Agreement No. CE 63/2012 (DS) Expansion of Sha Tau Kok Sewage Treatment Works, Phase 1 – Investigation, Design and Construction

Baseline Ecological Survey Report – Revised Final

Document No.331965/03/04/C

June 2015

Drainage Services Department

Mott MacDonald

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1. Introduction

1.1 General

Mott MacDonald Hong Kong Limited (MM) has been commissioned by the Drainage Services Department (DSD) as a sub-consultant to undertake the Baseline Ecological Surveys for the Expansion of Sha Tau Kok Sewage Treatment Works, Phase 1 – Investigation, Design and Construction under Agreement No. CE 63/2012. This Assignment commenced on 20 December 2013 and last for a period of about 12 months, covering a 9-month survey period including both wet and dry seasons. In September 2014, additional surveys were instructed for the alternative location of the submarine outfall and diffuser. The additional surveys included Horseshoe Crab and Seagrass Bed Survey, Intertidal Survey and Subtidal Benthos Survey, and were completed between October and December 2014 covering both wet and dry seasons.

The objectives of the Baseline Ecological Surveys are clearly spelt out in Clause 4.2 of the Contract Document, and are reproduced below as follows:

- *to identify sensitive receivers present within the Study Area;*
- *to establish an updated general ecological profile of the Study Area; and*
- *to provide baseline ecological conditions for the main consultant to conduct the assessment of potential environment impacts caused by the Project activities and for them to recommend suitable mitigation measures to mitigate such impacts.*

1.2 Environmental Legislation, Standards and Guidelines

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

- Forests and Countryside Ordinance (Cap. 96), which protects the rare plant species from selling, offering for sale, or illegal possession
- Wild Animals Protection Ordinance (Cap. 170), which protects wild animals listed under the second schedule from being hunted, possession, sale or export, disturbance of their nest or egg without permission by authorized officer
- Protection of Endangered Species of Animals and Plants Ordinance (Cap. 586), which regulates the import, introduction from the sea, export, re-export, and possession of specimens of a scheduled species, including live, dead, parts or derivatives. The Ordinance applies to all activities involving endangered species which include the parties of traders, tourists and individuals
- EIAO Guidance Notes NO. 6/2012, 7/2010, 10/2010 and 11/2010. These guidance notes provide the observations on Ecological Assessment from the EIAO perspective, providing the general guidelines for conducting an ecological baseline survey for ecological assessment, introducing some methodologies in conducting terrestrial and freshwater ecological baseline surveys, and methodologies for marine ecological baseline surveys respectively
- Country Parks Ordinance (Cap. 208) which gives designation to country parks and special areas to protect the vegetation and wild life for the public enjoyment
- Town Planning Ordinance (Cap. 131) which gives designation to conservation area, green belts, sites of special scientific interest, coastal protection area, and other specified uses to promote conservation, protection and education of the valuable environment

- Hong Kong Planning Standards and Guidelines Chapter 10 (HKPSG) provides the guidelines on landscape and conservation to achieve a balance between the need for development and the need to minimise disruption of the landscape and natural resources
- The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is an international agreement between Governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival
- The Convention on the Conservation of Migratory Species of Wild Animals (the Bonn Convention) is an intergovernmental treaty concluded under the aegis of the United Nations Environment Programme concerned with the conservation of wildlife and habitats on a global scale. Its aim is to conserve terrestrial, marine and avian migratory species throughout their range
- United Nations Convention on Biological Diversity (CBD) (1992) is an international legally binding treaty. Its aim is to develop national strategies for the conservation and sustainable use of biological diversity
- The IUCN Red List of Threatened Species is widely recognized as the most comprehensive, objective global approach for evaluating the conservation status of plant and animal species. The goal of the IUCN Red List is to provide information and analyses on the status, trends and threats to species in order to inform and catalyse action for biodiversity conservation
- Ramsar Convention is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources
- The Strategic Plan for Biodiversity 2011-2020 and Aichi Biodiversity Targets is a ten-year framework for action by all countries and stakeholders to save biodiversity and enhance its benefits for people
- Wild Animal Protection Law of the Peoples' Republic of China (PRC) is formulated for the purpose of protecting and saving the species of wildlife which are rare or near extinction, protecting, developing and rationally utilizing wildlife resources and maintaining ecological balances

1.3 Study Area

The Study Area for ecological field surveys included areas within 500 m distance from the boundary of the Works Area and other areas likely to be impacted by the Project (i.e. A Chau egretry). The additional surveys covered the eastern coast of Starling Inlet from near Kuk Po to Ah Kung Tsui and four benthos sampling locations near Ah Kung Au for the alternative effluent outfall location. The Study Area, proposed survey transects, sampling sites, locations and points for ecological survey are all shown in **Figure 1**.

1.4 Ecological Field Survey Methodology

1.4.1 Habitat Mapping and Vegetation Survey

Field surveys focusing on terrestrial habitat and vegetation (including tree, woodlands and plantations) within the Study Area were carried out three times in dry season and three times in wet season to establish the general terrestrial profile of the Study Area. Each survey covered the entire Study Area. Habitats were determined based on aerial photos and ground-truthing. Representative areas of each habitat type and the proposed Works Area were surveyed on foot. Floral species of each habitat type and their relative abundance were recorded with special attention to species of conservation concern. Nomenclature and conservation status of floral species followed Xing *et al*. (2000), Wu and Lee (2000), Siu (2000) and AFCD (2012).

1.4.2 Wildlife Survey

Mammal Survey

Mammal surveys were carried out three times in dry and three times in wet seasons during daytime by transect and point count methods on all five transects and point count locations within the Study Area. All sightings, tracks and signs of mammals (including droppings) within the Study Area were recorded by active searching. Night-time surveys were also conducted for nocturnal mammals, at a frequency of twice per dry and twice per wet season.

Avifauna Survey

Avifauna species within the Study Area were surveyed by transect and point count methods during daytime, three times in dry and three times in wet seasons. The location(s) of any avifauna species of conservation concern encountered during the surveys were recorded, along with notable behaviour (e.g. breeding behaviour such as nesting and presence of recently fledged juveniles, roosting, and feeding activities). Bird species encountered outside survey transects/sampling points but within the Study Area were also recorded to produce a complete species list.

Transect Survey

For transect method, all birds seen within either side of each of the five survey transects were counted and identified to species level where possible.

Point Count Survey

Ten minutes were spent counting birds at each of five sampling points, and all birds seen or heard within 30 m of each point were identified and counted. Observation was made with the aid of using binoculars (at least 8x) and photographic records were taken whenever possible.

Point Count Survey on Intertidal Mudflat

Birds (mainly water birds) utilizing the intertidal mudflat were surveyed monthly between January and September 2014 during low tide period at the edge of the mangrove with an unobstructed view over the mudflat area using a point count method. All birds seen or heard over the entire mudflat were identified and counted. Besides, all bird encountered on the mudflat during intertidal surveys and horseshoe crab and seagrass surveys were also recorded to enrich the bird list.

Herpetofauna Survey

Herpetofauna surveys were carried out three times in dry season and three times in wet season, through direct observation, hearing of species-specific calls and active searching in all habitat types along the five survey transects and in potential hiding places such as among leaf litter, inside holes, under stones and logs within Study Area. Night-time surveys were also conducted at a frequency of twice per dry and twice per wet season. Particular attention was paid to streams and watercourses. Active search of species of conservation concern was also conducted during the survey to confirm the current status.

Butterflies and Odonates Survey

Odonates and butterfly surveys were conducted three times in both dry and wet seasons. Odonates and butterflies of different habitats within the Study Area were surveyed using transect and point count methods on the survey transects and sampling points. Odonates and butterflies from either side of the survey transect or within 30 m of each point were identified and counted. Relative abundance of odonates and butterflies in each type of habitat were estimated. Odonates and butterflies encountered outside transects but within the Study Area were also recorded in order to produce a complete species list.

1.4.3 Egretry Survey

Egretry surveys for A Chau SSSI within the Study Area were conducted monthly during the ardeid breeding season between March and August 2014. Survey was conducted either early morning or near evening, by observation from a pre-determined vantage point. Noting that A Chau is a restricted area, the survey was conducted from a distant vantage point to avoid intrusion and disturbance to the egretry. The numbers of nests and individuals of every species of breeding ardeids were recorded.

Flight-line studies were also conducted for A Chau egretry during the breeding season together with the egretry count. The survey aimed at studying the uses of foraging habitats by ardeids, and flight paths of ardeids to-and-from nesting/roosting colony and foraging habitats. Flight paths of all ardeids flying in and out from the A Chau egretry were observed from the survey point. Birds observed were identified to species level. Their flight directions were recorded on topographic map, with heights of flight estimated. Surveys were conducted for two hours in the morning and two hours in the late afternoon per month.

1.4.4 Freshwater Aquatic Assemblages Survey

Freshwater aquatic assemblages surveys were conducted three times in dry and three times in wet seasons on the identified stream. Aquatic fauna, including freshwater macro-invertebrates and fishes, were identified by direct observation and active searching by hand nets and standard field sampling techniques (e.g. kick sampling). Organisms, mostly fish and aquatic macro-invertebrates (e.g. freshwater crabs & shrimps, freshwater molluscs and aquatic insect larvae) were recorded and identified.

In the identified stream, the survey was conducted at three different sections (i.e. upstream, midstream and downstream). At each stream section, three sampling points were selected for sample collection (i.e. a total 9 samples).

1.4.5 Horseshoe Crab and Seagrass Survey

Active searchings of horseshoe crabs were conducted between February to September 2014 covering the active period of juveniles to confirm presence and abundance of horseshoe crab within the Study Area. Additional surveys of horseshoe crab and seagrass beds for the alternative effluent outfall location were also conducted through active searching methods along the eastern coast of Starling Inlet at least once in both wet and dry seasons between October and December 2014, which also covered the active period of juvenile horseshoe crab.

Horseshoe crabs could be difficult to observe as they are often buried under sediments. Therefore, signs of trails/ tracks made by horseshoe crabs' movements were looked for on the sediment surface. For seagrass bed, it was surveyed together with horseshoe crab surveys. The size, location and species of any seagrass bed or patch found were recorded.

1.4.6 Intertidal Survey

The intertidal surveys were conducted in both hard and soft shores, including artificial seawall, mangrove, mudflat and sandflat within the Study Area. Additional intertidal surveys were also conducted to cover rocky shores and sandy shores on the eastern coast of Starling Inlet from Kuk Po to Ah Kung Tsui. The intertidal surveys consisted of qualitative spot checks (i.e. walk-through surveys) and quantitative transect surveys. Local tide tables were used to assess tidal height at the site and times of surveys.

During walk-through surveys, intertidal species encountered were recorded with their relative abundance.

In quantitative transect surveys, at each of the six survey locations within the Study Area and at each of the six additional survey locations along the eastern coast of Starling Inlet, three 100 m horizontal (belt) transects along the shoreline were surveyed at each of the three shore heights: 2 m (high-shore), 1.5 m (midshore) and 1 m (low-shore) above Chart Datum (CD). On each transect, five quadrats (50 cm x 50 cm) were placed randomly to assess the abundance and diversity of flora and fauna. All organisms found within the quadrat were identified and recorded to the lowest possible taxonomic level (at least Genus level). Sessile species, such as algae (encrusting, foliose and filamentous), barnacles and oysters, in each quadrat were also identified to the lowest possible taxonomic level (at least Genus level) and estimated as percentage cover. In addition, should the transect locations prove to be soft shores, all organisms found in the top 50 cm x 50 cm x 10 cm layer (length x width x depth) of the substrate were identified to the above-mentioned lowest possible taxonomic level and recorded.

1.4.7 Subtidal Coral Survey

The subtidal coral survey has been designed to encompass subtidal hard bottom habitat with potential hard coral colonizes within the Study Area (e.g. area near the artificial seawall and breakwater of Sha Tau Kok). Two targeted types of subtidal dive survey were carried out by a team of qualified coral specialists, including:

- Specific spot dive checks; and
- Rapid Ecological Assessment (REA) survey: this was conducted if corals were recorded by the spot dive surveys to collect semi-quantitative ecological information of the coral communities.

Spot Dive Checks

At each survey location, a spot dive reconnaissance check was conducted at 10 points along a 100 m transect, and the substrate type, associated sessile benthos, particularly the presence of coral communities (including all hard corals, octo corals and black corals) were recorded. Representative photographs of the seabed and associated fauna were taken.

Standardized REA Survey

The standardized semi-quantitative Rapid Ecological Assessment (REA) survey technique was used to obtain semi-quantitative data on the benthic communities along the transects. During the REA survey, any species of conservation concern, noticeable seahorse was searched. Detailed survey methodology of REA survey refers to the subtidal coral dive survey report attached as **Appendix 3**.

1.4.8 Subtidal Benthos Survey

Benthic sediment samples were collected from four sampling sites representative of the subtidal soft-bottom habitats within Study Area in particular the soft bottom sea bed adjacent to the submarine effluent outfall. Additional samples were also collected from four sampling sites around the alternative effluent

outfall location near Ah Kung Au at the eastern coast of Starling Inlet (i.e. a total of eight sampling sites). Each of the eight subtidal benthos sampling sites was sampled once in dry and once in wet seasons.

Detailed survey methodology of grab sampling may refer to subtidal benthos survey reports attached as **Appendix 4** and **5**.

2. Ecological Survey Results

2.1 Surveys Schedule

The dates of various types of ecological surveys are summarized in **Table 2.1** below.

Table 2.1: Survey Schedules

Surveys		2014											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Habitat and Vegetation Survey		29	19	14				24	18	30			
Wildlife Survey	Day	29	19	14				24	18	30			
	Night		17, 27	17, 19				11	22				
Egretry Survey	a.m.			27	15	30	27	30	25				
	p.m.			28	17	29	25	8	15				
Freshwater Aquatic Assemblages Survey		18	27	18				10	8	30			
Horseshoe crab & Seagrass Survey			18	17	16, 17	27	11	10	8	8, 10	(6, 7, 8)	(3, 4)	(1)
Intertidal Survey			17, 18	17, 18, 19, 20	16				11, 22	8, 10	(6, 7, 8)	(3, 4)	(1)
Subtidal Coral Survey									5				
Subtidal Benthos Survey				22					4		(18)	(22)	

Note:

*Survey dates in ( ) indicates additional surveys.

2.2 Habitat and Vegetation Survey

A total of eight major habitat types were identified within the Study Area. The distribution of habitats within the Study Area is shown in **Figure 2**. The areas of each habitat type within the Study Area and the Project Area are listed in **Table 2.2** and **Table 2.3** respectively. The plant list obtained from the vegetation surveys is presented in **Table 1** of **Appendix 1**. Representative photographs of each habitat type are shown in **Plates 1** to **8** of **Appendix 2**.

Table 2.2: Habitats Present in the Study Area (excluding the Project Area)

Habitat	Study Area	
	Area (ha)	%
Woodland	11.87	10.51
Shrubland	0.61	0.54
Abandoned Agricultural Land / Low-lying Grassland	15.61	13.82
Marsh	8.40	7.44
Mangrove	1.37	1.21
Pond	2.06	1.82
Stream / River	0.61	0.54

Habitat	Study Area	
	Area (ha)	%
Developed Area	72.40	64.11
Total	**112.93**	**100**

Table 2.3: Habitats Present in the Project Area

Habitat	Project Area	
	Area (ha)	%
Abandoned Agricultural Land / Low-lying Grassland	0.26	20.0
Developed Area	1.04	80.0
Total	**1.3**	**100**

2.2.1 Woodland

Study Area

Patches of woodland areas have been found scattered on hillsides. This habitat is dominated by common tree species such as *Celtis sinensis*, *Mallotus paniculatus*, *Schefflera heptaphylla* and *Sterculia lanceolata*. Other plant species such as *Alpinia oblongifolia*, *Aporusa dioica*, *Desmos chinensis, Ficus hirta* and *Uvaria macrophylla* are also common.

Project Site

This habitat is not identified within the Project Site.

2.2.2 Shrubland

Study Area

A small isolated patch of shrubland is located off the shore. This habitat is dominated by *Leucaena leucocephala*.

Project Site

This habitat is not identified within the Project Site.

2.2.3 Abandoned Agricultural Land and Low-lying Grassland

Study Area

This habitat is dominated by grass species on relatively flat ground in the western part of the Study Area. Dominant grass species include *Imperata cylindrica* var. *major* and *Leptochloa chinensis*. Other herbaceous plant species such as *Bidens alba*, *Ipomoea cairica*, *Mikania micrantha* and *Polygonum chinense* are also common in this habitat.

Project Site

This habitat is found in the northern part of the proposed relocation site for Police Operation Base. Floral species commonly observed include *Bambusa* species, *Ipomoea cairica* and *Wedelia trilobata*.

2.2.4 Marsh

Study Area

This habitat is likely established by the abandonment of agricultural practice. The areas are generally flat and wet. They are quite homogeneous in terms of floral species distribution with low species diversity. Floral species commonly found in this habitat include *Alocasia macrorrhizos*, *Apluda mutica*, *Colocasia esculenta*, *Cyclosorus interruptus*, *Ipomoea cairica*, *Mikania micrantha* and *Wedelia trilobata*.

Project Site

This habitat is not identified within the Project Site.

2.2.5 Mangrove

Study Area

Mangrove habitats are mainly found along the coast, but some are surrounded by developed area. Mangroves species identified include *Aegiceras corniculatum*, *Avicennia marina*, *Bruguiera gymnorhiza* and *Kandelia obovata*. Other coastal species such as *Clerodendrum inerme*, *Hibiscus tiliaceus*, *Sageretia thea* and *Scolopia chinensis* are also observed in this habitat.

Project Site

This habitat is not identified within the Project Site.

2.2.6 Pond

Study Area

Two man-made ponds have been identified near the coast. They are likely used for aquaculture. Floral species observed in the pond bunds include *Aporusa dioica*, *Bridelia tomentosa*, *Cinnamomum camphora*, *Ligustrum sinense* and *Schefflera heptaphylla*.

Project Site

This habitat is not identified within the Project Site.

2.2.7 Stream / River

Study Area

This habitat includes Sha Tau Kok River at the northeastern periphery of the Study Area and a small stream section west of Sheung Tam Shui Hang. Sha Tau Kok River was not visited in the field survey due

to inaccessibility. Floral species observed at the stream west of Sheung Tam Shui Hang include *Bidens alba*, *Colocasia esculenta*, *Ficus microcarpa*, *Ficus subpisocarpa* and *Kyllinga polyphylla*.

Project Site

This habitat is not identified within the Project Site.

2.2.8 Developed Area

Study Area

This is the dominant habitat within the Study Area which includes residential housing estates, urban public facilities and village settlement. Floral diversity is high due to presence of landscape planting and roadside greening. Floral species commonly observed include *Aglaia odorata* var. *microphyllina*, *Calliandra haematocephala*, *Callistemon viminalis*, *Ficus benjamina*, *Ficus microcarpa*, *Ficus virens*, *Melaleuca cajuputi* subsp. *cumingiana* and *Wedelia trilobata*.

Project Site

This is the dominant habitat within the Project Site with specified land uses as public facilities. Landscape planting in this habitat includes *Acacia confusa*, *Ficus benjamina*, *Hippeastrum vittatum*, *Ligustrum sinense* and *Neomarica northiana*.

2.2.9 Floral Species of Conservation Concern

Study Area

Within the Study Area, three floral species of conservation concern have been identified. Photographs of the identified floral species of conservation concern are shown in **Plates 9** to **11** of **Appendix 2**.

Tree species *Thespesia populnea* has been recorded at numerous locations along the coastal and mangrove habitats. This species has restricted distribution (Tam and Wong, 2000) but is not legally protected in Hong Kong.

About eight individuals of a native orchid species *Zeuxine strateumatica* is found in an abandoned argicultural land / lowing-lying grassland adjacent to the drainage channel. All orchids in Hong Kong are protected under the Forestry Regulations (Cap. 96A) except “plants grown outside Hong Kong or on any land held from the Government under a lease, licence or permit or by virtue of an Ordinance”. They are also scheduled under the Protection of Endangered Species of Animals and Plants Ordinance (Cap. 586). The observed individuals are likely wild-grown and hence a species of conservation concern protected under both the Forestry Regulations (Cap. 96A) and Protection of Endangered Species of Animals and Plants Ordinance (Cap. 586). This orchid species is regarded as “near threatened” in Hong Kong (Barretto *et al*, 2011).

Other than a native orchid species, the fern species *Ceratopteris thalictroides* is also observed at the same location in the abandoned argicultural land / lowing-lying grassland. This species is not legally protected in Hong Kong. However, it is a Category II protected species in mainland China and recorded in Rare and Precious Plants of Hong Kong (AFCD, 2003).

Other than the three floral species of conservation concern, individuals of *Camellia* species has been identified within the landscape area of the existing Sha Tau Kok Sewage Treatment Works. All *Camellia* species in Hong Kong are protected under the Forestry Regulations (Cap. 96A) except "plants grown outside Hong Kong or on any land held from the Government under a lease, licence or permit or by virtue of an Ordinance". Since the observed *Camellia* species is within a planter in a maintained landscape area, it is very unlikely wild-grown but imported and planted intentionally as ornamental plants. Hence, it is not protected under the Forestry Regulations (Cap. 96A) and not considered a species of conservation concern.

Similarly, *Rhododendron* species have been recorded within roadside planters and landscape areas of public open space and private property. All *Rhododendron* species in Hong Kong are protected under the Forestry Regulations (Cap. 96A) except "plants grown outside Hong Kong or on any land held from the Government under a lease, licence or permit or by virtue of an Ordinance". The recorded *Rhododendron* species are all observed within maintained landscape areas. It is obvious that these *Rhododendron* species have been purposively planted as ornamental shrub planting. They are therefore not protected under the Forestry Regulations (Cap. 96A) and not considered a species of conservation concern.

Another floral species encountered, *Hylocereus undatus*, which belong to the family Cactaceae is scheduled under the Protection of Endangered Species of Animals and Plants Ordinance (Cap. 586). It is recorded on trees along pond bund, on a chain-link fence in village settlement and on the fence of the existing Sha Tau Kok Police Operation Base. It is a non-native species often planted as ornamental or food plant. The observed individuals are likely intentionally planted and therefore also not considered a species of conservation concern.

Project Site

None of the three floral specie of conservation concern is within the Project Site. However, *Camellia* species and *Hylocereus undatus* are observed within the Project Site. *Camellia* species has been identified within the landscape area of the existing Sha Tau Kok Sewage Treatment Works; *Hylocereus undatus* has been recorded on the fence of the existing Sha Tau Kok Police Operation Base.

2.3 Wildlife Survey

2.3.1 Mammal

A total of 131 individuals from six mammal species were recorded during the wildlife transect surveys. These six mammals species are Domestic Cat *Felis catus*, Domestic Dog *Canis lupus familiaris,* Eurasian Wild Pig *Sus scrofa,* Leopard Cat *Prionailurus bengalensis,* Musk Shrew *Suncus murinus* and Unidentified Bats.

Domestic Cats were mainly recorded at and near the artificial seawall covered by Transect No.4. Some individuals were found inhabiting at the artificial seawall. Domestic Dogs were mainly recorded along Sha Tau Kok Road.

Calls of Eurasian Wild Pigs were heard from the woodland between Lin Ma Hang Road and Shan Tsui Village Road at Transect No.3. Footprints were also observed inside the mangrove next to the pond which is just opposite to the existing Sha Tau Kok sewage treatment facility during transect survey.

An individual of an uncommon insectivore, Musk Shrew, was recorded at the woodland behind the abandoned Kwan Ngar School in Sheung Tam Sheung Hang during a night survey in July 2014.

At the same woodland, scats of Leopard Cats were also found on a tomb. Leopard Cat is uncommon in Hong Kong (Shek *et al*. 2007). It is listed in Cap. 170, Cap. 586 and CITES Appendix II. It is also categorized as "Vulnerable" by China Red Data Book (Wang, 1998). The approximate location of the Leopard Cat is shown in **Figure 3**.

Besides non-flying mammals, unidentified bat species were also recorded during night surveys and it was the most abundant mammal species recorded during the surveys. Due to the difficulties in observing fast flying bats in dark, it was unable to identify the bat species but all individuals of the unidentified bats were recorded having short wing spread. These bats were majorly recorded in developed areas throughout the Study Area and at the woodland just north to Kong Ha Village inside the Sha Tau Kok Closed Area.

During wildlife point counts, only one individual of Domestic Cat was recorded at the artificial seawall.

Representative photos of mammal surveys are shown in **Plate 12** of **Appendix 2** while detailed findings of mammal surveys may refer to **Tables 2** and **3** of **Appendix 1**.

2.3.2 Avifauna

During the wildlife transect surveys, a total 1,898 individuals from 54 avifauna species were recorded. Abundant avifauna species within the Survey Area were common urban bird species such as Chinese Bulbul *Pycnonotus sinensis*, Crested Myna *Acridotheres cristatellus* and Red-whiskered Bulbul *Pycnonotus jocosus*, and ardeid species the Great Egret *Ardea alba*.

Amongst these species, Great Egret was the most abundant one. This is due to the presence of a night roosting site at the proposed temporary work area just south to the Sha Tau Kok Bus Terminal. The night roosting site was first recorded during the night survey in July 2014. Some detailed observations were taken during the wildlife survey in September 2014. The earliest arrival of Great Egret to the roosting site was around 16:00 and most of the Great Egret settled at around 17:00. Some Great Egret were also observed gathering on the sandflat before returning to the night roosting site. The number of roosting Great Egret was observed to be around 220 and they were observed mainly coming from two directions, southwest from the mudflat in Sha Tau Kok and southeast possibly from the coastal area and marsh in Kok Po.

During the wildlife point surveys, a total of 152 individual from 24 avifauna species were recorded. Chinese Bulbul was the most abundant species recorded. A relatively high number of Great Egret was recorded at Sha Tau Kok mudflat, mangrove and shallow water at Starling Inlet. However, the mudflat could not be covered by any transect or point count survey point of the wildlife survey, therefore, specific point count surveys were conducted on the mudflat during intertidal survey to investigate the bird community utilizing the mudflat habitat. A total number of 345 individuals from 16 avifauna species were recorded from the point count surveys on the intertidal mudflat. The most abundant avifauna species on the mudflat and its associated habitats was again Great Egret.

Overall, a total number of 59 avifauna species were recorded from the three types of avifauna surveys aforementioned. Amongst them, 16 species including Black Kite *Milvus migrans*, Black-crowned Night Heron *Nycticorax Nycticorax*, Black-tailed Gull *Larus crassirostris*, Chinese Grosbeak *Eophona migratoria*, Chinese Pond Heron *Ardeola bacchus*, Collared Scops Owl *Otus lettia*, Great Cormorant *Phalacrocorax carbo*, Great Egret *Ardea alba*, Greater Coucal *Centropus sinensis*, Grey Heron *Ardea cinerea*, Little Egret *Egretta garzetta*, Little Grebe *Tachybaptus ruficollis*, Red-billed Starling *Spodiopsar sericeus*, Western

Osprey *Pandion haliaetus*, White-cheeked Starling *Spodiopsar cineraceus* and White-throated Kingfisher *Halcyon smyrnensis*, are of conservation concern.

Black Kite were recorded soaring over various habitats such as developed area, woodland between Lin Ma Hang Road and Shan Tsui Village Road, pond near the mudflat and some areas of Starling Inlet with shallow water. Black Kite is a raptor listed in Protection of Endangered Species of Animals and Plants Ordinance (Cap. 586) and it is considered to be of "Regional Concern" (Fellowes *et al.* 2002). However, it is actually a common resident which widely distributed in Hong Kong (Allcock *et al.*, 2014).

Black-crowned Night Heron were recorded in mangrove, downstream section of the stream next to the existing Sha Tau Kok Sewage Treatment Plant and abandoned agricultural land / low-lying grassland habitats. This nocturnal ardeid species was regarded as "Local Concern" by Fellowes *et al.* (2002). The common resident and migrant population are mainly in Deep Bay wetlands while the population in Starling Inlet are most likely the scattered breeding colonies in Hong Kong (Allcock *et al.*, 2014). 20 and 10 nests of Black-crowned Night Heron were recorded at A Chau egretry which located at Luk Keng inside the Starling Inlet during the annual egretry count conducted by Hong Kong Bird Watching Society in the ardeid's breeding season in 2013 and 2014 respectively (Anon, 2013 and Anon, 2014).

A group of around 33 individuals of Black-tailed Gull was flying around over Starling Inlet on 19th February 2014. It is a common winter visitor to intertidal areas of Deep Bay and spring passage migrant to coastal waters (Allcock *et al.*, 2014). Black-tailed Gull is considered to be of "Local Concern" by Fellowes *et al.* (2002).

Several individuals of Chinese Grosbeak were recorded at the plantation near the Sha Tau Kok Police Station of which is the proposed site for expansion of Sha Tau Kok Sewage Treatment Works, and at vegetation on pond bund in February and March 2014. It is a common winter visitor and scarce breeding species in recent years and found in wooded, open-country habitats (Allcock *et al.*, 2014). It is considered to be of "Local Concern" (Fellowes *et al.* 2002).

Chinese Pond Heron is a common species of wetlands and damp areas with winter, migrant and breeding populations in Hong Kong (Allcock *et al.*, 2014). Two individuals of Chinese Pond Heron were recorded at the downstream section of the river just next to the existing Sha Tau Kok Sewage Treatment Plant. It is regarded as "Potential Regional Concern" (Fellowes *et al.* 2002).

Collared Scops Owl is listed in Cap. 586. It is a common resident which is widely distributed in shrubland throughout Hong Kong (Allcock *et al.*, 2014). Calls of Collared Scopes Owl were heard during night-time surveys and the approximate locations of Collared Scopes Owl were at woodlands within the Study Area.

Great Cormorant winters in widespread locations of Hong Kong from October to April (Allcock *et al.*, 2014). Three individuals of Great Cormorant were recorded over-flying on Starling Inlet during the point count survey on the intertidal mudflat in January and February 2014. This species is considered to be of "Potential Regional Concern" by Fellowes *et al.* (2002).

Great Egret is an ardeid species of "Potential Regional Concern" (Fellowes *et al.* 2002) but it has abundant population present in all year in wetlands particularly in Deep Bay area. There are also breeding populations in Hong Kong. In the egretry counts in 2013 and 2014, 37 and 53 nests of Great Egret were recorded respectively at A Chau egretry that both are the highest number of nests of Great Egret in Hong Kong in that year (Anon, 2013 and Anon, 2014). Being the most abundant bird species recorded during the wildlife surveys, Great Egret were recorded at various habitats including developed area, mangrove, pond,

mudflat, stream / river and shrubland. A night roosting site was also found located within the proposed temporary works area of the Project.

Greater Coucal is considered to be “Vulnerable” in China Red Data Book (Wang, 1998). It is a common resident which widely distributed in woodland and open country within Hong Kong (Allcock *et al.*, 2014). This species were recorded in woodlands within the Study Area.

Grey Heron is considered to be of “Potential Regional Concern” by Fellowes *et al.* (2002). However, it is locally common in wetland and some coastal areas particularly in Deep Bay area and it presents all year with highest numbers in winter and very low abundance in summer (Allcock *et al.*, 2014). Grey Heron were recorded in various habitats and locations including artificial seawall, small shrubland island, mudflat and coastal waters.

Little Egret is regarded as of “Potential Regional Concern” by Fellowes *et al.* (2002). This species is actually locally abundant and present all year in wetland areas throughout Hong Kong, particularly in the Deep Bay area. There were also migrants and winter visitor populations in Hong Kong (Allcock *et al.*, 2014). It has breeding colony at A Chau egretry with only two nests recorded in 2013 (Anon, 2013). The number of nests of Little Egret at A Chau egretry increase to six in 2014 (Anon, 2014). Little Egret were recorded in various habitats and locations with the majority of the records being found on the intertidal mudflat.

Little Grebe is a water bird species with “Local Concern” (Fellowes *et al.* 2002). It is common all year in Hong Kong primarily in Deep Bay wetland area such as ponds and pools with higher number in winter (Allcock *et al.*, 2014). Little Grebe were recorded on pond and coastal waters in between the two shrubby islands from January to March 2014.

Red-billed Starling is the only avifauna species recorded during the wildlife survey being considered to be of “Global Concern” by Fellowes *et al.* (2002). It is an abundant winter visitor to open-country areas mainly in northwest New Territories and some summer records with breeding were found in recent years (Allcock *et al.*, 2014). A group of 12 individuals were recorded in woodland area near Yuen Tuen Shan at the northeast edge of the Study Area in March 2014.

Western Osprey is a raptor of “Regional Concern” (Fellowes *et al.* 2002) and considered as “Rare” by China Red Data Book (Wang, 1998). It is a common winter visitor to wetland areas, mainly in Deep Bay from October to April, with a few individuals over-summering. There was historical record of one individual at Starling Inlet from January to March 2012 (Allcock *et al.*, 2014). During the point count survey on the mudflat, one individual of Western Osprey was recorded perching on a stake on shallow waters near the intertidal mudflat in January 2014.

White-cheeked Starling is considered by Fellowes *et al.* (2002) to be of “Potential Regional Concern”. It is a locally common winter visitor to open-country areas, particularly Deep Bay, with breeding records recently (Allcock *et al.*, 2014). Two records of White-cheeked Starling were made in mangrove and developed area. One of the records consisted of 42 individuals found perching on trees at the mangrove just next to the Sha Tau Kok Police Station in March 2014.

White-throated Kingfisher is considered to be “Local Concern” by Fellowes *et al.* (2002). It is locally common and present all year mostly in wetland areas (Allcock *et al.*, 2014). White-throated Kingfisher were recorded at the small shrubland island and on the intertidal mudflat.

Representative photos from avifauna surveys are shown in **Plates 13** to **17** of **Appendix 2** while species list and detailed survey findings of avifauna refer to **Tables 4** to **6** of **Appendix 1**. The approximate locations of avifauna species of conservation concern are shown in **Figure 3**.

2.3.3 Herpetofauna

A total of three reptile species and eight amphibian species were recorded during the daytime and/or night time wildlife transect surveys but no herpetofauna species were found during the wildlife point count. The reptile species included Changeable Lizard *Calotes versicolor*, Chinese Gecko G*ekko chinensis* and Long-tailed Skink *Mabuya longicaudata* while the amphibian species included Asian Common Toad *Bufo melanostictus*, Brown Tree Frog *Polypedates megacephalus*, Chinese Bullfrog *Hoplobatrachus chinensis*, Gunther's Frog *Rana guentheri*, Ornate Pigmy Frog *Microhyla ornate*, Paddy Frog *Fejervarya limnocharis* and Spotted Narrow-mouthed Frog *Kalophrynus interlineatus*.

All these herpetofauna species are abundant, very common or common in Hong Kong and have no conservation concern except the uncommon Chinese Bullfrog. Chinese Bullfrog inhabit cultivated fields, ponds, rivers and marshes in lowland area (Chan *et al.* 2005). Calls of this species were heard from marsh habitat around Ha Tam Shui Hang during night time wildlife survey in July 2014. Chinese Bullfrog is considered to be of "Potential Regional Concern" by Fellowes *et al. (*2002) and it is also listed "Class II" protected species in China (Chan *et al.* 2005). The approximate locations of Chinese Bullfrog is shown on **Figure 3**.

Representative photos from herpetofauna surveys are shown in **Plates 18** to **22** of **Appendix 2** while species list and detailed survey findings of herpetofauna surveys refer to **Table 8** of **Appendix 1**.

2.3.4 Butterflies and Odonates

Butterflies

A total of 271 individuals from 41 butterfly species were recorded during wildlife transect surveys. The most abundant species were Indian Cabbage White *Pieris canidia canidia* and Pale Grass Blue *Zizeeria maha serica*. Amongst these 41 species, five are rare or very rare species with conservation concern. The five butterfly species of conservation concern included Comma *Polygonia c-aureum c-aureum*, Great Swift *Pelopidas assamensis*, Metallic Cerulean *Jamides alecto alocina*, Pigmy Scrub Hopper *Aeromachus pygmaeus* and Shiny-spotted Bob *Isoteinon lamprospilus lamprospilus.*

Comma is a "Very Rare" and considered as "Species of Conservation Concern" under AFCD assessment (Chan *et al.* 2011). It has previous records in Peng Chau, Siu Lang Shui, Nam Chung and Ho Sheung Heung. An individual of Comma was recorded feeding on nectar of *Lantana camara* on the artificial seawall during the transect survey in July 2014.

Great Swift is a "Rare" species (Chan *et al.* 2011) and is considered to be of "Local Concern" by Fellowes *et al.* (2002). Historical records of this species included Shan Liu, Fung Yuen, Tal Lam Wu and Sam A Chung. An individual of Great Swift was recorded at the marsh just west to Sheung Tam Shui Hang in August 2014.

Metallic Cerulean is assessed as "Very Rare" by AFCD assessment (Chan *et al.* 2011). It has historical records in Vitoria Peak, Fung Yuen, Cheung Lung and Mui Wo. An individual of Metallic Cerulean was

recorded at the edge of the woodland which located between Lin Ma Hang Road and Shan Tsui Tsuen Road in August 2014.

Pigmy Scrub Hopper is a "Very Rare" species (Chan *et al.* 2011) of "Regional Concern" (Fellowes *et al.* 2002). It has been previously recorded in Cheung Sheung, Yung Shue O and Kuk Po. An individual of Pigmy Scrub Hopper was recorded at the abandoned agricultural land / low laying grassland east to Sheung Tam Sheung Hang in August 2014.

Shiny-spotted Bob is assessed as "Very Rare" and as "Species of Conservation Concern" by AFCD assessment (Chan *et al.* 2011). It was also considered to be of "Local Concern" by Fellowes *et al.* (2002). It has been previously recorded in Shing Mun, Lai Chi Wo and Wu Kau Tang. An individual of Shiny-spotted Bob was recorded in August 2014 at similar location of the record of Metallic Cerulean.

For the point count surveys, only three very common butterfly species were recorded.

Representative photos from butterfly surveys are shown in **Plates 23** to **28** of **Appendix 2** while species list and detailed survey findings refer to **Tables 9** and **10** of **Appendix 1**.

The approximate locations of butterfly species of conservation concern are shown in **Figure 3**.

Odonates

During the course of odontate transect surveys, a total number of 463 individuals from 20 species were recorded. The most abundant odonate species recorded was Wandering Glider *Pantala flavescens*. Most of the species were abundant or common except one uncommon species, Blue-spotted Emperor *Anax nigrofasciatus nigrofasciatus*, and one species with conservation concern, Emerald Cascader *Zygonyx iris insignis* (Wilson *et al.* 2011).

The uncommon Blue-spotted Emperor is recorded at a small patch of agricultural land in Ha Tam Shui Hang while Emerald Cascader were recorded at the abandoned agricultural land / low-lying grassland between Sheung Tam Shui Hang and Ha Tam Shui Hang. The locally abundant Emerald Cascader is considered to be of "Potential Global Concern" by Fellowes *et al.* (2002).

For the point count surveys, a total of 102 individuals of 10 odonate species were recorded. All these species are abundant or common with no conservation concern. The most abundant odonate species recorded was again Wandering Glider *Pantala flavescens.*

Representative photos from odonate surveys are shown in **Plates 29** to **33** of **Appendix 2** while species list and detailed survey findings refer to **Tables 11** and **12** of **Appendix 1**.

The approximate locations of odonate species of conservation concern are shown in **Figure 3**.

2.4 Egretry Survey

Egretry counts and flight path surveys were conducted for A Chau egretry from March to August 2014 covering ardeids' breeding season. Five ardeid species including Black-crowned Night Heron *Nycticorax nycticorax*, Eastern Cattle Egret *Bubulcus coromandus*, Great Egret *Ardea alba*, Grey Heron *Ardea cinerea* and Little Egret *Egretta garzetta* were recorded during egretry counts. Only nests of Black-crowned Night Heron and Great Egret were found at A Chau egretry during the field survey but Little Egret was also

previously recorded in the Egretry. Different types of breeding activities, for instance, pairing up, collecting nesting materials and nest-sitting, were started to be observed in March 2014. The highest number of nests of both Black-crowned Night Heron and Great Egret were seven and 43 nests respectively in April 2014. Details of the abundance of ardeids and the number of nests recorded during the egretry counts are presented in **Table 13** in **Appendix 1**.

A total number of four ardeid species were recorded during flight path surveys. Around 73 individuals of ardeids were recorded per each flight path survey. Part of the incoming ardeids to A Chau egretry was come from mangrove habitats (44.1%) while 50.3% of ardeids leaving the egretry was flying to the same habitat types. When taking the flight direction information into account, the survey result shows that 28.5% of the ardeids coming back to the egretry was from the mangrove located southwest to the egretry (i.e. mangrove in Luk Keng) and 40.8% of the ardeids leaving the egretry was flying to the same mangrove. This indicates that a localized foraging range was used by part of the ardeids of A Chau egretry.

The result also shows that about 8.2% (flying-in) and 10.3% (flying-out) ardeids were associated with the Sha Tau Kok Sea at the northeast direction. It should be clarified that the flight distance of these records were long and the actual origin or destination of these flights could not be determined during the surveys but they were potentially linked with coastal habitats in Sha Tau Kok or other locations within the Starling Inlet.

Representative photos of egretry surveys of A Chau egretry are presented in **Plates 34** and **35** in **Appendix 2**. Detailed information of the flight origin and destination obtained during the flight path surveys can be found in **Table 14** in **Appendix 1**. The major indicative flight paths of ardeids flying to and fliying out from A Chau Egretry were shown in **Figure 4** and **5** respectively.

2.5 Freshwater Aquatic Assemblages Survey

Twenty species from 10 Orders including Anura, Cypriniformes, Decapoda, Diptera, Ephemeroptera, Heteroptera, Mugiliformes, Odonata, Perciformes and Trichoptera were recorded during the freshwater aquatic assemblages surveys covering both dry and wet seasons. Abundant species recorded during the surveys included *Bufo melanostictus*, *Parazacco spilurus*, *Caridina cantonensis*, *Chelon subviridis* and *Ambassis* sp..

Only *Caridina cantonensis* and *Rhinogobius duospilus* were recorded at all survey points in both dry and wet seasons. Both these two species were common in Hong Kong streams. The abundant *Chelon subviridis* was only recorded at downstream section and was mostly recorded during dry season.

Amongst the recorded species, *Parazacco spilurus* is listed as “Vulnerable” in China Species Red List but it is common in Hong Kong (Lee *et al.* 2004).

Mating and spawning of *Bufo melanostictus* were observed at middle stream section during other fauna survey in wet season.

Representative photos of freshwater aquatic assemblages surveys are presented in **Plates 36** to **42** in **Appendix 2**. Detailed information of the species recorded during the aquatic surveys can be found in **Table 15** in **Appendix 1**. The approximate locations of species of conservation concern are shown on **Figure 3**.

2.6 Horseshoe Crab and Seagrass Bed Survey

2.6.1 Horseshoe Crab

During the whole course of horseshoe crab surveys, a total number of 523 individuals/ mating pairs of Mangrove Horseshoe Crab *Carcinoscorpius rotundicauda* including both juveniles and adults were recorded at the mangrove edge and on the mudflat in Sha Tau Kok within the Study Area (i.e. intertidal areas cover transects MG1, MF1 and MF2 as shown in **Figure 1**). No Chinese Horseshoe Crab *Tachypleus tridentatus* was found and no horseshoe crab was recorded during the additional horseshoe crab survey along the eastern coast of Starling Inlet.

The prosomal width of the recorded horseshoe crab ranged from 1.9 to 17.1 cm. Chiu, H.M. & Morton, B. (2003) determined the prosomal width of mature *C. rotundicauda* ranged from 12.8 to 16.7 cm. Based on the reference and obsevred mating activities, seven individuals/ mating pairs of *C. rotundicauda* recorded during the survey were regarded as adult horseshoe crabs. These adults were recorded between June and August 2014. Juvenile *C. rotundicauda* were recorded with high abundance on the mudflat. The prosomal wideth of the juveniles ranged from 1.9 to 9.8 cm and the mean prosomal width was 5.8 cm.

Luk Keng within the Starling Inlet was known to be an important breeding and nursery ground of *C. rotundicauda* (Shin *et al*. 2009). The field survey results suggest that the mudflat in Sha Tau Kok is potentially another important breeding and nursery ground for the *C. rotundicauda* within Starling Inlet. It is worth noting that this potential breeding and nursery ground of *C. rotundicauda* within the Study Area is adjacent to one of the proposed effluent outfall locations.

Representative photos of horseshoe crabs are presented in **Plates 43** and **44** in **Appendix 2**. Survey records are presented in **Table 16** in **Appendix 1**.

2.6.2 Seagrass Bed

Seagrass species *Halophila ovalis* was found on the mangrove edge and the sandflat during the seagrass walk-through survey. The record on the mangrove edge was a tiny patch of an area around 1 m^2 recorded in June 2014. Since this record, no record of *H. ovalis* could not be found on the mangrove edge and mudflat again even at the location with previous record. During the additional seagrass bed survey conducted along the eastern coast of Starling Inlet, no seagrass was found.

Several patches of *H. ovalis* with various sizes ranging from around 1 to 120 m^2 were found on the sandflat during the seagrass walk-through surveys from March to June 2014. However, no *H. ovalis* was found between July and September 2014 at all survey locations even at those with previous records. This indicates a seasonal variation of the emergence of *H. ovalis*.

Representative photos of seagrass are presented in **Plates 45** and **46** in **Appendix 2**. Survey records are presented in **Table 17** of **Appendix 1** and the approximate locations of the records are presented in **Figure 3**.

2.7 Intertidal Survey

Intertidal surveys, both qualitative walk-through and quantitative transect survey, were conducted on both hard-bottom and soft-bottom intertidal habitats including artificial seawall, mudflat, mangrove and sandy

shore within the Study Area in February, March, August, and September 2014, covering both dry and wet seasons.

Additional intertidal surveys were carried out in October, November and December 2014 covering both dry and wet seasons along the coastline from Kuk Po to Ah Kung Tsui opposite to Sha Tau Kok, in rocky shore and sandy shore habitats.

Representative photos of intertidal surveys refer to **Plates 47** to **56** in **Appendix 2**.

2.7.1 Artificial Seawall

Sloping artificial seawalls composed of large armour rocks were built along the coastline of Sha Tau Kok Town. Some parts of the artificial seawalls were further modified by local fishermen to enhance accessibility to their fishing sampans mooring just next to the seawalls. For instance, some concrete or woody stairs were built on the seawalls along the sloping.

Walk-through Survey

The qualitative survey results of intertidal species recorded along the artificial seawall of Sha Tau Kok Town are presented in **Table 2.4** below. A total of 31 species were recorded.

During dry season, a total of 27 intertidal species were found at the artificial seawall. The most abundant species was *Saccostrea cucullata while Barbatia virescens*, *Septifer virgatus*, *Ligia exotica*, *Chroococcus* sp. and *Hildenbrandia rubra* were also frequently observed.

During wet season, a total of 20 intertidal species were observed at the artificial seawall. Abundant species included *Saccostrea cucullata* and *Ligia exotica*.

Table 2.4: List of Intertidal Species recorded at Artificial Seawall during Qualitative Walk-through

Category	Scientific Name	Relative Abundance (Dry Season)	Relative Abundance (Wet Season)
Bivalve	*Barbatia virescens*	+++	+++
	Isognomon isognomum	++	++
	Saccostrea cucullata	++++	++++
	Septifer virgatus	+++	+++
	Trapezium sublaevigatum	+	
Cnidarian	*Diadumene lineata*	++	++
Crustacean	*Balanus amphitrite*	++	+++
	Grapsus albolineatus	+	
	Hemigrapsus sanguineus	++	
	Ligia exotica	+++	++++
	Metopograpsus frontalis		++
	Unidentified juvenile crab	++	+++
Gastropod	*Cellana grata*	++	++
	Cellana toreuma	++	+
	Littoraria articulata	++	+
	Monodonta labio	++	+
	Nipponacmea concinna	++	++
	Onchidium verrucosa	+	

Category	Scientific Name	Relative Abundance (Dry Season)	Relative Abundance (Wet Season)
	Patelloida pygmaea	++	++
	Patelloida saccharina	+	
	Planaxis sulcatus		++
	Siphonaria japonica	++	
	Reishia clavigera	+	
	Thais luteostoma		+
Lichen, Cyanobacteria and Algae	*Chroococcus* sp.	+++	+++
	Colpomenia sinuosa	+	
	Corallina spp.		++
	Hildenbrandia rubra	+++	+++
	Ulva spp.	++	
Worm	*Hydroides* spp.	+	
	Spirorbis spp.	+	
	Total No. of Species	**27**	**20**

Keys:

+ : Present

++ : Occasional

+++ : Frequent

++++ : Abundant

Quantitative Transect Survey

The quantitative survey results of intertidal species recorded at artificial seawall in dry and wet seasons are presented in **Table 2.5** and **Table 2.6** respectively. A total of 30 species were recorded.

During dry season, 27 intertidal species were recorded during transect surveys. The Shannon Index (*H'*) and Species Evenness Index (*J'*) of artificial seawall for dry season were 1.29 and 0.41 respectively.

During wet season, a lower number of 20 intertidal species were recorded during transect surveys. However, higher values of Shannon Index (*H'*) and Species Evenness Index (*J'*) of artificial seawall for wet season were determined. The (*H'*) and (*J'*) were 1.37 and 0.48 respectively.

