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7. TERRESTRIAL AND MARINE ECOLOGICAL IMPACTS

Introduction

- 7.1 The following section presents the results of an ecological assessment of potential impacts resulting from the Project. Reference was made to previous assessments of the area, in particular the *NLDFS EIA Report*. Further field surveys were undertaken to supplement and assess the validity of data from previous assessments. As stated in the *EIAO TM*, the aim of ecological impact assessment is to protect, maintain or rehabilitate the natural environment.

Environmental Legislation, Standards and Guidelines

- 7.2 Guidelines, standards, documents and HKSAR Government ordinances and regulations listed in the following sections were referred to during the course of the ecological impact assessment.
- 7.3 The *Country Parks Ordinance* (Cap. 208) provides for the designation and management of country parks and special areas. Country parks are designated for the purpose of nature conservation, countryside recreation and outdoor education. Special Areas are created mainly for the purpose of nature conservation.
- 7.4 The *Forests and Countryside Ordinance* (Cap. 96) prohibits felling, cutting, burning or destroying of trees and growing plants in forests and plantations on Government land. Related subsidiary Regulations prohibit the selling or possession of listed restricted and protected plant species. The list of protected species in Hong Kong which comes under the Forestry Regulations was last amended on 11 June 1993 under the *Forestry (Amendment) Regulation 1993* made under *Section 3* of the *Forests and Countryside Ordinance*.
- 7.5 Under the *Wild Animals Protection Ordinance* (Cap. 170), designated wild animals are protected from being hunted, whilst their nests and eggs are protected from injury, destruction and removal. All birds and most mammals, including marine cetaceans, are protected under this Ordinance. The Second Schedule of the Ordinance which lists all the animals protected was last revised in June 1992.
- 7.6 The amended *Town Planning Ordinance* (Cap. 131) provides for the designation of coastal protection areas, Sites of Special Scientific Interest (*SSSIs*), Conservation Area, Country Park, Green Belt or other specified uses that promote conservation or protection of the environment. The authority responsible for administering the *Town Planning Ordinance* is the Town Planning Board.
- 7.7 *Chapter 10* of the *HKPSG* covers planning considerations relevant to conservation. This chapter details the principles of conservation, the conservation of natural landscape and habitats, historic buildings, archaeological sites and other antiquities. It also describes enforcement issues. The appendices list the legislation and administrative controls for conservation, other conservation related measures in Hong Kong and government departments involved in conservation.
- 7.8 *Annex 16* of the *EIAO TM* sets out the general approach and methodology for assessment of ecological impacts arising from a project or proposal, to allow a complete and objective identification, prediction and evaluation of the potential ecological impacts. *Annex 8* recommends the criteria that can be used for evaluating habitat and ecological impact.
- 7.9 *EIAO Guidance Note No. 6/2002* clarifies the requirements of ecological assessments under the *EIAO*.
- 7.10 *EIAO Guidance Note No. 7/2002* provides general guidelines for conducting ecological baseline surveys in order to fulfil requirements stipulated in the *EIAO TM*.

Terrestrial Ecological Impact

Assessment Methodology

- 7.11 Ecological baseline data presented relevant reports such as the *NLDFS EIA Report* were reviewed. To confirm the validity of existing data, terrestrial ecology surveys covering both the wet and dry seasons were conducted from September 2002 to January 2003. The surveys covered all areas within 500m of the proposed works area. During the surveys, particular attention was paid to species of conservation interest (e.g., *Thespesia populnea*) identified in the *NLDFS EIA Report*, and areas of recognised conservation value (i.e., Luk Keng Conservation Area and the proposed Lantau North Extension Country Park). The surveys comprised:

Habitat/vegetation surveys

- 7.12 Habitats inside the Assessment Area were identified and mapped. Plant species, relative abundance and growth forms were recorded. Identification of species and status in Hong Kong were made with reference to AFD (1993), AFCD (2002) and Xing *et al.* (2000).

Wildlife Surveys

- 7.13 Avifauna, herpetofauna, mammals and terrestrial invertebrates were surveyed in the Assessment Area. The surveys were conducted by direct observation, listening for calling animals, searching potential micro-habitats and searching for signs of animal activity (e.g., tracks, burrows).

Impact Assessment

- 7.14 Potential ecological impacts arising from the Project were assessed following *EIAO TM Annex 16* guidelines and the impacts evaluated based on criteria in *EIAO TM Annex 8*.

Baseline Conditions

Sites of Conservation Interest

- 7.15 Two sites of recognised conservation interest fall partially within the Assessment Area, the Proposed Lantau North Country Park Extension (LNCPE), and the Luk Keng Conservation Area (LKCA).
- 7.16 The proposed LNCPE contains well-established woodlands and freshwater habitats. It encompasses the mountainous areas stretching from Tai Shan above Penny's Bay in the east, to Tai Ho, Tung Chung and Sham Wat in the west, covering an area of 2360 hectares. The secondary woodland, mature montane forests and fresh water habitats are potentially of conservation value.
- 7.17 The LKCA has a relatively natural environment including tall shrub/woodland and natural coastline. Under the *NLDFS*, an Eco-Park has been proposed on the Luk Keng Headland covering Luk Keng Bay. The aim of the park is to provide passive recreation in an unspoilt environment that includes woodland and natural coastline. The Eco-Park would act as a buffer between commercial tourism uses on the planned Theme Park Gateway to the east and the planned residential areas at Siu Ho Wan to the west.

Habitat Type and Vegetation

- 7.18 The *NLDFS EIA Report* identified grassland/shrubland mosaic as the dominant habitat in North-eastern Lantau. Other habitats identified in the current Assessment Area included tall shrubland, wasteland, secondary woodland, village/orchard, backshore vegetation and brackish wetland.
- 7.19 Recent field surveys confirmed that habitat baseline data presented in the *NLDFS EIA Report* was still largely valid, especially in the LKCA. However, some changes to habitats were observed in relation to the on-going theme park infrastructure works. Additionally, recently reclaimed areas close to the North Lantau Highway and Airport Express railway were classified as wasteland in the *NLDFS*

EIA Report. Some wasteland in the Assessment Area has recently been planted with shrubs and trees, and should now be regarded as plantation habitat.

- 7.20 Updated habitat maps are given in [Figure 7.1](#). Representative photographs of habitats are given in [Appendix 7.1](#). Photographs of species of conservation interest are given in [Appendix 7.2](#). Plant species recorded in each habitat are listed in [Appendix 7.3](#). A more detailed description of habitats recorded in the Assessment Area is given in the following sections.

Grassland/shrubland mosaic

- 7.21 The *NLDFS EIA Report* recorded grassland/shrubland mosaic to be the dominant habitat type in Northeast Lantau, including the current Assessment Area. Grassland/shrubland mosaic was noted to be especially prominent in upland areas and hillsides. Species and structural diversity were considered low to moderate. No species of conservation interest were recorded from this habitat in the current Assessment Area.
- 7.22 A total of 43 plant species were recorded in grassland/shrubland mosaic during recent surveys. Species recorded are typical of the habitat types in Hong Kong, and were similar in composition to those reported in the *NLDFS EIA Report*.
- 7.23 During recent surveys, it was observed that areas of grassland/shrubland mosaic on hillsides south of the North Lantau Highway have been developed in relation to the theme park infrastructure works and the on-going construction of Yam O Tuk Reservoirs and associated infrastructure.

Tall Shrubland

- 7.24 The *NLDFS EIA Report* recorded patches of tall shrubland habitat in the current Assessment Area, particularly along the coast of the LKCA. The habitat type was characterised by woody vegetation with an average height of 2-5m, and was dominated by shrubs such as *Cratoxylum cochinense*, *Litsea rotundifolia* and *Rhus succedanea*. Species diversity was considered moderate.
- 7.25 The climber *Vitis balanceana* was recorded from tall shrubland at Tin Tsui Tau in the *NLDFS EIA Report*. *Vitis balanceana* was formerly considered to have a restricted distribution in Hong Kong (Corlett *et al.* 2000). However, more recent surveys have shown it to be relatively widespread in Hong Kong (AFCD, 2002). *Vitis balanceana* was not recorded from Tin Tsui Tau during recent surveys.
- 7.26 A total of 62 plant species were recorded in tall shrubland during recent surveys. Species recorded are typical of the habitat in Hong Kong, and were similar in composition to those reported in the *NLDFS EIA Report*.
- 7.27 In addition to areas of grassland/shrubland mosaic, areas of tall shrubland on hillsides south of the North Lantau Highway were noted to be developed by on-going infrastructure works during recent surveys.

Wasteland

- 7.28 The *NSLDFS EIA Report* recorded large areas of wasteland formed from reclamation on both sides of the North Lantau Highway near Sunny Bay, and also on newly formed slopes alongside the road and railway. Species recorded included exotic weeds such as *Mikania micrantha* and *Lantana camara*. The habitat was considered to be of low diversity, habitat heterogeneity and naturalness.
- 7.29 During recent surveys, plantations of native and exotic tree and shrub species were found to cover some areas of wasteland habitats previously identified in the *NSLDFS EIA Report*. Wasteland habitats were confined to temporary works areas and newly disturbed areas south of the North Lantau Highway. Additional wasteland habitats were associated with temporary works areas close to reclamation works for P2 road and other infrastructure works for the Penny's Bay Development.

- 7.30 In recent surveys, 12 species were recorded in wasteland habitats. Common species included exotic weeds such as *Mikania micrantha* and *Ageratum conyzoides*. The habitat was considered to be of low diversity, habitat heterogeneity and naturalness.

Secondary woodland

- 7.31 The *NLDFS EIA Report* recorded patches of secondary woodland in several locations in North-eastern Lantau, including two areas within the current Assessment Area: Luk Keng Tsuen and Ngong Shuen Au. Species diversity in the woodlands was considered moderate. No plant species of conservation interest were noted from these two woodland patches.
- 7.32 Recent field surveys confirmed woodland habitats at Luk Keng Tsuen had not changed noticeably since the *NLDFS EIA Report*. The woodland area at Ngong Shuen Au has been developed by Theme Park infrastructure works, with only a few small patches remaining on the hillsides above new roads and associated slope works.
- 7.33 A total of 46 plant species were recorded in woodland habitats during recent surveys. As noted in the *NLDFS EIA Report*, plant species recorded are typical of secondary woodlands in Hong Kong, with trees species such as *Cratoxylum cochinchense*, *Aporosa dioica*, *Litsea glutinosa*, *Mallotus paniculatus*, and *Schefflera octophylla* observed.
- 7.34 One species of conservation interest, *Diospyros vaccinioides*, was recorded from Luk Keng Tsuen secondary woodland during recent surveys. *Diospyros vaccinioides* is common in Hong Kong, but is classified as critically endangered in China according to the International Union for Conservation of Nature and Natural Resources (IUCN) 2000 red data list.

Village/orchard

- 7.35 The *NLDFS EIA Report* identified one village/orchard in the current Assessment Area at Luk Keng Tsuen. Species in this habitat type included common fruit trees (e.g., *Dimocarpus longan*, *Clausena lansium*) and ornamental plants (e.g. *Acacia confusa*, *Albizia lebbbeck*). No species of conservation interest were recorded.
- 7.36 Recent surveys at Luk Keng Tsuen recorded similar findings, with a total of 34 species recorded. Most of the recorded species were common and widespread fruit/ornamental trees and shrubs. No species of conservation interest were recorded.

Plantation

- 7.37 No plantation habitat was recorded from the current Assessment Area in the *NLDFS EIA Report*. However, as noted in section 7.29, reclaimed areas close to Sunny Bay have recently been landscaped to form plantation habitats.
- 7.38 Sixteen species were recorded from plantation habitats during recent surveys. The habitat was dominated by ornamental tree and shrub species. Species diversity was low.

