CONTENTS

ANNEX

1 BASELINE MARINE ECOLOGICAL RESOURCES

1.1 INTRODUCTION

This report presents the baseline conditions of the marine ecological resources within the Assessment Area for Marine Ecology (Northwest Water Control Zone) and the Tai O Study Area (i.e. 500 m from the Project Boundary in Tai O). Marine ecological habitats and resources along the shoreline have been identified and the ecological values of the Assessment Area and Study Area have been evaluated based on information from available literature and recent ecological field surveys that were conducted during the wet season of 2011 to collect up-to-date marine ecological information.

1.2 RELEVANT LEGISLATION AND ASSESSMENT CRITERIA

The local relevant regulations, legislation and guidelines for the protection of species and habitats of ecological importance include the following:

- *Marine Parks Ordinance (Cap 476)*;
- *Wild Animals Protection Ordinance (Cap 170)*;
- *Protection of Endangered Species of Animals and Plants Ordinance (Cap 586)*;
- *Town Planning Ordinance (Cap 131)*;
- *Hong Kong Planning Standards and Guidelines Chapter 10 (HKPSG)*;
- *Technical Memorandum on Environmental Impact Assessment Process* under the *Environmental Impact Assessment Ordinance (EIAO TM)*;
- *United Nations Convention on Biodiversity (1992)*;
- *Wild Animal Protection Law*;
- *IUCN Red List Categories and Criteria;*
- *China Red Data Book of Endangered Species;* and
- *The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)*.

Details on each of the above are presented below.

1.2.1 *Marine Parks Ordinance (Cap 476)*

The *Marine Parks Ordinance* provides for the designation, control and management of marine parks and marine reserves. It also stipulates the Director of Agriculture, Fisheries and Conservation as the Country and

Marine Parks Authority, which is advised by the Country and Marine Parks Board. The *Marine Parks and Marine Reserves Regulation* was enacted in July 1996 to provide for the prohibition and control of certain activities in marine parks or marine reserves.

1.2.2 Wild Animals Protection Ordinance (Cap 170)

Under the *Wild Animals Protection Ordinance*, designated wild animals are protected from being hunted, whilst their nests and eggs are protected from destruction and removal. All birds and most mammals including all cetaceans are protected under this Ordinance, as well as certain reptiles (including all sea turtles), amphibians and invertebrates. The Second Schedule of the Ordinance that lists all the animals protected was last revised in June 1997.

1.2.3 Protection of Endangered Species of Animals and Plants Ordinance (Cap 586)

The *Protection of Endangered Species of Animals and Plants Ordinance* was enacted to align Hong Kong's control regime with the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). With effect from 1 July 2006, it replaces the *Animals and Plants (Protection of Endangered Species) Ordinance* (*Cap 187)*. The purpose of the *Protection of Endangered Species of Animals and Plants Ordinance* is to restrict the import and export of species listed in CITES Appendices so as to protect wildlife from overexploitation or extinction. The Ordinance is primarily related to controlling trade in threatened and endangered species and restricting the local possession of them. Certain types of corals are CITES listed, including Blue coral (*Heliopora coerulea*), Organ pipe corals (family Tubiporidae), Black corals (order Antipatharia), Stony coral (order Scleractinia), Fire corals (family Milleporidae) and Lace corals (family Stylasteridae). The import, export and possession of listed species, no matter whether dead or living, is restricted.

1.2.4 Town Planning Ordinance (Cap 131)

The *Town Planning Ordinance* provides for the designation of areas such as "Coastal Protection Areas", "Sites of Special Scientific Interest (SSSIs)", "Green Belt" and "Conservation Area" to promote conservation or protection or protect significant habitat.

1.2.5 Hong Kong Planning Standards and Guidelines Chapter 10 (HKPSG)

Chapter 10 of the *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 addresses the issue of enforcement. The appendices list the legislation and administrative controls for conservation, other conservation-related measures in Hong Kong, and Government departments involved in conservation.

1.2.6 Technical Memorandum on Environmental Impact Assessment Process under the Environmental Impact Assessment Ordinance (EIAO TM)

Annex 16 of the *EIAO TM* 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 ecological impacts.

1.2.7 United Nations Convention on Biological Diversity

The Peoples' Republic of China (PRC) is a Contracting Party to the *United Nations Convention on Biological Diversity* of 1992. The Convention requires signatories to make active efforts to protect and manage their biodiversity resources. The Government of the Hong Kong Special Administrative Region (HKSAR) has stated that it will be "committed to meeting the environmental objectives" of the Convention (PELB 1996).

1.2.8 Wild Animal Protection Law

The PRC in 1988 ratified the *Wild Animal Protection Law* of the PRC, which lays down basic principles for protecting wild animals. The Law prohibits killing of protected animals, controls hunting, and protects the habitats of wild animals, both protected and non-protected. The Law also provides for the creation of lists of animals protected at the state level, under Class I and Class II. There are 96 animal taxa in Class I and 161 in Class II. Class I provides a higher level of protection for animals considered to be more threatened.

1.2.9 IUCN Red List Categories and Criteria

The International Union for Conservation of Nature and Natural Resources (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.

1.2.10 China Red Data Book of Endangered Species

China Red Data Book of Endangered Species is a joint publication of China National Environmental Protection Agency (NEPA) and the Endangered Species Scientific Commission, PRC (ESSC). The first four volumes of this series cover China's vertebrates (i.e. aves, pisces, amphibia, reptilian and mammalia). The criteria of categories of species included in these volumes are 'extinct', 'extirpated', 'endangered', 'vulnerable', 'indeterminate' and 'rare'. These categories are basically based on the criteria set out by the IUCN Species Survival Commission (IUCN-SSC) for its global Red List. However, there are some important differences. The category "Extirpated"

includes those species which experts believe have been lost from China, although they may be secure in the other countries. The use of the category "Rare" has been discontinued by the IUCN-SSC, however, it is used here for those species that have always been rare in China but are not necessary to be vulnerable or endangered.

1.2.11 The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

CITES is an international agreement between governments. It aims to ensure that international trade in specimens of wild animals and plants does not threaten their survival. Roughly 5,000 species of animals and 28,000 species of plants are protected by CITES against over-exploitation through international trade. They are listed in the three CITES Appendices, in which the species are grouped according to how threatened they are by international trade. Appendix I lists species that are the most endangered and are threatened with extinction. Appendix II lists species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled. And Appendix III is a list of species included at the request of a Party that already regulates trade in the species and that needs the cooperation of other countries to prevent unsustainable or illegal exploitation.

1.3 DESCRIPTION OF THE ASSESSMENT AREA AND STUDY AREA

The Assessment Area for marine ecological impact assessment shall be the same as the Assessment Area for water quality impact assessment (i.e. Northwest Water Control Zone), while the efforts of field surveys are focused within a Study Area. The Study Area for the marine ecological surveys in Tai O is 500 m from the boundary of the project components, which include the upgrade of Tai O Sewage Treatment Works (STW), the construction of a new submarine sewage outfall alignments from the Tai O STW, the construction of Fan Kwai Tong and Hang Mei Sewage Pumping Stations (SPS), the associated rising mains, new sewerage system to various unsewered areas, construction of effluent reuses facilities and some existing and proposed sewers (*Figure 1.1)*.

The existing Tai O STW is situated in the northern coastal fringe of Tai O headland. The extent of Tai O STW is 0.34 ha of which 0.26 ha will be formed by reclamation. The sewage outfall will be re-aligned next to the existing one with the aim to cater for the increase in sewage flow. Soft- and hard-bottom subtidal habitats and both natural and artificial rocky shores were found within the vicinity of the Tai O STW.

The proposed Fan Kwai Tong SPS is located along Lantau Trail (Stage 7) between Fan Kwai Tong and Nam Chung Tsuen. Natural rocky and sandy shores are just off the proposed Fan Kwai Tong SPS. The proposed Hang Mei SPS is located to the south of Wang Hang Village next to Tai O Road where the site is relatively inland and far away from coastline.

All of the proposed rising mains and sewers to be constructed are along existing footpaths or within more developed residential areas except the section of the proposed sewer in Hang Mei where it will run across Tai O Creek.

1.4 SITE OF CONSERVATION IMPORTANCE

Within the Marine Ecological Assessment Area, there are a number of recognized sites of conservation importance, including Marine Parks, SSSIs, Artificial reefs, and seagrass and horseshoe crab sites (*Figure 1.2*). However, there are no existing Marine Parks, Sites of Special Scientific Interest (SSSIs) or Conservation Areas (CA) within the 500m Study Area, but it covers areas of Coastal Protection Area (CPA) (*Figure 1.3*). The sites of conservation importance are described below.

1.4.1 Sha Chau and Lung Kwu Chau Marine Park

The Sha Chau and Lung Kwu Chau Marine Park, designated on 22 November 1996, is situated in the open water on the western side of Hong Kong. This marine park covers a total sea area of about 1,200 hectares. The boundary is demarcated by yellow light buoys deployed at the corners of the marine park. The landward boundary largely follows the high water mark along the coastline of the islands. This marine park is about 10 km away from Tai O.

1.4.2 Proposed Marine Park at Brothers Islands

The proposed marine park is a mitigation measure for the HKBCF reclamation. The authority made a firm commitment to seek the designation of a marine park at Brothers Islands, to mitigate the habitat loss of Chinese White Dolphin. The detailed study for the proposed Marine Park is still ongoing, but a preliminary boundary has been proposed.

1.4.3 San Tau Beach Site of Special Scientific Interest (SSSI)

San Tau Beach SSSI was designated in 1994 and is a shallow sheltered beach of about 2.7 ha with fine sand and silt at the west coast of Tung Chung Bay. It harbours one of the largest seagrass areas on Lantau. Two species of seagrasses, *Zostera japonica* and *Halophila ovalis*, were recorded at San Tau Beach. San Tau is the only site located in western waters among the other known sites in Hong Kong where *Zostera japonica* is found. This species of seagrass was previously thought to be limited to the temperate regions, and is thus of special interest to plant biogeography. Besides seagrass beds, it is also one of the recognized horseshoe crab nursery sites Hong Kong (1).

(1) Chiu, H.M.C. and Morton, B. 1999. The distribution of horseshoe crabs (Tachypleus tridentatus and *Carcinoscorpius rotundicauda*) in Hong Kong. *Asian Marine Biology* 16: 185 – 196.

1.4.4 *Tai Ho Stream SSSI*

Tai Ho Stream SSSI is about 5ha in area and comprises the Tai Ho Stream and the inner part of Tai Ho Wan. "Tai Ho Stream" includes several tributaries that lie to the south and east of Tai Ho Wan, passing Tin Liu, Tai Ho San Tsuen, and merging just below Ngau Kwu Long, and entering Tai Ho Wan at its southern end. The importance of Tai Ho Stream to Hong Kong's freshwater fish fauna, and the linkages to other ecologically important intertidal habitats in Tai Ho Wan, qualify Tai Ho Stream as a habitat of high ecological value. Conservation and prevention of damage to the stream channel and riparian zone is essential. The Tai Ho Stream and part of its estuarine zone were designated as an SSSI in 1999 in recognition of the ecological importance of the stream and its fish fauna.

1.4.5 *Artificial Reef*

Two sets of artificial reefs (ARs) were deployed by government at the Sha Chau and Lung Kwu Chau Marine Park, and near the northeast corner of Airport Island within Marine Exclusion Zone 3, to enhance the food resources for dolphins. Both ARs were deployed in year 2000, with a footprint of 3,660 m^2 (5,580 m^3 in terms of volume) in the Marine Park, and a footprint of 1,200 m^2 (3,600 m^3 in terms of volume) in the Marine Exclusion Zone (1).

1.4.6 *Seagrass Site and Horseshoe Crab Breeding Site at Sunny Bay*

Surveys during September 2002 to January 2003 at Sunny Bay mudflat discovered an extensive seagrass bed estimated to cover an area of at least 0.8ha (2). The seagrass bed was formed by a dense cover of the *Halophila ovalis*. The seagrasses appeared to be in good condition with new growths appearing as sparsely arranged leaves fringing the dense beds. Re-identification of that seagrass found in Sunny Bay is *Halophila minor*. Juveniles of horseshoe crab were also recorded in Sunny Bay (3).

1.4.7 *Coastal Protection Area (CPA)*

About 6.7 ha covering the coastline north of Tai O Island and another coastal strip to the east of Po Chue Tam is zoned as "Coastal Protection Area" (CPA). According to the planning intention of *Outline Zoning Plan No. S/I-CC/5*, the CPA zone was gazetted to conserve, protect and retain the natural coastlines and the sensitive coastal natural environment, including attractive geological features, physical landform or area of high landscape, scenic or ecological value, with a minimum of built development. There is a general assumption against development in this zone, but some public works coordinated or implemented by Government including sewage works are always permitted. No construction or upgrading works under the Project will be carried out in the CPA area.

(1) AFCD website: http://www.artificial-reef.net/main2.htm#.

(2) CEDD 2005.EIA-109/2005 Road P1 Advance Works at Yam O on Lantau Island.

(3) AFCD website: http://www.afcd.gov.hk/english/conservation/con_wet/con_wet_sea/con_wet_sea.html.

1.5 LITERATURE REVIEW OF ECOLOGICAL CHARACTERISTICS AND HISTORICAL ECOLOGICAL SURVEYS

1.5.1 Introduction

A literature review was conducted to characterise the existing conditions within the Marine Ecological Assessment Area as well as the 500m Study Area and to identify habitats and species of potential importance in the area. The literature review included Government and private sector reports, independent and Government published literature, academic studies, vegetation maps and land use maps. Reviewed information included, but was not limited to, the following:

- *Hong Kong Biodiversity – Newsletter of Agriculture, Fisheries and Conservation Department (AFCD)*; and
- *Tai O Sheltered Boat Anchorage – Environmental & Drainage Impact Assessment EIA* (2000). Scott Wilson (Hong Kong) Ltd.

1.5.2 Marine Waters as Habitats for Marine Mammals

Marine waters constitute a type of marine habitat within Assessment Area as well as the Study Area. There are sixteen recorded cetacean species from Hong Kong waters (1). And in March 2009, a humpback whale was reported in Hong Kong. In March 2014 and January 2015, stranding of two new cetacean species to Hong Kong were recorded. This made the number of recorded cetacean to nineteen species. Only two of these recorded species, the Chinese White Dolphin (CWD in short form, also commonly known as Indo-Pacific humpback dolphin, *Sousa chinensis*) and Finless porpoise (*Neophocaena phocaenoides*) are resident. While the distribution range of Finless Porpoise in Hong Kong is limited to the southern and eastern Hong Kong waters and outside the Marine Ecological Assessment Area, only Chinese White Dolphins are present within the Assessment Area.

