub Contact	NO		
Last Amended	15/10/2008		
Position Last Amended			
Position Last	**Latitude** =	**Longitude** =	
Name			
Type			
Flag			
Dimensions	**Length** =	**Beam** =	**Draught** =
Tonnage			
Cargo			
Date Sunk			
Sonar Dimensions	**Length** =	**Width** =	**Shadow**
Height =			
Orientation			
Magnetic Anomaly			
Debris Field			
Scour	**Depth** =	**Length** =	**Orientation**
=			
Markers	G CAN LT BUOY, GPFL(2)10S.		
General Comments			
Circumstances of Loss			

Surveying Details
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**3.10.83 NOT CHARTED. (AUTHORITY NOT STATED) AMENDED TO DEAD. NC 3279.

APPENDIX D

Copies of Side Scan Sonar and Magnetic Data for HK-G

SPOEN-3822-01

Hong Kong – Guam Cable System

(HK-G)

Marine Archaeological Investigation Report (Appendix)

NEC Corporation

Tokyo, Japan

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Issue 1
Jan 2018

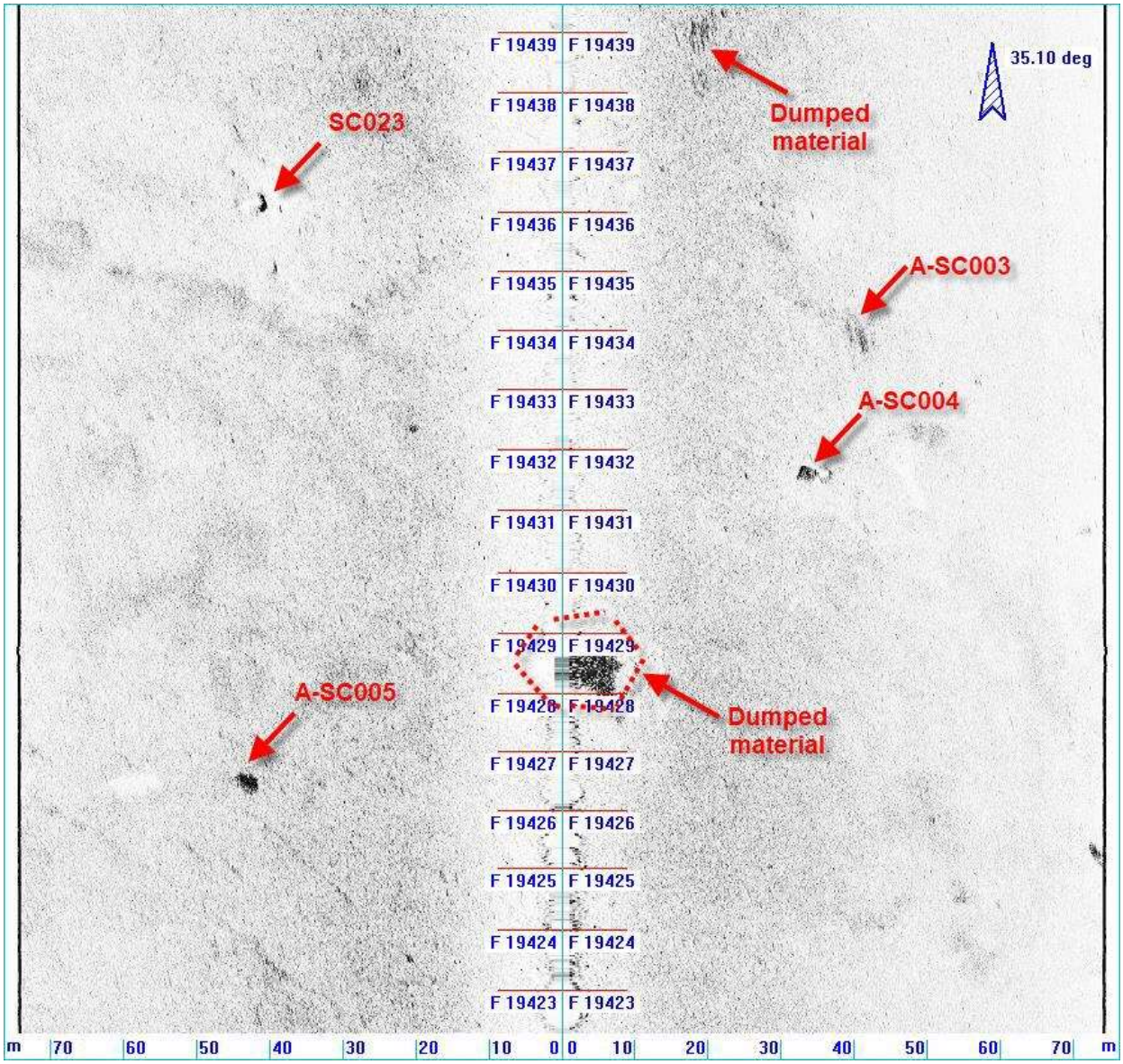
Revision History

Issue	Date	Description	Approved by	Remarks
1	17 January 2018	First Issue	K. Yamaguchi	

