6. ECOLOGICAL IMPACT ASSESSMENT

6.1 Introduction

6.1.1 This chapter assesses the impacts of the worst case scenario (i.e. preliminary Preferred Development Option) upon terrestrial and aquatic (including intertidal and marine) ecology. The Study Area is defined as the boundary of the development site (Figure 6.1) while the Assessment Area includes 500 m further out from the site boundary. Habitats of known conservation importance in the vicinity of the study area, including Wu Kai Sha (previously named as Lok Wo Sha) *fung shui* wood and Starfish Bay, will also be included for assessment purpose. The objectives of the ecological impact assessment are to establish the baseline ecological conditions of the study area, to assess the potential ecological impacts of the proposed project upon ecology, to develop adequate and feasible mitigation measures (via input to project design and layout, working practices, or compensation where appropriate) to keep residual ecological impacts within acceptable limits, and to develop ecological monitoring and audit measures as necessary to ensure that mitigation measures are implemented successfully.

6.1.2 Literature review and field visits have identified areas and features of key ecological concern for consideration in the impact assessment. The study began by reviewing existing information, aerial photography, other studies covering the area and its environs, and information available from published sources or relevant experts. This review and initial site visits commenced in the early weeks of the study.

6.1.3 The consultants have drawn on their experience at other sites in the vicinity, including the Study on Increased Population at Ma On Shan to which they contributed, and also Sai Sha / Shap Sz Heung, Sai Sha Road, and Wu Kai Sha.

6.1.4 Detailed field surveys of ecology were undertaken between January 2000 to April 2000, with adequate separation between field visits to ensure covering both dry season (January) and wet season (April) while using time efficiently.

6.1.5 The consultants assess the need for an ecological monitoring and audit regime to assess ecological impacts of project construction and operation. If required, a suitable EM&A scheme for ecology will be proposed in detail.

6.2 Relevant Legislation, Guidelines and International Conventions

6.2.1 The following Hong Kong SAR Government legislation and guidelines are relevant to the assessment of impacts to terrestrial ecology:

- Forests and Countryside Ordinance (Cap. 96);

- Forestry Regulations (Cap. 96, subsidiary legislation);
- Town Planning Ordinance (Cap. 131);
- Wild Animals Protection Ordinance (Cap. 170);
- Animals and Plants (Protection of Endangered Species) Ordinance (Cap. 187);
- Marine Parks Ordinance (Cap. 476) and associated subsidiary legislation;
- Environmental Impact Assessment Ordinance (Cap. 499) and associated Technical Memorandum on Environmental Impact Assessment Process (the "TM");
- "Guidelines for Implementing the Policy on Off-site Ecological Mitigation Measures" (PELB Technical Circular 1/97, Works Branch Technical Circular 4/97, dated 17 February 1997) (the "TC"); and
- Hong Kong Planning Standards and Guidelines (HKPSG), Chapter 10, "Conservation".

6.2.2 This study also takes note of the following relevant international agreements:

- Convention on Wetlands of International Importance Especially as Waterfowl Habitat ("Ramsar Convention");
- Convention on the Conservation of Migratory Species of Wild Animals ("Bonn Convention");
- Convention on International Trade in Endangered Species of Wild Fauna and Flora ("CITES"); and
- Convention on Biological Diversity.

6.3 Recognised Sites of Conservation Importance

6.3.1 No Conservation Area (CA) or Green Belt (GB) is zoned within the Study Area. No recognised sites of conservation interest, including Country Parks, Sites of Special Scientific Interest (SSSIs), Special Areas, Marine Parks or Reserves are located in the Study Area.

6.3.2 In the Assessment Area (500m from the study area boundary) there are three sites of conservation interest:

- Nai Chung Coast Site of Special Scientific Interest (SSSI)
- Starfish Bay (Hoi Shing Wan)
- Wu Kai Sha Fung Shui Wood

6.3.3 The other protected areas that lies beyond 500 m but in the vicinity of the Study Area are:

- the Ma On Shan Country Park
- the Kei Ling Ha Mangal SSSI
- the privately proposed Tolo Harbour Marine Park

6.4 Methodology

Literature Review

6.4.1 A literature review was conducted to determine existing conditions in the Study Area and the surroundings to identify habitats and species of potential importance that may be affected by the project. Literature review included Government and private sector reports, independent and Government published literature, academic studies, vegetation maps and land use maps. Literature review included the following:

- Study On Increased Population in Ma On Shan (Maunsell 1997);
- WWF's 1:50000 Hong Kong Vegetation Map (Ashworth et al. 1993);
- Aerial photos (CN23610-1 and A49903 taken in 1999, AW51905 and CW30921 taken in 2001) from the Hong Kong Government Map Office;
- Hong Kong Bird Reports (1991-1997);
- Hong Kong Dragonflies (Wilson 1995, 1997);
- Porcupine! (Newsletters of Department of Ecology and Biodiversity, University of Hong Kong);
- Memoirs of Hong Kong Natural History Society (Publication of Hong Kong Natural History Society);
- The Sea Shore Ecology of Hong Kong (Morton & Morton 1983);
- The Marine Flora and Fauna of Hong Kong and Southern China II (ed. Brian Morton);
- The Marine Flora and Fauna of Hong Kong and Southern China III (ed. Brian Morton); and
- Marine Ecology of Hong Kong: Report on Underwater Dive Surveys (October 1991 - November 1994) (Binnie 1995).

Field Survey Methodology

6.4.2 Literature review was supplemented by field surveys. Field surveys were designed to fill in data gaps which would prevent an adequate assessment of the project's impacts upon terrestrial and marine ecology and the development of appropriate mitigation measures.

6.4.3 Habitats identified as being "with conservation interest" in the Study Brief include woodlands, shrubland, natural coastline including rocky and sandy shores, coastal bay such as Starfish Bay, natural stream courses, and mangroves. These were taken as key issues for purposes of the ecological impact assessment.

6.4.4 Preliminary surveys for ecological baseline studies were conducted in November and December 1999, while the detailed field surveys were performed between January

2000 to April 2000 (4 months). As required under Section 3.9.4 (iii) of the EIA Study Brief, wet-season surveys were conducted within the study period (April 2000). Seasonal changes in the ecology of the site from winter to spring could be characterised within the study period.

6.4.5 A verification survey was conducted in September/October 2001 to update the habitat map and to verify / supplement the results of field surveys conducted in 1999/2000. Results of the verification survey were combined to the earlier data for discussion and assessment. The verification survey also provides further information on late wet season. The entire field survey period for ecological baseline studies was thus 8 months (November 1999 to April 2000, and September to October 2001) covering both dry and wet seasons.

6.4.6 Field surveys identified and characterised major groups of flora and fauna within the Study Area. Species lists were generated for key species groups to cover the whole of the Study Area. Estimates of species abundance/richness and diversity were provided for species groups surveyed, and special attention were given to habitats and species of special conservation interest as defined in the Technical Memorandum on EIA Process (TM).

6.4.7 For terrestrial habitats, key species groups will include higher plants, invertebrate species, birds, herpetofauna, and mammals. Identification of protected or rare species will be a key objective of field studies. For aquatic habitats, identification of species of conservation concern such as corals was a key objective of field studies.

6.4.8 Impacts to habitats, species or groups were assessed based on the guidelines in Annexes 8 and 16 of the TM, the consultants local knowledge and international standards / practice in conservation biology.

Habitats and Vegetation

6.4.9 Initial site visits were conducted at the early stage of the study to verify information from literature review and to identify and map habitats. Field surveys were performed on 30 December 1999, 18 January, 18 February, 24 March, and 20 April 2000, and 3 October, 2001 to describe habitats and record plant species within the study area. Efforts were made to find species protected under local regulations or known to be uncommon or rare on a regional or territorial basis. In this report, the conservation status of plant species follows Xing *et al.* (2000).

6.4.10 A reduced 1:5000 habitat map of the study area was produced based on 1999 and 2001 Government aerial photographs and ground truthing.

6.4.11 Colour photographs were taken of all habitat types surveyed and other features or

species of ecological importance found during the study, as outlined in Annex 16 of the Technical Memorandum on EIA Process.

Avifauna

6.4.12 Bird communities in habitats of potential ecological importance were surveyed on 18 and 31 January, 15, 18 and 22 February, 10, 17, and 24 March, and 1, 17 and 19 April, 2000 using the point count method. Locations of sampling points are shown in Figure 6.1. Ten minutes was spent counting birds at each sampling point and all birds seen or heard within 20 m of each point were counted. Relative abundance of birds in each type of habitat was then expressed in number of birds per hectare (total birds counted divided by total area surveyed). Birds on rocky shores in headlands of Starfish Bay were counted during every survey. Besides point count surveys, bird species outside sampling points but within the study area were also searched and recorded. Efforts were made to supplement the findings from point count surveys, and to produce a complete species list. Signs of breeding (e.g. nests, recently fledged juveniles) were also recorded. Ornithological nomenclature, commonness and distribution of bird species in Hong Kong in this report followed Viney *et al.* (1996), rarity and protection status of birds follows Zheng and Wang (1998).