Chinese White Dolphin is present in the coastal and inshore waters throughout the Indo-pacific, from Australia and China in the east to South Africa in the west (2). Off the coast of south China, at least seven separate populations were identified from Guangxi up to the mouth of the Yangtze River, and all coincide with the presence of river mouths (3). One population of Chinese White Dolphin lives in the estuary of the Pearl River, where they inhabit waters of the Hong Kong SAR and Guangdong Province (including the waters around Macau SAR) (4)(5). In Hong Kong, Chinese White Dolphin

(1) Jefferson T.A. and S. Hung. 2007. An updated, annotated checklist of the marine mammals of Hong Kong. Mammalia (2007), pp. 105-114.

(2) Jefferson, T.A. and Karczmarski, L. 2001. *Sousa chinensis*. Mammalian Species No. 655, 1-9.

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

(4) Zhou, K., S. Leatherwood, and T.A. Jefferson 1995. Records of small cetaceans in Chinese waters: a review. Asian Marine Biology 12: 119-139.

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

is concentrated in the more estuarine-influenced waters, i.e. all the waters of western Hong Kong. They are present commonly year-round in the waters north and west of Lantau, and also occur seasonally or in small numbers to the south and east of Lantau Island, as well as in southern Deep Bay and to the west of Lamma Island(1)(2).

There appears to be seasonal shifts of CWD occurrence with the extent of river influence, moving farther south and east from the Pearl River in the wet season, and farther into the estuary proper in the dry season (3).

Calving seasonality was determined by computing an estimated birth date for each neonate and fetus in the sample, based on the average length at birth, along with fetal and early neonatal growth rates from the literature (4). Breeding appears to occur throughout the entire year, but there is a peak in the occurrence of births between the months of March and August (5).

Western and Northern Lantau waters are the most important areas of the Chinese White Dolphin in SAR waters. This has been concluded from systematic boat surveys for *Sousa chinensis* in Hong Kong waters since 1996. In 2014-2015, 197 individual dolphins with 259 re-sightings were identified during the AFCD marine mammal annual monitoring were made in West Lantau and northwest Lantau survey areas (6). When compared with the distribution records in the previous five monitoring periods (2007-2013), distribution pattern of CWD in 2014-2015 remained similar. CWD were sighted along the entire coastline of West Lantau, in particular near Tai O Peninsula and Fan Lau (6). The occurrence of CWB in North Lantau waters on the other hand, is mainly grouped to the northwestern portion which includes the waters around Lung Kwu Chau, Sha Chau and the mouth of Deep Bay. The occurrence in the northeastern Lantau waters in 2014 are rare, some sightings were made to the north of the airport platform where the proposed reclamation expansion for the third runway ensued (6).

Based upon the data from April 2014-March 2015, it has been noted that the encounter rates of dolphins from the northeastern Lantau, northwestern Lantau, Western Lantau and southwestern Lantau was the lowest when compared to previous monitoring periods since 2002 (*Figure 1.4*) (6).

For calves and juveniles of CWD in 2014-2015, 14 unspotted calves and 37 unspotted juveniles were sighted, out of the 1, 897 dolphins, in which 53.1% of

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

(2) Jefferson, T. A. 2000. Population biology of the Indo-Pacific hump-backed dolphin in Hong Kong waters. Wildlife Monographs 144, 65 pp.

(3) Jefferson, T. A. 2000. Population biology of the Indo-Pacific hump-backed dolphin in Hong Kong waters. Wildlife Monographs 144, 65 pp.

(4) Jefferson T.A. 2005. *Monitoring of Indo-Pacific Humpback Dolphins (Sousa chinensis) in Hong Kong waters – data analysis - final report submitted to AFCD.*

(5) Jefferson T.A. 2005. *Monitoring of Indo-Pacific Humpback Dolphins (Sousa chinensis) in Hong Kong waters – data analysis - final report submitted to AFCD.*

(6) AFCD 2015. Monitoring of Marine Mammals in Hong Kong Waters (2014-15) Final Report (1 April 2014 to 31 March 2015).

them were categorised into six (6) age classes. In comparison to previous monitoring periods, the spotted juveniles (21.5%) and spotted adults (12.3%) dominated the proportion of dolphins that has been identified with their age classes. The young calves distribution in 2014 were similar to those of the overall dolphin distribution, in which they were mainly sighted near Tai O Peninsula, Kai Kung Shan and around Lung Kwu Chau, but mostly absent in northeastern Lantau, South Lantau waters and Deep Bay [1] (*Figure 1.5*).

1.5.3 Subtidal Soft Bottom Habitats

Except in eastern and southern shores where the shallow subtidal habitat is rocky and coral-encrusted, the majority of subtidal seabed of Hong Kong is soft and comprises an admixture of sand and mud. The detailed composition of the soft sediment varies from place to place and is one of the main factors that determine the type of bottom dwelling (benthic) organisms which inhabits the sediment. Soft sediments support a wide range of bottom-dwelling (benthic) communities and standing crops, and have been long recognized as valuable feeding areas as they are major food source for demersal fishery [2].

A study of benthic assemblages throughout Hong Kong was undertaken [3]. The study concluded that the western waters of Hong Kong supports assemblages that are polychaete dominated (over 80%). Results from 2001 territorial-wide marine benthic survey [4] showed that Shannon diversities (in the station 3 km northeast to Tai O) were 2.66 and 2.98 during summer and winter season, respectively. Polychaete *Mediomastus* sp. and crab *Neoxenophthalmus obscurus* were the dominant species in that station. No species of conservation interest was recorded in the station and nearby stations.

The assessment area of *Tai O Sheltered Boat Anchorage* [5] overlaps with the centre part of the current Study Area. Benthic surveys in Tai O Bay indicated that polychaetes (ie *Mediomastus californiensis* and *Euclymene* sp.) and molluscs (ie *Gafrarium* sp.) are the dominant fauna found, as is typical of Hong Kong in general. These two taxonomic groups comprised over 90% of the organisms collected. The mean number of species and mean diversity index H' were markedly low for each sampling location, being 5.91 and 1.48 respectively. No rare species were recorded.

(1) AFCD 2015. Monitoring of Marine Mammals in Hong Kong Waters (2014-15) Final Report (1 April 2014 to 31 March 2015).

(2) AFCD website, Available at: ttp://www.afcd.gov.hk/english/conservation/con_mar/con_mar_mar/con_mar_mar.html.

(3) Shin, P.K.S. and Thompson, G.B. (1982). Spatial Distribution of the Infaunal Benthos of Hong Kong. Marine Ecology Progress Series 10: 37-47.

(4) CityU Professional Services Limited (2002) Consultancy Study on Marine Benthic Communities in Hong Kong (Agreement No. CE 69/2000). Prepared for the Agriculture, Fisheries and Conservation Department (AFCD).

(5) Scott Wilson (Hong Kong) Ltd. (2000). Tai O Sheltered Boat Anchorage.

1.5.4 *Intertidal Habitats*

The intertidal natural shore within Tai O Bay is a semi-exposed boulder shore in the southwestern part of the bay. Other natural coastline is found on the north of the headland (i.e. location of the current Tai O STW). The shores of these areas are mainly comprised of large boulders rounded by wave action and are bordered by steep cliffs. Findings of intertidal survey indicated that littorinid snails are the dominant taxonomic group (1).

Intertidal natural shores were surveyed and local fishers were interviewed to investigate the occurrence of horseshoe crabs in the Tai O anchorage site (2). Interviews with fishers showed that horseshoe crabs were occasionally seen or caught inside Tai O Bay and the intertidal portion of Tai O Creek. Carcasses of 4 adult (prosoma width > 25 cm) individuals of *Carcinoscorpius rotundicauda* were entangled in abandoned fish nets along the salt pan perimeter. Local fishers noted that horseshoe crabs were more often seen on more sandy shores at Yi O, indicating that Tai O is a suitable but may not be the most preferred habitat.

1.6 *ECOLOGICAL BASELINE SURVEY METHODOLOGY*

1.6.1 *Introduction*

The literature review on the marine ecological habitats and resources of the waters within and in close proximity to the existing to-be-upgraded Tai O STW has provided an indication to the ecological value of the Study Area. With the aim to supplement the review findings, a number of baseline surveys were undertaken for the proposed Project in Tai O during the wet season (July, September and October) of 2011. The baseline surveys conducted are summarised in *Table 1.1*.

Table 1.1 Marine Ecology Baseline Surveys

Survey Type	Brief Methodology	Survey Date
Intertidal Assemblages	1. Qualitative walk-through surveys; and 2. Quantitative surveys at 3 sites (three 100m belt transect at each site, ie at high, mid and low intertidal zones)	28 July, 27 September 2011 and 31 October 2011
Subtidal Hard Bottom Assemblages (Coral)	1. Qualitative spot dive checks; 2. Semi-quantitative (Rapid Ecological Assessment (REA) technique)	26 September 2011
Subtidal Benthic Assemblages	1. Quantitative grab sampling surveys at 6 sites (three stations at each site)	15 September 2011

(1) Scott Wilson (Hong Kong) Ltd. (2000). Tai O Sheltered Boat Anchorage.

(2) Scott Wilson (Hong Kong) Ltd. (2000). Tai O Sheltered Boat Anchorage.

Survey methodologies have been made reference to the technical guidelines of ecological assessment in *Annex 16* of *EIAO-TM* and the relevant *Environmental Impact Assessment Ordinance* (*EIAO) Guidance Notes* (*GN 7/2010* and *GN 11/2010*).

1.6.2 Intertidal Assemblages

Intertidal surveys were carried out to characterise the existing profile of the intertidal assemblages within the Project Site. It consisted of qualitative walk-through surveys and quantitative transect survey along the natural rocky shore, boulder shore, sandy shore and artificial seawall within the Project Site.

For qualitative walk-through surveys, the accessible shorelines within the Tai O Study Area were surveyed (*Figure 1.1*). Organisms encountered were recorded and their relative abundance noted. Active searches of horseshoe crabs were conducted at Tai O during the active period of horseshoe crab juveniles (ie July to October) to confirm whether horseshoe crabs were present along the coastline of Tai O.

Quantitative transect surveys were conducted at three locations (T1, T2 and T3, *Figure 1.1*) within the Study Area. Local tide tables were used to estimate tidal height at the site and to determine the time of survey. At each transect survey location, one 100 m horizontal (belt) transect along the shoreline was surveyed at each of the three shore heights: 2 m (high-shore), 1.5 m (mid-shore) and 1 m (low-shore) above Chart Datum (CD). On each transect, 10 quadrats (50 cm x 50 cm) were placed randomly to assess the abundance and diversity of flora and fauna. All organisms found in quadrats would be identified and recorded to the lowest possible taxonomic level (at least Genus level) to allow density per quadrat to be calculated. Sessile species, such as algae (encrusting, foliose and filamentous), barnacles and oysters, in each quadrat were identified to the lowest possible taxonomic level (at least Genus level) and estimated as percentage cover on the rock surface using a double-strung, 50 cm x 50 cm quadrat. In addition, if the transect location proved to be soft shore, all organisms found in the top 50 cm x 50 cm x 5 cm layer (length x width x depth) of the substrate should be identified to the lowest possible taxonomic level (at least Genus level) and recorded.

1.6.3 Subtidal Hard Bottom Habitat - Coral

Subtidal coral surveys were undertaken at subtidal hard bottom habitats within and in close proximity to the Project Area with a key focus at the proposed submarine effluent outfall alignment off Tai O STW. Baseline coral survey was only conducted once. The following two types of subtidal dive survey were carried out at locations shown in *Figure 1.1*.

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

<u>Qualitative Spot Dive Survey</u>

Six spot dive checks at Tai O were conducted which covered areas that were in close vicinity to the proposed outfall alignment and near the future outfall discharge point. At each survey location, a spot dive reconnaissance check was conducted along a 50 m transect and the substrate type, associated sessile benthos, particularly the presence of coral communities (including all hard corals, octocorals and black corals) were recorded. In addition, dive reconnaissance checks were carried out along the two 100 m transects for REA surveys. Representative photographs of the seabed and associated fauna were taken.

Quantitative Rapid Ecological Assessment (REA) Survey

Two locations were designated for REA survey which covered areas transversed by, and along the proposed outfall alignment (*Figure 1.1*). The REA technique allows semi-quantitative information on the ecological attributes of the subtidal habitat to be obtained in a relatively simple way without compromising scientific rigour along a 100 m transect. This technique is the standard practices for EIA marine baseline surveys in Hong Kong and has been modified from the standardised REA survey technique established for the assessment of coral communities on the Great Barrier Reef [(1)] for marine environment of Hong Kong [(2)]. Standard methodology for REA survey is summarised below.

REA surveys were conducted by coral specialists who were responsible for recording the field data. At each REA transect location, coral specialists were deployed underwater and swam along identified sections of survey area from haphazardly-chosen starting points. REA surveys were carried out using a 100 m transects with transects laid out within a single ecological zone – habitat – depth range.

The REA methodology will encompass an assessment of the benthic cover (Tier I) and taxon abundance (Tier II) undertaken in a swathe ~ 4 m wide, 2 m either side of each transect. The belt transect width was dependent on underwater visibility and might be adjusted to a swathe ~ 2 m wide, 1 m either side of each transect in case of reduced visibility. An explanation of the two assessment categories (Tiers) used in the survey is presented below.

Tier I – Categorisation of Benthic Cover

Upon the completion of each survey transect, five ecological and seven substratum attributes will be assigned to one of seven standard ranked (ordinal) categories (Table *1.2* and *1.3*).

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

(2) Fabricius, K.E. and D. McCorry. (2006). *Changes in octocoral communities and benthic cover along a water quality gradient in reefs of Hong Kong*. Marine Pollution Bulletin 52: 22-23.

Table 1.2 Categories used in the REA Surveys – Benthic Attributes

Ecological	Substratum
Hard coral	Hard Substratum
Dead standing coral	Continuous pavement
Soft coral	Bedrock
Black coral	Rubble
Macroalgae	Sand
Turf Algae	Silt
	Large boulders (>50 cm)
	Small boulders (<50 cm)
	Rocks (<26 cm)

Table 1.3 Categories used in the REA Surveys – Ordinal Ranks of Percentage Cover

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

Tier II – Taxonomic Inventories to Define Types of Benthic Communities

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

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

Following the completion of each transect survey, each taxon in the inventory will be ranked in terms of abundance in the community (*Table 1.4*). These broad categories rank taxa in terms of relative abundance of individuals, rather than the contribution to benthic cover along each transect. The ranks are subjective assessments of abundance, rather than quantitative counts of each taxon.