APPENDIX A

Copies of Side Scan Sonar Data Showing Unidentified Objects

A-SC005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F 19423 F 19423
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A-SC003
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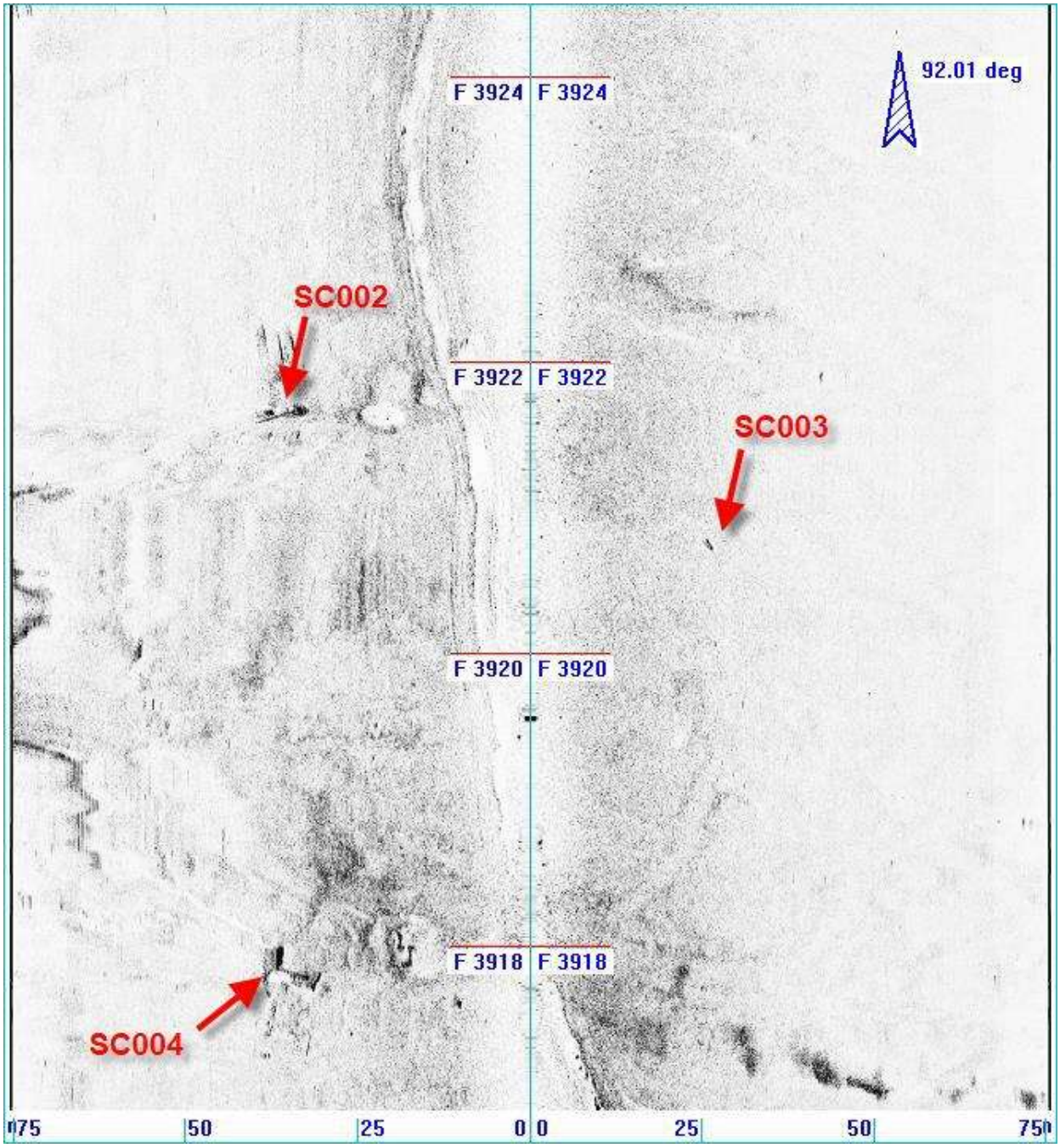
SC003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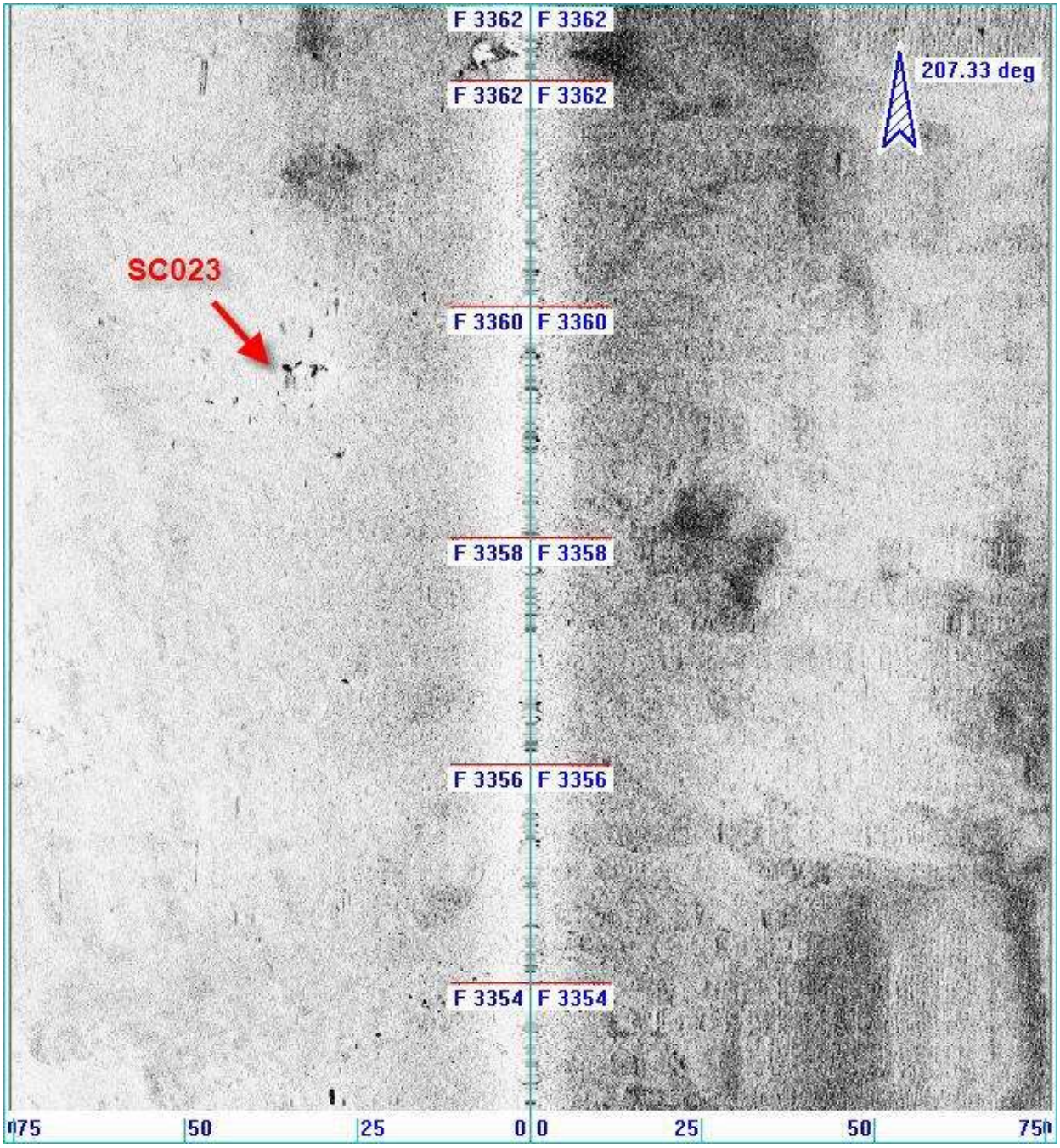
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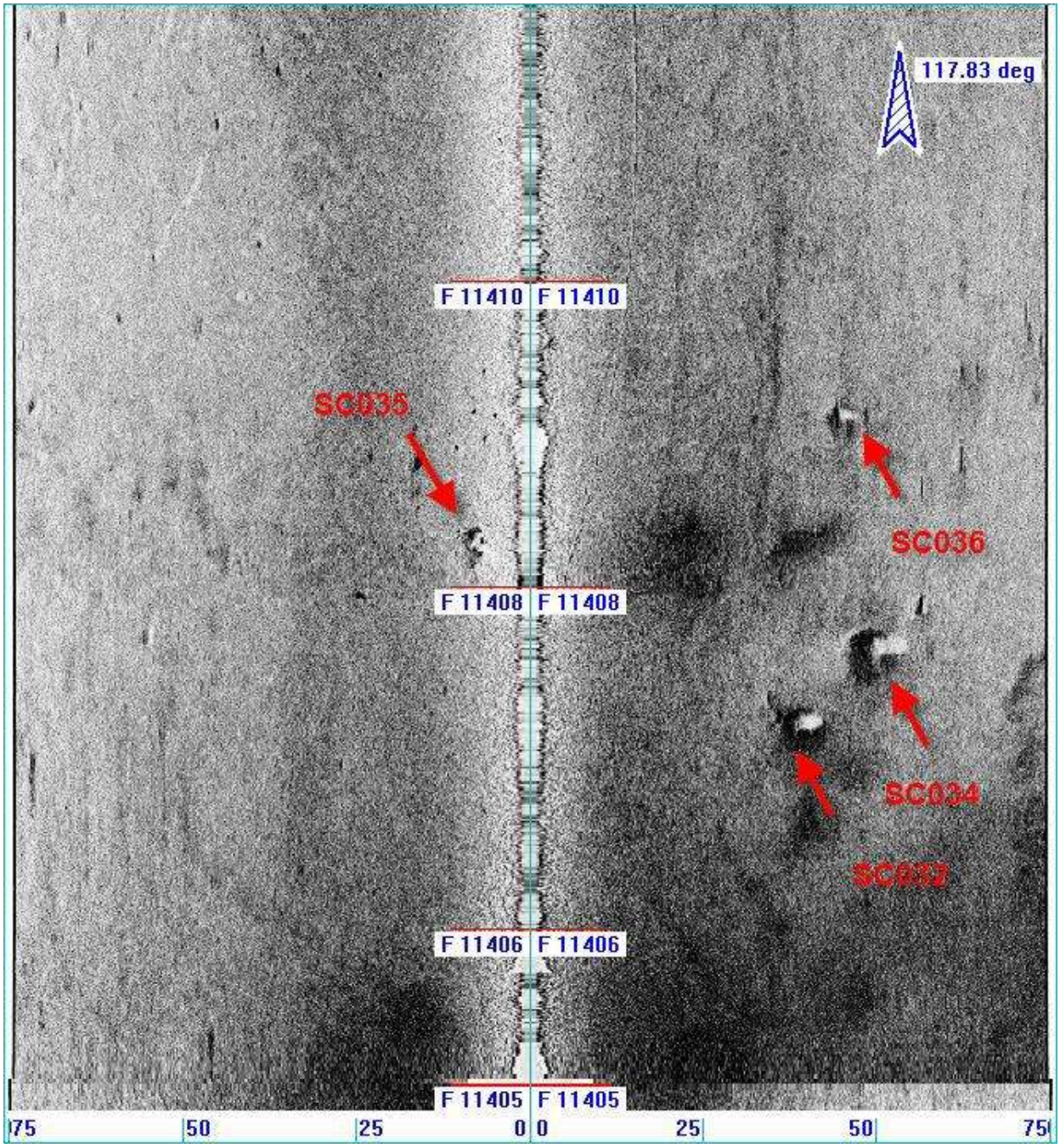
SC032-SC034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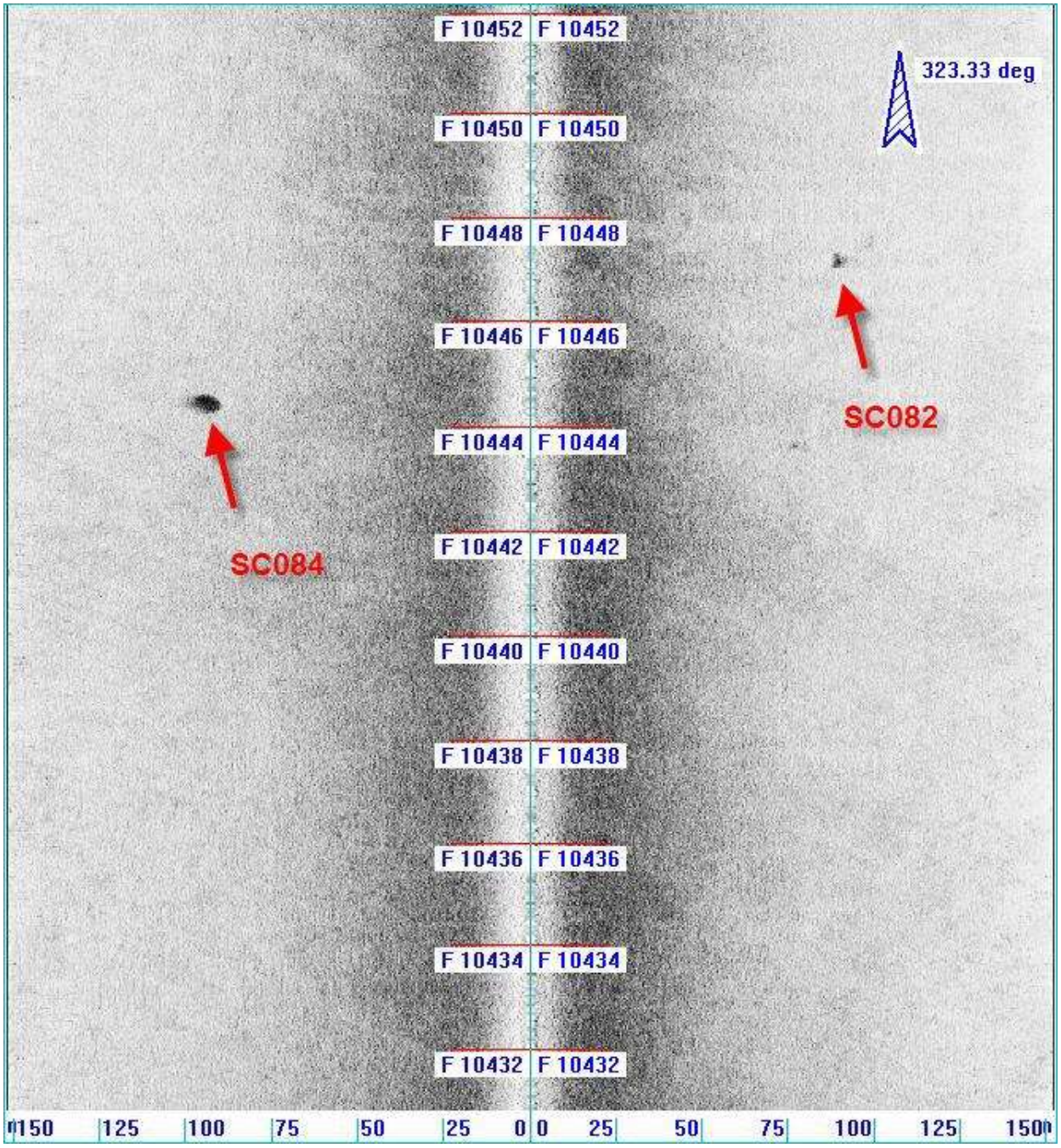
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APPENDIX B

