9 MARINE ECOLOGY

9.1 Introduction

9.1.1 This section identifies and evaluates the nature and extent of potential impacts on marine ecological resources in the proposed development area resulting from proposed reclamation and other marine works in the Project. Several relevant baseline studies and assessment reports are reviewed and both direct and indirect impacts on marine ecology during construction and operation phases are included in the assessment.

9.1.2 Where necessary, field surveys have been undertaken to check current ecological baseline conditions. Ecological importance of habitats and species potentially affected by proposed works are identified and assessed. The scale and significance of possible ecological impacts resulting from the Project are evaluated, and necessary mitigation measures have been recommended. Residual and cumulative ecological impacts are also identified and evaluated, and ecological monitoring and audit requirements are discussed.

9.2 Environmental Legislation, Policies, Plans, Standards and Criteria

9.2.1 This section makes reference to the following HKSAR Government ordinances, regulations, standards, guidelines and documents when identifying ecological importance of habitats and species, evaluating and assessing potential impacts of the proposed development on the ecological resources:

- *Environmental Impact Assessment Ordinance (EIAO) (Cap. 499)* - aims to avoid, minimise and control the adverse effects on the environment by designated projects through the application of the environmental impact assessment process and the environmental permit system.

- *EIAO Technical Memorandum on Environmental Impact Assessment Process (EIAO-TM) Annex 8* – provides guidelines for the evaluation of the ecological impact caused by the designated project. A list of criteria is provided for assessing the importance of habitat / species and the ecological impact.

- *EIAO-TM Annex 16* – describes 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 Note No. 3/2002* - provides guiding principles on the approach to assess the recommended environmental mitigation measures in Environmental Impact Assessment (EIA) reports.

- *EIAO Guidance Note No. 6/2002* - provides some guidance on conducting ecological assessment.

- *EIAO Guidance Note No. 11/2004* - introduces some general methodologies for marine ecological baseline surveys.

- *Wild Animals Protection Ordinance (Cap. 170)* - designated wild animals are protected from being hunted, whilst their nests and eggs are protected from injury, destruction and removal. All birds and most mammals, including marine cetaceans, are protected under this Ordinance. The Second Schedule of the Ordinance, which lists all the animals protected, was last revised in June 1997.

- *Protection of Endangered Species of Animals and Plants Ordinance (Cap. 586)* – to give effect to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the Ordinance strictly regulates the import, introduction from the sea, export, re-export and possession or control of certain endangered species of animals and plants and derivatives of those species scheduled in Appendices I, II and III. The Ordinance came into effect on 1 December 2006.

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

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

- *The Protection of the Harbour Ordinance (Cap.531)* – bases on a presumption against reclamation, the harbour is to be protected and preserved as a special public asset and a natural heritage of Hong Kong people.

- *The Water Pollution Control Ordinance (Cap.358)* – aims to control water pollution in waters of Hong Kong. Water control zones are designated with individual water quality objective to promote the conservation and best use of those waters in the public interest. The most updated water quality objective for the Victoria Harbour Water Control Zone was revised in June 1997.

9.2.2 This section also makes reference to the following international conventions and nearby national regulation:

- *International Union for Conservation of Nature and Natural Resources (IUCN) 2006 Red Data Books* - provides taxonomic, conservation status and distribution information on threatened species 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 PRC National Protection Lists of Important Wild Animals and Plants* - lists detailed Category I and Category II key protected animal and plant species under Mainland Chinese Legislation. The list was last updated in November 2002.

9.3 Assessment Methodology

9.3.1 The proposed reclamation area would affect part of the existing shoreline and seabed at Wan Chai District and Eastern District. In general, the boundary of the Assessment Area is 500 m from the proposed reclamation area. The marine ecological environment of the proposed development area, as shown in **Figure 9.1**, comprises largely the Victoria Harbour extending from Wan Chai to North Point, including the Causeway Bay Typhoon Shelter (CBTS).

Literature review

9.3.2 The assessment of ecological impact on marine habitats has been undertaken with reference to the previous baseline surveys and EIA studies for other proposed projects in and within the vicinity of the proposed reclamation area. These include the following:

- Central Reclamation Phase III Studies - Site Investigation, Design and Construction. Comprehensive Feasibility Study for Minimum Option: Final Key issues and Initial Environmental Impact Assessment Report (CRIII EIA report).
- Agreement No. CE 52/95, Strategic Sewage Disposal Scheme Environmental Impact Assessment Study (SSDS EIA study).
- Agreement No. CE 74/98, Wan Chai Development Phase II Comprehensive Feasibility Study (WDII EIA report).
- Agreement No. CE 42/2001, Environmental and Engineering Feasibility Assessment Studies in Relation to the Way Forward of the Harbour Area Treatment Scheme – Water Quality, Ecological and Fisheries Impact Assessment (HATS EEFS report).
- Agreement No. CE 25/2002, Drainage Improvement in Northern Hong Kong Island – Hong Kong West Drainage Tunnel Environmental Impact Assessment Final Report.
- CityU Professional Services (2003) Consultancy Study on Marine Benthic Communities in Hong Kong. Final Summer Field Survey Report. Submitted to AFCD.
- EPD Water Quality in Hong Kong 2004.
- AFCD Port Survey 2001-2002.
- Agriculture, Fisheries and Conservation Department, 2004. Ecological Status and Revised Species Records of Hong Kong's Scleractinian Corals. Hong Kong: Agriculture, Fisheries and Conservation Department, HKSAR.
- Alan L.K. Chan, Choyce L.S. Choi, Denise McCorry, Khaki K., Chan, M.W. Lee and Ang Put Jr. 2005. Field Guide to Hard Corals of Hong Kong. 1st Edition (Eds. W.C. Chan and Edward Stokes). Friends of the Country Parks and Cosmos Book Ltd, Hong Kong.

Ecological surveys

9.3.3 Field surveys are considered necessary, where appropriate, to supplement and check the validity of data collected through the literature review process. The field surveys for this assessment include:

- *Ecological survey* on intertidal and benthic habitats in and within the vicinity of proposed reclamation area was conducted in January 2007. The survey included spot-check reconnaissance dives on 29 representative line transects and Rapid Ecological Assessment (REA) (DeVantier *et al.,* 1998) at two spot-check sites where signs of coral colonies were first observed during the spot-check dives. Detailed survey plan and methodology were presented in the Dive Survey Report (**Appendix 9.1**);

- *Intertidal communities surveys* on artificial intertidal habitats within the Project area were conducted in August 2006 by direct observation along the shoreline. Fauna species and relative abundance were recorded and identified according to Williams (2003). In addition, the natural coastline at the northern part of Kellett Island was surveyed in January 2007 for the intertidal assemblage using standard transect method. Detailed survey plan and methodology were presented in the Intertidal Survey Report (**Appendix 9.2**).

- *Avifaunal survey* was conducted in area of Victoria Harbour and CBTS during August 2006 by fixed point direct observation (sight and call). Identification of bird species was made reference to Viney *et al*. 2005;

Impact assessment methodology

9.3.4 Evaluation and assessment of potential impact on ecological resources was conducted in accordance with the criteria and guidelines specified in Annex 8 and Annex 16, respectively, of the EIAO-TM.

9.3.5 The significance of impacts was ranked as "*low*", "*moderate*" or "*high*" based on the criteria shown in **Table 9.1**. The description of the ranking is as below:

9.3.6 *Low* - Impacts to species or groups are assessed as "low" if the predicted impact would result in a slight, and / or short-term reduction in the local population numbers or geographic distribution of a species or group, but the species or group is predicted to recover from the perturbation with no-long term adverse impacts. Impacts to habitat are assessed as "low" when the habitat is widely distributed locally and that no rare or restricted species are found in the habitat.