6.4.13 Bird communities are affected by floral composition, habitat complexities (Willson 1974, Erdelen 1984, Bersier and Meyer 1995) and degree of human disturbance (Watts and Bradshaw 1994). There are considerable differences in floral composition and habitat complexities between *fung shui* woods and other secondary woodland patches. Degree of human disturbance also differed considerable between plantations along roadside and in headlands. Therefore, both habitat types were divided into 2 sub-categories, i.e. secondary woodland (natural) & secondary woodland (*fung shui* woods), and plantation (roadside) & plantation (headland). Birds observed in these habitats were recorded and analysed separately.

6.4.14 Some construction works have taken place in the Study Area since April 2000 and some habitats in the Study Area were affected. A verification survey on avifauna was carried out in the Study Area on 28 September 2001. The validation of the data collected between January and April 2000 was verified by comparison between the bird abundance and species richness of the Study Area in September 2001 and those between January and April 2000.

Invertebrates, Herpetofauna and Mammals

6.4.15 Field surveys of invertebrates, herpetofauna and mammals were performed during the course of bird surveys. Efforts were made to produce lists of species of these groups of fauna in the study area. Tracks or other signs of mammals observed during surveys were also noted. Night surveys for bats and amphibians were performed once a

month. Nomenclature of dragonfly follows Wilson (1997), butterfly follows Walthew (1997), reptile follows Karsen *et al.* (1998), amphibian follows Lau and Dudgeon (1999) and mammal follows Ades (1999).

6.4.16 Some construction works have taken place in the Study Area since April 2000 and some habitats in the Study Area were affected. A verification survey on non-avifauna was carried out in the Study Area on 28 September 2001. The validation of the data collected between January and April 2000 was verified by comparison between the non-avifauna abundance and species richness of the Study Area in September 2001 and those between January and April 2000.

Stream Habitats and Fauna

6.4.17 A preliminary field survey in December 1999 identified no streams in the Study Area. This is probably due to severe modification of the terrain and thus the hydrology of the Study Area. One stream shown on the old topographical map does not exist because of disturbance. The original location of the stream is currently part of a car parking space. Therefore no systematic surveys were conducted for freshwater fauna.

Intertidal Community

6.4.18 As stipulated in the Study Brief, baseline surveys included "ecological survey of Starfish Bay including its intertidal zone, and including the adjacent headland with its sandy and rocky shores". Baseline surveys of Starfish Bay included a combination of qualitative surveys for both the natural coastline and the intertidal sandflat, and quantitative transect survey for the intertidal sandflat, covering all shore types within the bay but particularly the sandflat area.

6.4.19 Surveys for different kinds of natural coastline habitats and the intertidal sandflat conducted from January to April 2000. The habitats were described and all fauna species found were recorded or collected for identification. Species lists were created.

6.4.20 Quantitative survey for the sandflat conducted in April 2000. Three transects perpendicular to the backshore were established during low spring tide. Quadrats of 0.25 m^2 were used for the survey of epibenthos at 10 m intervals. In each 0.25 m^2 quadrat all epibenthos were identified and counted. The number of burrows was recorded. A core (10 cm diameter & 10 cm depth) of sediment was taken from each quadrat. Sediment was sorted through sieves of 0.2 mm mesh size, which was selected by on-site trial. In addition to the cores, at least two quadrats were set into each of the low, middle and high intertidal zone. Sediment within these quadrats was dug and sorted down to 10 cm deep, to supplement the data from the cores. All infauna found were counted, recorded and identified to the lowest identifiable taxon. Data were reported as abundance, biomass and density for each sample. Species richness, species

diversity and species evenness was also reported. A verification survey on sandflat fauna was carried out in September 2001. Quick samplings were applied in representative areas to verify the validation of the data collected in April 2000.

Corals

6.4.21 No field survey for corals were conducted for the first layout plan. In the Preferred Development Option, however, a water sports centre was proposed at the western shore of the Whitehead and would involve some construction works. A dive survey was thus conducted immediate outside the location of the proposed water sports facilities (Site 1, Impact site) and at the western tip of Whitehead peninsula (Site 2, Control site) to verify the conditions of the seabed. The location of the study sites is shown in Figure 6.1.

6.4.22 The fieldwork took place on 22 and 23 September 2001. Three underwater transects running parallel with the coastline were laid at each of the two sites, at 3 different water depth (-3m CD, -5m CD and -10m CD). Each transect was 100 m in length. Totally six 100m transects were surveyed. The total length of the transects was 600m.

6.4.23 Video footage was taken along each of the transects. Each transect was filmed at approximately 40cm above the substrate and at a constant speed in compliance with standard protocols for coral surveys (no more than 10 metres per minute). The video transects recorded a 40cm swath of seabed. The video camera was held perpendicular to the substrate to minimise parallelax error and to keep the substrate in focus. Any coral colony, or any species of conservation concern, recorded along the transects was identified to species level and the exact location was also provided.

6.4.24 Besides the transect video footage, photographs of representative species of conservation concern including corals located in the surveyed areas, and photos of special features in the areas were taken using an underwater camera to provide supplementary information. The conditions of the subtidal habitats, as well as the marine ecological assemblages of conservation concern, in the vicinity of the transects were also surveyed and recorded with the provision of video samples and photographs.

6.4.25 Data on colony abundance of hard corals and soft corals were extracted from the video transects. Counts were made for each site and the locations of the corals along the transects noted. Results were presented as total number of colonies of hard and soft corals along the 300m of surveyed area for each site.

6.4.26 Wherever possible, hard corals were identified to species level by coral specialists using regional texts. Soft corals recorded within the transects were identified to the lowest taxonomic level possible which for this survey was genus. Species

composition and percentage cover of corals (hard and soft) on each transect were provided.

6.4.27 Information was recorded during the survey concerning the physical nature of the two sites. This information consisted of observations regarding the degree of exposure of the site to wave action, the nature of the substrate type and the topographic profile of the site.

Cetaceans

6.4.28 Tolo Harbour is out of the distribution range of the two locally resided cetacean species, i.e. *Sousa chinensis* (Jefferson 1997) and *Neophocaena phocaenoides* (Jefferson 1999). Only a few cases of cetacean strandings have been recorded within Tolo Harbour (Parsons et al. 1995). Therefore no field survey was conducted for cetaceans.

6.5 Baseline Conditions

6.5.1 A brief ecological assessment was performed previously for the Study Area (Maunsell 1997). A review of relevant literature found no study on ecology nor sightings or records of wildlife within the Study Area. Immediately outside the Study Area literature regarding findings at Starfish Bay is rich and is summarised below. The ecological baseline of the Study Area was therefore described based on the results of literature review and field surveys for this Study.

6.5.2 Ecological resources at the Study Area have been historically degraded by previous developments including village housing, the Whitehead detention centre and agricultural practice. Most of the natural terrain and/or its associated vegetation were gone, and habitats modified by man.

6.5.3 No areas within the Study Area or within the Assessment Area (a 500 m buffer zone) of the Project are protected for ecological importance. No Country Parks, Special Areas, Sites of Special Scientific Interest (SSSIs), Marine Parks or Reserves or other designated sites of conservation interest were found within the study area. Nai Chung SSSI is located within the Assessment Area; however, it is designated due to its geological but not ecological importance. No greenbelts, conservation areas or other designations or zoning categories apply to lands of ecological importance within the Study Area.

6.5.4 The "Important Habitats Where an Ecological Assessment Will Be Necessary" listed in Note 2, Appendix A, Annex 16 to the TM existing in or near the Study Area are:

- woodland larger than 1 ha in size (Wu Kai Sha *fung shui* woods and secondary woodland on the peninsula);
- natural coastal area longer than 500m (Starfish Bay and the surrounding intertidal habitats);
- small stands of mangroves at Starfish Bay.

Terrestrial Habitats and Vegetation

6.5.5 Terrestrial habitats found within the Study Area include woodland, plantation, grassland, agriculture and disturbed / urbanised area (Figures 6.1 and 6.2). Results of verification survey show that habitats within the Study Area had minor changes which mainly occurred along Sai Sha Road where road side plantation and grassland were disturbed/removed by various construction projects. Secondary woodland cover was slightly reduced due to construction of car park areas near the villages. Other habitats had little changes.

6.5.6 The site is fairly disturbed and comprised mainly of man-made habitats. A total of 252 plant species was recorded (Annex F1). Additional species recorded during the verification survey were mainly common grasses and herbs. No species protected or known to be rare was found in the Study Area. One shrub species protected under Forestry Regulations, *Pavetta hongkongensis*, and one tree species with restricted distribution, *Celtis timorensis*, were recorded in the Fung Shui Woods outside the Study Area.

