4 Marine Ecological Impact

4.1 Introduction

The Marine Ecological Impact Assessment has been conducted in accordance with the requirements stipulated under Section 3.4.3 and Appendix C of the EIA Study Brief No. ESB-282/2014 as well as Annexes 8 and 16 of the EIAO-TM. This chapter of the EIA report presents the summary of the baseline information of the marine ecological resources within the Study Area, finding of the field surveys conducted under this Project and thus the findings of the marine ecological impact assessment associated with the construction and operation of the proposed Project.

The broad objectives of the Marine Ecological Impact Assessment, as detailed in the EIA Study Brief, are as follows:

- Review of the findings of relevant studies / surveys and collection of the available information regarding the ecological characters of the Study Area (**Section 4.3**);
- Evaluate information collected, identify any information gap relating to the assessment of potential ecological impact, and determine the need of the ecological field surveys and investigations for a comprehensive assessment (**Section 4.3**);
- Establish the general ecological profile of the Study Area based on information collected and describe the characteristics of each habitat found (**Section 4.5.1**);
- Investigate and describe the existing wildlife uses of the various habitats with special attention to those wildlife groups and habitats with conservation interests (**Section 4.5.2**);
- Use suitable methodology and considering also other works activities from other projects reasonably likely to occur at the same time, identify and quantify as far as possible of any direct, indirect, on-site, off-site, primary, secondary and cumulative ecological impacts on the wildlife groups and habitats (**Section 4.6**);
- Evaluate the marine ecological impacts including cumulative marine ecological impacts based on the best and latest information available during the course of the EIA study, using quantitative approach as far as practicable covering the construction and operation phases of the proposed Project (**Section 4.7**);
- Recommend possible and practicable mitigation measures and evaluate the feasibility and effectiveness of the recommended mitigation measures (**Section 4.8**);
- Determine and quantify as far as possible the residual ecological impacts after implementation of the proposed mitigation measures and evaluate the significance of impact and acceptability of the residual ecological impacts (**Section 4.9**); and
- Review the need for and recommend any ecological monitoring programme required (**Section 4.10**).

4.2 Environmental Legislation, Standards, Guidelines and Criteria

A number of international conventions, local legislation and guidelines provide the framework for the protection of species and habitats of marine ecological importance. Those related to this Project are as follows:

- Wild Animals Protection Ordinance (Cap. 170);
- Protection of Endangered Species of Animals and Plants Ordinance (Cap. 586);
- Marine Parks Ordinance (Cap. 476);

- Town Planning Ordinance (Cap. 131);
- Environmental Impact Assessment Ordinance (Cap. 499) and the Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM);
- EIAO Guidance Notes No. 6/2010 Some Observations on Ecological Assessment from the Environmental Impact Assessment Ordinance Perspective;
- EIAO Guidance Notes No. 7/2010 Ecological Baseline Survey for Ecological Assessment;
- EIAO Guidance Note No. 11/2010 Methodologies for Marine Ecological Baseline Surveys;
- The Convention on Biological Diversity (1992) and the Strategic Plan for Biodiversity 2011-2020 and Aichi Biodiversity Targets;
- Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES);
- The IUCN Red List of Threatened Species; and
- Wild Animal Protection Law of the Peoples' Republic of China (PRC).

Under the *Wild Animals Protection Ordinance (Cap. 170)*, 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, amphibians and invertebrates. The Second Schedule of the Ordinance that lists all the animals protected was last revised in June 1992.

The *Protection of Endangered Species of Animals and Plants Ordinance (Cap. 586)* was gazetted on 10 March 2006 to replace the previous Animals and Plants (Protection of Endangered Species) Ordinance (Cap. 187). The new Ordinance was effective on 1 December 2006 and regulates the import, introduction from the sea, export, re-export and possession or control of certain endangered species of animals and plants and parts and derivatives of those species; and to provide for incidental and connected matters.

The *Marine Parks Ordinance (Cap. 476)* vests the Country and Marine Parks Authority the power to designate, control and manage marine parks and marine reserves for the protection of marine life in these areas.

The *Town Planning Ordinance (Cap. 131)* 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 of significant habitat.

Environmental Impact Assessment Ordinance (Cap. 499), which specifies designated projects under Schedule 2 of the Ordinance, unless exempted, must follow the statutory environmental impact assessment (EIA) process and require environmental permits for their construction and operation. *Annex 8* of the EIAO-TM recommends the criteria that can be used for evaluating ecological impacts, while *Annex 16* 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.

EIAO Guidance Notes No. 6/2010, 7/2010 and 11/2010 provide respectively the observations on Ecological Assessment from the EIAO perspective, the general guidelines for conducting an ecological baseline survey for ecological assessment, and methodologies for marine ecological baseline surveys in order to fulfil the

requirements stipulated in the EIAO-TM in respect of marine ecological assessment for the proposed development.

The PRC is a Contracting Party to the Convention on Biological Diversity (CBD) of 1992. The Convention was extended to Hong Kong on 9 May 2011. The Convention requires signatories to make active efforts to protect and manage their biodiversity resources. The government of the Hong Kong Special Administrative Region has stated that it will be "committed to meeting the environmental objectives" of the Convention. In 2010 the Parties to the CBD adopted the *Strategic Plan for Biodiversity 2011-2020 and Aichi Biodiversity Targets* with the purpose of inspiring broad-based action in support of biodiversity over the next decade by all countries and stakeholders. The Strategic Plan comprised 5 strategic goals and 20 headline targets, known as the Aichi Biodiversity Targets (ABTs). The ABTs serve as a flexible framework for the establishment of national and regional targets for biodiversity conservation.

The Convention on International Trade in Endangered Species of Wild Fauna and Flora of Wild Fauna and Flora (CITES) is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.

The International Union for Conservation of Nature (IUCN) is the world's main authority on the conservation status of species. The *IUCN Red List of Threatened Species™*, founded in 1963, is widely recognised as the most comprehensive, objective global approach for evaluating the conservation status of plant and animal species. From its small beginning, the IUCN Red List has grown in size and complexity and now plays an increasingly prominent role in guiding conservation activities of governments, NGOs and scientific institutions. The introduction in 1994 of a scientifically rigorous approach to determine risks of extinction that is applicable to all species, has become a world standard.

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 97 animal species in Class I and 155 in Class II. Class I provides a higher level of protection for animals considered to be more threatened.

4.3 Study Area and Methodology

4.3.1 Study Area

The Study Area of the Project for ecological impact assessment covers the Southern Water Control Zone (WCZ) and Western Buffer WCZ as designated under the Water Pollution Control Ordinance. Flora, fauna and other components of the ecological habitats within the Study Area will be examined, with special attention to coral communities, habitat of Finless Porpoise, nesting site of Green Turtle, benthic and littoral/intertidal species of conservation interest, as mentioned in Appendix C of the EIA Study Brief. Ecological sensitive receivers within the Study Area are identified. Owing to the nature of this Project that the proposed dredging activities will directly affect the marine environment but not affect the terrestrial ecology, the ecology section for this EIA study will focus on marine ecology.

4.3.2 Desktop Review

4.3.2.1 Literature Review

Desktop literature review has been carried out to establish the preliminary baseline conditions and general ecological profile of the marine environment for this Project. Information gap identified during the desktop review were addressed by field surveys in suitable seasons.

Literature review includes the approved EIA of relevant projects, available information on the findings of relevant ecological studies/surveys in the Study Area, as well as published scientific studies relevant to the ecological resources of the Study Area. The following is a non-exhaustive list of literature:

- Monitoring of Marine Mammals in Hong Kong Waters;
- EIA for Lamma Power Station Navigation Channel Improvement, HK Electric (2003) (EIAO Register No. AEIAR-069/2003);
- Consultancy Study on Marine Benthic Communities in Hong Kong, AFCD (2002);
- East Lamma Channel Borrow Area – Scoped Environmental Assessment, Final Report, CED (1993);
- Green Turtles in Hong Kong (2004);
- Characterization and Conservation Concerns of Green Turtles (*Chelonia mydas*) Nesting in Hong Kong, China (2014); and
- EIA Study for Development of a 100MW Offshore Wind Farm in Hong Kong, ERM (2010) (EIAO Register No. AEIAR-152/2010).

4.3.2.2 Findings from the Field Surveys conducted at the Project Profile Stage

In the wet season (May and June) of 2014, one set of ecological field surveys including coral dive survey, benthic survey and intertidal survey were conducted to provide baseline for the preparation of Project Profile for this Project. Survey locations are presented in **Figures 4.1** to **4.3**. In view of the recentness and validity of these survey data sets, they are used as part of the ecological field survey findings for this EIA. Information gap identified in this data set were supplemented with an ecological field survey of a study period in accordance with the Study Brief.

4.3.3 Ecological Field Surveys

In order to collect baseline information to supplement the desktop study findings and update the marine ecological condition of the Project Area and the Study Area, the ecological field surveys carried out for this Project include coral dive survey, soft-bottom benthic grab sampling and intertidal survey. Locations of the above surveys are presented in **Figures 4.1** to **4.3** whilst details of the methodologies for the field surveys are presented in **Appendix 4.1**, **Appendix 4.2** and **Appendix 4.3** respectively.

Long-term research and monitoring programme of marine mammals in Hong Kong has been conducted by the Hong Kong Cetacean Research Project since 1995 with funding support from AFCD. Systematic monitoring data collected for assessment of the distribution and abundance of Finless Porpoise has covered the Study Area and is deemed adequate for this EIA study. In view of the systematic data available, no

information gap is identified and therefore no field survey for marine mammals is proposed under this EIA study.