Copies of Magnetic Data Presentation

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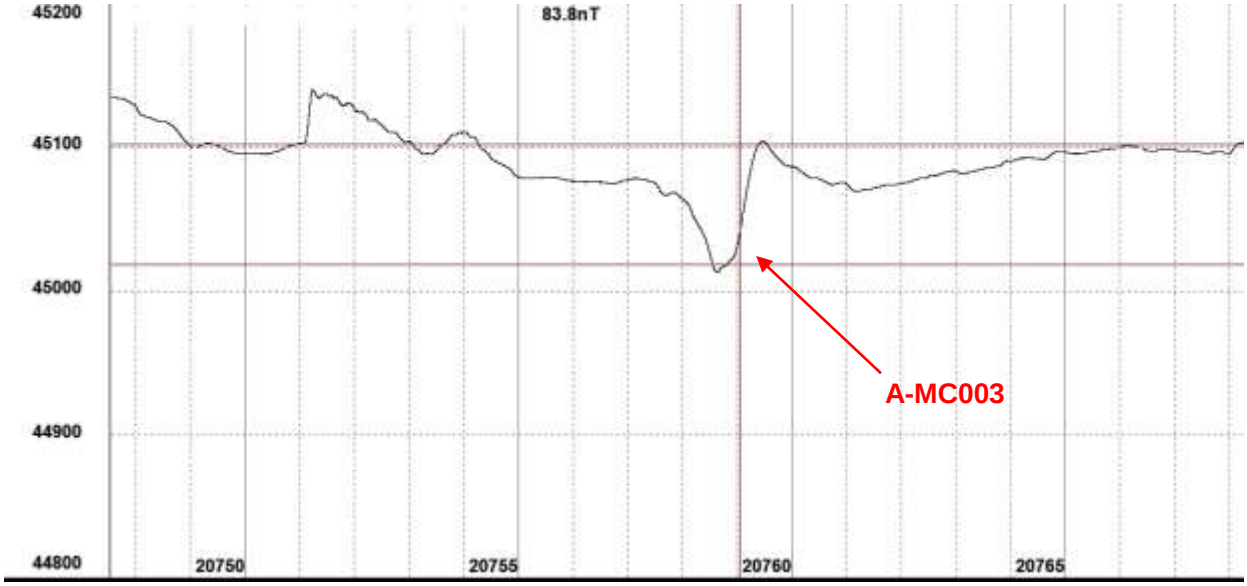

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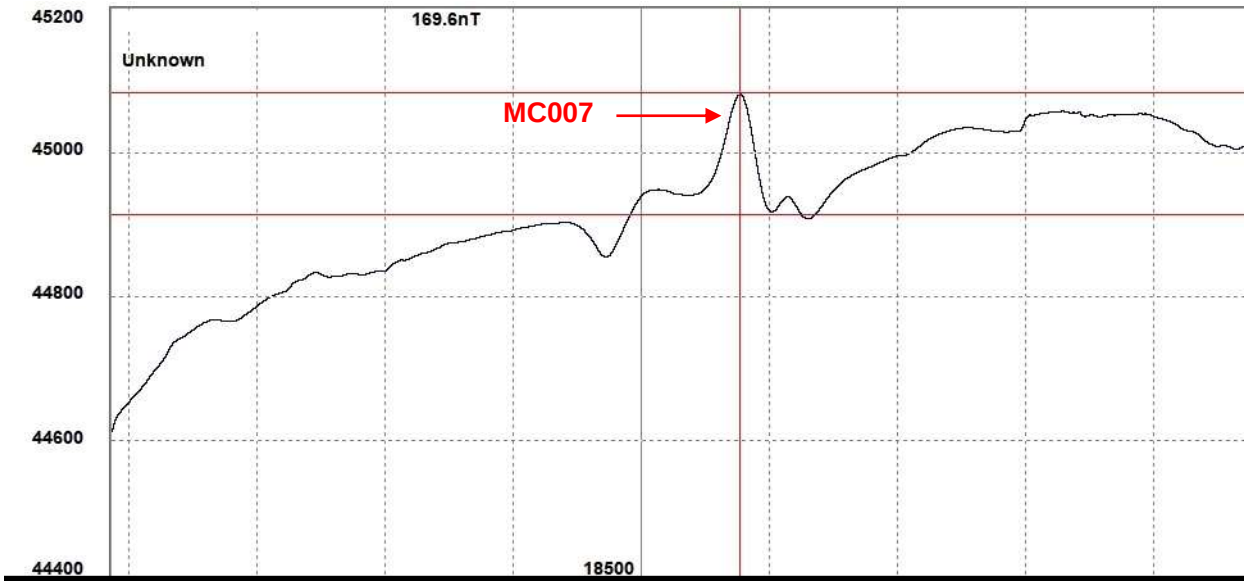