6.5.7 Plantation (15.24 ha) was the dominant habitat type mainly located at the east and west headlands and along roads. The trees were planted densely, with height ranging between 5 to 12 m. *Acacia confusa, Casuarina* spp. and *Pinus elliotii* dominated the stand, while at the two headlands, some pioneer native tree and shrub species such as *Sterculia lanceolata, Bridelia tomentosa and Psychotria rubra* started to establish in the understorey. The understorey of plantation along the road was little developed due to the intensive management such as mowing and weeding and lack of canopy cover. Overall, the plantation habitat in the Study Area supported plant species typical of those types of habitats and had a low plant diversity and simple structure. This habitat is of little ecological interest. However, the plantation woodland at the headlands have good potential to gradually succeed into more natural woodland given time and protection from disturbance such as fire.

6.5.8 Secondary woodlands are forests composed mainly of native plant species developed after World War II when most of the primeval forest cover were cleared for firewood. The secondary woodland patches within the Study Area were mainly located at a knoll towards the eastern edge of the study area, on abandoned agricultural field and

along the west coast, covering a total of 2.46 ha. The secondary woodland habitat in the Study Area was young and had an open canopy. It consisted mainly of pioneer tree and shrub species including *Celtis sinensis, Bridelia tomentosa* and *Sterculia lanceolata* and have a moderate diversity. The woodland along the west coast near To Tau Village was dominated by typical backshore species such as *Hibiscus tiliaceus* of 5 to 7 m in height. Other relatively more mature tree species probably planted by villagers including *Cinnamomum camphora, Dimocarpus longan, Acacia confusa,* and *Musa paradisiaca* also formed part of the canopy of the secondary woodland. Little understorey were developed, which is typical to densely grown backshore tree and isolated village trees. These patches of woodland probably provided proximate seed source for establishment of native species in the understorey of the plantation. The secondary woodland habitat is moderate in size, young and quite simple in structure and therefore has moderate ecological value.

6.5.9 Fung Shui Woods are forest patches preserved behind old villages for traditional beliefs. They contain a mixture of native and planted species and have ecological values due to their age, relatively high species richness and presence of species of conservation interest. The woodland immediately outside the Study Area at Wu Kai Sha village is a *fung shui* wood. A study of *fung shui* woods in Hong Kong (Chu 1998) shows that this woodland has an area of 0.9 ha with 50 plant species recorded (Annex F2). Among these, *Aquilaria sinensis*, is a Class III protected species in China (Qiu and Liu 1994) although it is quite common in Hong Kong secondary forests and *fung shui* woods (Xing *et al.* 2000). *Pavetta hongkongensis* is protected under Forestry Regulations in Hong Kong, although it is also fairly common locally. *Celtis timorensis* recorded within the *fung shui* wood during the survey for this Study has restricted distribution in Hong Kong. Although small in size, moderate in species diversity, and presence of grave sites in the woodland, results of field surveys show that the canopy trees were well established, tall and mature. Some had a trunk diameter of over 50cm and reached a height of over 20m. As the grave sites are all on paved ground and are well managed, fire disturbance is not apparent. This *fung shui* wood has moderate ecological value and should be preserved.

6.5.10 Grassland within the Study Area (3.55 ha) was mainly found hydroseeded slopes, in abandoned fields and among plantation. It was dominated by the grass *Neyraudia reynaudiana* and a few young plantation trees such as *Pinus elliotii*. Remnants of crops could still be seen in abandoned field. The grassland habitat in the Study Area was small in size, has a low plant diversity and simple structure and is of little ecological interest.

6.5.11 About 2.14 ha of area within the Study Area was occupied by active dry agriculture. Vegetables and potted plants were the major crops. Most of the agriculture fields were left fallow during the verification survey in October 2001. Due to small size, simple structure and low diversity, this habitat is therefore of little ecological interest.

6.5.12 Most of the area (36.862 ha) within the Study Area, including the golf driving range, car park, remnants of the Whitehead detention centre, residential areas, and villages, was developed / urbanised / disturbed. This area was little vegetated, occasionally with planted trees and ruderal species. This habitat is therefore of little ecological value.

Avifauna

6.5.13 No published information of birds in the Study Area was found in the literature reviewed. A total of 322 birds and 53 species were recorded at sampling points in the Study Area between January and April 2000 (Annexes F3 - F8). No additional species was recorded outside sampling points in the Study Area.

6.5.14 Bird abundance and species richness recorded in September 2001 were similar to those between January and April 2000 (Table 6.1) (Annex F10). This showed that the data collected in 2000 were still valid. The construction works in the last one and half year only affected grassland and some plantations (roadside) in the Study Area, which only supported low bird abundance and species richness, and hence did not cause much impact on the avifauna in the Study Area. No additional species was recorded in the Study Area in September 2001.

Table 6.1
Bird Abundance and Species Richness in 2000 and 2001

	January – April 2000 mean)	**September 2001**
Bird abundance	27.7	24
Species richness	16.1	15

6.5.15 Bird abundance was highest in secondary woodlands (*fung shui* woods) (Table 6.2), and this was due to higher habitat complexities (Erdelen 1984, Bersier and Meyer 1995). Species richness was highest in plantations (headland). This was the combined effect of more sampling points and the relative isolation from human disturbance of plantations (headland) . Species richness in secondary woodlands (including *fung shui* woods) and agriculture was also high (18 species). However, bird species recorded in agriculture are mainly habitat generalists (e.g., Spotted Dove *Streptopelia chinensis*, Magpie *Pica pica*), and are common and widespread in Hong Kong.

6.5.16 Both bird abundance and species richness were low in sandy shores and plantations (roadside). The low bird abundance and species richness in plantations (roadside) were the combined effects of high disturbance from humans and traffic and low insect food abundance. Insect food abundance is generally lower in exotic tree species (Dudgeon and Corlett 1994, Kwok and Corlett 2000, in press). The low bird

abundance and species richness in sandy shores might be due to human disturbance. However, ardeids and cormorants *Phalacrocorax carbo* were frequently observed feeding in outer Starfish Bay during the surveys (Annex F9). Little Egrets *Egretta garzetta* were the most abundant species on the rocky shores in the headlands of Starfish Bay. The sandy shores are therefore potential feeding habitat of ardeids nesting in Centre Island Egretry, 2km NWW of the study area.

Table 6.2
Bird Abundance and Species Richness in Each Type of Habitat

Habitats	Bird abundance (no. of birds ha^{-1})	Total number of species
Plantations (roadside)	5.4	11
Plantations (headland)	8.8	26
Secondary woodlands	13.2	19
Secondary woodlands (*fung shui* woods)	21.6	20
Agriculture	11.8	18
Sandy shore	4.1	9

6.5.17 Black-necked Starlings *Sturnus nigricollis* and White Wagtails *Motacilla alba* were collecting nesting materials. Juvenile Great Tits *Parus major* were observed in secondary forests in the study area. These species are all common and widespread in Hong Kong (Viney *et al.* 1996). Black-necked Starling and Great Tit mainly nest in trees (Cheng 1993, Viney *et al.* 1996). White Wagtail nests on ground in open areas and hillsides (Li 1995).

Reptiles and Amphibians

6.5.18 No published information of reptile in the Study Area was found in the literature reviewed. Reeves' Smooth Skink *Scincella reevesii* and Changeable Lizard *Calotes versicolor* were recorded in secondary woodlands (*fung shui* woods) in the Study Area during the field surveys of this Study. These two species are widely distributed in Hong Kong and can be found in a wide range of habitats (e.g., woodland edge) (Karsen *et al.* 1998).

6.5.19 Six species of frogs were reported at Wu Kai Sha, adjacent to the Study Area, between November 1991 and December 1996 by Lau and Dudgeon (1999). These were Gunther's Frog *Rana guentheri*, Paddy Frog *Rana limnocharis*, Brown Tree Frog *Polypedates megacephalus*, Asiatic Painted Frog *Kaloula pulchra*, Ornate Pigmy Frog *Microhyla ornata* and Marbled Pigmy Frog *Microhyla pulchra*. All are common and widely distributed in lowland areas in Hong Kong (Karsen *et al.* 1998, Lau and Dudgeon 1999).

6.5.20 Asian Common Toad *Bufo melanostictus* and Gunther's Frog *Rana guentheri* were recorded in agriculture in this Study Area. Both species are very common and widespread in Hong Kong (Karsen *et al.* 1998, Lau and Dudgeon 1999). Gunther's Frogs inhabit mainly lowland habitats while Asian Common Toads can be found in many types of habitats in Hong Kong.

6.5.21 No reptile or amphibian was recorded in the Study Area in September 2001. However, this did not necessarily mean that construction work cause impact to reptile or amphibian in the Study Area. Construction work in the Study Area only affected grassland and roadside plantations, which are not important reptile or amphibian habitat. It is believed that the construction work did not cause much impact on the reptile or amphibian fauna in the Study Area.