Backshore vegetation

- 7.39 Floristic diversity of backshore vegetation was recorded as being low to moderate/moderate in the *NLDFS EIA Report*. Dominant species included *Clerodendrum inerme*, *Scaevola sericea*, *Vitex rotundifolia*, *Macaranga tanarius*, *Cerbera manghas* and *Hibiscus tiliaceus*. One locally restricted species, the tree *Thespesia populnea* was recorded from this habitat type in the current Assessment Area.
- 7.40 Forty plant species were recorded in backshore vegetation during recent field surveys. Species composition was similar to that reported in the *NLDFS EIA Report*. *Thespesia populnea* was again recorded from this habitat type.

Brackish wetland.

- 7.41 A small area of brackish wetland (approximately 0.3ha) was recorded close to Luk Keng Tsuen in the *NLDFS EIA Report*. The habitat was dominated by grasses and sedges such as *Panicum repens* and *Cyperus malaccensis*, and was thought to be formed from abandoned farmland that had been partially flooded. The habitat, along with another patch of brackish wetland at Penny's Bay (outside the current Assessment Area), was considered low in habitat heterogeneity and species diversity.
- 7.42 Few species were recorded from the brackish wetland during recent surveys. Relatively common species included *Cyperus spp.*, *Panicum repens* and *Phragmites* sp. Species diversity and habitat heterogeneity was low.

Fauna

- 7.43 Terrestrial fauna recorded in the Assessment Area during recent surveys is listed in [Appendix 7.4](#).

Mammals

- 7.44 No direct or indirect sightings of mammals were recorded from the current Assessment Area in the *NLDFS EIA Report*, or during recent field surveys.

Herpetofauna

- 7.45 Previous surveys conducted for the *NLDFS EIA Report* recorded seven common herpetofauna species in North-eastern Lantau. Six of these species were recorded in freshwater habitats outside the current Assessment Area. The remaining species, the Common Rat Snake (*Ptyas mucosus*), was recorded in grassland/shrubland mosaic.
- 7.46 No herpetofauna were recorded from the Assessment Area during recent field surveys.

Invertebrates

- 7.47 Twenty-four species of dragonfly and damselfly common to Hong Kong were recorded around North-eastern Lantau during the *NLDFS EIA Report*. Most of recorded species were encountered close to areas with fresh water. Field surveys recorded sixty-nine species of butterfly. Most of the butterflies were encountered at the edge of woodlands and nearby shrubland. No terrestrial insects of conservation interest were recorded.
- 7.48 During recent field surveys, three odonate species and 18 butterfly species were recorded. All recorded species are common and widespread in Hong Kong.

Avifauna

- 7.49 Almost all the 59 species of avifauna recorded in the *NLDFS EIA Report* are common in Hong Kong. Typical species included: Black-eared Kite (*Milvus milgrans*), Common Sandpiper (*Actitis hypoleucos*), Spotted Dove (*Streptopelia chinensis*), Chinese Bulbul (*Pycnonotus sinensis*), Red-whiskered Bulbul (*Pycnonotus jocosus*), Japanese White-eye (*Zosterops japonica*), Long-tailed Shrike (*Lanius schach*) and Yellow-bellied Prinia (*Prinia flaviventris*). No notable observations were made from the current Assessment Area.
- 7.50 Recent field surveys recorded 42 mostly common and widespread species in the assessment area, six of which were not recorded in the *NLDFS EIA Report*. Several species of conservation interest were recorded within or close to Sunny Bay:

- ♣ Large numbers of Little Egret (*Egretta garzetta*) were observed foraging in Sunny Bay, and also along boom lines close to nearby dredging/reclamation works. Little Egrets are of

conservation interest, being a locally common species with a regionally significant population present in Hong Kong (Fellowes *et al.*, 2002).

- ♣ Several Chinese Pond Heron (*Ardeola bacchus*) were observed feeding along the Sunny Bay coastline. This species is common in Hong Kong, but the overall local population and number of breeding birds has declined from the late 1980's to the present. The decline is thought to be linked to the loss of favoured feeding grounds (fishponds). Despite the reduced numbers of Chinese Pond Heron in Hong Kong, the local population is still large enough to be of regional significance (Carey *et al.*, 2001).
- ♣ A pair of Collared Crows (*Corvus torquatus*) were observed in Cheung Sok, along with records of single birds in Sunny Bay. This species was formerly regarded as common and widespread in Hong Kong, but has shown a gradual decline in both numbers and range (Carey *et al.*, 2001). It is now regarded as uncommon in Hong Kong, and is usually recorded from coastal areas.
- ♣ Two White-Bellied Sea Eagles (*Haliaeetus leucogaster*) were recorded flying over Sunny Bay, although no record of breeding activity was made in the Assessment Area. White-Bellied Sea Eagles are a locally uncommon species, and have been recorded breeding elsewhere in North-east Lantau at Pau Tau Kwu, some 2.3km from the proposed works area.

Ecological Value

7.51 In accordance with the *EIAO TM Annex 8* criteria, the ecological importance of recorded habitats has been evaluated in **Tables 7.1a-7.1d** below.

Table 7.1a Ecological Value of Grassland/Shrubland Mosaic and Tall Shrubland in the Assessment area

Criteria	Grassland/shrubland mosaic	Tall shrubland
Naturalness	Habitat maintained by frequent hill fires.	Habitat maintained by frequent hill fires.
Size	The grassland low shrub mosaic is the dominant habitat type in the Assessment Area.	Small patches scattered throughout the Assessment Area.
Diversity	Low to moderate.	Low to moderate.
Rarity	No species of conservation interest recorded.	No species of conservation interest recorded.
Recreatability	Habitat regenerates naturally after fire disturbance.	Habitat regenerates naturally after fire disturbance.
Fragmentation	The grassland/shrubland mosaic is not fragmented.	Small patches scattered throughout the assessment area.
Ecological linkage	Habitat falls partly within the LKCA and proposed LNECP.	Habitat falls partly within the LKCA and proposed LNECP.
Potential value	The potential value is low-moderate.	The potential value is low-moderate.
Nursery ground	No record of significant nursery or breeding ground was found in the survey.	No record of significant nursery or breeding ground were found in the survey.
Age	The habitats are frequently disturbed and therefore are secondary in nature.	The habitats are disturbed and therefore are secondary in nature.
Abundance/Richness of Wildlife	Low to moderate species diversity.	Low to moderate species diversity.
Ecological value	Low	Low

Table 7.1b Ecological Value of Secondary Woodland and Wasteland in the Assessment area

Criteria	Secondary woodland	Wasteland
Naturalness	The secondary woodlands have been modified and subjected to human disturbance.	Created habitat.
Size	Small patches found at Luk Keng Tsuen and Ngong Shuen Au.	Moderate in size.
Diversity	The species diversity is moderate.	The species diversity is low.
Rarity	One locally common but regionally endangered species, <i>Diospyros vaccinioides</i> , recorded from the habitat type.	No species of conservation interest recorded.
Re-creatability	Habitat will regenerate in 10-40 yrs.	The habitat can be re-created easily.
Fragmentation	The woodlands are not fragmented.	The habitat is not fragmented.
Ecological linkage	Woodland at Luk Keng Tsuen falls within the LKCA.	Habitat is not functionally linked to any highly valued habitat in close proximity in a significant way.
Potential value	The potential value is considered moderate.	Low value.
Nursery ground	No record of significant nursery or breeding ground was found in the survey.	No record of significant nursery or breeding ground was found in the survey.
Age	The habitat is relatively mature.	Not applicable.
Abundance/Richness of Wildlife	Moderate.	Low.
Ecological value	Moderate	Very Low

Table 7.1c Ecological Value of Village/Orchard and Plantation in the Assessment Area

Criteria	Village/Orchard	Plantation
Naturalness	Created Habitat.	Created habitat.
Size	Small in size.	Small in size.
Diversity	Species diversity is low.	Species diversity is low.
Rarity	No species of conservation interest recorded.	No species of conservation interest recorded.
Re-creatability	Habitat can be re-created easily.	Habitat can be re-created easily.
Fragmentation	Habitat is not fragmented.	Habitat is not fragmented.
Ecological linkage	Habitat within the LKCA.	The plantation is not functionally linked to any highly valued habitat in close proximity in a significant way.
Potential value	Low potential value.	Low value.
Nursery ground	No record of significant nursery or breeding ground was found in the survey.	No record of significant nursery or breeding ground was found in the survey.
Age	Not applicable.	Not applicable.
Abundance/Richness of Wildlife	Low.	Low.
Ecological value	Low	Low

Table 7.1d Ecological Value of Backshore Vegetation and Brackish Wetland in the Assessment Area

Criteria	Backshore vegetation	Brackish Wetland
Naturalness	Natural habitat with limited human disturbance.	Marsh formed from abandoned farmland, therefore naturalness is low-moderate.
Size	Small in size.	Small in size.(app. 0.3ha).
Diversity	The species diversity is moderate.	The species diversity is low.
Rarity	<i>Thespesia populnea</i> , with a locally restricted distribution, recorded from the habitat.	No species of conservation interest recorded.
Re-creatability	Moderate.	Re-creatability is moderate.
Fragmentation	The habitats are not fragmented but always have a linear shape.	This habitat type is not fragmented.
Ecological linkage	The habitat falls within the LKCA.	Habitat falls within the LKCA.
Potential value	The potential value is low.	The potential value is considered moderate.
Nursery ground	No record of significant nursery or breeding ground was found in the survey.	No record of significant nursery or breeding ground was found in the survey.
Age	Relatively mature.	Not applicable.
Abundance/Richness of Wildlife	Low.	Low-moderate.
Ecological value	Moderate	Low-Moderate

- 7.52 Grassland/shrubland mosaic habitat within the Assessment Area has low value because of poor diversity; and also because most of the species identified are common, widespread and typical to such habitats in Hong Kong.
- 7.53 Tall shrubland habitat generally has low ecological value, because of low diversity and common, widespread species.
- 7.54 Given their small size, secondary woodlands are regarded as having only moderate ecological value.
- 7.55 The brackish wetland has low-moderate value, given the relatively species poor vegetation community found in the habitat.
- 7.56 The ecological value of the village/orchard, wasteland and plantation habitats is limited given the frequent human disturbance and low species diversity in these habitat types.
- 7.57 Although small in area, backshore vegetation in the Assessment area was found to support a restricted plant species, and is considered to be of moderate ecological value.
- 7.58 In accordance with the *EIAO TM Annex 8* criteria, the species of conservation interest are evaluated in Tables 7.2a and 7.2b below.

Table 7.2a Evaluation of Floral Species of Conservation Interest Recorded Within Assessment Area

Species	Growth Form	Location	Protection Status	Distribution	Rarity
<i>Thespesia populnea</i>	Tree	Luk Keng	Not protected	Sha Tau Kok, Tung Chung and Sui Hau	Restricted*
<i>Diospyros vaccinioides</i>	Shrub	Luk Keng	Not Protected	Common across Hong Kong	Critically endangered**

*Source: Xing *et al.* 2000

**Source: IUCN 2002. 2002 IUCN Red List of Threatened Species.

Table 7.2b Evaluation of Faunal Species of Conservation Interest Recorded Within Assessment Area

Common Name	Location	Protection Status	Distribution/Rarity	Conservation Status**
Ardeids Little Egret <i>Egretta garzetta</i>	Sunny Bay	Protected*	Locally common species, with regionally significant populations occurring in Hong Kong.	PRC
Chinese Pond Heron <i>Ardea cinerea</i>			Common resident. Regionally significant population occurring in Hong Kong. Declining local population.	PRC
Collared Crow <i>Corvus torquatus</i>	Sunny Bay/ Cheung Sok	Protected*	Restricted to coastal areas. Declining local population	LC
White-Bellied Sea Eagle <i>Haliaeetus leucogaster</i>	Sunny Bay (Airspace)	Protected*	Coastal Areas and Offshore Islands. Locally uncommon	-

*All wild birds are protected under the *Wild Animals Protection Ordinance*

** LC – Local Concern (Habitat loss/damage in Hong Kong would pose significant threat to local survival); PRC – Potential Regional Concern (Large, secure populations in Hong Kong are of regional significance). Refer to Fellowes *et al.* (2002) for further explanation of status.