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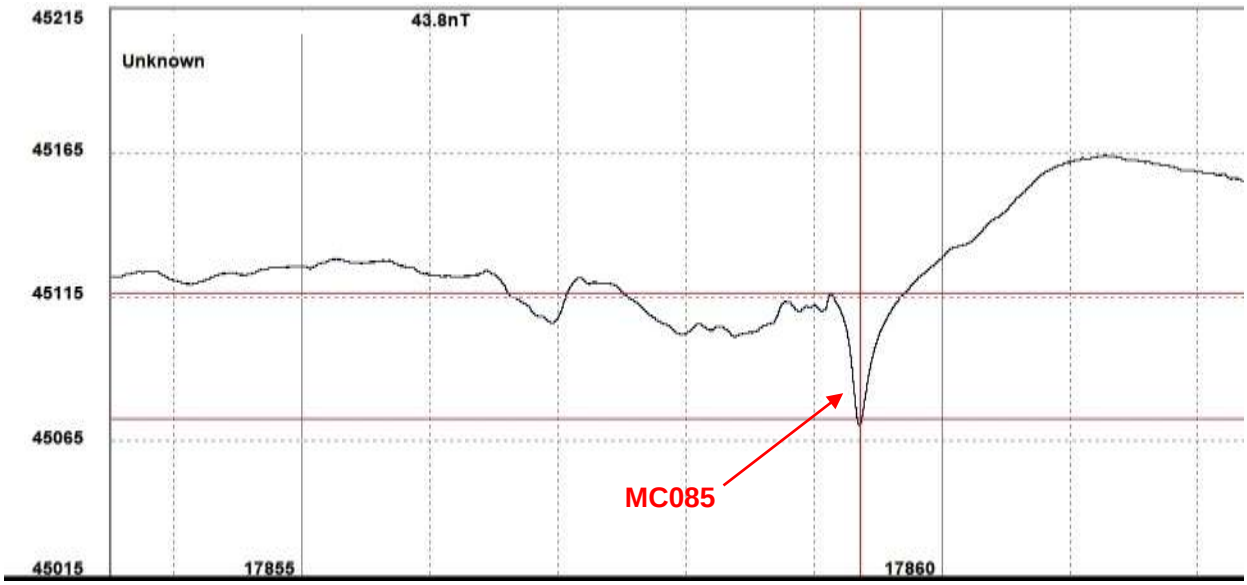
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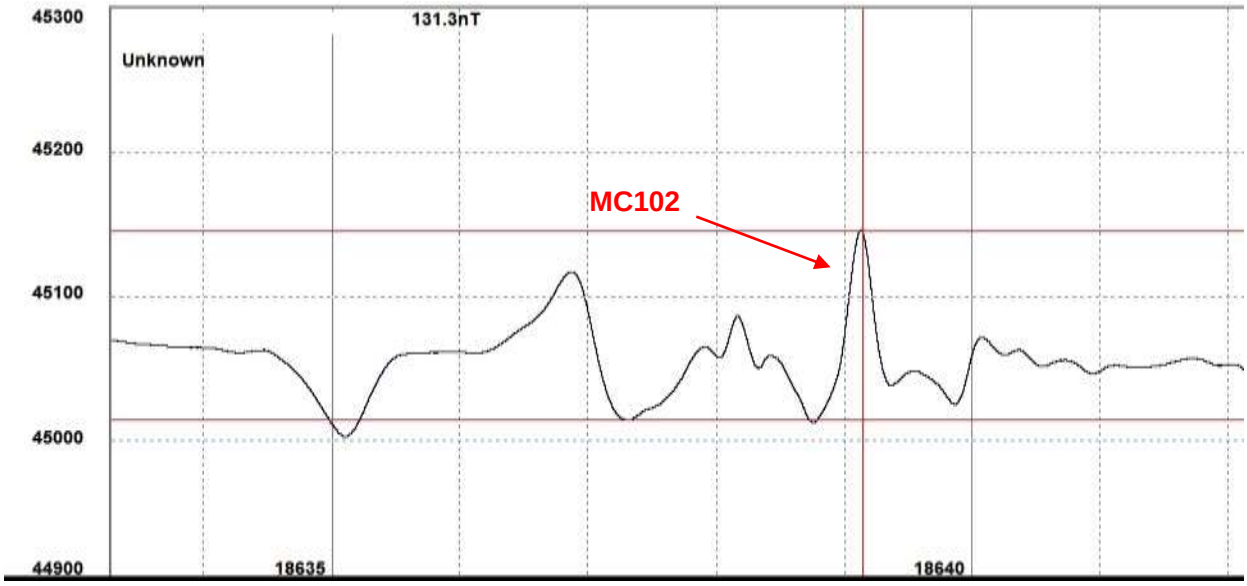
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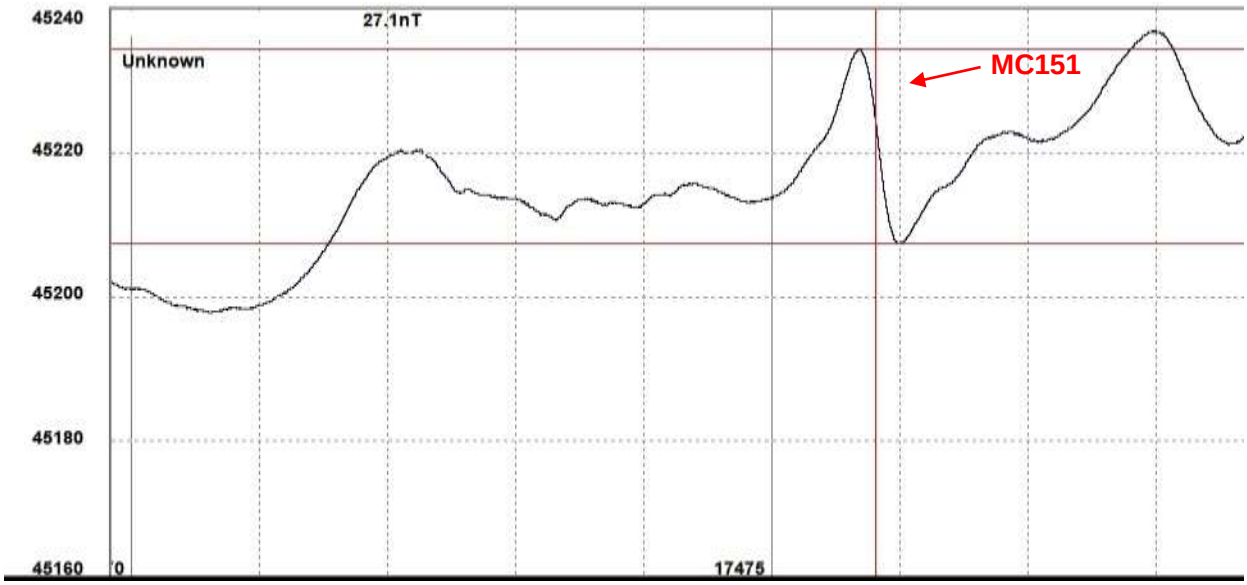
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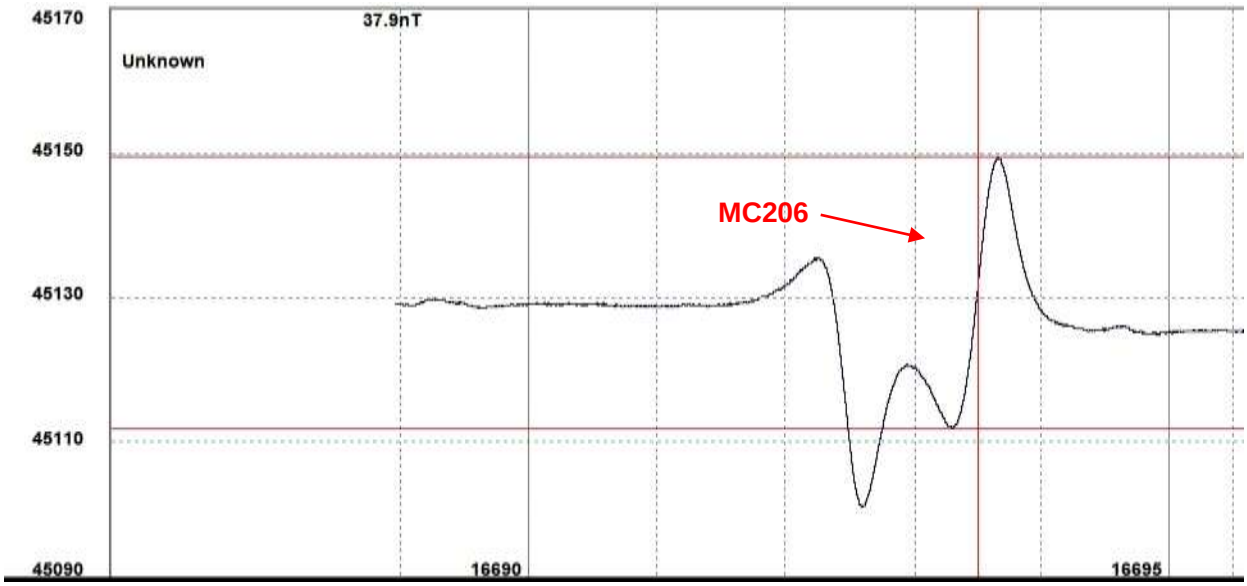
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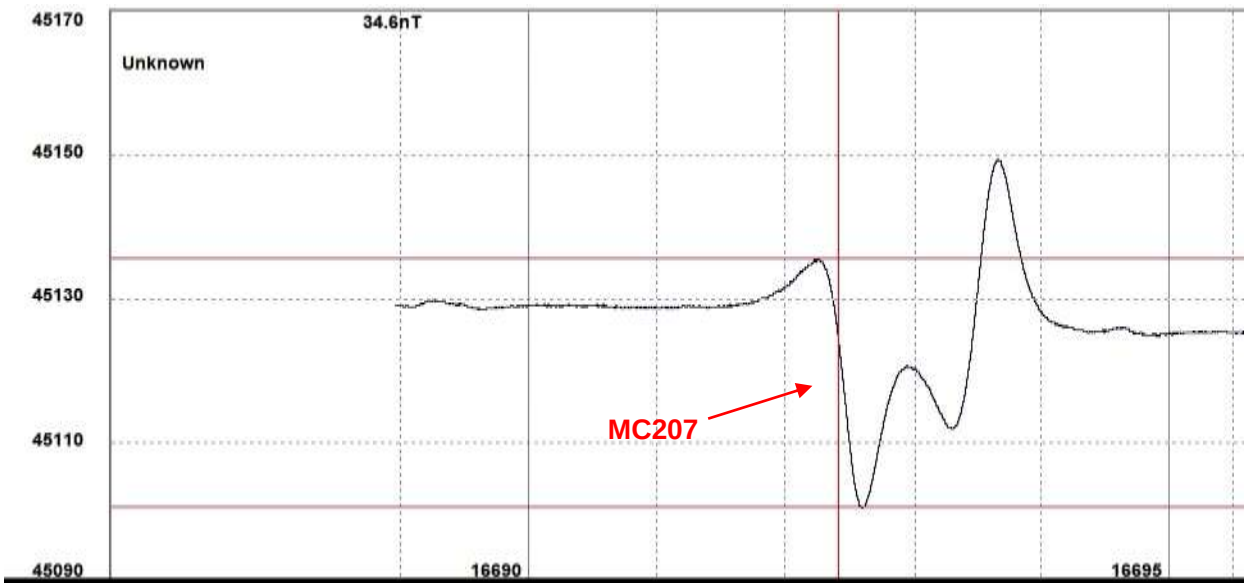
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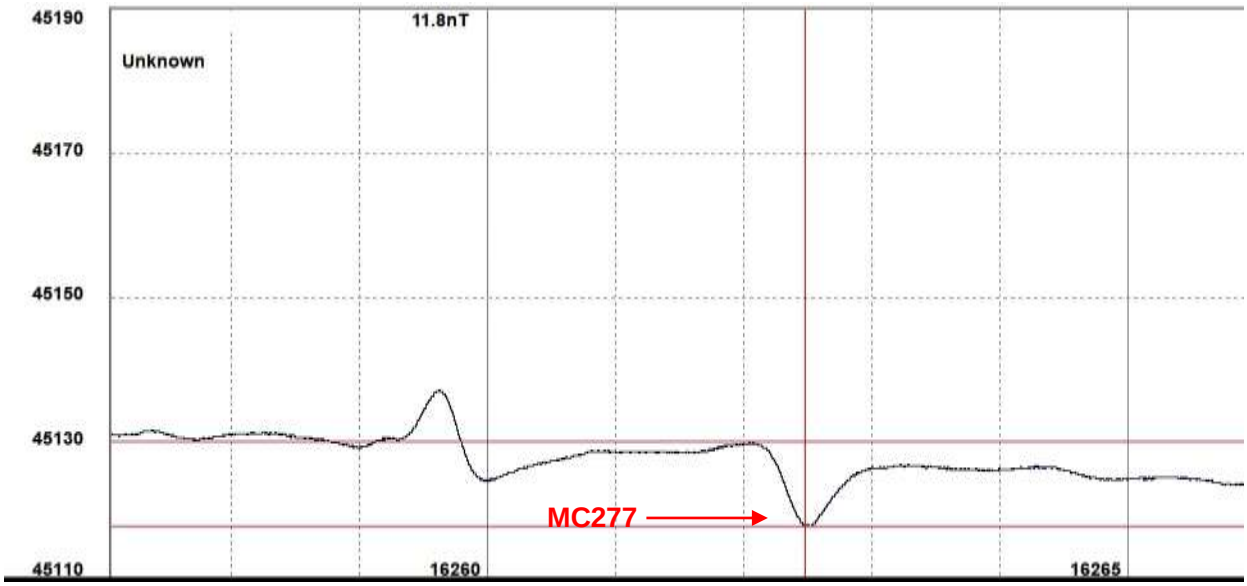
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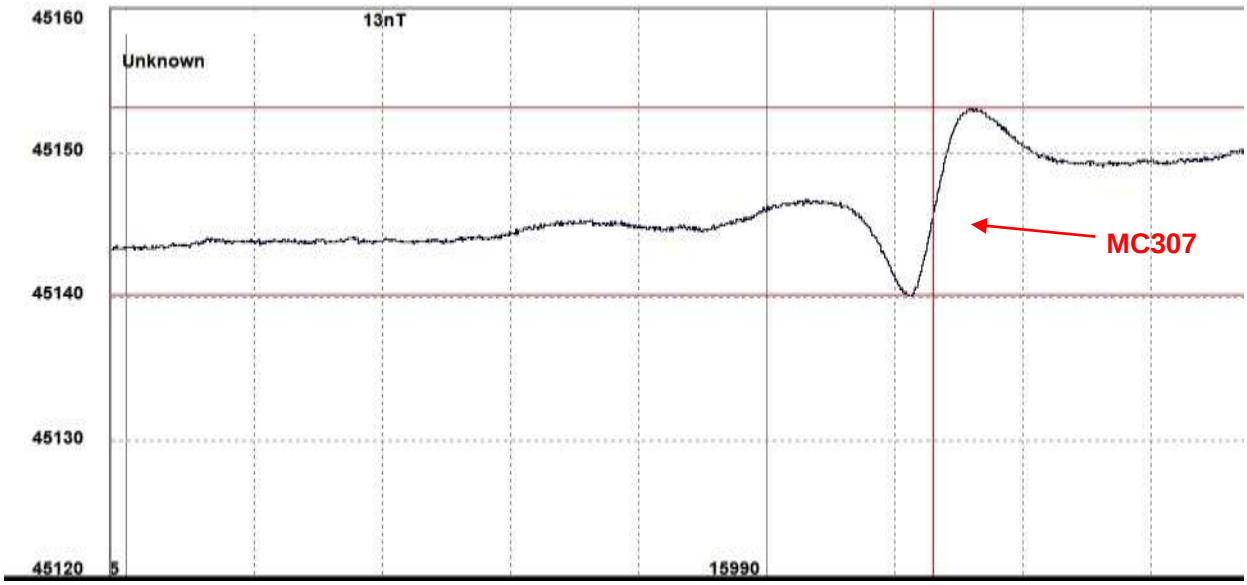