Table 1.4 Ordinal Ranks of Taxon Abundance

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

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

A set of environmental site descriptors will be recorded for each REA transect as follows:

(A) The degree of exposure to prevailing wave energy is ranked from 1 – 4, where:
1 = sheltered (highly protected by topographic features from previailing waves);

2 = semi-sheltered (moderately protected);

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

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

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

0 = no sediment;

1 = minor (thin layer) sediment deposition;

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

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

A suite of representative photographs will be taken for each REA transect. All field data will be checked upon completion of each REA transect and a dive survey proforma sheet will be completed at the end of the fieldwork day. Photographs will be compiled for each REA transect which will then be reviewed and REA data be verified. Verified REA data will be presented in terms of:

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

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

1.6.4 Subtidal Soft Bottom Assemblages - Benthos

Benthic sediment samples were collected from six sampling sites in the subtidal soft-bottom habitats for biological analyses (ie identification and abundance of macrobenthos). Sampling sites were along and/ or near the submarine outfall alignment and the future outfall discharge point (*Figure 1.1*).

Field Sampling Procedures

At each survey site, three sediment samples were collected by a grab sampler of at least 0.1 m^2 and 15 cm biting depth. Sediments from the grab samples were sieved on board the survey vessel, washed onto a sieve stack (comprising 500 μm and 250 μm meshes) and gently rinsed with seawater to remove all fine material. Materials remained on the two screens were combined and carefully rinsed using a minimal volume of seawater into a pre-labelled thick tripe-bagged ziplock plastic bags with 5% solution of borax-

buffered formalin containing Rose Bengal in seawater added for tissue preservation. Samples were transferred to the taxonomy laboratory for sorting and identification.

Laboratory Procedures

Macrobenthos

The benthic laboratory performed sample re-screening after the samples to be held in formalin for a minimum of 24 hours to ensure adequate fixation of the organisms. Individual samples from the 500 m^2 and 1 mm^2 mesh sieves were gently rinsed with fresh water into a 250 μm sieve to remove the formalin from the sediments. Sieves were partially filled while rinsing a specific sample to maximize washing efficiency and prevent loss of material. All materials retained on the sieve were placed in a labelled plastic jar, covered with 70% ethanol, and lightly agitated to ensure complete mixing of the alcohol with the sediments. Original labels retained with the re-screened sample material.

Standard and accepted techniques were used for sorting organisms from the sediments. Small fractions of a sample was placed in a petri dish under a 10-power magnification dissecting microscope and scanned systematically with all animals and fragments removed using forceps. Each petri dish was sorted at least twice to ensure removal of all animals. Organisms representing major taxonomic groups including Polychaeta, Arthropoda, Mollusca, and miscellaneous taxa were sorted into separate, labelled vials containing 70% ethanol.

Taxonomic identification was performed by qualified and experienced specialist using stereo dissecting and high-power compound microscopes. These are generally to the species level except for unidentified taxa, which was identified to genera as far as practical. The careful sampling procedure employed minimizes fragmentation of organisms. If breakage of soft-bodied organisms occurs, only anterior portions of fragments were counted, although all fragments retained and weighed for biomass determinations (wet weight).

1.7 RESULTS OF ECOLOGICAL BASELINE SURVEYS

1.7.1 Intertidal Assemblages

Qualitative Walk-through Survey

Within the 500 m Study Area, qualitative walk-through survey was conducted along all accessible shorelines to record organisms encountered with their relative abundance noted (*Figure 1.1*). Based on the findings of the qualitative walk-through survey, a habitat map of suitable scale (ie 1: 5,000) was produced (*Figure 1.3*).

Results of this qualitative survey showed that the shorelines along the StudyArea mainly comprised of natural rocky shore and artificial seawall and

boulder/sandy shore and mudflat. The mangrove habitats were discussed in the Terrestrial Ecological Baseline Report.

Common intertidal fauna species found at the boulder/sandy shore habitats, other than mudflat, include rock oysters *Saccostrea cucullata*, sea slaters *Ligia exotica*, barnacles *Capitulum mitella*, snails *Nodilittorina trochoides, Lunella coronata, Monodonta labio*, *Nerita albicilla, Nodilittorina radiata, Thais clavigera* and *Nassarius festiva*. Common intertidal fauna species found at the intertidal hard bottom habitats include rock oysters *Saccostrea cucullata,* snails *Littoraria articulata, Nodilittorina trochoides, Nodilittorina radiata, Thais clavigera, Nerita albicilla*, limpets *Nipponacmea concinna* and *Patelloida pygmaea*

Mudflats were dominated by fiddler crabs *Uca radiata*, mudskippers *Periophthalmus cantonensis*, rock oysters *Saccostrea cucullata* and snails *Lunella coronata*, *Cerithidea rhizophorarum*, *Monodonta labio* and *Nerita costata*. Since mudflat is considered to be suitable habitats for horseshoe crabs, active search for this species has been done along shores in Tai O Bay during the qualitative walk-through while no signs of it could be found along the shores within the Study Area.

Quantitative Intertidal Survey

Transects T1 to T3 were located on the northern part of Tai O Island where the shoreline was composed of rocks and large boulders. GPS coordinates of transects T1 to T3 are presented in *Table 1.5*. T1 and T2 were located just off and adjacent to the Tai O STW respectively where these locations were more exposed, whereas T3 was in a more sheltered location compared with transects T1 and T2. Dominant species from these three transects were found to be quite different (*Annex A1*).

A total of 31 faunal and flora groups were recorded on transects T1 to T3 during the quantitative survey in the wet season of 2011. On transect T1, 17 fauna and 3 algal groups were recorded. Both the density of mobile species and percentage cover of sessile fauna were 29.0 individual m^{-2} and 7.2 % m^{-2} respectively. On transect T2, 20 faunal groups were recorded with no encrusting algae recorded. The density of mobile species and percentage cover of sessile fauna were 10.3 individual m^{-2} and 16.9 % m^{-2} respectively. On transect T3, 14 faunal groups were recorded whereas the density of mobile species and percentage cover of sessile were 1.0 individual m^{-2} and 3.4 % m^{-2} respectively. Summarised data for the Baseline Intertidal Survey is presented in *Table 1.6*.

Baseline intertidal surveys showed that these natural boulder shores supported a typical boulder/ rocky shore fauna and flora assemblages. Dominant (in terms of abundance) epibenthic species recorded on transects T1 and T2 included the periwinkles *Nodilittorina trochoides* and *Nodilittorina radiata* in the high-shore, the nerites *Nerita albicilla,* the barnacles *Tetraclita japonica* and the rock oysters *Saccostrea cucullata* in the mid-shore and the rock oysters *Saccostrea cucullata,* the snail *Monodonta labio* and the barnacles *Tetraclita japonica* in the low-shore.

Transect T1 was characterised by the higher coverage percentage of encrusting algae *Hildenbrandia rubra* (~20%) in the high-shore and *Pseudulvella applanata* (~30%) in the low-shore. Transect T2 was characterised by the higher density of the periwinkles *N. radiata* in the high-shore and the nerites *N. albicilla* in the mid-shore. Transect T3 was dominated by a high coverage of rock oysters *S. cucullata* and peanut worms *Sipunculus vulgaris* at all three shore levels. Mid-shore were characterised by relatively higher density of the topshells *Monodonta labio* while low-shore was characterised and dominated by the bivalves *Septifer virgatus.* Transect T3 was unique from transects T1 and T2 for the absence of snails *Littoraria articulata* and the presence of peanut worms *Sipunculus vulgaris.*

Overall, no rare species were recorded in the baseline intertidal survey in the Study Area. All species recorded were considered to be common and widespread as in other rocky shores in Hong Kong.

Table 1.5 GPS Coordinates of Intertidal Survey Transects for the Baseline Survey

	T1		T2		T3	
Start	22°15.848′	113°51.365′	22°15.771′	113°51.472′	22°15.606′	113°51.678
End	22°15.775′	113°51.460′	22°15.741′	113°51.561′	22°15.648′	113°51.762

Table 1.6 Mean Density (m^{-2}) of Intertidal Fauna and Mean Percentage Cover (%) of Sessile Fauna and Flora recorded at Three Transects T1-T3 at Tai O during Wet Season (July, September and October 2011) Surveys

	T1			T2			T3		
	High-Intertidal Zone (2.0 m CD)	Mid-Intertidal Zone (1.5 m CD)	Low-Intertidal Zone (1 m CD)	High-Intertidal Zone (2.0 m CD)	Mid-Intertidal Zone (1.5 m CD)	Low-Intertidal Zone (1.0 m CD)	High-Intertidal Zone (2.0 m CD)	Mid-Intertidal Zone (1.5 m CD)	Low-Intertidal Zone (1.0 m CD)
Snail									
Chlorostoma argyrostoma	0	0	0	0	0	4.4	0	0	0
Littoraria articulata	25.2	7.6	0	0.8	4	0	0	0	0
Lunella coronata	0	0	0	0	0	0	1.6	1.6	0
Monodonta labio	0	28.8	39.6	0	2	3.2	0	19.2	4.8
Morula musiva	0	0.8	2.4	0	0	16.4	0	0	0
Nassarius festiva	0	0	0	0	0	0	1.6	0	1.6
Nerita albicilla	0	30.8	28.8	0	40	33.2	0	1.6	0
Nodilittorina radiata	87.6	0	0	142	14.4	0	0	0	0
Nodilittorina trochoides	0	0	0	104	1.2	0	0	1.6	0
Planaxis sulcatus	0	0.4	0	0	0	0	0	0	0
Thais clavigera	0	0.4	6.4	0	4.4	1.6	0	0	4.8
Limpet									
Nipponacmea concinna	2.4	8.8	37.6	0.4	0	6	0.4	3.2	3.2
Patelloida pygmaea	0	0	40.8	0	19.6	4.8	0	0	0
Siphonaria japonica	0.8	0	0	0	0	1.6	0	0	0
Chiton									
Acanthopleura japonica	0	0	0.4	0	0	0.4	0	0	0
Bivalve (%)									
Barbatia virgatus	0	0	0	0	0	6	0	0	0
Perna viridis	0	0	0	0	0.3	0.8	0	0	0
Saccostrea cucullata	8.7	36.0	59.0	1.0	33.3	67.5	6.6	6.9	9.9

	T1			T2			T3		
	High-Intertidal Zone (2.0 m CD)	**Mid-Intertidal Zone (1.5 m CD)**	**Low-Intertidal Zone (1 m CD)**	**High-Intertidal Zone (2.0 m CD)**	**Mid-Intertidal Zone (1.5 m CD)**	**Low-Intertidal Zone (1.0 m CD)**	**High-Intertidal Zone (2.0 m CD)**	**Mid-Intertidal Zone (1.5 m CD)**	**Low-Intertidal Zone (1.0 m CD)**
Septifer virgatus	0	0	0	0	0	0	0	0	1.6
Barnacle (%)									
Capitulum mitella	0	0	0	4.0	2.1	0	0	0	0
Chthamalus malayensis	0.1	0	0	0	0	0	0	0.1	0.1
Tetraclita japonica	0	3.0	3.5	0	4.4	12.6	0	0	0
Crab									
Hermit crab	0	0.8	0	0	0	0	3.2	3.2	0
Hemigrapsus sanguineus	0.4	0	0	0	0.4	0	8	8	0.4
Worm									
Marphysa sanguinea	0	0	0	0	0	0	0	0	0
Sipunculus vulgaris	0	0	0	0	0	0	12.8	14.4	27.2
Algae (%)									
Hilenbrandia rubra	20.1	3.8	0	0	0	0	0	0	0
Krytuthrix maculans	3.8	0	0	0	0	0	0	0	0
Pseudulvella applanata	10.0	1.8	30	0	0	0	0	0	0
Others									
Sea anemone	0	0	0	0	0.4	0	1.6	0	0
Ligia exoctica	0.4	0	0.4	0	0.4	0	0	0	0
Total number of Species		**20**			**20**			**14**	
Density of Mobile Species per Quadrat (Individual m^{-2})		**29.0**			**10.3**			**1.0**	
Percentage Cover of Sessile Fauna (% m^{-2})		**7.2**			**16.9**			**3.4**	

1.7.2 Subtidal Hard Bottom Habitat - Coral

Qualitative Spot Dive Survey

Qualitative spot dive check was conducted by qualified coral specialists at six sites (ie Spot Dive Sites 3-8) by SCUBA within the Survey Area to confirm the substrate type and associated sessile benthos, particularly the presence of coral communities (hard and soft corals). Coral species encountered during the spot dive checks were identified to the lowest possible taxonomic level. *Figure 1.6* presented the locations where gorgonians and ahermatypic cup corals were found. Representative photographs of the seabed and associated fauna were taken and presented in *Figure 1.7*.

Abiotic Composition

In the shallow water region from approximately -2.0m to -3.5m CD, large boulders were the main seabed component with small proportion of small boulders and sand. In the deep water region from approximately -3.5m CD onwards, silt was the only seabed component found.

Biotic Composition

Among all six spot dive sites, only two species of corals (one ahermatypic coral and one gorgonian) were recorded on the subtidal hard bottom substratum. Ahermatypic cup coral *Balanophyllia* sp. recorded at sites 5 and 7. Gorgonian *Echinomuricea* sp. colonies were found at all spot dive sites between -2 m CD to -4 m CD, except at site 4 (*Table 1.7)*.

Other common subtidal sessile species recorded include green mussels, coralline algae and whelks.