Table 2.5: List of Intertidal Species recorded at Artificial Seawall during Quantitative Survey in Dry Season

Intertidal Habitat Type: Artificial Seawall	Season: Dry	Abundance / Percentage Cover (per quadrat)					
		Transect AS1			Transect AS2		
Category	*Scientific Name*	High	Mid	Low	High	Mid	Low
Bivalve	*Barbatia virescens*		0.8%	1.4%		1.6%	1.6%
	Isognomon isognomum		0.3%	0.2%		0.1%	2.2%
	Saccostrea cucullata		33.0%	66.0%		52.0%	59.0%
	Septifer virgatus		0.9%	1.1%		2.6%	2.5%
	Trapezium sublaevigatum			0.1%			
Cnidarian	*Diadumene lineata*		0.3	0.7		0.3	0.3
Crustacean	*Balanus amphitrite*		0.4%	0.3%		0.5%	
	Grapsus albolineatus		0.2	0.3			0.3
	Hemigrapsus sanguineus					0.1	0.1
	Ligia exotica	0.5	3.3	1.9	0.4	0.5	1.7
	Unidentified juvenile crab			0.2		0.1	0.9

Intertidal Habitat Type: Artificial Seawall	Season: Dry	Abundance / Percentage Cover (per quadrat)					
		Transect AS1			Transect AS2		
Category	***Scientific Name***	**High**	**Mid**	**Low**	**High**	**Mid**	**Low**
Gastropod	*Cellana grata*			0.4		0.2	0.3
	Cellana toreuma		0.9	2.1		1.6	1.5
	Littoraria articulata			0.1		2.3	0.6
	Monodonta labio		2.1	0.3		1.1	0.8
	Nipponacmea concinna			0.7		1.6	1.2
	Onchidium verrucosa						0.1
	Patelloida pygmaea		0.2	0.9		0.9	1.2
	Patelloida saccharina		0.1			0.1	
	Siphonaria japonica		0.3	0.6		0.8	1.4
	Reishia clavigera			0.1			
Lichen, Cyanobacteria and Algae	*Chroococcus* sp.		29.0%			23.0%	
	Colpomenia sinuosa			0.1%			
	Hildenbrandia rubra		7.2%	0.5%		5.0%	8.0%
	Ulva spp.		2.5%	4.8%		0.2%	13.7%
Worm	*Hydroides* spp.			0.1			
	Spirorbis spp.					0.1	
Total No. of Species: 27							
Shannon Index (*H'*): 1.29							
Species Evenness Index (*J'*): 0.41							

Table 2.6: List of Intertidal Species recorded at Artificial Seawall during Quantitative Survey in Wet Season

Intertidal Habitat Type: Artificial Seawall	Season: Wet	Abundance / Percentage Cover (per quadrat)					
		Transect AS1			Transect AS2		
Category	***Scientific Name***	**High**	**Mid**	**Low**	**High**	**Mid**	**Low**
Bivalve	*Barbatia virescens*		1.6%	1.4%		0.9%	1.10%
	Isognomon isognomum		0.2%	0.3%		0.1%	0.5%
	Saccostrea cucullata		49.6%	78.0%		38.1%	84.0%
	Septifer virgatus		2.9%	2.8%		1.7%	4.1%
Cnidarian	*Diadumene lineata*			1.5		0.1	0.1
Crustacean	*Balanus amphitrite*		1.3%	1.9%		2.2%	1.7%
	Ligia exotica	0.2	10.7	11.4		5.1	14.2
	Metopograpsus frontalis		0.2	2.5		0.2	1.3
	Unidentified juvenile crab		1.8	1.9		0.8	0.3
Gastropod	*Cellana grata*		0.2	0.1		1	0.4
	Cellana toreuma		0.7	0.6		0.4	0.2
	Littoraria articulata				0.1		
	Monodonta labio		0.1	0.1		0.4	
	Nipponacmea concinna		0.7	1.3		0.4	0.2
	Patelloida pygmaea		1.6	1.5		1	0.4
	Planaxis sulcatus		0.7	0.2		1.4	
	Thais luteostoma					0.1	
Lichen, Cyanobacteria and Algae	*Chroococcus* sp.		33.0%			39.0%	
	Corallina spp.						0.1%
	Hildenbrandia rubra					17.0%	
Total No. of Species: 20							

Intertidal Habitat Type: Artificial Seawall	Season: Wet	Abundance / Percentage Cover (per quadrat)					
		Transect AS1			Transect AS2		
Category	*Scientific Name*	High	Mid	Low	High	Mid	Low
Shannon Index (*H'*): 1.37							
Species Evenness Index (*J'*): 0.48							

2.7.2 Rocky Shore

There were no rocky shore habitat inside the Study Area. Due to latest amendment of the outfall location which is close to Ah Kung Au, additional intertidal surveys were carried out for the rocky shores on east coast of Starling Inlet. The east coast of Starling Inlet, from Fung Hang to Ah Kung Tsui is featured with large boulder rocky shores on the outer region and mixed habitats of rocky shore and sandy shore in the relative inner region.

Qualitative Walk-through

The qualitative survey results of intertidal species observed on the rocky shores are presented in **Table 2.7** below. A total of 42 species were observed on the rocky shores during the walk-through surveys.

During dry season, a total of 39 intertidal species were found on rocky shores during the qualitative walk-through. Abundant species included *Saccostrea cucullata*, *Septifer virgatus*, *Balanus Amphitrite*, *Monodonta labio* and *Planaxis sulcatus*.

During wet season, a total of 34 intertidal species were observed on rocky shores. Abundant species included *Saccostrea cucullata*, *Septifer virgatus*, *Balanus Amphitrite*, *Echinolittorina radiata*, *Echinolittorina pascua*, *Monodonta labio* and *Planaxis sulcatus.*

Table 2.7: List of Intertidal Species recorded on Rocky Shores during Qualitative Walk-through

Category	Scientific Name	Relative Abundance (Dry Season)	Relative Abundance (Wet Season)
Bivalve	*Barbatia virescens*	+++	+++
	Caecella chinensis	+	+
	Isognomon isognomum	++	++
	Perna viridis	++	
	Saccostrea cucullata	++++	++++
	Septifer virgatus	++++	++++
	Trapezium sublaevigatum	++	
Cnidarian	*Diadumene lineata*	+++	+++
Crustacean	*Balanus albicostatus*	+	
	Balanus amphitrite	++++	++++
	Capitulum mitella	++	++
	Clibanarius virescens	+	
	Epixanthus frontalis	++	
	Eriphia laevimana	++	++
	Gaetice depressus	++	++
	Ligia exotica	+++	+++
	Metopograpsus frontalis	++	++
	Metopograpsus quadridentatus	++	+++

Category	Scientific Name	Relative Abundance (Dry Season)	Relative Abundance (Wet Season)
	Pagurus dubius	++	
	Scylla serrata		+
	Thalamita crenata	+	
	Unidentified juvenile crab	+++	+++
Gastropod	*Cellana grata*		++
	Cellana toreuma	++	++
	Cerithidea diadjariensis	+	
	Echinolittorina radiata	+++	++++
	Echinolittorina pascua	+++	++++
	Littoraria articulata	+	++
	Lunella coronata	+++	+++
	Monodonta labio	++++	++++
	Nerita albicilla	+	+
	Nerita chamaeleon		+
	Nipponacmea concinna	+	+
	Patelloida pygmaea	+++	+++
	Planaxis sulcatus	++++	++++
	Reishia clavigera	+++	+++
Lichen, Cyanobacteria and Algae	*Chroococcus* sp.	+++	+++
	Corallina spp.	+	+
	Hildenbrandia rubra	++	++
	Ulva spp.	+	+
Polyplacophora	*Acanthopleura japonica*	+	+
Worm	*Oligochaeta*	+	+
	Total No. of Species	**39**	**34**

Keys:
+ : Present
++ : Occasional
+++ : Frequent
++++ : Abundant

Quantitative Transect Survey

The quantitative survey results of intertidal species recorded on rocky shores in dry and wet seasons are presented in **Table 2.8** and **Table 2.9** respectively. A total of 41 species were recorded.

During dry season, a total of 38 species were recorded on rocky shores during transect survey. The Shannon Index (*H'*) and Species Evenness Index (*J'*) of rocky for dry season shore were 1.98 and 0.56 respectively.

During wet season, a low number of 33 species were recorded on rocky shores during transect survey. The Shannon Index (*H'*) and Species Evenness Index (*J'*) of rocky shore for wet season were 1.95 and 0.57 respectively.

Table 2.8: List of Intertidal Species recorded on Rocky Shores during Quantitative Survey in Dry Season

Intertidal Habitat Type: Rocky Shore	Season: Dry	Abundance / Percentage Cover (per quadrat)														
		Transect RS1			Transect RS2			Transect RS3			Transect RS4			Transect RS5		
Category	Scientific Name	High	Mid	Low	High	Mid	Low	High	Mid	Low	High	Mid	Low	High	Mid	Low
Bivalve	*Barbatia virescens*		0.6%	3.4%		1.0%	3.4%		0.8%	4.0%		0.8%	0.4%		2.2%	0.8%
	Caecella chinensis											0.2				
	Isognomon isognomum		0.2%	0.2%					4.0%	1.0%						
	Perna viridis			0.4%			4.0%									
	Saccostrea cucullata		44.0%	38.0%		30.0%	66.0%		8.0%	53.0%		42.2%	44.0%		61.0%	49.0%
	Septifer virgatus		3.0%	1.2%		5.6%	2.2%		1.0%	4.2%		1.6%	0.8%		2.6%	1.4%
	Trapezium sublaevigatum			1.0%												
Cnidarian	*Diadumene lineata*		1.2			0.2	0.8		0	4.6		0.4	2.6		3.6	5.6
Crustacean	*Balanus albicostatus*													0.2%		
	Balanus amphitrite		0.6%	0.4%		9.6%	2.0%		1.2%	0.2%		5.2%	2.2%		1.2%	3.8%
	Capitulum mitella		3.0%			5.4%			1.6%							
	Clibanarius virescens			1.2												
	Epixanthus frontalis								0.2				0.2		0.2	
	Eriphia laevimana			0.2			0.2									
	Gaetice depressus												0.4		0.2	
	Ligia exotica										0.8	1.2		3.8		
	Metopograpsus frontalis			0.6					0.2						0.2	
	Metopograpsus quadridentatus											0.4			1.4	
	Pagurus dubius			0.2			2									
	Thalamita crenata			0.2												
	Unidentified juvenile crab		0.2	0.8								0.6	1.4		1.8	0.8
Gastropod	*Cellana toreuma*					0.6				0.4			0.6			1.4
	Cerithidea diadjariensis			3.2												
	Echinolittorina radiata	9.6			7.6			1.6	1		5.4			8.4		
	Echinolittorina pascua	9.6			17.8			6.8			3.8					
	Littoraria articulata										0.6			0.6		
	Lunella coronata		1.6	8.4			9.2		0.2	0.8		1.4	5.6		1.6	2.4

Intertidal Habitat Type: Rocky Shore	Season: Dry	Abundance / Percentage Cover (per quadrat)														
		Transect RS1			Transect RS2			Transect RS3			Transect RS4			Transect RS5		
Category	Scientific Name	High	Mid	Low	High	Mid	Low	High	Mid	Low	High	Mid	Low	High	Mid	Low
	Monodonta labio		1.2	7		7.4	1.2		15.6	8.4		9.6	16.8		10.4	4.8
	Nerita albicilla		0.2										0.4			
	Nipponacmea concinna		0.2										0.2		0.2	
	Patelloida pygmaea					0.2	0.2		1.2	0		0.4			2	0.4
	Planaxis sulcatus	0.4	56.2	38.2		41.6	27.6		16.6	35.2		19.4	22.8		41.4	37.2
	Reishia clavigera		0.6	10.4			1.6			2.2		0.2	0.2			
Lichen, Cyanobacteria and Algae	*Corallina* spp.			3.8%			4.0%			0.4%						
	Hildenbrandia rubra		7.2%	1.0%		15.0%		2.0%	20.0%		1.0%	11.0%	1.0%		10.0%	25.0%
	Ulva spp.						0.2%									
Polyplacophora	*Acanthopleura japonica*					0.2										
Worm	*Oligochaeta*			2												
Total No. of Species: 38																
Shannon Index (*H'*): 1.98																
Species Evenness Index (*J'*): 0.56																

Table 2.9: List of Intertidal Species recorded on Rocky Shores during Quantitative Survey in Wet Season

Intertidal Habitat Type: Rocky Shore	Season: Wet	Abundance / Percentage Cover (per quadrat)														
		Transect RS1			Transect RS2			Transect RS3			Transect RS4			Transect RS5		
Category	Scientific Name	High	Mid	Low	High	Mid	Low	High	Mid	Low	High	Mid	Low	High	Mid	Low
Bivalve	*Barbatia virescens*		1.0%	2.6%		2.0%	4.2%		1.0%	6.0%			10.0%		0.2%	1.6%
	Caecella chinensis														4.8	0.2
	Isognomon isognomum		4.0%	1.2%					0.2%	0.6%						
	Saccostrea cucullata		24.0%	71.0%		68.0%	85.0%		41.0%	74.0%		6.4%	78.0%		3.0%	38.2%
	Septifer virgatus		0.8%	2.6%		3.2%	2.8%		2.2%	2.2%		0.8%	6.6%	0.2%	0.4%	2.6%
Cnidarian	*Diadumene lineata*			8.4		0.6	1.4		0	0.8			1.8			1.2
Crustacean	*Balanus amphitrite*		1.0%	6.0%		1.6%	3.8%		0.6%	1.4%		1.0%	1.8%	8.0%	1.0%	2.0%
	Capitulum mitella		0.6%						4.4%			1.2%				
	Eriphia laevimana						4.2									
	Gaetice depressus															0.4
	Ligia exotica	0.4			0.2			1						0.4		0.4
	Metopograpsus frontalis															0.4
	Metopograpsus quadridentatus			0.2		0.2			0.2				0.2			0.4
	Scylla serrata						0.2									
	Unidentified juvenile crab		0.2			1.2				2.8		0.2	3.4		0.4	3.2
Gastropod	*Cellana grata*		0.2	0.2												
	Cellana toreuma						1.6		0.4	0.2			0.6			
	Echinolittorina radiata	11.2			10.4			15.8			34.8	0.8		4.8		
	Echinolittorina pascua	7.2			18			24.8			74.8			4.4		
	Littoraria articulata	0.4	0.6		0.2				1			0.4	4.6			5
	Lunella coronata		0.4	2.6		0.8	1.4		0.8	0.8		0.2	0.2			1.6
	Monodonta labio		2	0.6		2.2	0.4	0.8	4.2	3.8	2.2	5.2	16	0.4	4	13.2
	Nerita albicilla														0.2	0.6
	Nerita chamaeleon		0.4													1
	Nipponacmea concinna						0.2									
	Patelloida pygmaea			0.6		0.8	0.4		1.4	0.8			0.4			0.8
	Planaxis sulcatus	1	28.2	25.6	0.2	27.6	30.2		18.6	34.6		7.2	35.8			10.2

Intertidal Habitat Type: Rocky Shore	Season: Wet	Abundance / Percentage Cover (per quadrat)														
		Transect RS1			Transect RS2			Transect RS3			Transect RS4			Transect RS5		
Category	Scientific Name	High	Mid	Low	High	Mid	Low	High	Mid	Low	High	Mid	Low	High	Mid	Low
	Reishia clavigera		0.4	0.8						0.6						
Lichen, Cyanobacteria and Algae	*Corallina* spp.						2.0%			2.0%						
	Hildenbrandia rubra	11.2%		8.0%	36.0%			6.0%				59.0%			3.0%	12.0%
	Ulva spp.						8.0%			0.2%						
Polyplacophora	*Acanthopleura japonica*						0.4									
Worm	*Oligochaeta*														1.2	0.2
Total No. of Species: 33																
Shannon Index (*H'*): 1.95																
Species Evenness Index (*J'*): 0.57																

2.7.3 Mudflat

The mudflat in Sha Tau Kok area ranges from around Wu Shek Kok to Muk Min Tau and the size is estimated to be larger than the one in Luk Keng. A part of the mudflat within the Study Area is located just southwest to the existing Sha Tau Kok Sewage Treatment Works. It extends from the edge of the mangrove which connected to the freshwater pond to an offshore shrubby island. Even though the general water depth of that area is low, the majority of the mudflat still only emerges during low tide. Oysters and cockles picking were observed on that area.

Qualitative Walk-through

The qualitative survey results of intertidal species observed on the mudflat are presented in **Table 2.10** below. A total of 49 species were found on the mudflat including Mangrove Horseshoe Crab *Carcinoscorpius rotundicauda* and Round Ribbontail Ray *Taeniura meyeni*. A large number of juvenile *C. rotundicauda* and a few mating pairs of this species were found on the mudflat. A individual of *Taeniura meyeni* was occasionally seen swimming on the mudflat at low tide.

During dry season, a total of 42 species were found on the mudflat during the walk-through surveys. Abundant species included *Saccostrea cucullata*, *Batillaria multiformis*, *Batillaria zonalis*, *Cerithidea cingulate*, *Cerithidea diadjariensis* and *Enteromorpha* spp..

During wet season, a total of 36 species were observed on the mudflat during the walk-through surveys. Abundant species included *Saccostrea cucullata*, Carcinoscorpius rotundicauda, Batillaria multiformis, Batillaria zonalis, Cerithidea cingulate and Cerithidea diadjariensis.

Table 2.10: List of Intertidal Species recorded at Mudflat during Qualitative Walk-through

Category	Scientific Name	Relative Abundance (Dry Season)	Relative Abundance (Wet Season)
Bivalve	*Anomalocardia squamosa*	+++	+++
	Barbatia virescens		+
	Cyclina sinensis	++	++
	Donax spp.	+	
	Geloina erosa		++
	Gafrarium divaricatum		+
	Grafrarium pectinatum	++	++
	Isognomon isognomum	+	+
	Marcia hiantina	++	++
	Meretrix meretrix		+
	Pinna muricata		+
	Placamen calophylla	+	+
	Saccostrea cucullata	++++	++++
	Septifer virgatus	+++	+++
	Tapes philippinarum	++	++
	Trapezium sublaevigatum	+	++
Cndarian	*Diadumene lineata*	+	
Chelicerata	*Carcinoscorpius rotundicauda*	+++	++++
Crustacean	*Balanus amphitrite*	+++	+++
	Clibanarius virescens	+	+

Category	Scientific Name	Relative Abundance (Dry Season)	Relative Abundance (Wet Season)
	Hemigrapsus sanguineus	+	
	Pagurus dubius	+	+
	Scylla serrata	+	+
	Uca (Deltuca) arcuata		+
	Unidentified juvenile crab	+	++
	Unidentified shrimp	+	+
	Unidentified shrimp juvenile	+	
Fish	*Periophthalmus cantonensis*	++	++
	Taeniura meyeni	+	
Gastropod	*Batillaria multiformis*	++++	++++
	Batillaria zonalis	++++	++++
	Cellana grata	++	++
	Cellana toreuma	++	
	Cerithidea cingulata	++++	++++
	Cerithidea diadjariensis	++++	++++
	Clithon faba	++	++
	Clithon oualaniensis	+++	++
	Lunella coronata	+++	++
	Monodonta labio		++
	Nassarius festivus	+++	+++
	Natica sp.	+	
	Nerita chamaeleon	+	
	Nipponacmea concinna	+	+
Lichen, Cyanobacteria and Algae	*Colpomenia sinuosa*	+	
	Enteromorpha spp.	++++	
	Hincksia mitchelliae	+++	
	Ulva spp.	++	
Tunicate	*Stylea* sp.	++	
Worm	*Oligochaeta*	++	++
	Total No. of Species	**42**	**36**

Keys:

+ : Present

++ : Occasional

+++ : Frequent

++++ : Abundant

Quantitative Transect Survey

The quantitative survey results of intertidal species recorded at mudflat in dry and wet seasons are presented in **Table 2.11** and **Table 2.12** respectively. A total of 47 species were recorded.

During dry season, 40 intertidal species were recorded during transect surveys. The Shannon Index (*H'*) and Species Evenness Index (*J'*) of mudflat for dry season were 2.14 and 0.60 respectively.

During wet season, a lower number of 35 intertidal species were recorded during transect surveys. However, higher values of Shannon Index (*H'*) and Species Evenness Index (*J'*) of mudflat for wet season were determined. The (*H'*) and (*J'*) were 2.19 and 0.62 respectively.

Table 2.11: List of Intertidal Species recorded at Mudflat during Quantitative Survey in Dry Season

Intertidal Habitat Type: Mudflat	**Season: Dry**	**Abundance / Percentage Cover (per quadrat)**					
		Transect MF1			**Transect MF2**		
Category	**Scientific Name**	**High**	**Mid**	**Low**	**High**	**Mid**	**Low**
Bivalve	*Anomalocardia squamosa*	0.5		1.8	2.9	3.5	4
	Cyclina sinensis	0.2		0.1			0.1
	Donax spp.			0.1			
	Grafrarium pectinatum	0.8	0.2	1.1	0.6	1.2	0.5
	Isognomon isognomum		0.2%				0.1%
	Marcia hiantina	0.2	0.1	0.1		0.6	0.3
	Placamen calophylla					0.1	0.7
	Saccostrea cucullata	5.2%	14.6%	2.1%	1.0%	1.2%	2.4%
	Septifer virgatus	0.8%	1.2%	0.2%			0.1%
	Tapes philippinarum	0.7	0.1	0.9	0.1		0.1
	Trapezium sublaevigatum	0.1%					
Cnidarian	*Diadumene lineata*		0.3				
Crustacean	*Balanus amphitrite*	0.5%	0.7%	0.2%		0.1%	0.1%
	Clibanarius virescens	0.1		0.3			
	Hemigrapsus sanguineus			0.1			
	Pagurus dubius	0.1	0.1	0.2			
	Scylla serrata			0.1			
	Unidentified juvenile crab	0.1	0.1				
	Unidentified shrimp					0.1	
	Unidentified juvenile shrimp				0.4		
Fish	*Periophthalmus cantonensis*						0.1
Gastropod	*Batillaria multiformis*	3.1	6.3	5.5	0.9	0.7	0.1
	Batillaria zonalis	21.6	24.8	32.7	14.81	16.3	12.1
	Cellana grata	1.2	1	0.5	0.2	0.1	0.2
	Cellana toreuma	0.2	0.1	0.1			
	Cerithidea cingulata	28.1	8.9	24.1	30.1	29.9	26.7
	Cerithidea diadjariensis	17.8	21.1	33.5	26.5	19.8	19.2
	Clithon faba		0.3	0.1		1.3	0.2
	Clithon oualaniensis	3.8	0.4	5.8	8.5	9.7	3.1
	Lunella coronata	1	2.2	0.8	0.2	0.3	0.1
	Nassarius festivus	0.2	3.5	6.9	1.1	3.7	3.2
	Natica sp.					0.4	
	Nerita chamaeleon				0.1		
	Nipponacmea concinna	0.1					
Lichen, Cyanobacteria and Algae	*Colpomenia sinuosa*					0.5%	
	Enteromorpha spp.	0.6%	0.7%	7.1%	18.0%	29.0%	6.0%
	Hincksia mitchelliae		0.1%			0.8%	
	Ulva spp.	0.4%	3.2%	0.7%	12.3%	7.7%	4.9%
Tunicate	*Stylea* sp.						0.1%
Worm	*Oligochaeta*				0.3	0.4	0.2

Intertidal Habitat Type: Mudflat	Season: Dry	Abundance / Percentage Cover (per quadrat)					
		Transect MF1			Transect MF2		
Category	Scientific Name	High	Mid	Low	High	Mid	Low
Total No. of Species: 40							
Shannon Index (*H'*): 2.14							
Species Evenness Index (*J'*): 0.6							

Table 2.12: List of Intertidal Species recorded at Mudflat during Quantitative Survey in Wet Season

Intertidal Habitat Type: Mudflat	Season: Wet	Abundance / Percentage Cover (per quadrat)					
		Transect MF1			Transect MF2		
Categories	Scientific Name	High	Mid	Low	High	Mid	Low
Bivalve	*Anomalocardia squamosa*	1.2	0.6	1.6	3.4	3.2	2.2
	Barbatia virescens		0.1%				
	Cyclina sinensis	0.2	0.1	0.2			0.1
	Geloina erosa	0.1		0.1	0.3	0.1	
	Gafrarium divaricatum		0.2				
	Grafrarium pectinatum	0.1	0.5	0.9	1.1	1.7	1.1
	Isognomon isognomum		0.1%				
	Marcia hiantina	0.1	0.1	0.1		0.1	0.1
	Meretrix meretrix	0.3	0.2	0.3	0.1		0.1
	Pinna muricata	0.002					
	Placamen calophylla				0.1	0.1	
	Saccostrea cucullata	7.7%	7.8%	6.0%	0.5%	1.0%	0.3%
	Septifer virgatus	1.2%	1.5%	0.5%			
	Tapes philippinarum	0.5	0.6	1.1		0.4	
	Trapezium sublaevigatum	0.2%	0.2%	0.1%			
Crustacean	*Balanus amphitrite*	0.7%	1.1%	0.1%		0.1%	
	Clibanarius virescens				0.1		
	Pagurus dubius		0.1				
	Scylla serrata			0.1			
	Uca (Deltuca) arcuata	0.2					
	Unidentified juvenile crab	1.1	1.2	0.3		0.2	
	Unidentified shrimp			0.1			
Fish	*Periophthalmus cantonensis*		0.1	0.2			
Gastropod	*Batillaria multiformis*	10	13	33.6	14.8	18.7	9.7
	Batillaria zonalis	23.4	24.5	31.1	26.9	38.7	19.6
	Cellana grata	0.5	0.7	0.1	0.2		
	Cerithidea cingulata	13.5	18.3	24.9	19.1	13.8	14.7
	Cerithidea diadjariensis	10	14.9	22.5	15.5	12.4	12.6
	Clithon faba	0.1	1.5	0.9	1.2	0.2	0.6
	Clithon oualaniensis	0.1	0.5	0.2	0.4	1.5	0.2
	Lunella coronata	0.2	2.2	1.9			
	Monodonta labio			1			
	Nassarius festivus	0.3	0.4	1.8	11.4	1.3	1.3
	Nipponacmea concinna		0.1				
Worm	*Oligochaeta*	0.4	0.8	0.3	0.2	1.2	0.4
Total No. of Species: 35							
Shannon Index (*H'*): 2.19							

Intertidal Habitat Type: Mudflat	Season: Wet	Abundance / Percentage Cover (per quadrat)					
		Transect MF1			Transect MF2		
Categories	Scientific Name	High	Mid	Low	High	Mid	Low
Species Evenness Index (*J'*): 0.62							

2.7.4 Mangrove

Mangrove habitat are generally distributed along the coastline in Starling Inlet from Fung Hang, Luk Keng to Sha Tau Kok. The mangrove within the Study Area is scattered in areas around the existing Sha Tau Kok Sewage Treatment Works. Some small patches of mangrove located north to the plant are enclosed by developed area. A relatively larger mangrove which located west to the plant is ecologically connected to estuarine, freshwater pond and mudflat habitat.

Qualitative Walk-through

The qualitative survey results of intertidal species observed at the mangrove are presented in **Table 2.13** below. A total of 43 intertidal fauna species and 14 flora species were found at the mangrove.

During dry season, a total of 48 intertidal species were observed at the mangrove during the walk-through surveys. Abundant species included *Batillaria multiformis*, *Batillaria zonalis*, *Cerithidea cingulate*, *Cerithidea diadjariensis*, *Enteromorpha* spp. and *Kandelia obovata*.

During wet season, a total of 42 intertidal species were observed at the mangrove during the walk-through surveys. Abundant species included *Batillaria multiformis*, *Batillaria zonalis*, *Cerithidea cingulate*, *Cerithidea diadjariensis* and *Kandelia obovata.* A small patch of seagrass species *Halophila ovata* was found at the mangrove edge during a horseshoe crab survey in wet season, thus it is also added to the species list. However, this small patch of *Halophila ovate* was only observed one time.

Table 2.13: List of Intertidal Species recorded at Mangrove during Qualitative Walk-through

Category	Scientific Name	Relative Abundance (Dry Season)	Relative Abundance (Wet Season)
Bivalve	*Anomalocardia squamosa*	+++	+++
	Cyclina sinensis	+	
	Grafrarium pectinatum	+	++
	Marcia hiantina	+	+
	Meretrix meretrix		+
	Placamen calophylla		+
	Saccostrea cucullata	++	++
	Scapharca cornea	+	
	Septifer virgatus	+	
	Tapes philippinarum		+
	Trapezium sublaevigatum		+
Cnidarian	*Diadumene lineata*	+	
Chelicerata	*Carcinoscorpius rotundicauda*	+	++
Crustacean	*Balanus amphitrite*	+	++
	Clibanarius virescens	+	+
	Diogenes spinifrons		+
	Pagurus dubius		+

Category	Scientific Name	Relative Abundance (Dry Season)	Relative Abundance (Wet Season)
	Unidentified juvenile crab	+	++
	Unidentified shrimp		+
Fish	*Periophthalmus cantonensis*	++	++
Gastropod	*Batillaria multiformis*	++++	++++
	Batillaria zonalis	++++	++++
	Cellana grata	++	++
	Cerithidea cingulata	++++	++++
	Cerithidea diadjariensis	++++	++++
	Cerithidea rhizophorarum	++	
	Clithon faba	++	++
	Clithon oualaniensis	+++	++
	Clithon retropictus	+	
	Clypeomorus coralia	+	+
	Littoraria ardouiniana	+	
	Littoraria articulata	+	
	Littoraria melanostoma	+	+
	Littoraria pallescens	+	
	Lunella coronata	+	+
	Nassarius festivus	+	+
	Nerita chamaeleon	+	
	Nipponacmea concinna	+	
	Terebralia sulcata	+	
Lichen, Cyanobacteria and Algae	*Enteromorpha* spp.	++++	
	Hincksia mitchelliae	++	
	Ulva spp.	+	
Plant	*Aegiceras corniculatum*	+	+
	Avicennia marina	++	++
	Bruguiera gymnorhiza	+	+
	Celtis sinensis	+	+
	Clerodendrum inerme	+	+
	Halophila ovata		+
	Hibiscus tiliaceus	++	++
	Ipomoea cairica	+	+
	Kandelia obovata	++++	++++
	Leucaena leucocephala	+	+
	Rhus chinensis	+	+
	Sageretia thea	++	++
	Scolopia chinensis	++	++
	Thespesia populnea	+	+
Worm	*Oligochaeta*		++
	Total No. of Species	**48**	**42**

Keys:

+ : Present

++ : Occasional

+++ : Frequent

++++ : Abundant

Quantitative Transect Survey

The quantitative survey results of intertidal species recorded at mangrove in dry and wet seasons are presented in **Table 2.14** and **Table 2.15** respectively. A total of 43 intertidal fauna species and two flora species were recorded.

During dry season, 36 intertidal species were recorded during transect surveys. The Shannon Index (*H'*) and Species Evenness Index (*J'*) of mangrove for dry season were 2.01 and 0.59 respectively.

During wet season, a lower number of 28 intertidal species were recorded during transect surveys. A lower value of Shannon Index (*H'*) and a higher value of Species Evenness Index (*J'*) of mangrove for wet season were determined. The (*H'*) and (*J'*) were 1.98 and 0.60 respectively.

Table 2.14: List of Intertidal Species recorded at Mangrove during Quantitative Survey in Dry Season

Intertidal Habitat Type: **Mangrove**	**Season: Dry**	**Abundance / Percentage Cover (per quadrat)**		
		Transect MG1		
Category	**Scientific Name**	**High**	**Mid**	**Low**
Bivalve	*Anomalocardia squamosa*	1.8	3.5	2.9
	Cyclina sinensis	0.2	0.3	
	Grafrarium pectinatum	0.3	0.2	
	Marcia hiantina		0.4	
	Saccostrea cucullata		0.4%	1.7%
	Scapharca cornea			0.1
	Septifer virgatus			0.1%
Cnidarian	*Diadumene lineata*	0.5		
Crustacean	*Balanus amphitrite*	0.2%		
	Clibanarius virescens		0.2	
	Unidentified juvenile crab			0.2
Fish	*Periophthalmus cantonensis*	0.1		
Gastropod	*Batillaria multiformis*	8.9	10.7	4.9
	Batillaria zonalis		13.3	44.5
	Cellana grata		1.5	0.6
	Cerithidea cingulata	14.8	34.4	23.4
	Cerithidea diadjariensis	5.2	18.3	9.7
	Cerithidea rhizophorarum	1.4		
	Clithon faba	0.1	0.4	
	Clithon oualaniensis	4.7	21.3	18
	Clithon retropictus			0.1
	Clypeomorus coralia	0.7		0.1
	Littoraria ardouiniana	0.3		
	Littoraria articulata	0.4		
	Littoraria melanostoma	0.8		
	Littoraria pallescens	0.1		
	Lunella coronata			0.5
	Nassarius festivus		3.5	0.2
	Nerita chamaeleon	0.1		
	Nipponacmea concinna			0.1

Intertidal Habitat Type: Mangrove	Season: Dry	Abundance / Percentage Cover (per quadrat)		
		Transect MG1		
Category	**Scientific Name**	**High**	**Mid**	**Low**
	Terebralia sulcata	0.2		
Lichen, Cyanobacteria and Algae	*Enteromorpha* spp.	48.5%	11.1%	5.8%
	Hincksia mitchelliae	1.0%	1.8%	1.2%
	Ulva spp.		1.4%	0.3%
Plant	*Avicennia marina*	2.0%		
	Kandelia candel	42.0%		
Total No. of Species: 36				
Shannon Index (*H'*): 2.01				
Species Evenness Index (*J'*): 0.59				

Table 2.15: List of Intertidal Species recorded at Mangrove during Quantitative Survey in Wet Season

Intertidal Habitat Type: Mangrove	Season: Wet	Abundance / Percentage Cover (per quadrat)		
		Transect 1		
Category	**Scientific Name**	**High**	**Mid**	**Low**
Bivalve	*Anomalocardia squamosa*	1.5	3.6	4.8
	Grafrarium pectinatum	0.3	0.4	0.5
	Marcia hiantina			0.1
	Meretrix meretrix	0.1	0.5	0.5
	Placamen calophylla			0.1
	Saccostrea cucullata	0.1%	0.5%	0.3%
	Tapes philippinarum		0.1	
	Trapezium sublaevigatum			0.001
Crustacean	*Balanus amphitrite*	0.2%	0.1%	0.1%
	Clibanarius virescens	0.8		
	Diogenes spinifrons			0.4
	Pagurus dubius			0.1
	Unidentified juvenile crab	0.8	0.4	0.1
	Unidentified shrimp	0.1		
Fish	*Periophthalmus cantonensis*	0.3		
Gastropod	*Batillaria multiformis*	1.8	4.5	9
	Batillaria zonalis	2.4	16.2	18.3
	Cellana grata		0.6	0.2
	Cerithidea cingulata	4.9	4.8	27.4
	Cerithidea diadjariensis	19.2	12.3	16.4
	Clithon faba		2.2	1.3
	Clithon oualaniensis		2.1	0.9
	Clypeomorus coralia		0.1	
	Littoraria melanostoma	0.1		
	Lunella coronata			0.1
	Nassarius festivus		0.9	0.2
Plant	*Kandelia candel*	57.5%		
Worm	*Oligochaeta*	0.1	0.5	0.3
Total No. of Species: 28				
Shannon Index (*H'*): 1.98				

Intertidal Habitat Type: Mangrove	Season: Wet	Abundance / Percentage Cover (per quadrat)		
		Transect 1		
Category	Scientific Name	High	Mid	Low
Species Evenness Index (*J'*): 0.6				

2.7.5 Sandy Habitats

Within the Study Area, there is an intertidal sandflat located south to the break water and the larger shrubby island. In high tide, only a small portion of the sandflat emerges from the water, most areas of the sandflat submerge underwater even the general water depth of that area is low. Scattered patches of seagrass bed of *Halophila ovata* were found on southeastern side of the sandflat. Oysters and cockles picking were observed on the sandflat. On the middle region of east coast of Starling Inlet, there are small open breaches with coarse sand and gravels.

Qualitative Walk-through

The qualitative survey results of intertidal species observed on the sandy habitats are presented in **Table 2.16** below. A total of 44 intertidal fauna species and one flora species were found.

During dry season, a total of 35 species were found on the sandy habitats during the qualitative walk-through surveys. Abundant species included *Saccostrea cucullata* and *Cerithidea diadjariensis.*

During wet season, a total of 32 species were found on the sandy habitats during the qualitative walk-through surveys. Abundant species included *Saccostrea cucullata* and *Septifer virgatus*.

Table 2.16: List of Intertidal Species recorded on Sandy Habitats during Qualitative Walk-through

Category	Scientific Name	Relative Abundance (Dry Season)	Relative Abundance (Wet Season)
Bivalve	*Anomalocardia squamosa*	++	++
	Caecella chinensis	+++	+++
	Cyclina sinensis		+
	Geloina erosa		+
	Grafrarium pectinatum		++
	Isognomon isognomum		+
	Marcia hiantina	++	+
	Meropesta nicobarica	++	+++
	Saccostrea cucullata	++++	++++
	Scapharca cornea		+
	Septifer virgatus	+++	++++
	Tapes philippinarum	++	+++
	Trapezium sublaevigatum	+	
Cnidarian	*Diadumene lineata*	+	
Crustacean	*Alpheus brevicristatus*	+	
	Balanus amphitrite	++	+++
	Clibanarius spp.		+
	Clibanarius virescens	+	
	Gaetice depressus		+
	Ligia exotica		+

Category	Scientific Name	Relative Abundance (Dry Season)	Relative Abundance (Wet Season)
	Metopograpsus quadridentatus	+	+
	Mictyris longicarpus	+	
	Ocypode ceratophthalmus	+	+
	Unidentified juvenile crab	+	+++
	Unidentified shrimp		+
	Unidentified juvenile shrimp	+	
Gastropod	*Batillaria multiformis*	++	+
	Batillaria zonalis	+++	+++
	Cellana grata		+
	Cerithidea cingulata	+++	
	Cerithidea diadjariensis	++++	+++
	Clithon faba		+
	Clithon oualaniensis	+	+
	Lunella coronata	+	++
	Monodonta labio	++	++
	Nassarius festivus	+++	+
	Nerita chamaeleon	+	
	Planaxis sulcatus	+	
	Reishia clavigera	+	+
Lichen, Cyanobacteria and Algae	*Hincksia mitchelliae*	++	+
	Ulva spp.	+	
Plant	*Halophila ovata*	+	
Tunicate	*Styela plicata*	+	
Worm	*Hydroides* spp.	+	
	Oligochaeta	+	+
	Ribbon worms *(Nemertea)*	+	
	Total No. of Species	**35**	**32**

Keys:
+ : Present
++ : Occasional
+++ : Frequent
++++ : Abundant

Quantitative Transect Survey

The quantitative survey results of intertidal species recorded on sandy habitats in dry and wet seasons are presented in **Table 2.17** and **Table 2.18** respectively. A total of 44 intertidal fauna species and one flora species were recorded.

During dry season, 34 intertidal species were recorded during transect surveys. The Shannon Index (*H'*) and Species Evenness Index (*J'*) of sandy habitats for dry season were 2.3 and 0.68 respectively.

During wet season, 29 intertidal species were recorded during transect surveys. Lower values of both Shannon Index (*H'*) and Species Evenness Index (*J'*) of sandy habitats for wet season were determined. The values were 1.77 and 0.52 respectively.

Table 2.17: List of Intertidal Species recorded on Sandy Habitats during Quantitative Survey in Dry Season

Intertidal Habitat Type: Sandflat / Sandy Shore	Season: Dry	Abundance / Percentage Cover (per quadrat)					
		Transect SS1			Transect SS2		
Category	Scientific Name	High	Mid	Low	High	Mid	Low
Bivalve	*Anomalocardia squamosa*	0.4	5.1	1.4			
	Caecella chinensis				1.8	9	0.8
	Marcia hiantina		0.8	0.2			
	Meropesta nicobarica				1.2	7	
	Saccostrea cucullata	7.4%	0.7%	16.1%			0.8%
	Septifer virgatus	1.3%		0.2%			
	Tapes philippinarum				2.4	3.6	
	Trapezium sublaevigatum			0.1%			
Cnidarian	*Diadumene lineata*	0.1					
Crustacean	*Alpheus brevicristatus*			0.3			
	Balanus amphitrite	2.6%					0.6%
	Clibanarius virescens			0.2			
	Metopograpsus quadridentatus			0.1			
	Mictyris longicarpus	0.2					
	Unidentified juvenile crab			0.1			
	Unidentified juvenile shrimp			0.3			
Gastropod	*Batillaria multiformis*	1.7	0.6	0.8			
	Batillaria zonalis	13.1	53.3	6.4			
	Cerithidea cingulata	12.2	38	1.9			
	Cerithidea diadjariensis	6.3	31.6	2.2			
	Clithon oualaniensis	2.2					
	Lunella coronata	0.2					0.4
	Monodonta labio	0.6					0.4
	Nassarius festivus	0.6	7.9	14.7			
	Nerita chamaeleon						0.2
	Planaxis sulcatus	0.1					
	Reishia clavigera	0.1					
Lichen, Cyanobacteria and Algae	*Hincksia mitchelliae*		1.3%	10.6%			
	Ulva spp.	0.5%	0.2%	0.1%			
Plant	*Halophila ovata*		0.6%				
Tunicate	*Styela plicata*		0.3%	1.6%			
Worm	*Hydroides* spp.			0.5			
	Oligochaeta	0.1	0.3	0.1			
	Ribbon worms *(Nemertea)*			0.2			
Total No. of Species: 34							
Shannon Index (*H'*): 2.3							
Species Evenness Index (*J'*): 0.68							

Table 2.18: List of Intertidal Species recorded on Sandy Habitats during Quantitative Survey in Wet Season

Intertidal Habitat Type: Sandflat Sandy / Shore	Season: Wet	Abundance / Percentage Cover (per quadrat)					
		Transect SS1			Transect SS2		
Category	Scientific Name	High	Mid	Low	High	Mid	Low
Bivalve	*Anomalocardia squamosa*			0.3	0.2		0.4
	Caecella chinensis				0.2	12.4	2.8

Intertidal Habitat Type: Sandflat Sandy / Shore	Season: Wet	Abundance / Percentage Cover (per quadrat)					
		Transect SS1			Transect SS2		
Category	Scientific Name	High	Mid	Low	High	Mid	Low
	Cyclina sinensis			0.1			
	Geloina erosa		0.1	0.1			
	Grafrarium pectinatum		0.1	0.1		0.2	
	Isognomon isognomum			0.2%			
	Marcia hiantina	0.1					
	Meropesta nicobarica				0.4	6.6	0.4
	Saccostrea cucullata	5.6%	5.6%	5.1%		2.0%	3.6%
	Scapharca cornea			0.1			
	Septifer virgatus	0.2%	0.3%	0.6%		0.4%	1.2%
	Tapes philippinarum		0.2	0.2		4.6	1.2
Crustacean	*Balanus amphitrite*	1.2%	1.7%	1.6%		1.6%	2.8%
	Clibanarius spp.			0.1			
	Gaetice depressus						0.4
	Ligia exotica				4.4		
	Metopograpsus quadridentatus						0.2
	Unidentified juvenile crab		0.1	0.2	0.8	0.2	1
	Unidentified shrimp		0.1				
Gastropod	*Batillaria multiformis*		0.1				
	Batillaria zonalis	0.9	5	3.8			
	Cellana grata		0.1	0.1			
	Cerithidea cingulata	0.2	3.2	2.1			
	Cerithidea diadjariensis		2	2.1			
	Clithon faba						0.2
	Clithon oualaniensis	0.1	0.1	0.2			
	Lunella coronata		0.3	0.4			0.2
	Monodonta labio		0.1			0.4	1.8
Worm	*Oligochaeta*						0.4
Total No. of Species: 29							
Shannon Index (*H'*): 1.77							
Species Evenness Index (*J'*): 0.52							

2.8 Subtidal Coral Survey

No coral communities were recorded at any of the locations surveyed during both Sport Dive Checks and REA surveys and no other rare or endangered species were recorded in the surveyed areas. Detailed survey findings are present in subtidal coral survey report attached as **Appendix 3**.

2.9 Subtidal Benthos Survey

Organic enrichment occurs in the surveyed areas. For the benthic community, no species of conservation concern were found from the grab samples except *Carcinoscorpius rotundicauda.* Juvenile and adult *C. rotundicauda* were grabbed during the sampling within the Study Area. Detailed survey findings are present in subtidal benthos survey report attached as **Appendices 4** and **5**.

3. Habitat Evaluation

Ecological evaluation of each habitat type within the Study Area is presented from **Table 3.1** to **Table 3.14** below.

