Appendix 13.3 Survey Methodology Excluding CWD

1. Coral Field Survey Methodology

The coral surveys have included the reclamation footprint, especially within Area 3 of the Hong Kong International Airport Approach Areas (HKIAAA) and areas subject to potential direct impact. Sub-tidal habitats subject to direct impact included the artificial seawall at northern coast of the existing airport island, the rocky shore at the potential pipeline diversion landing point on Sha Chau within the SCLKCMP, the soft-bottom seabed at the north of Chek Lap Kok and submarine cable diversion at the west of Chek Lap Kok. Other potential coral sites that may experience indirect impact were also covered, including the artificial seawalls at the western and northeastern coasts of the existing airport island.

The artificial seawalls at Tung Chung Pier and North Lantau Highway near Tai Ho Wan were selected as the reference sites for the artificial seawalls on the airport island as they are not within the proposed reclamation footprint nor its immediate adjacent area. The natural shorelines between Tai O to Yan O Wan and the rocky shore at the Brothers were selected as reference sites for the proposed pipeline landing point at Sha Chau, to evaluate the ecological values of the habitats.

A total of 16 coral survey points for hard bottom coral were covered. Out of these six were within project footprint (D2, D3, D4, D5, D6 and D7), one was located at the proposed pipeline landing point at SCLKCMP (D9), three were in adjacent areas to the project (D1, D8 and D16) and six were at reference sites (D10, D11, D12, D13, D14 and D15).

A total of 22 coral survey points for soft bottom coral were covered. Out of these nine were within project footprint (C4, C5, C6, C7, C8, C9, C10, C11 and C12), four along proposed submarine pipelines and cables diversion alignments and in adjacent areas (C3, C13, C14 and C15), two were within the SCLKCMP (C16 and C17), and four other sites to the west and east of the airport island (C1, C2, C18 and C19) were selected as reference sites. Three sites with rock outcrops recorded at the northern Lantau waters (SC2, SC10 and SC12)) were also covered (**Drawing No. MCL/P132/EIA/13-008**).

The survey locations were based on the existing information on seabed features and on the latest geophysical survey conducted in December 2012 for the planning of soft bottom coral survey points (**Drawing No. MCL/P132/EIA/13-008**). It should be noted that there was no coral survey point on the eastern coast of the airport island due to safety considerations for diving activities in areas with heavy marine traffic in association with the marine works for the HZMB-HKBCF Project and the existing high-speed vessels travelling routes to and from Skypier. After discussion with various marine stakeholders and the Marine Department, the use of remote technique and devices such as Remotely Operated Vehicles (ROVs) was not considered as a suitable alternative underwater survey method as the marine traffic might interfere with the operation of the ROVs.

The coral survey was conducted once at each site (between August 2012 to September 2013) as coral is sessile and relatively stable, and shown to be resilient against physical disturbances (Tam and Put, 2008).

1.1. Spot-check Dive Survey

Spot-check dive surveys were conducted at both hard bottom and soft bottom subtidal habitats during daytime to identify locations with coral communities for later Rapid Ecological Assessment.

The spot-check dive survey was conducted by swimming in a search pattern along pre-determined areas at a density sufficient to cover any major coral areas and to assess the type of benthos existing in the proposed survey area, recording any presence of hard corals (order Scleractinia), octocorals (sub-class Octocorallia), and black corals (order Antipatharia). Information including estimated number of colonies, number of species, coral cover, and partial mortality (if any) were recorded during the actual dive.

The following data were also recorded during the survey:

- Temperature, time and date;
- Location (GPS);
- Depth range;
- Visibility;
- Substratum type (i.e. hard substratum seabed, intertidal rocky area); and
- Other invertebrates present.

Any special features encountered in the coral areas, such as non-typical reef structures, unusual coral species associations, unique or peculiar assemblages of the local incipient reef formations, and reefs that were almost completely dominated by one particular species, were recorded.

Representative photographs of any important ecological habitat, coral species and other ecological features were taken.