Mammals

6.5.22 There was no report of large mammals (e.g., Chinese Leopard Cat *Prionailurus bengalensis*) at and near the Study Area (Reels 1996, Porcupine! No. 16, 17, 18, 19, 20). No bat roost was reported in the Study Area (Ades 1999). Unidentified fruit bats (species not determined) were reported in the Study Area (Porcupine! No. 19). Two species of fruit bats have been recorded in Hong Kong to date – Greater Short-nosed Fruit Bat *Cynopterus sphinx* and Leschenault's Rousette Bat *Rousettus leschenaulti* (Ades 1999). All bats are protected in the HKSAR under the Wild Animals Protection Ordinance (Cap. 170) and these two species are of local concern (Fellowes *et al.* in prep.). One of the limiting factors on local populations of Greater Short-nosed Fruit Bat is the availability of suitable mature roost trees (Ades 1999). Old trees in the *fung shui* woods can provide roosts for Greater Short-nosed Fruit Bat.

6.5.23 Bats (probably Japanese Pipistrelle *Pipistrellus abramus*) were observed in the Study Area during the night surveys (< 10 individuals each time). This species is very common in Hong Kong (Ades 1999). No mammal was recorded in the Study Area in September 2001. However, construction work in the study area only affected grassland and roadside plantations, which are not important mammal habitat.

Butterflies and Dragonflies

6.5.24 There was no published report on butterfly or dragonfly at and near the Study Area. A total of 21 species of butterfly were recorded in the Study Area (Annex F11). All are common or very common in Hong Kong (e.g., Common Black Jezebel *Delias pasithoe*), and are of low conservation importance. Species richness was much higher in secondary woodlands (including *fung shui* woods) than in other habitats in the Study Area (Table 6.3), and this was mainly due to high flora diversity in the habitats (Preston-Mafham and Preston-Mafham 1988). Sixteen of the 21 species recorded in

the Study Area between January and April 2000 were recorded in September 2001. The construction work only affected grassland and some roadside plantation in the Study Area, which are not important butterfly habitats. The construction work did not cause much impact on the butterfly fauna in the Study Area. No additional butterfly species was recorded in the Study Area in September 2001.

6.5.25 Eight species of dragonfly (Wandering Glider *Pantala flavescens*) were recorded in the Study Area (Annex F12). All recorded species are common and widespread in Hong Kong (Wilson 1995), and are of low conservation importance. The low diversity of dragonfly in the Study Area was mainly due to the lack of aquatic habitats (e.g., stream, ponds), where dragonflies forage and breed. All dragonfly species except *T. festiva* were recorded in the Study Area in September 2001. The construction work only affected grassland and some plantation (roadside) in the Study Area, which are not important dragonfly habitats. The construction work did not cause much impact on the dragonfly fauna in the Study Area. No additional dragonfly species was recorded in the Study Area in September 2001.

Table 6.3
Species Richness of Butterfly in Each Type of Habitat

Habitats	Number of species
Plantations (roadside)	1
Plantations (headland)	4
Secondary woodlands	10
Secondary woodlands (*fung shui* woods)	15
Agriculture	6
Sandy shore	3

Intertidal and Aquatic Habitats

6.5.26 Mangroves along Starfish Bay were a small stand of and scattered individuals. They were not identified by Tam and Wong (1997) as an important conservation priority in Hong Kong. About 15 individuals of true mangroves, including 14 *Kandelia candel* and 1 *Bruguiera gymnorhiza*, were recorded. Mangrove associated species and backshore species including *Clerodendrum inerme, Excoecaria agallocha, Pandanus tectorius* and *Hibiscus tiliaceus* were also found at the estuary and along the foothill of the peninsula. Species typical of sandy beach such as *Ipomoea brasiliensis* and *Melanthera bicolor* were also found on Starfish Bay and the sandy beach on the west side of the peninsula. Due to the small size and patchiness and the mangroves and coastal vegetation, they were not mapped on the habitat map.

Marine Habitats

6.5.27 All marine habitats lie on and outside the boundary of the Study Area. The Assessment Area (which includes those areas within 500 m from the Study Area boundary) also cover intertidal sandflat and subtidal habitats. There are no designated sites of marine conservation interest located in the vicinity of the new development area or inside the assessment area for marine ecology.

Water Quality

6.5.28 Tolo Harbour, an enclosed waterbody with poor tidal flushing capacity, has been decimated by human and animal sewage pollution. Tolo Harbour has been identified as a priority site for pollution control, and water quality is now beginning to recover with the introduction of pollution reduction measures. The diversity of its marine ecology remains low compared to pre-pollution levels, but is expected to recover over time.

6.5.29 Tolo Harbour is a poorly flushed embayment. Because of the 'bottleneck' topography and the reclamation of new towns, tidal exchanges within Tolo Harbour were limited (Morton 1990). The development of the Sha Tin and Tai Po new towns had a major impact on the water quality of Tolo Harbour through input of sewage and reclamation. The population around inner Tolo Harbour was 75,000 in 1973 (Lam & Ho 1989). Large scale reclamation has been carried out along the coast of the inner basin since then and three new towns have been established.

6.5.30 From the early 1980s onwards as the population rapidly increased, the water quality of Tolo Harbour noticeably deteriorated. Sewage loading from the expanding population together with pollutant loads from livestock wastes provided unlimited nutrients to phytoplankton. The occurrence of red tides has become a regular phenomenon in late 80's and early 90's (Morton 1990). The oxygen levels in the water were decreasing and red tides became more frequent.

6.5.31 The situation has been improved for a certain degree since Tolo Harbour and Channel WCZ was declared in 1982 and control of certain categories of discharges took effect in 1987. Following the enforcement of the Waste Disposal (Livestock Waste) Regulations 1988 and the amendment of the Water Quality Control Ordinance in 1990, control has been extended to all types of effluent. The Tolo Harbour Action Plan, consisting of a number of separate actions to reduce and control the polluting inputs, was implemented in 1987. Tolo Harbour Effluent Export Scheme, as part of the Action Plan, has been put into operation in steps. The treated sewage effluent from both Sha Tin and Tai Po's sewage treatment works is being exported out of the catchment, via a major pipeline, to Victoria Harbour. This scheme was fully operational in 1998.

6.5.32 The decline in water quality has been halted and the number of red tide incidents has also decreased, from the peak level of 43 recorded in 1988, to eight in 1998.

6.5.33 The population in the three new towns, however, has increased in an even faster rate. Considerable stress has been still being imposed upon the marine system. In early 80's, inner Tolo Harbour represented a favorable environment for phytoplankton growth throughout the year (Lam & Ho 1989). Chan and Hodgkiss (1987) recorded the red tide frequency in Tolo Harbour.

6.5.34 An other research in early 90's (Ho & Hodgkiss 1993) showed that there was still a higher potential for red tide occurrence in inner Tolo Harbour than in Tolo Channel than in outer Tolo Harbour. This finding coincided with the previous study. Eutrophication and intense algal bloom were also demonstrated in late 80's (Chan & Wong 1993). Besides organic loading, heavy metal pollution is also an increasing problem (Blackmore 1996) to the marine life in Tolo Harbour.

Coastal Bay such as Starfish Bay

6.5.35 Although make up some 20% of Hong Kong's shoreline, soft shores in Hong Kong are far less well understood than rocky shores. There has been no long term monitoring of changes in biodiversity in soft shores and only a few studies of selected organisms have been made.

6.5.36 The relatively close distance to urban area and accommodation facilities nearby, make Starfish Bay a popular spot for studying of soft shore habitats (Morton & Morton 1983).

6.5.37 In the present Study, the fifteen sampling locations on each transect were divided into three zones, i.e. upper , middle and lower. The data of the core samples were presented as the average density of the organisms in the three zones. Supplementary data from the two quadrats from each zone had been combined into the core sample results. The distribution of dominant species was shown in the Table 6.4 below.

Table 6.4
Intertidal Fauna on the Sandflat in Starfish Bay

Organisms	Density (Individual/m^2)		
	Upper shore	Middle shore	Lower shore
Bivalves			
Tapes philippinarum	0	31	45
Gastropods			
Cerithidea rhizophorarum	78	184	267
Nassarius festivus	0	97	156
Crustaceans			
Scopimera globosa	37	26	0
Mictyris longicarpus	24	55	8

6.5.38 Verification survey conducted in September 2001 showed that the conditions of the sandlfat generally remained unchanged. The species of epifauna and infauna recorded in the survey were all recorded in the baseline survey.

6.5.39 Based on previous studies, Starfish Bay has been regarded as one of the richest sandy shore habitats in Hong Kong, but now disastrously polluted (Morton 1998). The once abundant starfish *Archaster typicus* to which the bay was named after is now absent, but replaced by scavenger snail *Nassarius festivus* and high tolerant clam *Tapes philippinarum* (Morton et al. 1996).

6.5.40 Starfish Bay is identified as plausible breeding habitat for horseshoe crabs in the past but has stopped being horseshoe crab breeding habitats and the most recent anecdotal sightings were in 1985, 1988 and 1993 (Chiu & Morton 1999). The deterioration of habitat quality caused by pollution and reclamation is considered leading to the decline in horseshoe crab numbers (ibid).

Natural Coastline including Rocky and Sandy Shores

6.5.41 Field surveys were conducted from January to April 2000 to record fauna on rocky shores and sandy beaches. A verification survey was conducted in September 2001 to update the previous data.