Table 3.1: Ecological Evaluation of Woodland

Criteria	Woodland
Naturalness	Mostly natural, but some parts are tree plantations
Size	Sacattered in patches (approx. 11.87 ha)
Diversity	Rich in terms of floral diversity (149 species recorded)
Rarity	This habitat type is common in Hong Kong; No floral species of conservation concern were recorded; Mammal species of conservation concern, Leopard Cat, and uncommon mammal species Musk Shrew were recorded; Avifauna species of conservation concern recorded included Black Kite, Collared Scops Owl and Greater Coucal; Butterfly species of conservation concern recorded included Metallic Cerulean and Shiny-spotted Bob
Re-creatability	It will take approximately 30 to 40 years to re-create this habitat provided that adequate resources are available and in the absence of large-scale disturbance such as hill fire
Fragmentation	Limited fragmentation due to access roads and footpaths
Ecological linkage	It may provide a movement corridor for wildlife and it could serve as a seed source to facilitate the succession process in the surrounding area; Functionally linked to adjoining low-lying grassland and marsh habitats
Potential value	Moderate to high in terms of species diversity
Nursery/ breeding ground	No record of significant nursery or breeding ground
Age	Relatively mature with respect to the structural complexity and community composition
Abundance/ Richness of wildlife	High avifauna and butterfly abundance. High species richness
Ecological value	High

Table 3.2: Ecological Evaluation of Shrubland

Criteria	Shrubland
Naturalness	Natural habitat
Size	Small isolated islands (approx. 0.61 ha)
Diversity	Low in terms of floral diversity (11 species recorded)
Rarity	This habitat type is very common in Hong Kong; No floral species of conservation concern is recorded; Avifauna species of conservation concern including Greater Egret and Grey Heron were recorded
Re-creatability	Readily re-creatable naturally or artificially and would easily recover from disturbance
Fragmentation	Isolated islands within the Study Area
Ecological linkage	It may act as a stop over point for avifauna
Potential value	Low, as the isolated nature suggests that it has very limited potential to become woodland in the absence of disturbance given enough time
Nursery/ breeding ground	No record of significant nursery or breeding ground
Age	Secondary in nature
Abundance/ Richness of wildlife	Low species richness
Ecological value	Low

Table 3.3: Ecological Evaluation of Abandoned Agricultural Land / Low-lying Grassland

Criteria	Abandoned Agricultural Land / Low-lying Grassland
Naturalness	Semi-natural, as the low-lying grassland habitat is likely derived from abandoned agricultural land
Size	Moderate in size (approx. 15.61 ha)
Diversity	Moderate floral diversity (82 species recorded)
Rarity	This habitat type is common in Hong Kong; Floral species of conservation concern recorded included *Ceratopteris thalictroides* and *Zeuxine strateumatica*; Avifauna species of conservation concern, Black-crowned Night Heron, was recorded; Butterfly species of conservation concern, Pigmy Scrub Hopper, was recorded; Odonate species of conservation concern, Emerald Cascader, was recorded
Re-creatability	Readily re-creatable naturally or artificially and would recover easily from disturbance
Fragmentation	Patchily distributed at certain level near villages and other developed area
Ecological linkage	Some areas are potentially connected to woodland of high ecological value
Potential value	Low, as this habitat is homogeneous
Nursery/ breeding ground	No record of significant nursery or breeding ground
Age	Young
Abundance/ Richness of wildlife	Low species richness
Ecological value	Low

Table 3.4: Ecological Evaluation of Marsh

Criteria	Marsh
Naturalness	Natural habitat
Size	Moderate in size (approx. 8.4 ha)
Diversity	Moderate floral diversity (64 species recorded)
Rarity	This habitat type is uncommon in Hong Kong; No floral species of conservation concern is recorded; Herpetofauna species of conservation concern, Chinese Bullfrog was recorded; Butterfly species of conservation concern, Great Swift, was recorded
Re-creatability	Cannot be easily re-created as particular geographical conditions are required
Fragmentation	Fragmented by roads and footpaths
Ecological linkage	Some areas are potentially connected to woodland of high ecological value
Potential value	Moderate
Nursery/ breeding ground	No record of significant nursery or breeding ground
Age	Ancient geomorphological drainage features
Abundance/ Richness of wildlife	Moderate species richness
Ecological value	Moderate

Table 3.5: Ecological Evaluation of Mangrove

Criteria	Mangrove
Naturalness	Natural and semi-natural habitats, some areas experienced artificial modification
Size	Small in size (approx. 1.37 ha)
Diversity	Low floral diversity (13 species recorded)

Criteria	Mangrove
Rarity	This habitat type is common in Hong Kong waters; Floral species of conservation concern, *Thespesia populnea* and *Halophila ovalis* were recorded; Avifauna species of conservation concern recorded included Black-crowned Night Heron, Great Egret and White-cheeked Starling; Horseshoe Crab species *Carcinoscorpius rotundicauda* was recorded
Re-creatability	Potentially re-creatable through planting
Fragmentation	Fragmented by roads
Ecological linkage	Potentially connected to mudflat habitat
Potential value	Moderate
Nursery/ breeding ground	Potentially connected to mudflat which is a potentially important nursery or breeding ground for *Carcinoscorpius rotundicauda*
Age	Ancient
Abundance/ Richness of wildlife	Moderate species richness
Ecological value	Moderate-high

Table 3.6: Ecological Evaluation of Pond

Criteria	Pond
Naturalness	Man-made habitat
Size	Small in size (approx. 2.06 ha)
Diversity	Moderate floral diversity (67 species recorded)
Rarity	This habitat type is common in Hong Kong; Avifauna species of conservation concern including Black Kite, Black-crowned Night Heron, Chinese Grosbeak, Great Egret, Little Egret and Little Grebe were recorded
Re-creatability	Readily re-creatable
Fragmentation	Not fragmented
Ecological linkage	Potentially linked with mangrove habitat
Potential value	Moderate
Nursery/ breeding ground	No significant nursery or breeding ground recorded
Age	Young
Abundance/ Richness of wildlife	Moderate species richness
Ecological value	Moderate-low

Table 3.7: Ecological Evaluation of Stream / River

Criteria	Stream / River
Naturalness	Semi-natural, pristine at some sections, generally modified at stream banks and stream bed
Size	Small in size (approx. 0.61 ha)
Diversity	Moderate floral diversity (45 species recorded)
Rarity	This habitat type is common in Hong Kong; No floral species of conservation concern was recorded; Avifauna species of conservation concern including Black-crowned Night Heron, Chinese Pond Heron, Great Egret and Little Egret were recorded
Re-creatability	Re-creatable provided that works conducted in ecologically-sensitive manner and original flow not diverted or polluted, and in the absence of disturbance
Fragmentation	Not fragmented
Ecological linkage	Not functionally linked to any terrestrial habitats of high ecological value
Potential value	Low

Criteria	Stream / River
Nursery/ breeding ground	No significant nursery or breeding ground recorded
Age	Young
Abundance/ Richness of wildlife	Moderate species richness particularly freshwater fishes
Ecological value	Moderate-low

Table 3.8: Ecological Evaluation of Developed Area

Criteria	Developed Area
Naturalness	Man-made habitat with intensive human activities
Size	Lagre in size (approx. 72.4 ha)
Diversity	Very high floral diversity (248 species recorded)
Rarity	This habitat type is common in Hong Kong; Avifauna species of conservation concern including Black Kite, Black-crowned Night Heron, Chinese Grosbeak, Great Egret, Grey Heron, Little Egret and White-cheeked Starling were recorded
Re-creatability	Readily re-creatable
Fragmentation	Not fragmented
Ecological linkage	Not functionally linked to any terrestrial habitats of high ecological value
Potential value	Low
Nursery/ breeding ground	No significant nursery or breeding ground recorded
Age	Young
Abundance/ Richness of wildlife	High species richness
Ecological value	Low

Table 3.9: Ecological Evaluation of Artificial Seawall

Criteria	Artificial Seawall
Naturalness	Man-made habitat
Size	Small in size (Artificial seawall within the Study Area in Sha Tau Kok, approx. 0.6 ha)
Diversity	Low floral diversity
Rarity	This habitat type is common in Hong Kong; Avifauna species of conservation concern including Great Egret and Little Egret were recorded; Butterfly species of conservation concern, Comma *Polygonia c-aureum c-aureum,* was recorded
Re-creatability	Readily re-creatable
Fragmentation	Not fragmented
Ecological linkage	Not functionally linked to any terrestrial habitats of high ecological value
Potential value	Low
Nursery/ breeding ground	No significant nursery or breeding ground recorded
Age	Young
Abundance/ Richness of wildlife	Low species richness with 31 intertidal species
Ecological value	Low

Table 3.10: Ecological Evaluation of Rocky Shore

Criteria	Rocky Shore
Naturalness	Natural habitat
Size	Small in size (Rocky Shores on the ast coast of Starling Inlet)

Criteria	Rocky Shore
Diversity	N/A
Rarity	This habitat type is common in Hong Kong
Re-creatability	Non-creatable
Fragmentation	Fragmented as large boulder rocky shores arelocated on the outer region of the Starling Inlet while mixed habitat rocky shores and sandy shores are in relative inner region
Ecological linkage	Not functionally linked to any terrestrial habitats of high ecological value
Potential value	Low
Nursery/ breeding ground	No significant nursery or breeding ground recorded
Age	Ancient
Abundance/ Richness of wildlife	Low species richness with 42 intertidal species
Ecological value	Low

Table 3.11: Ecological Evaluation of Mudflat

Criteria	Mudflat
Naturalness	Natural habitat
Size	Large in size (Mudflat within the Study Area in Sha Tau Kok, approx. 10.3 ha)
Diversity	Very low floral diversity (1 species recorded)
Rarity	This habitat type is common in Hong Kong; A tiny patch of seagrass bed of *Halophila ovalis* was recorded on the mudflat near the mangrove edge; Adult Mangrove Horseshoe Crab *Carcinoscorpius rotundicauda* and high numbers of juveniles were recorded; Avifauna species of conservation concern including Black Kite, Great Egret, Little Egret, Grey Heron and White-brested Kingfisher were recorded
Re-creatability	Non-creatable
Fragmentation	Not fragmented
Ecological linkage	Potentially linked to mangrove and marine benthic habitats
Potential value	Moderate-low
Nursery/ breeding ground	A highly potential breeding and nursery ground for Mangrove Horseshoe Crab *Carcinoscorpius rotundicauda*
Age	Ancient
Abundance/ Richness of wildlife	Moderate-high species richness
Ecological value	Moderate-high

Table 3.12: Ecological Evaluation of Sandy Habitats

Criteria	Sandy Habitats
Naturalness	Natural habitat
Size	Moderate in size (Sandflat within the Study Area in Sha Tau Kok, approx. 5.7 ha)
Diversity	Very low floral diversity (1 species recorded)
Rarity	This habitat type is common in Hong Kong; Seagrass bed of *Halophila ovalis* was recorded in the the Sandflat with the Study Area in Sha Tau Kok
Re-creatability	Cannot be easily re-created as particular geographical conditions are required
Fragmentation	Intertidal sandflat within the Study Area in Sha Tau Kok is not fragmented; Sandy shores on the middle region of east coast of Starling Inlet are scattered
Ecological linkage	Not functionally linked to any habitats of high ecological value
Potential value	Moderate-low

Criteria	Sandy Habitats
Nursery/ breeding ground	Seagrass bed of *Halophila ovalis* could be a potential nursery and/or breeding ground for some intertidal and marine species
Age	Ancient
Abundance/ Richness of wildlife	Moderate-low species richness with 46 intertidal species
Ecological value	Moderate-low

Table 3.13: Ecological Evaluation of Subtidal Benthic Habitat within the Study Area in Sha Tau Kok

Criteria	Subtidal Benthic Habitat within the Study Area in Sha Tau Kok
Naturalness	Sampling sites B1, B3 and B4: subtidal soft muddy substratum; Sampling sites B2: intertidal fine sand substratum, exposed to strong sunlight during low tide in wet season; All sampling sites were under long term, mild organic enrichment and temporary hypoxic condition in wet season
Size	Large in size (approx. 45.7 ha)
Diversity	Low to moderate species number and moderate to high abundance leaded to moderate biodiversity and species evenness at all sampling sites
Rarity	Mangrove Horseshoe Crab *Carcinoscorpius rotundicauda* was recorded
Re-creatability	Non-creatable
Fragmentation	Not fragmented
Ecological linkage	Sha Tau Kok, Nam Chung and Luk Keng mangroves locates within Sha Tau Kok Sea. But the ecological linkage with the present survey area was insignificant
Potential value	Moderate-low
Nursery/ breeding ground	Seagrass bed of *Halophila ovalis* could be a potential nursery and/or breeding ground for some intertidal and marine species
Age	Ancient
Abundance/ Richness of wildlife	Benthic community in moderate abundance
Ecological value	Moderate-low

Table 3.14: Ecological Evaluation of Subtidal Benthic Habitat in Starling Inlet outside the Study Area

Criteria	Subtidal Benthic Habitat in Starling Inlet outside the Study Area
Naturalness	Soft and muddy substratum, all sampling sites were under long term, mild organic enrichment
Size	Large in size
Diversity	Low species number and abundance leaded to low biodiversity at all sampling sites
Rarity	Neither rare species nor species of conservation importance was recorded
Re-creatability	Non-creatable
Fragmentation	Not fragmented
Ecological linkage	Sha Tau Kok, Nam Chung and Luk Keng mangroves locates within Sha Tau Kok Sea. But the ecological linkage with the present survey area was insignificant
Potential value	Low
Nursery/ breeding ground	No significant nursery or breeding ground recorded
Age	Ancient
Abundance/ Richness of wildlife	Benthic community in low abundance
Ecological value	Low

4. Discussion

4.1 Terrestrial Ecology

The results of the avifauna surveys suggest that various habitats within the Study Area and other areas such as Luk Keng and Kuk Po within the Starling Inlet are important to avifauna community. Several winter visitor species with conservation concern were found with the Study Area including landbirds such as Chinese Grosbeak, Red-billed Starling and White-cheeked Starling, and waterbirds such as Black-tailed Gull, Great Cormorant and Little Grebe. This suggests that the Starling Inlet including the Study Area maybe a potential wintering ground or stop over point for the wintering birds.

Moreover, the existence of the night roosting site of Great Egret in Sha Tau Kok Town, A Chau egretry, marine habitats and wetland habitats in Sha Tau Kok and other locations (e.g. Kok Po) within the Starling Inlet indicates the importance of the entire Starling Inlet including the Study Area to ardeid species especially Great Egret.

One of the possible locations of the effluent outfall is in close vicinity of the mudflat and water with plenty records of waterbirds and ardeids, particularly Great Egret. Besides, the night roosting site of Great Egret is directly located at the proposed temporary works area of the Project. The location of the roosting Great Egret is within the boundary of the project area.

4.2 Marine Ecology

Intertidal mudflat at Luk Keng within the Starling Inlet is known to be an important breeding and nursery ground for *Carcinoscorpius rotundicauda.* Belonging to the same water system of Starling Inlet, the intertidal mudflat at Sha Tau Kok was expected sharing similar ecological character of Luk Keng. This prediction is supported by the records of mating pairs and abundant juveniles *C. rotundicauda* found on the mudflat within the Study Area.

Besides horseshoe crabs, seagrass beds of *Halophila ovalis* were also found on the sandflat and mudflat in Sha Tau Kok. Seagrassess are ecologically important since they can provide function as feeding grounds and nursery areas for different organisms such as fishes and horseshoe crabs. They can also stablilize sediments and prevent erosion with their dense roots and rhizomes.

This perennial herb is the most common seagrass species in Hong Kong and has been found in various locations such as San Tau in Lantau, Lai Chi Wo in Crooked Harbour and Wu Shek Kok near Sha Tau Kok (AFCD 2003) where the mudflat and mangrove are actually extended to Sha Tau Kok. All seagrasses in Hong Kong share the same character of co-existing with mangroves on sand and mudflat habitats (Chan 1998). In the field surveys, there was one record of a tiny patch of *H. ovalis* on the mangrove edge. Other records were all found on the offshore shallow sandflat with no mangrove plant exist and showing a drastic disappearance in July.

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Appendix 1

Survey Findings

Table 1: Plant List

Family	Botanical Name	Chinese Name	Woodland WL	Shrubland SL	Abandoned Agricultural land / Low-lying Grassland GL	Marsh MH	Mangrove MG	Pond PD	Stream / River SR	Developed Area DA	Developed area directly affected DAF	Grassland directly affected GLF
MIMOSACEAE 含羞草科	*Acacia confusa*	台灣相思	+		+					+	+	+
EUPHORBIACEAE 大戟科	*Acalypha wilkesiana*	紅桑								+		
ACROSTICHACEAE 鹵蕨科	*Acrostichum aureum*	鹵蕨				++						
MIMOSACEAE 含羞草科	*Adenanthera microsperma*	海紅豆								+		
ADIANTACEAE 鐵線蕨科	*Adiantum flabellulatum*	扇葉鐵線蕨	++									
ADIANTACEAE 鐵線蕨科	*Adiantum malesianum*	鞭葉鐵線蕨	+									
MYRSINACEAE 紫金牛科	*Aegiceras corniculatum*	蠟燭果					+					
AGAVACEAE 龍舌蘭科	*Agave americana* var. *marginata*	斑葉龍舌蘭								+		
ASTERACEAE 菊科	*Ageratum conyzoides*	勝紅薊	+							+	+	
MELIACEAE 楝科	*Aglaia odorata var. microphyllina*	小葉米仔蘭								++	+	
ALANGIACEAE 八角楓科	*Alangium chinense*	八角楓	+									
MIMOSACEAE 含羞草科	*Albizia lebbeck*	大葉合歡								+	+	
EUPHORBIACEAE 大戟科	*Aleurites moluccana*	石栗								+		
APOCYNACEAE 夾竹桃科	*Allamanda schottii*	硬枝黃蟬								+		
LILIACEAE 百合科	*Allium fistulosum*	蔥								+		
ARACEAE 天南星科	*Alocasia macrorrhizos*	海芋	+		+	++			+	+		+
ALOEACEAE 蘆薈科	*Aloe vera*	蘆薈			+					+	+	
ZINGIBERACEAE 薑科	*Alpinia oblongifolia*	華山薑	++									
APOCYNACEAE 夾竹桃科	*Alstonia scholaris*	糖膠樹								+	+	
AMARANTHACEAE 莧科	*Alternanthera philoxeroides*	空心莧			+	+						+
AMARANTHACEAE 莧科	*Alternanthera sessilis*	蝦鉗菜										+
AMARANTHACEAE 莧科	*Amaranthus tricolor*	莧菜								+		
AMARANTHACEAE 莧科	*Amaranthus viridis*	野莧	+			+		+		+		
VITACEAE 葡萄科	*Ampelopsis cantoniensis*	廣東蛇葡萄	+									
ANNONACEAE 番荔枝科	*Annona squamosa*	番荔枝								+		
APIACEAE (UMBELLIFERAE) 傘形科	*Apium graveolens*	西芹								+		

Family	Botanical Name	Chinese Name	Woodland	Shrubland	Abandoned Agricultural land / Low-lying Grassland	Marsh	Mangrove	Pond	Stream / River	Developed Area	Developed area directly affected	Grassland directly affected
			WL	**SL**	**GL**	**MH**	**MG**	**PD**	**SR**	**DA**	**DAF**	**GLF**
POACEAE 禾本科	*Apluda mutica*	水蔗草			+	++				+		
EUPHORBIACEAE 大戟科	*Aporusa dioica*	銀柴	++					+				
ARAUCARIACEAE 南洋杉科	*Araucaria heterophylla*	異葉南洋杉								+		
MIMOSACEAE 含羞草科	*Archidendron lucidum*	亮葉猴耳環	+									
MIMOSACEAE 含羞草科	*Archidendron utile*	薄葉猴耳環	+									
ARECACEAE 棕櫚科	*Archontophoenix alexandrae*	假檳榔								+		
MYRSINACEAE 紫金牛科	*Ardisia quinquegona*	羅傘樹	+					+				
ASTERACEAE 菊科	*Artemisia annua*	黃花蒿			+							
MORACEAE 桑科	*Artocarpus heterophyllus*	菠蘿蜜						+		+		
LILIACEAE 百合科	*Asparagus cochinchinensis*	天門冬	+		+			+				
LILIACEAE 百合科	*Asparagus sprengeri*	武竹								+		
RUTACEAE 芸香科	*Atalantia buxifolia*	酒餅簕						+		+	+	
VERBENACEAE 馬鞭草科	*Avicennia marina*	白骨壤		+			++					
POACEAE 禾本科	*Bambusa multiplex var. riviereorum*	觀音竹								+		
POACEAE 禾本科	*Bambusa sp.*	簕竹屬	+		+					+		++
BASELLACEAE 落葵科	*Basella alba*	落葵								+		
CAESALPINIACEAE 蘇木科	*Bauhinia variegata*	宮粉羊蹄甲								+		
CAESALPINIACEAE 蘇木科	*Bauhinia variegata* var. *candida*	白花洋紫荊								+		
CAESALPINIACEAE 蘇木科	*Bauhinia x blakeana*	洋紫荊	+			+				+		
BEGONIACEAE 秋海棠科	*Begonia cucullata* var. *hookeri*	四季秋海棠				+						
ASTERACEAE 菊科	*Bidens alba*	白花鬼針草	+		+++	++		+	+	++	+	
EUPHORBIACEAE 大戟科	*Bischofia javanica*	秋楓	+			+		+		+		
BLECHNACEAE 烏毛蕨科	*Blechnum orientale*	烏毛蕨	+							+		
ASTERACEAE 菊科	*Blumea laciniata*	六耳鈴	+									
URTICACEAE 蕁麻科	*Boehmeria nivea*	苧麻			+				+	+		
BOMBACACEAE 木棉科	*Bombax ceiba*	木棉	+		+					+		+
NYCTAGINACEAE 紫茉莉科	*Bougainvillea spectabilis*	簕杜鵑								+		
BRASSICACEAE (CRUCIFERAE)	*Brassica alboglabr*	芥蘭								+		

Family	Botanical Name	Chinese Name	Woodland	Shrubland	Abandoned Agricultural land / Low-lying Grassland	Marsh	Mangrove	Pond	Stream / River	Developed Area	Developed area directly affected	Grassland directly affected
			WL	**SL**	**GL**	**MH**	**MG**	**PD**	**SR**	**DA**	**DAF**	**GLF**
十字花科												
BRASSICACEAE (CRUCIFERAE) 十字花科	*Brassica chinensis*	白菜						+		+		
BRASSICACEAE (CRUCIFERAE) 十字花科	*Brassica oleracea* var. *capitata*	椰菜								+		
EUPHORBIACEAE 大戟科	*Breynia fruticosa*	黑面神	+					+				
EUPHORBIACEAE 大戟科	*Bridelia tomentosa*	土蜜樹	+		+			+		+	+	
RHIZOPHORACEAE 紅樹科	*Bruguiera gymnorhiza*	木欖					+					
CRASSULACEAE 景天科	*Bryophyllum pinnatum*	落地生根								+	+	
MIMOSACEAE 含羞草科	*Calliandra haematocephala*	紅絨球								++		
MYRTACEAE 桃金娘科	*Callistemon viminalis*	串錢柳	+							++		
THEACEAE 山茶科	*Camellia sp.*	山茶屬								+	+	
RUBIACEAE 茜草科	*Canthium dicoccum*	魚骨木	+									
BRASSICACEAE (CRUCIFERAE) 十字花科	*Capsella bursa-pastoris*	薺菜	+							+		
SOLANACEAE 茄科	*Capsicum annuum*	辣椒								+		
CARICACEAE 番木瓜科	*Carica papaya*	番木瓜			+			+		+	+	
BORAGINACEAE 紫草科	*Carmona microphylla*	基及樹								+		
ARECACEAE 棕櫚科	*Caryota mitis*	短穗魚尾葵								+		
CASUARINACEAE 木麻黃科	*Casuarina equisetifolia*	木麻黃								+		
APOCYNACEAE 夾竹桃科	*Catharanthus roseus*	長春花								+		
AMARANTHACEAE 莧科	*Celosia argentea*	青葙	+							+		
ULMACEAE 榆科	*Celtis sinensis*	朴樹	++		+		+	+	+	+	+	+
POACEAE 禾本科	*Cenchrus echinatus*	蒺藜草								+		
APIACEAE (UMBELLIFERAE) 傘形科	*Centella asiatica*	崩大碗	+		+					+		
POACEAE 禾本科	*Centotheca lappacea*	假淡竹葉	+									
PTERIDACEAE 鳳尾蕨科	*Ceratopteris thalictroides* *	水蕨			+							
CHENOPODIACEAE 藜科	*Chenopodium ficifolium*	小藜								+		
POACEAE 禾本科	*Chloris barbata*	孟仁草			+					+		

Family	Botanical Name	Chinese Name	Woodland	Shrubland	Abandoned Agricultural land / Low-lying Grassland	Marsh	Mangrove	Pond	Stream / River	Developed Area	Developed area directly affected	Grassland directly affected
			WL	**SL**	**GL**	**MH**	**MG**	**PD**	**SR**	**DA**	**DAF**	**GLF**
ASTERACEAE 菊科	*Chrysanthemum segetum*	茼蒿								+		
LAURACEAE 樟科	*Cinnamomum burmannii*	陰香	+					+		+		
LAURACEAE 樟科	*Cinnamomum camphora*	樟	+					+		+		
LAURACEAE 樟科	*Cinnamomum parthenoxylon*	黃樟	+									
RUTACEAE 芸香科	*Citrus maxima*	柚			+					+		
RUTACEAE 芸香科	*Clausena lansium*	黃皮								+		
CAPPARACEAE 白花菜科	*Cleome burmannii*	印度白花菜								+		
VERBENACEAE 馬鞭草科	*Clerodendrum chinense*	重瓣臭茉莉			+					+		
VERBENACEAE 馬鞭草科	*Clerodendrum inerme*	苦郎樹		++			+	+				
EUPHORBIACEAE 大戟科	*Codiaeum variegatum*	變葉木								+		
ARACEAE 天南星科	*Colocasia esculenta*	芋			+	++			+	+		
COMMELINACEAE 鴨跖草科	*Commelina diffusa*	節節草				+						
COMMELINACEAE 鴨跖草科	*Commelina paludosa*	大苞鴨跖草							+			
ASTERACEAE 菊科	*Conyza bonariensis*	香絲草								+		
ASTERACEAE 菊科	*Conyza sumatrensis*	蘇門白酒草								+		
MALVACEAE 錦葵科	*Corchorus capsularis*	黃麻								+		
BORAGINACEAE 紫草科	*Cordia dichotoma*	破布木	+									
AGAVACEAE 龍舌蘭科	*Cordyline fruticosa*	朱蕉								+		
ASTERACEAE 菊科	*Crassocephalum crepidioides*	野茼蒿							+			
CLUSIACEAE 山竹子科	*Cratoxylum cochinchinense*	黃牛木	+		+							
LILIACEAE 百合科	*Crinum asiaticum*	文殊蘭	+					+				
FABACEAE (PAPILIONACEAE) 蝶形花科	*Crotalaria pallida* var. *obovata*	豬屎豆			+							
CUCURBITACEAE 葫蘆科	*Cucumis sativus*	青瓜								+		
LYTHRACEAE 千屈菜科	*Cuphea hyssopifolia*	細葉萼距花								+		
CUSCUTACEAE 菟絲子科	*Cuscuta campestris*	田野菟絲子	+		+	+						+
THELYPTERIDACEAE 金星蕨科	*Cyclosorus interruptus*	間斷毛蕨				+++				+		
CYPERACEAE 莎草科	*Cyperus compressus*	扁穗莎草			+							
CYPERACEAE 莎草科	*Cyperus distans*	疏穗莎草							+			

Family	Botanical Name	Chinese Name	Woodland	Shrubland	Abandoned Agricultural land / Low-lying Grassland	Marsh	Mangrove	Pond	Stream / River	Developed Area	Developed area directly affected	Grassland directly affected
			WL	**SL**	**GL**	**MH**	**MG**	**PD**	**SR**	**DA**	**DAF**	**GLF**
CYPERACEAE 莎草科	*Cyperus involucratus*	風車草						+				
CYPERACEAE 莎草科	*Cyperus pilosus*	毛軸莎草				+						
CYPERACEAE 莎草科	*Cyperus rotundus*	香附子							+			
POACEAE 禾本科	*Cyrtococcum patens*	弓果黍				+						
POACEAE 禾本科	*Cynodon dactylon*	狗牙根								+		
DAPHNIPHYLLACEAE 交讓木科	*Daphniphyllum calycinum*	牛耳楓	+					+				
APIACEAE (UMBELLIFERAE) 傘形科	*Daucus carota*	胡蘿蔔								+		
CAESALPINIACEAE 蘇木科	*Delonix regia*	鳳凰木	+							+		
ASTERACEAE 菊科	*Dendranthema indicum*	野菊			+							
FABACEAE (PAPILIONACEAE) 蝶形花科	*Desmodium heterocarpon*	假地豆	+		+							
FABACEAE (PAPILIONACEAE) 蝶形花科	*Desmodium heterophyllum*	異葉山螞蝗	+									
ANNONACEAE 番荔枝科	*Desmos chinensis*	假鷹爪	++					+		+	+	
LILIACEAE 百合科	*Dianella ensifolia*	山菅蘭	+									
GLEICHENIACEAE 裏白科	*Dicranopteris pedata*	芒萁	+									
POACEAE 禾本科	*Digitaria longiflora*	長花馬唐			+					+		
POACEAE 禾本科	*Digitaria sanguinalis*	馬唐	+							+		
SAPINDACEAE 無患子科	*Dimocarpus longan*	龍眼	+							+		
DIOSCOREACEAE 薯蕷科	*Dioscorea bulbifera*	黃獨	+					+				
AGAVACEAE 龍舌蘭科	*Dracaena fragrans*	巴西鐵樹	+							+	+	
AGAVACEAE 龍舌蘭科	*Dracaena sanderiana*	富貴竹								+		
CARYOPHYLLACEAE 石竹科	*Drymaria cordata*	荷蓮豆							+			
VERBENACEAE 馬鞭草科	*Duranta erecta*	假連翹								+		
VERBENACEAE 馬鞭草科	*Duranta repens variegata*	花葉假連翹								+		
ARECACEAE 棕櫚科	*Dypsis lutescens*	散尾葵			+					+		+
POACEAE 禾本科	*Echinochloa crusgalli*	稗	+									
ASTERACEAE 菊科	*Eclipta prostrata*	鱧腸			+	+			+	+		
ELAEOCARPACEAE 杜英科	*Elaeocarpus sylvestris*	山杜英								+		

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			WL	**SL**	**GL**	**MH**	**MG**	**PD**	**SR**	**DA**	**DAF**	**GLF**
POACEAE 禾本科	*Eleusine indica*	牛筋草						+		+		
ARALIACEAE 五加科	*Eleutherococcus trifoliatus*	白簕	+							+		
ASTERACEAE 菊科	*Emilia sonchifolia*	一點紅	+		+	+				+	+	
POACEAE 禾本科	*Eragrostis tenella*	鯽魚草			+					+		+
MYRTACEAE 桃金娘科	*Eucalyptus citriodora*	檸檬桉								+		
EUPHORBIACEAE 大戟科	*Euphorbia antiquorum*	火殃簕								+		
EUPHORBIACEAE 大戟科	*Euphorbia hirta*	飛揚草								+	+	
EUPHORBIACEAE 大戟科	*Euphorbia thymifolia*	小飛揚								+		
LOGANIACEAE 馬錢科	*Fagraea ceilanica*	灰莉								+		
MORACEAE 桑科	*Ficus altissima*	高山榕								+		
MORACEAE 桑科	*Ficus benghalensis* var. *krishnae*	囊葉榕								+		
MORACEAE 桑科	*Ficus benjamina*	垂葉榕				+				++	+	
MORACEAE 桑科	*Ficus benjamina* 'Variegata'	花葉垂榕								+		
MORACEAE 桑科	*Ficus hirta*	粗葉榕	++									
MORACEAE 桑科	*Ficus hispida*	對葉榕	+		+	+		+	+			
MORACEAE 桑科	*Ficus microcarpa*	細葉榕				+		+	+	+++	+	
MORACEAE 桑科	*Ficus microcarpa* 'Golden Leaves'	黃金榕								+		
MORACEAE 桑科	*Ficus microcarpa* var. *crassifolia*	圓葉榕								+		
MORACEAE 桑科	*Ficus pumila*	薜荔	+		+			+		+		
MORACEAE 桑科	*Ficus religiosa*	菩提樹								+		
MORACEAE 桑科	*Ficus subpisocarpa*	筆管榕		+					+	+	+	
MORACEAE 桑科	*Ficus variegata*	青果榕	+							+		
MORACEAE 桑科	*Ficus virens*	大葉榕						+	+	++		
CYPERACEAE 莎草科	*Fimbristylis dichotoma*	兩歧飄拂草			+							
CYPERACEAE 莎草科	*Fimbristylis littiralis*	水虱草				+						
CLUSIACEAE 山竹子科	*Garcinia subelliptica*	菲島福木								+		
RUBIACEAE 茜草科	*Gardenia jasminoides var. fortuniana*	白蟾								+		
ASTERACEAE 菊科	*Gerbera jamesonii*	非洲菊								+		

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EUPHORBIACEAE 大戟科	*Glochidion eriocarpum*	毛果算盤子	+									
EUPHORBIACEAE 大戟科	*Glochidion hirsutum*	厚葉算盤子			+	+		+				
EUPHORBIACEAE 大戟科	*Glochidion zeylanicum*	香港算盤子	+		+	+						
RUTACEAE 芸香科	*Glycosmis parviflora*	山小橘						+				
ASTERACEAE 菊科	*Gnaphalium pensylvanicum*	匙葉鼠麴草	+		+	+						
PROTEACEAE 山龍眼科	*Grevillea robusta*	銀樺								+		
RUBIACEAE 茜草科	*Hamelia patens*	長隔木								+		
ZINGIBERACEAE 薑科	*Hedychium coronarium*	薑花	+			+						
RUBIACEAE 茜草科	*Hedyotis acutangula*	方骨草	+									
RUBIACEAE 茜草科	*Hedyotis corymbosa*	繖房花耳草	+		+	+				+	+	+
RUBIACEAE 茜草科	*Hedyotis diffusa*	白花蛇舌草				+			+			
MALVACEAE 錦葵科	*Hibiscus rosa-sinensis var. rubro-plenus*	重瓣朱槿								+		
MALVACEAE 錦葵科	*Hibiscus schizopetalus*	吊燈花								+		
MALVACEAE 錦葵科	*Hibiscus tiliaceus*	黃槿		++	+	+	++			+		+
LILIACEAE 百合科	*Hippeastrum vittatum*	花朱頂蘭								+	+	
UMBELLIMACFERAE 繖形科	*Hydrocotyle sibthorpioides*	天胡荽				+						
UMBELLIMACFERAE 繖形科	*Hydrocotyle sp.*	天胡荽屬							++			
ACANTHACEAE 爵床科	*Hygrophila salicifolia*	水蓑衣				+						
CACTACEAE 仙人掌科	*Hylocereus undatus*	量天尺						+		+	+	
POACEAE 禾本科	*Imperata cylindrica* var. *major*	大白茅			++					+	+	
CONVOLVULACEAE 旋花科	*Ipomoea aquatica*	蕹菜								+		
CONVOLVULACEAE 旋花科	*Ipomoea batatas*	番薯								+		
CONVOLVULACEAE 旋花科	*Ipomoea cairica*	五爪金龍	+		++	++	+	+	++	+		++
CONVOLVULACEAE 旋花科	*Ipomoea mauritiana*	七爪龍	+									
POACEAE 禾本科	*Isachne globosa*	柳葉箬				+						
POACEAE 禾本科	*Ischaemum ciliare*	細毛鴨嘴草						+				
RUBIACEAE 茜草科	*Ixora chinensis*	龍船花								+		
RUBIACEAE 茜草科	*Ixora stricta*	細葉龍船花								+		

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CUPRESSACEAE 柏科	*Juniperus chinensis*	圓柏								+		
CRASSULACEAE 景天科	*Kalanchoe blossfeldiana*	長壽花								+		
RHIZOPHORACEAE 紅樹科	*Kandelia obovata*	秋茄樹		+			+++					
CYPERACEAE 莎草科	*Kyllinga brevifolia*	短葉水蜈蚣			+							
CYPERACEAE 莎草科	*Kyllinga nemoralis*	單穗水蜈蚣	+							+		
CYPERACEAE 莎草科	*Kyllinga polyphylla*	水蜈蚣			++	++		+	+			
ASTERACEAE 菊科	*Lactuca sativa*	萵苣						+		+		
LYTHRACEAE 千屈菜科	*Lagerstroemia speciosa*	大花紫薇	+							+		
VERBENACEAE 馬鞭草科	*Lantana camara*	馬纓丹	+	+	+	+		+		+	+	
POACEAE 禾本科	*Leersia hexandra*	李氏禾				+						
POLYPODIACEAE 水龍骨科	*Lemmaphyllum microphyllum*	伏石蕨								+		
LEMNACEAE 浮萍科	*Lemna minor*	青萍				+				+		
ACANTHACEAE 爵床科	*Lepidagathis incurva*	鱗花草	+									
POACEAE 禾本科	*Leptochloa chinensis*	千金子			++							
MIMOSACEAE 含羞草科	*Leucaena leucocephala*	銀合歡	+	+++	+	+	+		+	+	+	++
OLEACEAE 木犀科	*Ligustrum sinense*	山指甲	+					+		+	+	
SCROPHULARIACEAE 玄參科	*Lindernia anagallis*	長蕅母草				+			+			
SCROPHULARIACEAE 玄參科	*Lindernia crustacea*	母草	+		+			+		+		
SCROPHULARIACEAE 玄參科	*Lindernia rotundifolia* 'Aurea'	迷你虎耳草				+						
HAMAMELIDACEAE 金縷梅科	*Liquidambar formosana*	楓香								+		
LILIACEAE 百合科	*Liriope spicata*	山麥冬	+					+				
SAPINDACEAE 無患子科	*Litchi chinensis*	荔枝								+		
FAGACEAE 殼斗科	*Lithocarpus corneus*	煙斗柯	+									
LAURACEAE 樟科	*Litsea cubeba*	山蒼樹	+									
LAURACEAE 樟科	*Litsea glutinosa*	潺槁樹						+		+	+	
LAURACEAE 樟科	*Litsea rotundifolia* var. *oblongifolia*	豺皮樟	+									
ARECACEAE 棕櫚科	*Livistona chinensis*	蒲葵								+		
HAMAMELIDACEAE 金縷梅科	*Loropetalum chinense*	紅花繼木								+		

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ONAGRACEAE 柳葉菜科	*Ludwigia adscendens*	水龍				+			+			
ONAGRACEAE 柳葉菜科	*Ludwigia hyssopifolia*	草龍							+			
ONAGRACEAE 柳葉菜科	*Ludwigia octovalvis*	毛草龍			+	+		+	+			+
CUCURBITACEAE 葫蘆科	*Luffa aegyptiaca*	水瓜								+		
SOLANACEAE 茄科	*Lycium chinense*	枸杞								+		
LYCOPODIACEAE 石松科	*Lycopodium cernuum*	鋪地蜈蚣	+									
LYGODIACEAE 海金沙科	*Lygodium flexuosum*	長葉海金沙	+									
LYGODIACEAE 海金沙科	*Lygodium japonicum*	海金沙	+		+				+	+	+	
LYGODIACEAE 海金沙科	*Lygodium scandens*	小葉海金沙	+		+					+		
EUPHORBIACEAE 大戟科	*Macaranga tanarius var. tomentosa*	血桐	+		++	+		+	+	+	+	
LAURACEAE 樟科	*Machilus chekiangensis*	浙江潤楠	+									
MYRSINACEAE 紫金牛科	*Maesa perlarius*	鯽魚膽	+									
MAGNOLIACEAE 木蘭科	*Magnolia grandiflora*	荷花玉蘭								+		
EUPHORBIACEAE 大戟科	*Mallotus apelta*	白背葉	+									
EUPHORBIACEAE 大戟科	*Mallotus paniculatus*	白楸	++					+				
MALVACEAE 錦葵科	*Malvastrum coromandelianum*	賽葵						+		+		
MALVACEAE 錦葵科	*Malvaviscus arboreus var. penduliflorus*	垂花懸鈴花								+		
ANACARDIACEAE 漆樹科	*Mangifera indica*	杧果								+		
MARANTACEAE 竹芋科	*Maranta arundinacea*	竹芋								+		
CYPERACEAE 莎草科	*Mariscus javanicus*	羽穗磚子苗			+							+
MYRTACEAE 桃金娘科	*Melaleuca cajuputi* subsp. *cumingiana*	白千層								++	+	
MELASTOMATACEAE 野牡丹科	*Melastoma dodecandrum*	地茭	+									
MELASTOMATACEAE 野牡丹科	*Melastoma malabathricum*	野牡丹	+		+							
MELASTOMATACEAE 野牡丹科	*Melastoma sanguineum*	毛茭	+									
MELIACEAE 楝科	*Melia azedarach*	苦楝								+		
POACEAE 禾本科	*Melinis repens*	紅毛草			+					+		
MAGNOLIACEAE 木蘭科	*Michelia x alba*	白蘭								+		

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TILIACEAE 椴樹科	*Microcos nervosa*	布渣葉	+					+				
POACEAE 禾本科	*Microstegium ciliatum*	剛莠竹	+		+	+				+		++
ASTERACEAE 菊科	*Mikania micrantha*	薇甘菊	+		+++	++		+	+	+	+	
MIMOSACEAE 含羞草科	*Mimosa pudica*	含羞草			+					+		+
NYCTAGINACEAE 紫茉莉科	*Mirabilis jalapa*	紫茉莉								+		
POACEAE 禾本科	*Miscanthus floridulus*	五節芒	+							+	+	
POACEAE 禾本科	*Miscanthus sinensis*	芒	+		+							
MORACEAE 桑科	*Morus alba*	桑								+		
RUTACEAE 芸香科	*Murraya paniculata*	九里香						+		+	+	
MUSACEAE 芭蕉科	*Musa x paradisiaca*	大蕉	+		+	+				+	+	
RUBIACEAE 茜草科	*Mussaenda erythrophylla*	紅葉金花								+		
RUBIACEAE 茜草科	*Mussaenda pubescens*	玉葉金花	+									
CARYOPHYLLACEAE 石竹科	*Myosoton aquaticum*	鵝腸菜	+						+	+		
BRASSICACEAE (CRUCIFERAE) 十字花科	*Nasturtium officinale*	西洋菜							+			
IRIDACEAE 鳶尾科	*Neomarica northiana*	新瑪麗雅								+	+	
NEPHROLEPIDACEAE 腎蕨科	*Nephrolepis auriculata*	腎蕨								+		
APOCYNACEAE 夾竹桃科	*Nerium oleander*	夾竹桃								+		
POACEAE 禾本科	*Neyraudia reynaudiana*	類蘆						+		+	+	
LILIACEAE 百合科	*Ophiopogon jaburan*	花葉沿階草								+		
CACTACEAE 仙人掌科	*Opuntia stricta*	仙人掌								+		
OLEACEAE 木犀科	*Osmanthus fragrans*	桂花								+		
OXALIDACEAE 酢漿草科	*Oxalis corniculata*	酢漿草	+		+	+				+	+	
OXALIDACEAE 酢漿草科	*Oxalis debilis* subsp. *corymbosa*	紅花酢漿草	+			+				+	+	
BOMBACACEAE 木棉科	*Pachira macrocarpa*	馬拉巴栗								+		
RUBIACEAE 茜草科	*Paederia scandens*	雞矢藤	+		+				+	+	+	
PANDANACEAE 露兜樹科	*Pandanus tectorius*	露兜樹	+	+	+							
POACEAE 禾本科	*Panicum brevifolium*	短葉黍	+							+		
POACEAE 禾本科	*Panicum maximum*	大黍	+		+	+		+		+	+	+

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POACEAE 禾本科	*Paspalum distichum*	雙穗雀稗								+	+	
PASSIFLORACEAE 西番蓮科	*Passiflora foetida*	龍珠果								+		
CAESALPINIACEAE 蘇木科	*Peltophorum pterocarpum*	盾柱木								+		
ARECACEAE 棕櫚科	*Phoenix roebelenii*	江邊刺葵								+		
POACEAE 禾本科	*Phragmites australis*	蘆葦						+				
EUPHORBIACEAE 大戟科	*Phyllanthus emblica*	油甘子	+							+	+	
EUPHORBIACEAE 大戟科	*Phyllanthus reticulatus*	小果葉下珠	+		+	+				+	+	
EUPHORBIACEAE 大戟科	*Phyllanthus urinaria*	葉下珠	+					+		+		
URTICACEAE 蕁麻科	*Pilea microphylla*	小葉冷水花							+	+	+	
PINACEAE 松科	*Pinus massoniana*	馬尾松	+									
FABACEAE (PAPILIONACEAE) 蝶形花科	*Pisum sativum*	荷蘭豆			;+					+		
PLANTAGINACEAE 車前草科	*Plantago major*	車前草								+		
CUPRESSACEAE 柏科	*Platycladus orientalis*	扁柏								+	+	
APOCYNACEAE 夾竹桃科	*Plumeria rubra*	雞蛋花								+		
PODOCARPACEAE 羅漢松科	*Podocarpus macrophyllus*	羅漢松								+		
POLYGONACEAE 蓼科	*Polygonum barbatum*	毛蓼						+	+			
POLYGONACEAE 蓼科	*Polygonum chinense*	火炭母	+		++	+			+	+		
POLYGONACEAE 蓼科	*Polygonum dichotomum*	二歧蓼				+						
POLYGONACEAE 蓼科	*Polygonum lapathifolium*	大馬蓼				+						
POLYGONACEAE 蓼科	*Polygonum perfoliatum*	杠板歸							+			
POLYGONACEAE 蓼科	*Polygonum sp.*	蓼屬							+			
FABACEAE (PAPILIONACEAE) 蝶形花科	*Pongamia pinnata*	水黃皮								+		
PORTULACACEAE 馬齒莧科	*Portulaca oleracea*	馬齒莧			+					+		+
ASTERACEAE 菊科	*Praxelis clematidea*	假臭草								+	+	
THELYPTERIDACEAE 金星蕨科	*Pronephrium triphyllum*	三羽新月蕨	+									
ROSACEAE 薔薇科	*Prunus persica*	桃								+		
MYRTACEAE 桃金娘科	*Psidium guajava*	番石榴								+		
RUBIACEAE 茜草科	*Psychotria asiatica*	山大刀	+					+				

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RUBIACEAE 茜草科	*Psychotria serpens*	穿根藤	+									
PTERIDACEAE 鳳尾蕨科	*Pteris ensiformis*	劍葉鳳尾蕨						+	+			
PTERIDACEAE 鳳尾蕨科	*Pteris semipinnata*	半邊旗	++									
PTERIDACEAE 鳳尾蕨科	*Pteris vittata*	蜈蚣草							+	+	+	
ASTERACEAE 菊科	*Pterocypsela indica*	山萵苣			+							
FABACEAE (PAPILIONACEAE) 蝶形花科	*Pueraria lobata*	野葛	+		++	+						
FABACEAE (PAPILIONACEAE) 蝶形花科	*Pueraria phaseoloides*	三裂葉野葛							+			
CYPERACEAE 莎草科	*Pycreus polystachyos*	多枝扁莎				+						
BIGNONIACEAE 紫葳科	*Pyrostegia venusta*	炮仗花								+		
POLYPODIACEAE 水龍骨科	*Pyrrosia adnascens*	貼生石韋								+		
STERCULIACEAE 梧桐科	*Reevesia thyrsoidea*	梭羅樹	+									
ROSACEAE 薔薇科	*Rhaphiolepis indica*	車輪梅	+					+				
ARECACEAE 棕櫚科	*Rhapis excelsa*	棕竹								+		
ARECACEAE 棕櫚科	*Rhapis humilis*	細葉棕竹								+		
ERICACEAE 杜鵑花科	*Rhododendron sp.*	杜鵑屬								+		
MYRTACEAE 桃金娘科	*Rhodomyrtus tomentosa*	崗棯	+		++					+		
COMMELINACEAE 鴨跖草科	*Rhoeo discolor*	蚌花								+		
ANACARDIACEAE 漆樹科	*Rhus chinensis*	鹽膚木	++				+	+		+	+	
ANACARDIACEAE 漆樹科	*Rhus hypoleuca*	白背漆	+									
LAMIACEAE (LABIATAE) 唇形科	*Rosmarinum officinalis*	迷迭香			+							
ROSACEAE 薔薇科	*Rubus parvifolius*	茅莓	+		+			+	+			
ROSACEAE 薔薇科	*Rubus reflexus*	蛇泡勒	+									
ACANTHACEAE 爵床科	*Ruellia coerulea*	蘭花草								+		
POACEAE 禾本科	*Saccharum officinarum*	甘蔗								+		
RHAMNACEAE 鼠李科	*Sageretia thea*	雀梅藤		++			++	+		+	+	
AGAVACEAE 龍舌蘭科	*Sansevieria trifasciata* var. *laurenii*	金邊虎尾蘭								+		
EUPHORBIACEAE 大戟科	*Sapium discolor*	山烏桕	+									

Family	Botanical Name	Chinese Name	Woodland	Shrubland	Abandoned Agricultural land / Low-lying Grassland	Marsh	Mangrove	Pond	Stream / River	Developed Area	Developed area directly affected	Grassland directly affected
			WL	**SL**	**GL**	**MH**	**MG**	**PD**	**SR**	**DA**	**DAF**	**GLF**
EUPHORBIACEAE 大戟科	*Sapium sebiferum*	烏桕				+				+		
CHLORANTHACEAE 金粟蘭科	*Sarcandra glabra*	草珊瑚	+									
EUPHORBIACEAE 大戟科	*Sauropus spatulifolius*	龍脷葉	+									
CYPERACEAE 莎草科	*Scleria ciliaris*	緣毛珍珠茅	+									
FLACOURTIACEAE 大風子科	*Scolopia chinensis*	刺柊		+			++					
SCROPHULARIACEAE 玄參科	*Scoparia dulcis*	野甘草				+				+		
ARALIACEAE 五加科	*Schefflera arboricola*	鵝掌藤								+		
ARALIACEAE 五加科	*Schefflera arboricola* 'Variegata'	斑葉鵝掌籐								+		
ARALIACEAE 五加科	*Schefflera heptaphylla*	鴨腳木	++					+		+	+	
THEACEAE 山茶科	*Schima superba*	木荷	+									
FLACOURTIACEAE 大風子科	*Scolopia chinensis*	刺柊							+			
CAESALPINIACEAE 蘇木科	*Senna surattensis*	黃槐								+		
RUBIACEAE 茜草科	*Serissa japonica*	六月雪								+		
MALVACEAE 錦葵科	*Sida rhombifolia*	白背黃花稔						+				
SMILACACEAE 菝葜科	*Smilax china*	金剛藤	+									
SMILACACEAE 菝葜科	*Smilax lanceifolia* var. *opaca*	暗色菝葜	+									
SOLANACEAE 茄科	*Solanum americanum*	少花龍葵	+			+			+	+		
SOLANACEAE 茄科	*Solanum capsicoides*	癩茄	+							+	+	
SOLANACEAE 茄科	*Solanum lycopersicum*	番茄								+		
SOLANACEAE 茄科	*Solanum melongena*	茄子								+		
SOLANACEAE 茄科	*Solanum nigrum*	龍葵								+		
SOLANACEAE 茄科	*Solanum torvum*	水茄	+			+						
ASTERACEAE 菊科	*Soliva anthemifolia*	裸柱菊			+	+				+		
ASTERACEAE 菊科	*Sonchus arvensis*	苣買菜			+	+			+	+	+	
ASTERACEAE 菊科	*Sonchus oleraceus*	苦苣菜	+		+			+		+		
BIGNONIACEAE 紫葳科	*Spathodea campanulata*	火焰木	+							+		
RUBIACEAE 茜草科	*Spermacoce latifolia*	闊葉豐花草	+									
RUBIACEAE 茜草科	*Spermacoce stricta*	豐花草			+					+		
LINDSAEACEAE 鱗始蕨科	*Sphenomeris chinensis*	烏蕨	+									

Family	Botanical Name	Chinese Name	Woodland	Shrubland	Abandoned Agricultural land / Low-lying Grassland	Marsh	Mangrove	Pond	Stream / River	Developed Area	Developed area directly affected	Grassland directly affected
			WL	**SL**	**GL**	**MH**	**MG**	**PD**	**SR**	**DA**	**DAF**	**GLF**
ASTERACEAE 菊科	*Spilanthes paniculata*	金鈕扣				+			+			
POACEAE 禾本科	*Sporobolus fertilis*	鼠尾粟	+		+					+		
MENISPERMACEAE 防己科	*Stephania longa*	千金藤	+							+		
STERCULIACEAE 梧桐科	*Sterculia lanceolata*	假蘋婆	++					+		+	+	
LOGANIACEAE 馬錢科	*Strychnos angustiflora*	牛眼馬錢	+					+				
MYRTACEAE 桃金娘科	*Syzygium hancei*	韓氏蒲桃	+					+				
MYRTACEAE 桃金娘科	*Syzygium jambos*	蒲桃	+							+		
FABACEAE (PAPILIONACEAE) 蝶形花科	*Tadehagi triquetrum*	葫蘆茶	+									
ASPIDIACEAE 叉蕨科	*Tectaria subtriphylla*	三叉蕨	+									
COMBRETACEAE 使君子科	*Terminalia mantaly*	細葉欖仁								+		
DILLENIACEAE 五椏果科	*Tetracera asiatica*	錫葉藤	+									
MALVACEAE 錦葵科	*Thespesia populnea* *	恒春黃槿		+			+					
APOCYNACEAE 夾竹桃科	*Thevetia peruviana*	黃花夾竹桃						+		+		
ACANTHACEAE 爵床科	*Thunbergia grandiflora*	大花老鴉嘴								+		
MELASTOMATACEAE 野牡丹科	*Tibouchina semidecandra*	巴西野牡丹								+		
COMMELINACEAE 鴨跖草科	*Tradescantia pallida*	紫鴨跖草								+		
ASTERACEAE 菊科	*Tridax procumbens*	羽芒菊								+	+	
ANNONACEAE 番荔枝科	*Uvaria macrophylla*	紫玉盤	++					+				
ASTERACEAE 菊科	*Vernonia cinerea*	夜香牛	+		+	+				+	+	
CAPRIFOLIACEAE 忍冬科	*Viburnum odoratissimum*	珊瑚樹								+		
VIOLACEAE 堇菜科	*Viola diffusa*	蔓堇菜	+									
VIOLACEAE 堇菜科	*Viola inconspicua*	長萼堇菜	+							+		
VERBENACEAE 馬鞭草科	*Vitex negundo* var. *cannabifolia*	牡荊						+		+		
ASTERACEAE 菊科	*Wedelia biflora*	雙頭菊						+				
ASTERACEAE 菊科	*Wedelia trilobata*	三裂葉蟛蜞菊	+		+	++			++	++	+	+++
THYMELAEACEAE 瑞香科	*Wikstroemia indica*	了哥王			+							
ASTERACEAE 菊科	*Youngia heterophylla*	異葉黃鶴菜			+							