4.4 Baseline Conditions and Marine Ecological Sensitive Receivers

4.4.1 Marine Waters

4.4.1.1 Physical Environment

Lamma Island lies in the middle part of Southern Water Control Zone (WCZ). As shown in **Figure 4.4**, The Southern WCZ is a large water control zone in Hong Kong water that extends from Lantau Island to Hong Kong Island. The western part (south of Lantau Island) and northern part (east of Lantau Island) were adversely affected by the discharge from the Pearl River and flow from Victoria Harbour respectively. On the contrary, the effects on middle (Lamma Island) and eastern part (south of Hong Kong Island) were lower due to strong current flushing from South China Sea as well as further distances from pollution sources (EPD, 2006). In 2014, an overall 71% compliance with the Water Quality Objectives (WQOs) was reported in this WCZ since the compliance rate for the total inorganic nitrogen (TIN) WQO (<0.1 mg/L) was only 13% due to the higher background level of the Pearl River flow. On the other hand, full compliances with the WQO for dissolved oxygen (DO), unionized ammonia (UIA) and *E. coli* were achieved (details see EPD, 2014).

In the present survey area, the water temperature ranged 16.5 to 28.9 °C, salinity ranged 27.2 to 33.4 ppt and DO of bottom water layer ranged 3.0 to 8.3 mg/L O_2 throughout the year according to the data from closest monitoring station SM5 in the latest Marine Water Quality Report 2014. No hypoxic condition was recorded.

The natural coasts of western Lamma consist of rocky shores, sandy shores and wave cut platforms, and are mostly sheltered from prevailing winds. The subtidal bottom substrates are mainly sand and mud while offshore (within 400m from the shore) the seabed is covered by marine mud comprised primarily of silt clay.

4.4.1.2 Cetacean Species of Conservation Interest inhabiting the marine waters

In Hong Kong waters, there are records of 17 confirmed cetacean species whilst the majority of them are likely to be transient records except the Indo-Pacific Finless Porpoise *Neophocaena phocaenoides* and the Indo-Pacific Humpback Dolphin *Sousa chinensis* (usually called as Chinese White Dolphin, hereafter as “CWD”) that are residents in Hong Kong waters.

Finless Porpoises and the CWDs have a limited overlap in the distribution in Hong Kong waters, as there are more records of Finless Porpoises in southern and eastern waters of Hong Kong, whereas CWDs tend to be predominant in the western waters. The limited overlap of the distribution of these two resident cetacean species only occurs in the southwestern coast of Lantau around Fan Lau and the Soko Islands (Parsons *et al*., 1995; Jefferson, 2000; Jefferson *et al*., 2002). The proposed dredging area at the West Lamma waters locates within the range of Finless Porpoises and at the edge of the range of CWDs.

Finless Porpoise

Finless Porpoise is protected under the Wild Animals Protection Ordinance (Cap. 170) and Protection of Endangered Species of Animals and Plants Ordinance (Cap. 586) locally and also listed as a "Grade II National Key Protected Species" in mainland China. In addition, it is also categorised as "Vulnerable" in the IUCN Red List of Threatened Species (IUCN, 2016) and Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Therefore, Finless Porpoise is considered as a species of conservation interest in this study.

Finless Porpoises are generally shy and elusive, displaying minimal aerial and social behaviour. In Hong Kong waters, they spend the majority of their time (on average about 60%) at or near the surface waters and the remaining of their time (about 40% on average) on long dives (Beasley & Jefferson, 2002). Finless Porpoises feed on a variety of prey. An analysis of stomach contents of stranded Finless Porpoises revealed that they preyed on at least 25 species of fish, 3 genera of cephalopods and one shrimp. In terms of number, the most important prey taxa for Finless Porpoises were fish families Apogonidae, Sciaenidae, Engraulidae, Leiognathidae among teleosts, and the squid family Loliginidae. The most frequently taken prey of Finless Porpoises are Squids (*Loligo*) and cuttlefishes (*Sepia*), followed by anchovies (*Thryssa* spp.), cardinalfishes (*Apogon* spp.) and ponyfishes (*Gazza minuta*) that are inshore, bottom-dwelling and mid-water prey (Barros *et al.,* 2002). This research finding suggests that Finless Porpoises feed at different water depths and also in reef areas and sandy substrates.

Finless Porpoises in Hong Kong exhibit marked seasonal variation in distribution, which is shown in the AFCD's long term monitoring data. In general, Finless Porpoise is sparse in southern Lantau and southern Lamma in wet season (June to November) but becomes more frequent in dry season (December to May).

In the long-term marine mammals monitoring programme undertaken by AFCD, quantitative grid (1 km^2) analysis of habitat use is conducted, and the number of Dolphins/porpoises Per 100 units of Survey Effort (DPSE) is obtained to examine porpoise usage. Long-term data (2006-2015) shows that south of Tai A Chau, Shek Kwu Chau, south of Cheung Chau and the waters between Shek Kwu Chau and the Soko Islands are important porpoise habitats (DPSE>60) (refer to **Figure 4.5**).

In Lamma waters, Finless Porpoise generally vacates northern Lamma but occurs in moderate to low density in eastern, southern and western waters in dry season. The 2003 approved EIA report identified the Study Area, particularly the waters to the south of the Channel, as key porpoise habitat with peak abundance during dry season (December to May) (Hyder, 2003). The key Finless Porpoises habitat at the south of the Channel which has been previously identified in the 2003 approved EIA report together with east Lamma off Tung O Wan, are evaluated to have moderate porpoise densities (with DPSE ranging from 40 to 60) (Hung, 2016). However, its density within the Project Area (DPSE ranging from 0 to 20) is relatively low compared to southern, eastern and western waters of Lamma in dry season (Hung, 2016) (refer to **Figure 4.5**).

Chinese White Dolphin

Having the same local protection status as the Finless Porpoise, CWD is classified as "Grade I National Key Protected Species" in the Mainland and "Near Threatened" in the IUCN Red List (IUCN, 2016). CWD is an

active cetacean species compared to Finless Porpoise, exhibiting much aerial and social behaviour. They mostly prey upon estuarine pelagic, demersal species and often occur in large shoals, predominantly fish from Trichiuridae, Engraulidae, Sciaenidae and Clupeidae families. The most frequently taken and numerically most important prey is the croaker *Johnius* sp., followed by the lionhead *Collichthys lucida* and anchovies *Thryssa* spp.. The dietary of CWD and Finless Porpoises have some overlaps with around 13 fish species, particularly the anchovies (Barros et al., 2004).

The range of CWD extended as far as West Lamma in southern waters of Hong Kong during wet season, albeit with very infrequent usage of the area where the Channel lies. However, data from AFCD's long-term cetacean monitoring programme show that the eastern edge of their range has shifted west to area around Shek Kwu Chau, and the dolphins appear to avoid Lamma waters altogether in recent years (Hung, 2016). The area influenced by the works is therefore of very low importance to the CWD.

4.4.2 Recognized Sites of Conservation Importance

In the Southern WCZ, several locations have been identified as recognized sites of conservation importance, including the Sham Wan SSSI on Lamma Island, Cape D'Aguilar Marine Reserve on southeastern Hong Kong Island and the potential marine parks at South Lamma and the Soko Islands.

Sham Wan SSSI is the only remaining stable nesting site for Green Turtle, whilst the potential marine park at South Lamma is also considered in this EIA study as the coastal waters of South Lamma supported marine fauna of ecological value, mainly being green turtles and Finless Porpoises. These two recognized sites of conservation importance are both in association with green turtles and not far from the Project Area. On the other hand, Cape D'Aguilar is a designated Marine Reserve for its special geological and geomorphological features, whilst the Soko Islands are regularly used by Finless Porpoise and CWD and therefore regarded as a potential Marine Park for protection of marine ecological resources. Both Cape D'Aguilar Marine Reserve and the potential marine park at the Soko Islands are within Southern WCZ but far from the Project Area.

Green Turtle

In Hong Kong, there are records of five species of sea turtles including Green Turtle *Chelonia mydas*, Hawksbill Turtle *Eretmochelys imbricate*, Leatherback Turtle *Dermochelys coriacea*, Loggerhead Turtle *Caretta caretta* and Olive Ridley *Lepidochelys olivacea.* These records consist of live sightings and/or stranding of dead specimens. Amongst these records, Green Turtle is the only locally nesting sea turtle species in Hong Kong.

Green Turtles are threatened globally due to loss of suitable nesting sites as a result of rapid coastal development, disturbance from human activities, incidental by-catch in fishing gear, poaching of eggs and marine pollution particularly those non-degradable marine refuse in both shore habitats and marine waters. Green Turtles are therefore listed as "Endangered" in the IUCN Red List (IUCN, 2016), Appendix I of CITES, and Appendices I and II of the Convention on Migratory Species (CMS). Locally, they are also protected under the Wild Animals Protection Ordinance (Cap. 170) and the Protection of Endangered Species of

Animals and Plants Ordinance (Cap. 586). Green Turtle is hence considered as species of conservation interest in this study.

According to historical records and local villagers' memories, several decades ago sea turtles used to nest in remote beaches of Hong Kong like Tung O and Ha Mei Wan on Lamma Island, Tong Fok Miu Wan and Tai Long Wan on Lantau Island, as well as Shek O and Tai Tam Bay on Hong Kong Island (Chan, 2004). However, sea turtles were no longer found nesting around these areas, whilst in the last decade the sandy beach at Sham Wan on Lamma Island was found as the only regular nesting site of green turtle in Hong Kong. The sandy beach at Sham Wan was designated as a SSSI and a Restricted Area in 1999 for protection of the green turtle nesting site. During the restricted period from 1 June to 31 October, patrol would be conducted by the nature wardens of AFCD to control unauthorized activities and to monitor the nesting activities of green turtles.