9.3.7 *Moderate* – Impacts to species or groups are considered "moderate" if the predicted impact probably would result in non-recoverable and / or long-term reduction in population numbers. However, the species in question should be considered widely distributed or common, and abundant on a local, regional or global scale. Impacts to habitat are assessed as "moderate" if the habitat is of limited local or regional distribution or declining in extent and that the habitat has a potential of supporting fauna and / or fauna of conservation importance.

9.3.8 *High* – Impacts to species or groups are judged to be "high" if the predicted impact has an adverse effect on species or groups which are rare, protected or of conservation importance locally, regionally, or globally. Impacts to habitat are considered to be "high" if the habitat in question is of limited local or regional distribution or declining in extent and that it is generally considered by the scientific community to be of local, regional or global importance to the support of rare or restricted flora and /or fauna species.

9.3.9 If impacts on ecological resources are found to be significant (that is, moderate or high), mitigation measures would be recommended in accordance with the EIAO-TM Annex 16 and EIAO Guidance Note No. 3/2002. Impact mitigation would be sought in the following priority: avoidance, minimisation, on-site compensation and off-site compensation.

9.3.10 Impact avoidance generally consists of modifications to the preferred development options, but may in some extreme cases require abandonment of the project.

9.3.11 Impact minimisation includes any means of reducing the scope or severity of a given impact, for example, through timing of construction programme, modification in the design or ecological restoration of disturbed areas following the completion of works.

9.3.12 Impact compensation will be recommended if the effect on a given species or habitat is irreversible and attempts will be made to compensate it elsewhere, for example, enhancement, creation of suitable habitats or recreation of the habitat. Compensation can be on-site or off-site.

9.4 Description of the Environment

9.4.1 The marine environment in the Assessment Area is composed of the coastal water of Victoria Harbour and the Causeway Bay Typhoon Shelter (CBTS). Representative photographs of marine environments are given in **Appendix 9.3**. In general, these two areas are similar in water quality and sediment contamination as they are hydrographically interconnected with each other. However, as CBTS is located within an embayment with limited flushing, it is more vulnerable to pollution than the coastal water in Victoria Harbour.

Area of conservation interest

9.4.2 There are no ecological sensitive receivers, such as SSSIs, Marine Parks/Reserves or other areas of ecological importance or conservation interest, in and within the vicinity of the Assessment Area. As the proposed development will include dredging and new reclamation, far field ecological sensitive receivers have been identified. These potential off-site ecological sensitive receivers include coral area located at Green Island, Little Green Island (6 km) and Junk Bay (8 km).

Abiotic

Water

9.4.3 Under the Water Pollution Control Ordinance (Cap. 358), the Victoria Harbour is within the gazetted Victoria Harbour Water Control Zone. In the previous WDII EIA report (Maunsell, 2001), marine water in the Victoria Harbour was identified as turbid, hypoxic and highly eutrophic, that was due to the direct discharge of wastewater into the harbour area with only preliminary treatment for the discharged sewage (screening).

9.4.4 However, after the commissioning of the Stonecutters Island Sewage Treatment Works (SCISTW) in 2002 under stage 1 of the Harbour Area Treatment Scheme (HATS), water quality has improved significantly, especially in the eastern harbour area. According to the EPD's water quality monitoring results, marine water in the Assessment Area (Station VM4 and VM5) is now less turbid (turbidity 6.7-12.6 NTU), more oxygenated (dissolved oxygen 3.9-7.5 mg L^{-1}), and lower in inorganic nutrients (total nitrogen 0.14-0.61 mg L^{-1} and total phosphorus 0.02-0.08 mg L^{-1}) (EPD, 2005).

9.4.5 However, the levels of *E. coli* (510-15000 cfu per 100 mL) and faecal coliforms (2100-34000 cfu per 100 mL) increased substantially over the decade, indicating increasing faecal contamination (EPD, 2005).

9.4.6 In general, water quality in the Assessment Area has been improved recently but the Victoria Harbour provides a relatively poor marine habitat compared to eastern and southern waters in Hong Kong.

Sediment

9.4.7 The seabed in the Assessment Area is mainly composed of soft bottom sediment with coarse particle size. The marine sediment in Victoria Harbour, according to EPD's monitoring results, is highly anaerobic (electrochemical potential -409mV to -258 mV) due to high organic loading from sewage over the years. The sediment is toxic with high level of ammonia nitrogen (15-86 mg L^{-1}) and total sulphide (170-1700 mg kg^{-1}). It is also highly contaminated with copper (84-250 mg/kg) and silver (3.0-11 mg/kg) which exceed the Lower Chemical Exceedance Level (LCEL) or Upper Chemical Exceedance Level (UCEL), as defined in the ETWB Technical Circular (Works) No. 34/2002 (EPD, 2005).

9.4.8 Previous WDII EIA Report (Maunsell, 2001) pointed out that numerous ecological studies have been conducted in the Victoria Habour, and those have usually determined its polluted nature using single species or indicator groups (e.g. barnacles, Chan *et al*., 1990; Rainbow and Smith, 1992; Blackmore, 1999; fish, Kwan, 1999 and mussel, Nicholson, 1999).

9.4.9 A recent sediment toxicity test was carried out under the HATS EEFS study and sediments collected from Victoria Harbour (Station XN4 and VM7) were highly toxic to benthic amphipod *Leptocheirus plumulosus*, resulting in very low survivalship of 9-31% only (CDM, 2004).

Biotic

9.4.10 The study area comprises several broad marine habitats including:

- Benthic habitat on soft bottom substratum of the Victoria Harbour.
- Intertidal habitats on artificial seawall and mimic rocky shore.
- Intertidal habitats on natural rocky shore of northern Kellett Island.
- Subtidal habitat in Victoria Harbour.
- Feeding ground for waterbirds in CBTS near A King Shipyard.

9.4.11 Representative photographs of some identified marine habitats are presented in **Appendix 9.4**. The baseline ecological conditions of different marine habitats in the Assessment Area are described below.

Soft bottom benthos

9.4.12 Previous WDII EIA report summarised the findings in Thompson and Shin (1983) and showed that benthic assemblages in the Assessment Area were typically of low diversity and abundance, and community structure was largely dictated by organic pollution from sewage discharges in the past. As only a limited number of hypoxia tolerant species can survive the bottom conditions within the study area region, fauna was dominated by opportunists such as bivalves and polychaetes.

9.4.13 Dominant polychaetes include *Minuspio cirrifera* and the best-known marine organic enrichment indicator *Capitella capitata*. These polychaetes may be indicators of moderate and severe organic pollution, respectively. The moderately pollution tolerant bivalve *Ruditapes philippinarum* (stated as *Tapes philippinarum*) was also found dominant in the benthic infaunal population in the same study (Thompson and Shin, 1983).

9.4.14 Another field survey of soft bottom benthic organisms at the seabed in the Victoria Harbour near the Central District conducted for CRIII EIA Study (Atkins China Ltd., 1999) was also reviewed in previous assessment. This field survey indicated that the soft bottom marine environment in the Victoria Harbour was polluted and lacked a macroinvertebrate community.

9.4.15 The field survey carried out for the SSDS EIA study also confirmed a very low species diversity and evenness for benthic assemblages in Victoria Harbour and was indicative of stressful environment for benthos (Binhai, 2000).

9.4.16 A recent study on marine benthic communities in Hong Kong showed that a coarser sediment benthic group was found in Victoria Harbour (Station 53 & 54) as compared to eastern and southern waters, with lower species diversity and evenness resulted (CityU, 2002).

