Appendix 3.7 Marine Ecological Impact Assessment for West Kowloon Terminus Water Cooling System

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Appendix 3.7 Marine Ecological Impact Assessment for West Kowloon Terminus Water Cooling System

Introduction

1.1 This appendix presents the marine ecological impact assessment for the proposed water intake and outfall of the seawater cooling system for the West Kowloon Terminus (WKT) (**Figure no. NOL/ERL/300/C/XRL/ENS/M51/061** refers). Potential impacts arising from the construction and operation of the water cooling system on marine ecological resources were identified and evaluated No significant marine construction work (e.g. dredging, pile driving, etc*)* is anticipated.

1.2 The proposed seawater cooling system is located on developed land with no natural habitats. There will only be a small-scale replacement of the affected vertical seawall. Therefore, no terrestrial ecological issue is considered there.

Environmental Legislation, Standards and Guidelines

1.3 Guidelines, standards, documents and ordinances/regulations listed in the following sections were referred to during the course of the ecological impact assessment.

1.4 Under the *Wild Animals Protection Ordinance* (Cap. 170), designated wild animals are protected from being hunted, whilst their nests and eggs are protected from injury, destruction and removal. All birds and most mammals, including marine cetaceans, are protected under this Ordinance.

1.5 The *Marine Parks Ordinance* (Cap. 476) and Subsidiary Legislation allows for designation, control and management of marine parks and marine reserves through regulation of activities therein to protect, conserve and enhance the marine environment for the purposes of nature conservation, education, scientific research and recreation. The Ordinance came into effect on 1 June 1995. The Authority administering marine parks and reserves is the Country and Marine Parks Authority.

1.6 The amended *Town Planning Ordinance* (Cap. 131) provides for the designation of coastal protection areas, Sites of Special Scientific Interest (SSSIs), Conservation Area, Country Park, Green Belt or other specified uses that promote conservation or protection of the environment. The authority responsible for administering the Town Planning Ordinance is the Town Planning Board.

1.7 Chapter 10 of the Hong Kong Planning Standard and Guidelines (HKPSG) covers planning considerations relevant to conservation. This chapter details the principles of conservation, the conservation of natural landscape and habitats, historic buildings, archaeological sites and other antiquities. It also describes enforcement issues. The appendices list the legislation and administrative controls for conservation, other conservation related measures in Hong Kong and government departments involved in conservation.

1.8 Annex 16 of the TM-EIA sets out the general approach and methodology for assessment of ecological impacts arising from a project or proposal, to allow a complete and objective identification, prediction and evaluation of the potential ecological impacts. Annex 8 recommends the criteria that can be used for evaluating habitat and ecological impact.

1.9 EIAO Guidance Note No. 6/2002 clarifies the requirements of ecological assessments under the EIAO.

1.10 EIAO Guidance Note No. 7/2002 provides general guidelines for conducting ecological baseline surveys in order to fulfill requirements stipulated in the EIAO TM.

1.11 EIAO Guidance Note No. 11/2004 provides the general guidelines for conducting marine ecological baseline survey in order to fulfil the requirements stipulated in the TM in respect of marine ecological assessment for a proposed development.

1.12 The IUCN Red List of Threatened Species provides taxonomic, conservation status and distribution information on taxa that have been evaluated using the IUCN Red List Categories and Criteria. This system is designed to determine the relative risk of extinction, and the main purpose of the IUCN Red List is to catalogue and highlight those taxa that are facing a higher risk of global extinction. The IUCN Red List also includes information on taxa that are either close to meeting the threatened thresholds or that would be threatened were it not for an ongoing taxon-specific conservation programme.

1.13 The Key Protected Wildlife Species List details Category I and Category II protected animal species under the PRC's Wild Animal Protection Law.

Assessment Methodology

1.14 The marine ecological survey and impact assessment was conducted in accordance with the criteria and guidelines in Annex 8 and 16 of the EIAO-TM, EIAO Guidance Note No. 7/2002 – Ecological Baseline Survey for Ecological Assessment and EIAO Guidance Note No. 11/2004 – Methodologies for Marine Ecological Baseline Surveys.

1.15 Existing ecological baseline information was collated and reviewed through a desktop literature review. Representative marine ecological surveys were conducted to fill in information gaps for carrying out necessary impact assessment. The surveys conducted are detailed below (**Section 1.17** to **1.23** refer).

1.16 The study area for marine ecological impact assessment is the same as the water quality impact assessment for WKT seawater cooling system which covers the Victoria Harbour Water Control Zone (WCZ).

Ecological Survey

1.17 Ecological survey program under this assessment is detailed in **Table 1**.

Table 1 Ecological Survey Schedule

Survey Item	Dry Season				Wet Season		
	Dec-08	Jan-09	Feb-09	March-09	Apr-09	May-09	Jun-09
Dive Survey		✓					
Intertidal Survey		✓					✓
Scoping Survey	✓						

Dive Survey

1.18 Dive surveys to record subtidal habitats and species of ecological interest, such as corals, within or close to potentially impacted areas were conducted. The areas were surveyed employing qualitative reconnaissance spot-check dives, and as necessary, followed by quantitative Rapid Ecological Assessment (REA) surveys methodology with reference to DeVantier *et al.* (1998) (see **Annex A** for details).

1.19 Spot-check dives along 4 dive routes (**Figure no. NOL/ERL/300/C/XRL/ENS/M51/061** refers), covered the affected seawall (where seawater intake and outfall are proposed) and its vicinity. The surveys were conducted to record the presence of any corals. Subtidal substrata (hard substratum seabed, seawall, etc.) along the proposed spot-check dive routes were also surveyed for the presence of hard corals (order Scleractinia), octocorals (sub-class Octocorallia), and black corals (order Antipatharia).

1.20 Based on the results of spot-check dives, more detailed surveys along three 100m REA transects were established parallel to the shore (**Figure no. NOL/ERL/300/C/XRL/ENS/M51/061** refers). For each transect, the locations of dive routes, distance surveyed, number of colonies, sizes and types of corals, coverage, abundance, condition, translocation feasibility, and the conservation status of coral species in Hong Kong waters were recorded. Representative photographs of subtidal habitat/species were taken.

Intertidal Survey

1.21 Intertidal survey were conducted at four representative locations (**Figure No. NOL/ERL/300/C/XRL/ENS/M51/061** refers) to establish the ecological profile of existing intertidal communities on the affected artificial seawall and the surrounding area.

1.22 At each survey location, a qualitative or walk-through survey was conducted to identify the intertidal flora and fauna present and their occurrence. The qualitative walk-through survey helps assess whether the sampling exercise in the later quantitative survey collected representative data (e.g. the number and type of species encountered) and whether the sampling effort is adequate. The sampling effort for the walk-through survey included active searching by 4 surveyors for one hour at the site.

1.23 Effort spent in such qualitative or walk-through survey, such as number of surveyors involved and the time spent was also recorded as appropriate.

1.24 Following the qualitative survey, more detailed and quantitative line transect surveys were conducted. At each location, a transect was laid, starting from the high water mark down to low water mark during low tide period (tide below 1 m). Along each transect, a 0.5 m x 0.5 m sampling quadrat was laid at 1 m intervals. Intertidal epifauna and flora within each quadrat were identified and enumerated. Mobile fauna were counted in terms of abundance per unit area. Sessile organisms such as barnacles, oysters, algae and cyanobacteria were estimated in terms of percentage cover per fixed area. Representative photographs of intertidal habitat, flora and fauna species identified were taken.

Ecological Baseline Conditions

Subtidal Community

Soft Bottom Habitat

1.25 The seabed within the Victoria Harbour area is mainly composed of soft bottom sediment with coarse particle size. EPD sediment monitoring results indicated the highly anaerobic sediment due to high organic loading from sewage discharge over the years. Sediment toxicity studies revealed sediments within the Harbour area were usually determined as polluted through ecotoxicity testing using single species or indicator groups (e.g. barnacles, Chan *et al*., 1990; Rainbow and Smith, 1992; Blackmore, 1999; fish, Kwan, 1999; and mussel, Nicholson, 1999).

1.26 There have been numerous studies on benthic fauna assemblage conducted for various EIA studies and researches within the Victoria Harbour. The results of these studies are summarized in the following sections (**Section 1.27** to **1.33**).

1.27 Thompson and Shin (1983) reported that benthic assemblages in the Harbour area were typically of low diversity and abundance, and community structure was largely dictated by organic pollution from sewage discharges in the past. Only a limited number of hypoxia tolerant species could survive the bottom conditions within the study area region, fauna was dominated by opportunists such as bivalves and polychaetes. The dominant polychaetes included *Minuspio cirrifera* and marine organic enrichment indicator species, *Capitella capitata*. These polychaetes are indicators of moderate and severe organic pollution, respectively. The moderately pollution tolerant bivalve

Ruditapes philippinarum (stated as *Tapes philippinarum*) was also found dominant in the benthic infaunal population in the same study (Thompson and Shin, 1983).

1.28 Another field survey of soft bottom benthic organisms at the seabed in the Victoria Harbour near the Central District conducted for *Central Reclamation Phase III EIA Study* (TDD, 1999) indicated that the soft bottom marine environment in Victoria Harbour was polluted and lacked a macroinvertebrate community.

1.29 The field survey carried out for the *Strategic Sewage Disposal Scheme* EIA Study confirmed a very low species diversity and evenness for benthic assemblages in Victoria Harbour and was indicative of stressful environment for benthos (EPD, 2000).