Table 1.7 Coral Species Recorded at the Qualitative Spot Dive Sites

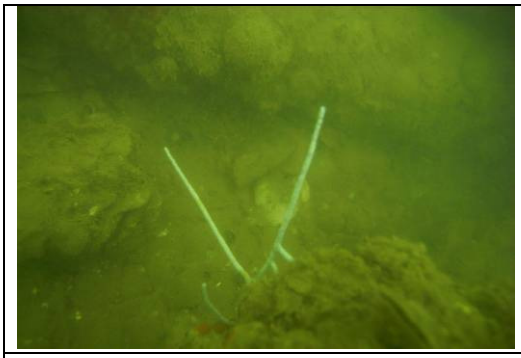
	Dive Site 3	**Dive Site 4**	**Dive Site 5**	**Dive Site 6**	**Dive Site 7**	**Dive Site 8**
Balanophyllia sp.	0	0	1	0	1	0
Echinomuricea sp.	1	0	1	1	1	1

Note: (a). 0=absent, 1=present

Semi-Quantitative REA Findings

REA surveys were conducted by qualified coral ecologists by SCUBA at a total of two transects that were laid onto the seabed of waters off the Tai O STW, with GPS coordinates shown in *Table 1.8*. One transect ran parallel to the proposed outfall alignment while the other one ran parallel to the shoreline of Tai O STW, both were in close vicinity of the proposed works (*Figure 1.1*). Survey field data is presented in *Table 1.9.*

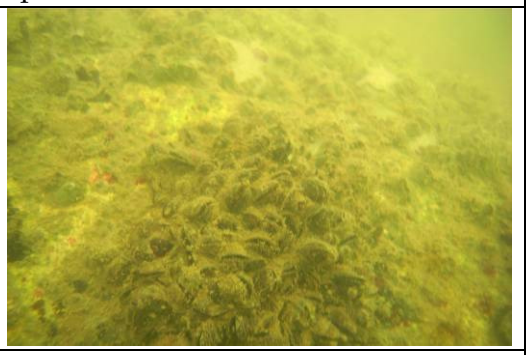
Figure 1.7 ***Representative Photographic Records Showing Coral Assemblages and Benthic Composition in the Study Area - Tai O***



Gorgonian *Echinomuricea* sp. recorded on transect T6

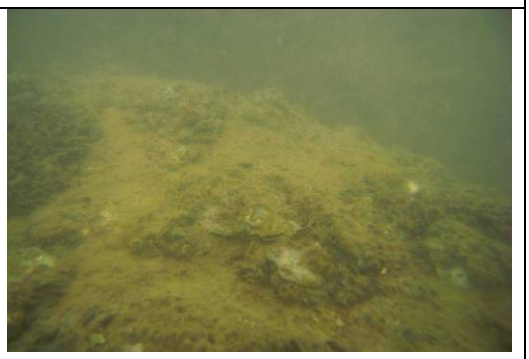
Ahermatypic cup coral *Balanophyllia* sp. recorded on transect T7

Colonies of ahermatypic cup corals found to be abundant in the Tai O Study Area



Black mussels, *Septifer virgatus* grew on boulders on transect T7

Sessile barnacles, *Balanus amphitrite*, found to be abundant on boulders in shallow region



Large boulder is the major benthic composition in shallow region (~ 1m CD to ~4m CD)

Table 1.8 ***GPS Coordinates of REA Transects for the Baseline Dive Survey***

	Start Point		End Point	
T1	22°15.671′	113°51.481′	22°15.736′	113°51.410′
T2	22°15.723′	113°51.582′	22°15.676′	113°51.498′

Table 1.9 REA Field Data during Baseline Dive Survey

	Ahermatypic Cup Coral *Balanophyllia* sp.	**Gorgonian *Echinomuricea* sp.**
Location of corals	-1.5 m CD to -3 m CD	-2 m CD to -4 m CD
Size of coral species	<1 cm diameter	<10 cm height
Coverage	<5%	<5%
Relative Abundance	Common	Common
Number of colonies	T1 =20; T2=5	T1=8; T2= 1
Health status	Good	Good
Substrate attached	Boulders	Boulders
Conservation status	Protection of Endangered Species of Animals and Plants Ordinance (Cap. 586)	-
Rarity	Common	
Distribution in Hong Kong waters	In Western Hong Kong waters, with a patchy distribution	

Abiotic/Physical Composition of REA Transects

Results of the Baseline Dive Survey indicated that the shallow region of T1 (-1.5 m CD to -3.5 m CD) and whole transect of T2 were mainly comprised of large and small boulders, while abiotic composition of deeper depth of transect T1 was mainly composed of silt. Underwater visibility was extremely low (<0.3 m) during the dive survey.

Biotic Composition of the Benthic Community

The sessile benthic community established on the hard substrates was composed predominantly of barnacles *Balanus amphitrite*, green mussels *Perna viridis*, sponges, black mussels *Septifer virgatus*, coralline algae and with sparse coral coverage (<5%) (*Table 1.10* and *1.11*). Only one species of ahermatypic cup coral *Balanophyllia* sp. and one species of white gorgonian *Echinomuricea* sp. were recorded along transects T1 and T2. Ahermatypic cup coral *Balanophyllia* sp. has rarely been recorded in the oceanic eastern and southern waters of Hong Kong and it is likely that these corals are adapted to the hyposaline waters in the Study Area. All subtidal species recorded in qualitative dive survey including ahermatypic cup coral *Balanophyllia* sp., gorgonian *Echinomuricea* sp., barnacles *Balanus* sp. and sponges were considered to be common and widespread within Hong Kong waters (1).

Twenty and five colonies of the dominant (in terms of abundance) ahermatypic cup coral species *Balanophyllia* sp. were recorded on transects T1 and T2, respectively. Eight and one colonies of gorgonian *Echinomuricea* sp. with height less than 15 cm were recorded on transects T1 and T2, respectively. The appearance of the majority of coral colonies indicated that their overall condition was good with no stress signs exhibited (eg retracted polyps, partial mortality and bleached colonies etc). Low salinity of Western waters in Hong Kong limited the development of hard coral to only a few thriving species which can tolerate low salinity and high turbidity such as

(1) Chan, L.K. Alan *et. al.* (2005). Field Guide to Hard Corals of Hong Kong. Published by Friends of the Country Park.

ahermatypic cup coral *Balanophyllia* sp. All coral colonies were growing on boulders which were immovable, so the feasibility to be translocated was low.

Overall, the results of the Baseline Dive Survey showed that sparse colonies of locally common, widespread coral species are present within the Survey Area. The low abundance and diversity of subtidal coral assemblages at the baseline dive sites in the Tai O Study Area is typical for the western Hong Kong waters.

Table 1.10 REA Results: Tier I Data – Key Benthic Attributes of Two Transects during Baseline Dive Survey

Benthic Attributes	T1	T2
Survey Date		
Ecological Attribute [a]		
Hard coral	1	1
Dead standing coral	0	0
Soft coral	1	1
Black coral	0	0
Macroalgae	0	0
Turf Algae	0	0
Substratum [a]		
Hard substrate	0	0
Continuous pavement	0	0
Bedrock	0	0
Rubble	0	0
Sand	3	2
Silt	5	0
Large boulders (>50cm)	4	6
Small boulders (<50cm)	3	3
Rocks (<26 cm)	0	0
Physical Descriptors		
Visibility	<0.3m	<0.3m
Exposure [b]	3	2
Sediment ©	2	2
Damage	0	0
Bleaching[d]	0	0
Slope [e]	1	0
Maximum depth	2m	2m
Minimum depth	5m	2m

Note:
(a) 0 = None recorded; 1 = 1-5% Cover, 2 = 6-10% Cover, 3 = 11-30% Cover, 4 = 31-50% Cover, 5 = 51-75% Cover, 6 = 76-100% Cover.
(b) Exposure: 1 = sheltered, 2 = semi-sheltered, 3 = semi-exposed, 4 = exposed
© Sediment: 0 = none, 1 = thin layer, 2 = resuspended, 3 = thick layer of mud
(d) Bleaching = % of total coral cover
(e) Slope: 0 = flat, 1 = gentle, 2 = medium, 3 = steep, 4 = vertical

Table 1.11 REA Results: Tier II Data – Species Inventory and General Abundance Rating of Two Transects during Baseline Survey

Type	Phylum/Family	Genus	Species	Abundance Rating T1	Abundance Rating T2
Ahermatypic Hard Coral	Dendrophyllidae	*Balanophyllia*	sp.	3	3
Octocoral	Plexauridae	*Echinomuricea*	sp.	3	3
Others	Crustacea	*Balanus*	*amphitrite*	4	4
	Porifera	Sponges		2	2
	Bivalvia	*Perna*	*viridis*	3	3
		Septifer	*virgatus*	3	3
	Gastropoda	Gastropod (eg Whelks)	---	2	2
	Coralline Algae	---	---	2	2

Notes:
Abundance rating: 0 = absent; 1 = rare; 2 = uncommon; 3 = common; 4 = abundant.

1.7.3 Subtidal Soft Bottom Assemblages -Benthos

A subtidal benthic survey was carried out in the subtidal soft-bottom habitats at the Northern Tai O offshore site along and/ or near the submarine effluent outfall alignment and the future outfall discharge point on 15 September 2011. This included 18 samples for macrobenthos (3 replicate samples at 6 stations). Locations and GPS coordinates of sampling sites are presented in *Figure 1.1* and *Table 1.12*, respectively. Benthos sampling results are presented in *Annex A1* in more details.

Table 1.12 GPS Coordinates of Subtidal Benthic Survey Locations

Stations	Depth (m)	Lat	Long
A	8.3	22°15.745′	113°51.425′
B	8.3	22°15.690′	113°51.482′
C	12	22°15.649′	113°51.106′
D	8.1	22°15.581′	113°51.183′
E	5.2	22°15.867′	113°51.847′
F	3.1	22°15.777′	113°51.915′

Benthic surveys at six sampling locations in waters north of Tai O headland showed that 122 individuals of organisms in 9 phyla with 10 classes, 32 families and 36 species in 18 benthic grab samples.

In terms of infaunal abundance, the majority of the organisms recorded in the subtidal soft bottom habitat were from the Phylum Annelida (~44%), followed by Mollusca (~27%) and Echiura (~10%) (*Table 1.13)*. Each of the other phyla contributed to around or less than 7% of the total population abundance. Generally, the subtidal soft-bottom habitat in Tai O was dominated by polychaetes *Notomastus latericens*, gastropods *Turritella bacillum* (present only in station D) and echiuridae *Thalassema sabinum* (*Annex A2*). All species

recorded are common and widespread in Hong Kong and no rare species could be found.

Table 1.13 Benthic fauna composition within the Study Area - Tai O

Phylum	Number of Families	Number of Species	Number of Individuals	Percentage of Abundance	Percentage of Biomass
Annelida	14	15	54	44.3	1.5
Arthropoda	5	6	9	7.4	2.2
Echinodermata	2	2	4	3.3	1.6
Mollusca	5	7	33	27.0	93.5
Nemertinea	1	1	1	0.8	0.03
Platyhelminthes	1	1	1	0.8	0.02
Echiura	1	1	13	10.7	1.0
Chordata	2	2	6	4.9	0.02
Coelenterata	1	1	1	0.8	0.05
Total	**32**	**36**	**122**	**100**	**100**

The data analysis in *Table 1.14* indicated that the numerical abundance at Stations A to D was much higher than that at Stations E and F. The total number of specimens ranged from the highest at Station A (n=28) to the lowest at Station E (n=11).

In terms of infaunal biomass, organisms from the Phylum Mollusca contributed to about 94% of the total biomass recorded, followed by Arthropoda (~2%) and Echinodermata (~1.6%) (*Table 1.13*). Each of the other phyla contributed to about or less than 1% of the total infaunal biomass. *Table 1.14* indicated that the highest average wet weight was observed at Station D (53.49 g per 0.5 m^2), while Station B (1.43 g per 0.5 m^2) exhibited the lowest wet weight. The highest biomass value at Station D was due to the presence of large specimens of mollusca fauna (ie *Turritella becillum*). Benthic Shannon Diversity Index (H') ranged from 1.47 at Station F to 2.89 at Station A, indicating that benthic faunal diversity was highest at Station A (*Table 1.14*). Pielou's Evenness Index (J') ranged from 0.73 at Station D to 0.98 at Station E.

The benthic assemblages within the Tai O Study Area shown in *Table 1.14* are much lower than that in Hong Kong waters. The average of number of species (11.17 species per 0.5 m^2), the average number of individuals (18.17 individuals per 0.5 m^2) and the average wet weight (12.38 g per 0.5 m^2) are low when compared with mean values reported by CityU Professional Services Limited (2002) (1) for benthic assemblages in Hong Kong (33 species per 0.5 m^2, 270 individuals per 0.5 m^2 and 35.60 g per 0.5 m^2). Such relatively lower species richness and abundance at the Tai O Study Area compared to other areas is likely due to the proximity of Pearl River Estuary which leads to low salinity and possibly due to the predominantly silt-clay composition of the seabed that tends not to support high diversity.

(1) CityU Professional Services Limited (2002) Consultancy Study on Marine Benthic Communities in Hong Kong (Agreement No. CE 69/2000). Prepared for the Agriculture, Fisheries and Conservation Department (AFCD)

On the whole, the subtidal benthos survey showed that the infaunal assemblages of the surveyed sites consisted of common, widespread species which are typical of disturbed environment, ie the presence of numerical dominance of low biomass, stress-tolerant and short-lived polychaete species in the Phylum Annelida. Infaunal assemblages were largely similar among the six surveyed sites within the Study Area.

Table 1.14 Summary Information from Subtidal Benthic Survey (Wet Season 2011)

Station No.	No. of Species (per 0.5m²)	No. of Individuals (per 0.5m²)	Wet Weight (g per 0.5m²)	Shannon Diversity Index (H′)	Pielou's Evenness Index (J′)
A	21	27	4.91	2.89	0.96
B	15	25	1.43	2.59	0.96
C	9	21	1.88	1.73	0.79
D	8	26	53.49	1.52	0.73
E	9	11	11.09	2.15	0.98
F	5	12	1.49	1.47	0.83
Overall Mean	11.17	18.17	12.38	--	--
Overall in HK (1)	33	270	14.00	--	--

(1) CityU Professional Services Limited (2002) Consultancy Study on Marine Benthic Communities in Hong Kong (Agreement No. CE 69/2000). Prepared for the Agriculture, Fisheries and Conservation Department (AFCD)

1.8 SUMMARY OF MARINE ECOLOGICAL RESOURCES

The existing conditions of the marine ecological habitats and resources in the waters of the proposed upgraded Tai O STW, sewer, rising main and SPS have been assessed. These baseline conditions have been based on available literature and, where considered necessary, focussed field surveys to update and supplement the data. Based on this information, the ecological importance of each habitat has been determined according to the *EIAO-TM Annex 8* criteria, as follows:

- Naturalness
- Size
- Diversity
- Rarity
- Re-creatability
- Fragmentation
- Ecological Linkage
- Potential Value
- Nursery Ground
- Age
- Abundance

It should be noted that in order to provide information of key relevance to the marine ecological assessment, the ecological importance of habitats presented in this baseline is therefore primarily focussed on the vicinity of the works areas of the proposed project.

1.8.1 Intertidal Habitats

The criteria listed below have been applied to the information gathered or reviewed on the marine ecology of the intertidal habitats within the Study Area in order to determine the ecological value. The application of these criteria has led to the intertidal habitats to be classified as low to moderate ecological importance (*Table 1.15*).