6.5.42 Rocky shores within the Study Area are all located along the perimeter of the headland. On the eastern coast of the headland, rocky shore was formed by natural bedrock and dominated by littorinid snails. Other fauna was only found close to the low water mark, and consisted mainly of barnacles. The rocky shore on the western

side of the headland was composed of large-sized angular boulders, and was the poorest in fauna among the rocky shores in the Study Area. On the northern coast of the headland, there was a boulder shore with smaller and rounder boulders. More intertidal fauna such as crabs and bivalves were found beneath boulders. Next to it, there was also a section of highly disturbed rocky shore outside the former detention centre.

6.5.43 Fauna recorded included Crab *Epixanthus frontalis*, Crab *Gaetice depressus*, Barnacle *Tetraclita squamosa*, Stalked Barnacle *Pollicipes mitella*, Bivalve *Barbatia obliqua*, Green Mussel *Perna viridis*, Small Pearl Oyster *Pinctada furcata*, and Littorinid snails. All are typical for rocky shore habitats in Hong Kong. No rare species or species of conservation importance have been found so far.

6.5.44 Beside Starfish Bay, two other sandy habitats were found inside the Study Area, one on the northern coast of the headland and the other on the western side of the Study Area near To Tau Village (Figure 6.1). Both sandy beaches were scattered with crab burrows, but at a higher density at To Tau beach.

Subtidal Benthos

6.5.45 *Cerianthus* sp. and *Atrina* sp. characterise the subtidal communities in Starfish Bay (Morton & Morton 1983). The lancelets were reported to be regularly recorded from Starfish Bay (Morton & Morton 1983). They can swim freely through the water but typically burrows in sand. Benthic ichthyofauna and portunidae in Tolo Harbour were studied (Lam 1990; Cheung 1990). Two species of crabs and decapoda in Tolo Harbour were studied (Lam 1992; Davie 1992) Epibenthic ichthyofauna of Tolo Harbour was also investigated (Leung 1997).

Corals

6.5.46 The result of the dive survey showed that there were no hard corals on the areas of seabed surveyed. One colony of Black coral (approximately 0.7 m in height 0.8 m in width) and was recorded in the Control site.

6.5.47 The dive survey was performed on the 22-23 September 2001. The weather was sunny and the sea was calm. The visibility was fair to poor which was common for Hong Kong, particularly poor at the depth over 7m, where visibility generally ranged between 0.6 m and 1.0 m. Video footage were available from all transects. Photographs of representative marine species located in the surveyed areas and the seabed composition were taken.

6.5.48 Site 1 is sheltered by Whitehead peninsula, and thus protected from wave actions. This contributes to the more muddy sea bed at the bay. Site 2 is a tip of the western

headland in Whitehead, to the north of Site 1. Site 2 was less muddy than the Site 1 due to the higher degree of exposure. The substrate is mainly sandy with shell fragment and boulders. The six transects were designated as Transect A to Transect F.

6.5.49 The seabed substrate types were similar between the six transects surveyed (Table 6.5). The majority of the transects had primarily mud and sand, or sand and gravel seabed composition. The sea bottom profile covered by Transects A to C was basically in a gentle slope towards the shore. Except the deepest transects, i.e. the -10 m CD transect, where the gradient of the sea bottom was greater than other transects. The other three 100-meter transects in Site 2 were also all laid on a gentle slope as Site 1.

Table 6.5
Seabed Attributes Along the Survey Transects

Seabed attributes [a]	Transects					
	Site 1 (Impact site)			Site 2 (Control site)		
	A	B	C	D	E	F
Hard substrate						
Continuous Pavement						
Bedrock/boulders						
Rubble				1	1	1
Cobbles						
Sand or sand and gravel	1			4	1	
Mud	4	5	5		3	4

a Note: 1 = 1-10% Cover, 2 = 11-30% Cover, 3 = 31-50% Cover, 4 = 51-75% Cover, 5 = 76-100% Cover.

6.5.50 Along each transect the marine fauna composition was identified and conditions were noted as shown in the table below.

Table 6.6
Description of the Seabed Recorded along each Transect

Transect	Average Depth	Description
Site 1		The seabed of Site 1 was basically a gentle slope of uniform muddy sand. Due to the soft substratum and the lack of attaching surface such as boulders, epifauna, especially sessile forms, were limited. The Borrowing anemone *Cerianthus* was the only dominant marine life on the sea floor.
A	3m	Transect A was located about 40m seawards the location of the proposed water sports centre, running from northwest to southeast and parallel with the coastline. It covered the zone of -3m depth The seabed was covered by muddy sand along the whole transect. Visibility was low (about 0.5 m). Neither hard nor soft corals were recorded along the transect. Borrowing anemone *Cerianthus*, however, is abundant along the transect.
B	5m	Transect B was located about 60m seawards the location of the proposed water sports centre, running from northwest to southeast and parallel with the coastline. It covered the zone of –5m depth The seabed was uniform muddy sand. Visibility was low (about 0.5 m). Neither hard nor soft corals were recorded along the transect. Borrowing anemone *Cerianthus*, however, is abundant along the transect.
C	10m	Transect C was located about 100m seawards the location of the proposed water sports centre, running from northwest to southeast and parallel with the coastline. It covered the zone of –10m depth The seabed was uniform muddy sand. Visibility was fair to poor (0.4 m to 0.3 m). Neither hard nor soft corals were recorded along the transect. Borrowing anemone *Cerianthus*, however, is abundant along the transect.
Site 2		This site was different to Site 1 as the transect was laid on top of sandy bottom with several patches of mussel beds. One colony of Black coral *Antipathes* sp. was recorded along one of the transects.
D	3m	Transect D was located about 30m seawards the control site i.e. the tip of the western headland in Whitehead, running from northeast to southwest and parallel with the coastline. It covered the zone of –3m depth. The seabed was sand with boulders and rubbles. Visibility was fair to poor (0.4 m to 0.3 m). Neither hard nor soft corals were recorded along the transect.
E	5m	Transect E was located about 60 m seawards the control site, i.e. the tip of the western headland in Whitehead, running from northeast to southwest and parallel with the coastline. It covered the zone of –5 m depth The seabed was uniform sand and rubble. Visibility was fair to poor (0.4 m to 0.3 m). Neither hard nor soft corals were recorded along the transect.
F	10m	Transect F was located about 90 m seawards the control site, i.e. the tip of the western headland in Whitehead, running from northeast to southwest and parallel with the coastline. It covered the zone of –10 m depth The seabed was uniform muddy sand. Visibility was fair to poor (0.4 m to 0.3 m). One colony of Black coral (*Antipathes* sp.) was recorded on the first one third of the transect.

Transects A to C – Impact Site

6.5.51 The dive surveys at Transects A, B and C reported that no corals were present along the entire length surveyed (100 m on each transect). As discussed above, the seabed consisted almost entirely of soft mud with few organisms present.

Transects D to F – Control Site

6.5.52 On Transect F, located at the deepest level, one colony of the Black coral (approximately 0.7 m in height and 0.8m in width) was recorded (Figure 6.4). No corals (either hard or soft) were reported along any of the other transects surveyed.

6.5.53 Only one colony of one species of Black coral was recorded on Transect F. *Anthipathes* sp. was widespread and common in soft sea bed. The total coverage of the only Black coral colony recorded on Transect F was about 0.4 m^2, which made up less than 1 % (about 0.01%) of the sea bottom surface within the area of Site 2 surveyed. For the whole subtidal area, the coverage is less than 0.01 %.

6.5.54 The Black coral colony was located at the deepest level at Site 2, i.e. –10 mPD, or about 90 m from the shore. This was the only one soft coral recorded during the survey within this area. Other marine organisms recorded included Burrowing Sea anemone *Cerianthus*, Green mussel *Perna viridus*, Sea urchin *Temnopleura toreumaticus*, and Sea cucumber *Holothuria leucospilota*. All of these organisms are common in shallow marine areas in the waters of Hong Kong.

6.5.55 In summary, information gathered from the dive survey indicated that none of the transects surveyed at Whitehead supports large numbers of coral colonies or any marine ecological assemblages which are considered to be of conservation value. Although one colony of Black coral was found at Transect F, they are considered a common soft coral in Hong Kong. The majority of other marine life found were all common in Hong Kong.

6.5.56 The water quality of Sha Tin and Tolo Harbour was considered as badly polluted, but Tolo Channel was comparatively unspoiled in the early 80's (Morton & Morton 1983). Corals still could be found starting from Centre Island, which in the middle of the Channel, to Chek Chau, which is located in the channel mouth and richest in corals.

6.5.57 Coral deaths was recorded since early 80's (Scott & Cope 1982). A resurvey of Tolo corals in 1986 demonstrated reductions in coral abundance and diversity since the previous study in 1980 (Scott & Cope 1990).