1.30 Benthos samplings at the typhoon shelters at To Kwa Wan, Kwun Tong, and Kai Tak Approach Channel were conducted in the *South East Kowloon Development Comprehensive Feasibility Study EIA Study* (TDD, 2001). Only two species of benthic fauna were found at the To Kwa Wan typhoon shelter, the dominant (>99% of all collected specimens) polychaete (*Capitella capitata*) and a juvenile ocypodid crab (*Macrophthalmus* sp.). The species diversity and evenness were very low (both 0.049). No living organisms were collected from the sampling locations at the Kai Tak Approach Channel and Kwan Tong Typhoon Shelter, indicating very poor habitat quality at these sites (TDD, 2001).

1.31 A recent study on marine benthic communities in Hong Kong showed that coarser sediment benthic groups were found in eastern Victoria Harbour (Stations 53 & 54) as compared to eastern and southern Hong Kong waters, with lower species diversity and evenness resulted (AFCD, 2002). This study showed that the benthic communities in Victoria Harbour were comprised mainly of polychaetes (*Cirratulus* sp., *Schistomeringo rudolphi*, *Dodecaceria* sp., *Naineris* sp., *Sigambra hanaoka* and *Prionospio* sp.), oligochaetes (*Thalassodrilides gurwitchi*), bivalves (*Ruditapes philippinarum*), and crustaceans (amphipod *Cheiriphotis megacheles*) (AFCD, 2002). These results indicated a distinct benthic composition characterized by species able to adapt to eutrophic environment.

1.32 The recent survey for the *HATS Environmental and Engineering Feasibility Assessment Study* (EPD, 2004) on benthic assemblages in the Victoria Harbour near North Point (Station VM2 and XM4) also indicated that the benthic assemblages were dominated by polychaeta (*Naineris* sp., *Glycera* sp., *Prionospio* sp.), mollusca (*Ruditapes* sp.) and crustacea (*Corophium* sp.). The bivalve *Ruditapes* sp. is the most abundant (44%) fauna, comprising 95% of the total biomass. Although a commercial species, the conservation value for *Ruditapes* is not high. The study noted that the benthic community structure has been relatively stable over the years and so quite robust to environmental disturbance (EPD, 2004).

1.33 A benthic community survey for the *Kai Tak Development* EIA study (CEDD, 2007) conducted in Kowloon Bay and the Kwan Tong typhoon shelter indicated that the benthic composition recorded was generally consistent with other previous surveys conducted within the Harbour area. The benthic communities at Kai Tak area were dominated by the polychaete species, *Eunic indica*, followed by *Mediomastus* sp., *Cirriformia* sp., *Glycinde gurjanovae*, *Glycera chirori*. These species are adapted to the organic-enriched sediment and considered to have low ecological significance. All the species recorded during the surveys are common and widespread in Hong Kong waters.

1.34 Based on the previous survey results, the soft benthos communities within the Harbour area are generally of low ecological value on the basis of low habitat quality and specie diversity and richness.

Subtidal Fauna

Coral

1.35 In Hong Kong, there is a gradient in physical conditions from the turbid estuarine waters in the west to the clear and more oceanic waters in the east. Such environmental gradient has given rise to a general pattern of distribution for coral communities in Hong Kong waters. The diversity and

coverage of coral communities are generally higher in the eastern water than the western water because of a favourable oceanic environment. The eastern waters are free from the influence of estuarine water from the Pearl River. In the middle of the gradient, the water within Victoria Harbour is still turbid with high suspended solid and considered not favourable for the survival and establishment of coral colonies. This explains why there is no significant coral record within Victoria Harbour in past decade.

1.36 However, a number of recent dive surveys within the Victoria Harbour have revealed the sparse cover of coral within the Harbour area. The results of these dive surveys are summarized in the following paragraphs (**Section 1.35** to **1.47**).

1.37 Literature review indicated soft corals and gorgonians were present at the Green Island and Little Green Island on the western edge of Victoria Harbour, 3.5 km west of the proposed water outfall and intake. A low coverage of black corals of *Anthipathes* sp. was also found on Green Island (TDD, 1998). In general, soft coral and gorgonians are more resistant to turbid waters than hard coral since they do not contain zooxanthallae and do not require light for photosynthesis. Therefore, they are more widely distributed in Hong Kong and are found in turbid areas.

1.38 Dive surveys in the central Victoria Harbour for the *Wan Chai Development Phase II and Central-Wan Chai Bypass* EIA conducted in January 2007 reported a very low coverage (<1%) of one species of hard coral (*Oulastrea crispata*) and one species of octocoral (gorgonian *Echinomuricea* sp.) at the central Harbour area (2.5 km and 3 km west of the proposed water intake and outfall). All the colonies found were in fair health condition but in small size (hard coral 3 - 8 cm in diameter). Neither soft coral nor black coral were recorded during this survey (CEDD, 2007).

1.39 Dive surveys for the *Kai Tak Development* EIA conducted in April 2007 identified small (<1 to 8 cm) isolated coral colonies of *Oulastrea crispata* with low coverage (<1%) attached on the surface of boulders and rocks in the subtidal habitats of the Kai Tak area (CEDD, 2008).

1.40 In Eastern Victoria Harbour, the *HATS Environmental and Engineering Feasibility Assessment Study* indicated that the shallow water of Jose Bay and Tung Long Chau (approximately 11.5 km east from proposed water intake and outfall) supported relatively diverse, low density hard coral communities. However, the same study showed that there was no coral observed in North Point (3.5 km east from proposed water intake and outfall) in central Victoria Harbour or southern Tsing Yi / Stonecutters Island (4.5 km northwest from the proposed water intake and outfall) near the western Victoria Harbour (EPD, 2004).

1.41 Due to similar environmental conditions (e.g. artificial subtidal substratum and water quality) in Western Kowloon and other areas with tolerant corals (*Oulastrea crispata* and *Echinomuricea* sp.) within Victoria Harbour, these corals may occur within the area of the proposed water intake and outfall. However, site-specific ecological information on coral community at the location of proposed water intake and outfall and the vicinity is lacking. Dive surveys were necessary to provide the information for the assessment.

1.42 Dive surveys at the seafront of West Kowloon including both spot-check dives and Rapid Ecological Assessments (REA). Spot-check reconnaissance dives were conducted first to identify the extent of hard substrate and to gain an overview of coral occurrence on the artificial subtidal substratum at site of the proposed water intake and outfall. Areas with coral colonies were then surveyed with more detailed REA transect surveys.

1.43 Four spot-check dives (SD 1 to SD4) were conducted at the proposed project site. The substrata of the four spot-check dive sites consist of artificial vertical seawall with sloping concrete bases at the bottom. Stretching outward offshore is muddy bottom where no epifauna were observed. Colonies of two hard coral species, *Oulastrea crispata* and *Balanophyllia* sp., were observed attached on the surface of sloping boulders and rocks with extremely low coverage (<1%) at all four sites. **Table 2** provides details of the spot-check dive survey.

Table 2 Species Coverage and Size of Coral Colonies Recorded during the Spot-Check Dive Surveys

Spot-Check Dive Site	Coral Species	Coverage	Size (Diameter in cm)
SD1	*Oulastrea crispata* *Balanophyllia* sp.	<1%	2 to 5cm < 0.5 cm
SD2	*Oulastrea crispata* *Balanophyllia* sp.	<1%	2 to 5cm < 0.5 cm
SD3	*Oulastrea crispata* *Balanophyllia* sp.	<1%	2 to 5cm < 0.5 cm
SD4	*Oulastrea crispata* *Balanophyllia* sp.	<1%	2 to 5cm < 0.5 cm

1.44 Three 100 m REA transects were surveyed following the spot-check dives. Limited marine life was observed within the REA transect survey sites. **Table 3** summarises the ecological and substratum attributes along the three REA transects.

Table 3 Species Coverage and Size of Coral Colonies Recorded from the REA Transects

Ecological Attributes	Rank of Percentage Cover (1)		
	REA 1	**REA 2**	**REA 3**
Hard Corals	0.5	0.5	0.5
Octocorals (soft corals and gorgonians)	0	0	0
Black Corals	0	0	0
Dead Standing Corals	0	0	0
Substratum Attributes	**Rank of Percentage Cover (1)**		
	REA 1	**REA 2**	**REA 3**
Bedrock/continuous pavement	0	4	2
Boulders Blocks (diam. > 50cm)	4	1	2
Boulders Blocks (diam. < 50 cm)	1	1	1
Rubble	1	0	0
Other	0	0	0
Soft Substrata	0	0	0
Sand	0	0	0
Mud/Silt	1	2	2

Note:
(1) Rank of percentage cover: 0 = None recorded; 0.5 = 1-5%; 1 = 6-10%; 2 = 11-30%; 3 = 31-50%; 4 = 51-75 %; 5 = 76 – 100%

1.45 Only sparse and patchy coverage of two hard coral species *Oulastrea crispata* (1-5%) and *Balanophyllia* sp. (<1%) were recorded during the surveys. A total of 64 colonies of *Oulastrea crispata* with a size range from 2 cm to 5 cm in diameter attached to the surface of boulders and rocks, were recorded along the REA transects at the depth from 2m to 6m. Patches of *Balanophyllia* sp. with very low coverage (<1%) were also found on the boulders and rock at the depth of 4m to 8m. No coral colonies were recorded on the surface of the artificial seawall. Indicative locations of coral colonies recorded are shown in **Figure No. NOL/ERL/300/C/XRL/ENS/M51/062**.