Table 1.15 Ecological Evaluation of Intertidal Habitats within Study Area of Tai O

Criteria	Natural Rocky Shore	Artificial Shoreline	Boulder/ Sandy Shores
Naturalness	Natural, largely undisturbed moderately-exposed rocky shores	Artificially constructed seawall	Natural, largely undisturbed
Size	The total length of the natural rocky shore in the Study Area is about 2 km and is one of the predominant habitat type in the 500 m Study Area.	The total length of the artificial seawall is about 20 to 30 m which is not the predominant habitat type in the 500 m Study Area.	The total length of the boulder/ sandy shore is 1.5 km which is one of the predominant habitat type in the 500 m Study Area.
Diversity	Low. The intertidal assemblages of the natural shore comprise of typical biota of moderately-exposed rocky shores in Hong Kong, but with low species diversity.	Very low. Intertidal organisms were only found at the low-shore region on the artificial seawall.	Low. The intertidal assemblages of the natural shore comprise of typical biota of sheltered shores in Hong Kong, but with low species diversity.
Rarity	No species recorded are considered rare or of recognised conservation interest	No species recorded are considered rare or of recognised conservation interest	No species recorded are considered rare or of recognised conservation interest
Re-creatability	Hard bottom substrata may be re-colonised by intertidal and subtidal organisms	Hard bottom artificial seawall may be re-colonised by intertidal and subtidal organisms	Soft bottom substrata may be re-colonised by intertidal and subtidal organisms
Fragmentation	Unfragmented	The surrounding coastlines are composed natural rocky shores	The surrounding coastlines are composed natural rocky shores
Ecological linkage	The habitat is not functionally linked to any high value habitat in a significant way. Generally linked with the open sea.	The habitat is not functionally linked to any high value habitat in a significant way. Generally linked with the open sea.	The habitat is not functionally linked to any high value habitat in a significant way. Generally linked with the open sea.
Potential value	Low. Unlikely to become an area of conservation value.	Very low. This artificial habitat does not support any intertidal organisms. Unlikely to become an area of conservation value.	Low. Unlikely to become an area of conservation value.
Nursey/ breeding ground	Not identified during the literature review or field surveys	Not identified in the literature review or field surveys	Not identified in the literature review or field surveys
Age	n/a	The artificial seawall has been in place for decade	n/a
Abundance/ Richness of wildlife	Low, and generally abundant in typical intertidal assemblages found in moderately-exposed shores in Hong Kong	Very low and generally occupied by very typical intertidal assemblages	Low, and generally abundant in typical intertidal assemblages found in sheltered shores in Hong Kong

Criteria	Natural Rocky Shore	Artificial Shoreline	Boulder/ Sandy Shores
SUMMARY	Diversity and abundance of intertidal species are low and they are typical among moderately-exposed rocky shores of Hong Kong	Diversity and abundance of intertidal species on artificial seawall are very low	Diversity and abundance of intertidal species are low and they are typical among sheltered shores of Hong Kong
Ecological Importance	**Low-Moderate**	**Low**	**Low-Moderate**

Note: n/a Not Applicable

1.8.2 Subtidal Hard Bottom Habitats

The criteria listed below have been implemented to the information gathered or reviewed on the marine ecology of the subtidal habitats at the proposed upgraded Tai O STW in order to determine the ecological importance. The application of these criteria has led the subtidal hard-bottom habitats to be classified as of low ecological importance (*Table 1.16*).

Table 1.16 Ecological Evaluation of the Subtidal Hard Bottom Habitats of the Study Area in Tai O

Criteria	Subtidal Hard Bottom Habitat
Naturalness	Natural and largely undisturbed
Size	Habitat is large in extent
Diversity	The assemblages are of low diversity compared to other areas in the Hong Kong waters. Only one species of ahermatypic hard coral *Balanophyllia* sp. and one species of octocoral *Echinomuricea* sp. were recorded
Rarity	Gorgonian *Echinomuricea* sp. and ahermatypic cup coral *Balanophyllia* sp. which were commonly found in Hong Kong waters could be recorded in subtidal hard bottom habitat in the Study Area
Re-creatability	Habitat is re-creatable. Benthic organisms including corals may recolonise disturbed seabed area
Fragmentation	Low. Subtidal hard bottom habitat from long continuous expanses along the margins of neighboring rocky coasts
Ecological linkage	The habitat is generally linked with the open sea and is not functionally linked to any high value habitat in a significant way
Potential value	Low. Development and growth of coral colonies constrained by estuarine environment
Nursery/ breeding ground	Breeding/nursery ground for marine species
Age	n/a
Abundance/ Richness of wildlife	Low. A sparse cover (<5%) of ahermatypic cup corals and octocorals were recorded. In comparison to parts of the southern waters, the hard and octocoral assemblages are of low abundance
SUMMARY	The subtidal hard-bottom habitat is supports a low diversity and abundance of benthic species which are common and widespread within Hong Kong waters. This is resulted from the high sedimentation rate and the estuarine conditions due to the Pearl River estuaries.
Ecological Importance	**Low**

Note: n/a Not Applicable

1.8.3 Subtidal Soft Bottom Habitats

The criteria listed above have been applied to the information reviewed on the marine ecology of the subtidal soft-bottom habitats within the Study Area. The evaluation is presented in *Table 1.17*.

Table 1.17 Ecological Evaluation of the Subtidal Soft Bottom Habitats of the Study Area in Tai O

Criteria	**Subtidal Soft Bottom Habitats**
Naturalness	Habitat in the vicinity of the Study Area is potentially affected by fishing activities, anchoring and regional water pollution to some extent
Size	Large in extent. Nearly all subtidal areas in the vicinity of the Study Area is comprised of soft-bottom habitat
Diversity	Assemblages are considered to be of low diversity when compared with other areas in Hong Kong
Rarity	No organisms recorded in the area that were considered to be rare or of recognised conservation interest
Re-creatability	Subtidal soft bottom habitats can be easily re-created. Benthic organisms may recolonise the disturbed seabed area within a relatively short time
Fragmentation	The habitat is not fragmented
Ecological linkage	The habitat is not functionally linked to any high value habitat
Potential value	Low. Subtidal soft bottom epifaunal assemblages are unlikely to develop conservation habitat
Nursery/ breeding ground	No significant records identified in the literature review or field survey
Age	The sediments in the habitats are constantly accreting and eroding and the fauna present there are typically short-lived
Abundance/ Richness of wildlife	The assemblage at the habitat in the Study Area is of low abundance compared with other areas in Hong Kong
SUMMARY	Subtidal soft bottom habitats within the Study Area are disturbed to some extent by fisheries, anchoring and pollution. Epibenthic faunal assmblages are in low abundance and diversity in comparison with other areas in Hong Kong. Epibenthos act as food source for demersal fisheries but do not consist of species of recognised conservation interest
Ecological Importance	**Low**

Note: n/a Not applicable

1.8.4 Marine Waters Habitats

The criteria listed above have been applied to the information reviewed on the marine ecology of the marine waters habitats within the Assessment Area as well as the Study Area. The evaluation is presented in *Table 1.18*.

Table 1.18 Ecological Evaluation of the Marine Waters Habitats of the Assessment Area and the Study Area in Tai O

Criteria	**Marine Waters Habitats**
Naturalness	Natural and largely undisturbed
Size	Large in extent. Cover all areas with hard bottom and soft bottom subtidal habitats inside and in the vicinity of the Study Area
Diversity	In general the diversity lower than the oceanic eastern Hong Kong waters.
Rarity	CWD which is considered as species of conservation importance are common in Hong Kong western waters. No other rare organisms in the area.
Re-creatability	No precedent case
Fragmentation	The habitat is not fragmented
Ecological linkage	Connect with other marine waters
Potential value	Low.
Nursery/ breeding ground	Part of the nursery grounds for dolphins
Age	n/a
Abundance/ Richness of wildlife	High for CWD.
SUMMARY	The ecological values of marine waters in western Hong Kong could largely relate to the habitat use of Chinese White Dolphin which is the most significant species of conservation importance in this habitat, and would vary in accordance with the levels of usage by CWD. The West Lantau waters and the waters near Tai O would be of high ecological value due to the high dolphin density and the functions as dolphin nursery grounds.
Ecological Importance	Generally High due to the presence of CWD, but lower in some fringe areas such as the near shore shallow areas where CWD are seldom present.

Note: n/a Not applicable

1.8.5 Species of Conservation Interest Identified within the Study Area during the Surveys

In accordance with EIAO-TM Annex 8 criteria, an evaluation of species of conservation value recorded from the Study Area during the surveys (not include marine mammal surveys) is presented in *Table 1.19*.

Table 1.19 Species of Conservation Interest within the Study Area

Common Name	Scientific Name	Location	Protection Status	Distribution	Commonness in Hong Kong
Gorgonian	*Echinomuricea* sp.	Subtidal hard bottom habitat between -2 to -4 m CD	--	Western Hong Kong waters	Common
Ahermatypic cup coral	*Balanophyllia* sp.	Subtidal hard bottom habitat between -2 to -4 m CD	*Protection of Endangered Species of Animals and Plants Ordinance (Cap. 586)*	Western Hong Kong waters	Common

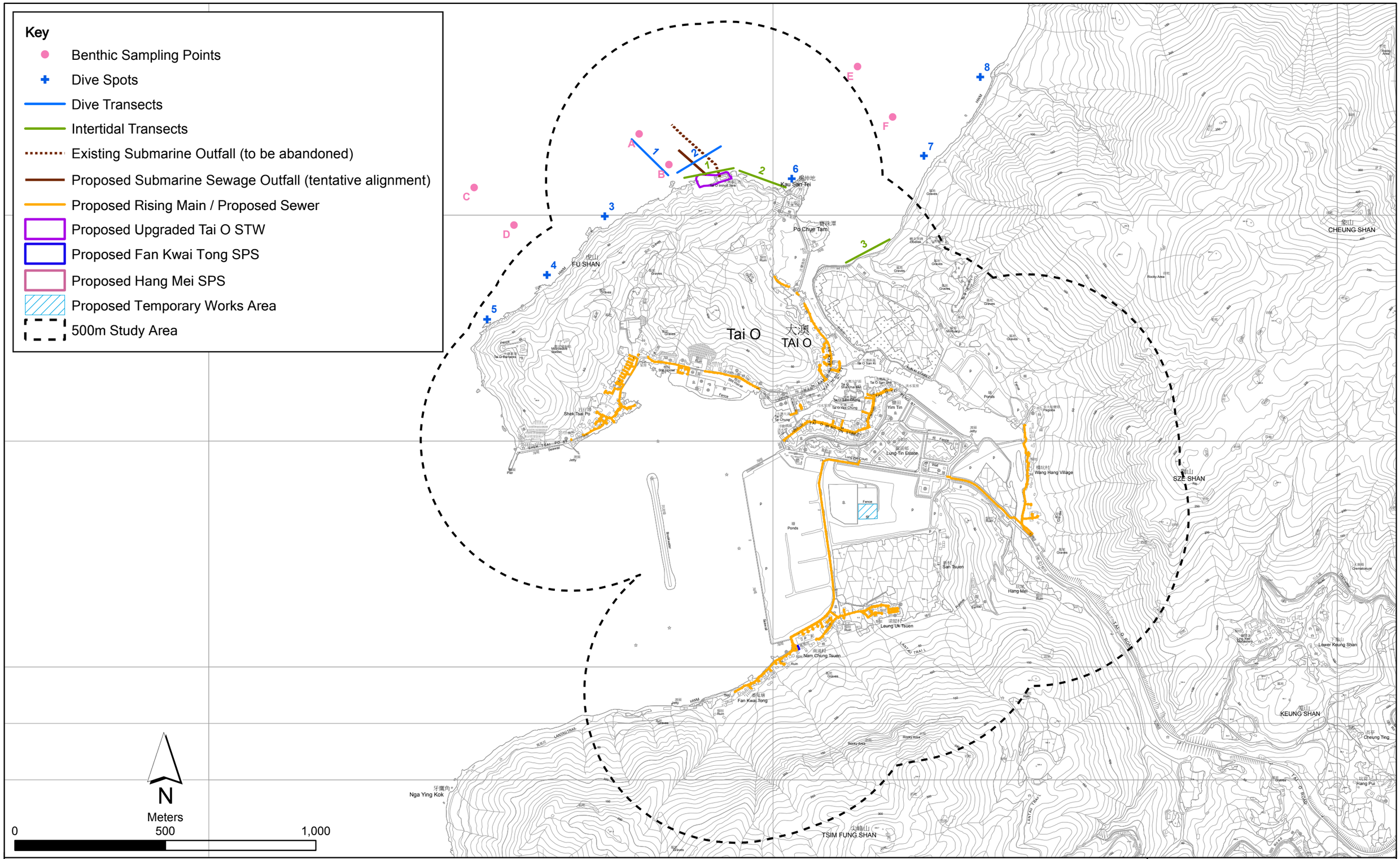


Figure 1.1

Survey Locations for Marine Ecology, Tai O

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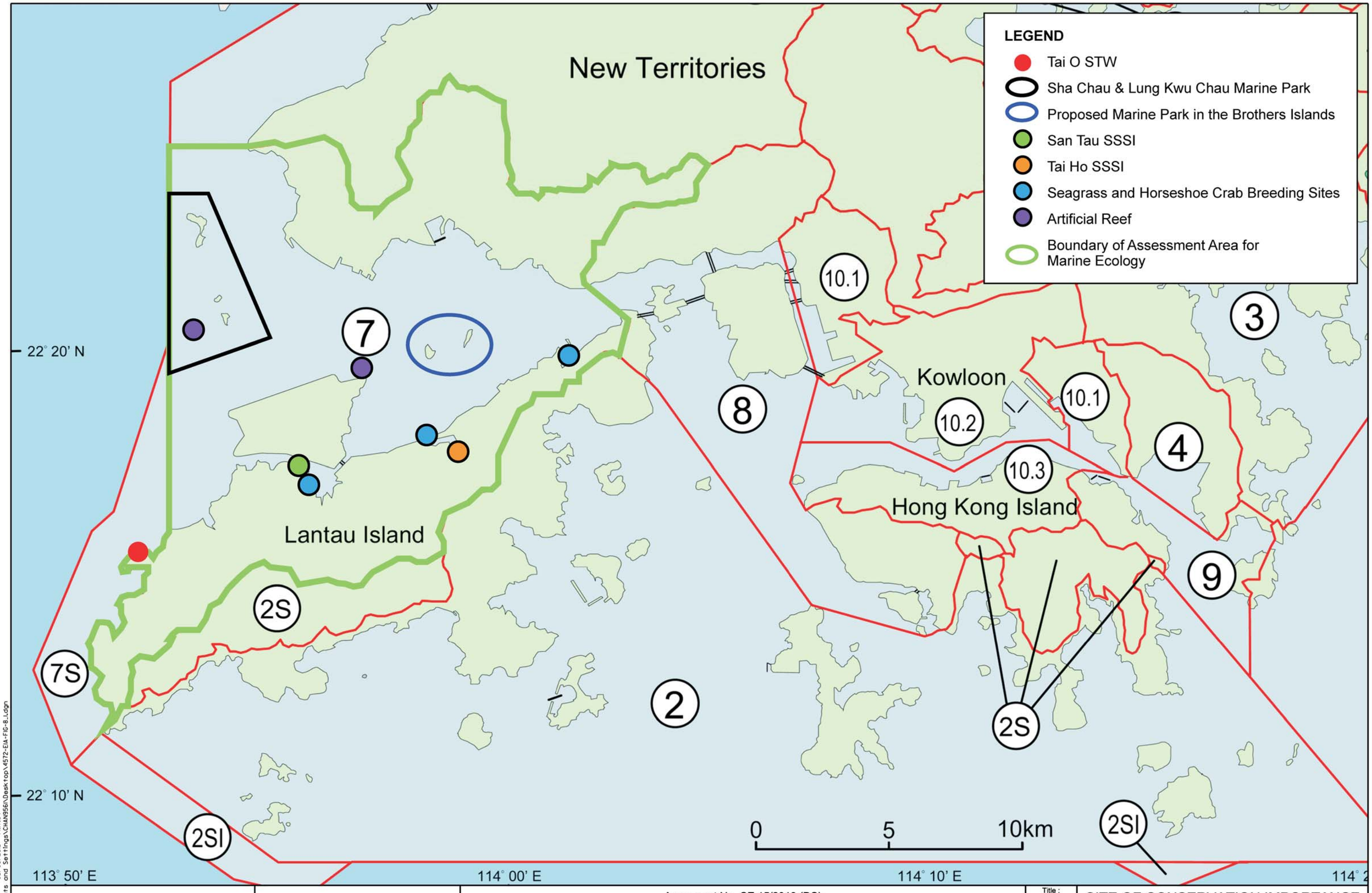
Date: 02/07/2014