1.2. Rapid Ecological Assessment Survey

With reference to the data collected during the spot-check dive survey, Rapid Ecological Assessment (REA) surveys were carried out at locations where coral communities were identified. Transects of 100m in length were laid following the contour of the seabed at areas where corals were recorded during the spot-check dives. As the water depths along the proposed survey area were shallow (around 5-6m deep), the entire seawall area along the REA transects was surveyed.

The REA survey was conducted underwater in a two-tier approach to assess the sub-littoral substrata and benthic organisms in an area:

- Tier I assessed the relative coverage of major benthic groups and substrata.
- Tier II provided an inventory of sedentary/ sessile benthic taxa, which were ranked in terms of their abundance at the survey site.

The taxon categories were ranked in terms of relative abundance of individuals, rather than the contribution to benthic cover along each transect. The ranks were made by visual assessments of abundance, rather than quantitative counts of each taxon.

The benthic coverage, taxon abundance, and ecological attributes of the transects were recorded in a swath of about 2m wide, with about 1m on either side of the transects.

Representative photographs of any important ecological features and corals were taken.

2. Artificial Reef Field Survey Methodology

Artificial reef (AR) site visit by SCUBA divers had been made in July and November 2013 at the SCLKCMP to review the status of the artificial reef's as well as the suitability of carrying out further underwater visual count (UVC) surveys. Since the underwater visibility was below 1 m during both visits, UVC was not performed. The status of the ARs was therefore not assessed.

Dive surveys within the artificial reefs which are located within the northeast of the Chek Lap Kok waters, i.e. within the existing HKIAAA were not undertaken as diving conditions were assessed to be unsafe. Safety reasons include the diversions to vessel access routes to and from Skypier as a result of BCF construction works which means vessel routes are extremely close to the AR sites combined with the high turbidity of the area, would pose unacceptable risks to divers. Attempts were made to arrange for dive surveys or other fisheries surveys using suitable fishing vessels, however marine users and stakeholders with knowledge of the waters suggested that locations of the AR's within marine traffic zones pose unacceptable hazards for divers. Combined with the fact that Chek Lap Kok is not considered as a site of marine ecological importance since it is heavily influenced by the construction works at HKBCF, it was concluded that dive survey were not required to be conducted as part of this assessment.

Initially Underwater Visual Census (UVC) using SCUBA was proposed for the AR inside SCLKCMP to investigate reef fish species composition and relative abundance, together with control sites by the same technique for comparison. In the initial proposal, two 50 m belt transects with belt width of 1.5m on both sides would be laid at each site, parallel to the coastlines. These transects would be left on seabed undisturbed for 15 minutes to allow time for fish to resume normal behaviour. Surveyors would then swim along the transect 1 m above seabed searching for fish both in the water column and among crevices. Each belt transect survey would spend around 20 – 30 minutes. Any fish noted to have entered the belt transect after the commencement of UVC would not be counted. Species and abundance of fish encountered during UVCs would be recorded. The fish length would be estimated and recorded. Physical parameters including seabed substrate would also be recorded. The date and the time of UVC would be chosen as randomly as possible.

However, it was found in the first dive survey in the wet season that the underwater visibility in the area was far below the minimum requirement for conducting UVC (previously proposed as 1.5m, which has already been adjusted from the commonly adopted distance of 3 m or above (Cornish 1999) as the western Hong Kong waters were heavily influenced by Pearl River discharge and the light conditions of the AR was also very low due to both the underwater visibility and the depth. The survey thus focused on the conditions of the AR rather than the UVC of fish communities.

Hence, two dive surveys were performed, one in the wet season (July 2013) and one in the dry season (November 2013). As there are no buoys on water surface to indicate the locations of AR or to demarcate their boundaries, the AR were located initially by a vessel GPS with marine navigation map on which the locations of the AR are shown, and then refined by vessel-mounted fish finder which could detect the water depth and show the seabed profile. As the AR were elevated structures on the more or less smooth seabed, they could be located on the fish finder by the changes of seabed profile. Divers using SCUBA equipment descended to the AR, and swam around the AR, with flashlights due to the very low light conditions. Organisms found were recorded.