Environmental Impact Identification, Prediction and Evaluation

Identification and Prediction of Ecological Impacts

7.59 Major works proposed under this Project that have the potential to impact terrestrial ecological resources include:

- ♣ Reclamation of approximately 3ha and construction of seawall.
- ♣ Construction of Road P1 Roundabout.
- ♣ Construction of elevated and at-grade roads between the Road P1 roundabout, North Lantau Highway, and Sunny Bay Road roundabout.

Construction Phase

Direct Impacts

- 7.60 Direct terrestrial ecological impacts resulting from the works would be minimal. Impacts would be limited to the loss of small areas of plantation (approx. 0.1 ha) and wasteland (approx. 0.12 ha) habitat to at-grade roads, and under the footprint of pillars supporting the proposed elevated slip roads.
- 7.61 No direct impacts to other terrestrial habitat types, species of conservation interest or areas of conservation value are anticipated.

Indirect Impacts

- 7.62 Indirect construction phase impacts would include increased disturbance to wildlife in the Assessment Area. Disturbance would result from potentially noisy construction works (e.g., dredging, reclamation, road construction), and a general increase in human activities associated with construction work (e.g., material storage and construction site run-off).

Operation Phase

Direct Impacts

- 7.63 No direct impacts to terrestrial ecological sensitive receivers would result from operation of the Road P1 advance works.

Indirect Impacts

- 7.64 Indirect operation phase impacts would include an increase in disturbance to wildlife in the Assessment Area. Disturbance would result from traffic using the P1 Roundabout and slip-roads, and a general increase in human activity.

Evaluation of Ecological Impacts

- 7.65 Potential ecological impacts to habitats in the Assessment Area resulting from the current Project have been evaluated according to Table 1 of Annex 8 of the *EIAO TM*, and are summarised in **Tables 7.3a-7.3b** below.

Table 7.3a Overall Impact Evaluation of Grassland/shrubland mosaic, tall shrubland, secondary woodland, village/orchard and backshore vegetation

Evaluation Criteria	Grassland/shrubland mosaic tall shrubland, secondary woodland, village/orchard and backshore vegetation
Habitat quality	The habitat quality ranges from low-moderate.
Species	No direct impact to species of conservation interest, although there may be potential indirect impact to the wildlife.
Size/Abundance	No habitat loss.
Duration	Minor, temporary increase in disturbance during construction phase. Very minor, permanent increase in disturbance during operational phase.
Reversibility	Minor increase in disturbance during operational phase will be permanent.
Magnitude	The scale of the impacts is considered low.
Overall impact conclusion	Low

Table 7.3b Overall Impact Evaluation of Wasteland and Plantation

Evaluation Criteria	Wasteland and Plantation
Habitat quality	The habitat quality of wasteland and plantation is very low-low.
Species	No direct impact to species of conservation interest, although there may be potential indirect impact to the wildlife.
Size/Abundance	Loss of small areas of wasteland and plantation habitats.
Duration	Loss of habitat would be permanent.
Reversibility	Loss of habitat would be permanent.
Magnitude	The scale of the impact is considered low.
Overall impact conclusion	Very Low

7.66 Direct impacts to terrestrial habitats and species resulting from the Project are considered very minor. Impacts would be limited to the loss of small areas of very low-low value habitats. No species or areas of conservation interest would be affected.

7.67 Indirect impacts to wildlife during both construction and operation phases are considered minor. The greatest potential impact would be to birds foraging in Sunny Bay during the construction phase, where disturbance could result from adjacent dredging and reclamation works. However, observations during recent field surveys have revealed birds in Sunny Bay Area to be tolerant of numerous existing sources of disturbance. These include:

- ♣ Adjacent dredging/reclamation works for Sunny Bay Road and other Infrastructure for the Penny's Bay Development: Large numbers of Ardeids and other birds (over 50 individuals) were regularly observed feeding along boom lines within 10-20m of dredging/reclamation works;
- ♣ Works associated with logging operations at Sunny Bay;
- ♣ Heavy traffic on the nearby North Lantau Highway/Railway; and
- ♣ Aircraft from Chep Lap Kok Airport flying low over the site at regular (sometimes as often as 5min) intervals.

7.68 Given the tolerance of birds to existing high levels of disturbance at Sunny Bay, construction phase activities are anticipated to have only temporary, minor impacts. Similarly, operation phase impacts are anticipated to be minor: birds feeding at Sunny Bay already tolerate noise from the nearby North Lantau Highway and railway. Increased noise disturbance from traffic using the P1 Roundabout and slip-roads would only lead to a small increase in general background noise levels.

Cumulative Impacts

7.69 Other current or planned projects that have potential for direct and/or indirect terrestrial ecological impacts in the assessment area include:

- ♣ Infrastructure for Penny's Bay Development (including remaining sections of Road P1, Sunny Bay Road from Sunny Bay to Penny's Bay, Sunny Bay Public Transport Interchange and Chok Ko Wan Link Road (Penny's Bay Section));
- ♣ Disneyland Resort Line;
- ♣ Yam O Tuk Fresh Water Service Reservoir;
- ♣ Water Mains and Sewerage Works from Siu Ho Wan to Sunny Bay;

♣ Eco-Park on the Luk Keng Headland

- 7.70 Cumulative impacts from these Projects were addressed in the *NLDFS EIA Report*. Provided mitigation measures from the Report are implemented, cumulative terrestrial ecological impacts in the Assessment Area are expected to be minor and acceptable.

Mitigation of Adverse Environmental Impacts

- 7.71 Terrestrial ecological impacts associated with the Project would be extremely limited and minor. Nevertheless, certain measures should be implemented to ensure potential adverse impacts are avoided, minimised and/or compensated for. Measures should include:

- ♣ Placement of equipment or stockpile in designated works areas and access routes selected on existing disturbed land to minimise disturbance to natural habitats.
- ♣ Construction activities should be restricted to the work areas that should be clearly demarcated.
- ♣ The work areas should be reinstated immediately after completion of the works.
- ♣ Waste skips should be provided to collect general refuse and construction wastes. The wastes should be disposed of timely and properly off-site.
- ♣ Drainage arrangements should include sediment traps to collect and control construction run-off.
- ♣ Open burning on works sites is illegal, and should be strictly prohibited.
- ♣ Landscaping works on newly reclaimed land should make use of native plant species.

Evaluation of Residual Impacts

- 7.72 Residual impacts resulting from this Project would be limited to the loss of small areas of low value plantation/wasteland habitat, and increased disturbance in the Assessment Area resulting from traffic on Road P1 roundabout and roads. As described in sections 7.66-7.68, these impacts are considered minor. Residual terrestrial ecological impacts are therefore considered minor.

Environmental Monitoring and Audit

- 7.73 Aside from auditing the implementation of mitigation measures recommended in section 7.71, no specific *EM&A* programme would be required for terrestrial ecology.

Conclusions

- 7.74 The major habitat types within the Assessment Area comprised grass/low shrub mosaic, tall shrubland, secondary woodland, brackish wetland, wasteland, plantation and backshore vegetation. The findings of the *NLDFS EIA Report* were found to be still valid, although some areas of natural vegetation had been developed in relation to recent infrastructure Projects. Most habitats within the assessment area were considered to be of low or low/moderate ecological value.
- 7.75 One plant species with a restricted local distribution (*Thespesia populnea*) recorded in the *NLDFS EIA Report* was found in the Assessment Area during recent surveys. Additionally, a locally common but regionally endangered species (*Diospyros vaccinioides*) was recorded from secondary woodland at Luk Keng Tsuen.
- 7.76 Fauna recorded in the Assessment Area were generally common and widespread species in Hong Kong. Several birds of conservation interest were recorded from Sunny Bay (Little Egret (*Egretta garzetta*), Chinese Pond Heron (*Ardea cinerea*), Collared Crow (*Corvus torquatus*)). The locally

uncommon White-Bellied Sea Eagle (*Haliaeetus leucogaster*) was recorded flying over the Assessment Area.

- 7.77 Direct impacts to terrestrial habitats and species resulting from the Project would be limited to the loss of very small areas of very low-low value habitats. No species or areas of conservation interest would be affected.
- 7.78 Limited indirect impacts to wildlife resulting from construction and operation phase disturbance have been predicted. Given the tolerance of wildlife (particularly avifauna in Sunny Bay) to existing high levels of disturbance, construction phase activities are anticipated to have only temporary, minor impacts. Similarly, operation phase impacts are anticipated to be minor. Existing conditions at the site has shown wildlife at Sunny Bay to be tolerant of noise from the nearby North Lantau Highway and railway.
- 7.79 Potential terrestrial ecological impacts resulting from the Project were found to be minor and acceptable.

Marine Ecological Impact

Assessment Methodology

- 7.80 This second part of the Section presents the results of a marine ecology assessment of impacts resulting from the proposed Project.
- 7.81 The Assessment Area extends 4km from the boundary of the proposed marine works and encompasses the shoreline and waters at and surrounding Luk Keng and Sunny Bay. In this way, it covers along the north Lantau Island coastline as far as Kwai Shek to the east and Shum Shiu Kok to the west. The coastal waters of the eastern portion of North Lantau waters are also included in the Assessment Area.
- 7.82 The marine ecological characteristics of the Assessment Area were elucidated via a review of the literature. This review included relevant marine ecological baseline data presented in the *NLDFS-EIA Report* as well as other reports and publications.
- 7.83 In addition, focused marine ecology surveys were undertaken, where appropriate, to supplement and check the validity of data collected through the literature review process for the Assessment Area. The field surveys covered both the wet and dry seasons and were conducted from September 2002 to January 2003, covering intertidal and subtidal habitats.
- 7.84 A key ecological sensitive receiver identified during surveys conducted in 2002/2003 for this Study was the seagrass bed recorded at Sunny Bay (section 7.114 Refers). To confirm and update information regarding the seagrass bed, an additional seagrass survey was conducted on 25th April, 2005 at Sunny Bay.
- 7.85 Potential ecological impacts arising from the development of the Assessment Areas were assessed following *EIAO TM Annex 16* guidelines and the impacts evaluated based on the criteria in *EIAO TM Annex 8*. During the assessment, particular attention was paid to species of conservation interest identified in the *NLDFS EIA Report* and field survey for this EIA Study.

Baseline Conditions

- 7.86 The Assessment Area was covered in the *NLDFS EIA Report*, and was reported to comprise several broad marine habitat types. These were:
- ♣ Intertidal habitats on hard substrate seashore consisting artificial seawall and natural rocky shore

- ♣ Intertidal habitat on soft substrate seashore consisting sandy shore, mangrove and mudflat areas
- ♣ Subtidal habitats including infaunal benthic assemblages on soft substrate
- ♣ Marine mammal habitat with waters of the Assessment Area forming part of the home range of the Indo-Pacific Humpback dolphin, *Sousa chinensis* (also locally known as the Chinese White Dolphin).

7.87 The Assessment Area for marine ecology impacts of the Project extends 4km from the proposed works boundary which is located on the eastern part of the north coast of Lantau Island. The marine environment in this area is situated within Hong Kong's western waters which is an area dominated by the influence of the Pearl River. This influence is typified by reduced salinity and high turbidity conditions which are most pronounced in the summer wet season. The marine environment of the Assessment Area is therefore regarded as estuarine which has implications on the marine ecology present. Also pertinent to the marine ecology of the Assessment Area is its relative shelter. The coastline in this area is considered to have low to moderate exposure to wave action. Nevertheless strong currents persist within the Assessment Area as water forces through the bottleneck coastal configuration of the neighbouring Kap Shui Mun Channel.

7.88 From the marine ecological perspective, the coastline of the Assessment Area has been much disturbed in recent years due to land reclamation for transport infrastructure for both the Airport and (on-going) Penny's Bay projects. However, relatively undisturbed natural stretches of coast also occur. Representative marine habitat of the Assessment Area is portrayed in [Figure 7.2](#). Baseline information giving the ecological profile of each habitat type within the Assessment Area is provided below.