Environmental Resources Management

ERM



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渠務署
DRAINAGE SERVICES DEPARTMENT

ATKINS

Agreement No. CE 15/2010 (DS)
Upgrading of Cheung Chau and Tai O Sewage Collection, Treatment and Disposal Facilities - Design and Construction

Outlying Islands Sewerage Stage 2 -
Upgrading of Tai O Sewage Collection, Treatment and Disposal Facilities

Title : SITE OF CONSERVATION IMPORTANCE WITHIN NORTH WESTERN WATER CONTROL ZONE

Date : September 2013

Figure : 1.2

Key

- Proposed Sewer
- Proposed Rising Main
- Existing Submarine Outfall (to be abandoned)
- Proposed Submarine Sewage Outfall (tentative alignment)
- Rocky Shore
- Artificial Seawall
- Sandy Shore
- Boulder / Sandy Shore
- Proposed Fan Kwai Tong SPS
- Proposed Hang Mei SPS
- Proposed Upgraded Tai O STW
- Proposed Temporary Works Area
- 500m Study Area
- Coastal Protection Area (CPA)
- Mudflat

N

Meters

0 500 1,000

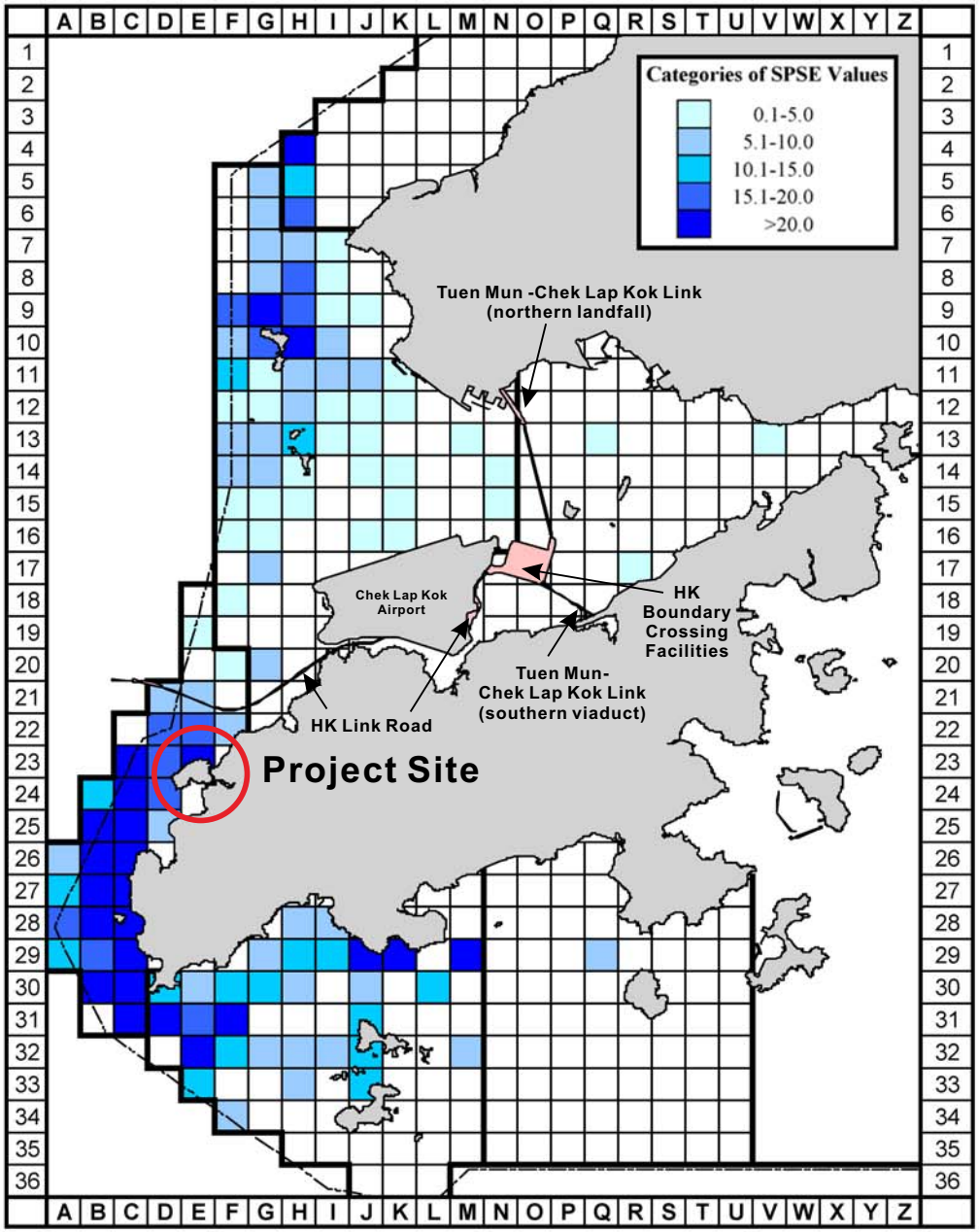
Figure 1.3

Intertidal Habitats Identified within the Study Area

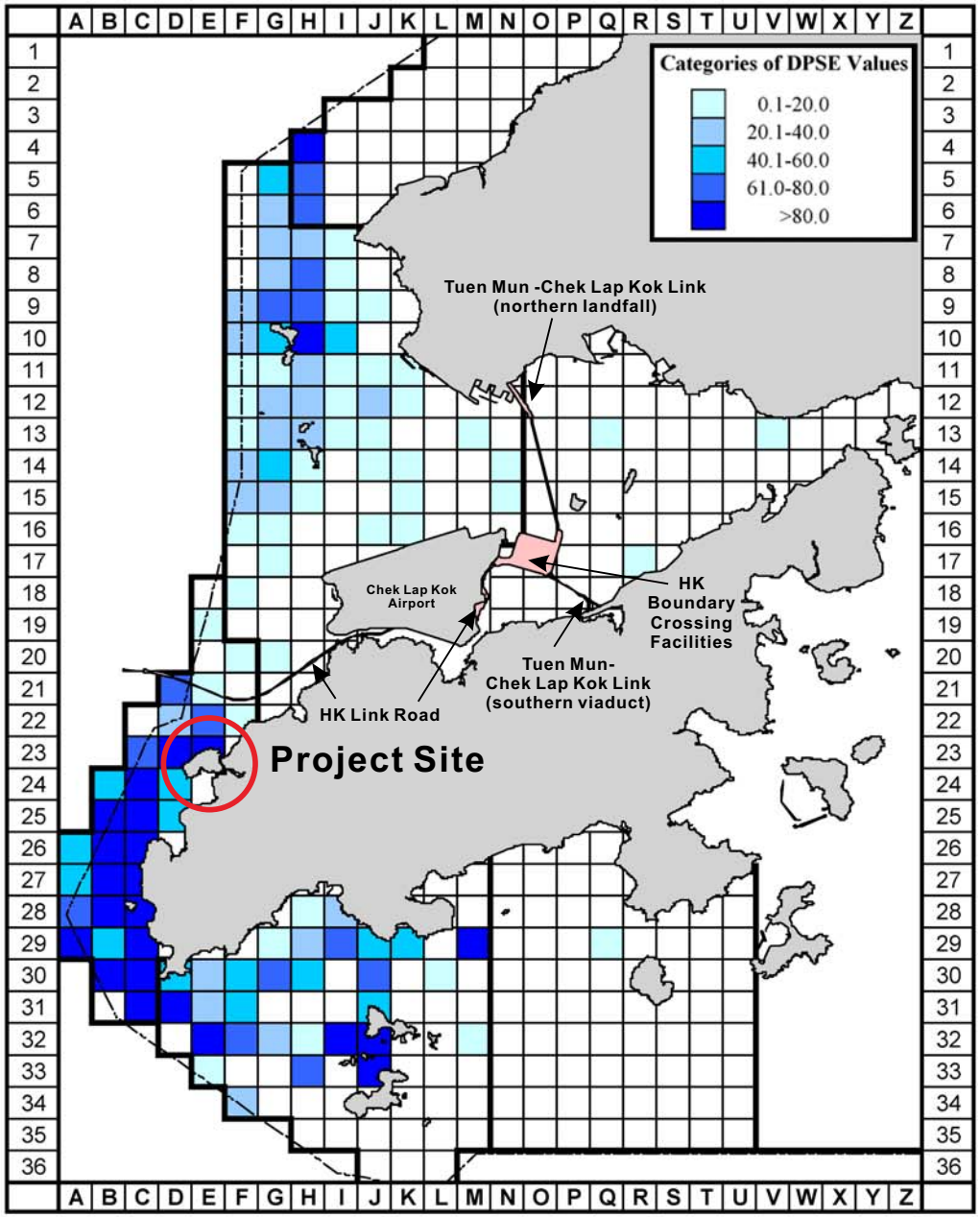
File: T:\GIS\CONTRACT\0133209\mxd\0133209_TaiO_Intertidal_habitats.mxd
Date: 02/07/2014

Environmental Resources Management

ERM



Chinese White Dolphin SPSE January - December 2014
(Number of On-Effort Sighting per 100 Units of Survery Effort)



Chinese White Dolphin DPSE January - December 2014
(Number of Dolphin 100 Units of Survery Effort)

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DRAINAGE SERVICES DEPARTMENT

ATKINS

Agreement No. CE 15/2010 (DS)
Upgrading of Cheung Chau and Tai O Sewerage Collection, Treatment and Disposal Facilities - Design and Construction
Outlying Islands Sewerage Stage 2 -
Upgrading of Tai O Sewage Collection, Treatment and Disposal Facilities

Title : CHINESE DOLPHIN SIGHTINGS

Date : March 2016

Figure : 1.4

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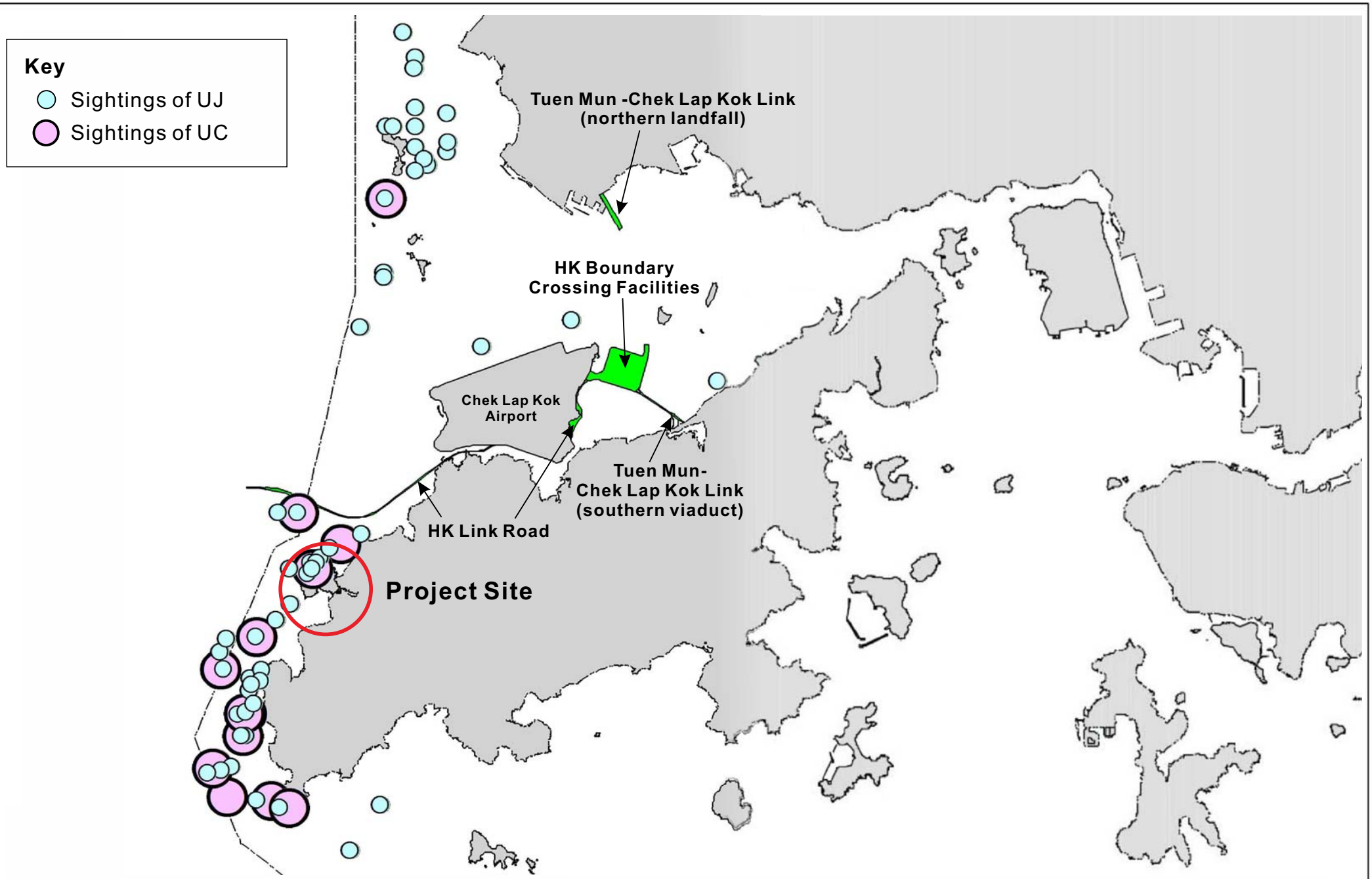