3. Bethnic Community Field Survey Methodology

Benthic sediment samples of the subtidal soft-bottom habitats were collected from a total of 22 marine benthic grab sampling locations inside North Lantau waters, including locations within and near the proposed reclamation site. The sampling locations are shown in **Drawing No. MCL/P132/EIA/13-009**. The numbers of sampling locations are considered sufficient given the relatively homogeneous nature of sediments in the Western Hong Kong waters, as well as the baseline information of the sensitive receivers in Sha Chau and Lung Kwu Chau Marine Park and the proposed Marine Park at the Brothers.

At each sampling location, at least three replicates of grab samples were collected. Samples were collected by a grab sampler of 0.1 m2 and 15 cm biting depth. Each grab sample collected was photographed. Sediments from the grab samples were sieved on board the survey vessel, washed onto a sieve stack (comprising 1 mm and 500 μm meshes) and gently rinsed with seawater to remove all fine material. Following rinsing, any materials remaining on the two screens were combined and carefully rinsed using a minimal volume of seawater into pre-labelled thick double-bagged ziplock plastic bags. A 5% solution of formalin in seawater containing Rose Bengal was then added to the bag to ensure tissue preservation. Care should be taken to ensure the concentration of solution is not adversely diluted through rinsing into the bags. Samples were sealed in plastic containers for transfer to the laboratory for sorting and identification.

Before sorting, the samples were held in formalin for a minimum of 24 hours to ensure adequate fixation of the organisms. Individual samples were gently rinsed with fresh water into a 500μm sieve to remove the formalin from the sediments. Sieves were partially filled while rinsing a specific sample to maximize washing efficiency and prevent loss of material. All material retained on the sieve was placed in a labelled plastic jar, covered with 70% ethanol, and lightly agitated to ensure complete mixing of the alcohol with the sediments. Original labels were retained with the rescreened sample material.

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

Taxonomic identifications were performed using stereo dissecting and high-power compound microscopes. Taxa, were identified to the lowest practicable level. If breakage of soft-bodied organisms occurs, only anterior portions of fragments were counted, although all fragments were retained and weighed for biomass determinations (wet weight).

Species and abundance of biota in the samples are reported. Diversity index, evenness index and other statistical analyses should be provided for evaluating and ranking the ecological values.

From the survey results, the status of community disturbance was assessed using the abundance/biomass comparison (ABC) method (Warwick, 1986; Warwick and Clarke, 1994). Samples are ranked in the order of dominance on the abscissa (logarithmic scale), and the cumulative percentage composition is plotted on the ordinate. Two curves based on abundance and biomass are generated. If the biomass curve lies above the abundance curve, it is interpreted as an indication of “undisturbed” community. If the abundance curve lies above the biomass curve, it indicates “grossly polluted” state. If the two curves largely overlap, it reflects “moderately polluted” state. Such interpretations are based on the observation that for climax communities of *r*-selected species, the biomass dominates are relatively large-body fauna, but do not dominate the abundance, and are amongst the more susceptible species to environmental impact. Gross disturbance is often characterized by large numbers of individuals of a few and small-body “opportunistic” species. The W statistic measures the extent to which the biomass curve lies above the abundance curve, with positive values for the “undisturbed” condition and negative values for the “disturbed” condition. The W statistic is calculated from the following formula (Clarke, 1990):

$$W = \sum_{i=1}^{s} (Bi - Ai) / [50\ (s - 1)]$$

s = total number of species rank

i = i-th species rank, from 1 to s

(Bi – Ai) = difference between biomass and abundance in cumulative % for i-th species rank

4. Intertidal Field Survey Methodology

Scope of field survey has been mentioned in **Section 13.4** of the EIA Report. Intertidal surveys were conducted by two surveyors during the low tide period (i.e. tidal level below 1 m Chart Datum) for approximately three hours for every habitat in both wet and dry seasons. The survey locations are shown in **Drawing No. MCL/P132/EIA/13-010**. Details of the field survey methodologies at intertidal habitats and communities are described in this section.