Artificial Seawalls

7.89 The *NLDFS EIA Report* identified artificial sloping seawall as the dominant intertidal habitat within the Assessment Area. Sloping artificial seawall comprise the majority of the Assessment Area coastline and have been constructed along the North Lantau coastline from Sui Ho Wan to Ta Pang Po and from Sunny Bay to To Kau Wan. According to the *NLDFS EIA Report*, artificial seawalls were of low ecological value and were anticipated to support similar assemblages to natural intertidal shores.

7.90 Owing to the lack of specific ecological data in the literature, a representative section of the sloping seawall within Sunny Bay was surveyed on 25th September 2002 (wet season) and 8th January 2003 (dry season). Survey methodology on this hard shore artificial seawall habitat was quantitative and involved identifying and recording the presence and abundance of sessile and mobile marine biota from five 50cm x 50cm quadrats placed at intervals along 10m long representative transects. These transects were laid at 3 representative tidal heights on the shore to allow characterisation of assemblages in the high, mid and low shore. Survey at different tidal heights was conducted because different intertidal species occur at different vertical positions on the seashore reflecting their ability to withstand exposure to the air and desiccation stress between tides.

7.91 **Table 7.4** presents the survey results. This table shows mean abundance for each species encountered at different tidal heights on the seashore as well as their overall mean abundance.

Table 7.4 Mean density (number of animals per m²) and percentage cover (%) of intertidal flora and fauna at Sunny Bay artificial seawall surveyed in dry and wet seasons

Species /Shore level	WET SEASON (25 th September 2002)				DRY SEASON (8 th January 2003)			
	High	Mid	Low	Overall	High	Mid	Low	Overall
Snails (count)								
<i>Littorina scabra</i>	2.4	-	-	0.8	3.2	-	-	1.1
<i>Monodonta labio</i>	4.8	28.8	8.8	14.1	-	13.6	21.6	11.7
<i>Nodolittorina</i> spp.	8	-	-	2.7	24	20	-	14.6
<i>Nerita yoldii</i>	-	-	-	-	-	-	0.8	0.3
<i>Thais clavigera</i>	-	-	1.6	0.5	-	0.8	7.2	2.7
Mussels (% cover)								
<i>Septifera bilocularis</i>	-	-	-	-	-	-	0.4	0.1%
Limpets (count)								
<i>Notocoema schrenkii</i>	-	-	-	-	-	0.8	-	0.3
Oysters (% cover)								
<i>Saccostrea cucullata</i>	-	-	8.2%	2.7%	-	-	10.6%	3.5%
Sea Slaters (count)								
<i>Ligia exotica</i>	1.6	-	-	0.5	-	-	-	-
Tube Worms (count)								
<i>Hydroides</i> sp.	-	-	2.4	0.8	-	-	-	-
Algae (% cover)								
<i>Kyrtuthrix maculans</i>	12.0%	-	-	4.0%	12.0%	26.3%	5.0%	10.4%
<i>Hildenbrandtia rubra</i>	-	12.8%	6.0%	6.2%	-	20.6%	12.0%	11.7%
<i>Entermorpha</i> tufts	-	-	-	-	-	-	0.4%	0.1%
green biofilm	-	8.6%	-	2.9%	-	25.0%	19.0%	14.7%

7.92 The stretch of seawall surveyed consisted of small to medium sized boulders arranged to make a sloping seawall surface. Rubbish and other debris washed ashore was commonly encountered along the strandline. Fauna occurring on the shoreline were mainly observed in the sheltered crevices between the boulders while encrusting algae were observed on the exposed rock surface. A total of 7 faunal species were encountered in the sampled area of the seashore in the wet season survey compared to 8 in the dry season. Of the species encountered, the herbivorous marine snail, *Monodonta labio* attained the highest abundance and dominated the mid shore of the seawall. Other species were less common and occurred infrequently. On the high shore the Nodolittorinid snails dominated but were encountered in lower numbers in the wet season. Low down on the shore, the rock oyster, *Saccostrea cucullata* was common and typically inhabited the sheltered crevices between boulders. Algal cover was observed to have augmented substantially in the dry season but notably, little erect macroalgae was recorded on the low shore in the survey area. Elsewhere along the sea wall close to the survey location, isolated boulders supporting small growths of macroalgae (*Entermorpha* sp) were observed but were small in extent. Other species noted on the seawall inside the Assessment Area were aggregations of barnacles (*Balanus* sp.) which were noted as occurring on the seawall close to To Ka Wan.

7.93 In summary, field survey findings of the artificial seawall are consistent with the previous findings and evaluation of the NSLDFS EIA Report. Biota found on seawall were of similar species composition to organisms inhabiting nearby natural rocky shore. Species encountered were common, widespread species and typical of semi-exposed rocky shores in Hong Kong. Their abundance was moderate to low and were of low species richness. The ecological value of seawall intertidal habitat was therefore evaluated as low.

Rocky Shore

- 7.94 The *NSLDFS EIA Report* identified rocky shore habitat along the natural shoreline within the Assessment Area. Natural rocky shore is the predominant intertidal habitat at the Luk Keng promontory and along the coast at Kwai Shek.
- 7.95 Quantitative surveys to determine the ecological attributes of the natural rocky shore assemblages within the Assessment Area were previously conducted in September 1998 (dry season) and February 1999 (wet season) at Kwai Shek for the *NSLDFS EIA*.
- 7.96 According to these *NSLDFS EIA* surveys, the faunal composition of rocky shore assemblages at Kwai Shek was highly similar in both the dry and wet season. On the rocky shore were marine snails (*Monodonta labio*, *Nerita albicilla*, *Nodolittorina* spp., *Planaxis sulcatus*, *Thais clavigera* and *Morula musiva*), limpets (*Cellana grata*, *C. toreuma*, *Notoacmaea shrenkii*, *Patelloida saccharina*, *P. pygmea*, *Siphonaria atra* and *S. sirius*), barnacles (*Balanus amphitrite*, *Capitulum mitella* and *Tetriclita squamosa*), bivalves (*Barbatia virescens*), chitons (*Anthopleura japonica*), sea hares (*Aplysia* sp.) and sponges (*Haliclona permollis*). Among these organisms, the herbivorous marine snails as well as chitons, limpets and barnacles were the most commonly encountered.
- 7.97 The typical pattern of seasonal succession on Hong Kong's rocky shore was reflected in the Kwai Shek survey data presented in the *NSLDFS EIA Report*. In the wet season, macroalgae cover was sparse (8.1% cover) and was mainly composed encrusting forms. The five species of macroalgae recorded in this season were *Ralfsia expansa*, *Neogoniolithon misakiense*, *Corallina sessilis*, *Kyrtuthrix maculans* and *Cladophora* sp. In contrast, twelve species of macroalgae were recorded in the dry season. Additional macroalgal species encountered in the dry season that were not encountered in the wet season were mainly erect forms and included *Chaetomorpha antennina*, *Entromorpha linza*, *E. prolifera*, *Ulva fasciata*, *Lygbia* sp., *Sargassum hemiphyllum* and *Ceramium byssideum*. Macroalgal cover at Kwai Shek in the dry season was recorded as 12.2%.
- 7.98 Based on these *NSLDFS EIA Report* surveys, the intertidal rocky shore assemblages of the Assessment Area was considered to be undisturbed by human impact and comprised flora and fauna typical of other semi-exposed rocky shore in Hong Kong. They were therefore assessed to be of medium ecological value.
- 7.99 To verify and supplement the *NSLDFS EIA Report* data on the rocky shore assemblages within the Assessment Area, focused field surveys were conducted to characterise the natural intertidal rocky shore assemblages occurring in proximity to the proposed works boundary (approximately 0.3km away).
- 7.100 This focused survey of the natural rocky shore assemblages was conducted on the southern fringe of Cheung Sok Island facing the proposed works area. This survey site was considered to be broadly representative of natural rocky shoreline at the Luk Keng peninsula. Survey methodology was the same as used to survey artificial seawall. Five 50cm x 50 cm were laid at regular intervals along three, 10m-long transects. These transects were laid parallel to the shoreline and placed at different representative tidal heights, namely the low, mid and high shore. Within each quadrat, sessile and mobile organisms were identified and their abundance determined. These surveys were conducted during the wet season on 25th September 2002 (low tide was 0.75m CD) and in the dry season on 8th January 2003 (low tide was 0.4m CD).
- 7.101 The survey site consisted a weathered granitic rocky shore. This was adjacent to cobble hard substrate shore areas which formed a narrow tidally-exposed tombolo to link Cheung Sok Island to the Luk Keng promontory. Results of the field survey on the natural rocky shore are presented in **Table 7.5**.

Table 7.5 Mean density (number of animals per m²) and percentage cover (%) of intertidal flora and fauna on the natural rocky shore at Cheung Sok Island, Sunny Bay, in dry and wet seasons

Species /Shore level	WET SEASON (25 th September 2002)				DRY SEASON (8 th January 2003)			
	High	Mid	Low	Overall	High	Mid	Low	Overall
Snails (count)								
<i>Monodonta labio</i>	-	51.2	30.4	27.2	-	47.0	15.2	20.7
<i>Nodolittorina</i> spp.	776.6	48.5	-	275.0	484.0	6.0	-	163.3
<i>Nerita albicilla</i>	-	-	9.6	3.2	-	15.0	-	5.0
<i>Nerita yoldii</i>	-	1.6	2.4	1.3	-	6.0	-	2.0
<i>Lunella coronata</i>	-	-	-	-	-	-	0.8	0.3
<i>Chlorostoma rustica</i>	-	-	-	-	-	-	1.6	0.5
<i>Thais clavigera</i>	-	-	-	-	-	0.8	4.8	1.9
Barnacles (% cover)								
<i>Balanus amphitrite</i>	-	-	1.2%	0.4%	-	-	3.8	1.3%
<i>Capitellum mitella</i>	-	1.6%	0.4%	0.7%	-	0.2%	-	0.1%
Limpets (count)								
<i>Collisella dorsuosa</i>	-	-	0.8	0.3	-	-	-	
<i>Siphonaria sirius</i>	-	-	0.8	0.3	-	-	-	
<i>Notocoema schrenkii</i>	-	-	-	-	-	5.6	3.2	2.9
Mussels (% cover)								
<i>Septifer virgatus</i>	-	-	-	-	-	0.2%	0.4%	0.2%
Oysters (% cover)								
<i>Anomia archaeus</i>	-	-	-	-	-	-	0.2%	0.1%
<i>Saccostrea cucullata</i>	-	-	1%	0.3%	-	-	1.2%	0.4%
Sea anemones (count)								
<i>Haliplanella luciae</i>	-	-	-	-	-	-	4	1.3
Crabs (count)								
<i>Hemigrapsus sanguineus</i>	-	0.8	-	0.3	-	-	-	
Algae (% cover)								
<i>Kyrtuthrix maculans</i>	2.0%	2.4%	-	1.5%	5%	3.0%	-	2.7%
<i>Hildenbrandtia rubra</i>	-	4.0%	6.0%	3.3%	-	22.0%	-	7.3%
<i>Enteromorpha</i> sp.	-	-	-	-	-	2.0%	-	0.7%
<i>Ulva lactuca</i>	-	-	-	-	-	-	53.0%	17.7%
<i>Porphyra</i> sp	-	-	-	-	-	-	9.2%	3.1%
green biofilm	-	-	2%	0.7%	-	14.0%	-	4.6%

7.102 During the wet season survey, 10 faunal and 2 encrusting algal species were encountered inside the surveyed area of the rocky shore. Species richness was higher in the dry season with 14 faunal species, 2 encrusting algal species and 3 erect macroalgal species present. Notable features of the rocky shore assemblage were the high abundance of the Nodolittorinid snails (periwinkles) on the high shore. While these snails were highly abundant, they were not evenly spread over the high shore but instead occurred in their hundreds sheltered inside the many narrow crevices that traversed the high shore. On the midshore, the herbivorous snail *Monodonta labio* dominated with the nerites (*Nerita yoldi* and *N. albicilla*) also common. On the low shore, barnacles (*Balanus amphitrite*) and rock oysters (*Saccostrea cucullata*) were frequently encountered. As is typical in Hong Kong, the main seasonal difference on the surveyed rocky shore was the appearance of a relatively high cover of erect macroalgae (seaweed) in the winter dry season on the low shore. These growths were identified as the green alga *Ulva lactuca* which carpeted many exposed boulder and rocky surfaces. Less abundant but also forming patches of dense cover on boulders and rocky surfaces was the brown alga *Porphyra* sp.