Chinese White Dolphin Unspotted Calves (UC) and Unspotted Juveniles (UJ) Sightings 2014

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Agreement No. CE 15/2010 (DS)
Upgrading of Cheung Chau and Tai O Sewerage Collection, Treatment and Disposal Facilities - Design and Construction
Outlying Islands Sewerage Stage 2 -
Upgrading of Tai O Sewage Collection, Treatment and Disposal Facilities

Title :	UNSPOTTED CALVES AND UNSPOTTED JUVENILES SIGHTINGS		
Date :	March 2016	Figure :	1.5

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FILENAME: P:\CNMA\Drainage CAD\Projects\4572\FIGURE\EIA-TAI\4572-EIA-T0-8.3.dgn

0133209c.cdr

Key

- Locations with *Echinomuricea*
- Locations with *Echinomuricea* and *Balanophyllia*
- Neither *Echinomuricea* nor *Balanophyllia* found
- 500m Study Area
- Proposed Fan Kwai Tong SPS
- Proposed Hang Mei SPS
- Proposed Upgraded Tai O STW
- Proposed Temporary Works Area
- Proposed Rising Main
- Proposed Sewer
- Existing Submarine Outfall (to be abandoned)
- Proposed Submarine Sewage Outfall (tentative alignment)

N

Meters

0 250 500 1,000

Figure 1.6

Locations with Gorgonian Echinomuricea and Ahermatypic Cup Coral Balanophyllia

File: T:\GIS\CONTRACT\0133209\mxd\0133209_TaiO_Coral.mxd
Date: 07/07/2014

Environmental Resources Management

ERM

Annex A

Marine Ecological Resources

Transect 1											
Group	**Species**	**H1**	**H2**	**H3**	**H4**	**H5**	**H6**	**H7**	**H8**	**H9**	**H10**
Snail	*Chlorostoma argyrostoma*	0	0	0	0	0	0	0	0	0	0
	Littoraria articulata	14	4	7	26	0	0	0	0	0	12
	Lunella coronata	0	0	0	0	0	0	0	0	0	0
	Monodonta labio	0	0	0	0	0	0	0	0	0	0
	Morula musiva	0	0	0	0	0	0	0	0	0	0
	Nassarius festiva	0	0	0	0	0	0	0	0	0	0
	Nerita albicilla	0	0	0	0	0	0	0	0	0	0
	Nodilittorina radiata	0	0	0	0	86	0	0	70	63	0
	Nodilittorina trochoides	0	0	0	0	0	0	0	0	0	0
	Planaxis sulcatus	0	0	0	0	0	0	0	0	0	0
	Thais clavigera	0	0	0	0	0	0	0	0	0	0
Limpet	*Nipponacmea concinna*	0	2	0	0	0	0	0	0	0	4
	Patelloida pygmaea	0	0	0	0	0	0	0	0	0	0
	Siphonaria japonica	0	2	0	0	0	0	0	0	0	0
Chiton	*Acanthopleura japonica*	0	0	0	0	0	0	0	0	0	0
Bivalve (%)	*Barbatia virgatus*	0	0	0	0	0	0	0	0	0	0
	Perna viridis	0	0	0	0	0	0	0	0	0	0
	Saccostrea cucullata	8	11	16	12	0	0	40	0	0	0
	Septifer virgatus	0	0	0	0	0	0	0	0	0	0
Barnacle (%)	*Capitulum mitella*	0	0	0	0	0	0	0	0	0	0
	Chthamalus malayensis	0	0	0	0	0	0	0	0	1	0
	Tetraclita japonica	0	0	0	0	0	0	0	0	0	0
Crab	*Hermit crab*	0	0	0	0	0	0	0	0	0	0
	Hemigrapsus sanguineus	0	0	1	0	0	0	0	0	0	0
Worm	*Marphysa sanguinea*	0	0	0	0	0	0	0	0	0	0
	Sipunculus vulgaris	0	0	0	0	0	0	0	0	0	0
Algae (%)	*Hilenbrandia rubra*	0	10	0	0	0	0	0	0	0	30
	Krytuthrix maculans	4	0	0	0	0	0	0	0	0	0
	Pseudulvella applanata	0	10	0	0	0	0	0	0	0	0
Others	*Sea anemone*	0	0	0	0	0	0	0	0	0	0
	Ligia exoctica	0	0	1	0	0	0	0	0	0	0

		Transect 1									
Group	**Species**	**M1**	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**
Snail	*Chlorostoma argyrostoma*	0	0	0	0	0	0	0	0	0	0
	Littoraria articulata	1	0	18	0	0	0	0	0	0	0
	Lunella coronata	0	0	0	0	0	0	0	0	0	0
	Monodonta labio	23	9	3	22	14	0	0	1	0	0
	Morula musiva	0	0	0	0	0	0	1	1	0	0
	Nassarius festiva	0	0	0	0	0	0	0	0	0	0
	Nerita albicilla	5	5	14	3	0	0	20	14	21	0
	Nodilittorina radiata	0	0	0	0	0	0	0	0	0	0
	Nodilittorina trochoides	0	0	0	0	0	0	0	0	0	0
	Planaxis sulcatus	0	0	1	0	0	0	0	0	0	0
	Thais clavigera	0	0	0	1	0	0	0	0	0	0
Limpet	*Nipponacmea concinna*	7	11	0	0	0	0	4	0	0	0
	Patelloida pygmaea	0	0	0	0	0	0	0	0	0	0
	Siphonaria japonica	0	0	0	0	0	0	0	0	0	0
Chiton	*Acanthopleura japonica*	0	0	0	0	0	0	0	0	0	0
Bivalve (%)	*Barbatia virgatus*	0	0	0	0	0	0	0	0	0	0
	Perna viridis	0	0	0	0	0	0	0	0	0	0
	Saccostrea cucullata	10	45	90	20	10	10	50	50	50	25
	Septifer virgatus	0	0	0	0	0	0	0	0	0	0
Barnacle (%)	*Capitulum mitella*	0	0	0	0	0	0	0	0	0	0
	Chthamalus malayensis	0	0	0	0	0	0	0	0	0	0
	Tetraclita japonica	0	0	0	0	0	15	5	0	0	10
Crab	*Hermit crab*	2	0	0	0	0	0	0	0	0	0
	Hemigrapsus sanguineus	0	0	0	0	0	0	0	0	0	0
Worm	*Marphysa sanguinea*	0	0	0	0	0	0	0	0	0	0
	Sipunculus vulgaris	0	0	0	0	0	0	0	0	0	0
Algae (%)	*Hilenbrandia rubra*	4	0	0	0	0	0	0	0	0	0
	Krytuthrix maculans	0	0	0	0	0	0	0	0	0	0
	Pseudulvella applanata	2	0	0	0	0	0	0	0	0	0
Others	*Sea anemone*	0	0	0	0	0	0	0	0	0	0
	Ligia exoctica	0	0	0	0	0	0	0	0	0	0

		Transect 1									
Group	**Species**	**L1**	**L2**	**L3**	**L4**	**L5**	**L6**	**L7**	**L8**	**L9**	**L10**
Snail	*Chlorostoma argyrostoma*	0	0	0	0	0	0	0	0	0	0
	Littoraria articulata	0	0	0	0	0	0	0	0	0	0
	Lunella coronata	0	0	0	0	0	0	0	0	0	0
	Monodonta labio	22	24	20	23	9	1	0	0	0	0
	Morula musiva	0	0	0	0	0	0	3	3	0	0
	Nassarius festiva	0	0	0	0	0	0	0	0	0	0
	Nerita albicilla	11	0	7	1	28	18	0	3	0	4
	Nodilittorina radiata	0	0	0	0	0	0	0	0	0	0
	Nodilittorina trochoides	0	0	0	0	0	0	0	0	0	0
	Planaxis sulcatus	0	0	0	0	0	0	0	0	0	0
	Thais clavigera	0	0	1	0	0	0	9	0	5	1
Limpet	*Nipponacmea concinna*	2	0	6	46	0	0	31	9	0	0
	Patelloida pygmaea	0	5	0	0	0	0	0	0	41	56
	Siphonaria japonica	0	0	0	0	0	0	0	0	0	0
Chiton	*Acanthopleura japonica*	0	0	0	0	0	0	0	0	1	0
Bivalve (%)	*Barbatia virgatus*	0	0	0	0	0	0	0	0	0	0
	Perna viridis	0	0	0	0	0	0	0	0	0	0
	Saccostrea cucullata	90	30	90	10	50	95	85	15	85	40
	Septifer virgatus	0	0	0	0	0	0	0	0	0	0
Barnacle (%)	*Capitulum mitella*	0	0	0	0	0	0	0	0	0	0
	Chthamalus malayensis	0	0	0	0	0	0	0	0	0	0
	Tetraclita japonica	0	0	0	0	2	5	15	5	8	0
Crab	*Hermit crab*	0	0	0	0	0	0	0	0	0	0
	Hemigrapsus sanguineus	0	0	0	0	0	0	0	0	0	0
Worm	*Marphysa sanguinea*	0	0	0	0	0	0	0	0	0	0
	Sipunculus vulgaris	0	0	0	0	0	0	0	0	0	0
Algae (%)	*Hilenbrandia rubra*	0	0	0	0	0	0	0	0	0	0
	Krytuthrix maculans	0	0	0	0	0	0	0	0	0	0
	Pseudulvella applanata	0	30	0	0	0	0	0	0	0	0
Others	*Sea anemone*	0	0	0	0	0	0	0	0	0	0
	Ligia exoctica	0	0	0	0	1	0	0	0	0	0

		Transect 2									
Group	**Species**	**H1**	**H2**	**H3**	**H4**	**H5**	**H6**	**H7**	**H8**	**H9**	**H10**
Snail	*Chlorostoma argyrostoma*	0	0	0	0	0	0	0	0	0	0
	Littoraria articulata	0	0	0	0	0	0	0	0	0	2
	Lunella coronata	0	0	0	0	0	0	0	0	0	0
	Monodonta labio	0	0	0	0	0	0	0	0	0	0
	Morula musiva	0	0	0	0	0	0	0	0	0	0
	Nassarius festiva	0	0	0	0	0	0	0	0	0	0
	Nerita albicilla	0	0	0	0	0	0	0	0	0	0
	Nodilittorina radiata	62	13	78	78	27	40	11	0	30	17
	Nodilittorina trochoides	54	23	72	32	18	20	22	0	0	18
	Planaxis sulcatus	0	0	0	0	0	0	0	0	0	0
	Thais clavigera	0	0	0	0	0	0	0	0	0	0
Limpet	*Nipponacmea concinna*	0	0	0	0	0	0	0	1	0	0
	Patelloida pygmaea	0	0	0	0	0	0	0	0	0	0
	Siphonaria japonica	0	0	0	0	0	0	0	0	0	0
Chiton	*Acanthopleura japonica*	0	0	0	0	0	0	0	0	0	0
Bivalve (%)	*Barbatia virgatus*	0	0	0	0	0	0	0	0	0	0
	Perna viridis	0	0	0	0	0	0	0	0	0	0
	Saccostrea cucullata	0	0	0	0	0	0	0	10	0	0
	Septifer virgatus	0	0	0	0	0	0	0	0	0	0
Barnacle (%)	*Capitulum mitella*	10	10	0	0	0	0	0	0	0	20
	Chthamalus malayensis	0	0	0	0	0	0	0	0	0	0
	Tetraclita japonica	0	0	0	0	0	0	0	0	0	0
Crab	*Hermit crab*	0	0	0	0	0	0	0	0	0	0
	Hemigrapsus sanguineus	0	0	0	0	0	0	0	0	0	0
Worm	*Marphysa sanguinea*	0	0	0	0	0	0	0	0	0	0
	Sipunculus vulgaris	0	0	0	0	0	0	0	0	0	0
Algae (%)	*Hilenbrandia rubra*	0	0	0	0	0	0	0	0	0	0
	Krytuthrix maculans	0	0	0	0	0	0	0	0	0	0
	Pseudulvella applanata	0	0	0	0	0	0	0	0	0	0
Others	*Sea anemone*	0	0	0	0	0	0	0	0	0	0
	Ligia exoctica	0	0	0	0	0	0	0	0	0	0

		Transect 2									
Group	**Species**	**M1**	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**
Snail	*Chlorostoma argyrostoma*	0	0	0	0	0	0	0	0	0	0
	Littoraria articulata	0	0	0	2	0	3	3	2	0	0
	Lunella coronata	0	0	0	0	0	0	0	0	0	0
	Monodonta labio	2	0	0	1	0	0	2	0	0	0
	Morula musiva	0	0	0	0	0	0	0	0	0	0
	Nassarius festiva	0	0	0	0	0	0	0	0	0	0
	Nerita albicilla	20	0	0	4	3	13	3	25	11	21
	Nodilittorina radiata	1	34	0	1	0	0		0	0	0
	Nodilittorina trochoides	0	0	0	3	0	0	0	0	0	0
	Planaxis sulcatus	0	0	0	0	0	0	0	0	0	0
	Thais clavigera	4	0	0	1	1	0	2	0	3	0
Limpet	*Nipponacmea concinna*	0	0	0	0		0	0	0	0	0
	Patelloida pygmaea	0	20	0	0	8	9	1	5	0	6
	Siphonaria japonica	0	0	0	0	0	0	0	0	0	0
Chiton	*Acanthopleura japonica*	0	0	0	0	0	0	0	0	0	0
Bivalve (%)	*Barbatia virgatus*	0	0	0	0	0	0	0	0	0	0
	Perna viridis	0	0	0	0	0	0	0	1	0	2
	Saccostrea cucullata	70	30	0	0	15	20	20	98	50	30
	Septifer virgatus	0	0	0	0	0	0	0	0	0	0
Barnacle (%)	*Capitulum mitella*	2	10	8	0	0	1	0	0	0	0
	Chthamalus malayensis	0	0	0	0	0	0	0	0	0	0
	Tetraclita japonica	0	40	0	0	0	0	0	1	1	2
Crab	*Hermit crab*	0	0	0	0	0	0	0	0	0	0
	Hemigrapsus sanguineus	0	1	0	0	0	0	0	0	0	0
Worm	*Marphysa sanguinea*	0	0	0	0	0	0	0	0	0	0
	Sipunculus vulgaris	0	0	0	0	0	0	0	0	0	0
Algae (%)	*Hilenbrandia rubra*	0	0	0	0	0	0	0	0	0	0
	Krytuthrix maculans	0	0	0	0	0	0	0	0	0	0
	Pseudulvella applanata	0	0	0	0	0	0	0	0	0	0
Others	*Sea anemone*	0	0	0	0	0	0	0	1	0	0
	Ligia exoctica	0	0	0	0	0	0	0	1	0	0