Family	Botanical Name	Chinese Name	Woodland	Shrubland	Abandoned Agricultural land / Low-lying Grassland	Marsh	Mangrove	Pond	Stream / River	Developed Area	Developed area directly affected	Grassland directly affected
			WL	**SL**	**GL**	**MH**	**MG**	**PD**	**SR**	**DA**	**DAF**	**GLF**
ASTERACEAE 菊科	*Youngia japonica*	黃鵪菜	+		+	+			+	+	+	
MAGNOLIACEAE 木蘭科	*Yulania x soulangeana*	二喬木蘭								+		
RUTACEAE 芸香科	*Zanthoxylum avicennae*	簕欓花椒	+					+		+	+	
RUTACEAE 芸香科	*Zanthoxylum nitidum*	兩面針	+									
RUTACEAE 芸香科	*Zanthoxylum piperitum*	胡椒木								+		
POACEAE 禾本科	*Zea mays*	玉蜀黍								+		
LILIACEAE 百合科	*Zephyranthes candida*	蔥蓮								+		
ORCHIDACEAE 蘭科	*Zeuxine strateumatica* *	線柱蘭			+							
ZINGIBERACEAE 薑科	*Zingiber officinale*	薑								+		
	TOTAL	**393**	**149**	**11**	**82**	**64**	**13**	**67**	**45**	**248**	**59**	**21**

Relative Abundance: + uncommon; ++ fairly common; +++ very common; * Species of conservation concern

Table 2: Mammal Species Recorded within the Study Area during the Ecological Surveys - Transect

Common Name	Scientific Name	Commonness	Conservation Status	Transect No.1			Transect No.2					Transect No.3		Transect No.4	Transect No.5			Grand Total
				DA	MG	PD	AbAL / LGL	DA	MH	WL	SR	DA	WL	DA	AbAL / LGL	DA	WD	
Domestic Cat	*Felis catus*	Uncommon*						1						14		3		**18**
Domestic Dog	*Canis lupus familiaris*	Common		4								2		1		2		**9**
Eurasian Wild Pig	*Sus scrofa*	Very Common*			1								3					**4**
Leopard Cat	*Prionailurus bengalensis*	Uncommon*	CRDB (V), Cap. 586, CITES II							1								**1**
Musk Shrew	*Suncus murinus*	Uncommon								2								**2**
Unidentified Bats						1	6	10	7		2	3	3	19	4	12	30	**97**
			Grand Total	**4**	**1**	**1**	**6**	**11**	**7**	**3**	**2**	**5**	**6**	**34**	**4**	**17**	**30**	**131**

Notes:
Commonness: (Shek *et al.* 2006);
*Shek et al. 2007 AFCD Biodiversity Newsletter No.15

Table 3: Mammal Species Recorded within the Study Area during the Ecological Surveys - Point Count

Common Name	Scientific Name	Commonness	Conservation Status	Point Count Location 1	Point Count Location 2	Point Count Location 3	Point Count Location 4	Point Count Location 5	Grand Total
							Developed Area		
Domestic Cat	*Felis catus*	Uncommon*					1		**1**
			Grand Total				**1**		**1**

Notes:
Commonness: (Shek *et al.* 2006);
*Shek et al. 2007 AFCD Biodiversity Newsletter No.15

Table 4: Avifauna Species Recorded within the Study Area during the Ecological Surveys - Transect

Common Name	Scientific Name	Level of Concern & Protection Status	Transect No.1					Transect No.2					Transect No.3			Transect No.4					Transect No.5		Grand Total
			AbAL / LGL	DA	MG	PD	SR	AbAL / LGL	DA	MH	SR	WL	DA	MH	WL	DA	MG	MH	STK Sea	SL	DA	WL	
Asian Koel	*Eudynamys scolopaceus*																					1	**1**
Azure-winged Magpie	*Cyanopica cyanus*																					1	**1**
Barn Swallow	*Hirundo rustica*		2	2				4	6							10					11	2	**37**
Black Drongo	*Dicrurus macrocercus*							1						1									**2**
Black Kite	*Milvus migrans*	(RC); China Protected Species (II); CITES (II); Cap.586				1						3	1			1							**6**
Black-collared Starling	*Gracupica nigricollis*			7	5	6		2	11					1	1	9					5		**47**
Black-crowned Night Heron	*Nycticorax nycticorax*	(LC)			2	1	2	1													3		**9**
Black-tailed Gull	*Larus crassirostris*	LC																	33				**33**
Blue Whistling Thrush	*Myophonus caeruleus*																					1	**1**
Chinese Bulbul	*Pycnonotus sinensis*			17	2	5			8			48			49	13	30				21	23	**216**
Chinese Grosbeak	*Eophona migratoria*	LC		1		2																	**3**
Chinese Pond Heron	*Ardeola bacchus*	PRC(RC)					2																**2**
Cinereous Tit	*Parus cinereous*				5							1	2		16	4					5	3	**36**
Collared Scops Owl	*Otus lettia*	China Protected Species (II); CITES (II); Cap.586										2											**2**
Common Kingfisher	*Alcedo atthis*				1	1																	**2**

Common Name	Scientific Name	Level of Concern & Protection Status	Transect No.1					Transect No.2					Transect No.3			Transect No.4					Transect No.5		Grand Total
			AbAL / LGL	DA	MG	PD	SR	AbAL / LGL	DA	MH	SR	WL	DA	MH	WL	DA	MG	MH	STK Sea	SL	DA	WL	
Common Sandpiper	*Actitis hypoleucos*			1																			**1**
Common Tailorbird	*Orthotomus sutorius*				1	1							1		4							3	**10**
Crested Myna	*Acridotheres cristatellus*		1	3			1	7	20				1	1		122		2		22	15	11	**206**
Daurian Redstart	*Phoenicurus auroreus*							1	2					1									**4**
Domestic Pigeon	*Columba livia*																					5	**5**
Dusky Warbler	*Phylloscopus fuscatus*					1																	**1**
Eastern Yellow Wagtail	*Motacilla tschutschensis*								1				1										**2**
Eurasian Magpie	*Pica pica*					1														2	2	6	**11**
Eurasian Tree Sparrow	*Passer montanus*		11	8					15				1			20						3	**58**
Fork-tailed Sunbird	*Aethopyga christinae*		1						1												1	3	**6**
Great Egret	*Ardea alba*	PRC(RC)		13	2	7	2									429				3			**456**
Greater Coucal	*Centropus sinensis*	CRDB (V); China Protected Species (II)													1							2	**3**
Grey Heron	*Ardea cinerea*	PRC														1				1			**2**
Grey Wagtail	*Motacilla cinerea*				1	2					2												**5**
House Swift	*Apus nipalensis*			4		2			3							3					5		**17**
Japanese Bush Warbler	*Horornis diphone*													1									**1**
Japanese White-eye	*Zosterops japonicus*			5	2	4			3			2	12	4	33	16					7	15	**103**
Little Egret	*Egretta garzetta*	PRC(RC)				4	3									1							**8**
Little Grebe	*Tachybaptus ruficollis*	LC				8																	**8**
Long-tailed Shrike	*Lanius schach*					1		5	2					1			1					1	**11**
Masked Laughingthrush	*Garrulax perspicillatus*			7				3	10						7	11		7				16	**61**

Common Name	Scientific Name	Level of Concern & Protection Status	Transect No.1					Transect No.2					Transect No.3			Transect No.4					Transect No.5		Grand Total
			AbAL / LGL	DA	MG	PD	SR	AbAL / LGL	DA	MH	SR	WL	DA	MH	WL	DA	MG	MH	STK Sea	SL	DA	WL	
Olive-backed Pipit	*Anthus hodgsoni*							2	2	4			4										**12**
Oriental Magpie Robin	*Copsychus saularis*					4			1							10					8	5	**28**
Oriental Turtle Dove	*Streptopelia orientalis*															1							**1**
Pallas's Leaf Warbler	*Phylloscopus proregulus*																					1	**1**
Plain Prinia	*Prinia inornata*					1								3									**4**
Plaintive Cuckoo	*Cacomantis merulinus*																					1	**1**
Red Turtle Dove	*Streptopelia tranquebarica*			1																			**1**
Red-billed Starling	*Spodiopsar sericeus*	GC																				12	**12**
Red-whiskered Bulbul	*Pycnonotus jocosus*			6		3		21	12			24	5		97	18					43	30	**259**
Scaly-breasted Munia	*Lonchura punctulata*								31														**31**
Scarlet-backed Flowerpecker	*Dicaeum cruentatum*					1			1						1							4	**7**
Sooty-headed Bulbul	*Pycnonotus aurigaster*								8	3			3										**14**
Spotted Dove	*Spilopelia chinensis*			6	4			1	2			1	5	2	3	17					18	3	**62**
Stejneger's Stonechat	*Saxicola stejnegeri*													1									**1**
White Wagtail	*Motacilla alba*			2	2	3		1		1	1		3	1		1							**15**
White-cheeked Starling	*Spodiopsar cineraceus*	PRC														4	42						**46**
Yellow-bellied Prinia	*Prinia flaviventris*			1				5	1	2		1		9	1						2	1	**23**
Yellow-browed Warbler	*Phylloscopus inornatus*					1									1							1	**3**
		Grand Total	**15**	**84**	**27**	**60**	**10**	**54**	**140**	**10**	**3**	**82**	**39**	**26**	**214**	**691**	**73**	**9**	**33**	**28**	**146**	**154**	**1898**

Reference and Notes:

Level of Concern – LC = Local Concern, RC = Regional Concern, PRC = Potential Regional Concern, PGC = Potential Global Concern, GC = Global Concern. Letters in parentheses indicate that the assessment is on the basis of restrictedness in breeding and/or roosting sites rather than in general occurrence. (Fellowes et al. 2002)

CRDB – China Red Data Book of Endangered Animals: Aves; E = Endangered, V = Vulnerable, R = Rare, I = Indeterminate (Zheng & Wang 1998).

*Cap. 586 – Listed in Protection of Endangered Species of Animals and Plants Ordinance

Table 5: Avifauna Species Recorded within the Study Area during the Ecological Surveys - Point Count

Common Name	Scientific Name	Level of Concern & Protection Status	Point Count Location 1		Point Count Location 2		Point Count Location 3		Point Count Location 4				Point Count Location 5		Grand Total
			MG	PD	AbAL / LGL	DA	DA	MH	DA	MG	STK Sea	SL	DA	WL	
Barn Swallow	*Hirundo rustica*		1	2	5				1				1	2	**12**
Black-collared Starling	*Gracupica nigricollis*				1									5	**6**
Chinese Bulbul	*Pycnonotus sinensis*			1	2	32			3						**38**
Cinereous Tit	*Parus cinereous*													1	**1**
Common Blackbird	*Turdus merula*						1								**1**
Common Sandpiper	*Actitis hypoleucos*										2				**2**
Crested Myna	*Acridotheres cristatellus*							2	14				2		**18**
Great Egret	*Ardea alba*	PRC(RC)		1					2		1	1			**5**
Greater Coucal	*Centropus sinensis*	CRDB (V); China Protected Species (II)												1	**1**
Grey Heron	*Ardea cinerea*	PRC									1				**1**
Grey Wagtail	*Motacilla cinerea*						1								**1**
House Swift	*Apus nipalensis*								4						**4**
Japanese White-eye	*Zosterops japonicus*						5						2	1	**8**
Large-billed Crow	*Corvus macrorhynchos*				2										**2**
Little Egret	*Egretta garzetta*	PRC(RC)		2					4	4	2				**12**
Little Grebe	*Tachybaptus ruficollis*	LC		1											**1**
Long-tailed Shrike	*Lanius schach*				1			1							**2**
Oriental Magpie Robin	*Copsychus saularis*								1				1	1	**3**
Red-whiskered Bulbul	*Pycnonotus jocosus*			3					2				1	5	**11**
Scaly-breasted Munia	*Lonchura punctulata*				5										**5**
Spotted Dove	*Spilopelia chinensis*			2	2			2	1			1	1	2	**11**
White Wagtail	*Motacilla alba*							1	2						**3**

Common Name	Scientific Name	Level of Concern & Protection Status	Point Count Location 1		Point Count Location 2		Point Count Location 3		Point Count Location 4				Point Count Location 5		Grand Total
			MG	PD	AbAL / LGL	DA	DA	MH	DA	MG	STK Sea	SL	DA	WL	
White-throated Kingfisher	*Halcyon smyrnensis*	(LC)										1			**1**
Yellow-bellied Prinia	*Prinia flaviventris*			1	2										**3**
		Grand Total	**1**	**13**	**20**	**32**	**7**	**6**	**34**	**4**	**6**	**3**	**8**	**18**	**152**

Reference and Notes:

Level of Concern – LC = Local Concern, RC = Regional Concern, PRC = Potential Regional Concern, PGC = Potential Global Concern, GC = Global Concern. Letters in parentheses indicate that the assessment is on the basis of restrictedness in breeding and/or roosting sites rather than in general occurrence. (Fellowes et al. 2002)
CRDB – China Red Data Book of Endangered Animals: Aves; E = Endangered, V = Vulnerable, R = Rare, I = Indeterminate (Zheng & Wang 1998).

Table 6: Avifauna Species Recorded within the Study Area during the Ecological Surveys - Point Count on Intertidal Mudflat

Common Name	Scientific Name	Level of Concern & Protection Status	Point Count on Intertidal Mudflat			Grand Total
			Mangrove	Mudflat	Sha Tau Kok Sea	
Barn Swallow	*Hirundo rustica*		11	6		**17**
Black Kite	*Milvus migrans*	(RC); China Protected Species (II); CITES (II); Cap.586	1	1	5	**7**
Black-collared Starling	*Gracupica nigricollis*		2			**2**
Black-crowned Night Heron	*Nycticorax nycticorax*	(LC)	1			**1**
Chinese Bulbul	*Pycnonotus sinensis*		32			**32**
Cinereous Tit	*Parus cinereous*		1			**1**
Common Kingfisher	*Alcedo atthis*		2	1		**3**
Common Sandpiper	*Actitis hypoleucos*			9	1	**10**
Great Cormorant	*Phalacrocorax carbo*	PRC			3	**3**
Great Egret	*Ardea alba*	PRC(RC)	4	168		**172**
Grey Heron	*Ardea cinerea*	PRC		24		**24**
Little Egret	*Egretta garzetta*	PRC(RC)		66		**66**
Little Grebe	*Tachybaptus ruficollis*	LC			3	**3**
Western Osprey	*Pandion haliaetus*	RC; CRDB (R); China Protected Species (II); CITES (II); Cap.586			1	**1**
White Wagtail	*Motacilla alba*			1		**1**
White-throated Kingfisher	*Halcyon smyrnensis*	(LC)		2		**2**
		Grand Total	**54**	**278**	**13**	**345**

Reference:

Level of Concern – LC = Local Concern, RC = Regional Concern, PRC = Potential Regional Concern, PGC = Potential Global Concern, GC = Global Concern. Letters in parentheses indicate that the assessment is on the basis of restrictedness in breeding and/or roosting sites rather than in general occurrence. (Fellowes et al. 2002)

CRDB – China Red Data Book of Endangered Animals: Aves; E = Endangered, V = Vulnerable, R = Rare, I = Indeterminate (Zheng & Wang 1998).

Table 8: Herpetofauna Species Recorded within the Study Area during the Ecological Surveys - Transect Survey

Common Name	Scientific Name	Commoness	Level of concern	China Protected Species	Transect No.1			Transect No.2			Transect No.3			Transect No.5			Grand Total
					DA	PD	DA	MH	WL	SR	AbAL / LGL	DA	MH	WL	DA	WL	
Asian Common Toad	*Bufo melanostictus*	Abundant				1	6	3	2	16	17	5	21	1	10	3	**85**
Asiatic Painted Frog	*Kaloula pulchra pulchra*	Common							1		10	1	2				**14**
Brown Tree Frog	*Polypedates megacephalus*	Common			2	2	5	2			5	1	2			4	**23**
Changeable Lizard	*Calotes versicolor*	Common					1							1			**2**
Chinese Bullfrog	*Hoplobatrachus chinensis*	Uncommon	PRC	II									2				**2**
Chinese Gecko	*Gekko chinensis*	Very Common					11		3								**14**
Gunther's Frog	*Rana guentheri*	Very Common			3	10	5	7			2		5		3	4	**39**
Long-tailed Skink	*Mabuya longicaudata*	Common					1				1	1		1			**4**
Ornate Pigmy Frog	*Microhyla ornata*	Abundant					3			1			2				**6**
Paddy Frog	*Fejervarya limnocharis*	Very Common				1	2	5	2		2	1	2			3	**18**
Spotted Narrow-mouthed Frog	*Kalophrynus interlineatus*	Common					2										**2**
				Grand Total	**5**	**14**	**36**	**17**	**8**	**17**	**37**	**9**	**36**	**3**	**13**	**14**	**209**

Commonness: Karsen *et. al* 1998.

Level of Concern: LC = Local Concern, RC = Regional Concern, GC = Global Concern, PGC = Potential Global Concern (Fellowes *et al.* 2002)

Table 9: Butterfly Species Recorded within the Study Area during the Ecological Surveys - Transect Survey

Common Name	Scientific Name	Commonness	Level of Concern	Transect No.1					Transect No.2					Transect No.3			Transect No.4	Transect No.5		Grand Total
				AbAL / LGL	DA	MG	PD	SR	AbAL / LGL	DA	MH	SR	WL	DA	MH	WL	DA	DA	WL	
Angled Castor	*Ariadne ariadne alterna*	C									1					1				**2**
Banded Tree Brown	*Lethe confusa confusa*	C					1		1				1							**3**
Black Prince	*Rohana parisatis staurakius*	C							1	1								1		**3**
Bush Hopper	*Ampittia dioscorides etura*	UC							3		4		1							**8**
Chocolate Pansy	*Junonia iphita iphita*	C							2			1								**3**
Colour Sergeant	*Athyma nefte seitzi*	C														1			1	**2**
Comma*	*Polygonia c-aureum c-aureum*	VR															1			**1**
Common Bluebottle	*Graphium sarpedon sarpedon*	VC							1							1				**2**
Common Five-ring	*Ypthima baldus baldus*	VC			2		1		5		1			1	1	2			3	**16**
Common Grass Yellow	*Eurema hecabe hecabe*	VC			2		1		2					2	3	2	1			**13**
Common Mormon	*Papilio polytes polytes*	VC		1	5		1	1	3	3			2	2		2	4		1	**25**
Common Sailer	*Neptis hylas hylas*	VC							4		1		1			1				**7**
Common Tiger	*Danaus genutia genutia*	C			1															**1**
Contiguous Swift	*Polytremis lubricans lubricans*	C							1											**1**
Dark-brand Bush Brown	*Mycalesis mineus mineus*	VC								1	2		3			2				**8**
Forest Hopper	*Astictopterus jama chinensis*	C											1							**1**
Formosan Swift	*Borbo cinnara*	C													1					**1**
Gram Blue	*Euchrysops cnejus cnejus*	UC			1								1							**2**
Great Egg-fly	*Hypolimnas bolina kezia*	C											1	1			1		1	**4**
Great Mormon	*Papilio memnon agenor*	VC													1	7			2	**10**
Great Orange Tip	*Hebomoia glaucippe*	C													1					**1**

Common Name	Scientific Name	Commonness	Level of Concern	Transect No.1					Transect No.2					Transect No.3			Transect No.4	Transect No.5		Grand Total
				AbAL / LGL	DA	MG	PD	SR	AbAL / LGL	DA	MH	SR	WL	DA	MH	WL	DA	DA	WL	
	glaucippe																			
Great Swift	*Pelopidas assamensis*	R	LC								1									**1**
Indian Cabbage White	*Pieris canidia canidia*	VC			1				15	10	6			9	4	5	1		4	**55**
Lemon Emigrant	*Catopsilia pomona pomona*	C							2					2	3		1			**8**
Long-banded Silverline	*Spindasis lohita formosana*	C							2											**2**
Metallic Cerulean	*Jamides alecto alocina*	VR														1				**1**
Pale Grass Blue	*Zizeeria maha serica*	VC			9				8	3	4			3		2	19	2	5	**55**
Paris Peacock	*Papilio paris paris*	VC														1				**1**
Peacock Pansy	*Junonia almana almana*	C				1			6						1					**8**
Pigmy Scrub Hopper	*Aeromachus pygmaeus*	VR	RC						1											**1**
Plain Tiger	*Danaus chrysippus chrysippus*	UC				1														**1**
Plains Cupid	*Chilades pandava pandava*	UC									1									**1**
Purple Sapphire	*Heliophorus epicles phoenicoparyphus*	C							1		1									**2**
Red Helen	*Papilio helenus helenus*	VC							1					1						**2**
Rustic	*Cupha erymanthis erymanthis*	VC														5	1			**6**
Shiny-spotted Bob*	*Isoteinon lamprospilus lamprospilus*	VR	LC													1				**1**
South China Bush Brown	*Mycalesis zonata*	C														1				**1**
Spangle	*Papilio protenor protenor*	VC					1			3			1			2				**7**
Tailed Jay	*Graphium agamemnon agamemnon*	C														1				**1**
Tawny Rajah	*Charaxes bernardus bernardus*	C											1							**1**
White-edged Blue Baron	*Euthalia phemius seitzi*	C								2										**2**
			Grand Total	**1**	**21**	**2**	**5**	**1**	**59**	**23**	**22**	**1**	**13**	**21**	**15**	**38**	**29**	**3**	**17**	**271**

Commonness: VR = Very Rare, R = Rare, UC = Uncommon, C = Common, VC = Very Common (Chan *et al*. 2011)

Level of Concern: LC = Local Concern, RC = Regional Concern (Fellowes *et al*. 2002)

*Species of Conservation Concern under AFCD Assessment (Chan *et al.* 2011)

Table 10: Butterfly Species Recorded within the Study Area during the Ecological Surveys - Point Count Survey

Common Name	Scientific Name	Commonness	Level of Concern	Point Count Location 1	Point Count Location 3		Point Count Location 5		Grand Total
				Pond	Developed Area	Marsh	Developed Area	Woodland	
Indian Cabbage White	*Pieris canidia canidia*	VC		2	1	4	4	2	13
Pale Grass Blue	*Zizeeria maha serica*	VC		2					2
Red Helen	*Papilio helenus helenus*	VC			1	1			2
			Grand Total	4	2	5	4	2	17

Commonness: VR = Very Rare, R = Rare, UC = Uncommon, C = Common, VC = Very Common (Chan *et al*. 2011)

Table 11: Odonate Species Recorded within the Study Area during the Ecological Surveys - Transect Survey

Common Name	Scientific Name	Commonness	Level of Concern	Transect No.1				Transect No.2					Transect No.3			Transect No.4	Transect No.5		Grand Total
				AbAL / LGL	DA	MG	PD	AgAL / LGL	DA	MH	SR	WL	DA	MH	WL	DA	DA	WL	
Black Threadtail	*Prodasineura autumnalis*	A									2								**2**
Blue Dasher	*Brachydiplax chalybea flavovittata*	C								1									**1**
Blue-spotted Emperor	*Anax nigrofasciatus nigrofasciatus*	U							1										**1**
Common Blue Jewel	*Rhinocypha perforata perforata*	A									1								**1**
Common Blue Skimmer	*Orthetrum glaucum*	A						5	2		2								**9**
Common Bluetail	*Ischnura senegalensis*	A							1		2								**3**
Common Red Skimmer	*Orthetrum pruinosum neglectum*	A						3	4		2						1		**10**
Crimson Darter	*Crocothemis servilia servilia*	A							4										**4**
Crimson Dropwing	*Trithemis aurora*	A						1	1				2						**4**
Emerald Cascader	*Zygonyx iris insignis*	A	PGC					2											**2**
Forest Chaser	*Lyriothemis elegantissima*	C										1	2					2	**5**
Green Skimmer	*Orthetrum sabina sabina*	C							3							1			**4**
Indigo Dropwing	*Trithemis festiva*	A			1														**1**
Marsh Dancer	*Onychargia atrocyana*	C							1				1						**2**
Marsh Skimmer	*Orthetrum luzonicum*	A						2		7	1							1	**11**
Orange-tailed	*Ceriagrion*	A					2			8									**10**

Common Name	Scientific Name	Commonness	Level of Concern	Transect No.1				Transect No.2					Transect No.3			Transect No.4	Transect No.5		Grand Total
				AbAL / LGL	DA	MG	PD	AgAL / LGL	DA	MH	SR	WL	DA	MH	WL	DA	DA	WL	
Sprite	*auranticum ryukyuanum*																		
Red-faced Skimmer	*Orthetrum chrysis*	C							1		1								**2**
Russet Percher	*Neurothemis fulvia*	A								1									**1**
Variegated Flutterer	*Rhyothemis variegata arria*	C		1	1	1		5	2	3				8	3	1			**25**
Wandering Glider	*Pantala flavescens*	A		22	24	26	2	19	16	68	6			50	13	87	4	28	**365**
			Grand Total	**23**	**26**	**27**	**4**	**37**	**36**	**88**	**17**	**1**	**5**	**58**	**16**	**89**	**5**	**31**	**463**

Commonness: A = Abundant, C = Common, U = Uncommon (Wilson *et al.* 2011)

Level of Concern: PGC = Potential Global Concern (Fellowes *et al*. 2002)

Table 12: Odonate Species Recorded within the Study Area during the Ecological Surveys - Point Count Survey

Common Name	Scientific Name	Commonness	Level of Concern	Point Count No.1			Point Count No.2		Point Count No.3		Point Count No.4		Point Count No.5		Grand Total
				MG	PD	SR	AbAL / LGL	DA	DA	MH	DA	SL	DA	WL	
Common Flangetail	*Ictinogomphus pertinax*	A			1										**1**
Common Red Skimmer	*Orthetrum pruinosum neglectum*	A			2					2					**4**
Crimson Darter	*Crocothemis servilia servilia*	A							1						**1**
Crimson Dropwing	*Trithemis aurora*	A			1	1									**2**
Green Skimmer	*Orthetrum sabina sabina*	C								1					**1**
Pied Skimmer	*Pseudothemis zonata*	C			1										**1**
Red-faced Skimmer	*Orthetrum chrysis*	C			1										**1**
Russet Percher	*Neurothemis fulvia*	A												1	**1**
Variegated Flutterer	*Rhyothemis variegata arria*	C					3			1					**4**
Wandering Glider	*Pantala flavescens*	A		4	4		19	4	1	19	8	11	16		**86**
			Grand Total	**4**	**10**	**1**	**22**	**4**	**2**	**23**	**8**	**11**	**16**	**1**	**102**

Commonness: A = Abundant, C = Common, U = Uncommon (Wilson *et al*. 2011)

Table 13: Number of Nests and Abudnace of Ardeid at A Chau

Common Name	Scientific Name	Mar-14		April		May-14		Jun-14		Jul-14		Aug-14	
		No. of Nests	Abundance	No. of Nests	Abundance	No. of Nests	Abundance	No. of Nests	Abundance	No. of Nests	Abundance	No. of Nests	Abundance
Black-crowned Night Heron	*Nycticorax nycticorax*			7	10	5	6		3		3		
Eastern Cattle Egret	*Bubulcus coromandus*				2				6				
Great Egret	*Ardea alba*	29	73	43	73	30	57	9	63	3	21		8
Grey Heron	*Ardea cinerea*		5		7								
Little Egret	*Egretta garzetta*				1				5				
Grand Total		**29**	**78**	**50**	**93**	**35**	**63**	**9**	**77**	**3**	**24**	**0**	**8**

Table 14: Abundance against Estimated Origin and Destination (Habitat) and Flight Direction of Ardeids Flying-to and Flying-out from A Chau Egretry

Estimated Origin/ Destination (Habitat) and Flight Direction	Common Name	Species Name	Coastal							Mangrove								Mudflat							Pond		Sha Tau Kok Sea					Grand Total
			N	NE	E	SE	S	SW	NW	N	NE	E	SE	S	SW	W	NW	N	NE	E	SE	S	SW	W	SW	NW	N	NE	E	SE	SW	
Flying To the Egretry From	Black-crowned Night Heron	*Gracupica nigricollis*	1		2										11	1						1	7	1								24
	Great Egret	*Ardea alba*	2	22	85	11			1		7	19	6		124	22	18	4	32		14	2	31	3			2	39	2			446
	Grey Heron	*Ardea cinerea*			1																											1
	Little Egret	*Egretta garzetta*		1												1											1					3
Grand Total of Flying-to			**3**	**23**	**88**	**11**			**1**		**7**	**19**	**6**		**135**	**24**	**18**	**4**	**32**		**14**	**3**	**38**	**4**			**3**	**39**	**2**			**474**
% of Grand Total of Flying-to			**0.6**	**4.9**	**18.6**	**2.3**			**0.2**		**1.5**	**4.0**	**1.3**		**28.5**	**5.1**	**3.8**	**0.8**	**6.8**		**3.0**	**0.6**	**8.0**	**0.8**			**0.6**	**8.2**	**0.4**			**100**
Flying Out From the Egretry To	Black-crowned Night Heron	*Gracupica nigricollis*	3		2	1								1	17	4							1		1							30
	Great Egret	*Ardea alba*	5	32	30	10	1	1	2		2		1		145	21	4	8	3	3	4	14	12	5	7	1		40	1	1	2	355
	Grey Heron	*Ardea cinerea*			1		1		1	2												3						1				9
	Little Egret	*Egretta garzetta*	1												1	3								1								6
Grand Total of Flying-out			**9**	**32**	**33**	**11**	**2**	**1**	**3**	**2**	**2**		**1**	**1**	**163**	**28**	**4**	**8**	**3**	**3**	**4**	**17**	**13**	**6**	**8**	**1**		**41**	**1**	**1**	**2**	**400**
% of Grand Total of Flying-out			**2.3**	**8.0**	**8.3**	**2.8**	**0.5**	**0.3**	**0.8**	**0.5**	**0.5**		**0.3**	**0.3**	**40.8**	**7.0**	**1.0**	**2.0**	**0.8**	**0.8**	**1.0**	**4.3**	**3.3**	**1.5**	**2.0**	**0.3**		**10.3**	**0.3**	**0.3**	**0.5**	**100**

Table 15: Species Recorded during Freshwater Aquatic Assamblages Survey against Seasons and Sections of Stream

Order	Family	Scientific Name	Commonness	Conservation Status	Dry Season			Wet Season			Grand Total
					Up	Middle	Down	Up	Middle	Down	
Anura	Bufonidae	*Bufo melanostictus*				137					**137**
Cypriniformes	Cyprinidae	*Parazacco spilurus*	Common	CRDB: Vulnerable	37	42	7	16	45		**147**
	Homalopteridae	*Liniparhomaloptera disparis*	Common			1					**1**
	Poeciliidae	*Gambusia affinis*							1		**1**
Decapoda	Atyidae	*Caridina cantonensis*	Common		174	66	3	58	35	8	**344**
	Palaemonidae	*Macrobrachium hainanense*				1					**1**
Diptera	Simuliidae	Unidentified Simuliidae			1						**1**
Ephemeroptera	Ephemerellidae	Unidentified Ephemerellidae			1	1					**2**
	Ephemeridae	*Ephemera spilosa*			1			2			**3**
Heteroptera	Gerridae	*Limnogonus fossarum*				1		8	31		**40**
	Gerridae	*Metrocoris lituratus*			33			28	7		**68**
Mugiliformes	Mugilidae	*Chelon subviridis*					370			38	**408**
	Mugilidae	*Mugil cephalus*	Common				10				**10**
Odonata	Calopterygidae	*Neurobasis chinensis chinensis*								1	**1**
	Chlorocyphidae	*Rhinocypha perforata*			3						**3**
	Gomphidae	*Ophiogomphus sinicus*				1					**1**
	Libellulidae	*Zygonyx iris*				2					**2**
Perciformes	Ambassidae	*Ambassis* sp.	Common				51	4	142	209	**406**
	Gobiidae	*Rhinogobius duospilus*	Common		3	26	1	10	32	5	**77**
Trichoptera	Calamoceratidae	*Anisocentropus maculatus*			1						**1**
				Grand Total	**254**	**278**	**442**	**126**	**293**	**261**	**1654**

Table 16: The Prosomal Width of *Carcinoscorpius rotundicauda* against Month

Prosomal Width (cm)	Feb-14	Apr-14	May-14	Jun-14	Jul-14	Aug-14	Sep-14	**Grand Total**
1.9							1	**1**
2.0						3		**3**
2.2					1		1	**2**
2.4					2		1	**3**
2.9	4		1				2	**7**
3.0							2	**2**
3.1							2	**2**
3.2						1		**1**
3.3							2	**2**
3.4							1	**1**
3.5							3	**3**
3.7							1	**1**
3.8						2	1	**3**
3.9		1	25	8	1	1	5	**41**
4.0							5	**5**
4.1		5					6	**11**
4.2							3	**3**
4.3							3	**3**
4.4		6	28	10	3		1	**48**
4.5							1	**1**
4.6			44				1	**45**
4.7							1	**1**
4.9				13	1			**14**
5.1						1	1	**2**
5.2						1		**1**
5.3						1		**1**
5.4				9	3	1		**13**
5.5						1	1	**2**
5.6						2	1	**3**
5.7						2	1	**3**
5.8						5	2	**7**
5.9				8	8	1	1	**18**
6.0						1	2	**3**
6.1	16					3	3	**22**
6.2						3	3	**6**
6.3			2	15	15	4	1	**37**
6.4						1	2	**3**
6.5						4	4	**8**
6.6		8				4	3	**15**
6.7						3	2	**5**
6.8		2		28	10	1	6	**47**
6.9						2		**2**
7.0						2	3	**5**
7.1						2	2	**4**

Prosomal Width (cm)	Feb-14	Apr-14	May-14	Jun-14	Jul-14	Aug-14	Sep-14	**Grand Total**
7.2						1		**1**
7.3				24	2	1	2	**29**
7.4							1	**1**
7.5						1		**1**
7.7							2	**2**
7.8				20	5		3	**28**
8.0							3	**3**
8.1						2	2	**4**
8.2						1		**1**
8.3				14	3	1	1	**19**
8.4							1	**1**
8.5							2	**2**
8.6						1		**1**
8.8				1			1	**2**
8.9						1		**1**
9.0							3	**3**
9.1							2	**2**
9.2						1		**1**
9.3				2	1			**3**
9.8					1			**1**
12.9*						1		**1**
13.7*					1^			**1**
14.1*				1^				**1**
15.1*				1	1^			**2**
15.6*					1			**1**
17.1*				1^				**1**
Grand Total	**20**	**22**	**100**	**155**	**59**	**63**	**104**	**523**

Notes:

March survey was re- scheduled to April 2014 due to adverse weather condition

No horseshoe crab was found during the addiotional horseshoe crab survey conducted in eastern coast of Sterling Inlet from Oct to Dec

*Adult Individual

^Mating Pair

Table 17: Approximate Size of the Seagrass Beds of *Halophila ovalis* found on the Sandflat against Month

Approximate Size (m^2)	Month	Latitude (N)	Longitude (E)
7	Mar-2014	22°32'30"	114°13'26"
80	Mar-2014	22°32'30"	114°13'24.9"
7.5	Mar-2014	22°32'32"	114°13'24"
8	Mar-2014	22°32'30"	114°13'23.7"
6	Mar-2014	22°32'29.7"	114°13'25.7"
8	Mar-2014	22°32'30.3"	114°13'26.2"
12	Mar-2014	22°32'30.6"	114°13'25.4"
100	Apr-2014	22°32'30"	114°13'24.9"
120	Apr-2014	22°32'29.8"	114°13'24.4"
6.25	Apr-2014	22°32'32"	114°13'24.1"
10	Apr-2014	22°32'29.9"	114°13'23.7"
2	Apr-2014	22°32'29.9"	114°13'25.4"
9	Apr-2014	22°32'29.8"	114°13'25.6"
16	Apr-2014	22°32'30.1"	114°13'26.3"
6	Apr-2014	22°32'30.4"	114°13'26.2"
12	Apr-2014	22°32'30.6"	114°13'25.5"
27	May-2014	22°32'30"	114°13'26"
26	May-2014	22°32'30"	114°13'26"
94	May-2014	22°32'30"	114°13'24"
30	May-2014	22°32'29"	114°13'25"
20	May-2014	22°32'29"	114°13'27"
1	Jun-2014	22°32'30.7"	114°13'24.8"
100	Jun-2014	22°32'29.8"	114°13'24.6"
60	Jun-2014	22°32'30"	114°13'24.3"
1*	Jun-2014	22°32'35.1"	114°13'9.5"
No Record of Seagrass	Jul-2014	N/A	N/A
No Record of Seagrass	Aug-2014	N/A	N/A
No Record of Seagrass	Sep-2014	N/A	N/A

Notes:

* Record on the Mangrove Edge

Appendix 2

Photos of the Ecological Surveys

Plate 1: Woodland

Plate 2: Shrubland

Plate 3: Marsh

Plate 4: Grassland

Plate 5: Mangrove

Plate 6: Pond

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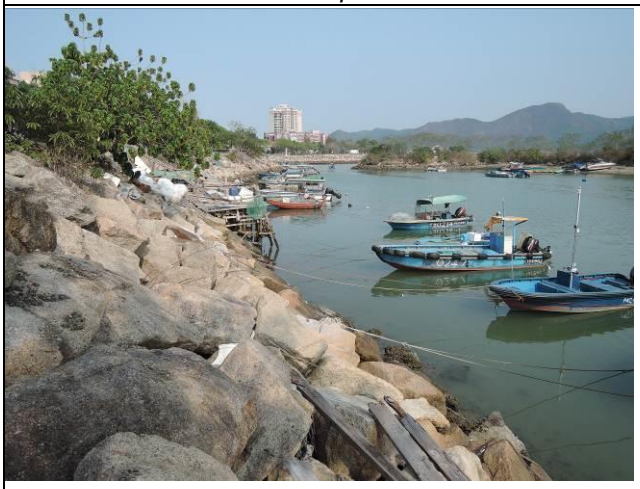

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Appendix 3

Subtidal Coral Survey Report

THE OCEANWAY CORPORATION LTD

REPORT

EXPANSION OF SHA TAU KOK SEWAGE TREATMENT WORKS, PHASE 1 – INVESTIGATION, DESIGN AND CONSTRUCTION

SUBTIDAL CORAL SURVEY

REF: AGREEMENT NO. CE 63/2012(DS)

Final Report

December 2014

EXECUTIVE SUMMARY

- In August 2014, a ecological survey at Sha Tau Kok was carried out in order to provide a baseline information prior to the "Expansion of Sha Tau Kok Sewage Treatment Works, Phase I- Investigation, Design and Construction" (Agreement No. CE 63/2012 (DS)).
- Eight locations within 500m of the Sha Tau Kok Sewage Treatment Works have been identified to be investigated. Data on such selected locations have been collected through a series of spot-check dive surveys. Ecological Assessment (REA) will be conducted if coral communities are identified.
- Results of these dive surveys will be used to verify the previous findings in the approved EIA report for "Expansion of Sha Tau Kok Sewage Treatment Works, Phase I- Investigation, Design and Construction" (Agreement No. CE 63/2012 (DS)).
- No coral communities occur at the study locations on the seabed of Sha Tau Kok.
- There were no other rare or endangered species recorded in the areas surveyed.
- The following mitigation measures are suggested for this project:
    - A silt curtain should be set up around the dredge equipment to minimize the suspended sediment generated. This should be from surface to seabed.
    - Periodic water quality measurements should be considered. These should be surface, mid-water and bottom measurements. Upon reaching limits, dredging activity (or rate) should be adjusted to lower levels.
    - The contractor should be reminded that precautions should be made to prevent sediment leakage when transferring sediment from grab to barge or from one barge to another.
    - The intertidal areas have a healthy community of mangrove and associated species. These communities are sensitive particularly to petroleum and other oil based products. A formal oil spill response plan is recommended for all vessels working in this area.

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INTRODUCTION

In August 2014, an ecological survey was carried out nearby the Sha Tau Kok Sewage Treatment Works in order to provide a baseline information of the subtidal seabed benthic community prior to the expansion for the Sha Tau Kok Sewage Treatment Works. Eight locations have been identified to be investigated, with transects lie within 500 m from the treatment works. Data on such selected locations have been collected through a series of spot-check dive surveys. Ecological Assessment (REA) would be conducted if coral communities are identified. Results of these dive surveys will be used to fulfill The EIA Study Brief (No. ESB-253/2012) required by the Environmental Permit from the Hong Kong SAR Government. This report the ecological survey for the "Expansion of Sha Tau Kok Sewage Treatment Works, Phase I- Investigation, Design and Construction" (Agreement No. CE 63/2012 (DS)).

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

Temperature, time and date;

Location (GPS);

Depth range;

Visibility;

Substratum type (i.e. hard substratum seabed, intertidal rocky area); and

Other invertebrates present.

Any special features encounter in the coral areas, such as non-typical reef structures, unusual coral species associations, unique or peculiar assemblages of the local incipient reef formations, and reefs that are almost completely dominated by one particular species, would be recorded. Representative photographs of any important ecological habitat, coral species and other ecological features would also be taken.

With reference to the data collected during the spot-check dive survey, Rapid Ecological Assessment (REA) surveys will be carried out at locations where coral communities are identified (Coral coverage >1%). The REA survey will be conducted

underwater in a two-tier approach to assess the sub-littoral substrata and benthic organisms in an area, i.e., Tier I, which assesses the relative coverage of major benthic groups and substrata, and, Tier II, which provides an inventory of sedentary/ sessile benthic taxa, which are ranked in terms of their abundance at the survey site. The benthic coverage, taxon abundance, and ecological attributes of the REA transects will be recorded. Representative photographs of any important ecological features and corals would also be taken.

MATERIALS AND METHODS

The survey techniques used was a tiered methodology used to assess sub-littoral benthic communities, in particular, presence of hard corals within the eight identified survey locations. These locations are on the seabed within 500 m at the south of the Sha Tau Kok Treatment Works. (as shown in Figure 1). The coordinates of the start of each transect locations are listed in Table 1.

Table 1. Coordinates for the center of each coral area surveyed

Location	GPS Readings	
SD1	22° 32.503 N	114° 13.500 E
SD2	22° 32.604 N	114° 13.455 E
SD3	22°32.623 N	114°13.273 E
SD4	22° 32.571 N	114° 13.323 E
SD5	22°32.546 N	114°13.311 E
SD6	22°32.397 N	114°13.333 E
SD7	22° 32.458 N	114° 13.184 E
SD8	22°32.354 N	114°13.214 E

All the dive surveys were conducted during daytime. Such surveys consist of a two tiered multi survey approach with simple Spot-check Dive Surveys, and detailed Area Survey. The simple Diver Survey consists of a suite of three standardized 'nested' survey methods targeting coral damage and coral health: More detail surveys included detailed quantitative surveys, i.e., Rapid Ecological Assessment (REA), This would be conducted if coral communities were identified. Coral species, abundance and coverage would be recorded.

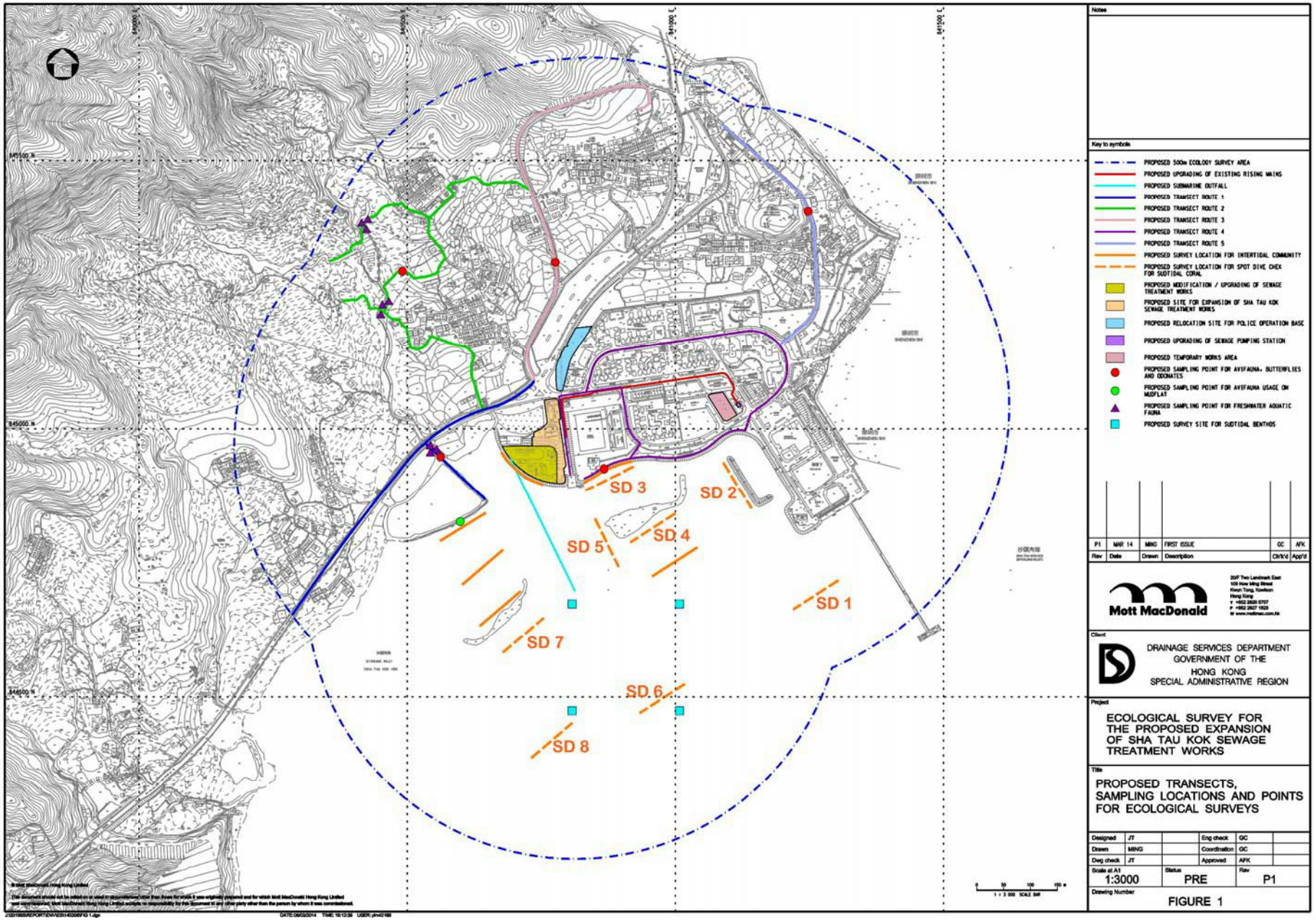

Figure 1. Map of Sha Tau Kok showing the survey locations.

LEVEL 1: SPOT-CHECK DIVE SURVEYS

These surveys provide general information and gives a general indication of a coral area. Suitably trained SCUBA divers dived within each coral area to look for specific indicators or situations within that area. The dives covered each area at a density that was sufficient to satisfactorily cover the majority of the area concerned. For each dive the following information was recorded:

- Depth range.
- Visibility.
- Estimated % of hard coral cover.
- Estimated % overturned or damaged coral.
- Estimate the anthropologenic and natural coral damage %.
- Approximate locations of the damage.
- Distance surveyed.
- Type and amount of rubbish present.

Data was recorded on waterproof paper attached to a suitable slate. Appendix 1 shows the sample data sheet used in the survey. This data should be transferred to the report as general comments and observations.

LEVEL 2 : RAPID ECOLOGICAL ASSESSMENT (REA) SURVEY METHODOLOGY

Rapid Ecological Assessment (REA) methods have been developed to provide highly informative baseline information on many coral regions, including the Florida Reef Tract (Chiappone and Sullivan 1997), Palau (Maragos and Cook 1995), the Great Barrier Reef (DeVantier *et al.* 1998) and Red Sea (DeVantier *et al.* 2000). The REA method developed for the Indo-Pacific (DeVantier *et al.* 1998, 2000) was refined for use in local waters and a standardized methodology was employed for the dive surveys. The field and analytical methods described below are modified from DeVantier *et al.* (1998, 2000). These methods have been applied successfully in a wide range of coral reef and community types, including those in Hong Kong waters (Fabricius 2001, Oceanway 2001a, 2001b).

The field data was recorded by observers experienced in the underwater identification of sessile benthic taxa, swimming down-current along coral communities or identified sections of coastline on SCUBA from haphazardly-chosen starting points. The swims covered most of the coral community at each site in that they encompassed the main characteristics of each coral community surveyed.

Two types of information was recorded during each survey swim in each area:

1) Tier I: An assessment of the relative cover of the major benthic groups; and
2) Tier II: An inventory of sessile benthic taxa.

Tier I: Categorization of ecological (benthic cover) and environmental variables. Ecological variables – benthic cover site descriptors.

At completion of each survey swim, six ecological and seven substratum attributes (Table 2a) were assigned to one of seven standard ranked (ordinal) categories (Table 2b), based on an assessment integrated over the length of the swim. These broad categories have been shown to be relatively insensitive to biases among different observers and capable of discriminating among contrasting benthic assemblages (Miller and De'Ath 1995).

Table 2. Categories of a) benthic attributes, b) ordinal ranks of percentage cover and c) ordinal ranks of taxon abundance.

a) Attributes		**b) Cover**		**c) Taxon Abundance**	
Ecological	**Substratum**	**Rank**	**Percentage**	**Rank**	**Abundance**
Hard coral	Hard substrate	0	not recorded	0	absent
Dead standing coral	Continuous pavement	1	1-5%	1	rare
Soft coral	Large blocks (diam. > 50 cm)	2	6-10%	2	uncommon
Black Coral	Small blocks (diam. < 50 cm)	3	11 - 30%	3	common
	Rubble	4	31 - 50%	4	abundant
	Sand	5	51 - 75%	5	dominant
	Silt	6	76 - 100%		

Environmental variables:

- Salinity
- Turbidity
- Depth
- Slope of the community at regular intervals along the transect.
- Exposure.
- Sediment

Water clarity - turbidity was measured as horizontal visibility along transect tape (m), while vertical light penetration was measured with a secchi disk (m). Salinity was measured with a portable refractometer. The depth of sites (maximum and minimum) and average angle of community slope to the horizontal (nearest 10 %) was recorded at 2m intervals.