9.4.17 This study showed that the benthic communities in Victoria Harbour comprised of mainly polychaete (*Cirratulu*s sp., *Schistomeringo rudolphi*, *Dodecaceria* sp., *Naineris* sp., *Sigambra hanaoka* and *Prionospio* sp.), oligochaete (*Thalassodrilides gurwitchi*), bivalve (*Ruditapes philippinarum*) and crustacean (amphipod *Cheiriphotis megacheles*) (CityU, 2002). It indicated a distinct benthic composition which is characterized by species strongly adaptable to eutrophic environment.

9.4.18 Other recent survey for HATS EEFS study on benthic assemblages in Victoria Harbour near North Point (Station VM2 and XM4) also indicated that the benthic assemblage was dominated by polychaeta (*Naineris* sp., *Glycera* sp., *Prionospio* sp.), mollusca (*Ruditapes* sp.) and crustacea (*Corophium* sp.). Bivalve *Ruditapes* sp. is the most abundant (44%) fauna, comprising 95% of the whole benthic assemblage biomass. Although it is a commercial species, the conservation value is not high. It was noted that the benthic community structure has been relatively stable over the years and so quite robust to environmental disturbance (CDM, 2004).

Intertidal Communities (Artificial)

9.4.19 Intertidal seashore habitats in the Assessment Area mostly comprise of the artificial vertical seawalls, with small portion of man-made sloping seawalls and rockfills (rocky shores 'mimic' natural habitat) at the Wan Chai Ferry Pier and around the HKCEC.

9.4.20 Previous WDII assessment reviewed a number of literatures and indicated that fauna presented in seawalls and rockfills were largely restricted to encrusting sessile organisms such as bivalves, molluscs and barnacles (Morton and Morton, 1983; Lee, 1985; Lee and Morton, 1985).

9.4.21 Fauna commonly encountered included molluscs such as the common neogastropod (*Thais clavigera*) and the pollution-tolerant bivalve (*Perna viridis*), as well as encrusting crustaceans such as barnacles (*Balanus* spp., *Tetraclita squamosa* and *Capitulum mitella*) and the ubiquitous mobile isopod (*Ligia exotica*) (Morton and Morton, 1983; Lee, 1985; Lee and Morton, 1985).

9.4.22 Flora is mostly restricted to algae that are either organic or nutrient enrichment indicators such as *Ulva* spp. and *Cladophora* (Morton and Morton, 1983; Ho, 1987; Moore, 1990).

9.4.23 A recent intertidal fauna survey on artificial seawalls and rockfills within the Assessment Area was carried out in August 2006 to confirm the validity of the literature results. The list of intertidal fauna is summarised in **Appendix 9.5**. Compared to the past records, similar biotic assemblages on artificial intertidal habitats around HKCEC, CBTS and the shoreline of City Garden in North Point were found in current survey and the intertidal composition in the Assessment Area was generally consistent with the past recorded results.

9.4.24 The artificial seawalls in the Assessment Area were found to be generally inhabited densely by few species of sessile encrusting fauna, including chiton (*Acanthopleura japonica*), barnacle (*Tetraclita squamosa*) and bivalve (*Saccostrea cucullata*). The only mobile species found on the artificial seawalls were the common Sea Slater (*Ligia exotica*) and topshell (*Monodonta labio*). All of them are common local intertidal species with low conservation interest.

9.4.25 It was found that the mimic rocky shores located at the Wan Chai Ferry Pier and the shoreline of the HKCEC provided a more diverse and abundant intertidal community compared with the vertical and sloping seawalls. Limpet (*Patelloida saccharina*) and small crab, together with the species described in 9.4.23, were recorded in the rockfill habitats.

9.4.26 In the current study, encrusting algae (*Pseudulvella applanata* and *Hildenbrandia* sp.) were recorded on the surface of artificial vertical seawalls in the Assessment Area. No erect algae or higher flowering plant was found during the recent survey.

Intertidal Communities (natural)

9.4.27 Part of the coastline found at the northern part of the Kellett Island is the only natural coastline within the study area. The natural coastline on Kellett Island is a typical sheltered rocky shore subjected to only slight wave action.

9.4.28 Field survey conducted for the WDII EIA study indicated that the sheltered rocky shore communities were composed of large quantities of topshell (*Monodonta austrailis)* dominating the lower shore and periwinkles (*Nodilittorina millegrana*), dominating the upper shore (Maunsell, 2001).

9.4.29 Other intertidal species including Stalked Barnacle (*Pollicipes mitelia*), Acorn Barnacle, (*Tetraclita squamosa*), common chiton (*Liolophura japonica*) and limpet (*Cellana toreuma*) were occasionally observed. In general, the species diversity and abundance were relatively low compared to other natural shoreline in Hong Kong. No rare species or species of conservation value were observed in this survey (Maunsell, 2001).

9.4.30 A recent intertidal survey on the shoreline of northern Kellet Island was conducted in January 2007 in order to provide more detailed and updated information on the existing ecological assemblage profile in this natural habitat. Detailed survey methodology, location, result and discussion are provided in the Intertidal Survey Report (**Appendix 9.2**). **Figure 1** of the **Appendix 9.2** indicates the two surveyed locations within the natural shoreline where quadrats of 0.5 m x 0.5 m dimension were laid at 1 m interval along 10 m transects which extended from high tide mark to low tide mark. Epifauna within each quadrats were identified, enumerated and recorded.

9.4.31 Recent survey revealed that natural coastline at the northern Kellet Island was limited to small area of less than 20 m x 100 m dimension only with natural substrata of large boulders, cobbles and bedrocks and some old concretes. The nearby intertidal habitats were mainly composed of artificial seawalls and rock armours and this habitat was subjected to high level of disturbance from past construction and reclamation works at nearby areas.

9.4.32 A total of seven species were recorded during recent survey and their abundances were shown in **Table 1** of **Appendix 9.2**. Similar composition and distribution pattern of intertidal communities were observed during recent survey compared with those reported in WDII EIA Study. Periwinkles (*Nodilittorina millegrana*) and topshell (*Monodonta austrailis)* were the most common species recorded on both transects with *N. millegrana* dominating the upper shore and *M. austrailis* dominating the lower shore. Other intertidal species including limpet (*Cellana toreuma*), Nerite (*Nerita chanaeleon*), Stalked Barnacle (*Capitulum mitella)* and Acorn barnacle (*Tetraclita squamosa*) were also recorded. All the recorded species are common in most of the shorelines in Hong Kong and no species of conservation importance or nursery/breeding activities was observed in this area.

Subtidal fauna

Marine mammals

9.4.33 Literature review has shown that there were no sightings of marine mammals within the Assessment Area. One of the most important marine mammals in Hong Kong waters is the Chinese White Dolphin (*Sousa chinensis*) which was only seen in the western estuarine waters in Hong Kong including outer Deep Bay, north, south, east Lantau and west Lamma (Hung, 2006). The other common marine mammal Finless porpoise (*Neophocaena phocaenoides)* was also never reported in the Victoria Harbour and only occurs in the eastern and southern waters of Hong Kong (Jefferson, 2001). There is no significant record of such marine mammals with high conservation interest within the Assessment Area.

Corals

9.4.34 In Hong Kong, the richest coral communities are found in the eastern part where water is free from the influence of estuarine water from the Pearl River. As water in Victoria Harbour was turbid with high level of suspended solids, it was unsuitable for coral to survive and colonise there. Based on the review on a number of previous literatures, there was no significant record of coral reported within the Assessment Area.

9.4.35 Literature review indicated that the nearest soft corals and gorgonians are located at Green Island and Little Green Island about 6 km west from the reclamation area. A low coverage of black coral of *Anthipathes* sp. was also found in Green Island (TDD, 1998). In general, soft coral and gorgonians are more resistant to turbid waters than hard coral as they do not contain symbiotic algae zooxanthallae and do not require light penetration for photosynthesis. Therefore, they are more widely distributed in Hong Kong and are also found in areas of higher turbidity.