1.46 *Oulastrea crispata* has a wide range of adaptations to different environmental conditions (including those unfavourable to corals) and locations (Chen e*t al.,* 2003). With opportunistic life history traits, a wide range of reproductive strategies and surface-orientation independent growth, *O crispata* is able to colonise a variety of substrata and flourish as a pioneer coloniser of newly immersed

structures (Lam, 2000a & 2000b). It is common and widespread in Hong Kong marine waters, especially those more turbid and harsh environment in the western waters (Chan *et al.,* 2005).

1.47 *Balanophyllia* sp. is also a common coral in Hong Kong waters. It belongs to the group of solitary ahermatypic corals which are normally distributed in cold temperate waters and arctic seas with individuals adhering to rocks, mollusc shells, and even under shaded overhangs. The colonies of *Balanophyllia* sp. are cryptic, they are unlikely to be noticed unless sought, but they occur in deep waters of Hong Kong, even the turbid and harsh north-western waters. (Scott, 1984).

1.48 More detailed information on raw data of the dive surveys is provided in the **Annex B**.

Marine Mammal

1.49 Literature reviews showed that there were no sightings of marine mammals within the study area. One of the most important marine mammals in Hong Kong is the Chinese White Dolphin (*Sousa chinensis*) which was only seen in the western estuarine waters in Hong Kong including the outer Deep Bay as well as north, south, east Lantau and west Lamma (Hung, 2008). The other common marine mammal Finless porpoise (*Neophocaena phocaenoides*) was never reported in Victoria Harbour and only occurs in the eastern and southern waters of Hong Kong (Hung, 2008).

Intertidal Community

1.50 The intertidal habitat within Victoria Harbour is mainly comprised of artificially modified coastline (artificial vertical seawall and man-made sloping boulders). The rocky shore around the Green Island, Little Green Island and the Kellet Island are the remaining natural intertidal habitats.

Intertidal Community (Artificial)

1.51 Literature review indicated that the intertidal fauna supported by seawalls and rockfills within Victoria Harbour were largely restricted to encrusting sessile organisms such as bivalves, molluscs, and barnacles (Morton & Morton 1983; Lee 1985; Lee & Morton 1985). Fauna commonly found included molluscs such as the common neogastropod (*Thais clavigera*) and the pollution tolerant (*Perna virdis*), as well as encrusting crustaceans such as barnacles (*Balanus* spp., *Tetraclita squamosa* and *Capitulum mitella*) and ubiquitous mobile isopod (*Ligia exotica*) (Morton & Morton 1983; Lee 1985; Lee & Morton 1985). Flora is mostly restricted to algae that are either organic or nutrient enrichment indicators such as *Ulva* spp. and *Cladophora* spp. (Morton & Morton 1983; Ho 1987; Moore, 1990).

1.52 An intertidal survey on artificial seawall and rockfill conducted for *Wan Chai Development Phase II and Central-Wan Chai Bypass EIA Study* (CEDD, 2007), reported that the artificial seawall were inhabited densely by a few species of sessile encrusting fauna, including chiton (*Acanthopleura japonica*), barnacle (*Tetraclita squamosa*) and bivalve (*Saccostrea cucullata*). The only mobile fauna recorded on the artificial seawall were the common sea slater (*Liga exotica*) and topshell (*Monodonta labio*). Encrusting algae (*Pseudulvalla applanata* and *Hildenbrandia* sp.) were also recorded on the surface of the artificial seawalls but no erect algae or higher flowering plant was found during the survey. All the fauna and flora are common local intertidal species with low conservation importance. Compared with the homogenous nature of the concrete seawalls, artificial rockfills provided a more diverse and abundant intertidal community.

1.53 Another intertidal survey on the artificial vertical seawall and sloping boulder-mounted seawall along the coastline of former airport runway, undertaken under the *Kai Tak Development EIA Study* (CEDD, 2008),recorded an intertidal community generally consisting of several sessile encrusting fauna such as periwinkle (*Echinolittorina radiata*), topshell (*Monodonta labio*), limpets (*Cellana grata, C. toreuma* and *Patelloida saccharina*), bivalves (*Saccostrea cucullata*) and barnacles (*Balanus amphitrite, Tetraclita japonica* and *T. squamosa*). Mobile species recorded on the artificial seawall included common Sea Slater (*Liga exotica*) and crabs. Encrusting algae (*Pseudulvella applanata* and *Hildenbrandia rubra*) were commonly recorded on the surface of artificial seawall along the runway while the erect algae (*Hincksia mitchelliae*) was also found during the survey. The artificial

seawall along the Kai Tak Approach Channel was found to support no intertidal fauna but only an algae, *Hincksia mitchelliae* because of poor ambient water quality.. In general, the artificial intertidal habitats within Kai Tak area were very typical of Hong Kong and all of the recorded fauna and flora were common local species with low conservation importance.

1.54 Because of similar environmental conditions, the artificial seawall along the seafront of West Kowloon may support intertidal communities similar to other artificial seawalls within Victoria Harbour. Intertidal surveys on the artificial seawall along the seafront of West Kowloon were conducted to examine intertidal community structure.

1.55 Current intertidal surveys for the Project at West Kowloon indicated that the intertidal substrata at the seafront of West Kowloon consist of artificial vertical seawall (T2 and T3, **Figure No. NOL/ERL/300/C/XRL/ENS/M51/061** refers) and artificial sloping boulders (T1 and T4, **Figure No. NOL/ERL/300/C/XRL/ENS/M51/061** refers). A total of 28 species of intertidal epifauna and flora were observed during the walk-through survey (**Table 4** refers).

Table 4 Intertidal Species recorded during the Walk-through Survey under this Study

Scientific Name	Status in Hong Kong
Chitons	
Acanthopleura japonica	Common
Limpets	
Patelloida saccharina	Common
Cellana grata	Common
Nipponacmea concinna	Common
Patelloida pygmaea	Common
Siphonaria japonica	Common
Periwinkles	
Littoraria articulata	Common
Echinolittorina radiata	Common
Echinolittorina vidua	Common
Echinolittorina trochoides	Common
Topshells	
Monodonta labio	Common
Monodonta neritoides	Common
Chlorostoma argyrostoma	Common
Snails	
Planaxis sulcatus	Common
Whelks	
Thais clavigera	Common
Morula musiva	Common
Barnacles	
Tetraclita squamosa	Common
Capitulum mitella	Common
Balanus Amphitrite	Common
Chthamalus malayensis	Common
Bivalves	
Saccostrea cucullata	Common
Septifer virgatus	Common
Sea anemone	
Spheractis cheungae	Common
Crab	
Hemigrapsus sanguineus	Common
Eriphia laevimana	Common
Sea Slaters	
Ligia exotica	Common
Algae	

Scientific Name	Status in Hong Kong
Ulva lactuca	Common
Hildenbrandia rubra	Common

1.56 Four representative transects (T1 to T4, **Figure No. NOL/ERL/300/C/XRL/ENS/M51/061** refers) were laid out on the artificial seawall and surveyed. Twenty-six species were recorded during the transect survey (**Annex C** refers) including chitons (*Acanthopleura japonica*), limpets (*Patelloida saccharina*), acorn barnacles (*Tetraclita squamosa*), and rock oysters (*Saccostrea cucullata*).

1.57 On the artificial sloping boulders (T1 and T4), limpets (*Patelloida saccharina*) and acorn barnacles (*Tetraclita squamosa*) dominated the lower tidal level, while periwinkles (*Echinolottprina radiata*) was the dominant species at the higher tidal level.

1.58 On the artificial vertical seawall (T2 and T3), limpets (*Patelloida saccharina*) and rock oysters (*Saccostrea cucullata*) dominated the lower tidal level, while periwinkles (*Echinolottprina radiata*) was the dominant species at the higher tidal level.

Intertidal Community (Natural)

1.59 The natural coastline Kellet Island was surveyed in August 2000 with the results presented in *Wan Chai Development Phase II EIA* Report (CEDD, 2001). The field survey indicated that the species assemblages were of sheltered rocky shore communities with high quantities of Top Shells (*Monodonta austrailis*) dominating the lower shore and Periwinkles (*Nodilittorina millegrana*) dominating the upper shore. Other intertidal species including Stalked Barnacle (*Pollicipes mitelia*), Acorn Barnacle (*Tetraclita squamosa*), Common Chiton (*Liolophura japonica*), and Limpet (*Cellana toreuma*) were occasionally observed. No rare species or species of conservation value were observed during the survey.

1.60 A more recent intertidal survey on the shoreline of northern Kellet Island was conducted in January 2007 for the *Wan Chai Development Phase II & Central-Wan Chai Bypass EIA Study*. Similar composition and distribution patterns to those reported in the W*an Chai Development Phase II EIA Study* (CEDD, 2001) were observed during this survey. Periwinkles (*Nodilittorina millegrana*) and topshell (*Monodonta austrailis*) were the most common species recorded on both transects with *N. millegrana* dominating the upper shore and *M. austrailis* dominating the lower shore. Other intertidal species including the limpet (*Cellana toreuma*), Nerite (*Nerita chanaeleon*), Stalked barnacles (*Capitulum mitella*), and Acorn barnacles (*Tetraclita squamosa*) were also recorded. All the recorded species are common in most of the shorelines in Hong Kong and no species of conservation importance or nursery/breeding activities was observed in this area.