The degree of exposure to prevailing wave energy will be ranked from 1 - 4, where:

1 = sheltered (highly protected by topographic features from prevailing waves);
2 = semi-sheltered (moderately protected);
3 = semi-exposed (only partly protected); and
4 = exposed (experiences the full force of prevailing wave energy).

Sediment deposition on the reef substratum (particle sizes ranging from very fine to moderately coarse) rated on a four point scale. from 0 - 3, where:

0 = no sediment;
1 = minor (thin layer) sediment deposition;
2 = moderate sediment deposition (thick layer), but substrate can be cleaned by fanning off the sediment; and
3 = major sediment deposition (thick, deep layer), and substrate cannot be cleaned by fanning.

Tier II. Taxonomic inventories to define types of benthic communities

An inventory of benthic taxa was compiled during each swim. Taxa was identified *in situ* to the following levels:

- **Hard corals** (Class Anthozoa, Order Scleractinia) - species wherever possible (Veron and Pichon 1976, 1980, 1982, Veron, Veron and Wallace 1984, Scott 1984, Veron 1982, 1986, 1993, 2000, Wallace 1999, Lam et al. 2008), AECD 2005, otherwise genus and growth form (e.g. *Porites* spp. of massive growth-form).
- **Soft corals** (Class Anthozoa, Subclass Octocorallia) and conspicuous macro-algae - genus (Allen and Steene 1994, Colin and Arneson 1995, Goslinger *et al.* 1996, Fabricius and Alderslade 2000, Lam and Morton 2008).
- **Black Corals** (Class Anthozoa, Order Antipathes and Cirripathes) – there is not that much known about the local species. . (Lam and Morton 2008) .
- **Other benthos** (including sponges, zoanthids, ascidians, bryozoans) - higher taxonomic level (usually phylum plus growth form, Allen and Steene 1994, Colin and Arneson 1995, Goslinger *et al.* 1996)

Appendix 2A and 2B show the raw data sheets used in this survey. All data was input to Excel spreadsheets for initial storage and preliminary analyses.

RESULTS

LEVEL 1: DIVER SURVEYS

Diver Survey dives covering 910 m (eight locations × >100 m) were carried out in the eight locations (Figure 1 and Table 1). All these were carried out on 5th August 2014. These dives were concentrated in areas where corals were found and thus those areas that had little hard substrate or low coral cover received less attention. Table 3 gives details of the number of dives and distance surveyed within each area.

Table 3. Distance surveyed and number of dives conducted during the spot dive surveys within each coral survey area

Location	Distance surveyed (m)	Number of dives
SD1	115	10
SD2	105	10
SD3	110	10
SD4	115	10
SD5	125	10
SD6	110	10
SD7	125	10
SD8	105	10

Summary Results

The raw data and results of the Diver Survey are shown in Appendix 3 and Table 4, respectively. The physical parameters such as weather, air and water temperature, water depth and visibility and biological parameters such as occurrences of hard and soft corals and invertebrates have been recorded.

Photographs of the species occur in all the locations are shown in Appendix 6.

Table 4. Summary results of the Diver Survey.

Location	SD1	SD2	SD3	SD4	SD5	SD6	SD7	SD8
Weather	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny
Air temperature (°C)	31	31	32	32C	29C	29C	29C	29C
Survey time start	16.42	15:10	13:50	13:06	12:30	11:36	11:00	10:18
Survey time end	17:02	15:38	13:52	13:36	12:56	12:05	11:27	10:51
Date of survey	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014
Water Temperature (°C at 0m depth)	35	34	35	36C	35C	35C	35C	35C
Salinity (‰)	24-25	25	23	27	26	26	26	28
GPS N (Start point)	22° 32.503	22°32.604	22°32.623	22°32.571	22°32.546	22°32.397	22°32.458	22°32.354
GPS E (Start point)	114° 13.500	114°13.455	114°13.273	114°13.323	114°13.311	114°13.333	114°13.184	114°13.214
Depth (m)	0.5 – 1	0.4 - 1	1.5	0.5 - 1.4	1 - 2.1	2 - 2.3	0.5 – 0.9	1.1 – 1.3
Visibility (m)	0.3	0.2	0.2	0.3 – 0.4	0.1 -0.3	0.2 - 0.3	0.2 – 0.3	0.3
Substratum type	Soft mud, silt	Shells, mud and rocks	Mud	Sand	Soft Mud	Soft Mud & Shells	Soft Mud & Shells	Soft Mud & Shells
Occurrence of hard coral	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Occurrence of soft coral	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Occurrence of other invertebrates	*Batillaria multiformis* *Batillaria zonalis* *Batillaria cumungii*	Oysters	Nil	Nil	Nil	Oysters	*Batillaria multiformis* *Batillaria zonalis* Oysters	Ascidians Oysters
Remarks		Occurrence of rubbish	Occurrence of rubbish Location is on the boat channel	Occurrence of rubbish Location is on the boat channel				Occurrence of dead oysters

A. SD1

This location is at the southeast offshore within the 500 boundary of the Treatment Works. The substratum of the sea bottom is covered with soft mud and silt and thus with a very low visibility of 0.3 m. Salinity is 24-25 ‰. No hard and soft coral occurrences were observed. This area is colonized by invertebrates such as mud-dwelling gastropods *Batillaria multiformis*, *Batillaria zonalis* and *Batillaria cumungii*.

B. SD2

This location is at the southwerstern side of the Treatment Works. The dive locations was along the typhoon shelter.The substratum of the sea bottom is covered with empty sea shells, mud and rocks. Visibility is low at 0.2 m. Salinity is 25 ‰. No hard and soft coral occurrences were observed. The hard substratum in this location are colonized by small size oysters. The habitat is subjected to disturbance by occurrence of rubbish.

C. SD3

This location is at the immediate south along the shoreline of the Treatment Works. The substratum of the sea bottom is covered with mud. Visibility is low at 0.2 m. Salinity is 23 ‰. No hard and soft coral occurrences were observed. No other invertebrates were observed. The habitat is subjected to disturbance by occurrence of rubbish and that the location is on the boat channel.

D. SD4

This location is at the south offshore within the 500 boundary of the Treatment Works. The spot dive transect was laid along the southern side of a small island. The substratum of the sea bottom is covered with sand. Visibility is low at 0.3-0.4 m. Salinity is 27 ‰. No hard and soft corals and other invertebrate occurrences were observed. The habitat is subjected to disturbance by occurrence of rubbish and that the location is on the boat channel.

E. SD5

This location is at the south offshore within the 500 boundary of the Treatment Works. The spot dive transect was laid along the eastern side of a small island. The substratum of the sea bottom is covered with soft mud. Visibility is low at 0.1-0.3 m. Salinity is 26 ‰. No hard and soft corals and other invertebrate occurrences were observed.

F. SD6

This location is at the south offshore within the 500 boundary of the Treatment Works. The substratum of the sea bottom is covered with soft mud and empty shells.

Visibility is low at 0.2-0.3 m. Salinity is 26 ‰. No hard and soft coral occurrences were observed. Only small oysters occurred.

F. SD7

This location is at the southwest offshore within the 500 boundary of the Treatment Works. The spot dive transect was laid along the southern side of a small island. The substratum of the sea bottom is covered with soft mud and empty shells. Visibility is low at 0.2-0.3 m. Salinity is 26 ‰. No hard and soft coral occurrences were observed. This area is colonized by invertebrates such as small oysters and mud-dwelling gastropods *Batillaria multiformis*, *Batillaria zonalis* and *Batillaria cumungii*.

G. SD8

This location is at the southwest offshore within the 500 boundary of the Treatment Works. The transect of SD8 is further offshore than that of SD7. The substratum of the sea bottom is covered with soft mud and empty shells. Visibility is low at 0.3 m. Salinity is 28 ‰. No hard and soft coral occurrences were observed. This area is colonized by invertebrates such as small oysters and ascidians. Dead oyster shells occurred among the substratum.

LEVEL 2: RAPID ECOLOGICAL ASSESSMENT

REA surveys were conducted on Locations SD1, SD2, SD4 and SD7. Appendix 4 is the raw data collected for the REA surveys at SD1, SD2, SD4 and SD7.

A. SD1

There is no hard and soft corals occur in this location. Occurrence of invertebrate, scallops, were also recorded, in addition to the gastropod *Batillaria* spp. recorded in the Spot Dive Survey. This location is disturbed by fishing activities as ghost nets were found.

B. SD2

There is no hard and soft corals occur in this location. Occurrence of invertebrates, barnacles, scallops and green mussel *Perna viridis*, in addition to oyster, were also recorded.

C. SD4

There is no hard and soft corals occur in this location. Occurrence of invertebrates, barnacles, scallops and green mussel *Perna viridis*, in addition to oyster, were also recorded.

D. SD7

There is no hard and soft corals occur in this location. Only ascidians and oysters was recorded in this area.

CONCLUSIONS

Coral communities do not occur at any of the locations surveyed nearby the Sha Tau Kok Treatment Works. The results of the Spot Dive Survey and REA Survey shows there is no occurrence of hard and soft corals. The area has a mainly soft seabed covered in soft mud and/or sand. The water turbidity is high with visibility at less then 30cm. Furthermore the salinity was measured at between 23 and 28ppT. This is low. Water temperature was high with values of 34ºC ~ 36ºC recorded. Both of these factors are not conducive for corals.

There were no other rare or endangered species recorded in the areas surveyed. Seahorses had been recorded in this area in the past (Oceanway 2001) but this record was near to the pier in this area. No seahorses were recorded during this survey.

NOT USED

APPENDIX 1: SAMPLE DATA SHEET FOR SPORT DIVE SURVEYS

Data sheet used to record observations in the spot dives

Sha Tau Kok Survey	
Parameter / Location	
Weather	
Air temperature (^{o}C)	
Survey time start	
Survey time end	
Date of survey	
Water Temperature (^{o}C at 0m depth)	
Salinity (‰)	
GPS N	
GPS E	
Depth (m)	
Visibility (m)	
Substratum type	
Occurrence of hard coral	
Occurrence of soft coral	
Occurrence of other invertebrates	
Remarks	

APPENDIX 2A: SAMPLE DATA SHEET FOR REA SURVEYS

REA Data Forms

Location:

General data / Transect	**SD1**	**SD2**	**SD4**	**SD7**
GPS N				
GPS E				
Time:				
Depth min				
Depth max				
Exposure (1~4)				
Sediment (0~3)				
Slope 0=flat, 4=vertical.				
Visibility(m)				
Salinity (psu)				
Temp ºC				
Hard Substratum (% of total)				
Bed Rock (% of HS)				
Large Boulder (% of HS)				
Soft Substratum (% of total)				
Sand (% of SS)				
Silt/Mud (% of SS)				
Mud (% of SS)				
Taxa				
Bryazoa				
Brown/orange encrust				
Red encrust				
Cyanobacterial mats				
Mollusca				
Perna viridis				
Scallops				
Oysters				
Sponge				
Encrusting				
Golf ball				
Crustacea				
Portunus spp.				
Charybdis spp.				
Gastropoda				
Ergalatax contractus				

Thais luteostoma				
Thais clavigera				
Morula musica				
Echinodermata				
Diadema setosum				
Anthocidaris crassispina				
Parasalenia gratiosa				
Salmacis sphaeroides				
Temnopleurus reevesii				

APPENDIX 2B: SAMPLE DATA SHEET FOR REA SURVEYS

REA Data Forms

Location:

General data / Transect	**SD1**	**SD2**	**SD4**	**SD7**
Taxa				
Hard Corals				
Acropora tumida				
Acropora pruinosa				
Montipora peltiformis				
Galaxea astreata				
Psammocora superficialis				
Coscinaraea n sp.				
Pavona decussata				
Lithophyllon undulatum				
Echinophyllia aspera				
Hydnophora exesa				
Turbinarea peltata				
Favia speciosa				
Favia favus				
Favia lizardensis				
Favia rotumana				
Favia veroni				
Favia maritima				
Favites pentagona				
Favites chinensis				
Favites abdita				
Favites acuticollis				
Goniastrea aspera				
Platygyra carnosus				
Platygyra acuta				
Plesiastrea versipora				
Oulastrea crispata				
Leptastrea purpurea				
Leptastrea pruinosa				
Cyphastrea serailia				
Cyphastrea japonica				
Porites lobata				
Porites lutea				
Goniopora columna				
Goniopora stutchburya				
Goniopora lobata				
Other Coral				
Tubastrea spp.				
Balanophyllia sp.				
Paracyathus rotundatus				

Soft Coral				
Guaiagorgia sp.				
Euplexaura sp.				
Echinomuricea sp.				
Dendronephthya gigantea				
Cnidaria				
Anemone				
Sand Anemone				
Spirobranchus tricornis				
Myxicola infundibulum				

APPENDIX 3: DIVER SURVEY RAW DATA - PHYSICAL PARAMETERS AND SPCECIES COMPOSITION DATA

Parameter / Location	SD1a	SD1b	SD1c	SD1d	SD1e	SD1f	SD1g	SD1h	SD1i	SD1j
Weather	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny
Air temperature (^{0}C)	31C	31C	31C	31C	31C	31C	31C	31C	31C	31C
Survey time start	16.42	16:44	16:45	16:47	16:49	16:51	16:53	16:55	16:57	17:00
Survey time end	16:44	16:45	16:46	16:48	16:51	16:52	16:54	16:56	16:59	17:02
Date of survey	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014
Water Temperature (^{0}C at 0m depth)	35	35	35C	35C	35C	35C	35C	35C	35C	35C
Salinity ppT	25	24	25	25	25	25	25	25	25	25
GPS N	22° 32.503	22° 32.506	22° 32.509	22° 32.512	22° 32.515	22° 32.517	22° 32.520	22° 32.523	22° 32.526	22° 32.529
GPS E	114° 13.500	114° 13.505	114° 13.510	114° 13.515	114° 13.528	114° 13.524	114° 13.529	114° 13.535	114° 13.539	114° 13.544
Depth (m)	0.5	0.6	0.7	0.5	0.5	0.5	0.5	0.5	1.0	0.8
Visibility (m)	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Substratum type	Soft Mud / Silt	Soft Mud / Silt	Soft Mud / Silt	Soft Mud / Silt	Soft Mud / Silt	Soft Mud / Silt	Soft Mud / Silt	Soft Mud / Silt	Soft Mud / Silt	Soft Mud / Silt
Occurrence of hard coral	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Occurrence of soft coral	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Occurrence of other invertebrates	*Batillaria multiformis*	*Batillaria multiformis*	*Batillaria multiformis*	*Batillaria multiformis*	*Batillaria multiformis*	*Batillaria multiformis*	*Batillaria multiformis*	*Batillaria multiformis*	*Batillaria multiformis*	*Batillaria multiformis*
	Batillaria zonalis	*Batillaria zonalis*	*Batillaria zonalis*	*Batillaria zonalis*	*Batillaria zonalis*	*Batillaria zonalis*	*Batillaria zonalis*	*Batillaria zonalis*	*Batillaria zonalis*	*Batillaria zonalis*
	Batillaria cumungii		Oysters	*Batillaria cumungii*		*Batillaria cumungii*			*Batillaria cumungii*	
Remarks										
Parameter / Location	**SD2a**	**SD2b**	**SD2c**	**SD2d**	**SD2e**	**SD2f**	**SD2g**	**SD2h**	**SD2i**	**SD2j**
Weather	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny
Air temperature (^{0}C)	31C	31C	31C	31C	31C	31C	31C	31C	31C	31C
Survey time start	15:10	15:13	15:17	15:20	15:24	15:27	15:30	15:32	15:35	15:37
Survey time end	15:12	15:15	15:19	15:22	15:26	15:28	15:31	15:33	15:36	15:38
Date of survey	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014
Water Temperature (^{0}C at 0m depth)	34C	34C	34C	34C	34C	34C	34C	34C	34C	34C
Salinity ppT	25	25	25	25	25	25	25	25	25	25
GPS N	22°32.604	22°32.608	22°32.613	22°32.618	22°32.623	22°32.627	22°32.632	22°32.636	22°32.641	22°32.646
GPS E	114°13.455	114°13.452	114°13.449	114°13.446	114°13.443	114°13.440	114°13.437	114°13.435	114°13.431	114°13.429
Depth (m)	0.5	0.5	0.4	0.6	0.6	0.6	1.0	0.5	0.6	0.7
Visibility (m)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Substratum type	Shells, Mud & Rocks	Shells, Mud & Rocks	Shells, Mud & Rocks	Shells, Mud & Rocks	Boulders	Boulders	Boulders	Boulders	Shells, Mud & Rocks	Shells & Mud
Occurrence of hard coral	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Occurrence of soft coral	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Occurrence of other invertebrates	Oysters	Oysters	Oysters	Oysters	Oysters	Oysters	Oysters	Oysters	Oysters	Oysters
		Tunicates	Barnacles	Barnacles	Barnacles	Barnacles	Barnacles	Barnacles		Tunicates
Remarks										
		Rubbish	Rubbish	Rubbish	Rubbish	Rubbish	Rubbish	Rubbish	Rubbish	Rubbish

Parameter / Location	SD3a	SD3b	SD3c	SD3d	SD3e	SD3f	SD3g	SD3h	SD3i	SD3j
Weather	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny
Air temperature (^{o}C)	32C	32C	32C	32C	32C	32C	32C	32C	32C	32C
Survey time start	13:50	13:53	13:56	13:59	14:03	14:06	14:08	14:11	14:13	14:16
Survey time end	13:52	13:55	13:58	14:01	14:05	14:07	14:10	14:12	14:15	14:17
Date of survey	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014
Water Temperature (^{o}C at 0m depth)	35C	35C	35C	35C	35C	35C	35C	35C	35C	35C
Salinity ppT	23	23	23	23	23	23	23	23	23	23
GPS N	22°32.623	22°32.625	22°32.627	22°32.629	22°32.631	22°32.633	22°32.636	22°32.638	22°32.640	22°32.642
GPS E	114°13.273	114°13.279	114°13.285	114°13.290	114°13.296	114°13.301	114°13.306	114°13.312	114°13.317	114°13.322
Depth (m)	1.5	1.0	0.7	0.7	1.0	1.0	1.2	1.2	1.5	1.1
Visibility (m)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Substratum type	Mud	Mud	Soft Mud	Mud	Mud	Soft Mud	Soft Mud	Mud	Mud	Mud
Occurrence of hard coral	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Occurrence of soft coral	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Occurrence of other invertebrates	Nil	Nil	Oysters	Nil	Nil	Nil	Nil	Oysters	Nil	Nil
Remarks	Boat channel	Boat channel	Boat channel	Boat channel	Boat channel	Boat channel	Boat channel	Boat channel	Boat channel	Boat channel
	Rubbish	Rubbish	Rubbish	Rubbish	Rubbish	Rubbish	Rubbish	Rubbish	Rubbish	Rubbish

Parameter / Location	SD4a	SD4b	SD4c	SD4d	SD4e	SD4f	SD4g	SD4h	SD4i	SD4j
Weather	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny
Air temperature (^{o}C)	32C	32C	32C	32C	32C	32C	32C	32C	32C	32C
Survey time start	13:06	13:09	13:12	13:15	13:18	13:21	13:23	13:26	13:30	13:34
Survey time end	13:08	13:10	13:14	13:17	13:20	13:22	13:25	13:28	13:32	13:36
Date of survey	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014
Water Temperature (^{o}C at 0m depth)	36C	36C	36C	36C	36C	36C	36C	36C	36C	36C
Salinity ppT	27	27	27	27	27	27	27	27	27	27
GPS N	22°32.571	22°32.574	22°32.576	22°32.579	22°32.582	22°32.584	22°32.587	22°32.589	22°32.592	22°32.594
GPS E	114°13.323	114°13.328	114°13.333	114°13.338	114°13.343	114°13.349	114°13.354	114°13.359	114°13.364	114°13.369
Depth (m)	0.7	1.2	1.2	1.4	1.2	1.3	1.0	0.9	0.7	0.5
Visibility (m)	0.3	0.4	0.4	0.3	0.4	0.3	0.3	0.4	0.4	0.4
Substratum type	Sand	Sand	Sand & Mud	Sand	Sand	Sand	Sand	Sand & Mud	Sand	Sand
Occurrence of hard coral	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Occurrence of soft coral	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Occurrence of other invertebrates	Nil	Nil	Nil	Nil	*Batillaria multiformis*	*Batillaria multiformis*	Nil	Nil	*Batillaria multiformis*	*Batillaria multiformis*
					Batillaria zonalis	*Batillaria zonalis*			*Batillaria zonalis*	*Batillaria zonalis*
Remarks	Boat channel	Boat channel	Boat channel	Boat channel	Boat channel	Boat channel	Boat channel	Boat channel	Boat channel	Boat channel
	Rubbish	Rubbish	Rubbish						Rubbish	Rubbish

Parameter / Location	SD5a	SD5b	SD5c	SD5d	SD5e	SD5f	SD5g	SD5h	SD5i	SD5j
Weather	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny
Air temperature (^{0}C)	29C	29C	29C	29C	29C	29C	29C	29C	29C	29C
Survey time start	12:30	12:34	12:36	12:40	12:42	12:44	12:46	12:48	12:51	12:54
Survey time end	12:32	12:35	12:38	12:41	12:43	12:45	12:47	12:50	12:53	12:56
Date of survey	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014
Water Temperature (^{0}C at 0m depth)	35C	35C	35C	35C	35C	35C	35C	35C	35C	35C
Salinity ppT	26	26	26	26	26	26	26	26	26	26
GPS N	22°32.546	22°32.551	22°32.556	22°32.561	22°32.566	22°32.571	22°32.577	22°32.582	22°32.587	22°32.592
GPS E	114°13.311	114°13.309	114°13.307	114°13.305	114°13.303	114°13.302	114°13.299	114°13.297	114°13.295	114°13.294
Depth (m)	2.0	2.0	2.1	2.0	1.8	1.7	1.6	1.5	1.3	1.0
Visibility (m)	0.2	0.1	0.2	0.3	0.2	0.2	0.2	0.3	0.2	0.2
Substratum type	Soft Mud	Soft Mud	Soft Mud	Soft Mud	Soft Mud	Soft Mud	Soft Mud	Soft Mud	Mud	Mud
Occurrence of hard coral	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Occurrence of soft coral	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Occurrence of other invertebrates	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Remarks										

Parameter / Location	SD6a	SD6b	SD6c	SD6d	SD6e	SD6f	SD6g	SD6h	SD6i	SD6j
Weather	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny
Air temperature (^{0}C)	29C	29C	29C	29C	29C	29C	29C	29C	29C	29C
Survey time start	11:36	11:39	11:42	11:45	11:48	11:52	11:55	11:58	12:02	12:04
Survey time end	11:38	11:41	11:44	11:47	11:50	11:53	11:56	12:00	12:03	12:05
Date of survey	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014
Water Temperature (^{0}C at 0m depth)	35C	35C	35C	35C	35C	35C	35C	35C	35C	35C
Salinity ppT	26	26	26	26	26	26	26	26	26	26
GPS N	22°32.397	22°32.400	22°32.404	22°32.407	22°32.410	22°32.414	22°32.417	22°32.420	22°32.423	22°32.427
GPS E	114°13.333	114°13.337	114°13.342	114°13.347	114°13.351	114°13.356	114°13.361	114°13.365	114°13.370	114°13.374
Depth (m)	2.1	2.0	2.2	2.1	2.3	2.0	2.1	2.1	2.0	2.3
Visibility (m)	0.3	0.3	0.2	0.2	0.3	0.3	0.3	0.2	0.3	0.3
Substratum type	Soft Mud & Shells	Soft Mud & Shells	Soft Mud	Soft Mud	Soft Mud	Soft Mud & Shells	Soft Mud & Shells	Soft Mud	Soft Mud & Shells	Soft Mud & Shells
Occurrence of hard coral	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Occurrence of soft coral	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Occurrence of other invertebrates	Oysters	Oysters	Nil	Nil	Nil	Oysters	Nil	Nil	Nil	Oysters
Remarks										

Parameter / Location	SD7a	SD7b	SD7c	SD7d	SD7e	SD7f	SD7g	SD7h	SD7i	SD7j
Weather	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny
Air temperature (^{o}C)	29C	29C	29C	29C	29C	29C	29C	29C	29C	29C
Survey time start	11:00	11:03	11:06	11:10	11:13	11:16	11:19	11:21	11:24	11:26
Survey time end	11:02	11:04	11:08	11:12	11:15	11:17	11:20	11:23	11:25	11:27
Date of survey	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014
Water Temperature (^{o}C at 0m depth)	35C	35C	35C	35C	35C	35C	35C	35C	35C	35C
Salinity ppT	26	26	26	26	26	26	26	26	26	26
GPS N	22°32.458	22°32.461	22°32.464	22°32.466	22°32.469	22°32.472	22°32.475	22°32.478	22°32.481	22°32.483
GPS E	114°13.184	114°13.189	114°13.194	114°13.199	114°13.204	114°13.209	114°13.214	114°13.219	114°13.224	114°13.229
Depth (m)	0.6	0.8	0.9	0.6	0.5	0.5	0.6	0.8	0.7	0.8
Visibility (m)	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.2	0.2
Substratum type	Soft Mud & Shells	Soft Mud & Shells	Soft Mud & Shells	Soft Mud & Shells	Soft Mud & Shells	Soft Mud	Soft Mud	Soft Mud & Shells	Soft Mud	Soft Mud
Occurrence of hard coral	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Occurrence of soft coral	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Occurrence of other invertebrates	*Batillaria multiformis*	*Batillaria multiformis*	*Batillaria multiformis*	*Batillaria multiformis*	Nil	*Batillaria multiformis*	Oysters	Nil	Nil	Oysters
	Batillaria zonalis	*Batillaria zonalis*	*Batillaria zonalis*	*Batillaria zonalis*		*Batillaria zonalis*	*Batillaria multiformis*			
							Batillaria zonalis			
Remarks										

Parameter / Location	SD8a	SD8b	SD8c	SD8d	SD8e	SD8f	SD8g	SD8h	SD8i	SD8j
Weather	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny	Sunny
Air temperature (^{o}C)	29C	29C	29C	29C	29C	29C	29C	29C	29C	29C
Survey time start	10:18	10:22	10:25	10:30	10:33	10:36	10:40	10:43	10:47	10:49
Survey time end	10:20	10:24	10:27	10:32	10:35	10:38	10:42	10:45	10:48	10:51
Date of survey	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014	5th August 2014
Water Temperature (^{o}C at 0m depth)	35C	35C	35C	35C	35C	35C	35C	35C	35C	35C
Salinity ppT	28	28	28	28	28	28	28	28	28	28
GPS N	22°32.354	22°32.358	22°32.362	22°32.366	22°32.370	22°32.374	22°32.378	22°32.382	22°32.386	22°32.390
GPS E	114°13.214	114°13.218	114°13.222	114°13.226	114°13.229	114°13.233	114°13.237	114°13.241	114°13.245	114°13.249
Depth (m)	1.2	1.3	1.2	1.1	1.2	1.2	1.2	1.1	1.3	1.2
Visibility (m)	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Substratum type	Soft Mud & Shells	Soft Mud & Shells	Soft Mud & Shells	Soft Mud & Shells	Soft Mud & Shells	Soft Mud & Shells	Soft Mud & Shells	Soft Mud & Shells	Soft Mud & Shells	Soft Mud & Shells
Occurrence of hard coral	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Occurrence of soft coral	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Occurrence of other invertebrates	Ascidians	Nil	Olysters	Oysters	Nil	Oysters	Oysters	Nil	Nil	Oysters
	Oysters			Ascidians			Ascidians			Ascidians
Remarks					Dead oysters			Dead oysters	Dead oysters	

APPENDIX 4: REA RAW DATA

REA Data Forms				
Location:	**Sha Tau Kok**			
General data / Transect	**SD1**	**SD2**	**SD4**	**SD7**
GPS N	22° 32.503	22° 32.604	22° 32.571	22° 32.458
GPS E	114° 13.500	114° 13.455	114° 13.323	114° 13.184
Time:	17:10	17:30	17:48	18:05
Depth min	0.5	0.4	0.5	1.1
Depth max	1.2	1.1	1.4	1.3
Exposure (1~4)	1	1	1	1
Sediment (0~3)	2	1	2	1
Slope 0=flat, 4=vertical.	0	3	0	0
Visibility(m)	0.3	0.3	0.3	3
Salinity (‰)	24	25	24	25
Temp (ºC)	34	34	35	34
Hard Substratum (% of total)	0	80	0	0
Bed Rock (% of HS)	0	0	0	0
Large Boulder (% of HS)	0	80	0	0
Small Boulders	0	20	0	0
Soft Substratum (% of total)	100	20	100	100
Sand (% of SS)	0	40	0	0
Silt/Mud (% of SS)	50	50	50	50
Mud (% of SS)	50	10	50	50
Taxa				
Bryazoa				
Brown/orange encrust	0	0	0	0
Red encrust	0	0	0	0
Schizoporella unicornis	0	0	0	0
Cyanobacterial mats	0	0	0	0
Coralline algae	0	0	0	0
Mollusca				
Perna viridis	0	1	0	0
Scallops	1	1	1	0
Oysters	0	4	0	1
Sponge				
Encrusting	0	0	0	0
Golf ball	0	0	0	0
Crustacea				
Portunus spp.	0	0	0	0
Charybdis spp.	0	0	0	0
Thalamata	0	0	0	0
Gastropoda				
Batillaria multiformis	1	0	2	0
Batillaria zonalis	2	0	2	0
Batillaria cumungii	1	0	0	0
Echinodermata				
Diadema setosum	0	0	0	0
Anthocidaris crassispina	0	0	0	0
Parasalenia gratiosa	0	0	0	0
Salmacis sphaeroides	0	0	0	0
Temnopleurus reevesii	0	0	0	0
Holothuria leucospilota	0	0	0	0
Barnicles	0	2	0	0
Sichopus sp.	0	0	0	0
Misc				
Ascidians	0	0	0	0

REA Data Forms				
Location:	**Sha Tau Kok**			
General data / Transect	**SD1**	**SD2**	**SD4**	**SD7**
Taxa				
Hard Corals				
Acropora tumida	0	0	0	0
Acropora pruinosa	0	0	0	0
Montipora peltiformis	0	0	0	0
Galaxea astreata	0	0	0	0
Psammocora superficialis	0	0	0	0
Coscinaraea n sp.	0	0	0	0
Pavona decussata	0	0	0	0
Lithophyllon undulatum	0	0	0	0
Echinophyllia aspera	0	0	0	0
Hydnophora exesa	0	0	0	0
Turbinarea peltata	0	0	0	0
Favia speciosa	0	0	0	0
Favia favus	0	0	0	0
Favia lizardensis	0	0	0	0
Favia rotumana	0	0	0	0
Favia veroni	0	0	0	0
Favia maritima	0	0	0	0
Favites pentagona	0	0	0	0
Favites chinensis	0	0	0	0
Favites abdita	0	0	0	0
Favites acuticollis	0	0	0	0
Goniastrea aspera	0	0	0	0
Platygyra carnosus	0	0	0	0
Platygyra acuta	0	0	0	0
Plesiastrea versipora	0	0	0	0
Oulastrea crispata	0	0	0	0
Leptastrea purpurea	0	0	0	0
Leptastrea pruinosa	0	0	0	0
Cyphastrea serailia	0	0	0	0
Cyphastrea japonica	0	0	0	0
Porites lobata	0	0	0	0
Porites lutea	0	0	0	0
Goniopora columna	0	0	0	0
Goniopora stutchburya	0	0	0	0
Goniopora lobata	0	0	0	0
Coral Cover	<1%	<1%	<1%	<1%
Other Coral				
Tubastrea spp.	0	0	0	0
Balanophyllia sp.				
Paracyathus rotundatus	0	0	0	0
Soft Coral				
Guaiagorgia sp.	0	0	0	0
Euplexaura sp.	0	0	0	0
Echinomuricea sp.	0	0	0	0
Dendronephthya gigantea	0	0	0	0
Red				
Cnidaria				
Anemone	0	0	0	0
Sand Anemone	0	0	0	0
Spirobranchus tricornis	0	0	0	0
Myxicola infundibulum	0	0	0	0
Ghost Nets				
Rubbish				

APPENDIX 5: REFERENCES

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APPENDIX 6: PHOTOGRAPHS

SD1a

SD1f

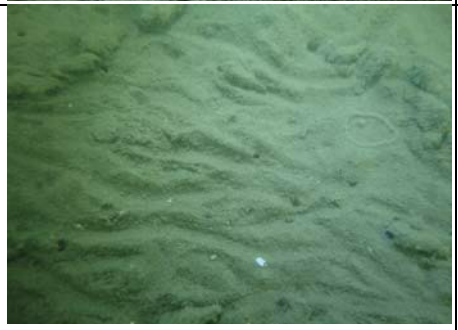
SD1b

SD1g

SD1c

SD1h

SD1d



SD1i

SD1e

SD1j

Plate 1. Photos of the Spot Dive Survey at Location SD1.

SD2a		SD2f	
SD2b		SD2g	
SD2c		SD2h	
SD2d		SD2i	
SD2e		SD2j	

Plate 2. Photos of the Spot Dive Survey at Location SD2.

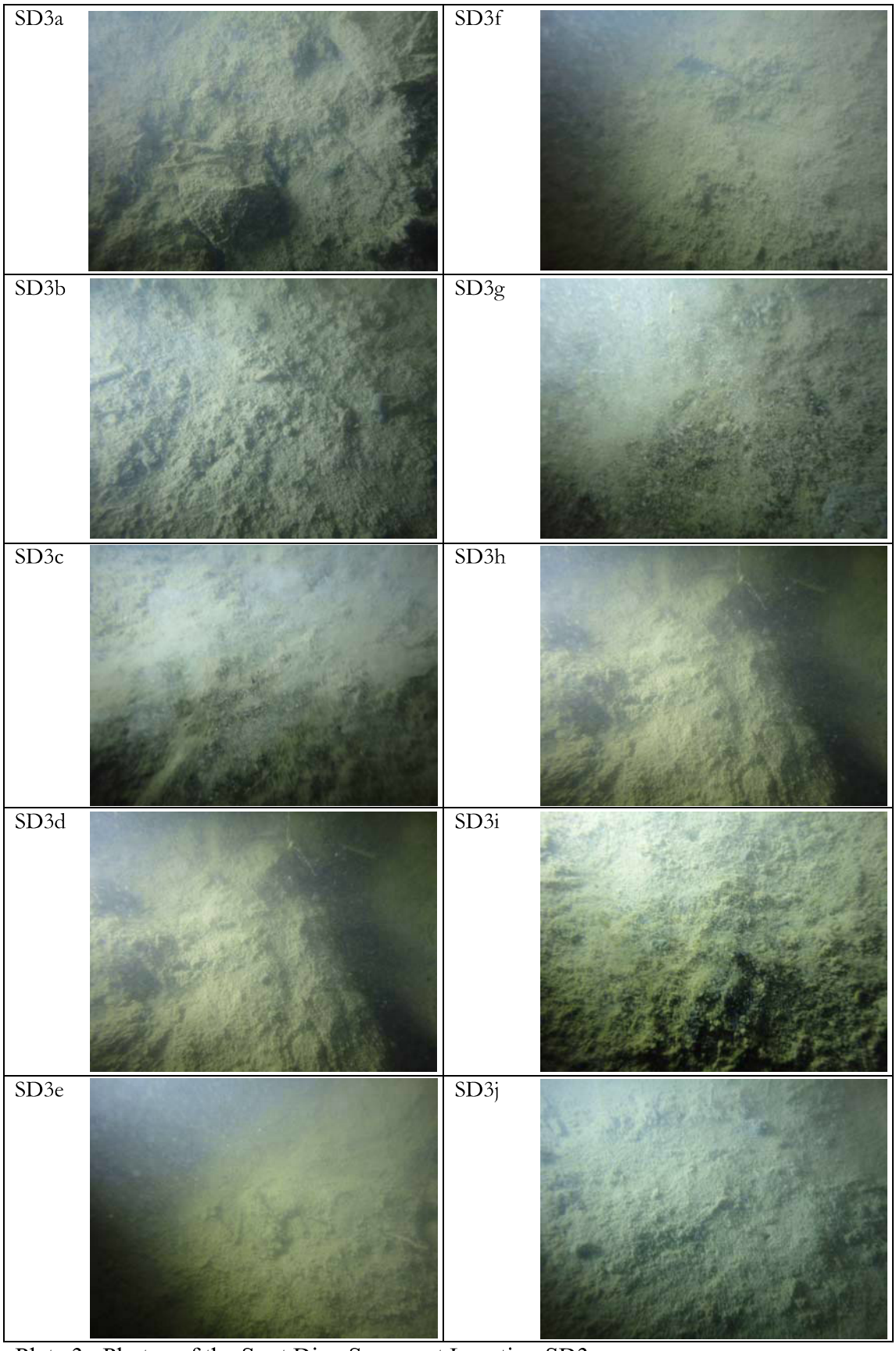


Plate 3. Photos of the Spot Dive Survey at Location SD3.

SD4a 	SD4f 
SD4b 	SD4g 
SD4c 	SD4h 
SD4d 	SD4i 
SD4e 	SD4j 

Plate 4. Photos of the Spot Dive Survey at Location SD4.

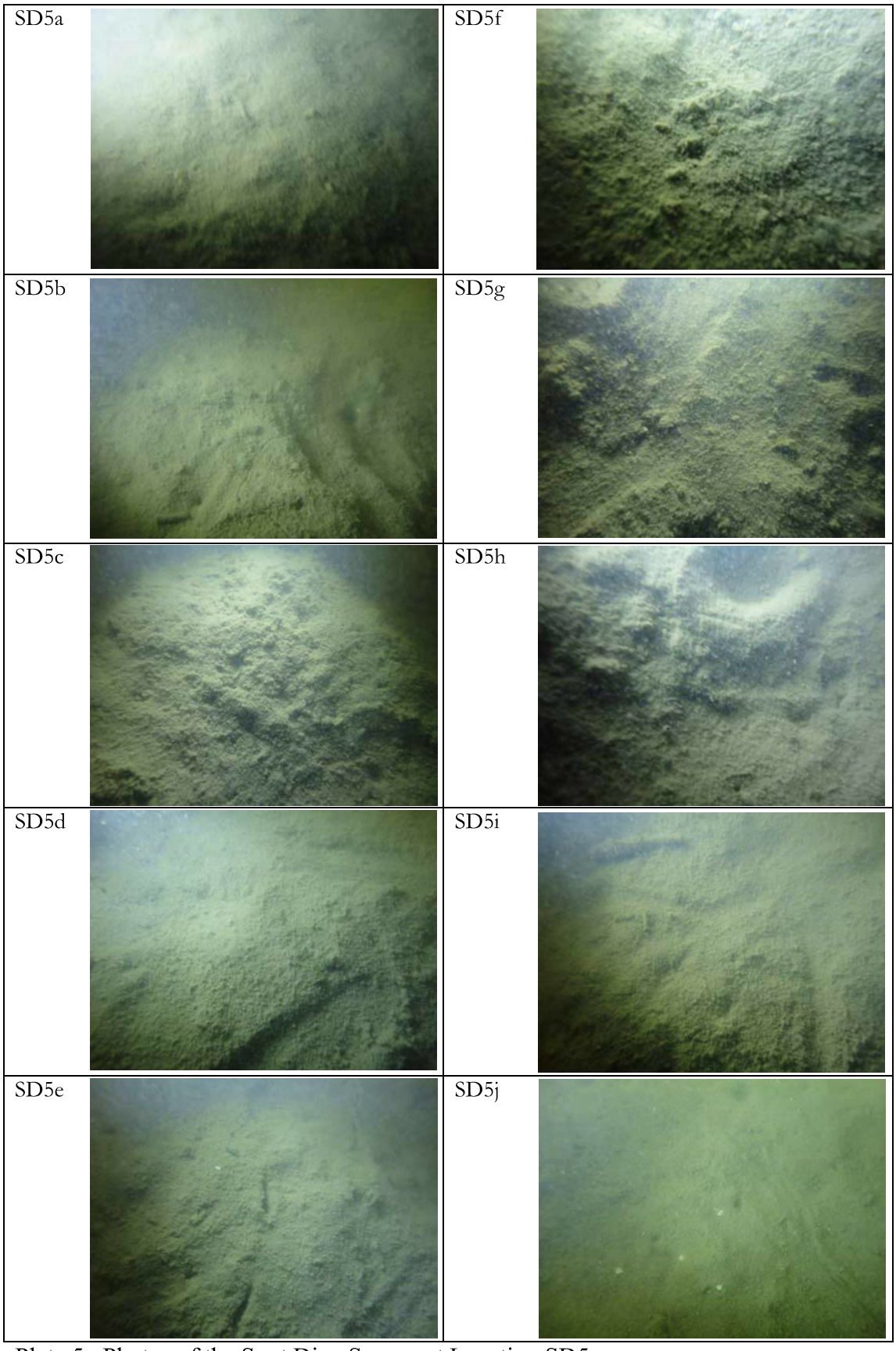


Plate 5. Photos of the Spot Dive Survey at Location SD5.

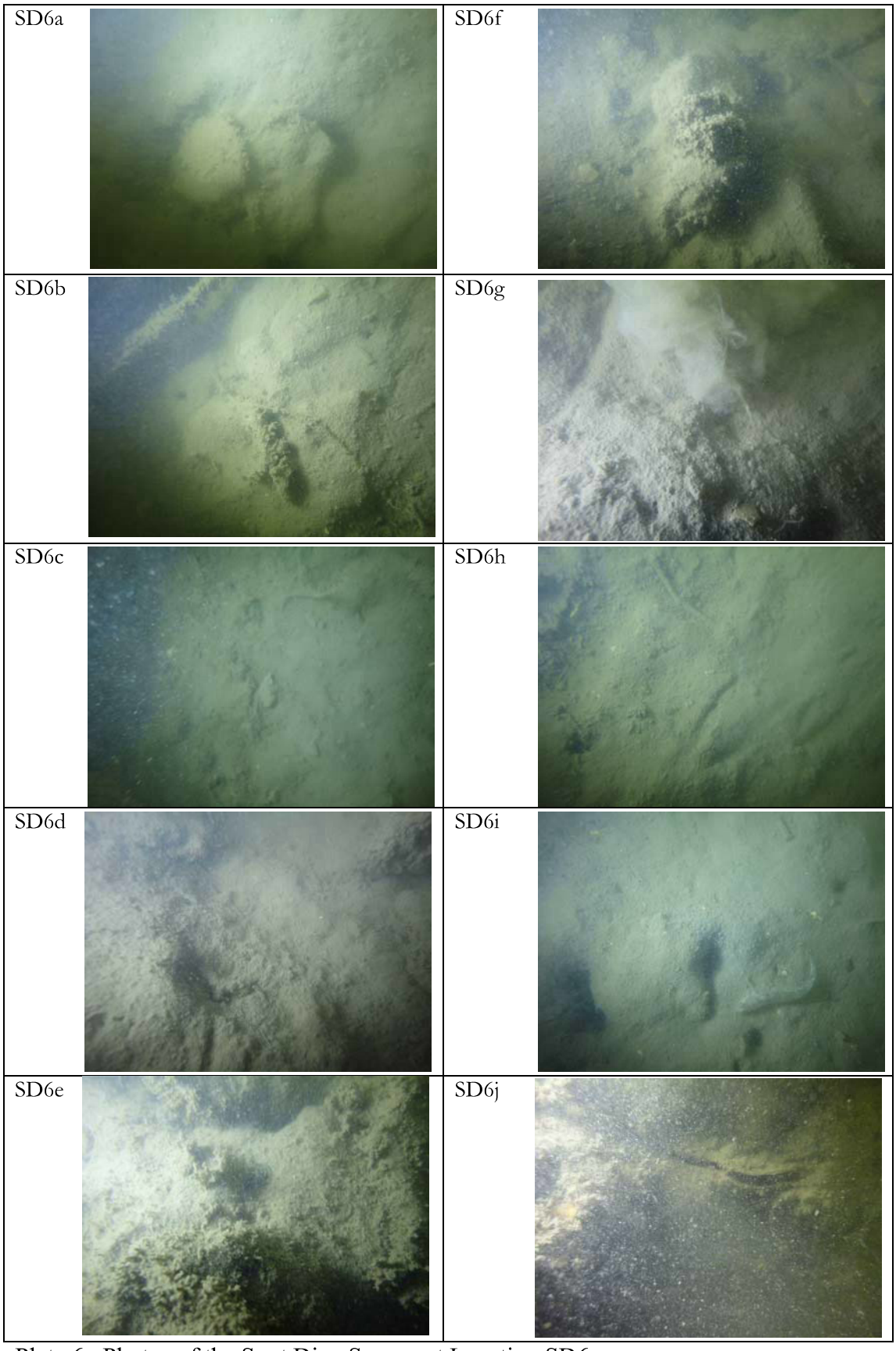


Plate 6. Photos of the Spot Dive Survey at Location SD6.

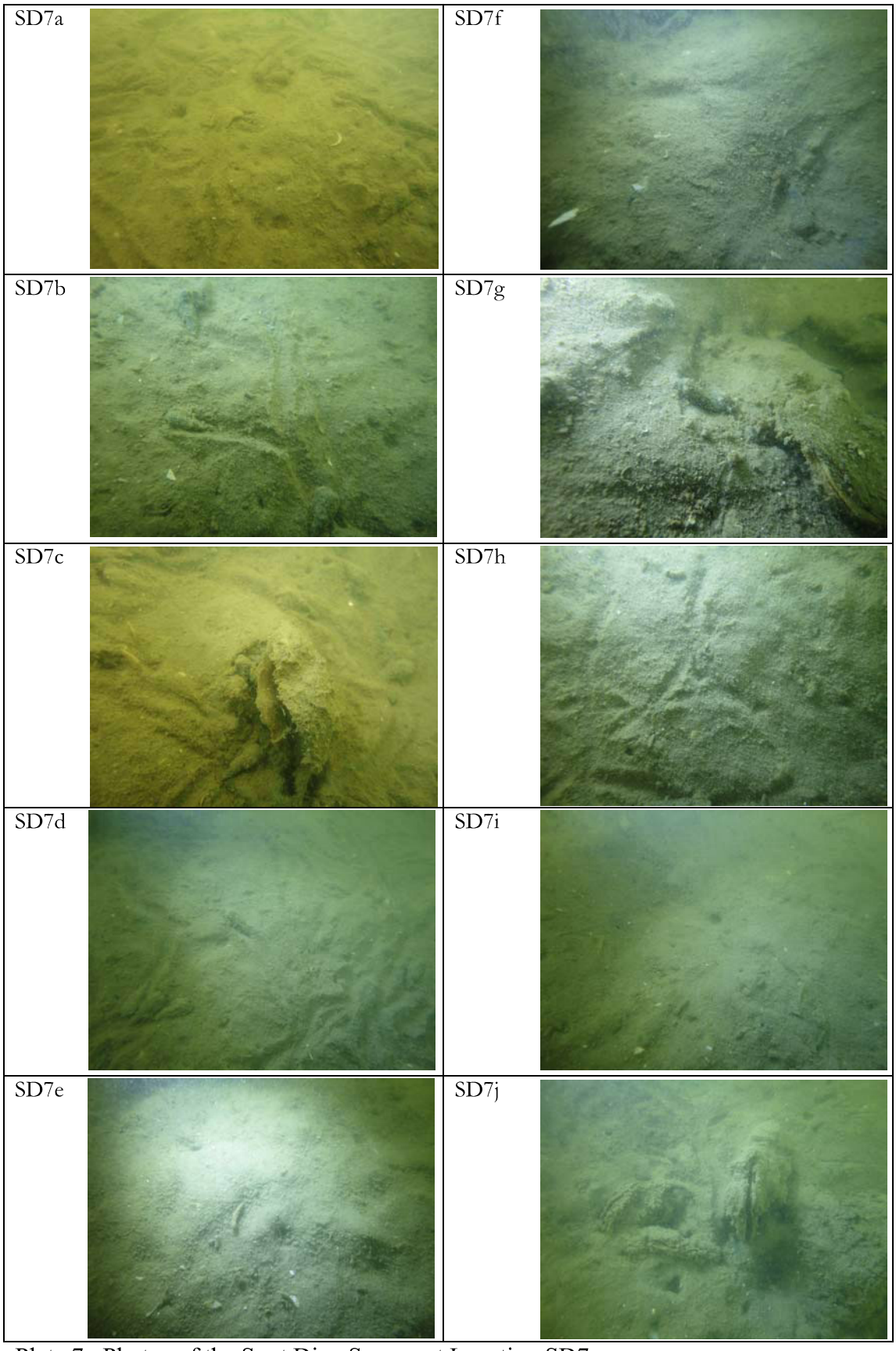


Plate 7. Photos of the Spot Dive Survey at Location SD7.

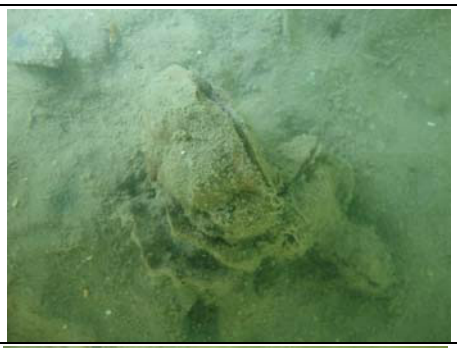
SD8a 	SD8f 
SD8b 	SD8g 
SD8c 	SD8h 
SD8d 	SD8i 
SD8e 	SD8j 

Plate 8. Photos of the Spot Dive Survey at Location SD8.