Long-term study of the green turtles in Hong Kong has been conducted by AFCD. For the Sham Wan nesting site, the last record of green turtle nesting was in 2012 (AFCD, 2013) and up to five green turtles were observed each nesting season at Sham Wan between 1998 and 2012 with an average number of 93 to 152 eggs being laid per clutch in a nesting season (Ng *et al.*, 2014). Other than the regular nesting record at Sham Wan, sporadic nesting of green turtle has also been recorded in Shek Pai Wan, Tung O on Lamma Island (AFCD, correspondence, 2015), Tai Wan in Sai Kung and Tai Long Wan in Shek O on Hong Kong Island in the last two decades (Ng *et al.*, 2014).

Satellite telemetry studies have been undertaken for the female which nested on Sham Wan in 2003, 2008 and 2012 (ERM, 2010; AFCD, unpublished data). The results of the telemetry studies showed that the inter-nesting movement of the green turtle, i.e. the at-sea movements of female between nesting attempts within the same season (Eckert *et al.*, 1999), mainly appeared in the southern, southeastern and western waters of Lamma Island (attached in **Appendix 4.4** for reference) which are considered as their inter-nesting habitats. A mean inter-nesting interval of 11 to 13 days in a nesting season was recorded for green turtles in Sham Wan (Ng *et al.*, 2014). Another recent study of green turtles revealed that during the inter-nesting period green turtles were found mainly using areas close to the nesting beach (within 10 km) and their inter-nesting dive behaviour was within 15 m of the water surface (Clyde-Brockway, 2014).

4.4.3 Coral Communities and Sub-tidal Hard Bottom Habitat

4.4.3.1 Literature Review

In the 2003 approved EIA report, several hard coral species were reported to be found at western coastlines of Lamma Island including *Tubastraea* (=*Tubastrea*) spp., *Psammocora profundacella* (=*Psammocora superficialis*), *Goniopora* sp., *Acropora* sp., *Montipora* sp., *Pavona decussata*, *Porites* sp., *Montastrea* sp., *Platygra* sp. and faviid corals. All hard corals are protected in Hong Kong by the Protection of Endangered Species of Animals and Plants Ordinances (Cap. 586) and hence considered as species of conservation interest in this study. However, distribution of hard corals at those subtidal habitats (e.g. at rocky shores around Yung Shue Wan, Hung Shing Yeh and Lo So Shing) was generally patchy and occupied only small areas. Within the study area, sub-tidal coral communities at Shek Kok Tsui, Green Islands, Little Green

Island, Kau Yi Chau and Siu Kau Yi Chau consisted of common hard coral species, while species abundance and diversity were moderate-low (Mott, 2010 and Scott Wilson, 2003). Northwest Ha Mei Tsui had medium abundance of soft corals and sea whips (Hyder, 2003) while granite boulder seawall at Yung Shue Wan was assessed to have moderately diverse community of common hard corals (BMT, 2005). Southwest Ha Mei Tsui, Luk Chau Wan, Tung O Wan, Wong Chuk Kok, Sok Kwu Wan, Pak Kok and Sham Wan were identified to have high coverage and diversity of corals (Hyder, 2003; ENSR, 2008; BV, 2006; and Maunsell, 2007) with rare species *Pseudosiderastrea tayami* recorded at Sham Wan (Maunsell, 2007).

Dive surveys from an EIA study (ERM, 2010) had been conducted for hard substrates in marine waters off west Lamma near the Project Area, which were superficial dumped materials occurring at less than 10 m depth. Sparse patches of gorgonians *Echinomuricea* sp. and *Menella* sp., soft corals *Dendronephthya* sp. and black corals *Cirripathes* sp. were recorded, which were locally common and widespread in Hong Kong.

4.4.3.2 Baseline Sub-tidal Dive Survey

A coral dive survey was conducted at four locations in June 2014 for the preparation of the Project Profile of this Project, as well as in October 2015 at another three locations under this EIA study to verify the information from literature review and to provide an updated status of the coral communities within the study area. At the sloping artificial seawalls along the Lamma Power Station Extension where the sub-tidal habitat is close to the Project Area, only one hard coral species, *Oulastrea crispata*, was recorded with low coral cover (<1%). This hard coral species is widespread, opportunistic and can live in degraded habitat. Soft corals were also recorded including *Dendronephthya gigantea*, *Echinomuricea* spp., *Echinogorgia* sp. and *Carijoa* sp. These species have high tolerance to sediment.

For the natural sub-tidal hard bottom habitats along the western coast of Lamma near the Project Area, overall a total of 18 hard coral species were recorded from the dive surveys conducted in 2014 and 2015. These hard coral species include *Cyphastrea serailia*, *Cyphastrea japonica*, *Turbinaria peltata*, *Goniopora columna*, *Goniastrea aspera*, *Bernardpora stutchburyi (=Goniopora stutchburyi)*, *Oulastrea crispata*, *Leptastrea purpurea*, *Leptastrea pruinosa*, *Favia speciosa*, *Favites abdita*, *Favites chinensis*, *Favites pentagona*, *Psammocora profundacella* (=*Psammocora superficialis*), *Coscinaraea* n sp., *Porites lutea* and *Hydnophora exesa* and ahermatypic cup coral *Balanophyllia* sp. There were no other rare or endangered species recorded in the surveys.

At Hung Shing Yeh, the 2014 survey has recorded relatively healthy and rich coral communities with a total of 11 hard coral species. Coral cover was <5%. These coral communities were disturbed as nets and plastic bags were observed in the survey. Mobile and attaching invertebrates colonized in the area are all typical species occurring at coral communities in Hong Kong.

At Lo So Shing beach where survey was conducted in 2014, three hard coral species with low coral cover of <1% and one soft coral species *Dendronephthya gigantea* were recorded. Invertebrates associated with the habitat are common species.

For Ha Mei Tsui, the 2014 survey recorded only one hard coral species *Porites lutea* with low coral cover (<1%). Invertebrates colonized in the area are commonly occurring species in Hong Kong coral communities.

At Tit Sha Long (south of Kat Tsai Wan) where survey was conducted in 2015, a total of 10 hard coral species were recorded and coral cover was <5%. A healthy and rich coral community is found in the area. The invertebrates attaching and inhabiting the habitat are typical species.

At the western shore of Shan Tei Tong, only one hard coral species *Porites lutea* was recorded with low coral cover of <1%. A soft coral species *Dendronephthya gigantea* was also recorded.

In summary, coral communities found at the natural sub-tidal hard bottom habitats along the western coast of Lamma vary in diversity, from rich communities with more than 10 coral species at the northern side, to less diverse communities with only one to three coral species at the southern side.

Details of the coral surveys conducted in May 2014 and November 2015, including the sampling locations, methodology and results are presented in **Appendix 4.1**.

4.4.4 Benthic Infauna and Sub-tidal Soft Bottom Habitat

4.4.4.1 Literature Review

The benthic community within the Project Area and its proximity is anticipated to be healthy as the water quality of Southern WCZ was under influences of both Pearl River discharge and flows from Victoria Harbour. The sediments were generally in unpolluted conditions without environmental stress as strong current flushing from South China Sea had mitigated the adverse effects (EPD, 2006). The 2003 approved EIA report stated the benthic sediment off western Lamma was mostly silt-clay dominated by common polychaete species during both wet and dry seasons, while sipunculids were also abundant in areas such as the reclamation site for Lamma Power Station Extension. Coarser sediments due to tidal scouring at the southern reaches of works area was anticipated to lead to higher species abundance and diversity than the northern reaches (Hyder, 2003).

Several grab samplings had been conducted within or in close vicinity of the Project Area in the past. The findings of the benthic infauna community from these studies slight vary. In 2001, a benthic study was conducted in close proximity to the Project Area and the study shown that the biomass at the eastern side of the northern reach of Project Area was higher (54.70 g/m^2) than other locations within west Lamma (3.93 – 30.60 g/m^2) (CityU, 2001). However, in another benthic study conducted in an EIA study in 2008 and 2009, the biomass at the western side of the northern reach of the Project Area was found to be similar to other survey locations within west Lamma (ERM, 2010). Amongst these benthic studies, no benthic infauna species of conservation interest were recorded in the Project Area.

Further away from the Project Area, benthic community diversity at soft-bottom habitat in Sham Wan was assessed to be low (ENSR, 2008).

4.4.4.2 Baseline Field Surveys

Benthic survey was conducted in May 2014 for the preparation of the Project Profile of this Project, as well as in September and December 2015 under this EIA study to verify the information from literature review for

the Project Profile, to fill in the information gap of benthic community within the navigation channel and to provide an updated status of the marine benthic communities in the Study Area.

The survey was conducted at six locations, including four (B1 to B4) within the navigation channel and two (B5 and B6) outside the channel in 2014. Sediments within the navigation channel were found to be soft mud while those outside the channel were mixtures of soft mud and fine sand. In total, 61 taxa (identified to genus or species levels) were recorded and the benthic communities in the survey area were generally delineated into two groups (inside-channel and outside-channel) due to different sediment textures. Bivalves and polychaetes were the most abundant groups within the navigation channel, while sipunculids and polychaetes were the most abundant groups outside the channel. Except for the high biomass at one of the sampling stations within the channel (B1: 75.09 g/m^2), species richness, density, biomass and diversity were generally higher at survey locations outside the channel. No benthic infauna species of conservation interest were recorded in the survey area. No significant environmental stress was found on the benthic communities which was consistent with the sediment quality.