1.61 The Green Island and Little Green Island were surveyed in 1997 with the results presented in *Dredging at Area of Kellett Bank for Reprovisioning of Six Government Mooring Buoys EIA Study* (EPD 2007). The results indicated that the species diversity at the intertidal zone of Green Island was similar on both northern and southern shores, but different assemblages of intertidal fauna were recorded. The most abundant species were grazing gastropods including Chitons and Limpets at the low shore, and Periwinkles at the high shore. Predatory gastropods such as the Dogwhelks (*Thais clavigera* and *T. luteostoma*) were also recorded in low density at the low shore. Sessile organisms including Stalked Barnacles and Acorn Barnacles were recorded in high abundances. Algae were sparsely distributed along the shore during summer, with Cyanobacteria *Pseydoulvella* spp. having the higher percentage cover. The findings displayed the intertidal communities on Green Island and Little Green Island to be typical of semi-exposed rocky shores.

Area of conservation interest

1.62 There are no SSSIs, Marine Parks / Reserves or other areas of ecological importance or conservation interest, in the vicinity of the study area.

Ecological Significance

1.63 Based on the ecological baseline information discussed above, the ecological significance of marine ecological habitats identified within the study area have been assessed and evaluated in **Table 5** and **6**, in accordance with the EIAO-TM Annex 8 Table 2.

Table 5 Ecological Evaluation of Subtidal Habitat and Soft Bottom Habitat within the Study Area

Criteria	Subtidal Habitat	Soft Bottom Habitat
Naturalness	Low. Highly disturbed by marine traffic, subjected to extensive water pollution and anthropogenic disturbance.	Low. Subjected to extensive anthropogenic disturbance
Size	Large	Large
Diversity	Low	Low
Rarity	No rare species found, only two common hard coral species (*Oulastrea crispata* and *Balanophyllia* sp.) were recorded during the current dive survey. Another common gorgonian coral, *Echinomuricea* sp. was recorded in coastal area of Wan Chai (CEDD, 2007).	No rare species recorded.
Recreatability	High	High
Fragmentation	N/A	N/A
Ecological linkage	Ecological linkage to other valuable ecological resources was not observed.	Ecological linkage to other valuable ecological resources was not observed.
Potential value	Low	Low
Nursery ground	Nursery/breeding activity was not observed.	Nursery/breeding activity was not observed.
Age	N/A	N/A
Abundance / Richness of wildlife	Low for abundance and species richness	Low for abundance and species richness
Ecological Value	Low	Low

Table 6 Ecological Evaluation of Artificial and Natural Intertidal Habitats within the Study Area

Criteria	Intertidal Habitat (Artificial)	Natural Intertidal Habitat (Natural)
Naturalness	Low. The whole area is made up of concrete artificial seawalls and artificial sloping boulders, and highly disturbed by marine traffic.	Moderate. Natural rocky shores with little human disturbance.
Size	Large	Small
Diversity	Low	Low
Rarity	No species of conservation interest were recorded.	No species of conservation interest were recorded.
Recreatability	High.	High.
Fragmentation	N/A	N/A
Ecological linkage	Ecological linkage to other valuable ecological resources was not	Ecological linkage to other valuable ecological resources was not

Criteria	Intertidal Habitat (Artificial)	Natural Intertidal Habitat (Natural)
	observed.	observed.
Potential value	Low	Low to moderate
Nursery ground	Nursery/breeding activity was not observed.	Nursery/breeding activity was not observed.
Age	N/A	N/A
Abundance / Richness of wildlife	Low for abundance and species richness	Low for abundance and species richness
Ecological Value	Low	Low

1.64 The species of conservation interest recorded in the study area are evaluated in **Table 6** Representative photographs of fauna species of conservation interest are shown in **Annex C**.

Table 7 Species of Conservation Interest Recorded within the Study Area during the Recent Surveys

Species	Protection Status	Distribution in Hong Kong
Oulastrea crispata	All hard corals are protected under Cap. 586	Common and widespread
Balanophyllia sp.		

Identification and Evaluation of Environmental Impact

Construction Phase

Habitat loss

1.65 The proposed water intake and outfall of the water cooling system would be constructed by replacing the existing wave absorbing seawall units with precast water intake and outfall seawall units. No extensive marine construction, such as reclamation or dredging, would be carried out during the construction phase, direct impact to the soft bottom habitat is not anticipated. Potential direct marine ecological impact would be confined to a temporary loss of 126 m^2 artificial vertical subtidal-hard substratum (two 8m x 8m subtidal vertical surface of wave-absorbing seawall units, see **Annex D** for preliminary construction design of the precast water intake and outfall units).

1.66 No coral colonies were recorded on the vertical wave-absorbing seawall affected by the construction. The new precast water intake and outfall seawall units would provide surface for re-colonisation of intertidal fauna after the construction. The intertidal fauna recorded on the artificial intertidal habitat are common and widespread in Hong Kong and thus the seawall habitat affected is of low ecological value. Given the temporary nature and small scale of the construction work, the impact of marine habitat loss arising from the construction of proposed water intake and outfall is considered minor.

Impact to Water Quality

1.67 Potential indirect impact on the marine ecological habitats and associated marine life may include water quality deterioration due to sediment laden surface runoff from the construction, if uncontrolled. However, given the small scale of work provided with effective implementation of mitigation measures to minimize the water quality impact due to surface runoff (see **Section 11** for details), potential indirect impacts to marine life (e.g. coral) are limited.

Operational Phase

Thermal Stress

1.68 During operational phase, seawater will be pumped-in via the proposed water intake and utilized to carry waste heat from the air conditioning system of WKT. After which the seawater circulated through the system will be discharged back to the sea via the proposed water outfall. The discharged water would cause an increase of seawater temperature leading to thermal stress to marine life (in particular coral) in vicinity of the proposed water outfall. Potential impacts on marine fauna due to the thermal stresses include reduced growth and fecundity. These effects are dependent on the thermal tolerance of different species.

1.69 From the prediction of water modelling results under this Study (**Section 11** refers), temperature increases of no more than 1 ℃ in the surface water layer under different tidal conditions would occur in areas close to the outfall of the proposed seawater cooling water system, taken into account of other concurrent spent cooling water discharges in the West Kowloon area. The overall effect of thermal plume at the surface water layer would be localised and confined near the cooling water outfall. Temperature elevation of more than 2 ℃ (up to a maximum level of 3.4 ℃) was predicted within a 20m x 20m mixing zone in vicinity of the outfall in 4.1% of time during wet season.

1.70 Two locally common hard coral species (*Oulastrea crispata* and *Balanophyllia* sp.) were recorded along the coast near to the proposed water outfall. *Oulastrea crispata* is heat-tolerant species and has been proven to withstand temperature range from 12℃ to 35℃ (Chen, 2003) which explains its wide geographical distribution from the tropical Indo-West Pacific to high latitudes around Japan (Veron, 2000). Thus, the thermal stress on *O. crispata* arising from the temperature elevation in vicinity of the water outfall, even under worst predicted scenario (3.4 ℃ rise in wet season), is considered acceptable.

1.71 *Balanophyllia* sp. is a temperate species with distribution and growth being limited by the high seawater temperature in subtropical areas like Hong Kong. This may explain the local occurrence of *Balanophyllia* sp. in isolated colonies with very low coverage in deep waters (> 4 m). Lethal temperature for a 6-hour exposure of another species of this genus, *B. elegans*, distributed on eastern Pacific coast in North America was found to lie between 25℃ and 30 ℃ (Gerrodette, 1979). However, it is possible that the *Balanophyllia* spp. may tolerate a higher lethal temperature if the coral is acclimated gradually to higher temperature (Gerrodette, 1979). This may infer the possible acclimation of *Balanophyllia* sp. to the local water temperature as well as the temperature rise due to operation of the proposed water cooling system.

Chlorine Contamination

1.72 To prevent the settling and active growing of fouling marine organisms on the water outfall which may result in losses in thermal efficiency and even total shutdowns of the water cooling system, chlorine, in the form of sodium hypochlorite solution or from electrolysis of sea water, would be added to cooling water within the cooling system. The discharged water would contain residual chlorine that may affect the marine ecological habitats and the associated marine life in vicinity of the outfall.

1.73 In case of high dosage, chlorine contamination would impose negative effects on corals. Hypochlorite may cause coral bleaching and removal of living coral tissues. Residual chlorine would lower the pH of seawater which in turn impairing the coral growth through inhabiting coral calcification or even dissolving of calcium-carbonated skeleton (Marubini and Atkinson 1999).

1.74 The water modelling prediction indicates that the discharge would not contribute any non-compliance with the assessment criterion for total residual chlorine of 0.01 mg/l and no unacceptable chlorine impact is anticipated from this Project. The modelling results predicted some mixing zones for a number of background cooling water discharges (**Appendix 11.7a** and **Appendix 11.7b**) based on very conservation assumption such that 24-hour daily continuous peak discharge flow rate from water outfall was applied in the modelling. In actual case, the peak discharge flow rate would occur only for a short period of time within a day. Considering concentrations of residual chlorine typically would diminish rapidly with time and distance from the discharge point due to natural decay and dilution effect (Mattice and Zittel, 1976), actual residual chlorine discharged from

the water outfall should be significantly smaller than that predicted in the model. As such, impact of residual chlorine to corals in vicinity of the water outfall is considered minor.

Impingement and Entrainment of Fauna in the Seawater System

1.75 The seawater within the embayment of West Kowloon would be pumped into the West Kowloon Terminus (WKT) water cooling system via proposed water intake. There is a potential for impingement and subsequent entrainment of marine organism in the proposed water intake. This may affect different groups of animals to differing degrees. Smaller pelagic species are the most vulnerable, while burrowing animals are rarely impinged, and large pelagic species are usually strong enough to avoid the intake stream.