	Plate 9. View on water surface at Location SD1. Photo : August 2014.
	Plate 10. Gastropod *Batillaria* sp. at Location SD1. Photo : August 2014.
	Plate 11. View on water surface at Location SD2. Photo : August 2014.

	Plate 12. Oysters at Location SD2. Photo : August 2014.
	Plate 13. View on water surface at Location SD3. Photo : August 2014.
	Plate 14. View on water surface at Location SD4. Photo : August 2014.

	Plate 15. View on water surface at Location SD5. Photo : August 2014.
	Plate 16. View on water surface at Location SD6. Photo : August 2014.
	Plate 17. View on water surface at Location SD7. Photo : August 2014.

	Plate 18. View on water surface at Location SD8. Photo : August 2014.
	Plate 19. Oysters and ascidians at Location SD8. Photo : August 2014.

Appendix 4

Subtidal Benthos Survey Report

Appendix 4

MOTT MACDONALD HONG KONG LIMITED

Project No: 13100006

Sha Tau Kok Sea

Benthic Survey Report (Dry and Wet Seasons)

August 2014

prepared by
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1 Summary

The aim of present survey is to obtain ecological baseline information of macrobenthic community in the coastal area of Sha Tau Kok Sewage Treatment Works (STW). It is to investigate the potential ecological impacts caused by the expansion of STW. Grab sampling was undertaken at four sampling sites in the survey area of Sha Tau Kok Sea in the dry (March 2014) and wet season (August 2014).

In general, the sediments were generally in fair aerobic condition in the dry season. Although there were long-term organic enrichment and garbage pollution, tidal flushing of marine water at fair water quality might have mitigated the adverse effects. However, the aerobic condition became worse under temporary hypoxic condition in the wet season.

In general, the benthic communities at the four sampling sites were delineated into three groups based on the differences of species composition. All groups were generally healthy based on the moderate biodiversity value and species evenness. It existed between 'moderately disturbed' level and 'slightly disturbed' level. It could tolerate the environmental stresses in the survey area.

The overall ecological value of the benthic communities was graded 'moderate' based on overall moderate biodiversity and species evenness. Although long-term mild organic enrichment and temporary hypoxic condition were present, the benthic community could tolerate and was in fair condition.

For the benthic community, no species of conservation interest was collected. However Sha Tau Kok Sea might be potential nursery ground for horseshoe crab. A specific baseline survey for horseshoe crab population was highly recommended

The proposed expansion of Sha Tau Kok STW would be environmentally acceptable to the benthic communities. Since the upgraded STW would improve the water quality within Sha Tau Kok Sea. The overall impact of this project would be positive as long as sufficient mitigation measures were properly implemented during construction stage.

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Nelson W.Y. Lam

Environmental Consultant

2 Introduction

The aim of present survey is to obtain ecological baseline information of macrobenthic community in the coastal area of Sha Tau Kok Sewage Treatment Works (STW). It is to investigate the potential ecological impacts caused by the expansion of STW.

3 Methodologies

3.1 Field sampling

In order to collect benthic baseline information in the coastal area of Sha Tau Kok STW, benthos sampling was undertaken at four sampling sites (B1-B4) approximately 100m apart (Fig. 3.1). Sampling sites B1 and B2 were located closer to the submarine outfall. The coordinates of the sampling sites (Table 3.1) were fixed by Global Positioning System (GPS device model: Garmin 78S) on board. The surveys were conducted on 22nd March, 2014 and 4th August, 2014 under sunny weather as samplings of dry season and wet season respectively.

At all sampling sites except B2, three replicates of sediment samples were collected with a 0.1 m^2 van Veen grab (0.1 m^2 sampling area × 15 cm biting depth). Collected samples were accepted when at least two-third of grab volume was filled. At B2, the water depth was too shallow (~1.5 m) that direct grab sampling by mechanical vessel was not feasible. Alternatively successive sampling with smaller hand grab (0.025 m^2 sampling area) was done on small boat until equivalent sediment volume of van Veen grab was collected. The collected sediments of one successive sampling (6-7 times of collection) were pooled as one typical

replicate.

When the sediment samples were collected on board, a photographic record of the sediment texture and colour was taken. The samples were washed with gentle seawater through a sieve stack consisted of 1 mm (top) and 0.5 mm (bottom) mesh sizes to remove fine material. Large visible animals in the residues were hand-picked into a small, labeled plastic vial. All remains were transferred into a labeled plastic container followed by preservation with 70% ethanol solution and staining with 1% Rose Bengal solution.

3.2 Laboratory work

After arrival to laboratory, the samples were stored for at least one day to ensure sufficient preservation and staining. The persevered fauna were sorted out from the samples carefully by placing portion of sediment residues on a petri dish and picking up with forceps. For quality assurance, the sediment residues of one-third sorted samples were randomly rechecked. No missed specimen was found in the recheck.

The collected specimens were identified to the lowest taxonomic resolution. Examination of the morphological features of the specimens was undertaken with the aid of both stereoscopic and compound microscopes. The taxonomic classification was conducted in accordance to the following references: Polychaetes: Day (1967), Gallardo (1967), Fauchald (1977), Yang and Sun (1988), Wu *et al*. (1997), Sun (2004); Arthropods: Dai and Yang (1991), Dong (1991), Lowry (2000); Mollusks: Qi (2004); Echiuran and Sipunculan: Zhou *et al*. (2007). The number of individuals of each species was recorded by counting the anterior portions of the fauna only. Total biomass of each species was determined as preserved wet weight by blotting

the animals on filter paper for 3 minutes followed by weighing to the nearest 0.0001 g with microbalance.

3.3 Data analysis

Data collected from three replicate samples at every sampling site were pooled together for data analysis. Shannon-Weaver Diversity Index (*H'*) and Pielou's Species Evenness (*J*) were calculated using the formulae below,

$H' = -\Sigma (Ni / N) \ln (Ni / N)$ (Shannon and Weaver, 1963)
$J = H' / \ln S$ (Pielou, 1966)

where S is the total number of species in the sample, N is the total number of individuals, and Ni is the number of individuals of the i^{th} species.

The status of benthic community is assessed using the abundance/biomass comparison (ABC) method and *W* statistic is generated (Warwick, 1986; Warwick and Clarke, 1994) with the software PRIMER version 6 (Plymouth Marine Laboratory, UK). ABC method is based on an ecological theory: when the benthic community is approaching equilibrium under stable and undisturbed environment, the biomass becomes increasingly dominated by few large-sized species while abundance of each species is less. In contrast, the abundance is dominated by few small-sized species while biomass of each species is small in disturbed environment.

The ABC method plots relative proportions of biomass and abundance attributable to each species for every sampling site. The species are ranked in descending order of abundance on the x-axis (logarithmic scale) with superimposition of dominance curves of abundance and biomass on the y-axis (cumulative percentage scale). When biomass curve is above

abundance curve entirely, the benthic community reflects unpolluted / undisturbed status due to the presence of few, large-sized fauna. When abundance curve is above biomass curve entirely, the benthic community reflects grossly polluted / disturbed status due to presence of numerous small-sized animals. Under moderately disturbed status of benthic community, two curves cross over one or more times (Warwick and Clarke, 1994). Then *W* statistic is employed to measure the extent to which the biomass curve lies above the abundance curve (Clarke, 1990). The equation of *W* statistic is shown below:

$$W = \sum_{i=1}^{S} (Bi - Ai) / [50 (S - 1)] \qquad \text{(Clarke, 1990)}$$

where S = total number of species; B*i* - A*i* = difference between biomass and abundance (percentage) of the i_{th} species.

In case biomass curve lying above abundance curve, a positive *W* value is given that represented 'undisturbed' condition, and vice versa. The *W* statistic presents a continuum from 'disturbed' (W= -1), 'moderately disturbed' (*W* = 0), to 'undisturbed' conditions (*W* = +1).

Table 3.1. *The GPS coordinates (in WGS84 datum (ITRF96 Reference Frame)) and measured water depth of every sampling site*

Sampling site	Latitude (N)	Longitude (E)	Water depth (m)	
			dry	wet
B1	22° 32.502'	114° 13.258'	2.0	1.7
B2	22° 32.502'	114° 13.374'	1.5	0.5
B3	22° 32.395'	114° 13.258'	2.6	1.7
B4	22° 32.395'	114° 13.374'	3.0	2.7

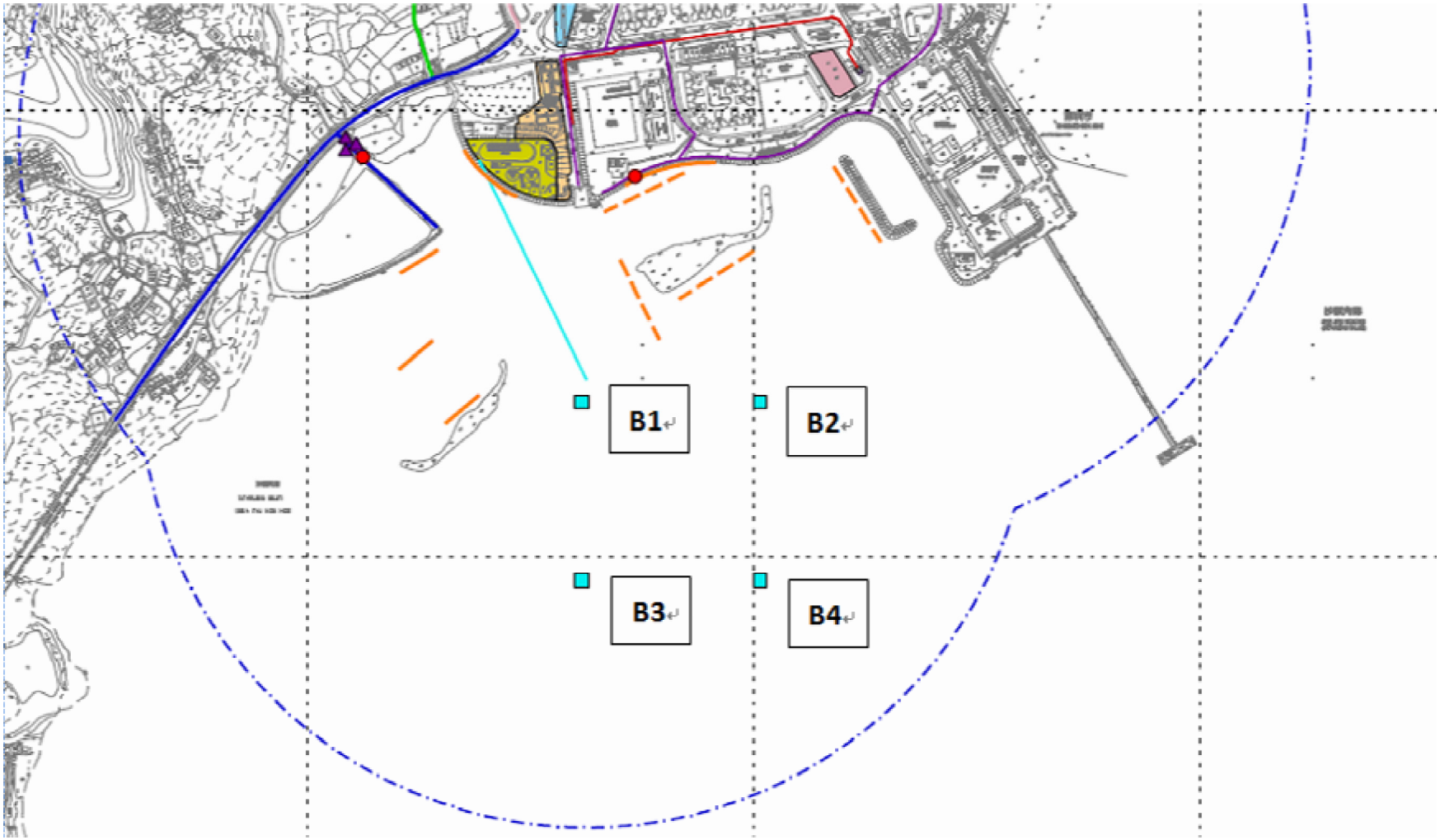

Figure 3.1 *Location of sampling sites (blue square) (map borrowed from Mott MacDonald Hong Kong Ltd.)*

B1

B2

B3

B4

Figure 3.2. *Photographic record of the environment at every sampling site.*

4 Results

4.1 Sediment quality

Table 4.1 and figure 4.1 show the sediment texture and colour at every sampling site. For the dry season sampling, the sediments were grey, soft mud with a thin, brown surface layer at B1, B3 and B4. At B2, the sediment was fine sand in brown colour. Mild level of hydrogen sulphite smell was detected from sediments at B4 on board. It indicated moderate content of organic matter inside the sediments. For the wet season sampling, the sediments became less oxygenated at B1, B2 and B3. The sediment changed to less oxygenated colour (e.g. from 'Grey with brown surface' to 'Black' at B1) while mild smell of hydrogen sulphite was detected at B1 and B3. It was possibly due to the lower oxygen solubility along with higher water temperature during wet season.

In general, lots of garbage (e.g. plastic bags, abandoned fish net) was found at sampling sites B1, B3 and B4 (Fig. 4.2). The garbage was possibly dumped from nearby urban area and fish farm then it accumulated in the enclosed bay. Besides, lots of broken rock oyster shell was found these three sites while it was possibly wave-driven from the nearby intertidal habitat.

4.2 Benthic baseline

Table 4.2 lists the total abundance and total biomass of every phylum. A total of 687 and 1129 specimens were collected in the dry season and wet season samplings respectively. Eighty four of 91 taxa were identified to genus or species levels. In general the most diverse phylum was Annelida (48 polychaete taxa), followed by Mollusca (12 bivalve taxa + 9 gastropod taxa), Arthropoda (6 amphipod taxa + 4 shrimp taxa + 2 crab taxa + 1 cumacea

taxon + 1 mantis shrimp taxon), Echinodermata (3 brittle star taxa), Chordata (1 fish taxon), Cnidaria (1 sea anemone taxon), Nemertea (1 Nemertean spp.), Platyhelminthes (1 platyhelminthes spp.) and Sipuncula (1 sipunculan taxon). All recorded species were common with no conservation interest. The complete list of collected specimens is provided in Appendix II.

For the dry season sampling, 43% of total abundance was dominated by arthropods (297 ind.) while the majority was amphipods. The second and third abundant phyla were annelids (230 ind., 33%) and mollusks (153 ind., 22%) respectively. Other phyla were relatively few in abundance (relative abundance ≤ 1%). The total biomass was 149.8721 g. It was mainly accounted by mollusks (139.44 g, 93%) while other phyla were relatively less in biomass (≤ 3%).

For the wet season sampling, 47% of total abundance was dominated by arthropods (529 ind.) while the majority was amphipods. The second and third abundant phyla were annelids (418 ind., 37%) and mollusks (182 ind., 16%) respectively. Other phyla were relatively few in abundance (relative abundance ≤ 1%). The total biomass was 270.3280 g. It was mainly accounted by mollusks (262.2147 g, 97%) while other phyla were relatively less in biomass (≤ 3%). Besides, two individuals of horseshoe crabs *Carcinoscorpius rotundicauda* were collected at sampling sites B1 (prosomal width 82.35 mm) and B4 (135.9 mm) (Fig. 4.3). Horseshoe crabs were highly motile and were excluded from benthic survey. The two individuals were released immediately after photo recording.

Table 4.3 shows the abundance and relative abundance of each phylum at every sampling site. For the dry season sampling, arthropods (mainly amphipods) were the most abundant (153 ind., 81%) at B1 followed by annelids (polychaetes) (32 ind., 17%). At B2, mollusks (mainly gastropods) were the most abundant (143 ind., 54%) followed by annelids (polychaetes) (100 ind., 38%). At B3 and B4, the abundances were dominated by arthropods (mainly amphipods) (53-72 ind., 51-55%) and annelids (polychaetes) (43-55 ind., 42%) similarily. Other taxa were relatively less in relative abundance (≤ 7%).

For the wet season sampling, arthropods were the most abundant (212 ind., 76%) at B1 followed by annelids (47 ind., 17%) similar to the results of dry season. However the abundances declined and phyla distribution changed clearly at other three sampling sites. At B2, the abundances were dominated by annelids (29 ind., 60%) and mollusks (17 ind., 35%). At B3 and B4, the abundances were dominated by annelids (54-58 ind., 74-89%) followed by less abundant arthropods (6-13 ind., 10-17%). Other taxa were relatively less in relative abundance (≤8%).

Table 4.4 lists the five most abundant taxa at every sampling site in the dry season sampling. At B1, the benthic community was dominated by amphipod species (79%). The most abundant one was *Cheiriphotis* sp. (223 ind. m^{-2}, relative abundance 35%) followed by *Cythura* sp. (90 ind. m^{-2}, 14%), unidentified amphipod spp. (80 ind. m^{-2}, 13%) and *Maera* sp. (63 ind. m^{-2}, 10%). At B2, the benthic community was evenly dominated by gastropod *Batillaria zonalis* (253 ind. m^{-2}, 29%) and polychaete *Glycinde gurjanovae* (243 ind. m^{-2}, 28%). At B3 and B4, the most dominant species was amphipod *Maera* sp. (117-157 ind. m^{-2}, 27-46%) while the unidentified amphipod spp. was the second abundant at B4 (83 ind. m^{-2},

19%).

Table 4.5 lists the five most abundant taxa at every sampling site in the wet season sampling. Similar to the results of dry season sampling, the benthic community at B1 was dominated by amphipods (70%). The most abundant one was *Cheiriphotis* sp. (463 ind. m^{-2}, relative abundance 50%) followed by *Maera* sp. (187 ind. m^{-2}, 20%). However, the species composition changed obviously at other sampling sites while no species was highly dominant. At B2, the common occurring species were gastropod *Cerithidea cingulata* (33 ind. m^{-2}, 21%) and polychaetes *Heteromastus* sp. (27 ind. m^{-2}, 17%) and *Glycinde gurjanovae* (23 ind. m^{-2}, 15%). At B3, the common occurring species were polychaetes *Sigambra hanaokai* (53 ind. m^{-2}, 21%) *Cirriformia* sp. (43 ind. m^{-2}, 17%) and *Terebellides stroemii* (30 ind. m^{-2}, 12%). At B4, the common occurring species were polychaetes *Terebellides stroemii* (60 ind. m^{-2}, 30%), *Sigambra hanaokai* (50 ind. m^{-2}, 25%) and *Pista* sp. (20 ind. m^{-2}, 10%).

Table 4.5 and Figure 4.4 show the number of species, density, biomass, *H'*, *J* and *W* statistic at every sampling site. For the dry season sampling, the number of species was moderate and ranged 25-30 spp. 0.3 m^{-2} among all sampling sites. Sampling site B2 was highest in density (877 ind. m^{-2}) and biomass (448.95 g m^{-2}) followed by B1 with high density (633 ind. m^{-2}) and moderate biomass (28.73 g m^{-2}). Relatively B3 and B4 were moderate in densities (343-437 ind. m^{-2}) and biomass (10.48-11.41 g m^{-2}). For the wet season sampling, the number of species (36 spp. 0.3m^{-2}) and abundance (927 ind. m^{-2}) increased at B1. However declines of number of species (14-21 spp. 0.3m^{-2}) and abundances (160-260 ind. m^{-2}) were found at other thee sampling sites. The biomasses were moderate at B1-B3 (110.97-162.07 g m^{-2}) but very low at B4 (1.78 g m^{-2}). The change of biomass did not reflect a change of species

composition since it was due to presence of few, large sized specimens.

Across two seasons of sampling, the values of *H'* (2.01-2.63) and *J* (0.56-0.87) were moderate at all sampling sites. No clear spatial difference could be observed. The *W* statistic values generated by ABC method were positive at all sampling sites (Fig. 4.5). B1 remained at 'moderately disturbed' level (*W* statistic 0.19-0.20) while B3 and B4 remained at 'slightly disturbed' level (0.22-0.43). But B2 increased from 'moderately disturbed' level in dry season (0.18) to ''slightly disturbed level' in wet season (0.40).

Table 4.1. *Sediment texture and colour at every sampling site*

Sampling site	Sediment texture	Sediment colour		Level of sulphite smell		Remark
		Dry	Wet	Dry	Wet	
B1	Soft mud	Grey with brown surface	Black	None	Mild	Lots of garbage and oyster shells
B2	Fine sand	Brown	Grey with brown surface	None	None	\
B3	Soft mud	Grey with brown surface	Grey	Mild	Mild	Lots of garbage and oyster shells
B4	Soft mud	Grey with brown surface	Grey and brown surface	None	None	Lots of garbage and oyster shells

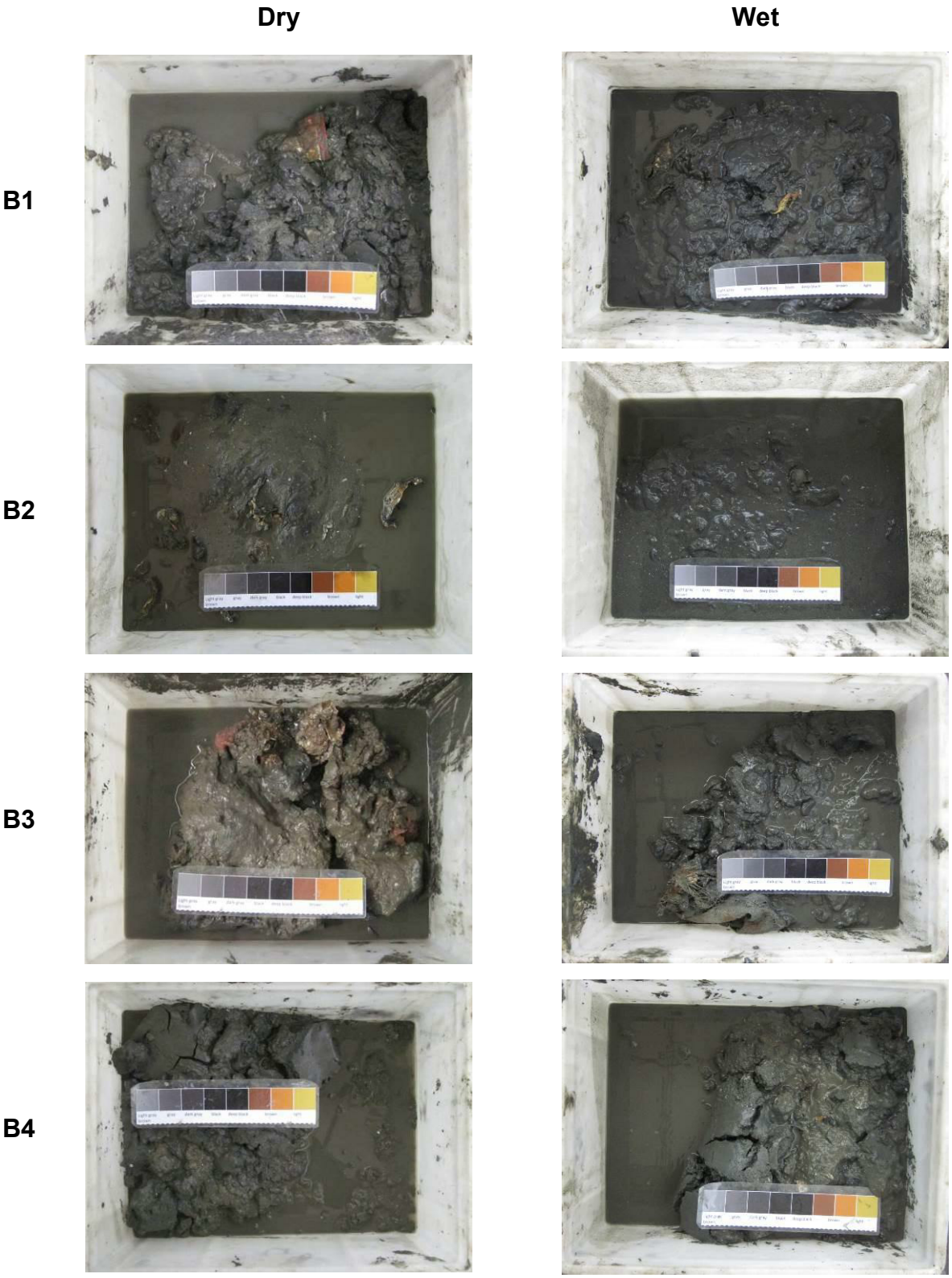

Figure 4.1. *Photographic record of sediment at every sampling site*

Figure 4.2. *Example of photographic record of garbage found at sampling sites B1 and B4 (taken during dry season sampling)*

Table 4.2. *Total abundance and total biomass of every phylum*

Phylum	Abundance (ind.)	%	Biomass (g)	%
Dry Season				
Arthropoda	297	43	5.0739	3
Annelida	230	33	1.0067	1
Mollusca	153	22	139.4394	93
Echinodermata	4	1	0.0156	0
Chordata	1	0	4.3348	3
Nemertea	1	0	0.0012	0
Platyhelminthes	1	0	0.0005	0
sub-total	**687**		**149.8721**	
Wet Season				
Arthropoda	529	47	6.0312	2
Annelida	418	37	2.08212	1
Mollusca	182	16	262.2147	97
Sipuncula	9	1	0.2174	0
Echinodermata	8	1	0.0954	0
Nemertea	2	0	0.0021	0
Platyhelminthes	2	0	0.0073	0
Chordata	1	0	4.3348	2
Cnidaria	1	0	0.0109	0
sub-total	**1129**		**270.3280**	
Total	**1816**		**420.2001**	

0 %: total individual / biomass of the phylum is less than 1% of that of all specimens

Figure 4.3. *Photographic records of horseshoe crab Carcinoscorpius rotundicauda collected at sampling sites B1 (below) and B4 (above) during wet season sampling*

Table 4.3. *The abundance and relative abundance (percentage) of each phylum at every sampling site*

Season	Dry								Wet							
Sampling site	**B1**	**%**	**B2**	**%**	**B3**	**%**	**B4**	**%**	**B1**	**%**	**B2**	**%**	**B3**	**%**	**B4**	**%**
Phylum																
Annelida	32	17	100	38	43	42	55	42	47	17	29	60	58	74	54	89
Arthropoda	153	81	19	7	53	51	72	55	212	76	1	2	13	17	6	10
Chordata	1	1														
Cnidaria													1	1		
Echinodermata					2	2	2	2	4	1						
Mollusca	4	2	143	54	4	4	2	2	6	2	17	35	6	8		
Nemertea					1	1					1	2				
Platyhelminthes			1	0											1	2
Sipuncula									9	3						
Total	190		263		103		131		278		48		78		61	

0 %: Relative abundance of the phylum is less than 1% of that of all specimens

Table 4.4. *The five most abundant taxa at every sampling site in the dry season sampling*

Sampling site	Group	Species	Density (ind. m^{-2})	Biomass (g m^{-2})	Relative abundance (%)
B1	A	*Cheiriphotis* sp.	223	0.75	35
	A	*Cythura* sp.	90	0.01	14
	A	Amphipod spp.	80	0.07	13
	A	*Maera* sp.	63	0.14	10
	A	*Corophium mortonii*	43	0.02	7
B2	G	*Batillaria zonalis*	253	327.67	29
	P	*Glycinde gurjanovae*	243	0.30	28
	G	*Cerithidea djadjariensis*	73	27.01	8
	G	*Nassarius festivus*	60	18.05	7
	A	*Cheiriphotis* sp.	47	0.08	5
B3	A	*Maera* sp.	157	0.16	46
	P	*Aglaophamus dibranchis*	27	0.02	8
	P	*Terebellides stroemii*	20	0.05	6
	A	*Corophium mortonii*	17	0.00	5
	P	*Glycinde gurjanovae*	13	0.01	4
B4	A	*Maera* sp.	117	0.09	27
	A	Amphipod spp.	83	0.03	19
	A	*Corophium mortonii*	30	0.00	7
	P	*Aglaophamus dibranchis*	27	0.02	6
	P	*Terebellides stroemii*	27	0.09	6

A= Amphipod, G = Gastropod, P = Polychaete

0.00 g m^{-2}: biomass of the taxon is less than 0.01 g m^{-2} at the sampling site

Table 4.5. *The five most abundant taxa at every sampling site in the wet season sampling*

Sampling site	Group	Species	Density (ind. m^{-2})	Biomass (g m^{-2})	Relative abundance (%)
B1	A	*Cheiriphotis* sp.	463	0.36	50
	A	*Maera* sp.	187	0.26	20
	Sp	*Sipunculus nudus*	30	0.72	3
	A	*Corophium mortonii*	23	0.01	3
	P	*Naineris* sp.	20	0.25	2
B2	G	*Cerithidea cingulata*	33	23.12	21
	P	*Heteromastus* sp.	27	0.01	17
	P	*Glycinde gurjanovae*	23	0.02	15
	P	Nereidiae spp.	13	0.01	8
	B	*Anomalocardia squamosa*	13	13.30	8
B3	P	*Sigambra hanaokai*	53	0.06	21
	P	*Cirriformia* sp.	43	0.02	17
	P	*Terebellides stroemii*	30	0.23	12
	A	*Corophium major*	13	0.02	5
	A	*Maera* sp.	13	0.02	5
B4	P	*Terebellides stroemii*	60	0.31	30
	P	*Sigambra hanaokai*	50	0.06	25
	P	*Pista* sp.	20	0.17	10
	P	*Artacama* sp.	17	0.06	8
	P	*Cirriformia* sp.	13	0.01	7

A= Amphipod, B = Bivalve, G = Gastropod, P = Polychaete, Sp = Sipunculan

0.00 g m^{-2}: biomass of the taxon is less than 0.01 g m^{-2} at the sampling site

Table 4.6. *Number of species, density, biomass, Shannon-Weaver Diversity Index (H'), Pielou's Species Evenness (J) and W statistic at every sampling site*

	Dry				Wet			
	B1	**B2**	**B3**	**B4**	**B1**	**B2**	**B3**	**B4**
Number of species (spp. 0.3 m^{-2})	27	30	25	25	36	16	21	14
Density (ind. m^{-2})	633	877	343	437	927	160	260	203
Biomass (g m^{-2})	28.73	448.95	11.41	10.48	162.07	110.97	142.26	1.78
Shannon-Weaver Diversity Index *H'*	2.26	2.24	2.27	2.56	2.01	2.40	2.63	2.08
Pielou's Species Evenness *J*	0.69	0.66	0.70	0.80	0.56	0.87	0.86	0.79
***W* statistic**	0.19	0.18	0.33	0.33	0.20	0.40	0.43	0.22

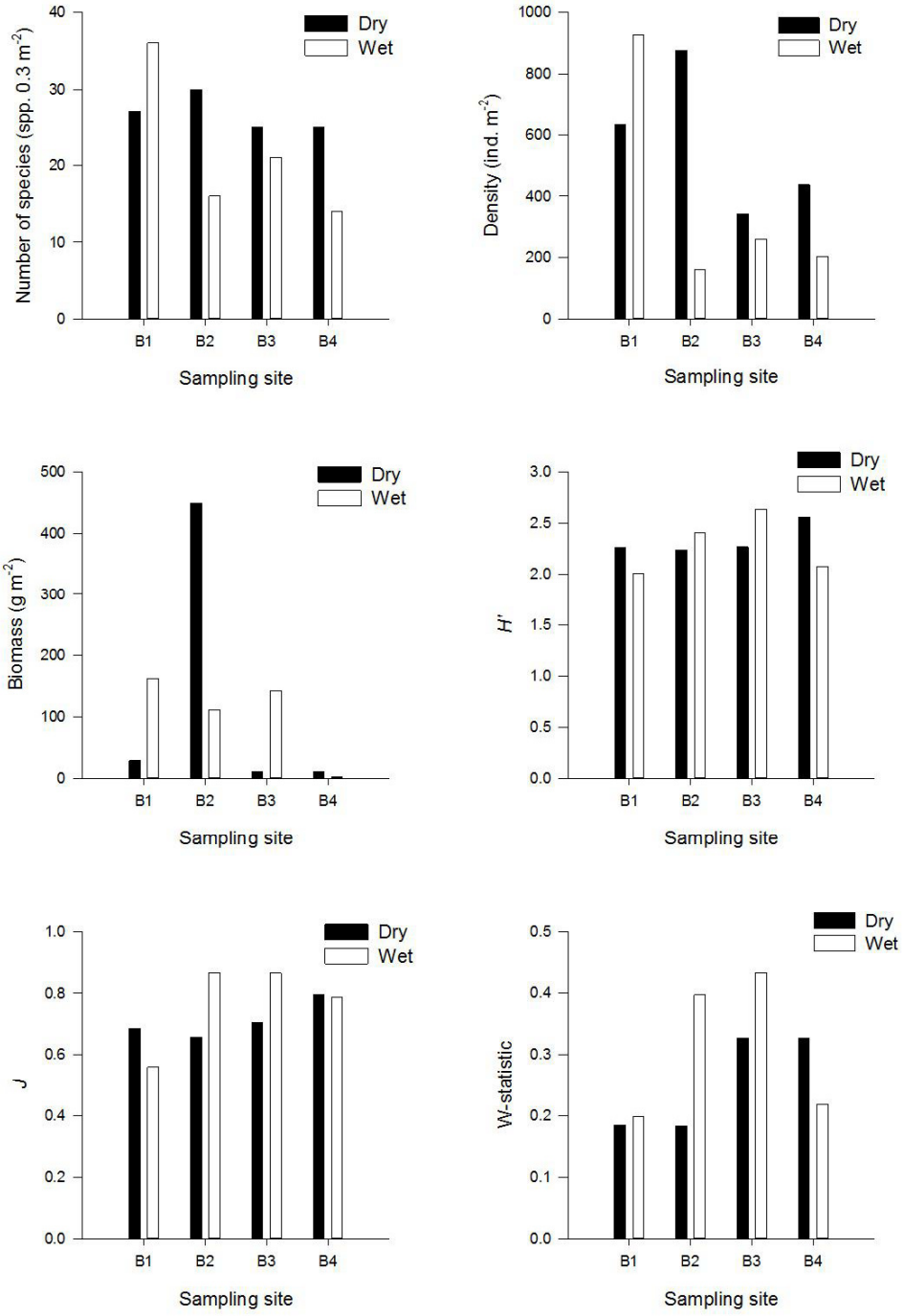

Figure 4.4. *Number of species, density, biomass, Shannon-Weaver Diversity Index (H'), Pielou's Species Evenness (J) and W statistic at every sampling site*

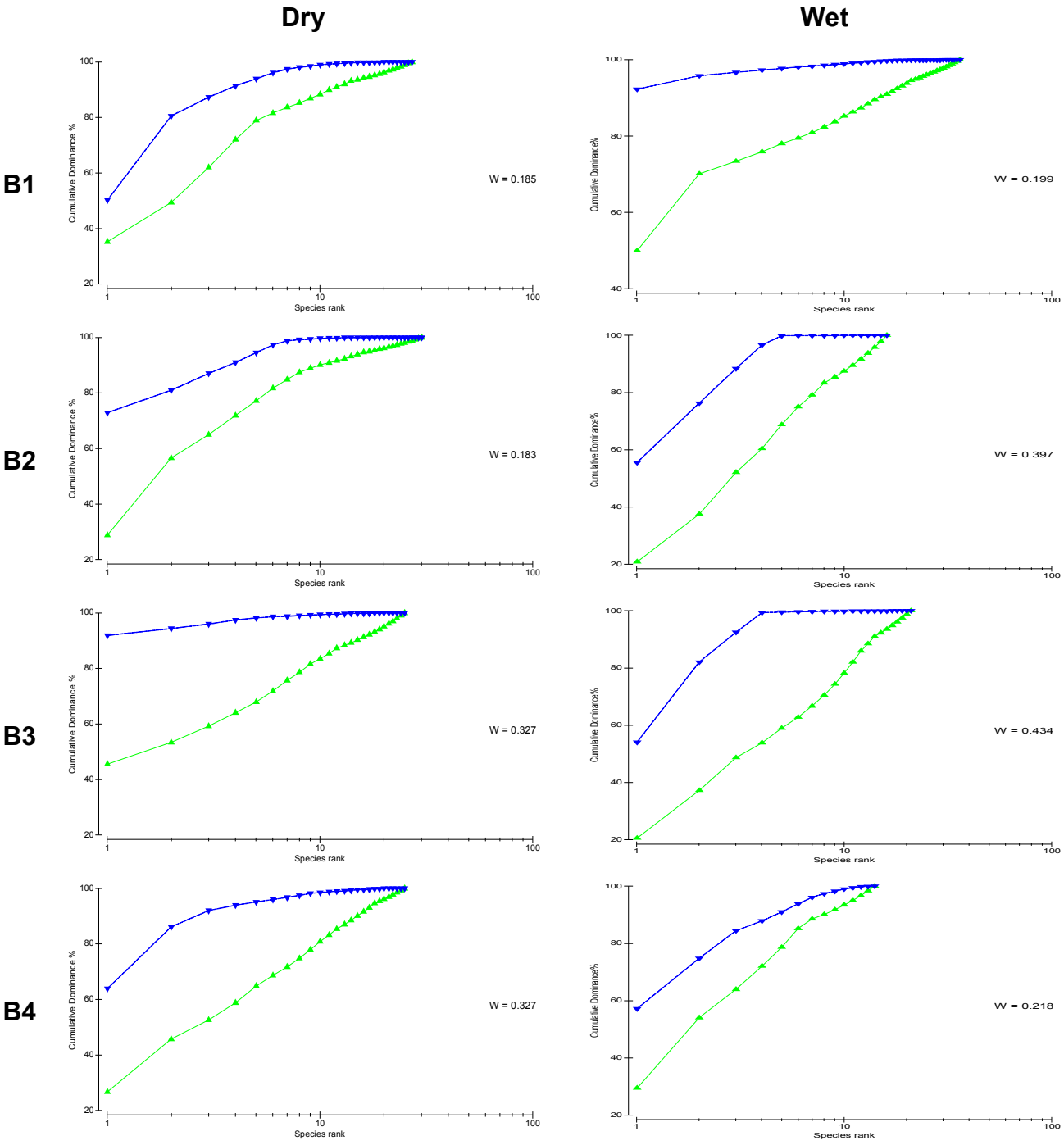

Figure 4.5. *ABC plots of every sampling site (blue ▼ with dotted line: biomass curve; green ▲ with solid line: abundance curve)*

5 Discussion

5.1 Sediment quality

Sha Tau Kok Sea locates within the northern part of Mirs Bay Water Control Zone (WCZ) that is the largest WCZ at the east of Hong Kong. According to the latest Marine Water Quality Report 2012, the water temperature, salinity and dissolved oxygen (D.O.) of bottom water layer ranged 16.2-28.7 °C, 30.0-32.3 ppt and 4.2-8.6 mg/L O_2 respectively (data from closest monitoring station MM1).

From 2010 to 2012, the Mirs Bay WCZ has achieved desirable compliance rate (98-100%) of Water Quality Objective (EPD, 2012, 2013). However the water quality in Sha Tau Kok Sea was worse within the WCZ. The annual average concentrations of *E. coli* (18 counts/100ml), faecal coliforms (37 counts/100ml) and chlorophyll-*a* (5.8 μg/L) were much higher than that of other monitoring stations of Mirs Bay WCZ (*E. coli*: 1-2 counts/100ml; faecal coliforms: 1-3 counts/100ml; chlorophyll-*a*: 1.3-4.0 μg/L) (details see EPD, 2013). The pollution source was possibly the cross-border sewage discharge from Shenzhen, mainland China. Although there was a sewage outfall of Sha Tau Kok STW, the treated effluent had undergone biological treatment and disinfection. The treated effluent should not have leaded to significant deterioration of water and sediment quality in Sha Tau Kok Sea.

Sha Tau Kok Sea is a designated fish culture zone with fish raft area 10,001-20,000 m^2 (EPD, 2013). Accumulation of organic wastes from uneaten feed, faeces and dissolved excretory products leads to organic enrichment in the benthic environment under fish raft area and at vicinities (Gao *et al.*, 2005). The degradation of organic matter depletes the dissolved oxygen

in the sediment and bottom water layer (Pearson and Rosenberg, 1978; Gray *et al.*, 2002).

Based on the sediment colour and odour, the sediments were generally in fair aerobic condition in the survey area during dry season sampling. Although there were long-term organic enrichment and garbage pollution, tidal flushing of marine water at fair water quality might have mitigated the adverse effects. However, the aerobic condition became worse during wet season sampling. Along with the increased water temperature, the oxygen solubility decreased resulting in temporary hypoxic condition. The sediments became darker and mild odour of hydrogen sulphite were detected at more sampling sites.

5.2 Benthic Baseline

In general, the benthic communities were delineated into three groups due to differences of benthic environment.

Group A (sampling site B1): the benthic community inhabited in subtidal soft mud that were characterized of moderate species number and density. It was strongly dominated by amphipods *Cheiriphotis* sp., *Cythura* sp., unidentified amphipod taxon, *Maera* sp. and *Corophium mortonii* in dry season sampling (amphipod density 499 ind m^{-2}). In the wet season sampling, only two species of amphipods *Cheiriphotis* sp. and *Maera* sp. were dominant at higher densities (amphipod density 673 ind m^{-2}). Across the two seasons of sampling, amphipod was still the most dominant faunal group. High dominance of amphipods indicated rich organic content in the sediments. Because organic deposit was an important food source for majority of amphipod species (Aljetlawi *et al*., 2000). Similar findings were reported in other organic-enriched regions of Hong Kong waters such as Kai Tak runway (282

ind. m^{-2} (Lam, 2007)), Hung Hom (627 ind. m^{-2} (Neanthes, 2009b)) and Lung Kwu Sheung Tan, Tuen Mun (715 ind. m^{-2} (Neanthes, 2009a)). B1 was closest to the sewage outfall of Sha Tau Kok STW while the discharge of treated sewage provides organic matter to benthic community continuously.

As mentioned above, hypoxic condition was found in the wet season sampling. But the number of species and density increased at B1. It was believed the flushing of treated sewage mitigated the stress of hypoxic condition.

Group B (sampling site B2): the benthic community inhabited in intertidal fine sand that were characterized of moderate species number and high density in the dry season sampling. It was evenly dominated by gastropod *Batillaria zonalis* and polychaete *Glycinde gurjanovae.* No relationship between their populations and water pollution was found. Tidal undulation might fasten the driven-away of organic matter. And the periodic low tide enhanced the aerobic decomposition of organic matter and aerated the surface sediment layer. However both the species number and density declined rapidly in the wet season sampling. In addition to hypoxic condition, the heat would be another stress factor to the benthic community. Since the low tide period was usually in day time during wet season while the sediments were strongly exposed under the sun.

Group C (sampling sites B3-B4): the benthic communities inhabited in subtidal soft mud that were characterized of moderate species number and densities. It was mainly dominated by amphipod *Maera* sp. and an unidentified amphipod taxon (amphipod density 174-230 ind m^{-2}). As mentioned, abundance of amphipod was positively correlated with the organic content in sediments. The organic content of sediments should be at moderate level at B3 and B4.

However, the species number and density declined due to hypoxic condition during wet season. The amphipod populations declined rapidly while the relatively common taxa were polychaete *Sigambra hanaokai*, *Terebellides stroemii* and *Cirriformia* sp..

No significant spatial pattern and temporal change of biodiversity, species evenness and *W*-statistic was observed. Although the species composition of benthic communities was different among the three groups, the benthic communities were generally healthy based on the moderate biodiversity value (2.01-2.63) and species evenness (0.56-0.87). Positive *W*-statistic values (0.18-0.43) were obtained at all sampling sites in both seasons of sampling. It indicated that benthic communities existed between 'moderately disturbed' level and 'slightly disturbed' level. It could tolerate the environmental stresses in the survey area. Hence the declines of species number and density of benthic communities were believed temporary and would restore in the next dry season.

5.3 Comparison of biodiversity

The benthic community was spatially divided into four groups in Hong Kong waters (Tolo Harbour, Eastern and Southern waters, Victoria Harbour, Deep Bay) (Shin *et al*., 2004) according to a territory-wide survey conducted by CPSL (2002). Waters of 'Eastern and Southern waters' group was characterized as unpolluted while that of other groups suffered from long-term sewage pollution (details see EPD, 2006). Table 5.1 shows the mean *H'* and *J* of benthic communities of the four groups, Sha Tau Kok Sea and other vicinal sampling sites of previous surveys. The biodiversity and species evenness of benthic communities of present survey were at intermediate levels between unpolluted water group 'Eastern and Southern waters' and polluted water group 'Deep Bay'. It reflected that the benthic communities could

tolerate the environment with long-term organic enrichment and temporary hypoxic condition. Focused on Sha Tau Kok Sea, both parameters remained stable compared with previous surveys conducted in 2009 and 2012 (details see Neanthes, 2009c, 2012).

5.4 Ecological value of Sha Tau Kok Sea

Table 5.2 lists the criteria of evaluating the benthic environment of present survey area in Sha Tau Kok Sea according to EPD (1997). The overall ecological value of the benthic communities was graded 'moderate-low'. The benthic communities were low to moderate in species number and moderate to high in abundance, resulting in overall moderate biodiversity and species evenness. Although long-term mild organic enrichment and temporary hypoxic condition were present, the benthic community could tolerate and was in fair condition.

There were three mangroves Sha Tau Kok, Nam Chung and Luk Keng inside Sha Tau Kok Sea. But the ecological linkage with the present survey area was insignificant.

For the benthic community, no species of conservation interest was collected. However horseshoe crab *Carcinoscorpius rotundicauda* of moderate size was found during sampling. Sha Tau Kok Sea might be a potential nursery ground.

Table 5.1. *Comparison of mean H' and J of benthic communities between present sampling sites in Sha Tau Kok Sea, vicinal sampling sites and other water zones of previous studies*

		Sha Tau Kok Sea	Vicinal sampling sites B1-B2	Vicinal sampling sites B1-B2	Tolo Harbour	Eastern and Southern waters	Victoria Harbour	Deep Bay
	Reference	Present survey	Neanthes, 2012	Neanthes, 2009c	Shin *et al*., 2004			
	Season							
H'	**Wet**	2.28	2.12	2.13	1.42	2.87	1.79	1.46
	Dry	2.33	2.57	2.57	1.36	2.82	1.64	2.32
	Mean	2.31	2.35	2.35	1.39	2.85	1.72	1.89
J	**Wet**	0.77	0.89	0.67	0.73	0.82	0.47	0.53
	Dry	0.71	0.74	0.74	0.83	0.81	0.44	0.73
	Mean	0.74	0.71	0.71	0.78	0.82	0.46	0.63

Table 5.2. *Criteria for evaluating the benthic environment in Sha Tau Kok Sea*

Criteria	Remarks
Naturalness	Sampling sites B1, B3 and B4: subtidal soft muddy substratum Sampling sites B2: intertidal fine sand substratum, exposed to strong sunlight during low tide in wet season All sampling sites were under long term, mild organic enrichment and temporary hypoxic condition in wet season.
Size	Large in size (approx. 45.7 ha)
Diversity	Low to moderate species number and moderate to high abundance leaded to moderate biodiversity and species evenness at all sampling sites.
Rarity	Mangrove Horseshoe Crab *Carcinoscorpius rotundicauda* was recorded.
Re-creatability	Non-creatable
Fragmentation	Not fragmented
Ecological linkage	Sha Tau Kok, Nam Chung and Luk Keng mangroves locates within Sha Tau Kok Sea. But the ecological linkage with the present survey area was insignificant.
Potential value	Moderate-low
Nursery/breeding ground	A potential nursery ground for horseshoe crab *Carcinoscorpius rotundicauda*. Specific baseline survey was recommended.
Age	Ancient
Abundance/Richness of wildlife	Benthic community in moderate abundance.
Ecological value	**Moderate-low**

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Appendix I *Photographic Records*

■ The sediment sample was collected with 0.1 m^2 van Veen grab

■ The collected sediments were washed with gentle seawater through a sieve box of mesh size 0.5mm

■ The preserved macrofauna in sediment residues was sorted out in laboratory

■ Taxonomic identification was undertaken with the aid of both stereoscopic and compound microscopes.