Six other locations including three (P1 to P3) within the navigation channel and three (P4 to P6) outside the channel were selected for survey in 2015 to supplement data gaps within the navigation channel and at the vicinities. Sediments sampled within the navigation channel were found to be of 95% soft mud which is consistent with the abovementioned findings in 2014. A total of 126 taxa (identified to genus or species levels) were recorded. All recorded species were common with no conservation interest.

In general, the diversity and species evenness of benthic communities of survey area were similar to the unpolluted water group 'Eastern and Southern waters' (Shin *et al*., 2004). Comparing the survey results in 2015 to the previous wet season survey conducted in 2014, both parameters were very similar, indicating stable and normal condition of benthic habitat at the west of Lamma Island. There was no clear difference between benthic community within the navigation channel and that outside-channel. The benthic communities were healthy without environmental stress in the survey area and the diversity was higher in more heterogeneous sediment texture, i.e. P4 outside the channel.

Details of the benthic field surveys conducted from 2014 to 2015 for this Project, including the sampling locations, methodology and results are presented in **Appendix 4.2**.

4.4.5 Intertidal Habitats and Communities

4.4.5.1 Literature Review

In the 2003 approved EIA report, it was recorded that the rocky shores along western coast south of Yung Shue Wan were generally natural with little disturbance, while the fauna there were common to semi-exposed shores in Hong Kong (Hyder, 2003). Another EIA study in 2005 also drew similar conclusions regarding the commonness of species found there (BMT, 2005).

Artificial seawall along Lamma Power Station Extension was found to consist of low diversity of species which were common and widespread, such as littornid snail, topshell and limpets (ERM, 2010). The sheltered

sandy shores along west coast of Lamma have low diversity and abundance of intertidal species without any records of species of conservation interest.

4.4.5.2 Intertidal Field Surveys

Intertidal surveys were conducted in May 2014 for the preparation of the Project Profile of this Project, as well as in August, September, November 2015 and January 2016 under this EIA study to verify the information from literature review and to provide an updated status of the intertidal communities in the Study Area. Field surveys were conducted at three types of representative intertidal habitats, namely artificial seawall, sandy shore and rocky shore at the west Lamma.

For sandy shores, the survey at Hung Shing Yeh beach recorded no intertidal species. This is consistent with the 2003 approved EIA report, which states that the recreational beaches in Hong Kong are generally devoid of life. For the sandy shore at Tai Wan To, a total of three common intertidal species were recorded throughout the surveys and no species of conservation interest was recorded. Both the diversity and abundance of species at sandy shore are low.

For rocky shores, overall 53 intertidal species were recorded at Lo So Shing and 49 species were recorded at Ha Mei Tsui throughout surveys conducted in wet and dry seasons. At Lo So Shing rocky shore, density of gastropod species *Echinolittorina radiata*, *Monodonta labio*, *Cellana toreuma* and percentage coverage of *Hildenbrandia rubra* and *Neoralfsia expansa* were recorded higher than other intertidal species. The species mentioned above were also recorded in the previous surveys conducted at this site (ERM, 1999). At Ha Mei Tsui rocky shore, relatively high density of *Echinolittorina radiata*, *Echinolittorina pascua Planaxis sulcatus, Reishia clavigera* and relatively high percentage coverage of *Saccostrea cucullata*, *Chroococcus* sp. and *Corallina spp.* were recorded. Except for *Chroococcus* sp., these species have also been recorded at the same location previously in other study (ERM, 1999). The majority of these species are common to semi-exposed and exposed shores.

At the artificial seawall of Lamma Power Station Extension, a total of 27 intertidal species were recorded throughout surveys conducted in wet and dry seasons. Abundant species recorded included *Echinolittorina radiata*, *Patelloida saccharina* and *Hildenbrandia rubra*, whilst *Patelloida pygmaea* and *Siphonaria japonica* were found abundant only in wet season. The results are in line with previous survey findings which indicated low species diversity and presence of common and widespread species, such as littornid snails and limpets (ERM, 2010).

Details of the intertidal surveys conducted including the survey locations, methodology and results are presented in **Appendix 4.3**.

4.5 Evaluation of Ecological Importance

4.5.1 Habitat Evaluation

The following sections evaluate the ecological importance of each habitat type recorded within the Study Area that are likely to be impacted by the Project Site, based on the criteria set forth in Annex 8 Table 2 of the EIAO-TM.

The key habitats and recognised sites of conservation interest identified within the Study Area, based on literature review and field survey findings, are listed below:

- Sham Wan SSSI and Restricted Area;
- Hard shore habitats including artificial and rocky shores;
- Soft shore habitat (sandy shores);
- Sub-tidal habitats including soft bottom substrates (benthos) and hard bottom substrate (with and without corals); and
- Marine waters (potential marine park at South Lamma and Finless Porpoise habitat).

The results of the habitat evaluation are presented in **Table 4.1** to **Table 4.7**.

Table 4-1: Ecological Evaluation of Sham Wan SSSI and Restricted Area

Criteria	Sham Wan SSSI and Restricted Area
Naturalness	Natural
Size	About 5 ha
Diversity	Green turtle *Chelonia mydas* was known to nest occasionally; Known coral communities of rich diversity and high ecological value in Sham Wan (ENSR, 2008; ERM, 2010)
Rarity	Habitat not rare; Endangered species Green Turtle *Chelonia mydas* was recorded.
Re-creatability	Not re-creatable
Fragmentation	Unfragmented
Ecological linkage	Linked with open waters and sub-tidal habitat
Potential value	Identified as of high ecological value, designated as SSSI and Restricted Area in 1999
Nursery/ breeding ground	Nesting site for green turtle *Chelonia mydas*
Age	N/A
Abundance/ Richness of wildlife	Occasional record of small number of green turtles
Ecological value	High

Table 4-2: Ecological Evaluation of Intertidal Habitat – Artificial Seawall of Lamma Power Station Extension

Criteria	Artificial Seawall of Lamma Power Station Extension
Naturalness	Artificial habitat
Size	Approx. 1 km
Diversity	Low diversity of intertidal species
Rarity	Common habitat in Hong Kong
Re-creatability	Readily re-creatable
Fragmentation	Fragmented
Ecological linkage	Not significantly linked to any habitat of high ecological value
Potential value	Low
Nursery/ breeding ground	No special nursery / breeding ground function observed
Age	Around 10 years
Abundance/ Richness of wildlife	Low abundance of intertidal species
Ecological value	Low

Table 4-3: Ecological Evaluation of Intertidal Habitat – Rocky Shores

Criteria	Lo So Shing	Ha Mei Tsui
Naturalness	Natural habitat	Natural habitat
Size	Small	Small
Diversity	Moderate species diversity with 53 intertidal species recorded	Moderate species diversity with 49 intertidal species recorded
Rarity	Common habitat in Hong Kong	Common habitat in Hong Kong
Re-creatability	Not re-creatable	Not re-creatable
Fragmentation	Unfragmented	Unfragmented
Ecological linkage	Generally link with the open sea	Generally link with the open sea
Potential value	Moderate-low	Moderate-low
Nursery/ breeding ground	No special nursery / breeding ground function observed	No special nursery / breeding ground function observed
Age	N/A	N/A
Abundance/ Richness of wildlife	Moderate abundance of intertidal species	Moderate abundance of intertidal species
Ecological value	Moderate-low	Moderate-low

Table 4-4: Ecological Evaluation of Intertidal Habitat – Sandy Shores

Criteria	Hung Shing Yeh Sandy Beach	Tai Wan To Sandy Shore
Naturalness	Natural	Natural
Size	Small	Medium
Diversity	Devoid of intertidal species	Very low intertidal species diversity with only 3 species recorded
Rarity	Common habitat at exposed shores in Hong Kong	Common habitat at exposed shores in Hong Kong
Re-creatability	Re-creatable by ordinary wave action	Re-creatable by ordinary wave action
Fragmentation	Unfragmented	Unfragmented
Ecological linkage	Generally link with the open sea	Generally link with the open sea
Potential value	Low (major substrates type is fine sand)	Low (major substrates type is fine sand)
Nursery/ breeding ground	No special nursery / breeding ground function	No special nursery / breeding ground function
Age	N/A	N/A
Abundance/ Richness of wildlife	Very low abundance of intertidal species	Very low abundance of intertidal species
Ecological value	Low	Low

Table 4-5: Ecological Evaluation of Sub-tidal Soft Bottom Habitat

Criteria	Within Navigation Channel	Outside Navigation Channel
Naturalness	Semi-natural being disturbed by regular operation dredging of the navigation channel	Natural
Size	Medium	Large
Diversity	Low to moderate diversity (Diversity Index H' ranges 1.10 to 2.67) in wet season and moderate diversity (Diversity Index H' ranges 2.94 to 3.22) in dry season (15 to 20 species in wet season; 33 to 43 species in dry season).	Moderate diversity (Diversity Index H' ranges 2.66 to 3.33) in wet season and moderate diversity (Diversity Index H' ranges 3.03 to 3.59) in dry season (17 to 43 species in wet season; 40 to 67 species in dry season).
Rarity	Common habitat and species in Hong Kong; No rare species or species of conservation interest recorded	Common habitat and species in Hong Kong; No rare species or species of conservation interest recorded
Re-creatability	Not re-creatable	Not re-creatable
Fragmentation	Unfragmented	Unfragmented
Ecological linkage	Not functionally or significantly linked to any habitat of high ecological value	Generally linked with the open waters
Potential value	Low	Low
Nursery/ breeding ground	Nursery ground for crustaceans, mollusca and bottom dwelling fishes	Nursery ground for crustaceans, mollusca and bottom dwelling fishes
Age	N/A	N/A
Abundance/ Richness of wildlife	High abundance of bivalves and polychaetes	High abundance of sipunculids and polychaetes
Ecological value	Low	Moderate-low