9.4.36 The EIA study for Tseung Kwan O Further Development also identified the presence of small colonies of hard corals with sparse cover of soft corals and gorgonians found in Chiu Keng Wan located at the northwestern Junk Bay, which is about 8 km to the east from the Project area (Maunsell, 2005).

9.4.37 Recent dive survey for HASTS EEFS Study also indicated that the shallow water of Joss House Bay and north-west Tung Lung Chau (over 10 m east of the reclamation area) supported reasonably diverse but low cover hard coral communities. However, the same study showed that there were no hard corals or soft corals observed in the North Point areas (CDM, 2004).

9.4.38 Due to lack of information on presence of coral communities in and within the proposed reclamation areas, recent dive survey was carried out during January 2007 in order to provide sufficient and updated information for the evaluation of any potential impact to coral arising from the proposed development. Details on the methodology, surveyed area, results, discussion and recommendation are provided in the Dive Survey Report (**Appendix 9.1**).

9.4.39 Spot-check reconnaissance dives were first conducted to identify the extent of hard substrate with an emphasis on gaining an overview of coral occurrence within and adjacent to the proposed reclamation area. Areas with corals identified in spot-check dives were then further surveyed using REA technique along 100 m transect. **Figure 1 & 2** of **Appendix 9.1** indicate the areas covered by the spot-check dives and the locations where the REA transects deployed.

9.4.40 As illustrated in **Table 2** of **Appendix 9.1**, 29 representative line transects of totally 4680 m were surveyed in spot-check dives. The underwater visibility at all surveyed sites were generally poor (< 2 m). The maximum water depth in all the surveyed sites ranged from 3 m to 8 m. Bottom substrata were mainly composed of muddy or sandy seabed with hard substrata rubble seawalls for most of the surveyed sites while rock or boulder was also found at Site 3, 6, 13, 14 and 18-21.

9.4.41 In all of the surveyed sites, the seabed quality is generally poor with limited marine life observed. Only one species of hard coral (*Oulastrea crispata*) and one species of octocoral (gorgonian *Echinomuricea* sp.) were found at Site 13 and Site 27 respectively. But they are all small in size, sparsely distributed and in very low coverage (< 1%). Neither soft coral nor black coral was identified during the spot-check dives.

9.4.42 More detailed REA surveys were then carried out at Site 13 and Site 27. Substrata at Site 13 were mainly composed of muddy and sandy bottom with boulders while Site 27 comprised muddy bottom with hard substrata of rubber seawalls.

9.4.43 At site 13, only sparse coverage (1-5%) of totally 18 colonies of single hard coral species (*Oulastrea crispata*) was recorded during the REA survey. Most of the colonies were attached on the small rocks or boulders less than 50 cm in diameter in the ex-Public Cargo Working Area (PCWA) basin near the pier of the Hong Kong Yacht Club. All the colonies found at Site 13 were in fair health condition but in small size ranged from 3 cm to 8 cm in diameter. *Oulastrea crispata* has a wide range of adaptations to different environmental conditions (including those unfavourable to corals) as well as geographic locations, which is a result of its stress-tolerant ability (Chen, *et al.* 2003). With an opportunistic life history trait, a wide range of reproductive strategies and surface-orientation independent growth, *O. crispata* is able to colonise a variety of substrata and to flourish as a pioneer coloniser of newly immersed structures (Lam, 2000a & 2000b). It is common and widespread in Hong Kong marine waters, especially those more turbid and harsh environment in the western waters (Chan, *et al.* 2005).

9.4.44 Very low coverage (1-5%) of only one colony of octocoral (gorgonian *Echinomuricea* sp.) was found at Site 27 during the REA survey. It was located on the seawall at the North Point Shoreline next to a public pier which is about 250 m away from the CBTS. The colony found was small in size (25 cm in diameter) and in fair condition. *Echinomuricea* sp. is a common gorgonian coral found in Hong Kong water, especially in those turbid waters at southern and western part of Hong Kong.

Feeding ground in CBTS

9.4.45 Recent avifaunal survey revealed few bird species presented in the Assessment Area and list of birds was summarised in **Appendix 9.6**. The locations of species of conservation interest recorded in the Assessment Area were indicated in **Figure 9.1**.

9.4.46 It was found that CBTS, particularly the area near the A King Shipyard, is a feeding ground for ardeids of conservation interest including Little Egret (*Egretta garzetta*), Great Egret (*Ardea alba*) and Black-crowned Night Heron (*Nycticorax nycticorax*). The other species of conservation interest found during recent survey included the White-throated Kingfisher (*Halcyon smyrnensis*) and Black Kite (*Milvus migrans*). All wild birds are protected under local law and the conservation status of the recorded species of conservation interest is discussed in details below.

9.4.47 A total of 36 Little Egret (*Egretta garzetta*) was found foraging and feeding in the coastal water of Victoria Harbour and CBTS. Although Little Egret is a common ardeid which is widely distributed in the coastal waters throughout Hong Kong, it is considered to be a species of conservation interest regionally due to its restricted site of breeding and roosting (Fellowes *et al.*, 2002).

9.4.48 A Great Egret (*Ardea alba*) was also observed forage and feed together with the Little Egret population at the CBTS near A King Shipyard. Although this species is a common resident and winter visitor in Hong Kong, the Great Egret is considered to be of conservation interest regionally due to its restricted breeding and roosting area (Fellowes *et al.*, 2002).

9.4.49 Six Black-crowned Night Heron (*Nycticorax nycticorax*) (including one juvenile) were also recorded foraging and feeding at the CBTS near A King Shipyard. This ardeid is a common local resident and winter visitor in Hong Kong. Due to its restricted breeding and roosting area, it is listed as a species of conservation interest locally (Fellowes *et al.*, 2002).

9.4.50 A total of four Black Kite (*Milvus migrans*) was observed at flight above the Victoria Harbour and CBTS during recent survey. This species is a common resident and winter visitor in Hong Kong (Carey *et al.*, 2001). Black Kite is a Category II protected species under Mainland Chinese Legislation. Although locally very common, Kites are considered as species of conservation interest regionally due to its restricted number of nesting and roosting sites (Fellowes *et al.*, 2002), with the current breeding population believed to be about 30 pairs (Carey *et al*., 2001).

9.4.51 A White-throated Kingfisher (*Halcyon smyrnensis*) was recorded in the CBTS near A King Shipyard. This species is a local common resident and is widely distributed in the coastal areas throughout Hong Kong (Carey *et al.* 2001). It is listed as species of conservation interest locally due to its restricted breeding and roosting site (Fellowes *et al.* 2002).

Ecological Importance

9.4.52 Based on the available literature and discussion presented above, the ecological values of marine resources present within the Assessment Area have been assessed and evaluated. This has been determined in accordance with the EIAO-TM Annex 8 Table 2 criteria and is shown in **Tables 9.1**.

Table 9.1 Criteria and Evaluation of Ecological Importance of Marine Habitats in the Assessment Area.