ANNEX E

Environmental Monitoring and Audit

CONTENTS

E ENVIRONMENTAL MONITORING AND AUDIT E-1

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E.4 Water Quality Monitoring E-3
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E.6 Reporting E-9

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Figure E-2 Water Quality Monitoring Stations in Zone A
Figure E-3 Water Quality Monitoring Station in Zone B

E ENVIRONMENTAL MONITORING AND AUDIT

E.1 Introduction

E.1.1 This Annex specifies the requirements of the Environmental Monitoring and Audit (EM&A) for the Project. Overall, the proposed EM&A programme allows for:

- Verification of the predictions in the Water Quality Assessment (***Annex A***) that the installation of the HK-G Cable will not result in unacceptable impacts on water quality (and thereby also on ecological resources dependent upon water quality) along the cable alignment.
- Ensure that the installation of the HK-G Cable is conducted in a careful manner and that appropriate action is undertaken promptly in the event that impacts are identified to sensitive receivers and are found to be caused by the cable installation works.

E.2 Environmental Team

E.2.1 The Permit Holder shall engage an Environmental Team (ET) to implement the EM&A programme in this Annex. The ET shall be led by an ET Leader who has at least 7 years of experience in EM&A or environmental management, and shall have suitably qualified staff included in the ET.

E.2.2 The ET and ET Leader shall not be in any way an associated body of the Project Proponent, any of its contractors, or the Independent Environmental Checker (IEC)/Independent Consultant (IC).

E.2.3 The ET and ET Leader shall implement the EM&A programme and shall comply with the Project's environmental performance requirements during cable installation. The ET shall:

- Carry out sampling, analysis and statistical evaluation of monitoring parameters
- Audit compliance with environmental protection, and pollution prevention and control regulations
- Monitor the implementation of environmental mitigation measures
- Monitor compliance with Conditions in the Environmental Permit
- Review the cable installation programme and comment, as necessary
- Review the construction methodology and comment, as necessary
- Prepare and update the EM&A works schedule with reference to the best available cable installation programme
- Investigate non-compliant events, evaluate and identify corrective measures
- Liaise with IEC/IC on all environmental performance matters
- Advise the Project Proponent and its contractors on environment improvement, awareness, enhancement matters, etc.
- Timely submission of the EM&A report to the IEC/IC for verification and thereafter to the EIAO Register Office, as required

E.3 Independent Environmental Checker/Independent Consultant

E.3.1 Prior to commencement of cable laying works, the Permit Holder shall engage an IEC/IC to advise on environmental issues related to the Project. The IEC/IC shall have at least 7 years of experience in EM&A or environmental management, and shall have suitably qualified staff included in the IEC/IC team.

E.3.2 The IEC/IC shall not be in any way an associated body of the Project Proponent, any of its contractors, or the ET.

E.3.3 The IEC/IC shall audit the overall EM&A programme including the implementation of all environmental mitigation measures, submissions relating to EM&A, and any other submission required under this Project Profile.

E.3.4 The IEC/IC shall ensure that baseline and impact monitoring is conducted by the ET according to the prescribed schedule at the correct locations.

E.3.5 The main duty of the IEC/IC is to carry out environmental audit of the installation of the cable, including the following:

- Review and audit all aspects of the EM&A programme
- Validate and confirm the accuracy of monitoring results, monitoring equipment, monitoring locations, monitoring procedures and locations of sensitive receivers
- Carry out random sample check and audit on monitoring data and sampling procedures, etc.
- Audit the recommendations and requirements in Project Profile against the status of implementation of environmental protection measures on site
- Review the effectiveness of environmental mitigation measures and Project environmental performance
- On an as needed basis, audit the construction methodology of the Project Proponent and its contractor and agree the least impact alternative in consultation with the ET Leader
- Investigate complaint cases and check the effectiveness of corrective measures
- Review accuracy of environmental monitoring section of EM&A reports
- Verify EM&A reports submitted by the ET Leader
- Feedback audit results to ET by signing off relevant EM&A proformas
- Prepare a monthly report to the Authority (in letter format) summarising the above

E.4 Water Quality Monitoring

Parameters Measured

Baseline Monitoring and Impact Monitoring

E.4.1 The parameters to be measured in situ are:

- Dissolved oxygen (DO) (% saturation and mg/L)
- Temperature (°C)
- Turbidity (NTU)

E.4.2 The only parameter to be measured in the laboratory is:

- Suspended Solids (SS) (mg/L)

E.4.3 In addition to the water quality parameters, other relevant data shall also be measured and recorded in field logs, including the location of the sampling stations and cable burial tool at the time of sampling, water depth, time, weather conditions such as wind direction and speed, sea conditions, tidal state, special phenomena and work activities undertaken around the monitoring and works area that may influence the monitoring results.