Appendix II *List of collected specimens at every sampling site*

Sampling site: B1			Sampling date: 22/03/2014							
No	Group	Species	1		2		3		row sum	
			ind.	wt.	ind.	wt.	ind.	wt.	ind.	wt.
1	A	Amphipod spp.	1	0.00	3	0.00	20	0.02	24	0.02
2	A	*Cheiriphotis* sp.	7	0.01	3	0.01	57	0.21	67	0.23
3	A	*Corophium mortonii*	3	0.00	1	0.00	9	0.00	13	0.00
4	A	*Cythura* sp.	2	0.00			25	0.00	27	0.00
5	A	*Maera* sp.	2	0.00			17	0.04	19	0.04
6	B	*Anomalocardia squamosa*					1	0.59	1	0.59
7	B	*Nitidotellina iridella*					1	0.12	1	0.12
8	B	*Laternula anatina*			1	0.18			1	0.18
9	C	*Thalamita crenata*					1	2.60	1	2.60
10	F	*Glossogobius* sp.					1	4.33	1	4.33
11	G	*Nassarius festivus*	1	0.35					1	0.35
12	P	*Aglaophamus dibranchis*	2	0.00	1	0.00	2	0.00	5	0.00
13	P	*Amaeana* sp.	2	0.00	1	0.01			3	0.02
14	P	*Glycinde gurjanovae*			2	0.00	2	0.00	4	0.01

A = Amphipod, B = Bivalve, C = Crab, F = Fish, G = Gastropod, P = Polychaete

ind. = no. of individual / 0.1 m^2; wt. = wet weight, g / 0.1 m^2

wt = 0.00 g / 0.1 m^2 : The specimen with total biomass less than 0.01 g / 0.1 m^2

Appendix II (Cont'd) *List of collected specimens at every sampling site*

Sampling site: B1			Sampling date: 22/03/2014							
No	Group	Species	1		2		3		row sum	
			ind.	wt.	ind.	wt.	ind.	wt.	ind.	wt.
15	P	Maldanidae spp	1	0.00	2	0.01			3	0.01
16	P	*Marphysa sanguinea*	1	0.03			1	0.01	2	0.04
17	P	*Onuphis eremita*	1	0.00	1	0.00			2	0.00
18	P	*Ophelina* sp.	1	0.00					1	0.00
19	P	*Pista* sp.					1	0.00	1	0.00
20	P	*Poecilochaetus* sp.	1	0.00	1	0.00			2	0.00
21	P	*Polyophthalmus pictus*					1	0.02	1	0.02
22	P	*Prionospio malmgreni*	3	0.00					3	0.00
23	P	*Sigambra hanaokai*			1	0.00			1	0.00
24	P	*Sternaspis scutata*	1	0.00					1	0.00
25	P	*Terebellides stroemii*	1	0.00	1	0.00	1	0.00	3	0.00
26	S	*Alpheus brevicristatus*					1	0.05	1	0.05
27	S	*Leptochela* sp.					1	0.00	1	0.00
		column sum	**30**	**0**	**18**	**0**	**142**	**8**	**190**	**8.62**

P = Polychaete, S = Shrimp

ind. = no. of individual / 0.1 m^2; wt. = wet weight, g / 0.1 m^2

wt = 0.00 g / 0.1 m^2 : The specimen with total biomass less than 0.01 g / 0.1 m^2

Appendix II (Cont'd) *List of collected specimens at every sampling site*

Sampling site: B2			Sampling date: 22/03/2014							
No	Group	Species	1		2		3		row sum	
			ind.	wt.	ind.	wt.	ind.	wt.	ind.	wt.
1	A	*Cheiriphotis* sp.	6	0.01	6	0.01	2	0.00	14	0.02
2	A	*Corophium mortonii*	2	0.00					2	0.00
3	A	*Maera* sp.	1	0.00					1	0.00
4	B	*Anomalocardia squamosa*	1	1.10	1	0.76			2	1.86
5	B	*Clausinella isabellina*					1	4.80	1	4.80
6	B	*Diplodonta sowerbyi*	1	0.07					1	0.07
7	B	*Soletellina virescens*	1	0.03					1	0.03
8	Cu	*Eocuma* sp.			1	0.00	1	0.00	2	0.00
9	G	*Batillaria multiformis*	7	5.52	4	4.32	1	0.96	12	10.80
10	G	*Batillaria zonalis*	40	48.41	19	24.26	17	25.63	76	98.30
11	G	*Cerithidea cingulata*	3	1.80	3	1.59	1	0.35	7	3.74
12	G	*Cerithidea djadjariensis*	9	3.15	5	2.10	8	2.86	22	8.10
13	G	*Cerithidea rhizophorarum*					1	0.56	1	0.56
14	G	*Nassarius festivus*	14	4.36	2	0.55	2	0.51	18	5.42

A = Amphipod, B = Bivalve, Cu = Cumacea, G = Gastropod

ind. = no. of individual / 0.1 m^2; wt. = wet weight, g / 0.1 m^2

wt = 0.00 g / 0.1 m^2 : The specimen with total biomass less than 0.01 g / 0.1 m^2

Appendix II (Cont'd) *List of collected specimens at every sampling site*

Sampling site: B2			Sampling date: 22/03/2014							
No	Group	Species	1		2		3		row sum	
			ind.	wt.	ind.	wt.	ind.	wt.	ind.	wt.
15	G	*Nassarius* sp.	2	0.34					2	0.34
16	P	*Ceratonereis erythraeensis*	1	0.01	6	0.01	1	0.02	8	0.04
17	P	*Glycinde gurjanovae*	30	0.03	24	0.03	19	0.03	73	0.09
18	P	*Linopherus paucibranchiata*					1	0.00	1	0.00
19	P	*Lumbrineris shiinoi*	2	0.00			1	0.00	3	0.00
20	P	*Marphysa sanguinea*	1	0.02	2	0.31	1	0.00	4	0.34
21	P	*Mediomastus* sp.			2	0.00			2	0.00
22	P	*Minuspio cirrifera*			1	0.00			1	0.00
23	P	*Onuphis eremita*	1	0.00	1	0.00			2	0.00
24	P	*Ophelina acuminata*	1	0.00					1	0.00
25	P	*Ophiodromus angustifrons*	1	0.00					1	0.00
26	P	*Perinereis cultrifera*	1	0.16					1	0.16
27	P	*Poecilochaetus* sp.					1	0.00	1	0.00
28	P	*Syllis sp.*	1	0.00					1	0.00

G = Gastropod, P = Polychaete

ind. = no. of individual / 0.1 m^2; wt. = wet weight, g / 0.1 m^2

wt = 0.00 g / 0.1 m^2 : The specimen with total biomass less than 0.01 g / 0.1 m^2

Appendix II (Cont'd) *List of collected specimens at every sampling site*

Sampling site: B2			Sampling date: 22/03/2014							
No	Group	Species	1		2		3		row sum	
			ind.	wt.	ind.	wt.	ind.	wt.	ind.	wt.
29	P	*Thelepus* sp.	1	0.00					1	0.00
30	Pl	Platyhelminthes spp.			1	0.00			1	0.00
		column sum	**127**	**65**	**78**	**34**	**58**	**36**	**263**	**134.69**

P = Polychaete, Pl = Platyhelminthes

ind. = no. of individual / 0.1 m^2; wt. = wet weight, g / 0.1 m^2

wt = 0.00 g / 0.1 m^2 : The specimen with total biomass less than 0.01 g / 0.1 m^2

Appendix II (Cont'd) *List of collected specimens at every sampling site*

Sampling site: B3			Sampling date: 22/03/2014							
No	Group	Species	1		2		3		row sum	
			ind.	wt.	ind.	wt.	ind.	wt.	ind.	wt.
1	A	*Corophium mortonii*			2	0.00	3	0.00	5	0.00
2	A	*Maera* sp.	27	0.04	7	0.00	13	0.01	47	0.05
3	B	*Abrina lunella*			1	0.09			1	0.09
4	B	*Anomalocardia squamosa*					1	3.15	1	3.15
5	B	*Nitidotellina iridella*			1	0.05	1	0.01	2	0.06
6	Ec	*Amphioplus ancistrotus*	1	0.01					1	0.01
7	Ec	*Ophiura pteracantha*	1	0.00					1	0.00
8	N	Nemertean spp.	1	0.00					1	0.00
9	P	*Aglaophamus dibranchis*	4	0.00	2	0.00	2	0.00	8	0.01
10	P	*Amaeana* sp.					1	0.00	1	0.00
11	P	*Cirriformia* sp.	2	0.00	1	0.00			3	0.00
12	P	*Eteone* sp.			1	0.00	1	0.00	2	0.00
13	P	*Glycinde gurjanovae*	3	0.00			1	0.00	4	0.00
14	P	*Leocrates claparedii*			1	0.00			1	0.00

A = Amphipod, B = Bivalve, Ec = Echinoderm, N = Nemertean, P = Polychaete

ind. = no. of individual / 0.1 m^2; wt. = wet weight, g / 0.1 m^2

wt = 0.00 g / 0.1 m^2 : The specimen with total biomass less than 0.01 g / 0.1 m^2

Appendix II (Cont'd) *List of collected specimens at every sampling site*

Sampling site: B3			Sampling date: 22/03/2014							
No	Group	Species	1		2		3		row sum	
			ind.	wt.	ind.	wt.	ind.	wt.	ind.	wt.
15	P	*Loimia* sp.	2	0.02	2	0.00			4	0.03
16	P	Maldanidae spp	1	0.00			2	0.00	3	0.00
17	P	*Naineris* sp.	2	0.00					2	0.00
18	P	*Pista* sp.			1	0.00			1	0.00
19	P	*Prionospio malmgreni*					1	0.00	1	0.00
20	P	*Prionospio* sp.	1	0.00					1	0.00
21	P	*Sigambra hanaokai*	1	0.00	3	0.00			4	0.00
22	P	Spirorbidae spp.	1	0.00					1	0.00
23	P	*Syllis* sp.	1	0.00					1	0.00
24	P	*Terebellides stroemii*	2	0.01			4	0.00	6	0.01
25	S	*Alpheus* sp.					1	0.01	1	0.01
		column sum	**50**	**0**	**22**	**0**	**31**	**3**	**103**	**3.42**

P = Polychaete, S = Shrimp

ind. = no. of individual / 0.1 m^2; wt. = wet weight, g / 0.1 m^2

wt = 0.00 g / 0.1 m^2 : The specimen with total biomass less than 0.01 g / 0.1 m^2

Appendix II (Cont'd) *List of collected specimens at every sampling site*

Sampling site: B4			Sampling date: 22/03/2014							
No	Group	Species	1		2		3		row sum	
			ind.	wt.	ind.	wt.	ind.	wt.	ind.	wt.
1	A	Amphipod spp.	1	0.00	20	0.00	4	0.00	25	0.01
2	A	*Corophium mortonii*	4	0.00	3	0.00	2	0.00	9	0.00
3	A	*Cythura* sp.			2	0.00			2	0.00
4	A	*Maera* sp.	5	0.01	29	0.02	1	0.00	35	0.03
5	B	*Abrina lunella*			1	0.19			1	0.19
6	B	*Ruditapes philippinarum*			1	0.70			1	0.70
7	C	*Thalamita sima*	1	2.01					1	2.01
8	Ec	*Amphioplus depressus*			2	0.01			2	0.01
9	P	*Aglaophamus dibranchis*	2	0.00	2	0.00	4	0.00	8	0.00
10	P	*Amaeana* sp.	1	0.02	2	0.01	1	0.01	4	0.04
11	P	*Branchiomma cingulata*					1	0.01	1	0.01
12	P	*Cirriformia* sp.	2	0.00			2	0.01	4	0.01
13	P	*Eunice indica*	1	0.00	1	0.00			2	0.00
14	P	*Glycera* sp.	1	0.00	0	0.00	0	0.00	1	0.00

A = Amphipod, B = Bivalve, C = Crab, Ec = Echinoderm, P = Polychaete

ind. = no. of individual / 0.1 m^2; wt. = wet weight, g / 0.1 m^2

wt = 0.00 g / 0.1 m^2 : The specimen with total biomass less than 0.01 g / 0.1 m^2

Appendix II (Cont'd) *List of collected specimens at every sampling site*

Sampling site: B4			Sampling date: 22/03/2014							
No	Group	Species	1		2		3		row sum	
			ind.	wt.	ind.	wt.	ind.	wt.	ind.	wt.
15	P	*Glycinde gurjanovae*	3	0.00	1	0.00			4	0.00
16	P	*Hydroides* sp.			1	0.00			1	0.00
17	P	*Loimia* sp.	1	0.05	2	0.01			3	0.06
18	P	Maldanidae spp	1	0.00	2	0.00			3	0.01
19	P	*Onuphis eremita*			1	0.00	1	0.00	2	0.00
20	P	*Ophiodromus angustifrons*			1	0.00	1	0.00	2	0.00
21	P	*Paralacydonia paradox*	1	0.00					1	0.00
22	P	*Pista* sp.	1	0.00	3	0.02			4	0.02
23	P	*Sigambra hanaokai*	1	0.00	2	0.00	2	0.00	5	0.00
24	P	*Terebellides stroemii*	1	0.00	4	0.02	3	0.00	8	0.03
25	P	*Thelepus* sp.					2	0.02	2	0.02
		column sum	**27**	**2**	**80**	**1**	**24**	**0**	**131**	**3.14**

P = Polychaete

ind. = no. of individual / 0.1 m^2; wt. = wet weight, g / 0.1 m^2

wt = 0.00 g / 0.1 m^2 : The specimen with total biomass less than 0.01 g / 0.1 m^2

Appendix II (Cont'd) *List of collected specimens at every sampling site*

Sampling site: B1			Sampling date: 04/08/2014							
No	Group	Species	1		2		3		row sum	
			ind.	wt.	ind.	wt.	ind.	wt.	ind.	wt.
1	A	Amphipod spp.					3	0.00	3	0.00
2	A	*Cheiriphotis* sp.	120	0.08			19	0.02	139	0.11
3	A	*Corophium major*	3	0.00					3	0.00
4	A	*Corophium mortonii*	6	0.00			1	0.00	7	0.00
5	A	*Maera* sp.	39	0.05			17	0.03	56	0.08
6	B	*Anomalocardia squamosa*	1	0.05					1	0.05
7	B	*Diplodonta sowerbyi*	1	0.04			1	0.04	2	0.08
8	B	*Irus irus*					1	0.43	1	0.43
9	B	*Tapes dorsatus*	1	44.87					1	44.87
10	C	*Thalamita crenata*					2	0.11	2	0.11
11	Ec	*Amphioplus ancistrotus*	1	0.00			3	0.08	4	0.08
12	G	*Tenguella musiva*	1	1.73					1	1.73
13	P	*Aglaophamus dibranchis*	3	0.00	1	0.00			4	0.00
14	P	*Amaeana* sp.			1	0.01			1	0.01

A = Amphipod, B = Bivalve, C = Crab, Ec = Echinoderm, G = Gastropod, P = Polychaete

ind. = no. of individual / 0.1 m^2; wt. = wet weight, g / 0.1 m^2

wt = 0.00 g / 0.1 m^2 : The specimen with total biomass less than 0.01 g / 0.1 m^2

Appendix II (Cont'd) *List of collected specimens at every sampling site*

Sampling site: B1			Sampling date: 04/08/2014							
No	Group	Species	1		2		3		row sum	
			ind.	wt.	ind.	wt.	ind.	wt.	ind.	wt.
15	P	*Branchiomma cingulata*	1	0.00			1	0.01	2	0.01
16	P	*Cirratulus* sp.	3	0.00					3	0.00
17	P	*Cirriformia* sp.			4	0.00			4	0.00
18	P	*Diopatra chiliensis*					1	0.11	1	0.11
19	P	*Harmothoe* sp.	1	0.00			2	0.02	3	0.02
20	P	*Heteromastus* sp.			1	0.00			1	0.00
21	P	*Loimia* sp.	1	0.00	1	0.02			2	0.02
22	P	Maldanidae spp.	1	0.00					1	0.00
23	P	*Marphysa sanguinea*	1	0.22			1	0.05	2	0.27
24	P	*Minuspio cirrifera*	1	0.00					1	0.00
25	P	*Naineris* sp.	5	0.06			1	0.01	6	0.07
26	P	*Notomastus* sp.	4	0.03					4	0.03
27	P	*Pista* sp.	1	0.01	2	0.03	1	0.01	4	0.05
28	P	*Prionospio* sp.	1	0.00					1	0.00

P = Polychaete

ind. = no. of individual / 0.1 m^2; wt. = wet weight, g / 0.1 m^2

wt = 0.00 g / 0.1 m^2 : The specimen with total biomass less than 0.01 g / 0.1 m^2

Appendix II (Cont'd) *List of collected specimens at every sampling site*

Sampling site: B1			Sampling date: 04/08/2014							
No	Group	Species	1		2		3		row sum	
			ind.	wt.	ind.	wt.	ind.	wt.	ind.	wt.
29	P	*Sigambra hanaokai*	2	0.00					2	0.00
30	P	*Sternaspis scutata*	1	0.00	1	0.00			2	0.00
31	P	Syllidae spp.	1	0.00					1	0.00
32	P	*Terebellides stroemii*	1	0.03					1	0.03
33	P	Unidentified Nereidiae spp.	1	0.00					1	0.00
34	S	*Alpheus brevicristatus*					1	0.05	1	0.05
35	S	*Alpheus distinguendus*	1	0.18					1	0.18
36	Sp	*Sipunculus nudus*	8	0.16			1	0.05	9	0.22
		column sum	211	47.55	11	0.06	56	1.02	278	48.62

P = Polychaete, S = Shrimp, Sp = Sipunculan

ind. = no. of individual / 0.1 m^2; wt. = wet weight, g / 0.1 m^2

wt = 0.00 g / 0.1 m^2 : The specimen with total biomass less than 0.01 g / 0.1 m^2

Appendix II (Cont'd) *List of collected specimens at every sampling site*

Sampling site: B2			Sampling date: 04/08/2014							
No	Group	Species	1		2		3		row sum	
			ind.	wt.	ind.	wt.	ind.	wt.	ind.	wt.
1	A	*Corophium major*			1	0.00			1	0.00
2	B	*Anomalocardia squamosa*	2	2.16	1	1.15	1	0.68	4	3.99
3	B	*Clausinella isabellina*	1	2.74					1	2.74
4	B	*Gafrarium pectinatum*	1	18.49					1	18.49
5	G	*Batillaria zonalis*			1	1.08			1	1.08
6	G	*Cerithidea cingulata*			10	6.93			10	6.93
7	N	Nemertean spp.					1	0.00	1	0.00
8	P	*Glycinde gurjanovae*	1	0.00	2	0.00	4	0.00	7	0.01
9	P	*Heteromastus* sp.	6	0.00	2	0.00			8	0.00
10	P	*Lumbrineris* sp.			1	0.00			1	0.00
11	P	*Marphysa sanguinea*	1	0.01	1	0.02	1	0.01	3	0.03
12	P	*Onuphis eremita*					2	0.01	2	0.01
13	P	*Poecilochaetus hystricosus*					2	0.00	2	0.00
14	P	*Prionospio malmgreni*			1	0.00			1	0.00

A = Amphipod, B = Bivalve, G = Gastropod, N = Nemertean, P = Polychaete

ind. = no. of individual / 0.1 m^2; wt. = wet weight, g / 0.1 m^2

wt = 0.00 g / 0.1 m^2 : The specimen with total biomass less than 0.01 g / 0.1 m^2

Appendix II (Cont'd) *List of collected specimens at every sampling site*

Sampling site: B2		Sampling date: 04/08/2014								
No	Group	Species	1		2		3		row sum	
			ind.	wt.	ind.	wt.	ind.	wt.	ind.	wt.
15	P	*Sigambra hanaokai*					1	0.00	1	0.00
16	P	Unidentified Nereidiae spp.			1	0.00	3	0.00	4	0.00
		column sum	12	23.40	21	9.18	15	0.71	48	33.29

P = Polychaete

ind. = no. of individual / 0.1 m^2; wt. = wet weight, g / 0.1 m^2

wt = 0.00 g / 0.1 m^2 : The specimen with total biomass less than 0.01 g / 0.1 m^2

Appendix II (Cont'd) *List of collected specimens at every sampling site*

Sampling site: B3			Sampling date: 04/08/2014							
No	Group	Species	1		2		3		row sum	
			ind.	wt.	ind.	wt.	ind.	wt.	ind.	wt.
1	A	*Corophium major*			2	0.00	2	0.00	4	0.00
2	A	*Maera* sp.	1	0.00	1	0.00	2	0.00	4	0.00
3	B	*Anomalocardia squamosa*	1	2.50			1	1.94	2	4.45
4	B	*Clausinella isabellina*	1	2.91					1	2.91
5	B	*Dosinia japonica*			1	5.01	1	18.06	2	23.07
6	B	*Ruditapes philippinarum*			1	11.96			1	11.96
7	C	*Thalamita crenata*	1	0.01	1	0.04	1	0.03	3	0.08
8	C	*Thalamita sima*					1	0.02	1	0.02
9	Cn	*Metedwardsia* sp.					1	0.01	1	0.01
10	P	*Cirriformia* sp.	7	0.00			6	0.00	13	0.01
11	P	*Ehlersia* sp.	1	0.00					1	0.00
12	P	*Glycinde gurjanovae*			1	0.00			1	0.00
13	P	Maldanidae spp.			2	0.00	1	0.00	3	0.01
14	P	*Mediomastus* sp.					3	0.00	3	0.00

A = Amphipod, B = Bivalve, C = Crab, Cn = Cnidarin, P = Polychaete

ind. = no. of individual / 0.1 m^2; wt. = wet weight, g / 0.1 m^2

wt = 0.00 g / 0.1 m^2 : The specimen with total biomass less than 0.01 g / 0.1 m^2

Appendix II (Cont'd) *List of collected specimens at every sampling site*

Sampling site: B3			Sampling date: 04/08/2014							
No	Group	Species	1		2		3		row sum	
			ind.	wt.	ind.	wt.	ind.	wt.	ind.	wt.
15	P	*Naineris* sp.	2	0.01	1	0.01			3	0.02
16	P	*Notomastus* sp.	2	0.00			1	0.00	3	0.00
17	P	*Pista* sp.			2	0.02	1	0.01	3	0.03
18	P	*Sigambra hanaokai*	3	0.00	9	0.01	4	0.00	16	0.02
19	P	*Terebellides stroemii*			7	0.05	2	0.01	9	0.07
20	P	Unidentified Nereidiae spp.			1	0.00	2	0.00	3	0.00
21	S	*Alpheus* sp.			1	0.01			1	0.01
		column sum	19	5.44	30	17.13	29	20.11	78	42.68

P = Polychaete, S = Shrimp

ind. = no. of individual / 0.1 m^2; wt. = wet weight, g / 0.1 m^2

wt = 0.00 g / 0.1 m^2 : The specimen with total biomass less than 0.01 g / 0.1 m^2

Appendix II (Cont'd) *List of collected specimens at every sampling site*

Sampling site: B4			Sampling date: 04/08/2014							
No	Group	Species	1		2		3		row sum	
			ind.	wt.	ind.	wt.	ind.	wt.	ind.	wt.
1	A	Amphipod spp.			1	0.00			1	0.00
2	A	*Corophium major*	2	0.00	2	0.00			4	0.00
3	P	*Amaeana* sp.	1	0.00					1	0.00
4	P	*Artacama* sp.	5	0.02					5	0.02
5	P	*Ceratonereis erythraeensis*	1	0.00					1	0.00
6	P	*Cirriformia* sp.	1	0.00	2	0.00	1	0.00	4	0.00
7	P	*Diopatra chiliensis*					1	0.01	1	0.01
8	P	*Marphysa stragulum*					1	0.00	1	0.00
9	P	*Onuphis eremita*	2	0.02					2	0.02
10	P	*Pista* sp.	1	0.01	3	0.02	2	0.02	6	0.05
11	P	*Sigambra hanaokai*	2	0.00	11	0.01	2	0.00	15	0.02
12	P	*Terebellides stroemii*			16	0.08	2	0.01	18	0.09
13	Pl	Platyhelminthes spp.	1	0.01					1	0.01
14	S	*Clorida latreillei*					1	0.31	1	0.31
		column sum	16	0.06	35	0.12	10	0.35	61	0.53

A = Amphipod, P = Polychaete, Pl = Platyhelminthes, S = Shrimp

ind. = no. of individual / 0.1 m^2; wt. = wet weight, g / 0.1 m^2

wt = 0.00 g / 0.1 m^2 : The specimen with total biomass less than 0.01 g / 0.1 m^2

Appendix III *Taxonomic resolution of every collected species*

Kingdom	Phylum	Class	Order	Family	Species
Animalia	Annelida	Polychaeta	Amphinomida	Amphinomidae	*Linopherus paucibranchiata*
Animalia	Annelida	Polychaeta	Eunicida	Eunicidae	*Eunice indica*
Animalia	Annelida	Polychaeta	Eunicida	Eunicidae	*Marphysa sanguinea*
Animalia	Annelida	Polychaeta	Eunicida	Eunicidae	*Marphysa stragulum*
Animalia	Annelida	Polychaeta	Eunicida	Lumbrineridae	*Lumbrineris shiinoi*
Animalia	Annelida	Polychaeta	Eunicida	Lumbrineridae	*Lumbrineris* sp.
Animalia	Annelida	Polychaeta	Eunicida	Onuphidae	*Diopatra chiliensis*
Animalia	Annelida	Polychaeta	Eunicida	Onuphidae	*Onuphis eremita*
Animalia	Annelida	Polychaeta	Phyllodocida	Glyceridae	*Glycera* sp.
Animalia	Annelida	Polychaeta	Phyllodocida	Goniadidae	*Glycinde gurjanovae*
Animalia	Annelida	Polychaeta	Phyllodocida	Hesionidae	*Leocrates claparedii*
Animalia	Annelida	Polychaeta	Phyllodocida	Hesionidae	*Ophiodromus angustifrons*
Animalia	Annelida	Polychaeta	Phyllodocida	Lacydoniidae	*Paralacydonia paradox*
Animalia	Annelida	Polychaeta	Phyllodocida	Nephtyidae	*Aglaophamus dibranchis*
Animalia	Annelida	Polychaeta	Phyllodocida	Nereididae	*Ceratonereis erythraeensis*
Animalia	Annelida	Polychaeta	Phyllodocida	Nereididae	*Perinereis cultrifera*
Animalia	Annelida	Polychaeta	Phyllodocida	Nereididae	Nereidiae spp.
Animalia	Annelida	Polychaeta	Phyllodocida	Phyllodocidae	*Eteone* sp.
Animalia	Annelida	Polychaeta	Phyllodocida	Pilargidae	*Sigambra hanaokai*
Animalia	Annelida	Polychaeta	Phyllodocida	Polynoidae	*Harmothoe* sp.

Appendix III (Cont'd) *Taxonomic resolution of every collected species*

Kingdom	Phylum	Class	Order	Family	Species
Animalia	Annelida	Polychaeta	Phyllodocida	Syllidae	*Ehlersia* sp.
Animalia	Annelida	Polychaeta	Phyllodocida	Syllidae	Syllidae spp.
Animalia	Annelida	Polychaeta	Phyllodocida	Syllidae	*Syllis* sp.
Animalia	Annelida	Polychaeta	Sabellida	Sabellidae	*Branchiomma cingulata*
Animalia	Annelida	Polychaeta	Sabellida	Serpulidae	*Hydroides* sp.
Animalia	Annelida	Polychaeta	Sabellida	Spirorbidae	Spirorbidae spp.
Animalia	Annelida	Polychaeta	Spionida	Poecilochaetidae	*Poecilochaetus hystricosus*
Animalia	Annelida	Polychaeta	Spionida	Poecilochaetidae	*Poecilochaetus* sp.
Animalia	Annelida	Polychaeta	Spionida	Spionidae	*Minuspio cirrifera*
Animalia	Annelida	Polychaeta	Spionida	Spionidae	*Prionospio malmgreni*
Animalia	Annelida	Polychaeta	Spionida	Spionidae	*Prionospio* sp.
Animalia	Annelida	Polychaeta	Terebellida	Cirratulidae	*Cirratulus* sp.
Animalia	Annelida	Polychaeta	Terebellida	Cirratulidae	*Cirriformia* sp.
Animalia	Annelida	Polychaeta	Terebellida	Sternaspidae	*Sternaspis scutata*
Animalia	Annelida	Polychaeta	Terebellida	Terebellidae	*Amaeana* sp.
Animalia	Annelida	Polychaeta	Terebellida	Terebellidae	*Artacama* sp.
Animalia	Annelida	Polychaeta	Terebellida	Terebellidae	*Loimia* sp.
Animalia	Annelida	Polychaeta	Terebellida	Terebellidae	*Pista* sp.
Animalia	Annelida	Polychaeta	Terebellida	Terebellidae	*Thelepus* sp.
Animalia	Annelida	Polychaeta	Terebellida	Trichobranchidae	*Terebellides stroemii*

Appendix III (Cont'd) *Taxonomic resolution of every collected species*

Kingdom	Phylum	Class	Order	Family	Species
Animalia	Annelida	Polychaeta		Capitellidae	*Heteromastus* sp.
Animalia	Annelida	Polychaeta		Capitellidae	*Mediomastus* sp.
Animalia	Annelida	Polychaeta		Capitellidae	*Notomastus* sp.
Animalia	Annelida	Polychaeta		Maldanidae	Maldanidae spp.
Animalia	Annelida	Polychaeta		Opheliidae	*Ophelina acuminata*
Animalia	Annelida	Polychaeta		Opheliidae	*Ophelina* sp.
Animalia	Annelida	Polychaeta		Opheliidae	*Polyophthalmus pictus*
Animalia	Annelida	Polychaeta		Orbiniidae	*Naineris* sp.
Animalia	Arthropoda	Malacostraca	Amphipoda	Caprellidae	*Maera* sp.
Animalia	Arthropoda	Malacostraca	Amphipoda	Corophiidae	*Cheiriphotis* sp.
Animalia	Arthropoda	Malacostraca	Amphipoda	Corophiidae	*Corophium major*
Animalia	Arthropoda	Malacostraca	Amphipoda	Corophiidae	*Corophium mortonii*
Animalia	Arthropoda	Malacostraca	Amphipoda	Maeridae	*Cythura* sp.
Animalia	Arthropoda	Malacostraca	Amphipoda		Amphipod spp.
Animalia	Arthropoda	Malacostraca	Cumacea	Bodotriidae	*Eocuma* sp.
Animalia	Arthropoda	Malacostraca	Decapoda	Alpheidae	*Alpheus brevicristatus*
Animalia	Arthropoda	Malacostraca	Decapoda	Alpheidae	*Alpheus distinguendus*
Animalia	Arthropoda	Malacostraca	Decapoda	Alpheidae	*Alpheus* sp.
Animalia	Arthropoda	Malacostraca	Decapoda	Pasiphaeidae	*Leptochela* sp.
Animalia	Arthropoda	Malacostraca	Decapoda	Portunidae	*Thalamita crenata*

Appendix III (Cont'd) *Taxonomic resolution of every collected species*

Kingdom	Phylum	Class	Order	Family	Species
Animalia	Arthropoda	Malacostraca	Decapoda	Portunidae	*Thalamita sima*
Animalia	Arthropoda	Malacostraca	Stomatopoda	Squillidae	*Clorida latreillei*
Animalia	Chordata	Actinopterygii	Perciformes	Gobiidae	*Glossogobius* sp.
Animalia	Cnidaria	Anthozoa	Actiniaria	Edwardsiidae	*Metedwardsia* sp.
Animalia	Echinodermata	Ophiuroidea	Ophiurida	Amphiuridae	*Amphioplus ancistrotus*
Animalia	Echinodermata	Ophiuroidea	Ophiurida	Amphiuridae	*Amphioplus depressus*
Animalia	Echinodermata	Ophiuroidea	Ophiurida	Ophiuridae	*Ophiura pteracantha*
Animalia	Mollusca	Bivalvia	Anomalodesmata	Laternulidae	*Laternula anatina*
Animalia	Mollusca	Bivalvia	Veneroida	Psammobiidae	*Soletellina virescens*
Animalia	Mollusca	Bivalvia	Veneroida	Semelidae	*Abrina lunella*
Animalia	Mollusca	Bivalvia	Veneroida	Tellinidae	*Nitidotellina iridella*
Animalia	Mollusca	Bivalvia	Veneroida	Ungulinidae	*Diplodonta sowerbyi*
Animalia	Mollusca	Bivalvia	Veneroida	Veneridae	*Anomalocardia squamosa*
Animalia	Mollusca	Bivalvia	Veneroida	Veneridae	*Clausinella isabellina*
Animalia	Mollusca	Bivalvia	Veneroida	Veneridae	*Dosinia japonica*
Animalia	Mollusca	Bivalvia	Veneroida	Veneridae	*Gafrarium pectinatum*
Animalia	Mollusca	Bivalvia	Veneroida	Veneridae	*Irus irus*
Animalia	Mollusca	Bivalvia	Veneroida	Veneridae	*Ruditapes philippinarum*
Animalia	Mollusca	Bivalvia	Veneroida	Veneridae	*Tapes dorsatus*
Animalia	Mollusca	Gastropoda	Caenogastropoda	Batillariidae	*Batillaria multiformis*

Appendix III (Cont'd) *Taxonomic resolution of every collected species*

Kingdom	Phylum	Class	Order	Family	Species
Animalia	Mollusca	Gastropoda	Caenogastropoda	Batillariidae	*Batillaria zonalis*
Animalia	Mollusca	Gastropoda	Caenogastropoda	Potamididae	*Cerithidea cingulata*
Animalia	Mollusca	Gastropoda	Caenogastropoda	Potamididae	*Cerithidea djadjariensis*
Animalia	Mollusca	Gastropoda	Caenogastropoda	Potamididae	*Cerithidea rhizophorarum*
Animalia	Mollusca	Gastropoda	Neogastropoda	Muricidae	*Tenguella musiva*
Animalia	Mollusca	Gastropoda	Neogastropoda	Nassariidae	*Nassarius festivus*
Animalia	Mollusca	Gastropoda	Neogastropoda	Nassariidae	*Nassarius festivus*
Animalia	Mollusca	Gastropoda	Neogastropoda	Nassariidae	*Nassarius* sp.
Animalia	Nemertea				Nemertean spp.
Animalia	Platyhelminthes				Platyhelminthes spp.
Animalia	Sipuncula	Sipunculidea	Golfingiida	Sipunculidae	*Sipunculus nudus*

- End of Report -

Appendix 5

Subtidal Benthos Survey Report of Additional Survey

Appendix 5

MOTT MACDONALD HONG KONG LIMITED

Project No: 14090013

Sha Tau Kok Sea

Benthic Survey Report

December 2014

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1 Summary

The aim of present survey is to obtain ecological baseline information of macrobenthic community in the coastal area of Sha Tau Kok Sea. It is to investigate the potential ecological impacts caused by the proposed new submarine outfall of Sha Tau Kok Sewage Treatment Works (STW). Grab samplings were undertaken at four sampling sites in the survey area of Sha Tau Kok Sea in October 2014 and November 2014.

In general, the sediments were under mild but long-term organic enrichment condition. Weak tidal flushing and non-shallow water could not mitigate the condition. Along with the increased water temperature during wet season, the oxygen solubility would decrease. Temporary hypoxic condition is predicted to occur.

The benthic communities inhabited in soft mud and were similar among the sampling sites. It was characterized of low biodiversity value and low density without dominant taxa. It was possibly caused by long-term organic enrichment.

The ecological value of the benthic communities was graded 'Low'. The benthic communities were low in species number and abundance, resulting in overall low biodiversity. No species of conservation interest was collected. The proposed construction of new submarine outfall of Sha Tau Kok STW would be environmentally acceptable as long as sufficient mitigation

measures were properly implemented during construction stage.

Nelson W.Y. Lam

Environmental Consultant

2 Introduction

The aim of present survey is to obtain ecological baseline information of macrobenthic community in the coastal area of Sha Tau Kok Sea. It is to investigate the potential ecological impacts caused by the proposed new submarine outfall of Sha Tau Kok Sewage Treatment Works (STW).

3 Methodologies

3.1 Field sampling

In order to collect benthic baseline information in the discharge area of proposed submarine outfall, benthos sampling was undertaken at four sampling sites (A-D, 5-6 m depth) surrounding the outfall location (Fig. 3.1). Every sampling site was about 200-280 m apart from each other. The coordinates of the sampling sites (Table 3.1) were fixed by Global Positioning System (GPS device model: Garmin 78S) on board. The first and second samplings were conducted on 18th October, 2014 and 22nd November, 2014 respectively. The weather was sunny and windy on both sampling days.

At every sampling site, three replicates of sediment samples were collected with a 0.1 m^2 van Veen grab (0.1 m^2 sampling area × 15 cm biting depth). Collected samples were accepted when at least two-third of grab volume was filled. When the sediment samples were collected on board, a photographic record of the sediment texture and colour was taken. The samples were washed with gentle seawater through a sieve stack consisted of 1 mm (top) and 0.5 mm (bottom) mesh sizes to remove fine material. Large visible animals in the residues were

hand-picked into a small, labeled plastic vial. All remains were transferred into a labeled plastic container followed by preservation with 70% ethanol solution and staining with 1% Rose Bengal solution.

3.2 Laboratory work

After arrival to laboratory, the samples were stored for at least one day to ensure sufficient preservation and staining. The persevered fauna were sorted out from the samples carefully by placing portion of sediment residues on a white tray and picking up with forceps under magnifying glass. For quality assurance, the sediment residues of one-third sorted samples were randomly rechecked. No missed specimen was found in the recheck.

The collected specimens were identified to the lowest taxonomic resolution. Examination of the morphological features of the specimens was undertaken with the aid of both stereoscopic and compound microscopes. The taxonomic classification was conducted in accordance to the following references: Polychaetes: Day (1967), Gallardo (1967), Fauchald (1977), Yang and Sun (1988), Wu *et al*. (1997), Sun (2004); Arthropods: Dai and Yang (1991), Dong (1991), Lowry (2000); Mollusks: Qi (2004). The number of individuals of each species was recorded by counting the anterior portions of the fauna only. Total biomass of each species was determined as preserved wet weight by blotting the animals on filter paper for 3 minutes followed by weighing to the nearest 0.0001 g with microbalance.

3.3 Data analysis

Data collected from three replicate samples at every sampling site were pooled together for data analysis. Shannon-Weaver Diversity Index (*H'*) and Pielou's Species Evenness (*J*) were

calculated using the formulae below,

$H' = -\Sigma (Ni / N) \ln (Ni / N)$ (Shannon and Weaver, 1963)
$J = H' / \ln S$ (Pielou, 1966)

where S is the total number of species in the sample, N is the total number of individuals, and Ni is the number of individuals of the i^{th} species.

The status of benthic community is assessed using the abundance/biomass comparison (ABC) method and *W* statistic is generated (Warwick, 1986; Warwick and Clarke, 1994) with the software PRIMER version 6 (Plymouth Marine Laboratory, UK). ABC method is based on an ecological theory: when the benthic community is approaching equilibrium under stable and undisturbed environment, the biomass becomes increasingly dominated by few large-sized species while abundance of each species is less. In contrast, the abundance is dominated by few small-sized species while biomass of each species is small in disturbed environment.

The ABC method plots relative proportions of biomass and abundance attributable to each species for every sampling site. The species are ranked in descending order of abundance on the x-axis (logarithmic scale) with superimposition of dominance curves of abundance and biomass on the y-axis (cumulative percentage scale). When biomass curve is above abundance curve entirely, the benthic community reflects unpolluted / undisturbed status due to the presence of few, large-sized fauna. When abundance curve is above biomass curve entirely, the benthic community reflects grossly polluted / disturbed status due to presence of numerous small-sized animals. Under moderately disturbed status of benthic community, two curves cross over one or more times (Warwick and Clarke, 1994). Then *W* statistic is employed to measure the extent to which the biomass curve lies above the abundance curve

(Clarke, 1990). The equation of *W* statistic is shown below:

$$W = \sum_{i=1}^{S} (Bi - Ai) / [50 (S - 1)] \quad \text{(Clarke, 1990)}$$

where S = total number of species; B*i* - A*i* = difference between biomass and abundance (percentage) of the i_{th} species.

In case biomass curve lying above abundance curve, a positive *W* value is given that represented 'undisturbed' condition, and vice versa. The *W* statistic presents a continuum from 'disturbed' (W= -1), 'moderately disturbed' (*W* = 0), to 'undisturbed' conditions (*W* = +1).

Table 3.1. *The GPS coordinates (in WGS84 datum (ITRF96 Reference Frame)), time, tidal state and measured water depth of every sampling site*

Sampling site	Latitude (N)	Longitude (E)	Oct. 2014			Nov. 2014		
			Time (hh:mm)	Tidal State	Water depth (m)	Time (hh:mm)	Tidal State	Water depth (m)
A	22° 32.716'	114° 14.144'	11:35	Low	5.6	10:30	Ebb	6.2
B	22° 32.778'	114° 14.239'	11:55	Low	5.9	10:48	Ebb	6.4
C	22° 32.627'	114° 14.212'	12:09	Low	5.6	11:04	Ebb	6.0
D	22° 32.689'	114° 14.307'	12:25	Low	5.7	11:20	Ebb	6.2

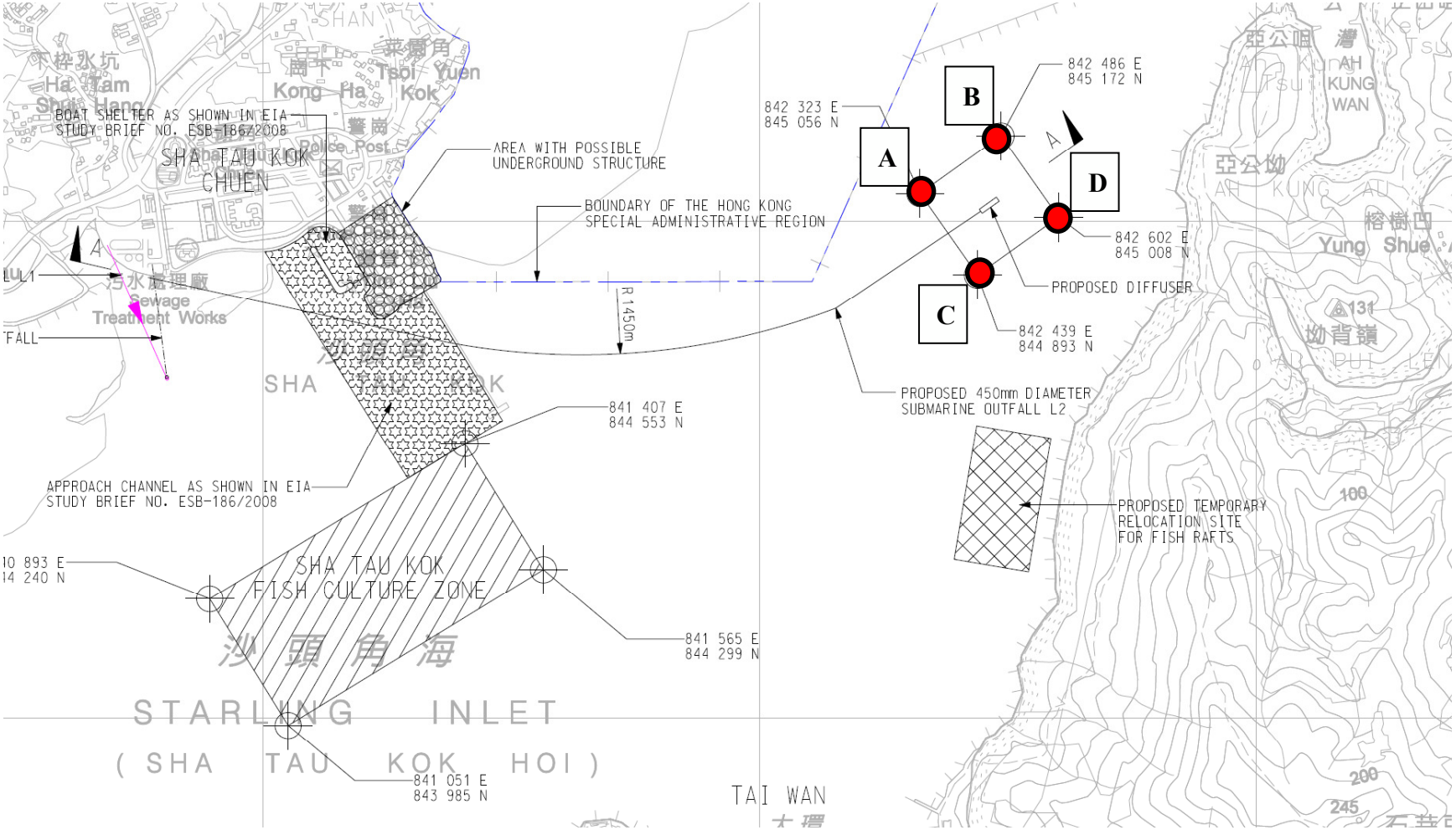

Figure 3.1 *Location of sampling sites (red dot, A-D) (map borrowed from Mott MacDonald Hong Kong Ltd.)*

Figure 3.2. *Photographic record of the environment around the sampling sites.*

4 Results

4.1 Sediment quality

Table 4.1 and figure 4.1 show the sediment texture and colour at every sampling site. In both months of sampling, the sediments were grey, soft mud with a thin, brown surface layer at all sampling sites. Mild level of hydrogen sulphite smell was detected from sediments at all sampling sites on board. It indicated moderate content of organic matter inside the sediments.

4.2 Benthic baseline

Table 4.2 lists the total abundance and total biomass of every phylum. A total of 56 and 48 specimens were collected in October 2014 and November 2014 respectively. Ten of 12 taxa were identified to genus or species levels. In general the most diverse phylum was Annelida (8 polychaete taxa) while the rest was Arthropoda (1 amphipod taxon + 1 crab taxon), Mollusca (1 bivalve taxon) and Nemertea (1 taxon). All recorded species were common with no conservation interest. The complete list of collected specimens is provided in Appendix II.

For the sampling of October 2014, the common taxa were Mollusca (34 ind., relative abundance 61%) and Annelida (21 ind., 38%) relatively. Arthropoda was very few in abundance (1 ind. 2%). The total biomass was 90.2261 g that was mainly accounted by Mollusca (89.6308 g, 99%). For the sampling of November 2014, the common taxa were Annelida (23 ind., 48%) and Mollusca (22 ind., 46%) relatively. Arthropoda (2 ind. 4%) and Nemertea (1 ind. 2%) were very few in abundance. The total biomass was 67.1544 g that was mainly accounted by Mollusca (67.0091 g, ~100%).

Table 4.3 shows the abundance and relative abundance of each phylum at every sampling site. Every sampling site was low in total abundance (7-21 ind.) in both months of sampling. No phylum was found abundant. Relatively the common taxa were Annelida (Oct.: 2-8 ind., relative abundance 19-58%; Nov.: 3-13 ind., 30-68%;) and Mollusca (Oct.: 5-17 ind., 42-81%; Nov.: 3-7 ind., 16-70%) across the sampling sites. No difference was found between two sampling months.

Table 4.4 lists the five most abundant taxa at every sampling site in the sampling of October 2014. As mentioned above, the total abundances of all sampling sites were low hence no single taxon could be regarded as dominant. In general, bivalve *Paphia undulata* (17-57 ind. m^{-2}, 42-81%) and polychaete *Sigambra hanaokai* (7-13 ind. m^{-2}, 10-25%) were the commonly occurring taxa.

Table 4.5 lists the five most abundant taxa at every sampling site in the sampling of November 2014. No single taxon could be regarded as dominant. In general, bivalve *Paphia undulata* (10-23 ind. m^{-2}, 16-70%) and polychaete *Sigambra hanaokai* (3-27 ind. m^{-2}, 10-42%) were the commonly occurring taxa. Besides polychaete *Linopherus paucibranchiata* (17 ind. m^{-2}, 26%) was common at sampling site D.

Table 4.6 shows the number of species, density, biomass, *H'*, *J* and *W* statistic at every sampling site. No obvious change was found between two sampling months. In October 2014, the number of species was very low and ranged 3-6 spp. 0.3 m^{-2} among all sampling sites. Site C (70 ind. m^{-2}) was higher in density relative to other sites (23-53 ind. m^{-2}). The values of *H'*

at sites A and B were low (1.42-1.49) while that at sites C and D were very low (0.68-0.80). The biomass ranged 37.14-139.57 g m^{-2} among the sampling sites. The difference was mainly due to varying abundances of commonly occurring bivalve *Paphia undulata* (density: 17-57 ind. m^{-2}, biomass: 37.10-139.55 g m^{-2}).

In November 2014, the number of species (4-5 spp. 0.3 m^{-2}) was very low at all sampling sites. Site D (63 ind. m^{-2}) was higher in density relative to other sites (30-33 ind. m^{-2}). The values of *H'* at sites A and D were low (1.15-1.40) while that at sites B and C were very low (0.94). The biomass ranged 32.97-82.71 g m^{-2} among the sampling sites. Similar to the sampling of October, the difference was due to varying abundances of bivalve *Paphia undulata* (density: 10-23 ind. m^{-2}, biomass: 32.54-82.68 g m^{-2}).

Since the total abundance was low at every site regardless of sampling months, the distribution of taxa would be seen quite even. It resulted in unrealistically moderate to high values of *J* (0.49-0.88).

The *W* statistic values generated by ABC method were positive at all sampling sites (Fig. 4.2). In October 2014, site C was at 'moderately disturbed' level (*W* statistic 0.22) while other sites were at 'slightly disturbed' level (0.43-0.58). In November 2014, all sites were at 'slightly disturbed' level (0.40-0.55).