7.103 Compared to rocky shore assemblage at Kwai Shek (presented in the *NSLDFS EIA Report*), the rocky shore assemblages at Sunny Bay comprised fewer species (14 faunal taxa compared to 20, 6

algal taxa compared to 12). Furthermore, not all species encountered in the field survey at Sunny Bay were previously recorded at Kwai Shek. In particular, fewer limpet, barnacle and macroalgal species were found on the rocky shore at Sunny Bay. Another difference was that the rocky shore assemblage at Sunny Bay comprised some species not previously recorded at Kwai Shek. These species were the limpet *Collisella dorsuosa*; the marine snails, *Nerita yoldii* and *Chlorostoma rustica*; and the oyster *Amonia archeus*. Nevertheless there was a high degree of similarity between the Sunny Bay and Kwai Shek assemblages with the remaining 10 (out of 14) species at Sunny Bay previously recorded at Kwai Shek. The differences between the rocky shore assemblages at Sunny Bay field survey site and Kwai Shek was not unexpected and was explained by the sheltered nature of Sunny Bay coast compared to the more wave exposed environment at Kwai Shek. Such differences in wave exposure influence intertidal rocky shore ecology in Hong Kong (Morton & Morton 1983). A clear indicator of the more sheltered nature of the Sunny Bay coast was that the rock oyster *Saccostrea cucullata* were observed with black spines radiating from their un-cemented upper valves. This growth form is only found in more sheltered areas (Morton & Morton 1983).

- 7.104 In summary, the ecological profile of natural rocky shore presented in *NSLDFS EIA Report* for the Assessment Area was considered to remain valid with the shoreline at Kwai Shek remaining undisturbed by human activity. Field survey of the natural rocky shore at Sunny Bay supplemented and supported this ecological profile. Based on the information from literature review and field surveys, the assessment on the ecological value of natural intertidal rocky shores within the Assessment Area was considered to remain valid and is regarded as medium.

Sandy Shore

- 7.105 Sandy shore comprises a relatively small portion of the coastline within the Assessment Area. Stretches of sandy shore occur at Yam Tsai Wan and Luk Keng Bay but also occur to a very limited extent in isolated coves on the northwest coast of Kwai Shek bordering the Kap Shui Mun Channel. For the *NSLDFS EIA*, field surveys on sandy shore were conducted in both dry and wet seasons at Yam Tsai Wan. Surveys at this location were conducted by sifting through a total of fifteen 50 x 50 x 50cm sand cores spread along 3 line transects running from the low to high water mark on the sandy shore. According to the *NSLDFS EIA Report*, the sandy shore at Yam Tsai Wan supported assemblages of low diversity and abundance and therefore the ecological value of sandy shore within the Assessment Area was considered to be low.
- 7.106 On 25th September 2002 (wet season) and 19th November 2002 (dry season), sandy shore field surveys were conducted at Luk Keng Bay by taking sand cores using methods as described above. In other words, sand core samples were sieved to determine the presence and identity of sandy shore macrofauna such as burrowing bivalves. Findings of these surveys were consistent with the ecological profile presented in the *NSLDFS EIA Report*. Sand cores taken in both the dry and wet season yielded highly similar results. On the low shore, recovered sand cores contained low abundance of *Tapes philippinarium* bivalves. Visual survey of sandy shore also revealed the amphipod sand hopper, *Orchestia* sp. as frequent on the high shore. In the wet season, a small number of crab burrows were observed at the high shore. These were occupied by the large ghost crab, *Ocyropode cerophthalmus*. A dead cuttlefish (*Sepia pharaonis*) was also observed on the shore. Owing to the low abundance and diversity of biota on the sandy shore, it was considered that the *NSLDFS EIA Report* findings remained valid with sandy shore within the Assessment Area considered to be of low ecological value.

Mangrove

- 7.107 As identified in the *NSLDFS EIA Report*, the Assessment Area supports a small mangrove stand (<0.5ha) at Sunny Bay bounded on its seaward edge an expanse of mudflat. Due to their small size and disturbance associated with the nearby logging works, the mangrove and mudflat habitat at Sunny Bay were both assessed as having low ecological value in the *NSLDFS EIA Report*.
- 7.108 According to the *NSLDFS EIA Report*, mangroves were of moderate floristic diversity and mainly comprised, *Kandelia candel*, *Avicennia marina*, *Excoecaria agallocha* and *Hibiscus tiliaceus*. Species considered to be locally rare identified at the mangrove included the woody climber

Dalbergia candenatensis and pan-tropical weed *Eleocharis geniculata*. Also recorded in the *NSLDFS EIA Report* were species with a restricted distributions in Hong Kong including *Bruguiera gymnorrhiza*, *Lumnitzera racemosa*, *Thespesia populnea* and *Caesalpinia bonduc*. However, based on latest records, all of these species recorded at the mangrove in the *NSLDFS EIA Report* are considered to be restricted in Hong Kong (Xing *et al.* 2000) and are no longer considered rare.

- 7.109 Survey of vegetation at the Sunny Bay mangrove was conducted as part of this EIA Study and yielded similar results to the *NSLDFS EIA Report*. Results are presented in **Table 7.6**. As reported in the *NSLDFS EIA Report*, the mangrove appeared to be in a reasonably good condition.

Table 7.6 Vegetation Survey Results of Mangrove Area at Sunny Bay

Species	Abundance	Growth form	Conservation Status in HK
True Mangroves			
<i>Kandelia candel</i>	Occasional	Tree	Very common
<i>Aegiceras corniculatum</i>	Frequent	Shrub	Common
<i>Bruguiera gymnorrhiza</i>	Scarce	Tree	Restricted
<i>Excoecaria agallocha</i>	Occasional	Tree	Common
<i>Lumnitzera racemosa</i>	Scarce	Tree	Restricted
Mangrove Associates			
<i>Hibiscus tiliaceus</i>	Occasional	Tree	Common
<i>Thespesia populnea</i>	Scarce	Tree	Restricted
<i>Clerodendrum inerme</i>	Occasional	Shrub	Common
<i>Cerbera manghas</i>	Occasional	Tree	Common
Other Species			
<i>Derris trifoliata</i>	Occasional	Climber	Common
<i>Canavalia maritima</i>	Occasional	Climber	Common
<i>Cryptolepis sinensis</i>	Occasional	Climber	Common
<i>Ipomoea brasiliensis</i>	Occasional	Climber	Exotic, common
<i>Macaranga tanarius</i>	Occasional	Tree	Very common
<i>Scolopia chinensis</i>	Occasional	Tree	Common

- 7.110 According to the survey results, mangrove vegetation was mainly comprised of common or very common true mangroves including *Aegiceras corniculatum*, *Kandelia candel* and *Excoecaria agallocha*. Scarce in the mangrove at Sunny Bay were the true mangroves *Bruguiera gymnorrhiza* and *Lumnitzera racemosa*. These species are both regarded as having a restricted distribution in Hong Kong. Although found at a number of locations, *Bruguiera gymnorrhiza* occurs in low abundance in Hong Kong mangroves. *Lumnitzera racemosa* on the other hand is only known in mangroves at Tolo Harbour and Sha Tau Kok. Other vegetation included common mangrove associates namely *Hibiscus tiliaceus*, *Clerodendrum inerme* and *Cerbera manghas* as well as the restricted *Thespesia populnea*. Also recorded were other species which included trees and climbers commonly found at coastal areas. The restricted woody climber *Dalbergia candenatensis* and pan-tropical weed *Eleocharis geniculata* were not recorded during the vegetation survey for this study.

- 7.111 In summary, the survey of the Sunny Bay indicates that the ecological profile of the mangrove is similar to that presented in the *NSLDFS EIA Report*.

Mudflat

- 7.112 Associated with the mangrove is the remaining small sandy/silty mudflat. A portion of this was previously reclaimed over for construction of the North Lantau Expressway and Airport Railway. *NSLDFS EIA Report* field survey results indicated that the mudflat (approximately 2.5 ha) supported mud snails including ceriths (*Cerithidea rhizophorum*), nerites (*Clithon faba*) and potamids (*Batillaria multiformis* and *Terebralia sulcata*). Fiddler crabs (*Uca lactea*), mudskippers (*Periophthalmus cantonensis*), snails (*Lunella coronata*) and rock oysters (*Saccostrea cucullata*) on cobbles were

also recorded as common. In the *NSLDFS EIA Report*, no seagrasses were recorded on the mudflat and owing to human disturbance this mudflat was considered to be of low ecological value.

- 7.113 Qualitative survey of the mudflat to verify its ecological profile presented in the *NSLDFS EIA Report* was conducted on 25th September 2002, 18th November 2002 and 8th January 2003. Mudflat fauna was similar to that reported in the *NSLDFS EIA Report*. Common species on the mudflat were *Batillaria multiformis*, *Terebralia sulcata* and *Cerithidea rhizophorum*. The oyster *Saccostrea cucullata* was also common and encrusted many of the cobbles. The hermit crab *Clibanarius* sp. was also common and found inhabiting mud snail shells. Less common were the snails *Lunella coronata*, *Planaxis sulcata* and *Clithon faba*. Rarely observed were juvenile mudskippers (*Periophthalmus cantonensis*), while a single stranded jelly (*Stomolophus meleagris*) was also encountered on the mudflat. *Nodolittorina* spp and *Monodonta labio* were also observed on isolated large boulders or rocky outcrops, while the snail *Nerita yoldii* was common on cobbles beneath the mangrove. Within the canopy of the mangals, *Littorina scabra* and *Littorina melastoma* were infrequently encountered.
- 7.114 During surveys conducted in 2002/03, an extensive seagrass bed covering an area of at least 0.8ha was recorded at Sunny Bay. This bed was formed by a dense cover of the Spoon Grass *Halophila ovalis* (sometimes called Paddle Grass and synonymous with *Halophila minor*). The seagrass appeared to be in good condition with new growth appearing as sparsely arranged leaves fringing the dense beds. It was noted that the plants with the largest leaf size and thickest rhizomes tended to occur at the low tidal levels of the bed. In addition it was observed that most of the substrate on which the seagrass was growing was very soft mud which was black and anoxic beneath the surface and with a hydrogen sulphide odour.
- 7.115 During additional surveys conducted in April 2005, no seagrass was observed growing on the Sunny Bay mudflat. The reason for the apparent disappearance of the seagrass cannot be specified categorically. However, the following two points are considered of relevance:
- ♣ *Halophila ovalis* is a short-lived annual plant that relies heavily on seeding for year-to-year survival and therefore often disappears completely over a short period of time but reappears in the next growing season. This cycle of disappearance and re-growth of *H. ovalis* seagrass beds is repeated each year in Hong Kong (Fong 2000). It is therefore possible that although no adult plants were recorded from Sunny Bay during the April 2005 survey, the mudflats may still retain seagrass seeds that would germinate at a later date.
 - ♣ Changes in the environmental characteristics of Sunny Bay between the surveys conducted in 2003 and those conducted in 2005 could be responsible for the disappearance of the seagrass bed. Although this is a possibility, it should also be noted that *H. ovalis* is an opportunistic, pioneer r-strategist that can rapidly colonise suitable areas in a short time due to its high fecundity and rapid rhizome extension rates (Fong 1998, 1999, 1999b). It is therefore probable that, if environmental changes were responsible for the seagrass disappearance, *H. ovalis* would rapidly recolonise Sunny Bay if and when conditions once again become suitable.
- 7.116 In light of the points noted in the previous section, it is considered entirely possible that seagrasses would re-establish in Sunny Bay at some point in the future. Indeed, this appears to have happened previously at Sunny Bay. Whereas an extensive seagrass bed of 0.8ha was recorded in 2002/2003, no seagrass was recorded from the site during earlier surveys conducted in 1998 and 1999 for the *NSLDFS EIA Report*.
- 7.117 Geographically, *Halophila ovalis* has a wide distribution which is centered around the South China Sea. Its distribution also extends through Indonesian waters to northern Australia. Its occurrence in Hong Kong is at the most northerly extent of its distribution. Nevertheless, seagrasses are considered to be in decline globally (Walker & McComb 1992).
- 7.118 *Halophila ovalis* is considered to be the most abundant of the 4 species of seagrass recorded in Hong Kong (Lee 1994, 1997, Kwok *et al.*, 2005). Nevertheless, this species was considered rare by

Xing *et al.* (2000) and was thought to be in decline in Hong Kong, with populations of *Halophila ovalis* having a fragmented distribution (Fong 1999). Until very recently, *Halophila ovalis* beds were only known from 3 locations in HKSAR (Fong 1999). However, a recent AFCD study has recorded this species at a total of 13 sites (Kwok *et al.*, 2005): it is much more common than previously thought. Kwok *et al.* (2005) have noted that *Halophila ovalis* has performed well at the sites where it has been found, and is perhaps more tolerant of pollution and other sources of disturbance than other seagrass species occurring in Hong Kong.