6.5.58 Although it is known from the evidence of dead skeletons that in Tolo Harbour corals did once grow (Scott & Cope 1982), due to the water pollution, only the eastern waters are capable of sustaining hermatypic coral growth (Morton 1992), such as Hoi Ha Wan in Tolo Channel. Tolo Harbour has not been considered as a habitat for hard coral anymore. These skeletons, however, provide habitats for coral-gallery communities (Morton et al. 1991).

6.5.59 Inside the Victoria Harbour WCZ, some soft corals and gorgonians were found in Green Island and Little Green Island during the Green Island Development Study (TDD, 1998). Some black corals (*Anthipathes* sp.), protected by CITES and Cap. 187, were found in Green Island.

6.5.60 Established coral communities of any size are regarded as important habitat type in Hong Kong as defined in Annex 8 EIAO-TM. Among the corals, however, hard corals are more vulnerable than soft corals. Soft corals and gorgonians do not contain zooxanthellae and do not require light penetration for photosynthesis. They are more widely distributed in Hong Kong, and could be found in areas of higher turbidity such as south Tsing Yi, where sea pens and gorgonians were recorded during a trawl survey for epibenthic community (ERM, 1995).

Cetaceans

6.5.61 Tolo Harbour is out of the distribution range of the two locally resided cetacean species, i.e. *Sousa chinensis* (Jefferson 1997) and *Neophocaena phocaenoides* (Jefferson 1999). Only a few cases of cetacean sightings and strandings have been recorded within Tolo Harbour (Parsons et al. 1995). Therefore no field survey was conducted for cetaceans.

Summary

6.5.62 Overall, the terrestrial habitats found within the Study Area is disturbed and surrounded by developed / urbanised area and therefore post little ecological constraints to the development. However, the secondary woodlands on site are of moderate ecological values and constitute a moderate constraint to development.

6.5.63 Most species of surveyed terrestrial fauna in the Study Area were mainly inhabitants of disturbed areas. Bird species of conservation importance (Table 6.8) were all found in plantations (headland) or secondary woodlands (including *fung shui* woods). Abundance and species richness of the surveyed fauna groups were generally higher in plantations (headland) and secondary woodlands (*fung shui* woods) than other types of habitats in the study area. Old trees in the *fung shui* woods in the study area can provide roost for Greater Short-nosed Fruit Bat.

6.5.64 Although the faunal diversity has degraded and no species of special conservation value was found in the present survey, as one of the few large size sand flats in Hong Kong, Starfish Bay is still of conservation importance. For subtidal habitat, no hard corals were found during the dive survey. One colony of Black coral, *Antipathes* sp., (of approximately 0.7m in height and 0.8m in width) was recorded in the control site during the dive survey.

6.6 Evaluation of Habitats and Species

6.6.1 One shrub species protected under Forestry Regulations, *Pavetta hongkongensis*, and one tree species with restricted distribution, *Celtis timorensis*, were recorded in the Fung Shui Woods outside the Study Area.

Table 6.7
Plant Species of Conservation Importance

Species	Protection status	Distribution	Rarity (Xing *et al.* 2000)
Pavetta hongkongensis	Forestry Regulations	Secondary Woodland	Common
Celtis timorensis	Not protected	Secondary Woodland	Restricted

Note: Locations of these species are shown on Figure 6.3.

6.6.2 Most bird species recorded in the Study Area are common and widespread in Hong Kong (Viney *et al.* 1996), and are generally of low conservation importance. Some bird species can be found in urbanized areas and urban parks (e.g., Chinese Bulbul *Pycnonotus sinensis*, Crested Bulbul *P. jocosus*) (Lock 2000). There were 9 bird species of conservation importance (Table 6.8). Four species are protected by regional or international regulations - Crested Goshawk *Accipiter trivirgatus*, Black-eared Kite *Milvus lineatus*, Greater Coucal *Centropus sinensis* and Hwamei *Garrulax canorus*. All were recorded in plantations (headland). Greater Coucal was also recorded in secondary woodlands (*fung shui* woods). Black-eared Kite and Greater Coucal can be found in many types of habitats in Hong Kong, while Hwamei inhabit shrubland (Viney *et al.* 1996). The other six species are mainly found in wooded habitats.

Table 6.8
Bird Species of Conservation Importance

Species	Protection status	Distribution	Rarity
Crested Goshawk	Class 2 Protected Animal of PRC Annex F3 of CITES	Found near wooded areas; Oriental	Rare in Hong Kong and China
Black-eared Kite	Class 2 Protected Animal of PRC Annex F2 of CITES	Found in many types of habitats; East Eurasia	Common and widespread in Hong Kong
Greater Coucal	Class 2 Protected Animal of PRC	Found in many types of habitats in Hong Kong; Oriental	Common and widespread in Hong Kong; Very rare in China
Hwamei	Annex F2 of CITES	Found in woodland and hillsides with thick shrubs in Hong Kong; Occurs in Central and South China	Common and widespread in Hong Kong; Rare in China
White's Thrush	Not protected in PRC nor listed in CITES	Found in many types of habitats in Hong Kong; Asia and Australia	Rare but widespread in Hong Kong
Red-throated Flycatcher	Not protected in PRC nor listed in CITES	Found in lightly-wooded areas; Eurasia	Rare but widespread in Hong Kong
Verditer Flycatcher	Not protected in PRC nor listed in CITES	Found in lightly-wooded areas; India to South China	Rare but widespread in Hong Kong
Black-naped Monarch	Not protected in PRC nor listed in CITES	Found in woodland edge; India to South China	Rare but widespread in Hong Kong, local abundance declining
Scarlet-backed Flowerpecker	Not protected in PRC nor listed in CITES	Found in woodlands and gardens; North India to South China	Rare but widespread in Hong Kong, local abundance declining

Note: * All birds in Hong Kong are protected under the Wild Animals Protection Ordinance (Cap. 170).
Locations of these species are shown on Figure 6.3.

6.6.3 The Black corals found during the dive survey, *Antipathes* sp., is protected under Animals and Plants (Protection of Endangered Species) Ordinance (Cap. 187). Though being regulated for import and export, this animal is widespread in Hong Kong waters and could be found in Tolo Harbour (Morton & Morton 1983) and Victoria Harbour (TDD, 1998 in the Green Island Development Study). The Black coral colony recorded is in good conditions. All other marine life recorded in the present survey, i.e. sea urchins and Green Mussel, are common in Hong Kong waters and have no special conservation value. From the information presented in the previous sections, it is clear that the areas covered by the dive survey cannot be considered as of high ecological value due to the absence of hard coral colony and the low abundance of Black corals. The ecological value should be ranked as low.

Table 6.9
Marine Species of Conservation Importance

Species	Protection status	Distribution	Rarity
Black corals, *Antipathes* sp.	Cap. 187, Schedule 1 and CITES	Widespread in Hong Kong	Not uncommon in Hong Kong waters

Note: Location of this observation is shown on Figure 6.3.

6.6.4 Habitats found within the Study Area were evaluated in terms of ecological importance, using the criteria set forth in Annex 8, Table 2 of the EIAO-TM. Ecological importance of the Study Area as a whole is summarised in Table 6.10. Overall, though some habitats within the Assessment Area were considered as important habitats, only limited ecological value was identified on the locations of future site formation.

Table 6.10
Evaluation of Ecological Importance of the Study Area

Criteria	Discussion
Naturalness	There are very few truly natural habitats left inside the Study Area. Most are man-made or highly disturbed.
Size	Varied habitats exist. Only Disturbed Area and Plantation are significant in size, others are small and isolated.
Diversity	Medium diversity of flora and fauna; medium diversity of habitats (7 types of habitats within the Study Area: Woodland, Plantation, Grassland, Agriculture, Disturbed Area, Mangrove and Natural coastline; plus another 2 types within the Assessment Area: Intertidal sandflat and Subtidal)
Rarity	Intertidal sandflat found immediate outside the Study Area is an uncommon habitat. Other habitats within the study area are not rare in the SAR. One shrub species protected under Forestry Regulations, *Pavetta hongkongensis*, and one tree species with restricted distribution, *Celtis timorensis*, were recorded in the Fung Shui Woods. Crested Goshawk *Accipiter trivirgatus*, which is rare, Class II Protected Animal of PRC and listed in Appendix II of CITES, was recorded in plantation (headland). This species usually inhabit woodlands.
Re-creatability	Habitat characteristics and structure as well as species composition of secondary woodland and sandflat are difficult to re-create. Other habitats within the Study Area are readily creatable.
Fragmentation	All habitats except sandflat and disturbed area are subject to certain levels of fragmentation or isolation.
Ecological linkage	Not functionally linked to any highly valued habitat in close proximity in a significant way
Potential value	Limited by on-going development and infrastructure project.
Nursery/breeding ground	Juvenile Great Tits *Parus major* were sighted in secondary woodlands in the Study Area.
Age	Generally young or early succession (20+years for woodland, plantation and grassland, n/a for marine, intertidal, aquatic, and urbanized/disturbed habitats)
Abundance/Richness of wildlife	Low abundance/richness of wildlife

6.7 Impact Identification and Assessment

6.7.1 Ecological impacts of the Project were assessed based upon the ecological resources identified as being at risk from the present development scenarios. Both negative and positive impacts were taken into account, and cumulative impacts of this and other projects were assessed. Mitigation measures were developed to reduce negative impacts, and residual impacts following implementation of all feasible mitigation measures were assessed. Impact assessment and development of mitigation measures were conducted in accordance with the Technical Memorandum on EIA Process and the PELB Technical Circular 1/97 on Off-Site Mitigation.