4.1. Artificial Shores

Belt transect method was adopted for the survey of artificial shores constructed of armour rock. A 50-meter belt transect was deployed horizontally along the shore for each of the three tidal levels (high tidal range 1.5-2.0 mCD, middle tidal range 1.0-1.5 mCD and low tidal range 0.5-1.0 mCD). Along each belt transect, five quadrats (each quadrat with dimension of 0.5m x 0.5m) were randomly deployed. All flora and fauna observed within the quadrat were identified and counted. For sessile organisms such as oysters, barnacles and algae, the percentage cover within the quadrat was estimated.

Qualitative walk through survey was undertaken before the quantitative survey to have an overview of the species distribution. During and after quantitative sampling, backshore vegetation and other intertidal species observed along the transects were also recorded by walk-through survey to establish a more complete list of species at the artificial shore.

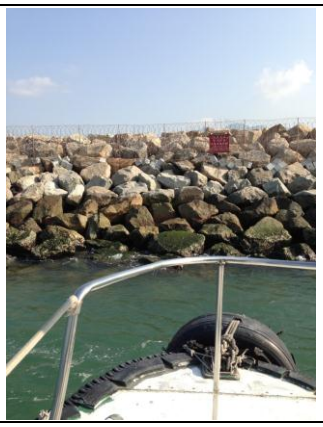
Artificial shores at the western coast of the airport island were surveyed twice in each season. Artificial shore at Tung Chung North (next to Tung Chung Pier) and north of Tai Ho Wan which are not directly affected by the proposed project were surveyed once in each season as reference sites to compare with the findings on the airport island. Two replicate transects were deployed at each survey location.

For survey of the artificial shores at the North Chek Lap Kok where directly affected by construction of the project, there was issue for safe access to the artificial shore. Ways of direct access to the artificial seashore at North Chek Lap Kok (the northern coast of Hong Kong International Airport) including land route and marine route were explored and considered not safe or feasible.

In exploring access by land route, it was found that landside of the artificial seashore (composed of armour rock) along the northern coast of Chek Lap Kok was completely fenced off by barb wires for security (see Plate 1). From the pier at the mid-way of northern runway, there is a significant height to reach the artificial seashore (see Plate 2) while considering the strong wind condition in the area, any possible tools for access (e.g. ladder and rope) are considered not safe.

In exploring access by marine route, considering the strong wave action in the area, no suitable specific vessels approved by Marine Department could provide safe landing on the seawall.

Given the constraints in direct access to the artificial seashore, qualitative surveys were undertaken by (1) observation with the aid of telescope from the pier at the mid-way of northern runway (see Plate 3); and (2) observation with the aid of binoculars from a launch vessel approved by Marine Department approaching the shoreline as close as possible (see Plate 4). Surveys covered the HKIAAA, in particular Area 3 which will be directly affected by the reclamation. Species observed during the course of survey were recorded.

	
Plate 1	Plate 2
	
Plate 3	Plate 4

4.2. Rocky Shores

Rocky shores at north Lantau, Airport island South, West Brother Island (i.e. Tai Mo To) and Sha Chau were surveyed by belt transect method. Two replicate transects were deployed at each survey location.

A 50-meter belt transect was deployed horizontally along the shore for each of the three tidal levels (high tidal range 1.5-2.0 mCD, middle tidal range 1.0-1.5 mCD and low tidal range 0.5-1.0 mCD). Along each transect, five quadrats (each quadrat with dimension of 0.5m x 0.5m) were randomly placed. All flora and fauna observed within the quadrat were identified and counted. For sessile organisms such as oysters, barnacles and algae, the percentage cover within the quadrat was estimated.

Qualitative walk through survey was undertaken before the quantitative survey to have an overview of the species distribution. During and after quantitative sampling, backshore vegetation and other intertidal species observed along the transects were also recorded qualitatively by walk-through survey to establish a more complete list of species at each survey location.

4.3. Sandy Shores

Sandy shores at north Lantau and Sha Chau were surveyed by belt transect method. Two replicate transects were deployed at each survey location.