- 7.119 Although still relatively common in Hong Kong, *Halophila ovalis* would appear to have been much more widespread in the past. Older records of seagrasses in Hong Kong indicate *Halophila ovalis* once occurred on the sheltered flats at Deep Bay, Tai Tam, Three Fathoms Cove and Hoi Sing Wan (Starfish Bay) in Tolo Harbour (Morton & Morton 1983, Fong 1999b) but these are now gone (Fong 1999). Although there are no definite records, it is also believed that Sha Tin, Tai Po and Plover Cove once had large seagrass beds associated with mangrove stands, but were lost due to reclamation and reservoir construction (Fong 1999b).

Subtidal Benthos

- 7.120 Soft substrate comprising silty/clayey mud is the major subtidal habitat within the Assessment Area. Owing to recent and ongoing dredging and reclamation projects (associated with the Airport and Penny's Bay infrastructure works), this habitat was considered to be much disturbed. For the *NSLDFS EIA Study*, sampling of benthic infauna was not conducted within this Study's Assessment Area. However, subtidal areas in the Assessment Area along the west coast of Kwai Shek were previously surveyed by dive survey for HyD (2002a) for *Route 10* in March 2002. Hard substrate at Kwai Shek was restricted to thin strip of boulders and bedrock a few meters from shore while about half the surveyed area comprised silt/mud. Fauna on the hard substrate were extremely scarce but included very limited numbers of Bryozoa (including *Bugula* spp.), barnacles (including *Balanus* spp.) and common gorgonian seawhips (*Guaiaogorgia* sp.). These gorgonians were in a poor condition with high partial mortality presumably due to pollution. Similarly, the benthos soft substrate appeared to support little marine life with only small patches of cyanobacterial mats on the sediment surface observed.
- 7.121 To verify the ecological profile of this habitat a benthic grab survey conducted on 28th October 2002 with results supplemented by literature review. The grab survey location was within the area that would be reclaimed under the Project.
- 7.122 The benthic community was surveyed by retrieving 5 replicate sediment grab samples. Each replicate sample consisted mud from 0.1m² of the seabed and were obtained by deploying a van Veen grab. To collect the organisms present from within the mud, samples were then sieved through 0.5 mm sieves. The collected organisms were preserved and stained using 70% formalin and rose bengal before being identified and counted. Identification of the benthic organisms was conducted to the lowest practicable taxon.
- 7.123 The co-ordinates of the sampling site was 22° 19.792`N and 114° 01.527`E. Two out of the five replicates contained no biota. A total of 4 individuals from 3 species were collected in the sampling. The species composition, biomass, and species richness recorded are provided in **Table 7.7**.

Table 7.7 Benthos in 5 replicate sediment grabs from Sunny Bay.

Phylum/Class/Family	Species	Numerical abundance	Biomass (g)
ANNELIDA			
Polychaeta			
Lumbrineridae	<i>Lumbrineris nagae</i>	1	0.05
	<i>Lumbrineris</i> sp.	2	0.02
Nephtyidae	<i>Nephtys oligobranchia</i>	1	0.01

- 7.124 No rare species was found in the samples. Polychaetes were the only fauna in the grab samples collected. The number of species in each sample was very low. None of them exceed 2. Diversity index (H') of the pooled data of all replicates was 1.04 and Evenness index (J) was 0.75. In terms of species number and diversity index, the benthic fauna was not diverse. The density of organisms and average biomass were also very low, i.e. 8 individuals/m² and 0.16 g m², given that only 4 organisms were found in 5 samples.
- 7.125 *Nephtys oligobranchia* belongs to the family Nephtyidae. Members of this family have elongated and flattened bodies and the parapodia are in bi-lobe form. The distribution range of this species covers India, Vietnam, South China Sea, East Sea and Yellow Sea of China (Yang & Sun 1988). It was also recorded in Deep Bay in a recent benthic survey for Shenzhen Western Corridor (HyD 2002b).
- 7.126 *Lumbrineris nagae* belongs to the family Lumbrineridae. Members of this family have slender bodies. Parapodia are in single-lobe form. This species distributes in Vietnam and South China Sea (Yang & Sun 1988). The western waters of Hong Kong supports assemblages that are polychaetes dominated (Shin & Thompson 1982). In general, species diversity of benthos at locations near North Lantau was ranked as intermediate, while the mean number of individuals (107.1 individual/m²) was higher than the average for Hong Kong (101.4 individual/m²) but the mean biomass (23.9 g m²) was lower than the average for Hong Kong (35.2 g m²) (*ibid.*).
- 7.127 PAA (1991) reported the results of grab-samples at sites some 8 km north-east of Tai O for the Chek Lap Kok airport EIA. They concluded that the heterogeneity of sediment types and depths promoted high species richness and abundance of sublittoral infauna. Echinoderms were found to be the exception to the trend of high fauna diversity, presumably due to the freshwater influence of the Pearl River and the resulting low salinity. Two species new to science were reported. Dominant benthic species were found to be similar in many cases to those reported for the 1978/79 period by Richards and Wu (1985). In the report submitted to PAA, it was concluded that the sublittoral benthos near Chek Lap Kok and The Brothers Islands was a good example of that expected in Hong Kong coastal waters.
- 7.128 The Study on Tonggu Waterway also provided benthic data for the waters in Northwest Lantau (CED 1998a). Benthic grab sampling was conducted bimonthly over 12 months (*ibid.*). Benthic samples at all stations were dominated by 3 groups - molluscs, polychaete worms, and crustaceans - which constituted over 80% of all species recorded (CED 1998b). The bivalve *Potamocorbula laevis*, an estuarine species, constituted over 60% of total abundance and roughly 50% of total biomass (*ibid.*). Total numbers of species recorded ranged from 54 to 69, and total number of individuals from 1,102 to 1,687 (*ibid.*), which represented benthic fauna densities ranging from 62.6 to 818.0 individuals/m². Species recorded are common benthic infauna species of the South China Sea (*ibid.*). Higher diversity was suggested to be due to greater stability of environmental conditions (lower influence from the Pearl River).
- 7.129 The benthic survey at Penny's Bay conducted for Northshore Lantau Development Feasibility Study recorded an average biomass of 30.21 g m² (CED 2000). The dominant fauna groups recorded were also Annelida and Arthropoda.
- 7.130 Comparing the results of the present study with those from other studies in the western waters, it showed that the infauna density and average biomass were very low in the present reclamation site. The density of infauna and the average biomass in the proposed reclamation site were only approximately 7.5% and 0.45% of the Hong Kong averages respectively. Furthermore, the value of Diversity index H' was low (only around 1), and all species recorded were contributed by only one faunal group (Polychaete).
- 7.131 To conclude, the findings of the grab survey indicated that the benthic infauna was dominated by polychaetes, as is typical of polluted environment in Hong Kong in general. The ecological value of this habitat was considered to be low.

Marine Mammal Habitat

- 7.132 As identified in the *NSLDFS EIA Report*, the waters of the Assessment Area form part of the home range for the Indo-Pacific Humpback dolphin, *Sousa chinensis* (also known as the Chinese White Dolphin). By contrast, the Assessment Area does not appear to be marine mammal habitat for the Finless Porpoise, *Neophocaena phocaenoides*. The Finless Porpoise is the only other resident cetacean of Hong Kong but has not been reported in the Assessment Area waters.
- 7.133 *Sousa chinensis* is of high conservation importance. In Hong Kong, this dolphin species, like all cetaceans, is afforded protection by the Wild Animals Protection Ordinance and the Animals and Plants (Protection of Endangered Species) Ordinance. This species is also CITES Appendix 1 listed and is catalogued in the IUCN Red Data Book.
- 7.134 The regional population of *Sousa chinensis* is centered around the Pearl River Estuary and has been estimated at over 1000 individuals (Jefferson 1998, 2000). At any one time, there are estimated to be between 81 and 144 dolphins present within Hong Kong's waters, depending on season (Jefferson 2002).
- 7.135 The range of *Sousa chinensis* extends across all Hong Kong western waters and includes nearly the entire North Lantau area. The area north of Lantau Island is considered the most important habitat for this species in Hong Kong. According to the latest estimates, these waters have a dolphin abundance of 91 in summer, 67 in autumn, 72 in winter and 42 in spring (Jefferson 2002). Dolphins are most frequently sighted in the areas north and west of Lantau Island up to Deep Bay (Jefferson 1998, 2000) but are most common in the western waters north of the new airport at Chek Lap Kok (Jefferson 1998, 2000, AFCD unpublished data). A recent trend has also been detected indicating dolphins are more frequently utilising areas close to the Brothers Islands (Jefferson 2002). Further to the east of the Brothers Islands, North Lantau waters appear to be less frequently utilized.
- 7.136 The *NSLDFS EIA Report* identified North Lantau waters as being by far the most important and heavily used habitat for *Sousa chinensis* in Hong Kong. However, it was considered that the waters of the Assessment Area, which comprise the eastern section of North Lantau waters, supported a low abundance of dolphins (mainly in Autumn) and were not critical habitat for these species. The *NSLDFS EIA Report* rated the ecological value of marine mammal habitat in the Assessment Area for *Sousa chinensis* as medium.
- 7.137 **Figure 7.3** illustrates the location of dolphin sighting in different 'seasons' over a nine-year period (1995-2004) in the vicinity of the Assessment Area incorporating the most recent sighting data from AFCD (with permission). This data supports the assessment provided in the *NSLDFS EIA Report* that it appears that dolphins are most frequently sighted in these waters in autumn. While the Assessment Area does not extend as far as the Brothers Islands, nevertheless, it incorporates a portion of the area surrounding these islands. Because of a recent trend for increased dolphin abundance in this area (Jefferson 2002), it appears that part of the Assessment Area may be utilised more frequently by dolphins than was previously reported in the *NSLDFS EIA Report*. It was also noted that dolphins have not been recorded approaching closer than approximately 1km to shore along the Sunny Bay to To Kau Wan coastline or inside Sunny Bay where project works would take place.

Ecological Value

- 7.138 In accordance with the EIAO TM *Annex 8* criteria, the ecological importance of recorded habitats has been evaluated in **Tables 7.8a-7.8d** below.