Criteria	Soft bottom habitat	Intertidal habitat (artificial)	Intertidal habitats (natural)	Subtidal habitat	Feeding ground in CBTS
Naturalness	Subjected to extensive anthropogenic disturbance	Man-made habitat	Basically natural but its naturalness were partially affected by past reclamation and construction.	Highly disturbed by marine traffic, subjected to extensive water pollution	Disturbed by marine traffic and human activities
Size	Large, 15 ha	Large, 1 km long	Small, less than 100 m long	Large, 15 ha	Large, 16 ha
Diversity	Low, mainly dominant by pollution-tolerant fauna	Low, mainly composed of few intertidal fauna	Low, mainly composed of few intertidal fauna	Low, species confined to those resistant to polluted water	Low, only few avifaunal species found
Rarity	No rare species found	No rare species found	No rare species found. But this coastline is one of the remaining natural habitats on the north shore of Hong Kong Island	No rare species found but only one species of common hard coral and one species of common gorgonian were recorded	No rare species recorded but species of conservation interest including Little Egret, Great Egret, Black-crowned Night Heron, Black Kite and White-throated Kingfisher were found
Re-creatability	High	Very High	Moderate	High	High
Fragmentation	The habitat is not fragmented.	The habitat is highly fragmented.	The habitat is fragmented.	The habitat is not fragmented.	The habitat is not fragmented.
Ecological linkage	Not functionally linked to any highly valued habitat in close proximity.	Not functionally linked to any highly valued habitat in close proximity.	Not functionally linked to any highly valued habitat in close proximity.	Not functionally linked to any highly valued habitat in close proximity.	Not functionally linked to any highly valued habitat in close proximity.
Potential value	Very low	Very low	Low	Low	Low
Nursery ground	No significant record.	No significant record.	No significant record.	No significant record.	No significant record.
Age	NA	NA	NA	NA	NA
Abundance / Richness of wildlife	Low for abundance and species richness	High for abundance but low for species richness	High for abundance but low for species richness	Low for abundance and species richness	Low for abundance and species richness
Ecological importance	**Very low**	**Very low**	**Low**	**Low**	**Low**

9.4.53 Species of conservation interest recorded in the Assessment Area are evaluated in **Table 9.2** below.

Table 9.2 Species of Conservation Interests recorded in the Assessment Area.

Species	Location	Protected Status [1]	Distribution & Rarity [2]
Coral			
Hard coral *Oulastrea crispata*	Ex-PCWA Basin near the pier of the Hong Kong Yacht Club	Listed in Cap. 586	Common in Hong Kong waters.
Gorgonian *Echinomuricea* sp.	Seawall next to a public pier which is about 250 m away from the CBTS	-	Common in Hong Kong waters.
Avifauna			
Black-crowned Night Heron *Nycticorax nycticorax*	CBTS near A King Shipyard	-	Locally common, but with limited number of breeding sites in Hong Kong. Local concerned conservation species.
Little Egret *Egretta garzetta*	CBTS near A King Shipyard and the Victoria Harbour	Listed in Cap. 586	Locally common, but with regional concerned conservation interest for its restricted breeding sites in regional area.
Great Egret *Ardea alba*	CBTS near A King Shipyard	Listed in Cap. 586	Locally common, but with regional concerned conservation interest for its restricted breeding sites in regional area.
White-throated Kingfisher *Halcyon smyrnensis*	CBTS near A King Shipyard	-	Common resident in Hong Kong, but is local concerned conservation species for its restricted breeding site recorded.
Black Kite *Milvus migrans*	CBTS near A King Shipyard and the Victoria Harbour	Listed in Cap.586 and Category II protected species under Mainland national legislation	Common resident and winter visitor in Hong Kong. Regional concerned conservation species.

Note 1: All wild birds in Hong Kong are protected under Ordinance Cap.170
Note 2: Information taken from various sources including Viney *et al.* (2005), Carey *et al.* (2001), Fellowes *et al.* (2002) and Chan *et al.* (2005).

9.4.54 Soft bottom seabed and artificial interidal habitat are considered as very low ecological importance. This is based on the considerations of their highly disturbed nature, low species diversity and absence of rare species found in current ecological impact assessment.

9.4.55 Ecological value of natural intertidal habitat found in northern coastline of Kellet Island is ranked of low level due to its small size, low species richness and partial loss of naturalness by past reclamation and construction works, though it is scarce natural intertidal habitat existing in the northern Hong Kong Island.

9.4.56 The colonies of hard coral and gorgonian found in the subtidal habitat are low in species richness and abundance, small in size and they are common species which can tolerant to more turbid water and can be found in many locations of Hong Kong waters. In view of the poor habitat quality (e.g. high SS level, low light intensity, etc) for coral colonization compared with other locations in Hong Kong waters, the subtidal habitat is considered as low in ecological importance.

9.4.57 Although feeding ground in CBTS serves as a foraging area for some waterbirds and other avifaunal species of conservation interest in local or regional area due to their restricted breeding number and site recorded, the habitat size, species diversity and abundance are relatively low. Similar alternative feeding grounds for ardeids and other bird species of conservation interest are also found available in the vicinity such as the Kwun Tong Typhoon Shelter, To Kwa Wan Typhoon Shelter and Yau Ma Tei Typhoon Shelter. Therefore, this habitat is not considered as an important feeding ground for the bird population and its ecological significance is ranked as low.

9.5 Identification of Ecological Impacts

9.5.1 Impacts to marine ecological resources may occur during the construction and operational phases. The impacts may be derived from direct loss of the habitats or indirect disturbance through changes to key water quality parameters.

Construction phase

Direct impact

9.5.2 Potential direct impacts on marine ecology arising from the proposed development would include loss of habitats and the associated marine species due to dredging and filling activities. This would include:

- Permanent loss of approximately 12.7 hectares of soft bottom seabed and subtidal habitat along the Wan Chai and North Point Shoreline for land reclamation.

- Temporary loss of approximately 7.9 hectares of soft bottom seabed and subtidal habitat within ex-PCWA basin and CBTS for temporary reclamation, but area near A King Shipyard is not included in the reclamation plan and so no direct loss of feeding ground for waterbirds would be resulted. Temporary loss of approximately 0.4ha of soft bottom seabed and subtidal habitat at the eastern end of Wan Chai Shoreline for temporary reclamation. Temporary loss of approximately 2.4ha of soft bottom seabed and subtidal habitat for the temporary typhoon shelter.

- Permanent loss of approximately 1 km long artificial intertidal habitat due to reclamation work.

- Temporary loss of approximately 850 m long artificial intertidal habitat for temporary reclamation.

Indirect impact

Changes in water quality

9.5.3 Potential indirect impacts to the marine habitats and the associated fauna would include changes in water quality due to dredging activities of seabed sediment and potential site run-off from land-based construction works.

Elevation of suspended solid (SS)

9.5.4 Possible indirect impact on subtidal habitat may include water quality deterioration due to siltation effects during the marine works. Marine fauna especially sessile filter feeders are susceptible to deleterious impacts from sedimentation through smothering and clogging of their respiratory and feeding apparatus. Similarly, more turbid water may reduce the amount of light reaching beneath the water surface, which may also be detrimental to marine flora and fauna. This may result in both direct (e.g. mortality) and indirect (e.g. slow growth rate, low in reproductive success rate) impacts on marine life and may eventually cause the reduction of population size of marine assemblage. Potential secondary impact on the waterbird population may be resulted due to the reduced food availability caused from the dredging works of this Project.

9.5.5 To assess the impacts associated with elevated SS, the assessment was based on compliance with the statutory Water Quality Objectives (WQO) for concerned Water Control Zones, which are set for among other reasons, to offer protection for marine ecological resources. Water quality modelling predictions were analyzed for compliance with the WQO through comparison of worst case scenario's 15-day depth-averaged SS level against baseline levels. Using this criterion, if the elevation in SS levels exceeds 30% above ambient baseline conditions, adverse impacts on marine ecology, may be predicted and suitable mitigation pursued.

9.5.6 There are no WQOs regarding sedimentation rates. To assess impacts due to sediment deposition on far-field ecological sensitive receivers, the sedimentation rate of not exceeding 100 mg cm^{-2} per day (or 0.1 kg m^{-2} per day) which was also adopted in other EIA studies in Hong Kong for ecological resources conservation (Hyder, 1997; ERM, 2001; Black & Veatch, 2006), is considered as suitable for coral protection in this study.

Release of contaminants and nutrients

9.5.7 As bottom sediment is disturbed during dredging activities and particles released into the water column, organic and inorganic substances contained in the sediment may be released to the water column. Released substances may cause toxic effects to marine fauna.