1.76 The impact of impingement and entrainment of pelagic fauna in the seawater system is considered minor given the small size of the water inlet (2m x 5.5m in dimension). The provision of screening at the entrance of water intake would limit the entrained fauna to the typical plankton of small size which have high natural mortality. Previous research (Majewski & Miller, 1979; Turnpenny, 1988) shows the mortality of plankton due to impingement in water cooling system do not give rise to adverse ecological impacts.

1.77 A summary of marine ecological impacts associated with the proposed water cooling system is presented in **Table 8** and **9**.

Table 8 Evaluation of Ecological Impacts on Subtidal Habitat and Intertidal Habitat

Criteria	Subtidal Habitat	Intertidal Habitat (Artificial)
Habitat Quality	Low	Low
Species	No direct impact to the two hard coral species (*Oulastrea crispata* and *Balanophyllia* sp.) recorded on sloping concrete bottom of the artificial seawall. Indirect impacts to the two hard coral during operation phase.	28 species of intertidal epi-fauna and flora recorded from the artificial intertidal habitat along seafront of West Kowloon. No species of conservation of interest would be affected.
Size / Abundance	Temporary loss of 126 m^2 of subtidal-hard substratum (two 8m x 8m subtidal vertical surface of wave-absorbing seawalls) along the seafront of WKT	Temporary loss of 16 m^2 intertidal habitat (two 8m x 1m* intertidal habitat on wave-absorbing seawall) along the seafront of WKT.
Duration	Construction phase The direct impact to the habitat would be temporary and confined to construction period only. The precast units of water intake and outfall would provide new subtidal hard substratum. Operation phase Impact of seawater temperature rise and chlorine contamination from spent cooling water would be long term but considered minor and localised.	Construction phase The direct impact to the habitat would be temporary and confined to construction period only. The precast units of water intake and outfall would provide new intertidal substratum Operation phase Impact of seawater temperature rise and chlorine contamination from spent cooling water would be long term but considered minor and localized.
Reversibility	Construction phase Temporary and reversible Operation phase Temporary and reversible	Construction phase Temporary and reversible Operation phase Temporary and reversible
Magnitude	The scale of habitat loss is low in the context of the surrounding similar habitats.	The scale of habitat loss is low in the context of the surrounding similar habitats.

Criteria	Subtidal Habitat	Intertidal Habitat (Artificial)
	Indirect water quality impact is considered minor and localised	Indirect water quality impact is considered minor and localised
Overall Impact	Low	Low

Note:
The average tidal range of in Victoria Harbour is 1m. (HKIS Website 2009)

Evaluation of Cumulative Environmental Impacts

Construction phase

1.78 The planned construction period of the West Kowloon Terminus would be from December 2009 to December 2014. A number of coastal construction projects are identified. Details of these projects are summarized in **Table 9**.

Table 9 Relevant Concurrent Projects

Project Title	Project Proponent	Planned Construction Period	Distance from Project Site
Laying of Western Cross Harbour Main and Associated Land Mains from West Kowloon to Sai Ying Pun	Water Supplies Department	August 2008 to February 2012	Approximately 1 km
Central Reclamation Phase III main works	Civil Engineering and Development Department	February 2003 to December 2009	Approximately 1.4 km
Dredging Works for Proposed Cruise Terminal at Kai Tak	Civil Engineering and Development Department	March 2009 to end of 2015	Approximately 4.5 km

1.79 The proposed construction works for WKT water cooling system would be small in scale. The potential water quality impacts are expected to be localized and confined in close proximity of the proposed water intake and outfall. No significant cumulative marine ecological impact would be contributed from this Project.

Operation phase

1.80 Other concurrent spent cooling water discharges identified within the West Kowloon area has been considered in the modelling for cumulative water quality assessment (**Section 11** refers). No unacceptable cumulative marine ecological impact is anticipated.

Mitigation of Environmental Impacts

1.81 Following EIAO-TM Annex 16 and EIAO Guidance Note No. 3/2002, mitigation measures are discussed in this section to avoid, minimize, and compensate for the identified ecological impacts, in the order of priority.

Avoidance

1.82 All permanent works proposed such as the vertical wave-absorbing seawall removal and installation of the water intake and outfall units are confined within the boundary of land. Extensive marine construction works such as dredging or direct disturbance to the seabed has been avoided. The precast vertical wave-absorbing seawall has been selected for the placement of water intake and outfall to avoid complex shore modification work over and upon the foreshore of the sea bed.

Minimization

1.83 During the construction period a number of mitigation measures to control water quality impacts would be adopted to minimize the indirect impact to the nearby intertidal and subtidal flora and fauna (see **section 11** for details). No further mitigation measures would be required.

Evaluation of Residual Environmental Impacts

1.84 With the effective implementation of mitigation measures proposed above, no adverse residual environmental impacts to the marine ecological habitats and the associated wildlife resulting from the construction and operation of the proposed seawater cooling system are anticipated.

Environmental Monitoring and Audit

1.85 The implementation of all the mitigation measures should be subject to the regular monitoring and audit during the construction phase.

Conclusion

1.86 Marine ecological survey recorded only common intertidal species and low coverage of locally common hard corals *Oulastrea crispata* and *Balanophyllia* sp. in the study area. No corals would be directly impacted. The loss of low value sub-tidal habitats due to replacement of vertical seawall for the intake and outfall seawall structures would be minimal.

1.87 Based on water quality modelling of the operation of the water cooling system, potential marine ecological impacts would be minor and localized.

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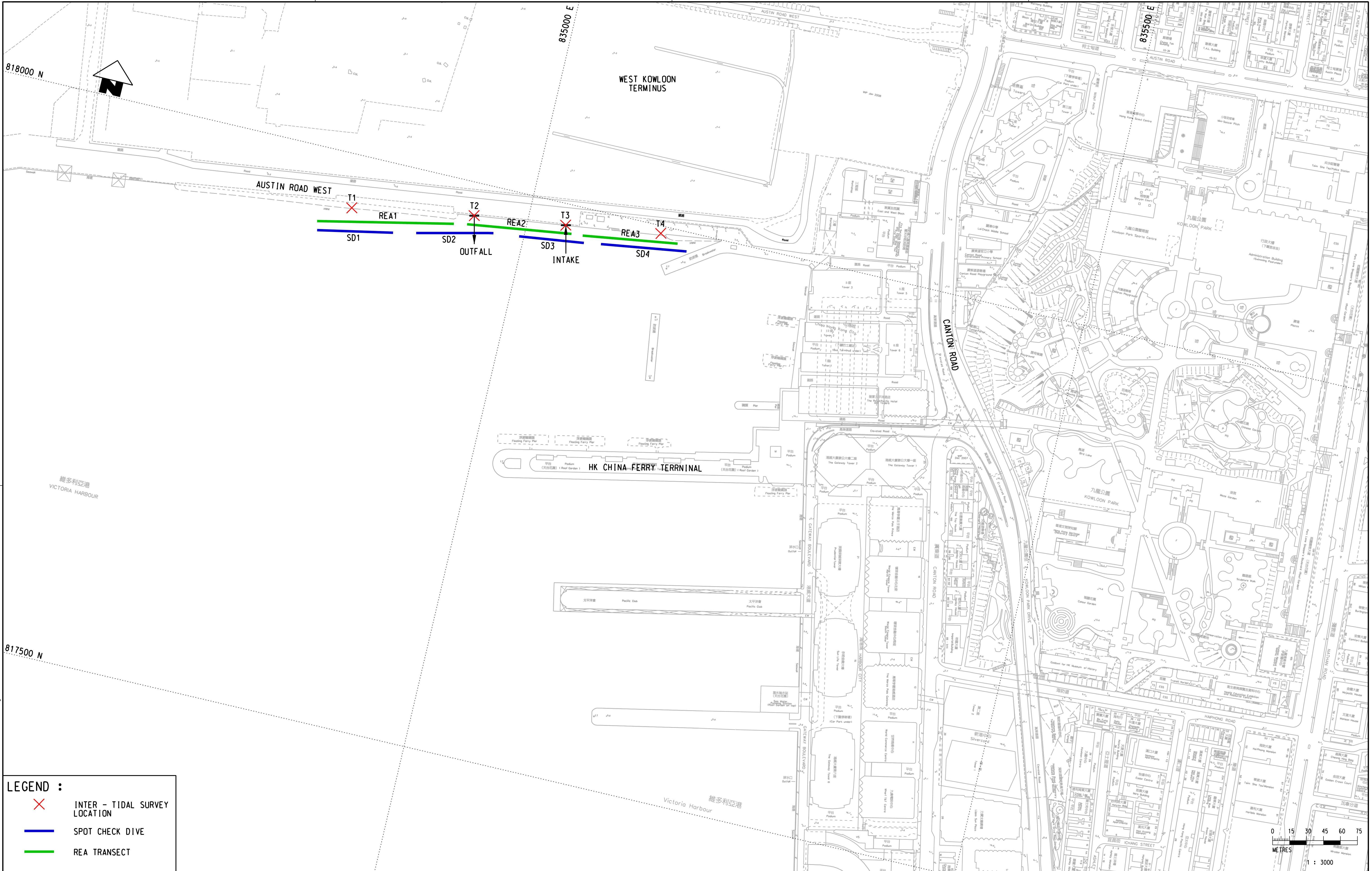
Figures