6.7.2 The significance of ecological impacts is evaluated based primarily on the criteria set forth in Table 1, Annex 8 of the TM:

- habitat quality;
- species affected;
- size/abundance of habitats/organisms affected;
- duration of impacts;
- reversibility of impacts; and
- magnitude of environmental changes.

6.7.3 Impacts are generally ranked as "minor", "moderate" or "severe", although in a few cases a ranking of "minimal" (less than "minor") may be given. The ranking of a given impact will vary based on the criteria listed above. For example, an impact might be ranked as "minor" if it affected only common species and habitats, or if it affected only small numbers of individuals or small areas, whereas it might be ranked as "severe" if it affected rare species or habitats, large numbers of individuals or large areas. The major factors giving rise to a ranking are explained in the text. As noted in Annex 16 of the TM, a degree of professional judgement is involved in the evaluation of impacts.

Construction Stage

6.7.4 This section of the report considers the potential impacts of project construction on terrestrial and marine ecology. Potential sources of impact include:

Terrestrial

- Site formation; and
- Noise and disturbance.

Marine

- Intertidal construction works;
- Surface runoff; and
- Suspended solid.

Terrestrial Ecology

Site Formation

6.7.5 The proposed development will require site formation within the development boundary, which will cause direct and permanent loss of all habitats and their associated flora, with the exception of the 4 patches of preserved woodland and 5 patches of preserved plantation, within the boundary. Habitat map is digitised and overlaid on the proposed layout plan using ArcView® GIS v3.1 software. Geoprocessing technique in the GIS is used to compute the habitat loss. The estimated loss of habitat is as follows:

Table 6.11
Estimated Habitat Loss Caused by the Proposed Development

Habitat	Estimated Loss (ha)
Woodland	0.48
Plantation	8.19
Grassland	2.66
Agriculture	2.08
Disturbed	36.65

6.7.6 Grassland and agriculture habitats in the Study Area support plant species typical of those types of habitats and have a low plant diversity and simple structure. Due to the commonness of the species recorded and small area of habitats to be lost, potential impacts to flora are considered minor.

6.7.7 Loss of disturbed area will cause loss of mainly ruderal plant species. Potential impacts to flora are thus minimal.

6.7.8 Although area of plantation to be lost is quite substantial (8.19 ha), plantation in the Study Area are young in age, support plant species typical of those types of habitats and have a low plant diversity and simple structure. Potential impacts to flora are considered minor to moderate which require mitigation.

6.7.9 Much of the woodland patch would be preserved by the proposed development. Due to the young age, and simple structure of the woodland to be lost, potential ecological impact are considered to be minor to moderate. Mitigation measures are required.

6.7.10 Plantations (headland) and secondary woodlands (including *fung shui* woods) either support high bird abundance or species richness. Since most woodlands in the study area will be preserved, species of conservation importance (e.g., Crested Goshawk) are therefore not going to experience habitat loss. Construction will mainly take place in developed areas. Some agriculture will be lost. However, agriculture habitats in the Study Area supported fauna species typical of disturbed habitats. Due to the commonness of the species recorded and small areas of habitats to be lost, potential impacts to fauna are considered minor.

Noise and Disturbance

6.7.11 Considerable noise and visual disturbance may be generated during site formation and construction, potentially affecting the distribution and behaviour of fauna of the adjacent/remaining habitats. Due to the highly urbanised nature of the surrounding areas, the limited conservation importance of the species recorded, and the temporary nature of the impact, potential impacts to fauna from this source are ranked as minor.

6.7.12 Most fauna recorded in the Study Area are disturbance tolerant. Construction will mainly take place in developed areas inside the Study Area, where biodiversity is highly impoverished. Fauna inhabiting plantations or secondary woodlands near construction site may be temporally affected by noise and disturbance generated during site formation and construction. However, alternative habitats are available in and near the Study Area, and the disturbance is going to be short term. Therefore, the impact from noise and disturbance during the construction stage on terrestrial fauna are ranked as minor.

Marine Ecology

Intertidal construction works

6.7.13 There will be no reclamation involved in the proposed development. Construction works within the intertidal zone, however, would be required in the proposed water sports centre and seawater pumping station to the north of To Tau Village. The intertidal sandflat of Starfish Bay would not be affected since it is located on the other side of the peninsular. The information gathered from the dive surveys conducted in September 2001 indicate that no hard or soft corals will be directly affected by the works relating to the water sports centre west of To Tau. The area of seabed just outside the proposed water sport centre (Site 1, Impact site) is all muddy bottom with no marine organisms with special conservation value. No significant direct ecological impacts would be expected. Due to the small scale of construction works involved, impacts are thus ranked as largely minimal in nature.

6.7.14 Due to the distance of Nai Chung Coast SSSI from the project site and the small scale of construction works involved, impacts to the Nai Chung Coast SSSI will be minimal in nature. In fact, the natural distance between the proposed development and the

SSSI will serve as a sufficient natural buffer

Site Runoff

6.7.15 Site runoff during construction stage might affect the salinity of the seawater. Impacts on benthos and other sessile or mobile organisms would be short-termed and localised, and would be self-correcting after project completion without active restoration efforts. Mobile organisms affected could return to the area after the construction works, while the nearby benthos and sessile organisms could disperse their offspring through water currents and recolonize the area. Species of conservation value in aquatic ecology such as black corals outside the peninsula would not be impacted since their capability to tolerate a lower salinity which is evident by their existence in the transition zone on the western part of Hong Kong waters. Impacts are thus ranked as largely minor in nature.

Suspended Solid

6.7.16 Facilities of the water sports centre and the seawater intake point of a nearby pumping station might require small-scale intertidal/subtidal construction works. Site runoff from site formation during construction stage might also carry sediment into the sea and increase the suspended solid in the water. Construction activities, both marine and terrestrial, may impact indirectly upon the marine environment through re-suspension of sediment from excavation and site formation activities, and site runoff. Re-deposition of suspended solids has the potential to affect marine benthic communities, including corals, and to alter seabed characteristics. No hard corals were found in the dive survey. The potential for sedimentation to impact any hard coral colony would be minimal. The one colony of Black coral indicated the potential of other colonies in the vicinity of the Study Area. They are, however, tolerant to suspended solid in the water as they need no light for photosynthesis. No other seabed assemblages of high conservation value have been recorded under this Study. Consequently, no unacceptable indirect impacts to marine ecological resources are predicted to occur during the construction and operations of the water sports centre.

Summary of Construction Impacts

6.7.17 Potential impacts of project construction on terrestrial ecology are summarised in the following table.

Table 6.12
Summary of Construction Stage Impacts

Activity	Receiver	Potential Impacts	Nature of Impacts	Severity	Mitigation Required
Terrestrial Ecology					
Site formation	Habitats (grassland, agriculture and dependent species)	Total loss of flora and habitats within site formation boundary Loss of habitats for fauna	Permanent, irreversible, small scale, limited species affected	Minor	No
	Habitats (plantation, woodland and dependent species)	Total loss of flora and habitats within site formation boundary Loss of habitats for fauna	Permanent, irreversible, moderate scale, limited species affected	Minor - moderate	Yes
Noise and disturbance	Sensitive wildlife species on and near the study area	Changes in distribution, activity patterns	Temporary, reversible, small scale, limited species affected	Minor	No
Marine Ecology					
Intertidal construction works	Intertidal and subtidal fauna	Direct disturbance	Temporary, small scale	Minimal	No
Site runoff	Intertidal and subtidal fauna	Changes in salinity, increase suspended solid	Temporary, reversible, small scale	Minor	Yes
Sedimentation	Intertidal and subtidal fauna	Suspended solid	Temporary, reversible	Minor	Yes

Operation Stage

6.7.18 This section of the report considers the potential impacts of project operation on terrestrial and marine ecology. Potential sources of impact include:

Terrestrial

- Noise and disturbance.

Marine

- Surface runoff.

Terrestrial Ecology

6.7.19 Potential impacts of project operation on terrestrial ecology include long term noise and light generated by road lighting and traffic. Based on the limited fauna community observed in the field and the urbanised nature of the surrounding habitat, potential impacts to fauna from this source are ranked as minimal.

6.7.20 Since most terrestrial fauna in the Study Area are disturbance tolerant and some are dwellers of urbanized areas, operational impacts are ranked as minimal. In addition, a botanical garden will be included in the development plan. This will provide habitats for wildlife in the Study Area. The design of the walking trails within the Study Area is aimed to keep visitors away from entering the intertidal sandflat. This can prevent excessive human disturbance on the intertidal fauna.