9.5.8 In addition, the release of inorganic substances may cause eutrophication and algal bloom in the construction area. Oxidation of dead algae may use up some of the oxygen in the water. If oxygen levels are depleted to low levels, benthic organisms unable to tolerate such conditions may suffer hypoxia-induced mortality and / or stress including reduced feeding and growth rate. The WQO standard that the average-depth and bottom water DO should remain above 4 mg/L and 2 mg/ L respectively for 90% of the time was adopted.

Disturbance impact

9.5.9 Marine construction and dredging activities within the existing CBTS may cause disturbance impacts on the associated waterbird population and other avifaunal species of conservation interest due to increase of background noise and human activities.

Operation phase

Direct impact

9.5.10 There is no direct ecological impact on marine resources expected during the operation phase of the Project.

Indirect impact

Change in tidal flow pattern

9.5.11 Potential indirect impacts caused by changes in hydrographic regime of the harbour and the subsequent tidal flow pattern may cause changes in water quality.

Disturbance impact

9.5.12 Because the proposed development plans of the Project include reprovision of Wan Chai Ferry Pier, other recreational port facilities near the ex-PCWA basin and the floating Tin Hau Temple on-shore to the site of the existing A King Shipyard, increased marine traffic and human activities during the operation phase is anticipated and potential disturbance impact to marine resources and associated wildlife would be expected.

9.6 Evaluation of Ecological Impacts

Construction phase

Direct impact

Habitat loss

9.6.1 Direct impacts to the marine ecological resources would include unavoidable habitat loss due to the dredging and filling activities in the Assessment Area. The reclamation works would lead to the permanent loss of approximately 12.7 hectares of soft bottom habitat and subtidal habitat. Reclamation of coastal area would also cause permanent loss of approximately 1 km of artificial intertidal habitat near the HKCEC and at the North Point Shoreline.

9.6.2 Temporary habitat loss of approximately 10.7 hectares soft bottom and subtidal habitats as well as 850 m long artificial intertidal habitat would also occur at the areas of ex-PCWA basin, CBTS and at the eastern end of Wan Chai shoreline where temporarily reclamation was proposed for the Trunk Road construction, and at the area of the temporary typhoon shelter. However, the identified feeding ground for waterbirds near the A King Shipyard and the existing natural shoreline at the Kellett Island will remain intact during construction. No direct loss of feeding ground for waterbirds and natural intertidal habitat would be resulted in this Project.

9.6.3 As discussed in Section 9.4, soft bottom seabed, intertidal (artificial) and subtidal habitat in the Assessment Area are ranked as low ecological importance (very low to low value). In addition, temporary loss of habitats due to temporary reclamation would be reinstated after the construction works and similar assemblages of flora and fauna are expected to re-colonise. Indeed, the removal of the contaminated sediments by dredging for the temporary reclamation and the reinstatement of the seabed material would provide improved seabed habitat condition. Therefore, permanent and temporary loss of these habitats would not result in adverse impact on the marine ecological system in and within the vicinity of the Project area.

9.6.4 Nevertheless, it is recommended to avoid direct loss or damage of any species of conservation interest within the proposed reclamation areas as far as possible. The species of conservation interest found within these affected habitats include only a single species of common hard coral (*Oulastrea crispata*) and a common gorgonian colony (*Echinomuricea* sp.). Those 19 existing coral colonies found at the coastlines within ex-PCWA Basin (Site 13) and along seawall at North Point (Site 27) (**Figure 1 & 2 of Appendix 9.1**) are attached to small and manually movable boulders and are practically feasible for translocation. In addition, the recorded species are not competitive and aggressive in nature (Lam, 2000a), these species are not expected to have any negative pressure on the other existing corals in the coral translocation recipient site and it is therefore considered suitable for translocation in the ecological point of view. It is therefore recommended to translocate all these existing coral colonies found at Site 13 and 27 to other suitable location such as Junk Bay where similar hydrographic condition and healthy coral communities of same coral species have been recorded.

9.6.5 In addition, about 1 km vertical wave absorbing seawalls would be reconstructed along the shoreline of the newly reclaimed area around the HKCEC and at North Point. Colonisation of intertidal flora and fauna on the newly formed seawalls would recover the impact of intertidal habitat loss due to the construction works.

9.6.6 Overall, all the marine habitats that would be permanently or temporarily lost due to this Project are all of very low or low ecological values and taking into account of all the mitigation measures proposed including coral translocation and reprovision of newly constructed seawalls, no adverse ecological impact on marine habitats and associated wildlife is expected.

Indirect impact

Changes in water quality

9.6.7 Indirect impacts on the marine ecology would be associated with changes of water quality due to dredging and reclamation activities, and site runoff from land-based construction works.

Elevation of Suspended Solid (SS)

9.6.8 Dredging and reclamation activities would temporarily elevate the suspended sediment level and create sediment plumes. Benthic epifauna could be susceptible to the effects of increased sediment loads. Effects could be lethal or sublethal through reduction in survivalship, growth rate and reproductive potential due to stress incurred by the need to constantly flush out deposited material. The effects of sedimentation on organisms depend on several factors, such as species tolerance to suspended solids, life modes of organisms (sessile or free-swimming) and water movement. Potential secondary impact of reduced food availability on waterbirds population and other avifaunal species of conservation interest recorded in the assessment area may be resulted if reduction of population size of marine assemblage occurs. However, considering there are a number of similar feeding areas within the Harbour area, the affected waterbirds are expected to displace to the nearby alternative feeding grounds for foraging and no adverse impact on the associated waterbirds population and other avifaunal species of conservation interest is expected.

9.6.9 Based on the prediction of the construction phase water quality modelling (see water impact assessment), potential water quality impact due to elevation of SS would occur at coastal waters of the Victoria Harbour. It is predicted that impacts to intertidal and subtidal assemblages immediately outside of the dredging and reclamation sites would occur during the construction phase because the elevation of SS is predicted to be more than 30% increase from ambient level at several locations. However, implementation of the proposed mitigation measures as suggested in the water quality assessment could effectively minimize this impact to less than 10 mg/L SS elevation in the assessment area. As suggested in Section 9.6.4, coral colonies found at the coastlines within ex-PCWA Basin and along seawall at North Point would be translocated to other locations prior to the commencement of proposed works and therefore these coral colonies would not be affected by this impact. Considering that the intertidal and subtidal communities identified in the Assessment Area are of generally very low ecological value and in view of the impact of suspended solids elevation is temporary, no adverse indirect ecological impact is anticipated.

9.6.10 Impact is not expected to occur at the far field ecological sensitive receivers including the coral areas located in the vicinity of Green Island, Little Green Island and Junk Bay. Sedimentation rate and elevations of SS at these locations are predicted to be less than 0.1 kg m^{-2} per day and 2 mg L^{-1} respectively under the worst case scenario. An elevation of this magnitude is very small and the total SS level is compliant with the WQO criteria for these areas. Thus, it is expected that adverse impacts to these areas arising from elevated SS levels would not occur.

9.6.11 The predicted elevation of SS at coastal water of the Kellet Island is less than 10 mg/L under the worst case scenario, implementation of proper mitigation measures could minimise this impact. In addition, existing man-made vertical seawalls along the shoreline of Kellet Island also provide partial protection to the intertidal fauna assemblage, no adverse impact to the present intertidal community is expected.

Release of contaminants and nutrients

9.6.12 As the sediment in the Project area is contaminated with heavy metals and organic pollutants, turbulence caused by dredging activities could release these substances to the water column. Increase of toxic substances in water could cause lethal or sublethal effects to subtidal fauna. Degree of toxic level depends on numbers of factors e.g. species tolerance, contaminant levels, water flow rate, etc.