Silt Curtain Monitoring

E.4.4 The parameter to be measured in situ is:

- Turbidity (NTU)

Equipment

E.4.5 The following equipment shall be supplied by the ET and shall be approved by the IEC/IC:

- **Dissolved Oxygen and Temperature Measuring Equipment.** The instrument shall be a portable, weatherproof dissolved oxygen measuring instrument complete with cable, sensor, comprehensive operation manuals, and shall be operable from a DC power source. It shall be capable of measuring: dissolved oxygen levels in the range of 0 – 20 mg/L and 0-200% saturation; and a temperature of 0-45^{o}Celsius. It shall have a membrane electrode with automatic temperature compensation complete with a cable of not less than 35m 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 turbidimeter should be used to measure the turbidity level in Nephelometric Turbidity Units (NTUs).
- **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.

- **Positioning Device.** A Global Positioning System (GPS) shall be used to ensure the accurate recording of the position of the monitoring vessel before taking measurements. The use of GPS 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 2L, which can be effectively sealed with cups at both ends, shall be used (Kahlsico Water Sampler 13SWB203 or an approved similar instrument). The water sampler shall have a positive latching system to keep it open and prevent premature closure until released by a messenger when the sampler is at the selected water depth.

Sampling / Testing Protocols

E.4.6 All in situ monitoring instruments shall be checked, calibrated and certified before use by a laboratory accredited under HOKLAS or other international accreditation scheme. All in situ monitoring instruments shall be 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.

E.4.7 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.

E.4.8 Water samples for SS measurements shall be collected in high density polythene bottles, packed in ice (cooled to 4^{o}C without being frozen), and delivered to a HOKLAS laboratory as soon as possible after collection. At least two replicate samples should be collected from each of the monitoring events for in situ measurement and lab analysis.

Laboratory Analysis

E.4.9 All laboratory work shall be carried out in a HOKLAS accredited laboratory. Water samples of about 1,000mL shall be collected at the monitoring and control stations for carrying out the laboratory determinations. The determination work shall start within the next working day after collection of the water samples. The laboratory measurements shall be provided within two days of the sampling event (48 hours).

E.4.10 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 used, 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 other internationally accredited scheme.

Monitoring Locations

Baseline Monitoring and Impact Monitoring

E.4.11 Based on the findings of the water quality assessment in ***Annex A***, a total of six monitoring locations are proposed at Water Sensitive Receivers (WSRs) within 500m of the cable alignment.

E.4.12 Water quality sampling in these locations will be conducted prior to cable laying (Baseline Monitoring), during cable laying (Impact Monitoring) and, if needed, after cable laying (Post-Project Monitoring) to document any impact of the installation works on the WSRs.

E.4.13 The proposed sampling locations are as follows, and are also shown on ***Figures E-1 to E-3*** (designations follow the WSR IDs in ***Annex A***):

- **C1** is a monitoring station to identify the impact of cable installation works on the coral communities at Ngan Wan (Cape Collinson)
- **C4** is a monitoring station to identify the impact of cable installation works on the coral communities at Fat Tau Chau
- **C9** is a monitoring station to identify the impact of cable installation works on the coral communities at Tai Long Pai
- **W1** is a monitoring station to identify the impact of cable installation works on the WSD Siu Sai Wan Seawater Intake.
- **F1** is a monitoring station to identify the impact of cable installation works on the Tung Lung Chau FCZ (representative location within 500m of the cable alignment)
- **F3** is a monitoring station to identify the impact of cable installation works on the Fish Spawning Grounds (representative location)

E.4.14 Indicative co-ordinates of these monitoring stations are listed in ***Table E-1***. Exact co-ordinates will be determined before commencement of Baseline Monitoring.

Table E-1 Co-ordinates of the Water Quality Monitoring Stations (HK Grid)

Station	Location	Easting	Northing
C1	Coral communities at Ngan Wan (Cape Collinson)	844564.9	813355.7
C4	Coral communities at the coast of Fat Tau Chau	845157.8	814903.5
C9	Coral communities at the coast of Tai Long Pai	845322.1	810822.3
W1	WSD Siu Sai Wan Seawater Intake	844094.4	814360.3
F1	Tung Lung Chau FCZ	845167.5	812577.6
F3	Fish Spawning Grounds	847320.7	809036.1

Silt Curtain Monitoring

E.4.15 Water quality monitoring “inside” and “outside” of the silt curtain will be undertaken between Ch.0.7km and Ch.1.1km (in proximity to west of Fat Tau Chau) and between Ch.2.4km and Ch.2.9km (in proximity to south of Cape Collison and north of Ngan Wan). The “inside” and “outside” monitoring locations are shown on ***Figure E-2***.

Frequency and Duration

Baseline Monitoring

E.4.16 Baseline monitoring shall be carried out for four weeks and shall commence no later than six weeks before the start of cable installation works. Two weeks prior to commencement of baseline monitoring, the ET shall propose a monitoring schedule to the IEC/IC for agreement and then shall submit the agreed schedule to EPD at least one week before baseline monitoring starts.

E.4.17 Monitoring shall be carried out three times each week and the interval between any two sets of monitoring shall not be less than 36 hours. For each set, monitoring shall be undertaken within a 4 hour window of 2 hours before and 2 hours after mid-flood and mid-ebb tides.

E.4.18 At each tide at each location, in situ measurement and samples shall be taken as follows:

- For stations with a water depth of 6m or greater, monitoring shall be carried out at three depths: 1m below the sea surface; mid-depth; and 1m above the seabed
- For stations with a water depth of between 3m and 6m, monitoring shall be carried out at two depths: 1m below the sea surface and 1m above the seabed
- For stations with a water depth of less than 3m, monitoring shall be carried out at one depth: the mid-depth

Impact Monitoring

E.4.19 Due to the length of the cable in Hong Kong Waters, the impact monitoring stations are divided into two zones to effectively and efficiently monitor the water quality, as shown in ***Figure E-1***. Monitoring shall be carried out section by section:

- **Zone A.** Monitoring at stations C1, C4, F1 and W1 shall be conducted when the cable laying works are within the boundary of Zone A, as shown in ***Figure E-2***
- **Zone B.** Monitoring at station C9, F1 and F3 shall be conducted when cable laying works are within the boundary of Zone B, as shown in ***Figure E-3***

E.4.20 Monitoring shall be required in the relevant Zone when cable laying works are being carried out in that Zone. Monitoring shall not be required when the cable-laying barge is outside Zones A or B, or when no cable laying works are conducted. Two weeks prior to the commencement of impact monitoring, the ET shall propose a monitoring schedule to the IEC/IC for agreement and then shall submit the agreed schedule to EPD at least one week before impact monitoring starts.

E.4.21 Monitoring shall be carried out three times each week and the interval between any two sets of monitoring shall not be less than 36 hours. For each set, monitoring shall be undertaken within a 4 hour window of 2 hours before and 2 hours after mid-flood and mid-ebb tides.

E.4.22 At each tide at each location, in situ measurement and samples shall be taken as follows:

- For stations with a water depth of 6m or greater, monitoring shall be carried out at three depths: 1m below the sea surface; mid-depth; and 1m above the seabed
- For stations with a water depth of between 3m and 6m, monitoring shall be carried out at two depths: 1m below the sea surface and 1m above the seabed
- For stations with a water depth of less than 3m, monitoring shall be carried out at one depth: the mid-depth

Silt Curtain Monitoring

E.4.23 Water quality monitoring "inside" and "outside" of the silt curtain shall be carried out on an hourly basis when the cable burial tool is operating between Ch.0.7km and Ch.1.1km, and between Ch.2.4km and Ch.2.9km in order to provide near-real time results so that prompt action can be taken if needed.

E.4.24 One water sample shall be taken from the "inside" of the silt curtain and one from the "outside" of the silt curtain using the water sampling equipment listed in the last bullet of ***Section E.4.5***. Each sample shall be taken 1m above the seabed. These water samples will be analysed by the ET for turbidity (in NTU) using a turbidimeter to determine real-time suspended solids readings (in mg/L) based on the relationship established between turbidity and suspended solids in the Baseline Monitoring Report.

Post-Project Monitoring

E.4.25 The need for post-project monitoring shall be proposed by the ET Leader and shall be agreed by the IEC/IC. The need for post-project monitoring shall depend upon the results of the impact monitoring: Only if the results show consistent exceedances of Action and/or Limit Levels attributable to the Project shall post-project monitoring shall be carried out to demonstrate that environmental conditions have returned to pre-Project (i.e. baseline) values.

E.4.26 If needed, post-project monitoring at each of the six monitoring stations shall commence no later than three weeks after the end of cable installation works. The duration of post-Project monitoring shall be two weeks. Two weeks prior to the commencement of post-Project monitoring, the ET shall propose a monitoring schedule to the IEC/IC for agreement and then shall submit the agreed schedule to EPD at least one week before post-Project monitoring starts.

E.4.27 Monitoring shall be carried out three times each week and the interval between any two sets of monitoring shall not be less than 36 hours. For each set, monitoring shall be undertaken within a 4 hour window of 2 hours before and 2 hours after mid-flood and mid-ebb tides.