Table 7.8a Ecological Value of artificial seawall and rocky shore within the Assessment Area

Criteria	Artificial Seawall	Rocky Shore
Naturalness	Man-made habitat is disturbed by human activity.	Rocky shore is relatively undisturbed by human impact.
Size	Majority of coastline in the Assessment Area is artificial seawall extending from Luk Keng Tuk to To Kau Wan and west of Ta Pang Po.	Rocky shore at Luk Keng and at Kwai Shek comprise about 4km of coastline.
Diversity	Field surveys found assemblages of low diversity.	The intertidal communities are typical of semi-exposed rocky shores in Hong Kong.
Rarity	No species recorded were considered rare.	No species recorded are considered rare.
Recreatability	The habitat is man-made and recreatable.	The habitat can be recreated.
Fragmentation	Not applicable.	The habitat is not fragmented.
Ecological linkage	The surrounding coast along North Lantau contains similar habitats.	The surrounding habitat contains similar intertidal habitats.
Potential value	None identified.	It is unlikely that the rocky shore can develop conservation interest.
Nursery ground	None identified.	None identified.
Age	Seawall was recently constructed and was about 5 years old.	Not applicable.
Abundance/ Richness of Wildlife	The abundance of intertidal organisms was low in comparison with nearby natural rocky shore habitat.	Field survey and literature review indicate assemblages are typical of semi exposed shores in Hong Kong.
Ecological value	Low.	Medium.

Table 7.8b Ecological Value of sandy shore and mangrove in the Assessment Area

Criteria	Sandy Shore	Mangrove
Naturalness	Sandy shores are undisturbed by human impact	Mangrove was disturbed by construction of North Lantau Expressway and Railway and through log storage works but appeared to be in a reasonably good condition.
Size	Small stretches of sandy shore occur at Yam Tsai Wan Luk Keng Bay and to an even lesser extent at Kwai Shek	Mangrove is at Sunny Bay and is small in size (<0.5ha).
Diversity	Field surveys indicate low diversity.	Moderately diverse floristic composition compared with other mangroves in Hong Kong.
Rarity	No species recorded are considered rare.	No species recorded are considered rare. Restricted plants at the mangrove were <i>Brugeria gymnorrhiza</i> , <i>Lumnitera racemosa</i> and <i>Thespesia populnea</i> .
Re-creatability	The habitat can be re-created.	The habitat can be re-created.
Fragmentation	There are relatively few other similar habitats in the surrounding environment.	The surrounding environment contains few similar habitat.

Criteria	Sandy Shore	Mangrove
Ecological linkage	Sandy shore is not functionally linked to any highly valued habitat in close proximity in a significant way.	The mangrove is structurally and functionally linked to adjacent areas of mudflat.
Potential value	Unlikely to develop conservation interest.	The mangrove can develop conservation interest.
Nursery ground	None identified.	Mangrove are reported to be nursery for many species.
Age	Not applicable.	Unknown. The mangroves appeared mature and in reasonably good condition.
Abundance/ Richness of Wildlife	Low.	Abundance was moderate given the small size of the habitat.
Ecological value	Low.	Low.

Table 7.8c Ecological Value of Mudflat and Subtidal Benthos within the Assessment Area

Criteria	Mudflat	Subtidal Benthos
Naturalness	Habitat previously disturbed by construction of Expressway and Railway and is disturbed through the log storage works. During field survey, much wood debris was encountered particularly on the low shore.	Assemblages were disturbed by past and on-going reclamation works.
Size	Mudflat at Sunny Bay cover approximately 2.5ha.	3ha of subtidal habitat would be lost due to the Project.
Diversity	Fauna were of low species diversity.	Subtidal habitat that would be lost in the Project supports benthic assemblages of very low diversity. Only 3 polychaete species were found.
Rarity	Faunal species were typical of mudflats in Hong Kong. An extensive seagrass bed comprised of <i>Halophila ovalis</i> was previously recorded from the mudflat. Known seagrass beds/patches of this species are currently exist at 12 other localities in Hong Kong.	No species considered rare were encountered during field survey.
Re-creatability	Seagrass bed could possibly re-establish at some point in the future.	The habitat cannot be recreated.
Fragmentation	The habitat is not fragmented.	This habitat is not fragmented and is the most common subtidal habitat type in Hong Kong.
Ecological linkage	The mudflat is structurally and functionally linked to adjacent areas of mangrove.	The surrounding habitat contains many other areas of soft substrate.
Potential value	Seagrass bed could possibly re-establish at some point in the future. Potential value is therefore high.	Unlikely that this site can develop conservation interest.
Nursery ground	Mudflats are reported to provide nursery habitats for many species.	None identified.
Age	Not applicable	Not applicable.

Criteria	Mudflat	Subtidal Benthos
Abundance/ Richness of Wildlife	Low-moderate.	Field survey indicated benthic fauna were in extremely low abundance.
Ecological value	Moderate-high.	Low.

Table 7.8d Ecological Value of Marine Mammal Habitat within the Assessment area

Criteria	Marine Mammal Habitat
Naturalness	Disturbed as a result of commercial fishing activities and busy shipping lanes.
Size	Large.
Diversity	Assessment area lies near the easterly extent of <i>Sousa chinensis</i> ' home range. No <i>Neophocaena phocaenoides</i> have been sighted in this area.
Rarity	<i>Sousa chinensis</i> is a species of conservation importance.
Re-creatability	This habitat cannot be recreated.
Fragmentation	Marine mammal habit is not fragmented.
Ecological linkage	Preferred marine mammal habitat occurs to the west of this area.
Potential value	Limited due to heavy marine traffic and general disturbance from human activity.
Nursery ground	Non identified.
Age	Not applicable.
Abundance/ Richness of Wildlife	North Lantau waters are heavily utilised year round by <i>Sousa chinensis</i> .
Ecological value	Medium.

- 7.139 Based on the ecological conditions presented in the above sections, it is considered that artificial seawall, sandy shore, subtidal benthos and mangrove habitats within the Assessment Area have low ecological value. Habitats of moderate ecological habitat were natural rocky shore and marine mammal habitat.
- 7.140 The mudflat at Sunny Bay was considered of moderate-high ecological value due to previous records of seagrass from this habitat. It is considered possible that a seagrass bed will re-establish at Sunny Bay at some point in the future.
- 7.141 In accordance with the *EIAO TM Annex 8* criteria, the species of conservation interest are evaluated in **Tables 7.9a** and **7.9b** below.

Table 7.9a Evaluation of Floral Species of Conservation Interest within Assessment Area

Species	Growth Form	Location	Protection Status	Distribution	Rarity
<i>Brugeria gymnorhiza</i>	tree	Sunny Bay mangrove	Not protected	Many mangroves in Hong Kong but with low abundance	Restricted
<i>Lumnitera racemosa</i>	tree	Sunny Bay mangrove	Not protected	Tolo Harbour, Sha Tau Kok	Restricted
<i>Halophila ovalis</i>	herb	Sunny Bay mudflat	Not protected	Known from 12 other sites in Hong Kong	Rare previously but now is much more common

Note: evaluation of *Thespesia populnea* was previously provided in **Table 7.2a**.

Table 7.9b Evaluation of Faunal Species of Conservation Interest within Assessment Area

Species	Location	Protection Status	Distribution/Rarity	Conservation Status**
<i>Sousa chinensis</i> , Indo-Pacific Humpback dolphin	Coastal waters off North Lantau	Wild Animals Protection Ordinance	North Lantau, South Lantau, East Lantau, Lamma, Deep Bay and Ling Ding Bay	CITES Appendix 1. Listed as data deficient in IUCN Red Book

Identification of Ecological Impacts

7.142 Impacts to marine ecological resources may arise during the construction phase of the Project. The impacts may result from direct disturbance of habitats and indirect disturbance through changes in key water quality parameters.

Construction Phase

Direct Impacts

7.143 The potential direct impacts on marine ecology arising from the construction activities may include:

- ♣ Loss of an approximately 0.5km stretch of sloping artificial seawall habitat due to reclamation.
- ♣ Loss of subtidal benthic habitat due to dredging and reclamation on 3ha of seabed.

Indirect Impacts

7.144 Potential indirect construction phase impacts may include:

- ♣ Sedimentation impacts on seagrass (if present in the future) due to release of sediments into the water column during dredging.
- ♣ Impacts on dolphin feeding resources due to perturbations to water quality due to increased SS levels.
- ♣ Potential disturbance to dolphins due to underwater noise

- ♣ Potential disturbance or injury to dolphins due to marine traffic

Operation Phase

Direct Impacts

- 7.145 No direct impacts to marine ecological sensitive receivers are anticipated from operation of the Road P1 advance works.

Indirect Impacts

- 7.146 No indirect impacts to marine ecological sensitive receivers are anticipated from operation of the Road P1 advance works.

Cumulative Impacts

- 7.147 Advanced works carried out under this Project would be followed by the planned construction of the remaining sections of Road P1 between Sunny Bay to Siu Ho Wan, to the west of the works area. The design of the further westward extension of the future Road P1 would be examined under a separate EIA Study and is likely to require refinement during the detailed design of Road P1 due to potential impacts the Sunny Bay mudflat, which has the potential to support seagrass. Refinement of design may include adopting elevated road structure before entering into the tunnel section of future Road P1 instead of further reclamation.

Assessment of Ecological Impacts

- 7.148 Potential ecological impacts to habitats in the Assessment Area resulting from the current Project have been evaluated according to *Table 1 of Annex 8 of the EIAO TM*.

Direct Impacts

Artificial Seawall

- 7.149 The proposed reclamation would lead to the direct loss of approximately 0.5km of sloping artificial seawall. Given the low ecological importance of this habitat and the fact that this loss would be partially compensated by the construction of 450m of vertical seawall and 100m of sloping seawall, a very limited impact is expected (**Table 7.10a** refers).

Table 7.10a Overall Impact Evaluation for Artificial Seawall

Evaluation Criteria	Artificial Seawall
Habitat quality	Habitat quality is low.
Species	No direct impact to species of conservation interest.
Size/Abundance	Approximately 0.5km of sloping artificial seawall would be lost.
Duration	Seawall loss would occur during construction phase.
Reversibility	Permanent loss of seawall habitat will be partially compensated by construction of new vertical and sloping seawalls. These new seawalls would be available for colonisation by intertidal organisms.
Magnitude	The scale of the impacts is considered low.
Overall impact conclusion	Low.

Subtidal Benthic Habitat

- 7.150 Dredging and subsequent reclamation would result in the permanent loss of approximately 3ha of subtidal habitat. Surveys indicate that this habitat has been disturbed by recent and on-going reclamation works at Sunny Bay and supports benthic assemblages of low abundance and diversity. Given the disturbed nature and low ecological value of this habitat, its loss is not expected to be significant (Table 7.10b refers).

Table 7.10b Overall Impact Evaluation for Subtidal benthos

Evaluation Criteria	Subtidal benthos
Habitat quality	The habitat quality is low.
Species	No direct impact to species of conservation interest.
Size/Abundance	Loss of approximately 3ha of seabed.
Duration	Loss of habitat would be permanent.
Reversibility	This habitat cannot be recreated.
Magnitude	The scale of the impact is considered low.
Overall impact conclusion	Low.