Marine Ecology

6.7.21 The proposed development preserves most of the existing woodlands and plantations, and also contains a large area of vegetated areas including botanical garden. A large percentage of land surfaces will be covered by vegetation. With the new drainage outlet at the northern shore of the peninsula, surface runoff into the sandflat is not expected to significantly increase, while the runoff released in the new drainage outlet could be diluted by seawater currents since the northern shore of the peninsula is the most exposed area within the Study Area. The salinity of the subtidal habitat would not be significantly changed. Potential impacts from surface runoff are thus ranked as minimal.

Summary of Operation Impacts

6.7.22 Potential impacts of project operation on terrestrial ecology are summarised in the following table.

Table 6.13
Summary of Operation Stage Impacts

Activity	Receiver	Potential Impacts	Severity	Mitigation Required
Terrestrial Ecology				
Long term noise and light disturbance	Terrestrial fauna	Changes in distribution, activity patterns	Minimal	No
Disturbance / vandalism	Terrestrial flora & fauna, and intertidal fauna	Vandalism / removal of species	Minimal	No
Marine Ecology				
Surface runoff	Intertidal and subtidal fauna	Changes in salinity	Minimal	No

Cumulative Impacts

6.7.23 Although development would cause limited loss on woodland habitat, the associated construction of Road D1 would potentially cause disturbance on Wu Kai Sha *fung shui* wood. Cumulative impacts to flora are considered moderate and would require mitigation.

6.7.24 Terrestrial fauna in the Study Area are mainly disturbance tolerant. Development mainly takes place in urbanized areas and areas of low ecological importance in the study area. Apart from the building of some cycle tracks, areas of ecological importance will remain relatively unchanged. Since human disturbance in the Study Area is already high before the development, fauna inhabiting the Study Area will be able to tolerate these human activities. In addition, a botanical garden will be included in the development plan and will provide habitats for wildlife in the Study Area. It is expected that these fauna will adapt to the redeveloped area with few problems. Cumulative impacts to terrestrial fauna are considered minimal.

6.7.25 The ecological impacts of project construction and operation must be considered in the context of inner Tolo Harbour and the surrounding environment. In the past 20 years or so, these areas have been subject to coastal reclamation and large-scale sewage discharges. The core area of inner Tolo Harbour is not known to harbour any marine ecological resources of special importance such as hard corals, though improvements are expected from the implementation of Tolo Harbour Action Plan. The development is not found to be a major contributor to cumulative impacts upon local marine ecology.

6.8 Mitigation Measures

6.8.1 Annex 16 of the TM and the TC require that mitigation of ecological impacts be sought in the following order of priority: (1) avoid, (2) minimise, (3) compensate on-site and (4) compensate off-site. At each stage, residual impacts should be re-assessed to determine whether there is a need to proceed to the next stage of mitigation. The following measures are proposed to mitigate the impacts discussed in the preceding section.

Construction Stage

6.8.2 Impacts to woodland and plantation on site has been partially avoided by preserving a total of 7.05 ha of plantation in 5 patches of "preserved plantation" and 1.98 ha of woodland in 4 patches of "preserved woodland". These include the 2 headlands where natural understorey of plantation is gradually established and the secondary woodland along the west coast and at the knoll.

6.8.3 Loss of woodland and plantation lying on the fringe of the preserved woodland area where no earthwork is required should also be minimised as possible.

6.8.4 Mature native trees which are commercially unavailable or difficult to establish should be transplanted, where feasible. A tree survey should be performed at the detailed design stage to assess in details the overall suitability of a tree (based on conservation status, size, health, form, landscaping value, etc.) for transplantation.

6.8.5 Loss of woodland/plantation can be mitigated by extending the existing secondary woodlands. A total size of 1.87 ha comprising several areas at the east and west of the proposed development will be available for this purpose ("Extension Area of Secondary Woodland" in Figure 6.5) (see also the landscape and visual impact section.). Native tree and shrub species should be planted in order to ensure like-to-like mitigation for the function of the woodland .

6.8.6 The two compensatory planting areas of 1.07 ha in total on government land at the southeast end of the Study Area and the proposed Botanical Garden of about 4.12 ha in size at the northern end of the development area would potentially provide space for transplanted trees. They can also provide opportunities for compensatory planting for the loss of woodland/plantation, though plantation is not a natural habitat type. Other landscape planting in Whitehead Site 1 and roadside planting within the study area could also compensate part of the plantation loss. There will be no net loss of woodland and plantation in terms of area and function with implementation of the above mentioned compensatory planting (see also Table 6.14).

Table 6.14
A summary of the proposed compensatory planting for woodland and plantation loss

Item	Area (ha)	Location
Woodland Loss	-0.48	
Plantation Loss	-8.19	
Compensatory Planting	+1.87	at woodland extension area using native species
Compensatory Planting	+1.07	in government land parcels using native species
Landscape Planting	+3.5	Botanical Garden
Landscape Planting	+2.23	Whitehead Site 1
Landscape Planting	Nominal	roadside within Study Area
Net loss of woodland/plantation	0	

6.8.7 Site runoff should be desilted and re-used on-site where possible. Runoff should not be discharged into the embayed sandflat area. These measures will reduce the potential for suspended sediments, organics and other contaminants to enter the local marine environment.

6.8.8 Coffer dam or silt curtain should be deployed during subtidal construction works if necessary. Given the scale of works involved, this mitigation measure should be able to prevent sedimentation during constructions.

Operation Stage

6.8.9 No ecological mitigation measures are required during operation stage. Net loss of small size of grassland and plantation habitats of little ecological values will constitute the residual impacts which is not predicted to be significant.

6.9 Residual Impacts

6.9.1 There will be no net loss of woodland or plantation area. The residual ecological impacts due to net loss of grassland and cultivated land is acceptable. No residual impacts on marine fauna are expected given that the mitigation measures and standard practices for construction sites are implemented.

6.10 Summary and Conclusion

Construction Stage

Terrestrial Ecology

6.10.1 The potential sources of impacts from project construction on ecology include: site formation; noise and disturbance; surface runoff; and suspended solid.

6.10.2 Site formation within the development boundary will cause direct and permanent loss of all habitats and their associated flora, with the exception of the preserved woodland and preserved plantation within the boundary. The estimated loss of habitat includes 0.48 ha woodland, 8.19 ha plantation, 2.66 ha grassland, 2.08 ha agriculture and 36.65 ha disturbed/urbanized area. Potential ecological impact on the woodlands and plantations are considered to be minor to moderate. Mitigation measures including compensatory planting for loss of woodlands and plantations are required. Potential impacts to flora in grassland and agriculture habitats are considered minor, while loss of disturbed/urbanized area will cause minimal potential impacts. Mitigation for loss of these habitats are therefore not required.

6.10.3 Since much of the woodlands in the Study Area will be preserved, species of conservation importance (e.g. Crested Goshawk) are therefore not going to experience habitat loss. Potential impacts to fauna from habitat loss of other habitat types are considered minor. Considerable noise and visual disturbance may be generated during site formation and construction, potentially affecting the distribution and behaviour of fauna of the adjacent/remaining habitats. Most fauna recorded in the Study Area are disturbance tolerant, and alternative habitats are available in and near the Study Area, and the disturbance is going to be short term. Therefore, the impact from disturbance during the construction stage on terrestrial fauna is ranked as minor.

Marine Ecology

6.10.4 Impacts from excavation and site runoff on benthos and other sessile or mobile organisms would be localised and would be self-correcting after project completion without active restoration efforts. Species of conservation value in aquatic ecology such as black corals outside the peninsula would not be impacted. Impacts are thus ranked as largely minor in nature.

Operation Stage

Terrestrial Ecology

6.10.5 Potential impacts of project operation on terrestrial ecology include long term noise and light generated by road lighting and traffic. Based on the limited fauna community observed in the field and the urbanised nature of the surrounding habitat, and most terrestrial fauna in the Study Area are disturbance tolerant, some are even dwellers of urbanized areas potential impacts to fauna are ranked as minimal. In addition, a botanical garden has been included in the development plan. This will provide habitats for wildlife in the Study Area.

Marine Ecology

6.10.6 The design of the walking trails within the Study Area is aimed to keep visitors away from entering the intertidal sandflat. This can prevent excessive human disturbance on the intertidal fauna. A large percentage of land surfaces will still be covered by vegetation. With the new drainage outlet at the northern and western shores of the peninsula, surface runoff into the sandflat is not expected to significantly increase. Potential impact from surface runoff is thus ranked as minimal.

6.10.7 The mitigation measures recommended for water quality during construction and operational phases will serve to protect against unacceptable impacts to aquatic ecological environment.

6.11 EM&A Requirement

6.11.1 Due to minor impacts on terrestrial ecology, no monitoring programme is required. There is also no monitoring programme specific for aquatic ecology required, as monitoring and audit activities for water quality will serve to protect against unacceptable impacts to aquatic ecological environment.

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