Table 4-6: Ecological Evaluation of Sub-tidal Hard Bottom Habitat

Criteria	Artificial Seawall of Lamma Power Station Extension	The Western Coast of Lamma
Naturalness	Artificial	Natural
Size	Approx. 1 km	N/A
Diversity	Low	Moderate
Rarity	Common habitat in Hong Kong; One common hard coral species *Oulastrea crispata* was recorded.	Common habitat in Hong Kong; Eighteen common hard coral species including hermatypic *Cyphastrea serailia*, *Cyphastrea japonica, Turbinaria peltata*, *Favites abdita*, *Psammocora profundacella* (=*Psammocora superficialis*), *Coscinaraea* n sp., *Hydnophora exesa*, *Bernardpora stutchburyi* (=*Goniopora stutchburyi*), *Goniopora columna*, *Goniastrea aspera, Oulastrea crispata*, *Leptastrea purpurea*, *Leptastrea pruinosa, Favia speciosa, Favites chinensis*, *Favites pentagona*, *Porites lutea* and the ahermatypic cup coral *Balanophyllia* sp.
Re-creatability	Readily re-creatable	Not re-creatable
Fragmentation	Unfragmented	Unfragmented
Ecological linkage	Generally linked with the open waters	Functionally linked with the open waters
Potential value	Low	Moderate-high
Nursery/ breeding ground	No special nursery / breeding ground observed	No special nursery / breeding ground observed
Age	Around 10 years	N/A
Abundance/ Richness of wildlife	Hard coral species *Oulastrea crispata* with low coral cover (<1%); low abundance of sub-tidal benthic fauna	Hard coral species with coral cover <5%; Moderate abundance of sub-tidal benthic fauna
Ecological value	Low	Moderate

Table 4-7: Ecological Evaluation of Marine Waters

Criteria	Within the Navigation Channel	Outside the Navigation Channel and around Lamma
Naturalness	Natural but being disturbed by operation dredging of the navigation channel over years	Natural but being disturbed by fish trawl activities prior to ban on fishing with trawl nets
Size	Medium	Large
Diversity	Scarce records of Finless Porpoises	The coastal waters of South Lamma supported marine fauna of ecological value, mainly being Green Turtles and Finless Porpoises
Rarity	Common habitat; Only very occasional usage of the area by Finless Porpoise and CWD	Common habitat; Low usage of the area by Finless Porpoise and CWD; Records of the endangered Green Turtle *Chelonia mydas*
Re-creatability	Not re-creatable	Not re-creatable
Fragmentation	Unfragmented	Unfragmented
Ecological linkage	Linked with the coastal habitat of Lamma Island	Functionally linked with the coastal habitat of Lamma Island
Potential value	Low	Moderate to high potential for longer time period, particularly the southern waters of Lamma that is potential to be designated as new marine park
Nursery/ breeding ground	Nursery ground for pelagic fish	Nursery ground for pelagic fish and Finless Porpoises
Age	N/A	N/A
Abundance/ Richness of wildlife	Low abundance of Finless Porpoises and very low abundance of CWD	Moderate to low abundance of Finless Porpoises and very low abundance of CWD; Low abundance of Green Turtle
Ecological value	Low	Moderate for southern waters of Lamma and low for the rest

4.5.2 Species of Conservation Interest

Based on the literature review and the results of field surveys conducted for this study, species recorded within the Study Area were evaluated with reference to Annexes 8 and 16 of EIAO-TM. Identification of species of conservation interest for this study generally conducted with reference to the criteria in Annex 16 Appendix A Note 3. However, it is acknowledged that those criteria are quite general and not all species that falls within one of those criteria would be automatically regarded as species of conservation interest. For instance, some species that are listed in IUCN Red List do not imply that they are under real threat if their

status is “Data Deficient” or “Least Concern”. The identification of species of conservation interest therefore relies on professional judgement.

Evaluation on species of conservation interest that are likely to be affected by this Project are summarised in the **Table 4-8** below.

Table 4-8: Evaluation of Fauna Species of Conservation Interest within the Study Area

Species	Protection Status / Conservation Status	Distribution	Recorded by other Studies	Recorded in Field Survey	Rarity
Cetacean					
Indo-Pacific Finless Porpoise *Neophocaena phocaenoides*	Cap. 170; Cap. 586; China Grade II Protected Species; IUCN “Vulnerable”; CITES App. I	Between Soko Island and Shek Kwu Chau, south of Soko Islands, around Shek Kwu Chau, south and southeast of Cheung Chau, around Po Toi Islands, to the east and south of Ninepins Islands, and offshore waters of Sai Kung Peninsula (Hung, 2016)	AFCD’s Long-term Monitoring of Marine Mammals in Hong Kong Waters	N/A	Locally recorded in southern and eastern waters, with decrease trend in coastal water of South Lantau and around Lamma Island (Hung, 2016)
Indo-Pacific Humpback Dolphin *Sousa chinensis* (Chinese White Dolphin)	Cap. 170; Cap. 586; China Grade I Protected Species; IUCN – Near Threatened; CITES App. I	Mainly west coast of Lantau, extending from Tai O Peninsula to Fan Lau and south Lantau waters; also in outer Deep Bay, Sha Chau and Lung Kwu Chau (Hung, 2016)	AFCD’s Long-term Monitoring of Marine Mammals in Hong Kong Waters	N/A	Locally recorded in west Lantau and south Lantau and northwest Lantau, with 65 CWDs recorded in 2015 (Hung, 2016)
Reptile					
Green Turtle *Chelonia mydas*	Cap. 170; Cap. 586; IUCN – Endangered; CITES App. I; CMS App. I and II	Occasionally seen in southern and eastern waters. Nesting was recorded in Sai Kung and Lamma. Sham Wan Lamma Island is known for regular nesting.	Recorded at Sham Wan by AFCD	--	Rare
Coral					
Bernardpora stutchburyi (=Goniopora stutchburyi)	Cap. 586	Widely distributed in Hong Kong. Higher occurrence is associated with deeper coral community	N/A	Hung Shing Yeh, Tit Sha Long	Common

Species	Protection Status / Conservation Status	Distribution	Recorded by other Studies	Recorded in Field Survey	Rarity
Coscinaraea n sp.	Cap. 586	Recorded from a few locations in northeastern, eastern, southeastern and western waters of Hong Kong, especially associated with low-light habitats	N/A	Hung Shing Yeh, Lo So Shing, Tit Sha Long	Not determined
Cyphastrea japonica	Cap. 586	Widespread, associated with communities from the eastern and northeastern waters of Hong Kong	N/A	Tit Sha Long	Abundant
Cyphastrea serailia	Cap. 586	Recorded in all locations of Hong Kong's inshore waters	N/A	Hung Shing Yeh, Tit Sha Long	Dominant
Favia speciosa	Cap. 586	Recorded from locations all around the Hong Kong waters	N/A	Tit Sha Long	Abundant
Favites abdita	Cap. 586	Recorded in all locations of Hong Kong's waters. Particularly common in the eastern and northeastern waters, associated with well-established coral communities. Also found in western waters	N/A	Hung Shing Yeh, Tit Sha Long	Dominant
Favites chinensis	Cap. 586	Found commonly throughout Hong Kong waters, but predominantly in the eastern and northeastern waters	N/A	Hung Shing Yeh, Tit Sha Long	Dominant
Favites pentagona	Cap. 586	Predominantly associated with well-established coral communities in the southern, southeastern, eastern and northeastern waters of Hong Kong	N/A	Tit Sha Long	Dominant

Species	Protection Status / Conservation Status	Distribution	Recorded by other Studies	Recorded in Field Survey	Rarity
Goniastrea aspera	Cap. 586	Records are made from both the eastern waters and the northeastern part of Hong Kong. Occasionally recorded in the southern part, but not common.	N/A	Tit Sha Long	Common
Goniopora columna	Cap. 586	Recorded mainly in the eastern and northeastern waters	N/A	Tit Sha Long	Abundant
Hydnophora exesa	Cap. 586	Found all over Hong Kong, but is more commonly recorded in the eastern waters	N/A	Hung Shing Yeh	Abundant
Leptastrea purpurea	Cap. 586	Predominant in the eastern and northeastern waters of Hong Kong. Also found in western waters	N/A	Hung Shing Yeh, Lo So Shing	Abundant
Leptastrea pruinosa	Cap. 586	Predominant from northeastern waters. Also found in southern, eastern and northeastern waters	N/A	Lo So Shing	Abundant
Oulastrea crispata	Cap. 586	Found in many places in Hong Kong	N/A	Artificial seawall of Lamma Power Station Extension, Hung Shing Yeh	Common
Porites lutea	Cap. 586	Widespread, recordedfrom all regions of Hong Kong, particularly in eastern and norheastern waters	Western coast of Lamma (Hyder, 2003)	Lo So Shing , Ha Mei Tsui, western shore of Shan Tei Tong, Tit Sha Long	Dominant
Psammocora profundacella (=*Psammocora superficialis*)	Cap. 586	Found in coral communities in eastern waters of Hong Kong. Also found in northeastern and southern waters	Western coast of Lamma (Hyder, 2003)	Hung Shing Yeh, Tit Sha Long	Abundant