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TITLE

NOL / ERL-300

ENVIRONMENTAL IMPACT ASSESSMENT

LOCATIONS OF MARINE ECOLOGICAL SURVEYS

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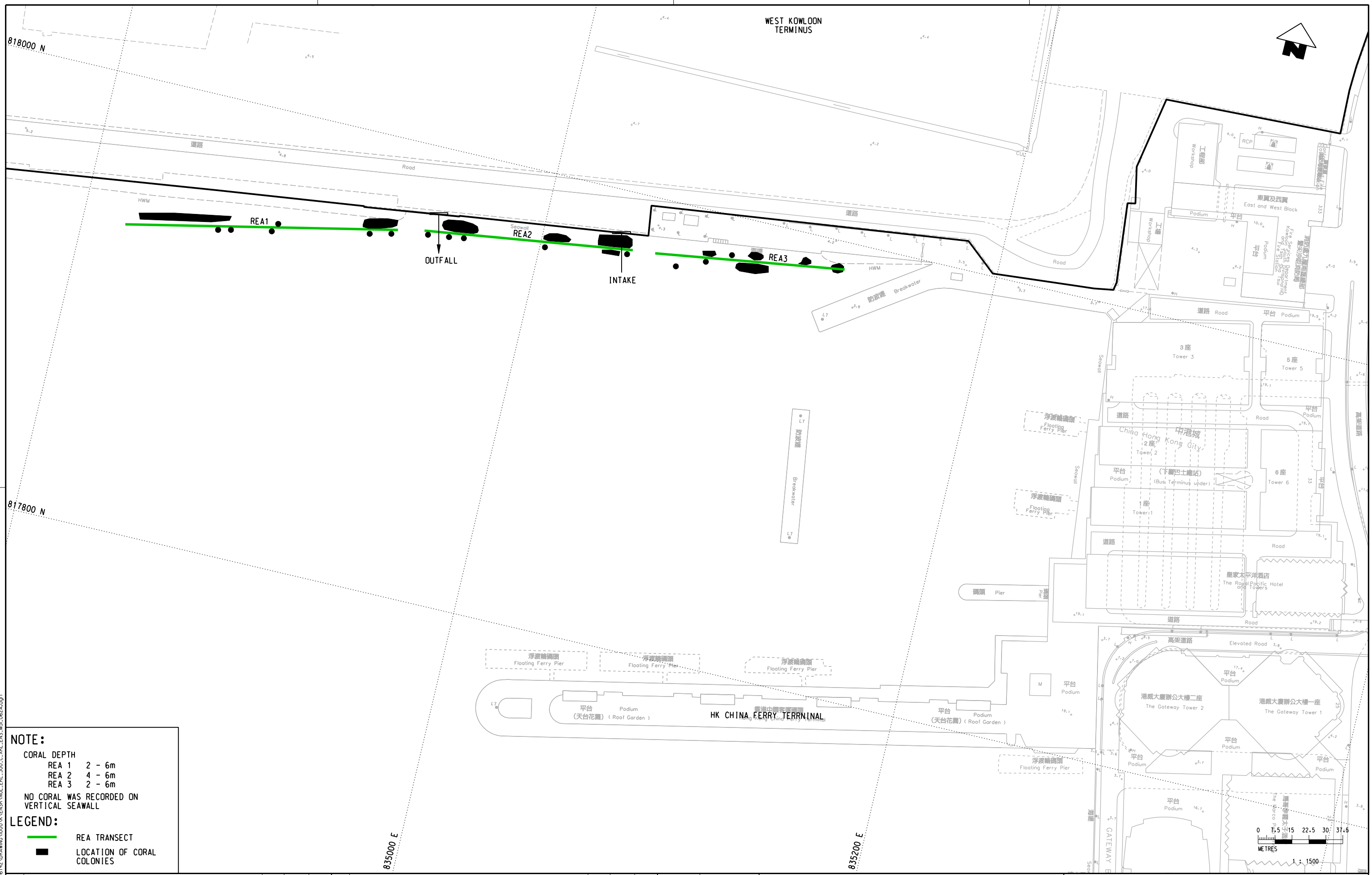

NOTE:

CORAL DEPTH

REA 1	2 - 6m
REA 2	4 - 6m
REA 3	2 - 6m

NO CORAL WAS RECORDED ON VERTICAL SEAWALL

LEGEND:

REA TRANSECT

LOCATION OF CORAL COLONIES

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TITLE

NOL / ERL-300
ENVIRONMENTAL IMPACT ASSESSMENT
LOCATIONS OF CORAL COLONIES

SCALE	FIGURE NO.	REV.
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Annex A	Rapid Ecological Assessment

Annex A Rapid Ecological Assessment

Rapid ecological assessment (see [1]DeVantier *et al.* 1998) is a two-tiered approach for underwater survey to assess the sub-littoral substrata and benthic organisms. This methodology has been modified to suit Hong Kong conditions and has become a standardised and widely adopted way to establish ecological baseline conditions. Two levels of information are to be recorded in a swathe ~2m wide, 1m on either side of each transect:

- Tier 1 will assess the relative cover of major benthic groups and substrata
- Tier 2 will provide an inventory of sedentary/ sessile benthic taxa, which are also ranked in terms of their abundance in the community at the survey site.

Self-evidently, data have to be recorded by an expert who is experienced in field identification of sedentary / sessile benthic taxa, particularly corals.

Tier 1: Categorization of benthic cover

For each transect, ecological and substratum attributes should be categorized and ranked. The required attributes are detailed as follows:

Table 1 Tier 1 Benthic Attribute Categories

Ecological Attributes	Substratum Attributes
Hard Corals	**Hard substrata**
Octocorals (soft corals and gorgonians)	Bedrock / continuous pavement
Black corals	Boulder blocks (diam. >50cm)
Dead Standing Corals	Boulder blocks (diam. <50cm)
	Rubble
	Other
	Soft substrata
	Sand
	Mud / Silt

Table 2 Tier 1 Ordinal Ranks of Percentage Cover of Benthic Attributes

Rank*	**Percentage Cover**
0	None recorded
0.5	1 – 5%
1	6 – 10%
2	11 – 30%
3	31 – 50%
4	51 – 75%
5	76 – 100%

*Note: For substatum attributes, it is preferable to record actual estimates of cover. The percentage of hard substrata vs soft substrata can be provided (e.g. 80% and 20% respectively). The percentage cover of the types of hard or soft substrata could also then be presented (e.g. bedrock pavement 60%, rubble 20%, sand 15%, mud / silt 5%). Similarly, recording and presenting actual estimates of, for instance, hard and soft coral cover may be more informative (e.g. <1%) and is also an approach adopted by similar recent survey reports.

[1] DeVantier, L.M., G. De'ath, T.J. Done and Turak, E. (1998). Ecological Assessment of a Complex Natural System: A Case Study from the Great Barrier Reef. *Ecological Applications* 8:480-496.

Tier 2 :Taxonomic inventories to define types of benthic communities

An inventory of benthic taxa along each transect should be compiled during the survey. The taxa should be defined in situ to at least the following levels:

Table 3 Taxonomic Inventory Identification

Type of Benthos	Level of Taxa
Hard corals	Species level, wherever possible
Octocorals	Genus level
Black Corals	Genus level

For each transect, each taxon in the inventory should be ranked in terms of abundance in the community.

Table 4 Ordinal Ranks of Taxon Abundance

Taxon Abundance Rank	Abundance
0	Absent
1	Rare
2	Uncommon
3	Common
4	Abundant
5	Dominant

The taxon categories should be ranked in terms of relative abundance of individuals, rather than the contribution to benthic cover along each transect. The ranks are visual assessments of abundance, rather than quantitative counts of each taxon. Representative photos of organisms should be taken.

Annex B	Raw Data Recorded during the Dive Surveys at Seafront of West Kowloon

Annex B Raw Data Recorded during the Dive Surveys at Seafront of West Kowloon

Table 1 Weather Condition During the Spot-Check Dives on 21st January 2009

Date	Condition	Average Underwater Visibility
21 January 2009	- Northeast force 4 to 5, - Sunny periods	1m

Table 2 GPS Location, Route Distance, Maximum Depth Bottom Substrate and Bottom Visibility of Spot-Check Dive Sites 1 to 4

Site	Location (GPS) (Starting Point)	Route Distance (m)	Max. Depth (m)	Bottom Substrate	Visibility (m)
1	E 114.16294° N 22.30037°	65	10	Boulder/Muddy	1
2	E 114.16354° N 22.30048°	60	10	Concrete Seawall /Muddy	1
3	E 114.16438° N 22°.30056	60	8	Concrete Seawall /Muddy	1
4	E 114.16521° N 22.30069°	60	6	Boulder/Muddy	1

Table 3 Weather Condition for the REA Survey on 28th – 29th January 2009

Date	Condition	Average Underwater Visibility
28 January 2009	- Northeast force 5 - Sunny	1m
29 January 2009	- Northeast force 4, occasionally 5 offshore - Sunny	1m

Table 4 GPS of Transect Starting Point and Ending Point, Maximum Depth, Bottom Substrate and Bottom Visibility of the Three REA Transects

Transect	Location (GPS) (Starting Point)	Location (GPS) (End Point)	Max. Depth (m)	Bottom Substrate	Visibility (m)
1	E 114.16160° N 22.30021°	E 114.16310° N 22.30037°	10	Boulders/muddy	1
2	E 114.16321° N 22.30039°	E 114.16445° N 22.30058°	8	Concrete Seawalls/Boulder/muddy	1
3	E 114.16454° N 22.30063°	E 114.16595° N 22.30082°	8	Concrete Seawalls/Boulder/muddy	1

Table 5 Size, Distance along the Transect and Health Condition of Coral Colonies found at Transect REA1