A 50-meter belt transect was deployed horizontally along the shore for each of the three tidal levels (high tidal range 1.5-2.0 mCD, middle tidal range 1.0-1.5 mCD and low tidal range 0.5-1.0 mCD). Along each transect, five quadrats (each quadrat with dimension of 0.5m x 0.5m) were randomly placed. All flora and fauna observed at the quadrat surface were identified and counted. The quadrat samples were also examined by digging substrate up to 15 cm depth where possible (as some locations with rocky substrates within the sand that digging has to cease), and all infauna observed were also identified and counted. For sessile organisms such as oysters, barnacles and algae, the percentage cover within the quadrat was estimated.

Qualitative walk through survey was undertaken before the quantitative survey to have an overview of the species distribution. During and after quantitative sampling, backshore vegetation and other intertidal species observed along the transects were also recorded by walk-through survey to establish a more complete list of species at each survey location.

4.4. Mangroves and Intertidal Mudflats

A line transect method was adopted for quantitative surveys of mangrove and intertidal mudflat habitats at north Lantau (i.e. at San Tau, Tung Chung Bay and Tai Ho Wan, Sham Wat Wan and Yan O). Two replicate transects were deployed at each survey location. The mangrove and intertidal habitat at Yan O was selected as a reference site as it is far away from the proposed reclamation area, with only one transect deployed due to the small extent.

Line transects were deployed perpendicular to the shoreline from the edge of backshore mangrove to the low tide mark. In the mangrove stands, quadrats for flora survey with dimension of 5m x 5m were deployed with separation of 2-m along each transect, except the transect at Yan O where 2m x 2m quadrat samples were deployed due to the small extent of mangrove. All flora species within the quadrat were identified and counted. A total of 30 quadrats with the size of 0.5m x 0.5m were evenly distributed along each of the line transect for fauna sampling. The epifauna and infauna (within the top 5cm sediment) in each quadrat were identified and their numbers recorded. One sample of about 10cm diameter x 20cm depth was also collected within each quadrat, the sediments sieved and the infauna inside identified and counted. For sessile organisms such as oysters, barnacles and algae, the percentage coverage within the quadrat was estimated.

Qualitative walk-through survey was undertaken for an overview of the presence and distribution of species inhabiting mangrove and intertidal mudflat habitats. Other than those recorded during quantitative sampling, flora and fauna species observed along transects were also recorded by qualitative survey to establish a more complete list of species at the mangrove and intertidal mudflat habitats.

4.5. Seagrass Beds

Particular attention was paid to the presence of seagrass beds that were recorded at mudflats in literature. Seagrass beds were investigated qualitatively by walk-through survey within the extent of soft shores and high-shore patches.

Survey locations for seagrass included San Tau, Tai Ho Wan and Yan O Wan where seagrass beds had been reported. Other than these locations, attention of any presence of seagrass was also paid at Sham Wat Wan and Tung Chung Bay during field surveys of intertidal mudflats. Size, location and species of seagrass bed or patch as well as the associated fauna species were recorded.

4.6. Horseshoe Crab Breeding and Nursery Sites

Particular attention was paid to the presence of horseshoe crabs of both juvenile and adult stages that were recorded at mudflats. Horseshoe crabs were investigated qualitatively by walk-through surveys within soft shores, estuaries and high-shore sand patches.

Survey locations for horseshoe crabs included Sham Wat Wan, Sha Lo Wan, Hau Hok Wan, San Tau, Tung Chung Bay and Tai Ho Wan where presence of horseshoe crabs had been reported. Apart from searching for individuals, movement trails by horseshoe crabs were also searched and traced for presence of individuals. The location, species, size and characteristics of horseshoe crab as well as the substrates were recorded.

5. Field Survey Methodology

5.1. Estuarine Fauna

For details refer to **Chapter 12 Terrestrial Impact Assessment**.

5.2. Marine Fishes and Other Fauna

For details refer to **Chapter 14 Fisheries Impact Assessment**.

Reference

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