		Transect 2									
Group	**Species**	**L1**	**L2**	**L3**	**L4**	**L5**	**L6**	**L7**	**L8**	**L9**	**L10**
Snail	*Chlorostoma argyrostoma*	0	0	0	0	0	11	0	0	0	0
	Littoraria articulata	0	0	0	0	0	0	0	0	0	0
	Lunella coronata	0	0	0	0	0	0	0	0	0	0
	Monodonta labio	0	0	0	0	1	0	0	2	5	0
	Morula musiva	1	4	9	20	0	0	4	1	2	0
	Nassarius festiva	0	0	0	0	0	0	0	0	0	0
	Nerita albicilla	4	3	0	8	30	12	2	0	0	24
	Nodilittorina radiata	0	0	0	0	0	0	0	0	0	0
	Nodilittorina trochoides	0	0	0	0	0	0	0	0	0	0
	Planaxis sulcatus	0	0	0	0	0	0	0	0	0	0
	Thais clavigera	0	1	0	0	0	1	0	2	0	0
Limpet	*Nipponacmea concinna*	0	2	0	10	0	0	0	0	3	0
	Patelloida pygmaea	0	0	0	0	12	0	0	0	0	0
	Siphonaria japonica	0	4	0	0	0	0	0	0	0	0
Chiton	*Acanthopleura japonica*	0	1	0	0	0	0	0	0	0	0
Bivalve (%)	*Barbatia virgatus*	0	0	0	0	0	0	0	**6**	0	0
	Perna viridis	1	1	1	0	0	0	5	0	0	0
	Saccostrea cucullata	40	40	80	40	80	60	80	95	70	90
	Septifer virgatus	0	0	0	0	0	0	0	0	0	0
Barnacle (%)	*Capitulum mitella*	0	0	0	0	0	0	0	0	0	0
	Chthamalus malayensis	0	0	0	0	0	0	0	0	0	0
	Tetraclita japonica	40	40	1	20	5	10	0	0	5	5
Crab	*Hermit crab*	0	0	0	0	0	0	0	0	0	0
	Hemigrapsus sanguineus	0	0	0	0	0	0	0	0	0	0
Worm	*Marphysa sanguinea*	0	0	0	0	0	0	0	0	0	0
	Sipunculus vulgaris	0	0	0	0	0	0	0	0	0	0
Algae (%)	*Hilenbrandia rubra*	0	0	0	0	0	0	0	0	0	0
	Krytuthrix maculans	0	0	0	0	0	0	0	0	0	0
	Pseudulvella applanata	0	0	0	0	0	0	0	0	0	0
Others	*Sea anemone*	0	0	0	0	0	0	0	0	0	0
	Ligia exoctica	0	0	0	0	0	0	0	0	0	0

		Transect 3									
Group	**Species**	**H1**	**H2**	**H3**	**H4**	**H5**	**H6**	**H7**	**H8**	**H9**	**H10**
Snail	*Chlorostoma argyrostoma*	0	0	0	0	0	0	0	0	0	0
	Littoraria articulata	0	0	0	0	0	0	0	0	0	0
	Lunella coronata	0	0	0	0	0	0	0	0	0	4
	Monodonta labio	0	0	0	0	0	0	0	0	0	0
	Morula musiva	0	0	0	0	0	0	0	0	0	0
	Nassarius festiva	0	0	0	0	0	0	4	0	0	0
	Nerita albicilla	0	0	0	0	0	0	0	0	0	0
	Nodilittorina radiata	0	0	0	0	0	0	0	0	0	0
	Nodilittorina trochoides	0	0	0	0	0	0	0	0	0	0
	Planaxis sulcatus	0	0	0	0	0	0	0	0	0	0
	Thais clavigera	0	0	0	0	0	0	0	0	0	0
Limpet	*Nipponacmea concinna*	0	0	0	0	0	0	0	0	0	1
	Patelloida pygmaea	0	0	0	0	0	0	0	0	0	0
	Siphonaria japonica	0	0	0	0	0	0	0	0	0	0
Chiton	*Acanthopleura japonica*	0	0	0	0	0	0	0	0	0	0
Bivalve (%)	*Barbatia virgatus*	0	0	0	0	0	0	0	0	0	0
	Perna viridis	0	0	0	0	0	0	0	0	0	0
	Saccostrea cucullata	0	20	2	5	0	6	3	10	20	0
	Septifer virgatus	0	0	0	0	0	0	0	0	0	0
Barnacle (%)	*Capitulum mitella*	0	0	0	0	0	0	0	0	0	0
	Chthamalus malayensis	0	0	0	0	0	0	0	0	0	0
	Tetraclita japonica	0	0	0	0	0	0	0	0	0	0
Crab	*Hermit crab*	0	0	0	0	4	0	0	0	4	0
	Hemigrapsus sanguineus	8	4	0	4	0	0	0	0	0	4
Worm	*Marphysa sanguinea*	0	0	0	0	0	0	0	0	0	0
	Sipunculus vulgaris	4	8	0	8	0	0	0	4	4	4
Algae (%)	*Hilenbrandia rubra*	0	0	0	0	0	0	0	0	0	0
	Krytuthrix maculans	0	0	0	0	0	0	0	0	0	0
	Pseudulvella applanata	0	0	0	0	0	0	0	0	0	0
Others	*Sea anemone*	0	0	0	0	0	0	4	0	0	0
	Ligia exoctica	0	0	0	0	0	0	0	0	0	0

		Transect 3									
Group	**Species**	**M1**	**M2**	**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**
Snail	*Chlorostoma argyrostoma*	0	0	0	0	0	0	0	0	0	0
	Littoraria articulata	0	0	0	0	0	0	0	0	0	0
	Lunella coronata	0	0	0	0	0	0	0	0	0	4
	Monodonta labio	0	4	0	0	0	12	0	20	0	12
	Morula musiva	0	0	0	0	0	0	0	0	0	0
	Nassarius festiva	0	0	0	0	0	0	0	0	0	0
	Nerita albicilla	0	0	4	0	0	0	0	0	0	0
	Nodilittorina radiata	0	0	0	0	0	0	0	0	0	0
	Nodilittorina trochoides	0	0	0	0	0	0	0	0	0	0
	Planaxis sulcatus	0	0	0	0	0	0	0	0	0	0
	Thais clavigera	0	0	0	0	0	0	0	0	0	0
Limpet	*Nipponacmea concinna*	0	0	0	0	0	0	0	4	0	4
	Patelloida pygmaea	0	0	0	0	0	0	0	0	0	0
	Siphonaria japonica	0	0	0	0	0	0	0	0	0	0
Chiton	*Acanthopleura japonica*	0	0	0	0	0	0	0	0	0	0
Bivalve (%)	*Barbatia virgatus*	0	0	0	0	0	0	0	0	0	0
	Perna viridis	0	0	0	0	0	0	0	0	0	0
	Saccostrea cucullata	10	15	5	2	1	6	5	10	3	12
	Septifer virgatus	0	0	0	0	0	0	0	0	0	0
Barnacle (%)	*Capitulum mitella*	0	0	0	0	0	0	0	0	0	0
	Chthamalus malayensis	0	0	0	0	1	0	0	0	0	0
	Tetraclita japonica	0	0	0	0	0	0	0	0	0	0
Crab	*Hermit crab*	0	0	0	8	0	0	0	0	0	0
	Hemigrapsus sanguineus	8	0	4	0	0	0	4	0	0	4
Worm	*Marphysa sanguinea*	0	0	0	0	4	0	0	0	0	4
	Sipunculus vulgaris	0	16	4	0	4	0	8	0	0	4
Algae (%)	*Hilenbrandia rubra*	0	0	0	0	0	0	0	0	0	0
	Krytuthrix maculans	0	0	0	0	0	0	0	0	0	0
	Pseudulvella applanata	0	0	0	0	0	0	0	0	0	0
Others	*Sea anemone*	0	0	0	0	0	0	0	0	0	0
	Ligia exoctica	0	0	0	0	0	0	0	0	0	0

		Transect 3									
Group	**Species**	**L1**	**L2**	**L3**	**L4**	**L5**	**L6**	**L7**	**L8**	**L9**	**L10**
Snail	*Chlorostoma argyrostoma*	0	0	0	0	0	0	0	0	0	0
	Littoraria articulata	0	0	0	0	0	0	0	0	0	0
	Lunella coronata	0	0	0	0	0	0	0	0	0	0
	Monodonta labio	0	0	0	0	0	0	4	8	0	0
	Morula musiva	0	0	0	0	0	0	0	0	0	0
	Nassarius festiva	0	0	0	0	0	0	0	0	0	4
	Nerita albicilla	0	0	0	0	0	0	0	0	0	0
	Nodilittorina radiata	0	0	0	0	0	0	0	0	0	0
	Nodilittorina trochoides	0	0	0	0	0	0	0	0	0	0
	Planaxis sulcatus	0	0	0	0	0	0	0	0	0	0
	Thais clavigera	0	0	0	0	0	0	0	12	0	0
Limpet	*Nipponacmea concinna*	0	0	0	0	0	4	0	4	0	0
	Patelloida pygmaea	0	0	0	0	0	0	0	0	0	0
	Siphonaria japonica	0	0	0	0	0	0	0	0	0	0
Chiton	*Acanthopleura japonica*	0	0	0	0	0	0	0	0	0	0
Bivalve (%)	*Barbatia virgatus*	0	0	0	0	0	0	0	0	0	0
	Perna viridis	0	0	0	0	0	0	0	0	0	0
	Saccostrea cucullata	10	24	10	2	1	1	10	10	1	30
	Septifer virgatus	0	0	16	0	0	0	0	0	0	0
Barnacle (%)	*Capitulum mitella*	0	0	0	0	0	0	0	0	0	0
	Chthamalus malayensis	0	0	1	0	0	0	0	0	0	0
	Tetraclita japonica	0	0	0	0	0	0	0	0	0	0
Crab	*Hermit crab*	0	0	0	0	0	0	0	0	0	0
	Hemigrapsus sanguineus	0	0	0	0	1	0	0	0	0	0
Worm	*Marphysa sanguinea*	0	0	0	0	0	0	0	0	0	0
	Sipunculus vulgaris	20	12	8	0	4	16	4	0	0	4
Algae (%)	*Hilenbrandia rubra*	0	0	0	0	0	0	0	0	0	0
	Krytuthrix maculans	0	0	0	0	0	0	0	0	0	0
	Pseudulvella applanata	0	0	0	0	0	0	0	0	0	0
Others	*Sea anemone*	0	0	0	0	0	0	0	0	0	0
	Ligia exoctica	0	0	0	0	0	0	0	0	0	0

Annex A2 Abundance of Subtidal Benthos Species Recorded at Each Sampling Site (A to F) within the Study Area – Tai O

Phylum	Class	Species (Family Name)	Subtidal Benthos Sampling Sites					
			A	B	C	D	E	F
Annelida	Polychaeta	*Aglaophamus dibranchis* (Nephtyidae)	4	0	3	0	0	1
		Chloeia parva (Anphinomidae)	1	1	0	0	0	0
		Cossurella dimprpha (Cossuridae)	1	0	0	0	0	0
		Dasybranchus caducus (Capitellidae)	0	0	0	0	0	1
		Glycera onomichiensis (Glyceridae)	0	0	1	0	0	1
		Iphione muricata (Polynoidae)	1	0	0	0	0	0
		Leocrates chinensis (Hesoonedae)	0	1	0	0	0	0
		Loimia medusa (Terebellidae)	2	2	0	1	0	0
		Lumbrineris sp. (Lumbrineridae)	1	1	0	0	0	0
		Notomastus latericens (Capitellidae)	2	2	2	1	2	6
		Ophelina grandis (Opheliidae)	2	1	0	4	0	0
		Poecilochaetus serpens (Poecilochaetidae)	0	0	0	0	1	0
		Polydora sp. (Spionidae)	1	0	0	0	0	0
		Sternaspis sculata (Sternaspidae)	1	4	0	2	0	0
		Synelmis albini (Pilargiidae)	0	1	0	0	0	0
Arthropoda	Crustacea	*Alpheus* sp. (Apheidae)	1	1	0	0	0	0
		Byblis sp. (Ampeliscidae)	0	1	0	0	0	0
		Clorida microphthalma (Squillidae)	0	0	1	0	0	0
		Neoxenophthalmus obscurus (Pinnotheridae)	0	0	1	0	1	1
		Oratosquilla oratoria (Squillidae)	1	0	0	0	0	0
		Typhlocarcinus nudus (Pilumnidae)	1	0	0	0	0	0
Chordata	Osteichthyes	*Trypauchen vagina*	1	2	0	0	1	0
	Actinopterygii	UNID Eel Juvenile	0	0	0	2	0	0
Coelenterata	Anthozoa	*Virgularia gustaviana* (Virgulariidae)	0	0	0	0	1	0
Echinodermata	Stelleroidea	*Amphioplus laevis* (Amphiuridae)	1	0	0	0	1	0
	Holothuridea	*Protankyra bidentata* (Synaptidae)	2	0	0	0	0	0
Echiura	Echiurida	*Thalassema sabinum* (Echiuidae)	1	1	10	1	0	0
Mollusca	Bivalvia	*Annapella retroconvexa* (Mesodesmatidae)	0	1	0	0	0	0
		Apolymetis meyeri (Tellinidae)	1	0	0	0	0	0
		Macoma candida (Tellinidae)	1	0	0	0	1	0
		Nitidotellina minuta (Bivalvia)	0	2	1	0	2	2
		Nucula cuningii (Nuculidae)	0	3	0	1	0	0
		Solen sp. (Solenidae)	1	0	0	0	0	0
		Theora lata (Semelidae)	0	2	0	0	1	0
Nemeritinea	Anopla	*Cerebratulina* sp. (Cerebratulidae)	1	0	0	0	0	0

Phylum	Class	Species (Family Name)	Subtidal Benthos Sampling Sites					
			A	B	C	D	E	F
Plathhelminthes	Turbellaria	*Leptoplana* sp. (Leptoplanidae)	0	0	1	0	0	0

Note: UNID – Unidentified Specimen