Coral Number	Coral Species	Size (cm)	Distance along the Transect (m)	Health Condition
1	*Oulastrea crispata*	2	8.5	Fair
2	*Oulastrea crispata*	2	12.6	Fair
3	*Oulastrea crispata*	2	15	Fair
4	*Oulastrea crispata*	4	16.2	Fair
5	*Oulastrea crispata*	3	16.3	Fair
6	*Oulastrea crispata*	3	16.3	Fair
7	*Oulastrea crispata*	3	18	Fair
8	*Oulastrea crispata*	2	29.5	Fair
9	*Oulastrea crispata*	5	46.7	Fair
10	*Oulastrea crispata*	5	46.8	Fair
11	*Oulastrea crispata*	4	47	Fair
12	*Oulastrea crispata*	3	68.2	Fair
13	*Oulastrea crispata*	5	77.3	Fair
14	*Oulastrea crispata*	2	80.9	Fair
15	*Oulastrea crispata*	2	85.3	Fair
16	*Oulastrea crispata*	3	90.6	Fair
17	*Oulastrea crispata*	3	92.5	Fair
18	*Oulastrea crispata*	3	92.6	Fair
19	*Oulastrea crispata*	4	95.5	Fair
20	*Oulastrea crispata*	5	95.5	Fair

Table 6 Size, Distance along the Transect and Health Condition of Coral Colonies found at Transect REA2

Coral Number	Coral Species	Size (cm)	Distance along the Transect (m)	Health Condition
1	*Oulastrea crispata*	3	7.6	Fair
2	*Oulastrea crispata*	3	12.5	Fair
3	*Oulastrea crispata*	2	35.6	Fair
4	*Oulastrea crispata*	2	35.9	Fair
5	*Oulastrea crispata*	2	38.2	Fair
6	*Oulastrea crispata*	3	39	Fair
7	*Oulastrea crispata*	3	39	Fair
8	*Oulastrea crispata*	3	39.5	Fair
9	*Oulastrea crispata*	3	45.2	Fair
10	*Oulastrea crispata*	3	45.4	Fair
11	*Oulastrea crispata*	5	45.9	Fair
12	*Oulastrea crispata*	3	55.9	Fair
13	*Oulastrea crispata*	5	66	Fair
14	*Oulastrea crispata*	2	66.7	Fair
15	*Oulastrea crispata*	2	76.4	Fair
16	*Oulastrea crispata*	2	77.5	Fair
17	*Oulastrea crispata*	2	77.8	Fair
18	*Oulastrea crispata*	2	77.8	Fair
19	*Oulastrea crispata*	2	82.4	Fair
20	*Oulastrea crispata*	3	83	Fair
21	*Oulastrea crispata*	5	89.1	Fair
22	*Oulastrea crispata*	3	95.1	Fair
23	*Oulastrea crispata*	3	97.5	Fair
24	*Oulastrea crispata*	2	98.4	Fair
25	*Oulastrea crispata*	2	98.4	Fair

Table 7 Size, Distance along the Transect and Health Condition of Coral Colonies found at Transect REA3

Coral Number	Coral Species	Size (cm)	Distance along the Transect (m)	Health Condition
1	*Oulastrea crispata*	2	18	Fair
2	*Oulastrea crispata*	3	25	Fair
3	*Oulastrea crispata*	2	25.4	Fair
4	*Oulastrea crispata*	3	25.4	Fair
5	*Oulastrea crispata*	2	35.1	Fair
6	*Oulastrea crispata*	3	44.8	Fair
7	*Oulastrea crispata*	4	44.8	Fair
8	*Oulastrea crispata*	3	44.9	Fair
9	*Oulastrea crispata*	2	55.5	Fair
10	*Oulastrea crispata*	2	56.8	Fair
11	*Oulastrea crispata*	3	56.8	Fair
12	*Oulastrea crispata*	3	72.6	Fair
13	*Oulastrea crispata*	3	77.5	Fair
14	*Oulastrea crispata*	2	82.4	Fair
15	*Oulastrea crispata*	2	82.5	Fair
16	*Oulastrea crispata*	2	90.1	Fair
17	*Oulastrea crispata*	3	90.1	Fair
18	*Oulastrea crispata*	2	95	Fair
19	*Oulastrea crispata*	4	95.1	Fair

Annex C	Raw Data Recorded during the Intertidal Surveys at Seafront of West Kowloon

Annex C - Raw Data Recorded during the Intertidal Surveys at Seafront of West Kowloon

Composition and Abundance (number of individuals / percentage cover per 0.25 m^2) of Organisms Recorded in Intertidal Community
Intertidal Invertebrates

	Dry Season															
Survey Date	21/1/2009															
Survey Location	Transect 1				Transect 2				Transect 3				Transect 4			
Intertidal Type	Artificial sloping boulders				Artificial vertical seawall				Artificial vertical seawall				Artificial sloping boulders			
Transect Length (m)	4 m				4 m				4 m				4m			
Quadrat	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Chitons																
Acanthopleura japonica	4	2			4				7	2			3	1	1	
Limpets																
Patelloida saccharina	25	15	10		23	8			30	12			21	11	5	
Cellana grata	10	3			5	3			5	2	1		7	6	2	
Nipponacmea concinna					9	4			7	2						
Patelloida pygmaea					7	2			4	1	1					
Periwinkles																
Littoraria articulata			15	5		8	1			5	1				12	5
Echinolittorina radiata			10	13		12	24	35		1	12	32			1	15
Echinolittorina vidua																3
Topshell																
Monodonta labio			3		4				6	3				1		
Monodonta neritoides										2						
Snails																
Planaxis sulcatus										1						
Barnacles																
Tetraclita squamosa	30%	20%	10%	<1%	10%	1%	<1%		10%	10%	<1%		30%	25%	5%	
Capitulum mitella										5%				5%	5%	
Balanus amphitrite											<1%					
Bivalves																
Saccostrea cucullata					50%	5%	<1%		80%	40%	<1%					
Septifer virgatus			10%							5%						
Algae																
Ulva lactuca															5%	
Hildenbrandia rubra	40%												30%		5%	

Note:
Low tide mark – Quadrat 1
Line transects: mobile fauna in terms of abundance 0.25 m^{-2}; sessile organisms estimated in terms of percentage cover
Quadrat area = 0.25 m^2

Sampling Effort During Walk-through Surveys

Date of Survey	21/1/2009
No. of Surveyor	4
Survey Time	1045-1145
Duration (hr):	1

Annex C - Raw Data Recorded during the Intertidal Surveys at Seafront of West Kowloon

Composition and Abundance (number of individuals / percentage cover per 0.25 m^2) of Organisms Recorded in Intertidal Community
Intertidal Invertebrates

	Wet Season															
Survey Date	17/6/2009															
Survey Location	Transect 1				Transect 2				Transect 3				Transect 4			
Intertidal Type	Artificial sloping boulders				Artificial vertical seawall				Artificial vertical seawall				Artificial sloping boulders			
Transect Length (m)	4 m				4 m				4 m				4m			
Quadrat	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Chitons																
Acanthopleura japonica	5	8	2		3	2			5	5			4	8		
Limpets																
Patelloida saccharina	15	17	18	2	16	13	2		15	12	5		15	18	8	
Cellana grata			4	7		4	7				5	7		2	3	5
Nipponacmea concinna					25	5			8	5						
Patelloida pygmaea		3	5			5	3		1	3						
Siphonaria japonica						2				3						
Periwinkles																
Littoraria articulata		7	18			5	12	2		6	3			11	6	
Echinolittorina radiata		15	38	72		11	18	45		5	25	62			15	46
Echinolittorina vidua							5			7	2				5	
Echinolittorina trochoides							5	3			1	4			7	5
Topshell																
Monodonta labio						2				4			2			
Whelks																
Thais clavigera		5				5	3						5	1		
Morula musiva		1								3						
Barnacles																
Tetraclita squamosa	45%	15%	5%		10%	1%			10%	5%			55%	10%		
Capitulum mitella		1%				1%				5%				2%		
Balanus amphitrite						5%	1%			5%						
Chthamalus malayensis										1%						
Bivalves																
Saccostrea cucullata	5%				55%	10%			65%	15%			5%			
Septifer virgatus		8%							5%	1%				1%		
Sea Anemone																
Spheractis cheungae		2								2			1			
Sea Slaters																
Ligia exotica		2		3			2	5			2	7			1	1
Crab																
Eriphia laevimana					12					5						
Algae																
Hildenbrandia rubra	45%	15%											25%	15%		