Indirect Impacts

Mudflat

- 7.151 If seagrass beds of *H. ovalis* have re-established in Sunny Bay before or during the construction phase, the plants could be indirectly affected by water quality impact, particularly siltation resulting from dredging. High turbidity may reduce light availability and hence subdue growth of seagrasses, cause die-back and potentially threaten their survival at a site (Lee 1994, 1997). In addition, spates of very high sedimentation such as a few centimetres of deposited material due to dredging may bend and then lead to complete burial of *H. ovalis* shoots, leaves and stems (Stephan *et al.* 2000). Once buried, *H. ovalis* may disintegrate within 24 hours (*ibid.*).
- 7.152 Indirect impacts on seagrasses including *H. ovalis* by high sediment levels in the water column have previously been documented in Hong Kong. During the peak construction period of the international airport at Chek Lap Kok airport, unmitigated dredging activity caused suspended sediment levels in the water at the seagrass beds to reach as high as 1,000 mg dry wt. L⁻¹ at the nearby seagrass beds at San Tau (Lee 1994). Prolonged exposure to very high suspended sediment levels caused *H. ovalis* beds at San Tau to suffer significant reduction in 1992 and by 1995 most of the plants had died (Fong 1999b).
- 7.153 Such severe impacts are not expected during the proposed reclamation works for Road P1. With mitigation by deployment of silt curtains and implementation of other water quality mitigation measures, impacts to any seagrass in Sunny Bay are anticipated to be minor. According to the works programme, dredging would be relatively short in duration (April to July) but may coincide with the peak flowering period of the species (late spring to summer). According to calculation of worst-case sediment levels (see Section 5.44 and Table 5.4), suspended sediment concentrations over seagrass bed would be in compliance with WQO standards.
- 7.154 The previous seagrass bed recorded at Sunny Bay lies in the intertidal zone at a distance of between 300m and 500m from the nearest point of the proposed reclamation area. If seagrass re-establishes in the same area, it would experience an elevation in suspended sediment of between 2.3 mg L⁻¹ and 3.9 mg L⁻¹ (when submerged by the tide) which is within the WQO standard on allowable SS elevation (Section 5 refers). This elevation is also of lower magnitude than natural variations in ambient suspended sediment levels at Sunny Bay based on EPD monitoring station

NM1 data. Therefore, it is expected that any *H. ovalis* present would be tolerant of the minor elevation in suspended sediment associated with the Project. Also, no burial would occur at these sedimentation levels.

- 7.155 The tolerance of *H. ovalis* is derived from its ability to grow and spread rapidly and its ability to survive under low light intensity. Indeed, from the literature it was reported that *H. ovalis*, unlike many other seagrass species, may be considered to be tolerant of disturbance (e.g AIMS 2002). Furthermore, Birch & Birch (1984) suggested that the presence of the pioneering coloniser *H. ovalis* in quantity may be evidence of past disturbance of a site. This was echoed by Josselyn *et al.* (1986: cited in Fonesca *et al.* 1998) and Fonesca (2002) who reported that *Halophila* spp. often colonises disturbed areas rapidly and requires relatively little light to grow.
- 7.156 Although impacts are anticipated to be minor, it may also be worth noting that *H. ovalis* appears to be capable of strong recovery following exposure to high suspended sediment levels. Experience of impacted *H. ovalis* beds in Hong Kong near the new airport, indicated that following the completion of construction works, *H. ovalis* not only recolonised San Tau but it also extended its presence in many small patches across Tung Chung Bay after only a short period of time (Fong 1999a, 1999b). Similarly, its ability to rapidly expand its cover was also noted by Fong (1999b) at Sheung Sze Wan where *H. ovalis* expanded from several small patches covering 10m² to about 1 ha within only 1 year. Fong (1999b) speculated that reoccurrence of this seagrass at Sheung Sze Wan may have coincided with completion of nearby land-based construction activities.
- 7.157 A summary of impacts on the mudflat, including an evaluation of impacts to any seagrass that may be present, is presented in **Table 7.11c**. Impacts on any *H. ovalis* seagrass present are anticipated to be minor and environmentally acceptable.

Table 7.10c Overall Impact Evaluation for Mudflat

Evaluation Criteria	Mudflat
Habitat quality	The habitat quality is moderate-high.
Species	No direct impact to any <i>Halophila ovalis</i> that could be present is anticipated.
Size/Abundance	No direct impact
Duration	Dredging would be relatively short (about 3 months), but may coincide with the peak flowering period of any <i>H.ovalis</i> present in Sunny Bay.
Reversibility	<i>H. ovalis</i> is a good coloniser and can expand its cover rapidly. Impacts to any <i>H. ovalis</i> present are therefore considered reversible.
Magnitude	Elevation of suspended sediment levels in Sunny Bay would be minor and of lower magnitude than natural variation in ambient conditions. Suspended solid level during construction phase would be in compliance with the WQO standard. The scale of the impact is considered low.
Overall impact conclusion	Low.

Marine Mammal

- 7.158 Potential indirect impacts on dolphins may result from increased SS levels and the effects on feeding resources. Locally, studies have shown *Sousa chinensis* feed primarily on fish (Jefferson 1998). Based on information from fisheries impact assessment (Section 8), impacts on dolphins through loss of feeding resources due to elevated SS and small loss of sea area are not anticipated because impacts on fisheries resources are considered low and acceptable.
- 7.159 Dolphins use ultrasonic pulses for echolocation of prey and navigation and communication (Jefferson, 2000). Noise disturbance that disrupts these abilities may lead to behavioural changes and may be potentially harmful. There is evidence to suggest that cetaceans may minimise its use of areas affected by underwater noise. Cetaceans can detect noises associated with vessels similar to dredgers at distances up to approximately 5 km. In HKSAR, cetaceans are protected under the Wild

Animals Protection Ordinance (Cap. 170), 1980 and so any lethal and sublethal impacts due to underwater noise associated with the Project will be deemed unacceptable.

- 7.160 It is unlikely that general construction activities such as dredging and movement of dredging vessels would cause problems for dolphins due to noise. Dredging and large vessels generate low frequency noise (typically 0.02-1 kHz) which is below the peak range used by dolphins (Richardson *et al.* 1995). No unacceptable adverse impact on dolphins from these construction activities was therefore anticipated. Furthermore, dolphins have not been sighted closer than 1km to the shore from the coastline where reclamation would take place.
- 7.161 Marine traffic also poses physical dangers to dolphins. Locally, the small cetaceans including *Sousa chinensis* have been found to have been killed or injured by vessel collisions (Parsons & Jefferson 1997). Locally, this appears to be one of the most significant impacts on dolphins. In addition, vessel passes and noise can cause behavioural disturbance to these animals. A moderate increase in the number of large, slow-moving (less than 10 knots) vessels in the area should not cause a significant impact to dolphins. Smaller faster out-board driven boats would pose a bigger threat because of their faster approach speed and greater potential for high frequency noise. However it is not anticipated that vessels associated with the Project would be of the latter type. A summary of impacts on marine mammal habitat is presented in **Table 7.10d**.

Table 7.10d Overall Impact Evaluation for Marine Mammal Habitat

Evaluation Criteria	Marine Mammal Habitat
Habitat quality	The habitat quality is moderate.
Species	The Indo-Pacific Humpback dolphin, <i>Sousa chinensis</i> is regularly sighted in North Lantau waters, year round. Dolphins appear to highest abundance offshore in the Assessment Area in autumn and winter.
Size/Abundance	3 ha of sea area would be permanently lost. 7 years of monitoring indicate dolphins have not been recorded approaching closer than approximately 1 km to shore along the Sunny Bay to To Kau Wan coastline or inside Sunny Bay where project works would occur.
Duration	Impacts due elevated SS during dredging would last about 3 months. Disturbance due to vessel movement would last throughout the construction phase (12-15 months).
Reversibility	Sunny Bay is not considered critical habitat for the dolphins.
Magnitude	Low.
Overall impact conclusion	Low.

Mitigation of Marine Ecological Impacts

- 7.162 The above assessment indicates that marine ecological impacts during construction and operation of the Project are anticipated to be minor and environmentally acceptable. The control of water quality to within acceptable levels is expected to also control impacts on any seagrass present in Sunny Bay and other marine ecology.
- 7.163 The evaluation of impacts above suggested that measures to minimise impacts on dolphins would be necessary. In accordance with the guidelines in the *EIAO TM* on marine ecology impact assessment, the general policy for mitigating impacts, in order of priority are:
- ♣ *Avoidance*: Potential impacts should be avoided to the maximum extent practicable by adopting suitable alternatives;
 - ♣ *Minimisation*: Unavoidable impacts should be minimised by taking appropriate and practicable measures such as constraints on intensity of works (e.g. dredging rates) or timing of works operations; and

- ♣ *Compensation:* The loss of important species and habitats may be provided for elsewhere in compensation. Enhancement and other conservation measures should always be considered whenever possible.

7.164 The following recommendations should be considered, if potential construction phase impacts on dolphins are to be minimised.

- ♣ All vessel operators working on the project should be given a briefing, alerting them to the possible presence of dolphins in the area, and setting out guidelines for safe operations around cetaceans.
- ♣ All vessels for the project works will be subject to a speed limit of 10 knots within the Project Site Boundary.
- ♣ The vessel operators should be required to use predefined and regular routes. As far as possible operators should follow the same routes used for the existing/ongoing Sunny Bay reclamation, as these may become known to the dolphins using North Lantau waters.
- ♣ A policy of no dumping of rubbish, food, oil or chemicals should be strictly enforced. This should also be covered in the contractors' briefing.
- ♣ Every attempt should be made to minimise the effects of the construction of the Project on the water quality (refer to Sections 5.61-5.67).

Residual Marine Ecological Impacts

7.165 Residual impacts resulting from this Project would be limited to the loss of small area (3 ha) of low value seabed and the benthos it supports. These impacts are considered minor. Residual marine ecological impacts are therefore considered minor and environmentally acceptable.

Ecological Monitoring and Audit (EM&A) Requirement

7.166 The dredging operations include constraints which act as appropriate mitigation measures to control environmental impacts to within acceptable levels. Actual impacts of construction activities will be measured through impacts to water quality. *EM&A* activities designed to detect and mitigate any unacceptable impacts to water quality will also serve to protect against unacceptable impacts to marine ecological resources. The water quality monitoring programme will provide management actions and supplemental mitigation measures to be employed should impacts arise, thereby ensuring the environmental acceptability of the Project. No specific *EM&A* programme would be required for marine ecology.

Conclusions

7.167 Findings of the *NLDFS EIA Report* regarding the Assessment Area were reviewed based on recent literature and field surveys. This indicated that the ecological value of intertidal artificial seawall, sandy shore, mangrove and subtidal benthic habitats were low. Of medium ecological value were the Assessment Area's natural rocky shore and marine mammal habitat. During surveys conducted in 2002/03, the mudflat at Sunny Bay was found to support a 0.8 ha dense cover of the locally rare seagrass, *Halophila ovalis*, which is of high conservation importance. Although no seagrass was recorded from Sunny Bay during a survey conducted in April 2005, it was considered that *H. ovalis* could re-establish on the mudflat in the future. Accordingly, the mudflat was considered of moderate-high ecological value.

7.168 The key marine ecological sensitive receivers in the Assessment Area were therefore the Indo-Pacific Humpback dolphin, *Sousa chinensis*. And the mudflat in Sunny Bay, which could support the locally rare and declining seagrass *H. ovalis*.

- 7.169 *Sousa chinensis* is regularly sighted in North Lantau waters year round, but apparently has a higher abundance in the Assessment Area in autumn and winter months. By strictly observing the recommended mitigation measures to control water quality as well as minimise physical dangers due to marine traffic and works, it is anticipated impact on dolphins would be low and environmentally acceptable.
- 7.170 Of key concern was that if the seagrass *H. ovalis* re-establishes in Sunny Bay, it may be indirectly impacted by increases in turbidity associated with the release of suspended sediment during dredging for the Project. However, according to the assessment, provided that mitigation by deployment of two layers of silt curtain is implemented within the works boundary of the works, indirect impacts on any seagrass present were considered to be minor. Elevations in suspended sediment levels elevations (predicted to be between 2.3 mg L⁻¹ and 3.9 mg L⁻¹) at the previous location of the seagrass bed (when submerged by the tide) would be within allowable levels under the WQO standard and of lower magnitude than natural variation in ambient conditions at the site.
- 7.171 The proposed reclamation would result in the permanent loss of 3 ha of disturbed seabed area and loss of 0.5km of sloping artificial seawall which would be partly compensated by construction of 450m of vertical seawall and 100m of sloping seawall and provide habitats for colonisation of intertidal organisms.
- 7.172 In summary, potential marine ecological impacts resulting from the Project were assessed as being minor and acceptable.

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