E.4.28 At each tide at each location, in situ measurement and samples shall be taken as follows:

- For stations with a water depth of 6m or greater, monitoring shall be carried out at three depths: 1m below the sea surface; mid-depth; and 1m above the seabed
- For stations with a water depth of between 3m and 6m, monitoring shall be carried out at two depths: 1m below the sea surface and 1m above the seabed
- For stations with a water depth of less than 3m, monitoring shall be carried out at one depth: the mid-depth

Action and Limit Levels and Event/Action Plan for Impact Monitoring

E.4.29 Impact monitoring results shall be evaluated against Action and Limit levels shown in ***Table E-2***, with action being taken as per the Event/Action Plan shown in ***Table E-3***. Please note that the Event/Action Plan relates only to exceedances that are directly attributable to the cable installation works, over which the installation contractor has control. The advice of the IEC/IC shall be sought in case of any concern.

Table E-2 Action and Limit Levels for Water Quality

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

Table E-3 Event / Action Plan for Water Quality

Event	Contractor
Action Level Exceedance	1. Repeat sampling event 2. Inform EPD and AFCD and confirm notification of the non-compliance in writing 3. Discuss with cable installation contractor and the IEC/IC the most appropriate method of reducing suspended solids during cable installation 4. Repeat measurements after implementation of mitigation for confirmation of compliance 5. If non-compliance continues, increase measures in Step 3 and repeat measurement in Step 4. If non-compliance occurs a third time, suspend cable laying operations and continue sampling until normal water quality resume.
Limit Level Exceedance	Undertake Steps 1-4 immediately, if further non-compliance continues at the Limit Level, suspend cable laying operations until an effective solution is identified

Silt Curtain Monitoring

E.4.30 The results of water quality monitoring “inside” and “outside” of the silt curtain in terms of suspended solids in mg/L shall be used for reference and shall be reviewed in near-real time by the ET.

E.4.31 If an increase in suspended solids is noticed “outside” the silt curtain compared to “inside” the silt curtain, then additional water quality control measures should be implemented. These will be determined by the ET as required, but may include decreasing the speed of cable installation barge, halting the burial works temporarily, increasing monitoring frequency, applying an additional layer of silt curtain, etc. until conditions return to normal.

E.4.32 Advice of the IEC/IC shall be sought in case of any concerns.

E.5 Marine Mammal Observation

E.5.1 Noise generated by cable laying works is not likely to have significant adverse impact on marine mammals, as assessed in ***Annex B***, since the noise level generated by the jetting works would fall below the hearing ranges of most marine mammals present in Hong Kong waters. As a precautionary measure, when cable laying is being carried out in south-eastern waters, a marine mammal exclusion zone will be implemented to mitigate and thereby minimize potential impacts on Finless Porpoises.

E.5.2 A marine mammal exclusion zone within a radius of 250m from the cable installation barge will be set up during the cable laying works in day-time hours. It begins when the installation barge moves to the east of Shek O Headland, continues on a daily basis as the barge heads eastwards and extend to the boundary of HKSAR along the cable alignment.

E.5.3 The observation shall be undertaken by a qualified observer, who shall be suitably trained to conduct the observation work, and whose curriculum vitae shall be provided to AFCD prior to the commencement of the observation.

E.5.4 Before the installation work starts, the qualified observer will stand on the open upper decks of the barge and scan the 250m exclusion zone for at least 30 minutes. If cetaceans are observed in the exclusion zone, cable installation works shall be halted until they have left the area. This measure guarantees that the area in vicinity of the cable route is clear of marine mammals before the installation works start and thus could reduce potential disturbance to marine mammals. Should cetacean(s) move into the exclusion zone during cable installation, it is considered that they have acclimatised to the works and therefore suspension of cable installation is not required.

E.6 Reporting

ET's Baseline Monitoring Report

E.6.1 Within two weeks of completion of baseline monitoring, a *Baseline Monitoring Report* shall be prepared by the ET. This shall include details of the monitoring carried out, such as location, weather conditions, parameters measured, monitoring results and discussion, etc. and any recommendations for subsequent monitoring.

E.6.2 The *Baseline Monitoring Report* shall be certified by the ET and verified by the IEC/IC, and thereafter submitted to the EIAO Register Office at least two weeks before start of cable installation. The Baseline Monitoring Report shall include the following:

- Brief project background information
- Drawings showing locations of the baseline monitoring stations
- An updated cable installation programme
- Monitoring results together with the information including monitoring methodology, parameters monitored, monitoring locations (with depth), monitoring date, time, frequency and duration
- Details on influencing factors, including major activities concerning the Project, if any, being carried out during the period, weather conditions during the period and other factors which might affect the results

- Determination of Action and Limit Levels for each monitoring parameter and statistical analysis of baseline data to determine if there is any significant difference between control and impact stations for the parameters monitored

ET's Monthly Impact Monitoring Report

E.6.3 During cable installation works, a *Monthly Impact Monitoring Report* shall be prepared by the ET detailing the EM&A carried out during that month. The *Monthly Impact Monitoring Report* shall be shall be certified by the ET and verified by the IEC/IC, and thereafter submitted to the EIAO Register Office within the first ten working days of the following month. The *Monthly Impact Monitoring Report* shall include the following:

- Basic project information
- Summary of EM&A requirements
- Operating practices of the cable burial tool during sampling and interpretation of monitoring results
- Implementation status
- Monitoring results together with the information including monitoring methodology, parameters monitored, monitoring locations (with depth), monitoring date, time, frequency and duration
- Report on non-compliance, complaints, notifications of summons and successful prosecutions

ET's Post-Project Monitoring Report (if needed)

E.6.4 If post-Project monitoring is needed, within two weeks of completion of monitoring a *Post-Project Monitoring Report* shall be prepared by the ET. The purpose of the *Post-Project Monitoring Report* is to review the environmental status after cable installation and compare with the results presented in the *Baseline Monitoring Report*. The *Post Project Monitoring Report* shall be certified by the ET and verified by the IEC/IC, and thereafter submitted to the EIAO Register Office. The *Post Project Monitoring Report* shall include the following:

- Brief project background information
- Drawings showing locations of the baseline monitoring stations
- The actual cable installation programme
- Monitoring results together with the information including monitoring methodology, parameters monitored, monitoring locations (with depth), monitoring date, time, frequency and duration
- Review of environmental status upon completion of installation by comparison to the baseline monitoring
- Conclusion

IEC/IC's Monthly Report

E.6.5 At the same time that the ET's *Monthly Impact Monitoring Report* (and *Post-Project Monitoring Repor*t, if needed) is submitted, the IEC/IC shall submit a short report (in letter format) to the Authority summarising the results of the IEC/IC's audit and any other observations on the environmental performance of the Project.