9.6.13 An indication of the likelihood of release of contaminants from the marine sediment during dredging is given by the results of the elutriation tests from the laboratory testing conducted under the Phase I and Phase II marine site investigation (SI) works (see water impact assessment, S.5.7.30 – 5.7.48 for details). The elutriate tests indicated that only the levels of silver and mercury measured in two isolated elutriate samples would marginally exceed the WQO standards. Although exceedences were measured in the elutriate samples, it is expected that any release of contaminants during dredging would be quickly diluted by the large volume of marine water within the construction site. Based on the detected highest concentrations, the required dilution rate to meet the WQO criteria for silver and mercury were calculated to be very low (i.e. 1.5 only), which is expected to be naturally achieved by dynamic water flow within the Harbour area. Meanwhile, the release of contaminants would also be minimised by the use of closed grab dredger and the dispersion of contaminants would be confined within the construction site by silt curtains (Section 5.8). Thus, it is considered that long-term off-site marine water quality impact would be unlikely and any local water quality impact would be transient.

9.6.14 Nevertheless, as subtidal fauna like fish and crab identified in the Assessment Area are mobile, it is likely that they would avoid the dredged area and recolonise after reclamation works. Furthermore, works will be carried out in different phase at different locations and so there is refuge habitat available in nearby coastal waters for the affected fauna. Thus, adverse impact due to release of contaminant on subtidal organisms is not expected.

9.6.15 Nutrient level (inorganic nitrogen and phosphorous) may also increase during dredging activities. High levels of nutrients in seawater can cause rapid increases in phytoplankton often to the point where an algal bloom occurs. An intense bloom of algae can lead to sharp decreases in the levels of DO in the water as dead algae fall through the water column and decompose on the bottom. Anoxic conditions may result if DO concentration is already low or is not replenished. This may result in mortality to marine organisms due to oxygen deprivation. Based on the results of water quality modelling (see water quality assessment), it is predicted that the resultant TIN would be slightly higher than the WQO standard (i.e. < 0.4 mg/L) at several locations immediately outside the reclamation area, implementation of proper mitigation measures would be adopted to minimise such impact. In contrast, it is predicted that the depth-averaged and bottom minimum DO concentration contours in the Victoria Harbour reveal a similar pattern to that of the baseline condition that the minimum depth-averaged DO is greater than 4.0 mg L^{-1} (except water around HKCEC which is predicted to be slightly lower than 4.0 mg/L) and the bottom layer minimum DO is greater than 2.0 mg L^{-1}. These results comply with the WQO for DO.

9.6.16 As discussed in Section 9.4, the soft bottom benthic habitats are already highly hypoxic and the associated benthic and subtidal communities in the Assessment Area are of generally very low ecological significance, so adverse impact due to elevation of nutrients level and DO depletion on the associated marine fauna is not expected.

Disturbance impact

9.6.17 During the marine construction works, increased marine traffic and noise generated from construction plant and dredging machines could cause disturbance impacts to the associated waterbirds and other avifaunal species of conservation interest. However, set against the background of intense human activities in Victoria Harbour and the CBTS, the associated avifaunal population are considered already well adapted to human disturbance. It is expected that displacement to the nearby waters for feeding area may occur temporarily but adverse impact is not anticipated.

Operation phase

Indirect impact

Changes in tidal flow pattern

9.6.18 Impacts to marine ecological resources could potentially occur if the shape of the reclamation causes a change to the hydrodynamic regime of the harbour. Impacts of this nature could lead to increased seabed current speeds that may cause seabed scour, thus impacting subtidal assemblages. Conversely, the current speeds may drop in some areas affecting flushing and water exchange of these areas. Inadequate flushing could lead to reduction in dissolved oxygen and increase in nutrients and consequent impacts to marine ecological resources.

9.6.19 The hydrodynamic modelling in previously WDII EIA report concluded that the reclamation proposed by the Project will have minimal impact on the hydrodynamic regime of the Assessment Area and there will be no insurmountable hydrodynamic impacts. The flow speed distributions within the Victoria Harbour before and after the implementation of the Project are very similar. The reclamation will only cause very slight change in the prevailing currents in the Assessment Area. Therefore, no ecological impact due to changes of tidal discharges and current patterns is anticipated.

Disturbance impact

9.6.20 The Project proposes the enhancement of recreational and heritage value of the harbour shoreline near the ex-PCWA basin and the CBTS, by enhancing the waterfront promenade and providing some leisure facilities including the water sport centre and harbour educational centre. Such recreational facility would possibly cause increase in human activities and marine traffic during the operational phase of the Project.

9.6.21 As mentioned previously, associated waterbirds and other bird species of conservation interest found in Victoria Harbour and the CBTS are well adapted to human disturbance and so impact caused by increase in background noise and human activities would be minimal and temporary. No adverse impact on this associated waterbirds population and other bird species of conservation interest would be resulted during the operation phase of the Project.

Overall impact

9.6.22 Based upon the foregoing discussion, no adverse marine ecological impacts associated with the Project are expected to occur during the construction and operation of the Project. A summary of impact evaluation is presented in **Table 9.3-9.4**.

Table 9.3 Evaluation of Ecological Impacts on Marine Resources during Construction Phase.

Criteria	Construction phase		
	Habitat loss	**Change in water quality**	**Disturbance impact**
Impacted habitat	Benthic, subtidal and intertidal (artificial) habitats	Subtidal and intertidal habitats	Feeding ground in CBTS
Habitat quality	Very low to low	Very low to low	Low
Species	Only isolated and low-valued hard coral and gorgonian would be affected	No rare species	Little Egret, Great Egret, Black-crowned Night Heron, Black Kite and White-throated Kingfisher would be affected
Size / Abundance	Permanent loss of 12.7 ha seabed and subtidal habitat as well as 1 km artificial seawall habitat Temporary loss of 10.7 ha seabed and subtidal habitat as well as 850 m artificial seawall habitat	Large in size Low to moderate species abundance	Low species abundance
Duration	Persist permanently Last throughout the construction phase	Temporary	Temporary
Reversibility	Irreversible for permanent reclamation area, but habitat in temporary reclamation area would be recovered.	Would recover after construction phase	Would recover after construction phase
Magnitude	The magnitude of impact is considered as moderate	The magnitude of impact is considered as minor after implementation of proper mitigation measures.	The magnitude of impact is considered as minor.
Ranking of Significance of Impacts	Low	Low	Low
Overall impact	**No adverse impact**		

Table 9.4 Summary of Evaluation of Marine Ecological Impacts during Operation Phase

Criteria	Operation phase	
	Change in tidal flow	**Disturbance impact**
Impacted Habitat	Subtidal and Intertidal habitat	Feeding ground in CBTS
Habitat quality	Very low to low	Low
Species	No rare species	Little Egret, Great Egret, Black-crowned Night Heron, Black Kite and White-throated Kingfisher would potentially be affected
Size / Abundance	Large in size Low to moderate species abundance	Low species abundance
Duration	Persist permanently	Temporary
Reversibility	Irreversible	Would recover
Magnitude	Very minor	Very minor
Ranking of Significance of Impacts	Low	Low
Overall impact	**No adverse impacts**	

9.7 Mitigation of Adverse Environmental Impact

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

Avoidance

9.7.2 The proposed alignment of the WDII has been substantially revised, with consequent large reductions in potential impacts to marine ecological resources. Under the previously proposed alignment, large reclamation area of about 27 hectares marine habitats from coastal area of CBTS to the HKCEC was proposed for the construction of the Trunk Road at ground level. The revised WDII alignment proposes alternative Trunk Road constructed in tunnel that avoids the permanent reclamation at ex-PCWA basin and the CBTS and the consequently direct impacts to benthic and subtidal habitats and the associated wildlife in large part of the Project area.