Species	Protection Status / Conservation Status	Distribution	Recorded by other Studies	Recorded in Field Survey	Rarity
Pseudosiderast rea tayami	Cap. 586	Only a few records in southern waters of Hong Kong, such as waters south to Soko Island and southern waters of Lamma	Sham Wan (Maunsell, 2007)	--	Rare
Turbinaria peltata	Cap. 586	Mostly found in Hong Kong's northeastern and eastern waters, but can occasionally be found in the southern and even western waters	Western coast of Lamma (Hyder, 2003)	Hung Shing Yeh, Tit Sha Long	Common
Balanophyllia sp.	Cap. 586	--	N/A	Hung Shing Yeh, Tit Sha Long	Abundant

Note:

1. Protection status / Conservation status refers to Cap. 170 - Cap. 170 Wild Animals Protection Ordinance; Cap. 586 - Cap. 586 The Protection of Endangered Species of Animals and Plants Ordinance; China Grade I Protected Species - Listed as Grade I National Key Protected Species; China Grade II Protected Species - Listed as Grade II National Key Protected Species; IUCN - IUCN (2016); CITES - the Convention on International Trade in Endangered Species of Wild Fauna and Flora, App. I – listed in Appendix I; CMS App. I and II – listed in Appendices I and II of the Convention on the Conservation of Migratory Species of Wild Animals.
2. Distribution and Rarity of corals (except ahermatypic cup coral *Balanophyllia* sp.) refer to the *Field Guide to Hard Corals of Hong Kong* (Chan et al., 2005).

4.6 Identification and Evaluation of Potential Marine Ecological Impacts

4.6.1 Assessment Methodology

The following criteria are used to assess the impacts of the Project on marine ecology based on Table 1 of Annex 8 of EIAO-TM:

- Habitat quality;
- Size of habitat and numbers of marine organisms affected;
- Duration of impacts;
- Reversibility of impacts; and
- Magnitude of impacts and environmental changes.

The potential direct, indirect, on-site and off-site impacts on marine ecological habitats and their associated species arising from the proposed dredging works are identified and significance of the potential impacts are evaluated using the 6-point range: "severe", "severe-moderate", "moderate", "moderate-minor", "minor" and "negligible".

4.6.2 Identification of Potential Ecological Impacts

For this Project, key marine ecological impacts include direct impact of habitat loss of the seabed and indirect impact due to increased suspended solids (SS) levels and changes in receiving water quality, which mainly arise from improvement dredging during construction phase; whilst recurrent marine ecological impacts arising from operation dredging activities in the operational phase will be similar to that for the construction phase, as mentioned in **Section 3.5.2**. Water quality impacts arising from all the proposed dredging activities including perturbation of the seabed, elevation of SS, sedimentation, potential release of contaminants (TIN and UIA) from sediment and impact on dissolved oxygen will also cause disturbance impact on marine ecological resources. The impact of changes of water quality during the dredging works was simulated by water quality modelling. On the other hand, potential ecological impacts associated with increased marine traffic include possible collisions with marine mammals and indirect acoustic disturbance effects.

Potential marine ecological impacts are identified below:

- Direct impact – Loss of subtidal soft bottom habitat and benthic communities due to dredging;
- Indirect disturbance impact on benthic communities associated with sedimentation generated by dredging works (which would affect their species abundance and diversity);
- Indirect disturbance impact on coral communities associated with water quality impacts (elevation in SS and sedimentation and associated reduction in DO);
- Indirect disturbance impact on intertidal communities associated with potential perturbations in water quality;
- Disturbance impact on Green Turtles and their inter-nesting habitat; and
- Disturbance impact on cetaceans' habitat use and other indirect impacts associated with construction vessels, e.g. increased acoustic disturbance and increased risk of injury to cetaceans by collision with vessels.

Despite of the impact identified above, dredging activities are not new to the Project area. Dredging activities and other marine works related to the Power Station have previously occurred in the Project area. The ecological community at the Project area and adjacent waters has experienced and survived through previous improvement and operation dredging. The Sensitive Receivers (SRs) has been evaluated in relation to the baseline conditions and the predicted magnitude of the impacts.

4.6.3 Evaluation of Potential Ecological Impacts

4.6.3.1 Loss of Subtidal Soft Bottom Habitat and Benthic Communities

Habitat loss of subtidal soft bottom sediment will occur at the proposed dredging area within the navigation channel. It will lead to direct removal of benthic communities inhabited. The seabed substrates are mainly composed of soft mud/ clay that receive continuous disturbances from operation dredging. Species recorded in this region were common and dominated by stress-tolerant marine benthos including polychaetes *Mediomastus* sp. and *Prionospio ehlersi* as well as bivalves *Paratapes undulatus* and *Saccella cuspidata*, which were also recorded outside the proposed dredging area. Benthic communities are expected to recolonize the seabed after the proposed dredging works. After recolonization and settlement of marine

organism on the benthic sediment, the habitat and benthic communities will recover, therefore the habitat loss is regarded as temporary only. In considering the high commonness of marine benthic organisms recorded, the low ecological value of the disturbed seabed and the reversibility of the seabed condition for recolonization of benthic fauna after construction, the significance of direct impact on the temporary loss of seabed habitat along the navigation channel is considered to be minor.

4.6.3.2 Indirect Disturbance Impact on Benthic Communities

The dredging activities will cause sediment transport, and high sediment deposition on the benthic environment could cause smothering and burial of soft-bottom benthos in the vicinity of proposed dredging area. Less mobile benthic species are more susceptible to these potential impacts. The evaluation of the potential impact has taken into account the ecological value of the potentially affected soft-bottom benthos and the dispersion of sediment plume. The influence of SS concentration is predicted by using the water quality modelling which simulated the dispersion of sediment generated as a result of various dredging scenarios.

For this Project, a 'backwards' approach is adopted for water quality modelling and impact assessment to estimate the maximum allowable dredging rates which would ensure no unacceptable environmental impacts for all dredging activities including improvement dredging during construction phase and recurrent operation dredging during operation phase, as mentioned in **Section 3.6.2**. The water quality modelling results indicated that any high concentration of SS will be confined to the area in close proximity to the dredging area, and to a lesser extent to the immediately adjacent area. The contours presented in **Appendix 3.7** show the extent of maximum surface, bottom and depth-averaged SS elevations over the complete simulation period during dry and wet seasons, respectively. As shown in these figures, the extent of SS impact appears to be confined near the dredging areas within the navigation channel. Given there is no soft-bottom benthos species of conservation interest in this region and the relatively low ecological value of the marine benthic communities, the potential impact induced by the increase in sediment deposition is considered as minor. As shown by the predicted SS sediment plumes and according to the predicted SS elevations presented in **Section 3.7.1**, the relatively important marine resources at the southern part of Lamma will unlikely be affected under the maximum allowable dredging rates.

4.6.3.3 Indirect Disturbance Impact on Coral Communities

For this Project, hard coral communities inhabiting the sub-tidal zone at the artificial seawall along the Lamma Power Station Extension as well as around western and southern coasts of Lamma would be of concern. These coral communities may be affected by the elevation of SS and change in sedimentation rate. Deposition of sediment would cause hard coral to suffocate and die, or indirectly affect the potential of photosynthesis through reduction of sunlight reaching the sub-tidal habitat. The hard coral communities closer to the dredging zone are more susceptible to the disturbance impact.

For the hard and soft corals identified at the artificial seawall along the Lamma Power Station Extension, they are sediment-tolerant with only one common hard coral species recorded with low coral cover (<1%). The significance of disturbance impact on these coral communities of low ecological value is therefore considered as minor.

To the east of the proposed dredging area, the natural sub-tidal hard bottom habitats along the western coast of Lamma were recorded with coral communities of moderate ecological value. Prediction of elevation of SS and change in deposition rate induced by the dredging works was determined through the assessment of water quality modelling results. By adopting the 'backwards' approach in modelling, the maximum allowable dredging rates were predicted and set to ensure compliance of water quality criteria at the coral communities. As stated in **Section 3.4.5** of this report, the limit of sedimentation rate at 0.1 kg/m^2 per day (according to Hawker and Connell, 1992) is adopted as the assessment criterion for protecting coral sensitive receivers, and the sedimentation results from the water quality model show no exceedance of this water quality criteria for corals under all dredging scenarios. As the maximum allowable dredging rates will be implemented for both construction and operation of this Project, the sedimentation rate at coral communities along the western coast of Lamma and within the Study Area will be controlled at acceptable level as presented in **Section 3.7.2** and there will be no significant DO depletion at coral communities due to the Project as mentioned in **Section 3.7.4**. Therefore, the disturbance impact of dredging activities on the coral communities is considered as minor.

4.6.3.4 Indirect Disturbance Impact on Intertidal Communities

The concern of the impact to intertidal communities is due to the release of SS and subsequent deposition on the fauna community.

The WQOs as presented in **Section 3.4** have been set to protect the ecological SRs and water quality modelling has been used to predict the release of SS by a 'backwards' approach. The dredging rates were set based on the water quality modelling results to ensure compliance with WQOs at the SRs at south Lamma waters during the proposed improvement dredging. Thus, it is expected that the representative ecological SRs would be compliant with WQO and no adverse impact on the intertidal communities is expected.

The impact area of SS for all dredging scenarios does not extend as far as south-eastern or eastern Lamma; therefore impact on the intertidal communities at further area within the Southern WCZ is anticipated to be negligible.