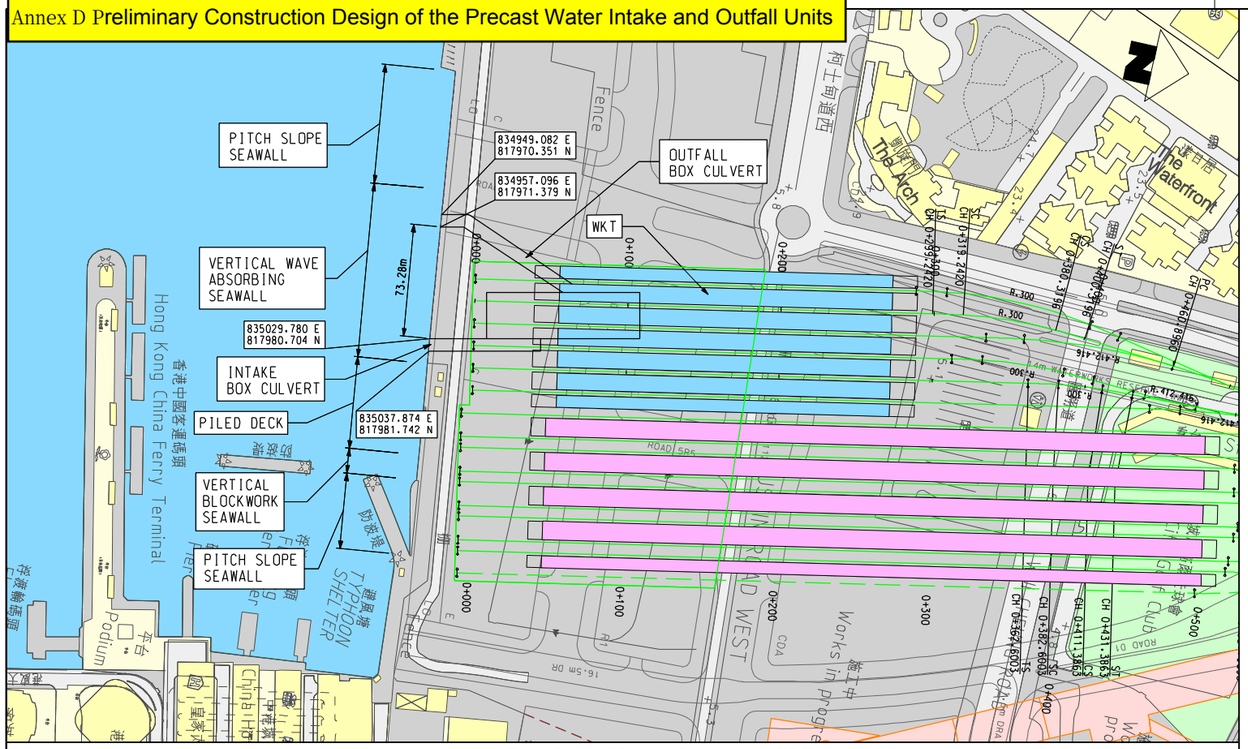
Note:
Low tide mark – Quadrat 1
Line transects: mobile fauna in terms of abundance 0.25 m^{-2}; sessile organisms estimated in terms of percentage cover
Quadrat area = 0.25 m^2

Sampling Effort During Walk-through Surveys

Date of Survey	17/6/2009
No. of Surveyor	4
Survey Time	1430-1530
Duration (hr):	1

Annex D	Preliminary Construction Design of the Precast Water Intake and Outfall Units

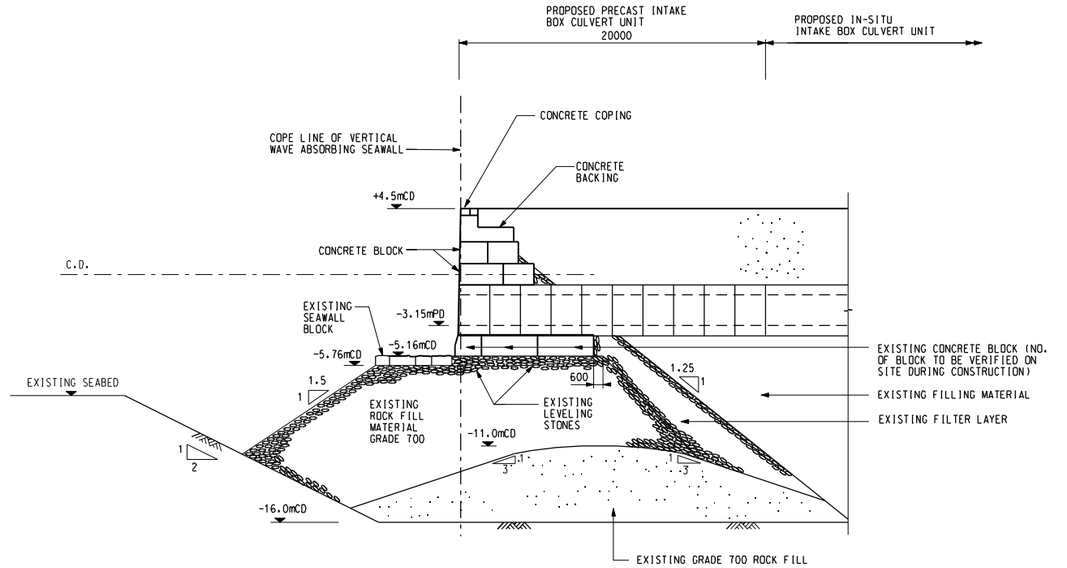
Annex D Preliminary Construction Design of the Precast Water Intake and Outfall Units



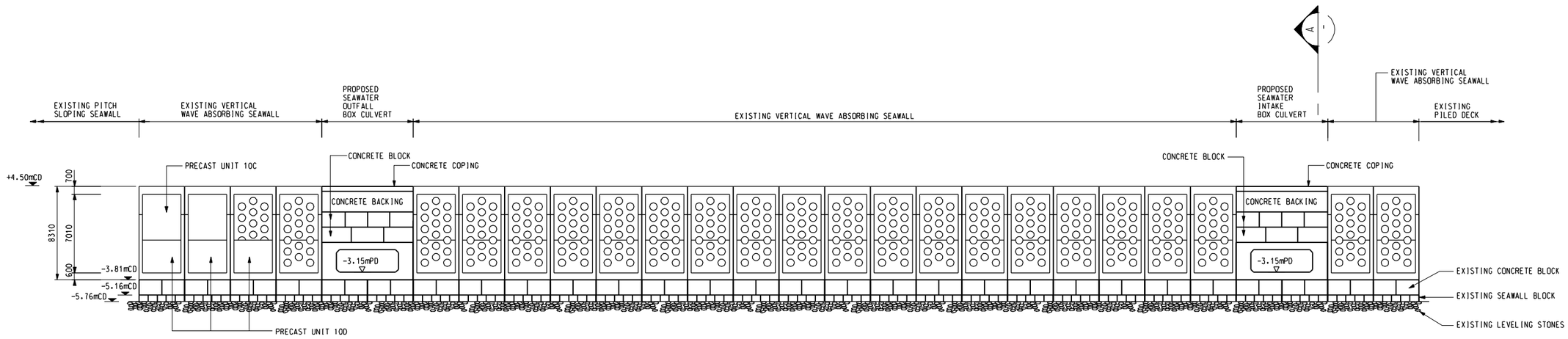
SEAWALL INTAKE AND OUTFALL BOX CULVERT LAYOUT
1:2000

NOTE:

CHART DATUM (C.D.) IS 0.146m BELOW THE PRINCIPAL DATUM (P.D.)



SECTION A
SCALE 1:200



ELEVATION OF SEAWATER INTAKE AND OUTFALL BOX CULVERTS
1:200

METRES 0 2 4 6 8 10 — 1 : 200
METRES 0 20 40 60 80 100 — 1 : 2000

REV	DESCRIPTION	BY	DATE	APPROVED
A	FIRST ISSUE	PTC	06FEB09	KC

DRAWN	WCH
DESIGNED	GLKW
CHECKED	PTC
APPROVED	KC
DATE	20/NOV/2008

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TITLE
NEX2101
WEST KOWLOON TERMINUS
SEAWATER INTAKE AND OUTFALL BOX CULVERTS - GENERAL ARRANGEMENT

SCALE 1 : 200 (A1)
DRAWING NO. NEX2101/P/WKT/AMT/C98/984
REV. A

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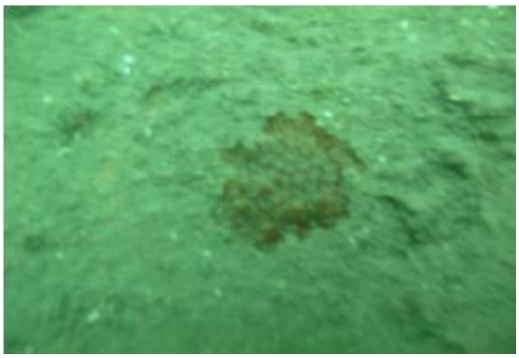
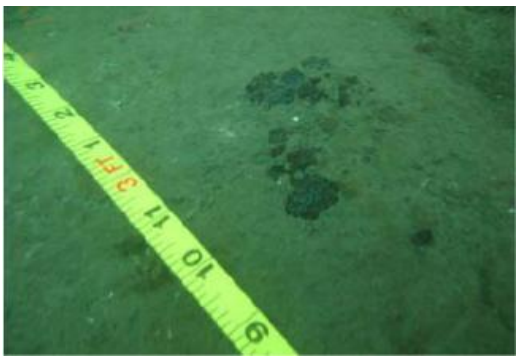
Annex E	Representative Photographs of Habitats and Species Recorded during the Survey

Annex E Representative Photographs of Habitats and Species Recorded during the Survey

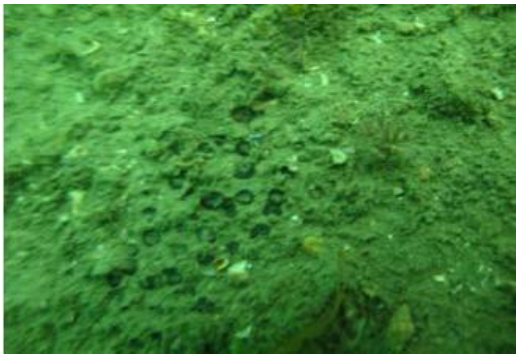

Artificial Vertical Seawall

Sloping Seawall

Big Boulders at the Seafront

Oulastrea Crispata

Balanophyllia sp.