Minimization

9.7.3 Recent dive surveys revealed that coral within subtidal habitat that would be directly affected by the proposed reclamation works was low in species diversity (only two species) and coverage (1 – 5%), with only small colonies and common species recorded. The subtidal habitat was therefore considered as low ecological value. Nevertheless, those 19 coral colonies identified in recent dive survey were small and attached to movable boulders and are practically feasible for transplantation. As an additional measure to protect coral, it is recommended to translocate all these potentially affected corals at ex-PCWA Basin (Site 13) and along seawall at North Point (Site 27) to the nearby suitable habitats such as Junk Bay where similar hydrographic condition and healthy coral communities of the same species were recorded. A 10 m x 10 m coastal area at Junk Bay is proposed as a practical and feasible recipient site (**Figure 9.2**). A detailed translocation plan (including translocation methodology, monitoring of transplanted corals, etc.) should be drafted during the detailed design stage of the Project. The coral translocation exercise should be conducted before the commencement of construction phase of the Project. The translocation methodology, monitoring proposal and, the ecologist involved in this translocation exercise should be approved by AFCD prior to commencement of this exercise. Detailed requirements on coral translocation are discussed in the EM&A Manual.

9.7.4 During dredging and filling operations, a number of mitigation measures to control water quality would be adopted to confine sediment plume within reclamation area and protect marine fauna in proximity to the reclamation. The mitigation measures include the following:

- Installation of silt curtains during dredging activities.
- Use of tightly-closed grab dredger.
- Reduction of dredging rate.
- Control of grab descending speed.
- Construction of leading edges of seawall in the early stages of the reclamation works.
- Adoption of multiple-phase construction schedule.

9.7.5 These mitigation measures are expected to result in no substantial changes in water quality, and only minimal ecological effects on marine environment and associated wildlife would result.

9.7.6 To minimize potential disturbance impacts on the foraging ardeid population in the CBTS, particularly in the area near the A King Shipyard, appropriate mitigation measures shall be adopted particularly during the construction phase. The following measures are recommended:

- Use of Quiet Mechanical Plant during the construction phase should be adopted wherever possible.
- Adoption of multiple-phase construction schedule.
- General measures to reduce noise generated during the construction phase (see noise impact assessment) should be effectively implemented.

9.7.7 Vertical seawalls should be placed around the dredging areas and construction boundaries within the area of the CBTS to screen adjacent feeding ground from construction phase activities, reduce noise disturbance to the associated seabirds and also to restrict access to this habitat adjacent to works areas by ship traffic.

Other Measures

9.7.8 As described previously, loss of artificial seawall habitat due to temporary reclamation would be reinstated after construction works and similar assemblages of flora and fauna would be re-colonized naturally over time. For the loss of artificial intertidal habitat, it would be recovered by the construction of about 1 km vertical wave absorbing seawall along the coastlines of the newly reclamation land around the HKCEC and at the North Point. The new seawalls are expected to provide large area of hard substrata for settlement and recruitment of intertidal and subtidal assemblages similar to those previously recorded from existing habitats.

9.8 Evaluation of Residual Impacts

9.8.1 With the effective implementation of mitigation measures proposed in Section 9.7, residual effects on marine ecology are expected to be very minor. The only identified residual impact would be the loss of approximately 12.7 hectares soft bottom benthic and subtidal habitats of generally very low ecological significance due to permanent reclamation works. Overall, no adverse residual impacts on marine ecology resulting from the Project are expected.

9.9 Evaluation of Cumulative Impacts

9.9.1 There are several planned or concurrent works for the other projects conducted in and within the vicinity of the Assessment Area, including the following:

- Central Reclamation Phase III (CRIII) Project
- Hong Kong Convention and Exhibition Centre (HKCEC) Atrium Link Extension Project
- Project for the Western Cross Harbour Main from Wan Chai to Tsim Sha Tsui
- Western Cross Submarine Gas Pipelines Project
- Kai Tak Development (KTD) Project

9.9.2 As dredging and filling activities are also included in the above projects, except the HKCEC Project, the most concerned cumulative impact would be the cumulative effect on the deterioration of water quality in the Victoria Harbour.

9.9.3 For all the concurrent projects listed above, water quality modeling (see water quality assessment) predicted that the dredging and reclamation works undertaken for these concurrent projects would result in elevation of SS level of more than 30 % of ambient level at several locations immediately outside the dredged area under the worse case scenario. With the implementation of proper mitigation measure mentioned and recommended in the water quality assessment, cumulative impact on change of water quality in the Assessment Area could be effectively minimized and is expected to be acceptable. Cumulative impact of change of water quality on far-field ecological sensitive receivers including coral areas at Green Island, Little Green Island and Junk Bay is predicted to be complied with the assessment criteria for corals set in this assessment and therefore no adverse cumulative impact on these far-field ecological sensitive receivers is expected to occur.

9.9.4 The other potential cumulative impact would be the cumulative disturbance impact to the marine habitat and the associate wildlife arising from the increased level of human activities and noise from construction and operation phases. Regarding the existing high level of disturbance in the Assessment Area, this cumulative impact is anticipated to be temporary and minimal. No adverse cumulative impact on the marine habitats and the associated wildlife is expected.

9.10 Environmental Monitoring and Audit

9.10.1 As all the 19 coral colonies found in recent dive surveys were identified as feasible for transplantation, it is recommended to translocate all these coral colonies to the nearby suitable habitats such as Junk Bay where similar hydrographic condition and healthy coral communities of the same species were recorded. A detailed translocation methodology (including baseline survey and monitoring of transplanted corals) should be drafted during the detailed design stage of the Project. Pre-translocation survey on coral at the ex-PWCA Basin (Site 13) and along seawall at North Point (Site 27) would be focused on identifying and mapping of coral colonies that would be directly affected by the proposed reclamation works and recording the condition of these coral colonies (e.g. health status of coral colony). The detailed methodology, monitoring proposal and ecologist involved in coral translocation should be approved by AFCD prior to commencement of this translocation exercises. It is also important to ensure that the proposed relocation of the coral colonies will not affect any private/public marine uses / rights at the recipient site.

9.10.2 It is recommended to implement monitoring of the transplanted corals after translocation. The health status of each transplanted coral colony should be carefully recorded. For hard corals, this should include information on surface area with partial mortality and blanched / bleached area. For gorgonian coral, the percentage of branches affected by partial mortality and secretion of mucus should be recorded. Details of monitoring requirements are presented in the EM&A manual.

9.11 Conclusion

9.11.1 Literature reviews of existing information supplemented with the results of recently undertaken field surveys on marine ecological resources indicated that identified marine habitats within the Assessment Area are of low ecological value. There are no ecological sensitive receivers, such as SSSIs, Marine Parks and / or Reserves and other areas of ecological importance or conservation interest, in and within the immediate vicinity of the study area.

9.11.2 Direct and indirect ecological impacts arising from the Project during construction phase and operation phase were identified and evaluated. The Project will result in the permanent loss of approximately 12.7 hectares of soft bottom benthic and subtidal habitats. Considering that the benthic, intertidal and subtidal habitats within affected area are of very low ecological value, and as direct impacts on some small and isolated coral colonies attached to movable boulders would be avoided by translocation, no adverse direct ecological impact is expected.

9.11.3 Indirect disturbance impact on the associated waterbirds and other avifaunal species of conservation interest in the CBTS and Victoria Harbour was expected to occur during the construction and operation phases of the Project. Considering the existing background of intense human activities in these areas, the affected wildlife are considered already well adapted to human disturbance and therefore no adverse indirect impact is expected to occur.

9.11.4 Other impacts arsing from the Project would be temporary and minimised with implementation of proper mitigation measures. Overall, no adverse ecological impacts on marine resources are anticipated.

9.12 References

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