4.6.3.5 Disturbance Impact on Green Turtles and their Inter-nesting Habitat

Sham Wan SSSI on south-eastern Lamma is a known nesting site for Green Turtle. Nesting Green Turtles usually linger around the nesting beach during the nesting season. In this EIA study, the Sham Wan SSSI and inter-nesting habitats of Green Turtle were identified as Water Sensitive Receivers (WSRs) and the potential disturbance in relation to water quality impact of the dredging works on Sham Wan SSSI and the inter-nesting habitats were determined through the water quality modelling and impact assessment results.

The Sham Wan SSSI is sheltered from the works area within the navigation channel at the western Lamma. The area of water quality impact for all dredging scenarios does not extend as far as south-eastern or eastern Lamma waters. Water quality impact assessment results (refer to **Section 3.7**) indicate that the SS and DO levels at WSR SS1 representing the Sham Wan SSSI are compliant with the corresponding criteria. The results for TIN show the contribution by the project to be either negligible or low and acceptable at the WSRs nearest to the project boundary, while the results for UIA show that the WSRs nearest to the project boundary

would comply with the criteria. Given these water quality results and noting the sheltered location of this nesting beach which is distant from the dredging area, Sham Wan SSSI is relatively undisturbed by the dredging works.

For the inter-nesting habitats of Green Turtle at western, southern and southeastern waters of Lamma Island represented by WSR GT1 to GT5, water quality impact assessment results (refer to **Section 3.7**) show that with the adoption of the recommended maximum allowable release / dredging rates during construction phase and operation phase recurrent dredging, no adverse water quality impacts due to SS release from the Project is expected. The results for DO and the results of the nearest WSRs for UIA (which includes GT1 and GT2) will comply with the corresponding criteria, while the results of the nearest WSRs for TIN show the contribution by the project to be negligible at GT1 and GT2 (which are the nearest inter-nesting habitats of Green Turtles to the project boundary). The record of inter-nesting locations in 2012 shows green turtle has occasional movements within and at the edge of the project boundary; nevertheless, potential impact on the inter-nesting movement at the project area is considered temporary and in short term whilst mitigation measures for water quality (presented in **Section 3.8**) such as localised cage-type silt curtains for the dredgers would control any SS release to ensure no acceptable water quality impact. Therefore, it can be summarised from the water quality impact assessment results that with the adoption of abovementioned maximum dredging rates and mitigation measures for water quality, potential impacts on the Green Turtles, the nesting site at Sham Wan and their inter-nesting habitats at western, southern and southeastern waters of Lamma are anticipated to be minor.

4.6.3.6 Disturbance Impact on Cetaceans

Water Quality

Dredging would indirectly affect Finless Porpoise that may occur at southwest Lamma and occasionally within the Project Area. Generally, increased SS should not cause concern for Finless Porpoises as they would not be subject to any risk of gill blockage under high levels of SS. In addition, as Finless Porpoise utilize echolocation for prey detection, they are less likely to be affected by sedimentation effects as they do not filter prey through water column. As the prey species of Finless Porpoise may be adapted to the constant turbidity in Hong Kong waters, they are not expected to be affected significantly by the low sediment release rate generated by the proposed improvement dredging. Similarly, as the Chinese White Dolphins are adapted to more turbid conditions at Pearl River Estuary and seldom sighted around Lamma Island in recent years, they are not expected to be affected by elevation in SS due to the works.

As assessed in **Section 3.7.1**, SS levels due to the Project were predicted to be within the WQOs at all WSRs including the Finless Porpoise habitat at southwest of Lamma, as long as dredging rates were kept under the recommended maximum allowable dredging rates. In view of the controlled dredging rates of this Project, the limited extent of sediment plumes generated and short-term nature of each dredging works with a relatively long period of no-dredging (approx. 4 to 10 years) between each recurrent operation phase dredging event, it is predicted that elevation in SS levels is unlikely to cause long-term damage to cetaceans. Regarding potential release of contaminants from sediment, as assessed in **Section 3.7.3**, the potential impact on Finless Porpoise habitat associated with contribution by the Project in TIN level is considered to be low and acceptable. There will be no significant DO depletion at Finless Porpoise habitat as presented

in **Section 3.7.4**. Overall significance of indirect water quality impacts on Finless Porpoise and CWD is therefore regarded as minor. Nevertheless, suitable water quality mitigation measures for minimising elevation of SS proposed in **Section 3.8** would also minimize potential water quality impact on Finless Porpoise.

Disturbance and Collision

Acoustic disturbance to Finless Porpoise from dredging is unlikely due to the low-frequency noise generated (between 50 and 500 Hz according to Hildebrand, 2004), which is below the range used by Finless Porpoises for echolocation (narrowband clicks at about 140 kHz and pulses at about 20 kHz, according to Goold & Jefferson, 2002 and Mooney et al., 2011). The slow movements of small number of dredgers are unlikely to cause collision, therefore such movements would have minimal disturbance on the Finless Porpoise. Furthermore, the usage of the Finless Porpoise in the Project Area is seasonal and limited to dry season (December to May) only; thus disturbance would occur only between these few months. Noting that calves are the most sensitive life stage, restricting the works to avoid the most critical period of the Finless Porpoise calving season (i.e. February to April, with reference to the 2003 approved EIA report (Hyder, 2003)) could avoid the disturbance impact.

Similar to dredging, other Project-related vessels would produce low-frequency underwater noises of less than 1 kHz (Jefferson et al., 2009), so the potential acoustic disturbance is well below the primary acoustic range for Finless Porpoise and it is not expected to adversely affect the behaviour of Finless Porpoise.

In the 2003 approved EIA report, Finless Porpoise was stated to mostly show no reaction to vessels and only a small percentage would actively avoid vessels. However, there is still potential risk of collision with fast-moving vessels. Precautionary measures are proposed in **Section 4.7** to minimise the potential impact of Project-related vessels on Finless Porpoise, such as setting a disposal route to bypass the key Finless Porpoise habitats in southwest and east Lamma, and setting a maximum speed limit in south, southwest and east Lamma waters for barges.

It is worth noting that since the last EIA report being approved in 2003, whilst the Project Area has undergone two periods of improvement dredging works in 2004 and 2010 (refer to **Chapter 2** of this EIA report), there were no noticeable changes in occurrence of Finless Porpoise that could attribute to these past dredging works at the western side of Lamma over the subsequent years. Also, a relative high occurrence of porpoises at the southwest corner of Lamma and the offshore waters between Cheung Chau and Lamma Island was noted from 2006 to 2012 (refer to Hung, 2012 & 2013). It is evidently that the past improvement dredging works had no significant effect on finless porpoise, therefore the potential disturbance or collision impacts of proposed dredging works on finless porpoise are considered as minor.

4.6.3.7 Potential Disturbance Impact on the potential Marine Park in South Lamma

The potential marine park in South Lamma including the marine lives therein is considered for any potential impact of dredging works as the coastal waters of South Lamma supported marine fauna of ecological value. It is represented by WSR PMP1 for assessing any water quality impact and relevant disturbance impact to the marine environment due to the dredging works as simulated by water quality modelling.

Under the aforementioned maximum allowable dredging rates, water quality impact assessment results (refer to **Section 3.7**) indicate that SS and DO levels at PMP1 will comply with the corresponding criteria. The results for TIN show the contribution by the project to be negligible at PMP1, while the results for UIA at PMP1 would comply with the corresponding criteria. Noting the very limited water quality changes induced by the dredging works, the project will unlikely have any adverse impact on marine lives and water environment in the potential marine park. It is therefore anticipated that potential disturbance impact on the potential marine park will be minor.

4.7 Mitigation/Precautionary Measures

In **Section 4.6**, it was identified that the ecological impact to marine ecology is generally minor. No mitigation/precautionary measure is considered necessary except for the cetacean Finless Porpoise, which has low density of usage of the Project Area in dry season.

Precautionary measures are recommended for both construction and operation (operation dredging) phases in order to further protecting Finless Porpoise.

For further avoiding potential impact on Finless Porpoise using southwest Lamma, the calving season for the porpoise shall be avoided as far as practicable, as the calves are more vulnerable to disturbance impacts. It is therefore recommended to avoid dredging Zone 4 of the navigation channel (as shown in **Figure 3.3**) from February to April when it is the most sensitive period for the calves, with the exception of necessary hotspot / localised dredging being kept under the recommended maximum allowable dredging rates which would ensure no unacceptable disturbance impacts on Finless Porpoise.

For further minimizing disturbance to Finless Porpoise habitat outside the Project Area, vessel movements to disposal grounds are recommended to bypass the Finless Porpoise habitat area in southwest and east Lamma, and to implement a maximum speed limit of 10 knots in south and east Lamma waters.

All vessel operators working on the Project should be thoroughly briefed on the possible occurrence of Finless Porpoise within and in the vicinity of the Project Area and along routes to the Project Area, as well as rules for safe vessel operation around cetaceans and slowing down to 10 knots in the presence of cetaceans in south and east Lamma waters. Water quality mitigation measures mentioned in **Section 3.8** will also minimise impacts on marine ecology associated with the changes in water quality.

4.8 Evaluation of Residual Impacts

With proper implementation of precautionary and environmental protection measures for marine ecology as described in **Section 4.7** as well as mitigation measures for water quality, it is expected that residual impacts on marine ecology are negligible.

4.9 Ecological Monitoring and Audit Requirements

With the implementation of recommended precautionary measures for marine ecology as well as water quality monitoring programme for construction and operation phases as mentioned in **Section 3.10**, no specific ecological monitoring is required as residual impacts on the marine ecology are negligible.