Figure E-1 Water Quality Monitoring Stations and Water Quality Monitoring Zones

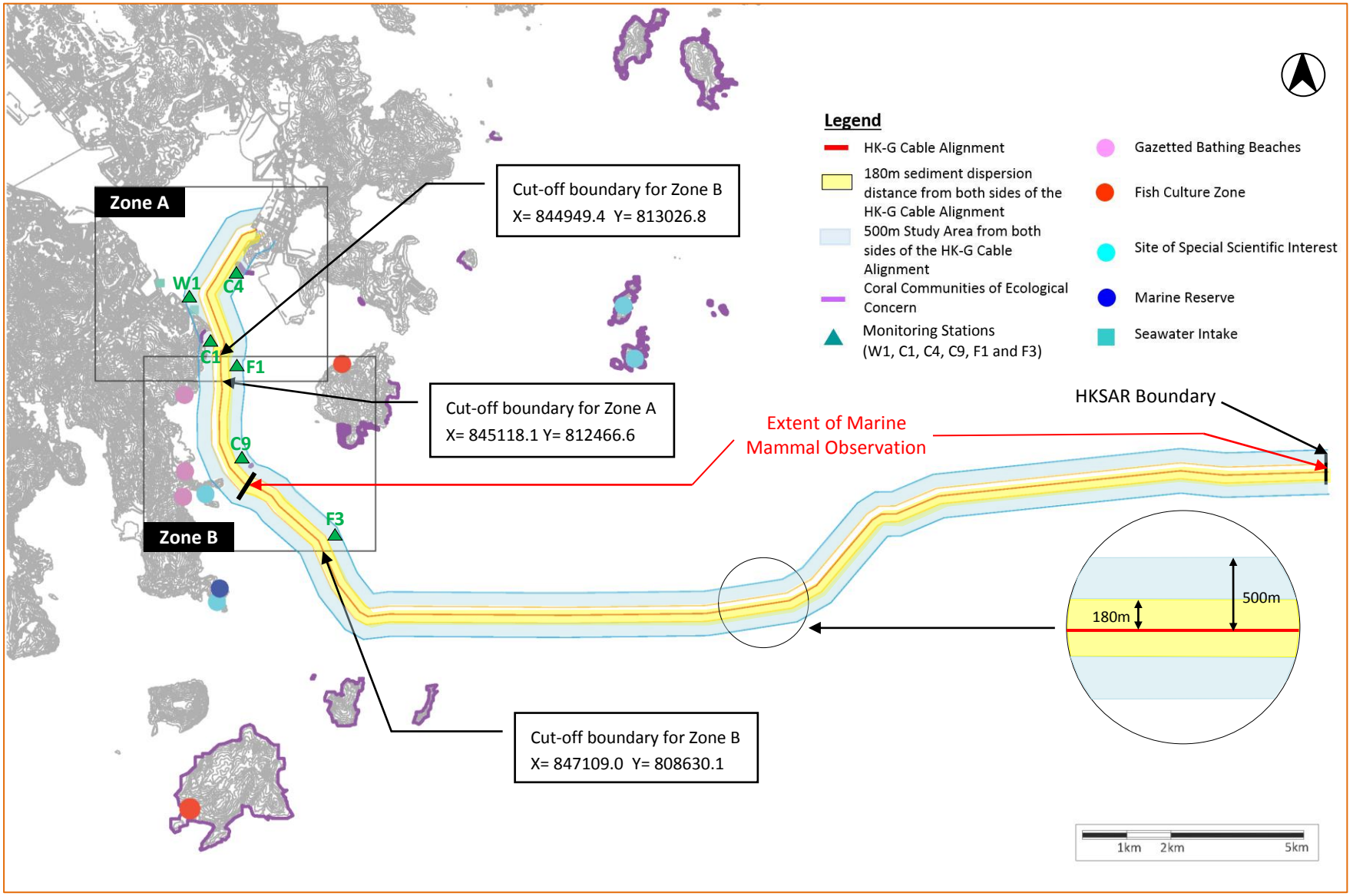

Figure E-2 Water Quality Monitoring Stations in Zone A

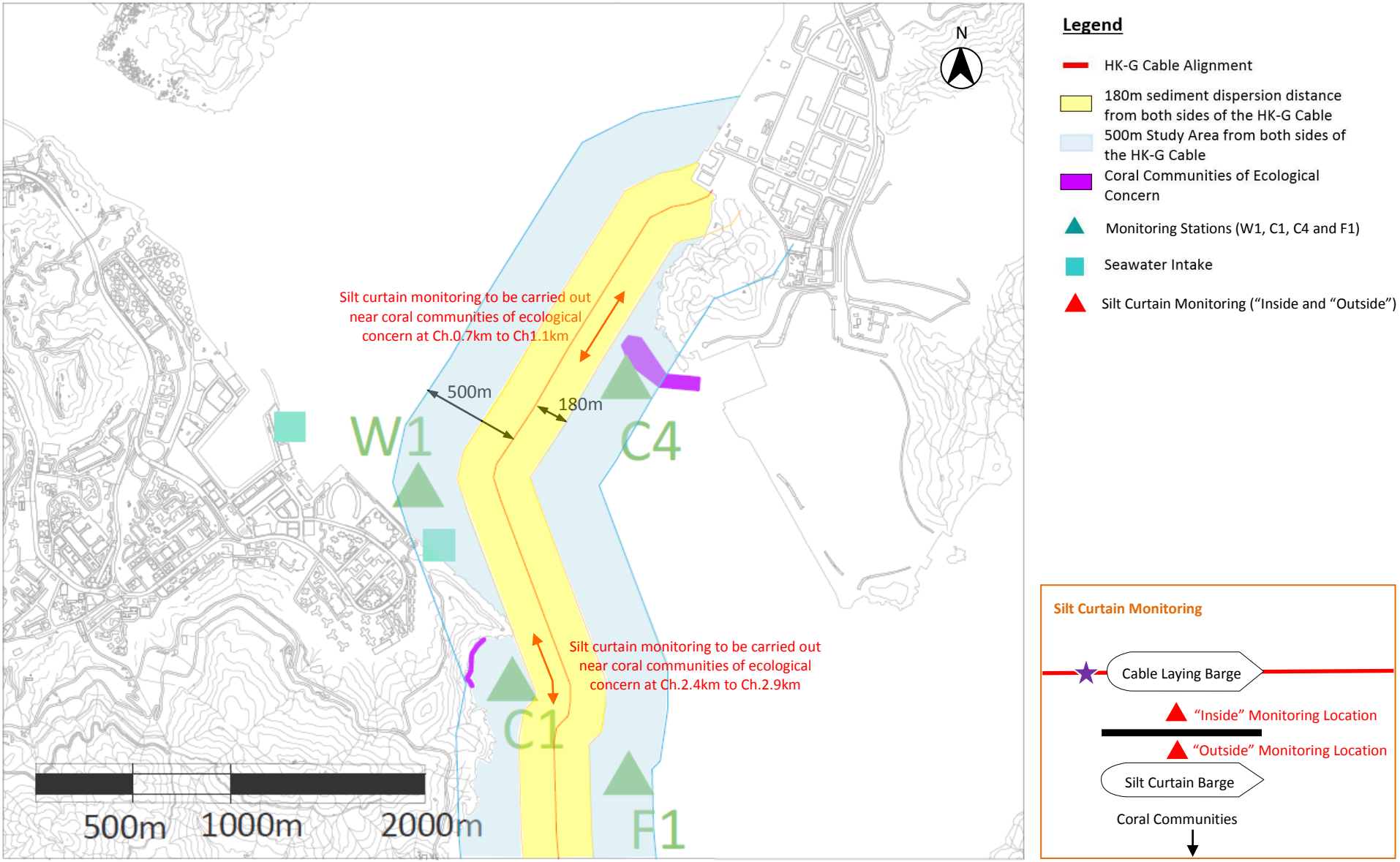
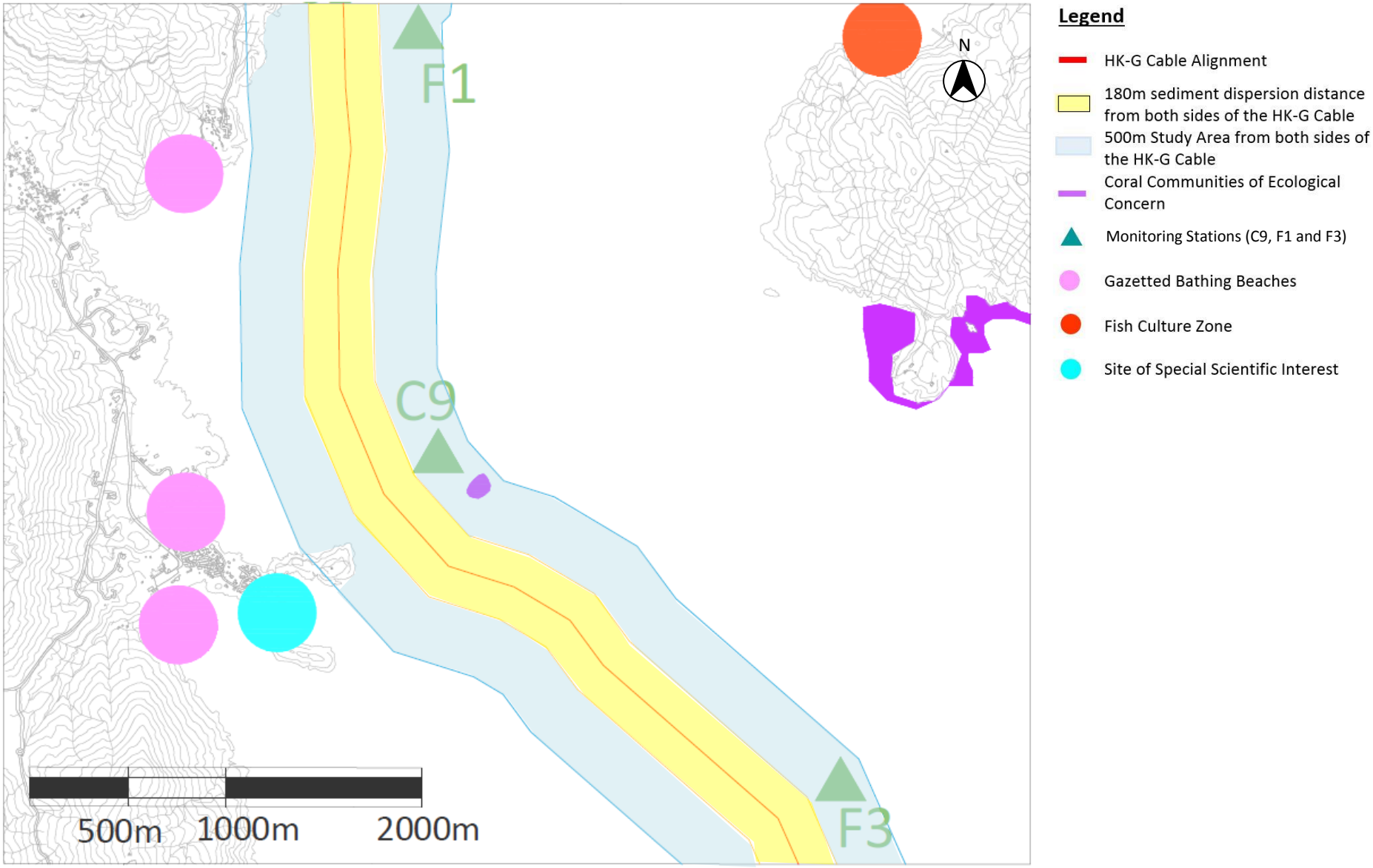
Figure E-3 Water Quality Monitoring Station in Zone B