4.10 Conclusion

The Marine Ecological Impact Assessment has been conducted in accordance with the requirements stipulated under Section 3.4.3 and Appendix C of the EIA Study Brief No. ESB-282/2014 as well as Annexes 8 and 16 of the EIAO-TM. The Study Area of the Project for ecological impact assessment will cover the Southern Water Control Zone (WCZ) and Western Buffer WCZ as designated under the Water Pollution Control Ordinance.

Based on literature review and field survey findings, the key habitats and recognised sites of conservation interest identifies within the Study Area are Sham Wan SSSI and Restricted Area, hard shore habitat including artificial and rocky shores, soft shore habitat (sandy shores), sub-tidal habitats including soft bottom substrates (benthos) and hard bottom substrate (with and without corals), and marine waters (potential marine park at South Lamma and Finless Porpoise habitat). From the evaluation of the potential ecological impacts, the direct impact of the loss of subtidal soft bottom habitat and benthic communities is considered to be minor. Similarly, the indirect disturbance impact on benthic communities and coral communities are anticipated to be minor, while the indirect disturbance impact on intertidal communities is anticipated to be negligible. The potential impact on the Green Turtle, its nesting site at Sham Wan and inter-nesting habitats at western, southern and southeastern waters of Lamma is also anticipated to be minor. For the disturbance impact on cetaceans, dredging activities for both construction and operation phases of this Project are unlikely to cause any long-term damage to cetaceans, and the potential disturbance or collision impacts of proposed dredging works on finless porpoise are considered as minor since the past dredging works had no significant effect on finless porpoise. Therefore, it is concluded that the overall marine ecological impact is assessed to be minor.

Nonetheless, precautionary measures are proposed to further protecting Finless Porpoise. It is recommended to avoid dredging Zone 4 of the navigation channel, except for necessary hotspot / localised dredging, during the most critical period of the Finless Porpoise calving season (i.e. February to April) to avoid disturbance impacts. To minimise the disturbance to Finless Porpoise habitat outside the Project Area, it is recommended that vessel movements to disposal grounds to bypass the Finless Porpoise habitat area in southwest and east Lamma, and to implement a maximum speed limit of 10 knots in south and east Lamma waters. All vessel operators working on the Project should be thoroughly briefed on the possible occurrence of Finless Porpoise within and in the vicinity of the Project Area and along routes to the Project Area, as well as rules for safe vessel operation around cetaceans and slowing down to 10 knots in the presence of cetaceans in south and east Lamma waters. With the implementation of the abovementioned precautionary measures and water quality mitigation measures recommended in **Section 3.8**, no residual impact on the marine environment is expected.

4.11 References

AFCD (2013). Rescued green turtle returned to the sea. Press release on Monday, January 28, 2013. In: website of AFCD, HKSAR Government [http://www.afcd.gov.hk/english/publications/publications_press/pr1819.html]

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

Barros, N.B., Jefferson, T.A., Parsons, E.C.M. (2002) Food habits of Finless Porpoises (*Neophocaena phocaenoides*) in Hong Kong waters. Raffles Bulletin of Zoology Supplement No. 10: 115-123

Barros, N.B., Jefferson, T.A., Parsons, E.C.M. (2004) Feeding habits of Indo-Pacific Humpback Dolphins (*Sousa chinensis*) stranded in Hong Kong. Aquatic Mammals 30 (1): 179 – 188.

Beasley, I. & Jefferson, T.A. (2002) Surface and dive times of Finless Porpoises (*Neophocaena phocaenoides*) in Hong Kong's coastal waters. Raffles Bulletin of Zoology Supplement No. 10: 125-129

Beasley, I. & Jefferson, T.A. (2004) Surface and dive times of Finless Porpoises (*Neophocaena phocaenoides*) in Hong Kong's coastal waters. Raffles Bulletin of Zoology Supplement No. 10: 125-129

Black & Veatch (2006) Agreement No. CE 25/2002 (DS) Drainage Improvement in Northern Hong Kong Island – Hong Kong West Drainage Tunnel – Final EIA Report. Prepared for DSD of HKSAR Government

BMT Asia Pacific Limited (2005) Agreement No. CE 18/2002 (EP) EIA Study for Construction of Helipads at Peng Chau and Lamma Island – Investigation. EIA Study for Helipad at Yung Shue Wan, Lamma Island – Final EIA Study Report. Prepared for CEDD of HKSAR Government.

Chan, L.K. Alan, Choi, L.S., Choyce, McCorry, D., Chan, K. Khaki, Lee, M.W. and Ang Put Jr. (2005) Field Guide to Hard Corals of Hong Kong. Friends of the Country Parks and Cosmos Books Ltd. Hong Kong.

Chan, S.K.F. (2004). Green turtles in Hong Kong. Friends of the Country Parks and Cosmos Books, Hong Kong. 103 pages.

CityU Professional Services Limited (2001) Agreement No. CE 69/2000. Consultancy Study on Marine Benthic Communities in Hong Kong. Submitted to AFCD.

Clyde-Brockway, C.E. (2014). Inter-Nesting and Post-Nesting Movements and Behavior of East Pacific Green Turtles (Chelonia mydas agassizii) from Playa Cabuyal, Guanacaste, Costa Rica. [Retrieved on 11 February 2016, from http://opus.ipfw.edu/masters_theses/35]

Eckert, K. L., Bjorndal, K. A., Abreu-Grobois, F. A. and Donnelly, M. (Editors). (1999). Research and Management Techniques for the Conservation of Sea Turtles. IUCN/SSC Marine Turtle Specialist Group Publication No. 4, 1999.

ENSR (2008) Agreement No. CE 43/2005 (EP) Harbour Area Treatment Scheme (HATS) Stage 2A – Final EIA Report. Prepared for DSD of HKSAR Government.

ERM (1999) EIA of a 1,800MW Gas-Fired Power Station at Lamma Extension – Final Report. Prepared for the The Hongkong Electric Company Limited.

ERM (2010) Development of a 100MW Offshore Wind Farm in Hong Kong – Final EIA report. Prepared for the Hongkong Electric Company Limited.

EPD (2006) 20 Years of Marine Water Quality Monitoring in Hong Kong 1986-2005. In: web site of Environmental Protection Department, HKSAR Government [Retrieve from http://www.epd.gov.hk/epd/misc/marine_quality/1986-2005/index.html].

Hung, S.K.Y. (2012). Monitoring of Marine Mammals in Hong Kong Waters (2011-12) Final Report (1 April 2011 to 31 March 2012). Hong Kong Cetacean Research Project. Submitted to Agriculture, Fisheries and Conservation Department of the Hong Kong SAR Government.

Hung, S.K.Y. (2013). Monitoring of Marine Mammals in Hong Kong Waters (2012-13) Final Report (1 April 2012 to 31 March 2013). Hong Kong Cetacean Research Project. Submitted to Agriculture, Fisheries and Conservation Department of the Hong Kong SAR Government.

Hung, S.K.Y. (2015). Monitoring of Marine Mammals in Hong Kong Waters (2014-2015) Final Report (1 April 2014 to 31 March 2015). Hong Kong Cetacean Research Project. Submitted to Agriculture, Fisheries and Conservation Department of the Hong Kong SAR Government.

Hung, S.K.Y. (2016). Monitoring of Marine Mammals in Hong Kong Waters (2015-2016) Final Report (1 April 2015 to 31 March 2016). Hong Kong Cetacean Research Project. Submitted to Agriculture, Fisheries and Conservation Department of the Hong Kong SAR Government.

Hyder Consulting Limited (2003). Lamma Power Station Navigation Channel Improvement Environmental Impact Assessment Report.

IUCN (2016). The Red List of Threatened Species. 2016-3. [Retrieve from http://www.iucnredlist.org/]

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

Jefferson, T. A., Hung, S. K., Law L., Torey M.& Tregenza N. (2002). Distribution and abundance of finless porpoises (*Neophocaena phocaenoides*) in Hong Kong and adjacent waters of China. Raffles Bulletin of Zoology Supplement 10: 43-55.

Jefferson, T. A., Hung, S. K. (2007). An updated, annotated checklist of the marine mammals of Hong Kong. Mammalia 71: 105-114.

Maunsell Consultants Asia Ltd (2007) Agreement No. CE7/2005 (EP) Harbour Area Treatment Scheme EIA Study for Provision of Disinfection Facilities at Stonecutters Island Sewage Treatment Works – Final EIA Report. Prepared for DSD of HKSAR Government.

Mott MacDonald Hong Kong Limited (2010) Agreement CE 63/2008 (CE) Providing sufficient water depth for Kwai Tsing Container Basin and its approach channel – Final EIA report. Prepared for CEDD of HKSAR Government.

Ng, C.K., Dutton, P.H., Chan, S.K., Cheung, K., Qiu, J., & Sun, Y. (2014) Characterization and conservation concerns of Green Turtles (*Chelonia mydas*) nesting in Hong Kong, China. Pacific Science, vol. 68, no. 2:231-243.

Parsons, E.C.M. & Felley, M.L., & Porter, L.J. (1995). An annotated checklist of cetaceans recorded from Hong Kong's territorial waters. Asian Marine Biology. 12:79-100.

The IUCN Red List of Threatened Species. Version 2016-2. <www.iucnredlist.org>. Downloaded on 22 November 2016.

Scott Wilson (2003) Agreement No. CE 45/99 Extension of Existing Landfills and Identification of Potential New Waste Disposal Sites – Final SEA report. Prepared for EPD of HKSAR Government.

Shin, P.K.S., Huang, Z.G. & Wu, R.S.S. (2004). An updated baseline of subtropical microbenthic communities in Hong Kong. Marine Pollution Bulletin. 49:119-141.