Table 4.1. *Sediment texture and colour at every sampling site*

Site	Sediment texture		Sediment colour		Level of sulphite smell		Remark
	Oct. 2014	Nov. 2014	Oct. 2014	Nov. 2014	Oct. 2014	Nov. 2014	
A	Soft mud	Soft mud	Grey with brown surface	Grey with brown surface	Mild	Mild	\
B	Soft mud	Soft mud	Grey with brown surface	Grey with brown surface	Mild	Mild	\
C	Soft mud	Soft mud	Grey with brown surface	Grey with brown surface	Mild	Mild	\
D	Soft mud	Soft mud	Grey with brown surface	Grey with brown surface	Mild	Mild	\

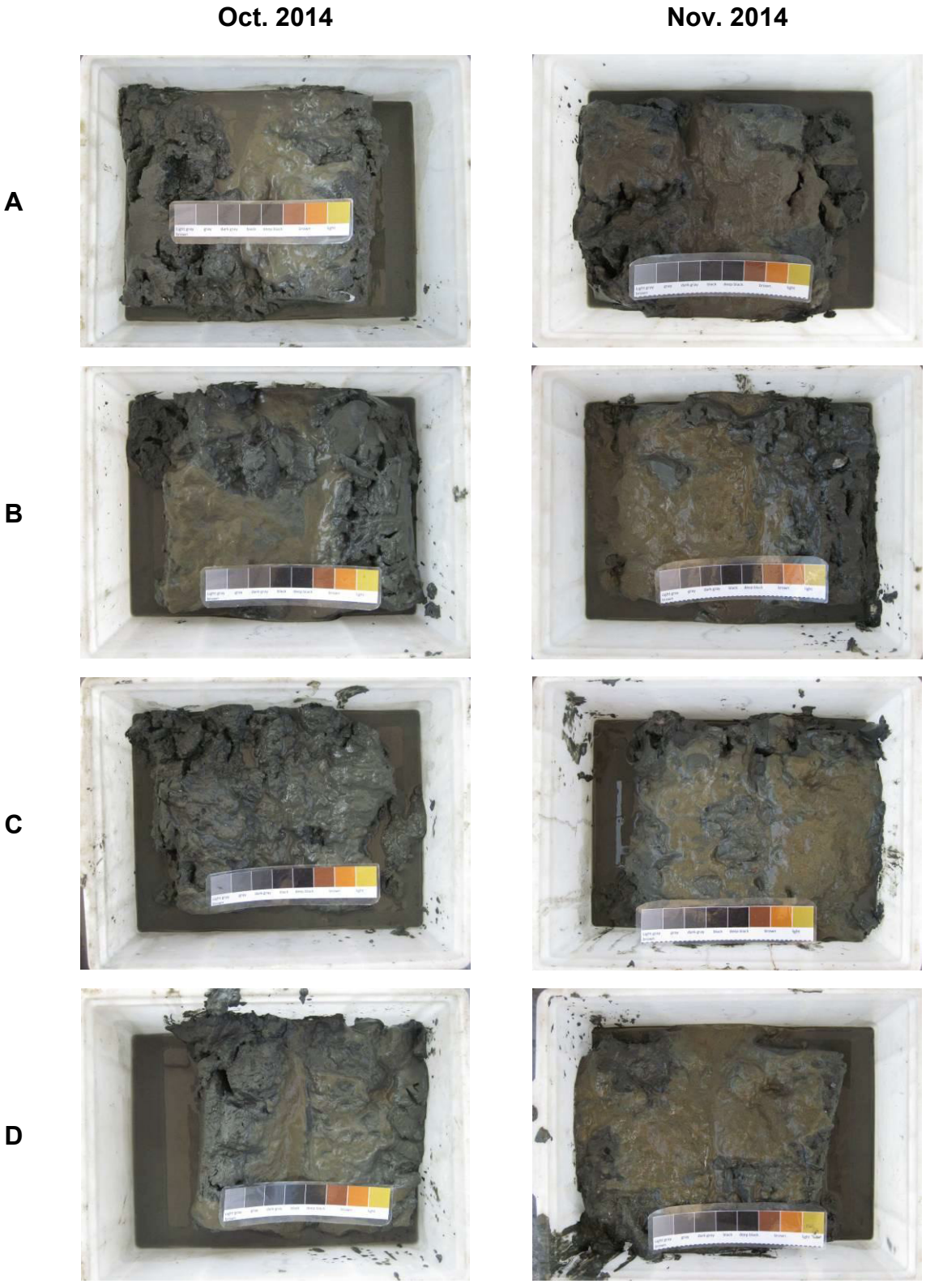

Figure 4.1. *Photographic record of sediment at every sampling site*

Table 4.2. *Total abundance and total biomass of every phylum*

Phylum	Abundance (ind.)	%	Biomass (g)	%
October 2014				
Mollusca	34	61	89.6308	99
Annelida	21	38	0.0382	0
Arthropoda	1	2	0.5571	1
sub-total	**56**		**90.2261**	
November 2014				
Annelida	23	48	0.1435	0
Mollusca	22	46	67.0091	100
Arthropoda	2	4	0.0006	0
Nemertea	1	2	0.0012	0
sub-total	**48**		**67.1544**	
Total	**104**		**157.3805**	

0 %: total individual / biomass of the phylum is less than 1% of that of all specimens

Table 4.3. *The abundance and relative abundance (percentage) of each phylum at every sampling site*

	Oct. 2014								Nov. 2014							
Sampling site	**A**	**%**	**B**	**%**	**C**	**%**	**D**	**%**	**A**	**%**	**B**	**%**	**C**	**%**	**D**	**%**
Phylum																
Annelida	7	58	8	50	4	19	2	29	4	44	3	30	3	30	13	68
Arthropoda			1	6											2	11
Mollusca	5	42	7	44	17	81	5	71	5	56	7	70	7	70	3	16
Nemertea															1	5
Total	12		16		21		7		9		10		10		19	

0 %: Relative abundance of the phylum is less than 1% of that of all specimens

Table 4.4. *The five most abundant taxa at every sampling site in the sampling of October 2014.*

Sampling site	Group	Species	Density (ind. m^{-2})	Biomass (g m^{-2})	Relative abundance (%)
A	B	*Paphia undulata*	17	53.93	42
	P	*Sigambra hanaokai*	10	0.01	25
	P	*Tharyx* sp.	7	0.01	17
	P	*Aglaophamus sinensis*	3	0.02	8
	P	*Pista* sp.	3	0.02	8
B	B	*Paphia undulata*	23	68.18	44
	P	*Sigambra hanaokai*	13	0.01	25
	P	*Otopsis* sp.	7	0.00	13
	P	*Tharyx* sp.	3	0.01	6
	C	*Typhlocarcinops denticarpus*	3	1.86	6
C	B	*Paphia undulata*	57	139.55	81
	P	*Sigambra hanaokai*	7	0.00	10
	P	*Otopsis* sp.	3	0.00	5
	P	*Aglaophamus sinensis*	3	0.01	5
D	B	*Paphia undulata*	17	37.10	71
	P	*Aglaophamus sinensis*	3	0.02	14
	P	*Linopherus paucibranchiata*	3	0.01	14

B = Bivalve, C = Crab, P = Polychaete

0.00 g m^{-2}: biomass of the taxon is less than 0.01 g m^{-2} at the sampling site

Table 4.5. *The five most abundant taxa at every sampling site in the sampling of November 2014.*

Sampling site	Group	Species	Density (ind. m^{-2})	Biomass (g m^{-2})	Relative abundance (%)
A	B	*Paphia undulata*	17	47.57	56
	P	*Tharyx* sp.	7	0.00	22
	P	*Otopsis* sp.	3	0.00	11
	P	*Sigambra hanaokai*	3	0.00	11
B	B	*Paphia undulata*	23	60.58	70
	P	*Tharyx* sp.	3	0.00	10
	P	*Sigambra hanaokai*	3	0.00	10
	P	*Paramphicteis angustifolia*	3	0.00	10
C	B	*Paphia undulata*	23	82.68	70
	P	*Sigambra hanaokai*	3	0.00	10
	P	*Otopsis* sp.	3	0.00	10
	P	*Aglaophamus sinensis*	3	0.03	10
D	P	*Sigambra hanaokai*	27	0.02	42
	P	*Linopherus paucibranchiata*	17	0.41	26
	B	*Paphia undulata*	10	32.54	16
	A	*Corophium* sp.	7	0.00	11
	N	Nemertea spp.	3	0.00	5

A= Amphipod, B = Bivalve, N = Nemertea, P = Polychaete

0.00 g m^{-2}: biomass of the taxon is less than 0.01 g m^{-2} at the sampling site

Table 4.6. *Number of species, density, biomass, Shannon-Weaver Diversity Index (H'), Pielou's Species Evenness (J) and W statistic at every sampling site*

	Oct. 2014				Nov. 2014			
	A	**B**	**C**	**D**	**A**	**B**	**C**	**D**
Number of species (spp. 0.3 m^{-2})	5	6	4	3	4	4	4	5
Density (ind. m^{-2})	40	53	70	23	30	33	33	63
Biomass (g m^{-2})	53.99	70.06	139.57	37.14	47.58	60.58	82.71	32.97
Shannon-Weaver Diversity Index *H'*	1.42	1.49	0.68	0.80	1.15	0.94	0.94	1.40
Pielou's Species Evenness *J*	0.88	0.83	0.49	0.72	0.83	0.68	0.68	0.87
***W* statistic**	0.58	0.49	0.22	0.43	0.52	0.40	0.40	0.55

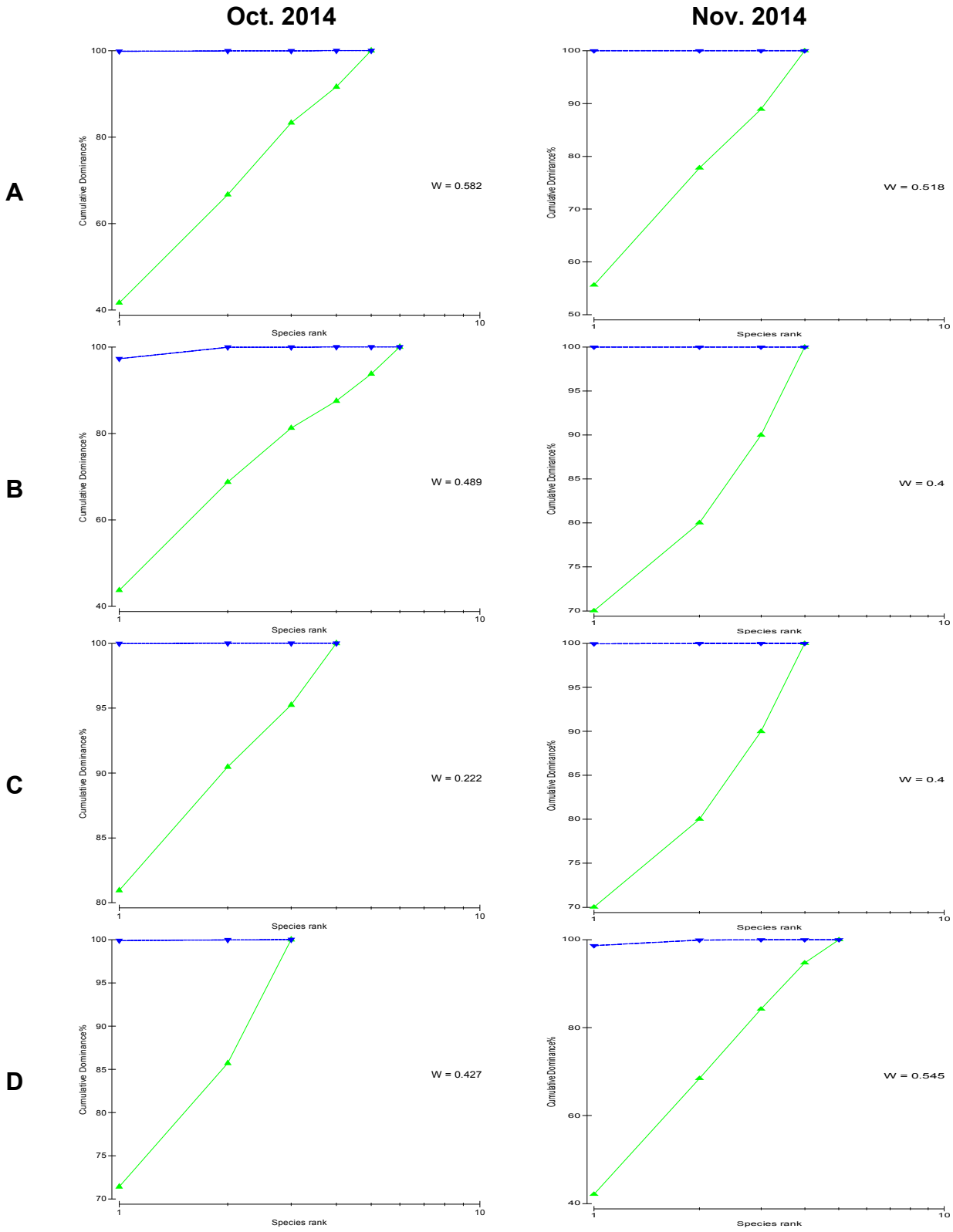

Figure 4.2. *ABC plots of every sampling site (blue ▼ with dotted line: biomass curve; green ▲ with solid line: abundance curve)*

5 Discussion

5.1 Sediment quality

Sha Tau Kok Sea locates within the northern part of Mirs Bay Water Control Zone (WCZ) that is the largest WCZ at the east of Hong Kong. According to the latest Marine Water Quality Report 2013, the water temperature, salinity and dissolved oxygen (DO) of bottom water layer ranged 18.4-29.1 °C, 28.7-32.6 ppt and 2.6-9.6 mg/L O_2 respectively (data from closest monitoring station Starling Inlet MM1).

From 2011 to 2013, the Mirs Bay WCZ has achieved desirable compliance rate (98-100%) of Water Quality Objective (WQO) (EPD, 2012, 2013, 2014). Although all water quality parameters fulfilled the WQO, long term data indicated an increasing trend of total inorganic nitrogen from 2009 to 2013 (EPD, 2014). It was possibly due to increased shipping and port activities.

Focused on Sha Tau Kok Sea, the water quality was worse than other areas within the WCZ. The annual average concentrations of *E. coli* (10 counts/100ml), faecal coliforms (21 counts/100ml) and chlorophyll-*a* (4.9 μg/L) were much higher than that of other monitoring stations of Mirs Bay WCZ (*E. coli*: 1-2 counts/100ml; faecal coliforms: 1-2 counts/100ml; chlorophyll-*a*: 1.0-3.6 μg/L) (details see EPD, 2014). The pollution source was possibly the cross-border sewage discharge from Shenzhen, mainland China. Although there was a sewage outfall of Sha Tau Kok STW, the treated effluent had undergone biological treatment and disinfection. The treated effluent should not have leaded to significant deterioration of water and sediment quality in Sha Tau Kok Sea.

There is a designated fish culture zone with fish raft area 10,001-20,000 m^2 in Sha Tau Kok Sea (EPD, 2014). Accumulation of organic wastes from uneaten feed, faeces and dissolved excretory products leads to organic enrichment in the benthic environment under fish raft area and at vicinities (Gao *et al.*, 2005). The degradation of organic matter depletes the dissolved oxygen in the sediment and bottom water layer (Pearson and Rosenberg, 1978; Gray *et al.*, 2002). Since the fish rafts were about 1300 m west from the present survey area, the adverse effects on benthic community were believed neglectable.

Based on the sediment colour and odour, mild but long-term organic enrichment was indicated in the survey area. Weak tidal flushing and non-shallow water (water depth: 5.6-6.4 m) could not mitigate the condition. Along with the increased water temperature during wet season, the oxygen solubility would decrease. Temporary hypoxic condition (<2.8 mg/L O2 (Gray *et al*., 2002)) is predicted to occur. In 2012, the DO concentration maintained above 5 mg/L in the bottom water layer but it dropped to 4.3 mg/L in July (EPD, 2013). Similar pattern was found in 2013. The DO concentration maintained above 4 mg/L in the bottom water layer but hypoxia (2.6 mg/L) was detected in August (EPD, 2014).

5.2 Benthic Baseline

The benthic communities inhabited in soft mud and were similar among the sampling sites. It was characterized of low biodiversity value and density without dominant taxa. It was possibly affected by long-term organic enrichment.

The positive *W* statistic values indicated benthic communities of the survey area existed at 'slightly disturbed' level generally. However the real situation should be worse. Since only

few individuals of bivalve *Paphia undulata* were collected, its biomass was relatively much higher than those few, small-sized polychaetes. For ABC method, such data pattern increased the extent to which the biomass curve lies above the abundance curve, thus resulting in positive *W* statistic value that might not be representative enough.

5.3 Comparison of biodiversity

The benthic community was spatially divided into four groups in Hong Kong waters (Tolo Harbour, Eastern and Southern waters, Victoria Harbour, Deep Bay) (Shin *et al*., 2004) according to a territory-wide survey conducted by CPSL (2002). Waters of 'Eastern and Southern waters' group was characterized as unpolluted while that of other groups suffered from long-term sewage pollution (details see EPD, 2006). Table 5.1 shows the mean *H'* and *J* of benthic communities of the four groups, sampling sites in Sha Tau Kok Sea of previous and present surveys. The biodiversity and species evenness of benthic communities of present survey were similar to the polluted water group 'Tolo Harbour'. It reflected the presence of long-term stress of organic enrichment. By comparing with other previous surveys conducted in Sha Tau Kok Sea, the biodiversity in more exposed (located closer to the opening of Sha Tau Kok Sea), deeper water (depth > 4 m) were lower than that in more protected (located more inshore), shallower water (depth < 3 m). It was believed shallower water facilitates the aeration of sediments in calm condition.

5.4 Ecological value of Sha Tau Kok Sea

Table 5.2 lists the criteria of evaluating the benthic environment of present survey area in Sha Tau Kok Sea according to EPD (1997). The ecological value of the benthic communities was graded 'Low'. The benthic communities were low in species number and abundance, resulting

in overall low biodiversity. No species of conservation interest was collected. Mild but long-term organic enrichment was the cause.

There were three mangroves Sha Tau Kok, Nam Chung and Luk Keng inside Sha Tau Kok Sea. But the ecological linkage with the present survey area was insignificant.

Table 5.1. *Comparison of mean H' and J of benthic communities between present sampling sites in Sha Tau Kok Sea, vicinal sampling sites and other water zones of previous studies*

	Opening of Sha Tau Kok Sea More exposed, Deeper water (> 4 m)		**Inshore of Sha Tau Kok Sea Less exposed, Shallower water (< 3 m)**		**Territory-wide survey**			
	Site A-D	**Vicinal sampling sites B9-B10**	**Vicinal sampling sites B1-B4**	**Vicinal sampling sites B1-B2**	**Tolo Harbour**	**Eastern and Southern waters**	**Victoria Harbour**	**Deep Bay**
Reference	Present survey	Neanthes, 2009	Neanthes, 2014	Neanthes, 2012	Shin *et al*., 2004			
Mean *H'*	1.10	1.55	2.31	2.35	1.39	2.85	1.72	1.89
Mean *J*	0.75	0.60	0.74	0.71	0.78	0.82	0.46	0.63

Table 5.2. *Criteria for evaluating the benthic environment in Sha Tau Kok Sea*

Criteria	Remarks
Naturalness	Soft and muddy substratum All sampling sites were under long term, mild organic enrichment.
Size	Large in size
Diversity	Low species number and abundance leaded to low biodiversity at all sampling sites.
Rarity	Neither rare species nor species of conservation importance was recorded.
Re-creatability	Non-creatable
Fragmentation	Not fragmented
Ecological linkage	Sha Tau Kok, Nam Chung and Luk Keng mangroves locates within Sha Tau Kok Sea. But the ecological linkage with the present survey area was insignificant.
Potential value	Low
Nursery/breeding ground	No significant nursery or breeding ground recorded.
Age	Ancient
Abundance/Richness of wildlife	Benthic community in low abundance.
Ecological value	**Low**

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Appendix I *Photographic Records*

■ The sediment sample was collected with 0.1 m^2 van Veen grab

■ The collected sediments were washed with gentle seawater through a sieve stacks of mesh sizes 1.0 mm and 0.5 mm

■ The preserved macrofauna in sediment residues was sorted out in laboratory

■ Taxonomic identification was undertaken with the aid of both stereoscopic and compound microscopes.

Appendix II *List of collected specimens at every sampling site*

Sampling site: A		Sampling date: 18/10/2014								
No	Group	Species	1		2		3		row sum	
			ind.	wt.	ind.	wt.	ind.	wt.	ind.	wt.
1	B	*Paphia undulata*	1	3.67	4	12.51			5	16.18
2	P	*Aglaophamus sinensis*					1	0.01	1	0.01
3	P	*Pista* sp.	1	0.01					1	0.01
4	P	*Sigambra hanaokai*			1	0.00	2	0.00	3	0.00
5	P	*Tharyx* sp.					2	0.00	2	0.00
									0	0.00
		column sum	2	3.67	5	12.51	5	0.01	12	16.20

B = Bivalve, P = Polychaete

ind. = no. of individual / 0.1 m^2; wt. = wet weight, g / 0.1 m^2

wt = 0.00 g / 0.1 m^2 : The specimen with total biomass less than 0.01 g / 0.1 m^2

Appendix II (Cont'd) *List of collected specimens at every sampling site*

Sampling site: B		Sampling date: 18/10/2014								
No	Group	Species	1		2		3		row sum	
			ind.	wt.	ind.	wt.	ind.	wt.	ind.	wt.
1	B	*Paphia undulata*	1	3.55	5	12.78	1	4.13	7	20.45
2	C	*Typhlocarcinops denticarpus*					1	0.56	1	0.56
3	P	Maldanidae spp.					1	0.00	1	0.00
4	P	*Otopsis* sp.					2	0.00	2	0.00
5	P	*Sigambra hanaokai*	2	0.00			2	0.00	4	0.00
6	P	*Tharyx* sp.	1	0.00					1	0.00
									0	0.00
		column sum	4	3.55	5	12.78	7	4.69	16	21.02

B = Bivalve, C = Crab, P = Polychaete

ind. = no. of individual / 0.1 m^2; wt. = wet weight, g / 0.1 m^2

wt = 0.00 g / 0.1 m^2 : The specimen with total biomass less than 0.01 g / 0.1 m^2

Appendix II (Cont'd) *List of collected specimens at every sampling site*

Sampling site: C		Sampling date: 18/10/2014								
No	Group	Species	1		2		3		row sum	
			ind.	wt.	ind.	wt.	ind.	wt.	ind.	wt.
1	B	*Paphia undulata*	8	17.76	4	8.72	5	15.39	17	41.87
2	P	*Aglaophamus sinensis*			1	0.00			1	0.00
3	P	*Otopsis* sp.			1	0.00			1	0.00
4	P	*Sigambra hanaokai*	1	0.00	1	0.00			2	0.00
									0	0.00
		column sum	9	17.76	7	8.72	5	15.39	21	41.87

B = Bivalve, P = Polychaete

ind. = no. of individual / 0.1 m^2; wt. = wet weight, g / 0.1 m^2

wt = 0.00 g / 0.1 m^2 : The specimen with total biomass less than 0.01 g / 0.1 m^2

Appendix II (Cont'd) *List of collected specimens at every sampling site*

Sampling site: D		Sampling date: 18/10/2014								
No	Group	Species	1		2		3		row sum	
			ind.	wt.	ind.	wt.	ind.	wt.	ind.	wt.
1	B	*Paphia undulata*	1	4.22	1	0.70	3	6.22	5	11.13
2	P	*Aglaophamus sinensis*			1	0.01			1	0.01
3	P	*Linopherus paucibranchiata*	1	0.00					1	0.00
									0	0.00
		column sum	2	4.22	2	0.70	3	6.22	7	11.14

B = Bivalve, P = Polychaete

ind. = no. of individual / 0.1 m^2; wt. = wet weight, g / 0.1 m^2

wt = 0.00 g / 0.1 m^2 : The specimen with total biomass less than 0.01 g / 0.1 m^2

Appendix II (Cont'd) *List of collected specimens at every sampling site*

Sampling site: A		Sampling date: 22/11/2014								
No	Group	Species	1		2		3		row sum	
			ind.	wt.	ind.	wt.	ind.	wt.	ind.	wt.
1	B	*Paphia undulata*	1	4.81	3	8.36	1	1.10	5	14.27
2	P	*Otopsis* sp.			1	0.00			1	0.00
3	P	*Sigambra hanaokai*			1	0.00			1	0.00
4	P	*Tharyx* sp.			2	0.00			2	0.00
		column sum	1	4.81	7	8.37	1	1.10	9	14.27

B = Bivalve, P = Polychaete

ind. = no. of individual / 0.1 m^2; wt. = wet weight, g / 0.1 m^2

wt = 0.00 g / 0.1 m^2 : The specimen with total biomass less than 0.01 g / 0.1 m^2

Appendix II (Cont'd) *List of collected specimens at every sampling site*

Sampling site: B			Sampling date: 22/11/2014							
No	Group	Species	1		2		3		row sum	
			ind.	wt.	ind.	wt.	ind.	wt.	ind.	wt.
1	B	*Paphia undulata*	3	8.07	3	6.60	1	3.50	7	18.17
2	P	*Paramphicteis angustifolia*					1	0.00	1	0.00
3	P	*Sigambra hanaokai*	1	0.00					1	0.00
4	P	*Tharyx* sp.					1	0.00	1	0.00
		column sum	4	8.07	3	6.60	3	3.50	10	18.18

B = Bivalve, P = Polychaete

ind. = no. of individual / 0.1 m^2; wt. = wet weight, g / 0.1 m^2

wt = 0.00 g / 0.1 m^2 : The specimen with total biomass less than 0.01 g / 0.1 m^2

Appendix II (Cont'd) *List of collected specimens at every sampling site*

Sampling site: C		Sampling date: 22/11/2014								
No	Group	Species	1		2		3		row sum	
			ind.	wt.	ind.	wt.	ind.	wt.	ind.	wt.
1	B	*Paphia undulata*			4	12.69	3	12.12	7	24.80
2	P	*Aglaophamus sinensis*					1	0.01	1	0.01
3	P	*Otopsis* sp.					1	0.00	1	0.00
4	P	*Sigambra hanaokai*			1	0.00			1	0.00
		column sum	0	0.00	5	12.69	5	12.12	10	24.81

B = Bivalve, P = Polychaete

ind. = no. of individual / 0.1 m^2; wt. = wet weight, g / 0.1 m^2

wt = 0.00 g / 0.1 m^2 : The specimen with total biomass less than 0.01 g / 0.1 m^2

Appendix II (Cont'd) *List of collected specimens at every sampling site*

Sampling site: D		Sampling date: 22/11/2014								
No	Group	Species	1		2		3		row sum	
			ind.	wt.	ind.	wt.	ind.	wt.	ind.	wt.
1	A	*Corophium* sp.					2	0.00	2	0.00
2	B	*Paphia undulata*	1	3.06	2	6.70			3	9.76
3	N	Nemertea spp.					1	0.00	1	0.00
4	P	*Linopherus paucibranchiata*					5	0.12	5	0.12
5	P	*Sigambra hanaokai*					8	0.01	8	0.01
		column sum	1	3.06	2	6.70	16	0.13	19	9.89

A = Amphipod, B = Bivalve, N = Nemertean, P = Polychaete

ind. = no. of individual / 0.1 m^2; wt. = wet weight, g / 0.1 m^2

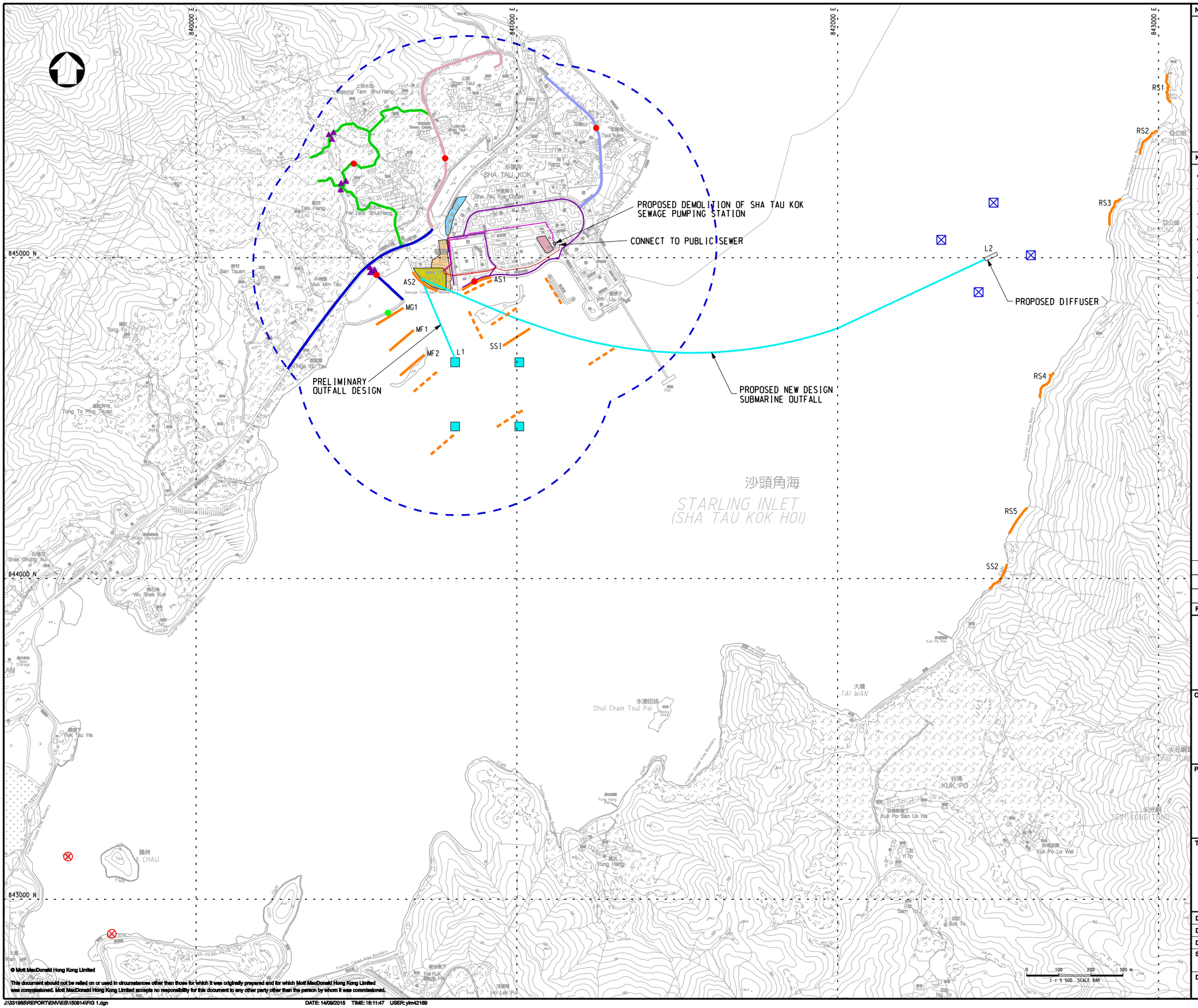
wt = 0.00 g / 0.1 m^2 : The specimen with total biomass less than 0.01 g / 0.1 m^2

Appendix III Taxonomic resolution of every collected species

Kingdom	Phylum	Class	Order	Family	Species
Animalia	Annelida	Polychaeta	Amphinomida	Amphinomidae	*Linopherus paucibranchiata*
Animalia	Annelida	Polychaeta	Phyllodocida	Nephtyidae	*Aglaophamus sinensis*
Animalia	Annelida	Polychaeta	Phyllodocida	Pilargidae	*Otopsis* sp.
Animalia	Annelida	Polychaeta	Phyllodocida	Pilargidae	*Sigambra hanaokai*
Animalia	Annelida	Polychaeta	Terebellida	Ampharetidae	*Paramphicteis angustifolia*
Animalia	Annelida	Polychaeta	Terebellida	Cirratulidae	*Tharyx* sp.
Animalia	Annelida	Polychaeta	Terebellida	Terebellidae	*Pista* sp.
Animalia	Annelida	Polychaeta		Maldanidae	Maldanidae spp.
Animalia	Arthropoda	Malacostraca	Amphipoda	Corophiidae	*Corophium* sp.
Animalia	Arthropoda	Malacostraca	Decapoda	Goneplacidae	*Typhlocarcinops denticarpus*
Animalia	Mollusca	Bivalvia	Veneroida	Veneridae	*Paphia undulata*
Animalia	Nemertea				Nemertea spp.

- End of Report -

Figures



Notes

Key to symbols

- PROPOSED 500m ECOLOGY SURVEY AREA
- RM — DECOMMISSION OF EXISTING RISING MAIN
- PROPOSED SEWER BY TRENCHLESS METHOD
- PROPOSED GRAVITY SEWER
- PROPOSED SUBMARINE OUTFALL
- TRANSECT ROUTE 1
- TRANSECT ROUTE 2
- TRANSECT ROUTE 3
- TRANSECT ROUTE 4
- TRANSECT ROUTE 5
- SURVEY LOCATION FOR INTERTIDAL COMMUNITY
- SURVEY LOCATION FOR SPOT DIVE CHEK FOR SUDTIDAL CORAL
- PROPOSED MODIFICATION / UPGRADING OF SEWAGE TREATMENT WORKS
- PROPOSED SITE FOR EXPANSION OF SHA TAU KOK SEWAGE TREATMENT WORKS
- PROPOSED RELOCATION SITE FOR POLICE OPERATION BASE
- PROPOSED TEMPORARY WORKS AREA
- SAMPLING POINT FOR AVIFAUNA, BUTTERFLIES AND ODONATES
- SAMPLING POINT FOR AVIFAUNA USAGE ON MUDFLAT
- SAMPLING POINT FOR FRESHWATER AQUATIC FAUNA
- SURVEY SITE FOR SUDTIDAL BENTHOS
- ADDITIONAL SURVEY SITE FOR SUDTIDAL BENTHOS
- SURVEY POINTS FOR EGRETRY SURVEY

AS - ARTIFICIAL SEAWALL
MF - MUDFLAT
MG - MANGROVE
RS - ROCKY SHORE
SS - SANDY SHORE

Rev	Date	Drawn	Description	Ch'k'd	App'd
P3	SEP 15	MING	GENERAL REVISION	JT	JFP
P2	DEC 14	MING	GENERAL REVISION	JT	AFK
P1	MAR 14	MING	FIRST ISSUE	GC	AFK

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DRAINAGE SERVICES DEPARTMENT
GOVERNMENT OF THE
HONG KONG
SPECIAL ADMINISTRATIVE REGION

Project

ECOLOGICAL SURVEY FOR THE PROPOSED EXPANSION OF SHA TAU KOK SEWAGE TREATMENT WORKS

Title

PROPOSED TRANSECTS, SAMPLING LOCATIONS AND POINTS FOR ECOLOGICAL SURVEYS

Designed	JT		Eng check	GC	
Drawn	MING		Coordination	GC	
Dwg check	JT		Approved	JFP	
Scale at A1	1:5500	Status	PRE	Rev	P3

Drawing Number

FIGURE 1

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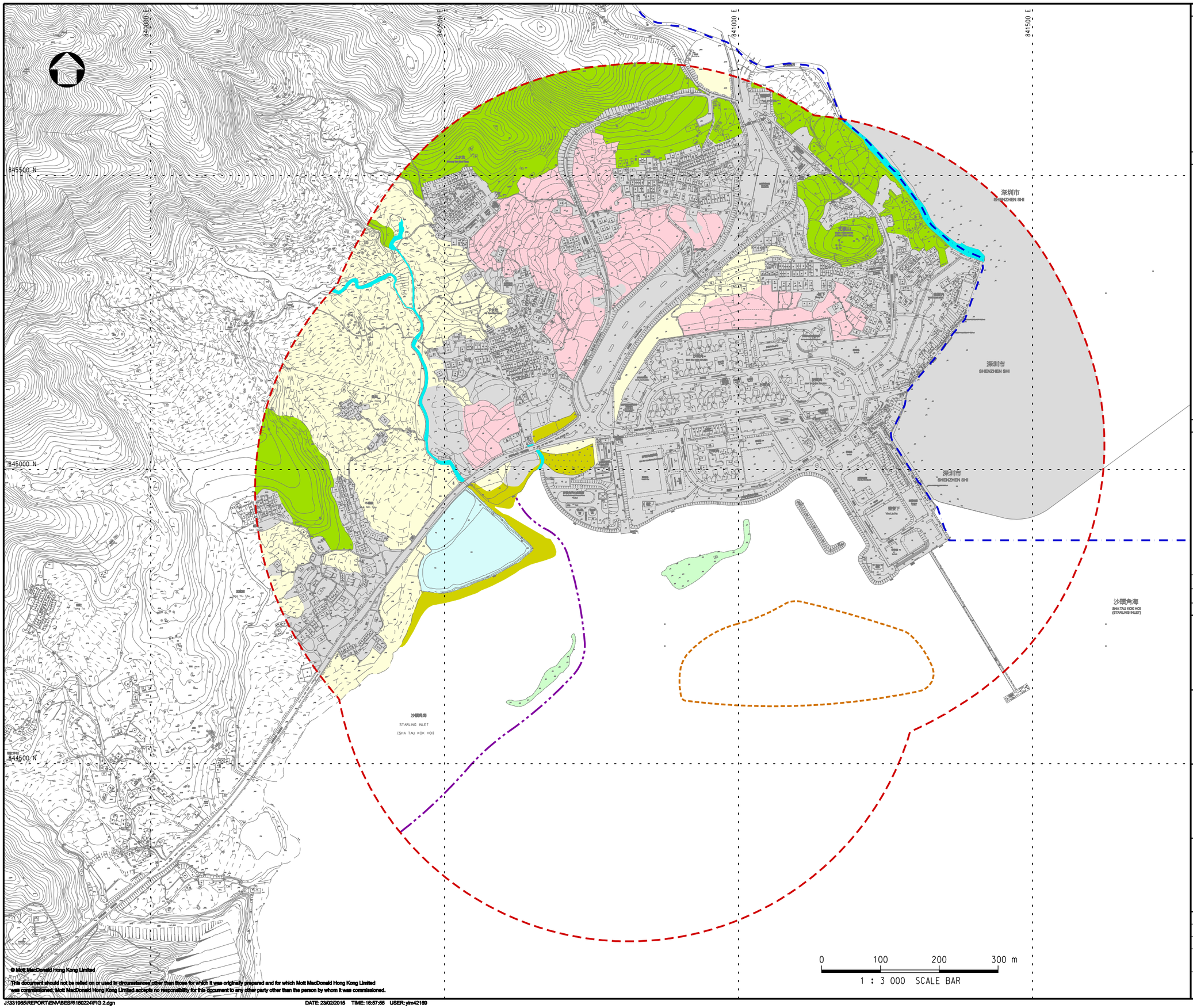

Notes

Key to symbols

- HKSAR BOUNDARY
- PROPOSED 500m ECOLOGY SURVEY AREA
- INDICATIVE BOUNDARY OF SANDFLAT
- INDICATIVE BOUNDARY OF MUDFLAT
- WOODLAND
- SHRUBLAND
- MANGROVE
- MARSH
- ABANDONED AGRICULTURAL LAND / LOW-LYING GRASSLAND
- POND
- STREAM / RIVER
- DEVELOPED AREA

Reference drawings

Rev	Date	Drawn	Description	Ch'k'd	App'd
P2	FEB 15	MING	GENERAL REVISION	JT	AFK
P1	DEC 14	MING	FIRST ISSUE	PK	AFK

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DRAINAGE SERVICES DEPARTMENT
GOVERNMENT OF THE
HONG KONG
SPECIAL ADMINISTRATIVE REGION

Project

ECOLOGICAL SURVEY FOR THE PROPOSED EXPANSION OF SHA TAU KOK SEWAGE TREATMENT WORKS

Title

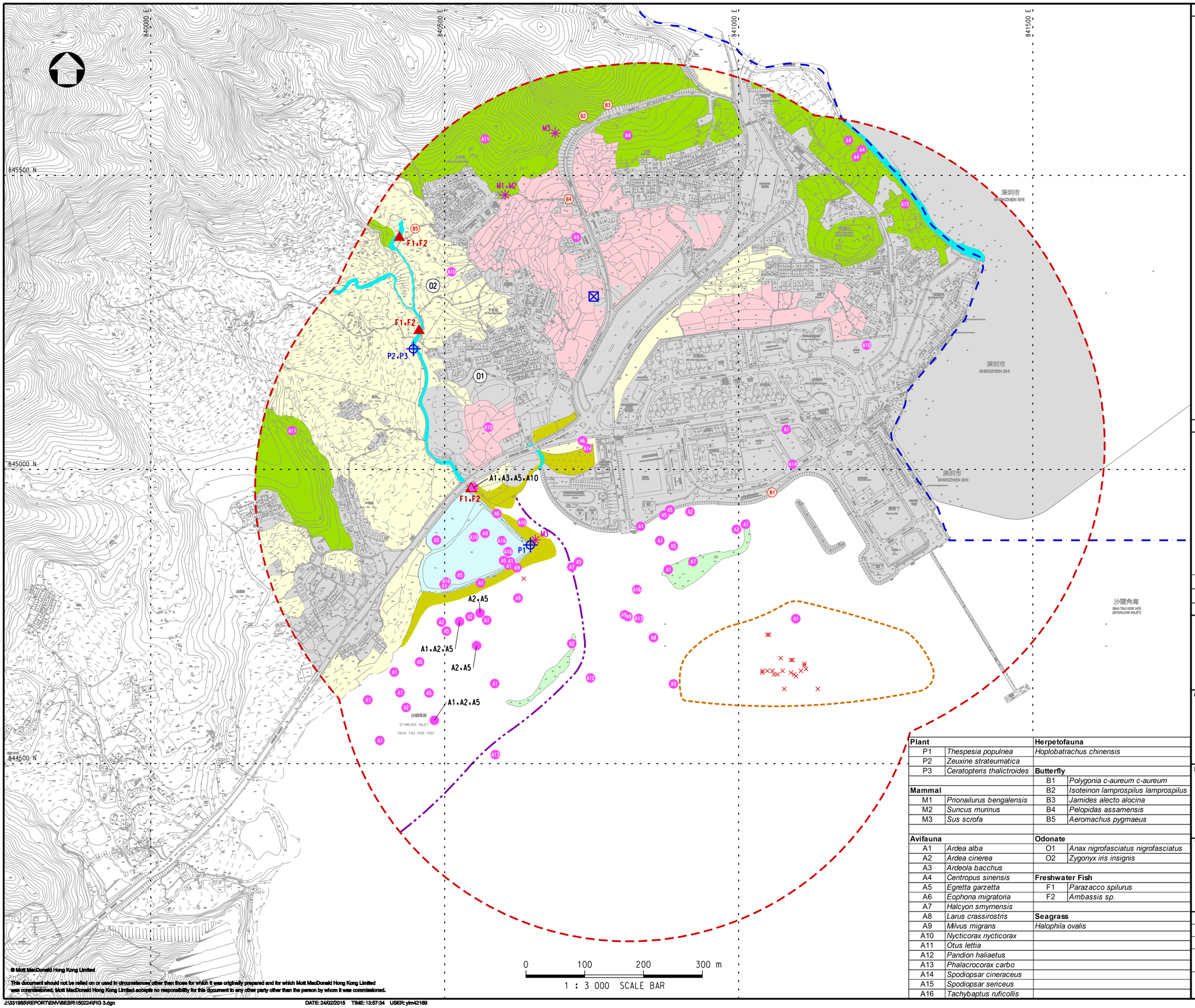
HABITAT MAP

Designed	PK		Eng check	GC	
Drawn	MING		Coordination	GC	
Dwg check	PK		Approved	AFK	

Scale at A1	Status	Rev
1:3000	PRE	P2

Drawing Number

FIGURE 2



Key to symbols

- HKSAR BOUNDARY
- PROPOSED 500m ECOLOGY SURVEY AREA
- INDICATIVE BOUNDARY OF SANDFLAT
- INDICATIVE BOUNDARY OF MUDFLAT
- WOODLAND
- SHRUBLAND
- MANGROVE
- MARSH
- ABANDONED AGRICULTURAL LAND / LOW-LYING GRASSLAND
- POND
- STREAM / RIVER
- DEVELOPED AREA
- PLANT
- BUTTERFLY (Bx)
- MAMMAL
- ODONATE (Ox)
- AVIFAUNA (Ax)
- FREAHWATER FISH
- HERPETOFAUNA
- SEAGRASS (×)

Reference drawings

Plant		Herpetofauna	
P1	*Thespesia populnea*	*Hoplobatrachus chinensis*	
P2	*Zeuxine strateumatica*		
P3	*Ceratopteris thalictroides*	**Butterfly**	
		B1	*Polygonia c-aureum c-aureum*
Mammal		B2	*Isoteinon lamprospilus lamprospilus*
M1	*Prionailurus bengalensis*	B3	*Jamides alecto alocina*
M2	*Suncus murinus*	B4	*Pelopidas assamensis*
M3	*Sus scrofa*	B5	*Aeromachus pygmaeus*
Avifauna		**Odonate**	
A1	*Ardea alba*	O1	*Anax nigrofasciatus nigrofasciatus*
A2	*Ardea cinerea*	O2	*Zygonyx iris insignis*
A3	*Ardeola bacchus*		
A4	*Centropus sinensis*	**Freshwater Fish**	
A5	*Egretta garzetta*	F1	*Parazacco spilurus*
A6	*Eophona migratoria*	F2	*Ambassis sp.*
A7	*Halcyon smymensis*		
A8	*Larus crassirostris*	**Seagrass**	
A9	*Milvus migrans*	*Halophila ovalis*	
A10	*Nycticorax nycticorax*		
A11	*Otus lettia*		
A12	*Pandion haliaetus*		
A13	*Phalacrocorax carbo*		
A14	*Spodiopsar cinereaceus*		
A15	*Spodiopsar sericeus*		
A16	*Tachybaptus ruficollis*		

Rev	Date	Drawn	Description	Ch'k'd	App'd
P2	FEB 15	MING	GENERAL REVISION	JT	AFK
P1	DEC 14	MING	FIRST ISSUE	JT	AFK

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DRAINAGE SERVICES DEPARTMENT
GOVERNMENT OF THE
HONG KONG
SPECIAL ADMINISTRATIVE REGION

Project

ECOLOGICAL SURVEY FOR THE PROPOSED EXPANSION OF SHA TAU KOK SEWAGE TREATMENT WORKS

Title

APPROXIMATE LOCATIONS OF SPECIES OF CONSERVATION CONCERN

Designed	JT		Eng check	GC	
Drawn	MING		Coordination	GC	
Dwg check	JT		Approved	AFK	
Scale at A1	1:3000	Status	PRE	Rev	P2

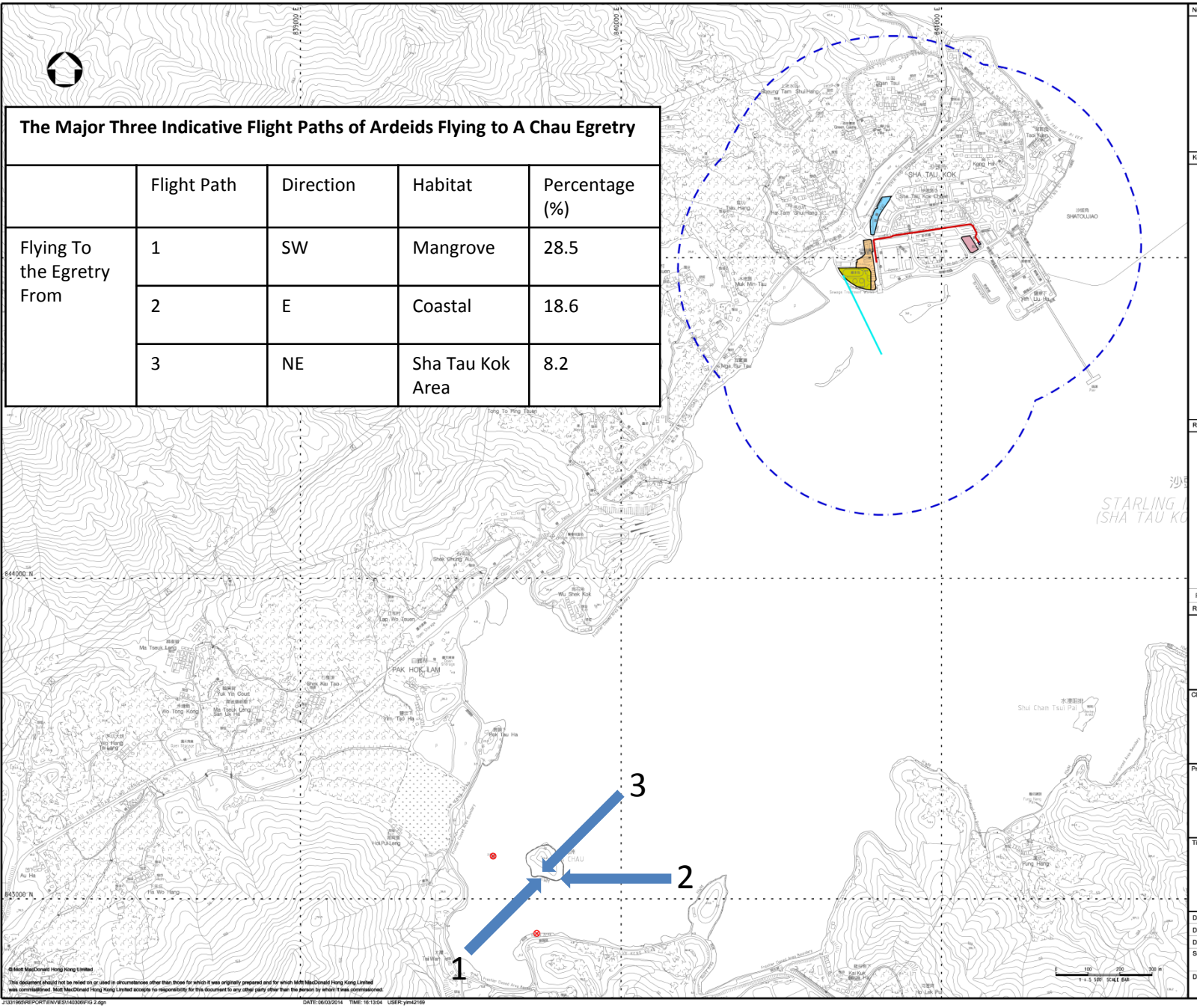
Drawing Number

FIGURE 3

J:\331985\REPORT\ENV\BESR\150224\FIG 3.dgn DATE: 24/02/2015 TIME: 13:57:34 USER: ylm42169

The Major Three Indicative Flight Paths of Ardeids Flying to A Chau Egretry

	Flight Path	Direction	Habitat	Percentage (%)
Flying To the Egretry From	1	SW	Mangrove	28.5
	2	E	Coastal	18.6
	3	NE	Sha Tau Kok Area	8.2



Notes

Key to symbols

- PROPOSED 500m ECOLOGY SURVEY AREA
- PROPOSED UPGRADING OF EXISTING RISING MAINS
- PROPOSED SUBMARINE OUTFALL
- PROPOSED MODIFICATION / UPGRADING OF SEWAGE TREATMENT WORKS
- PROPOSED SITE FOR EXPANSION OF SHA TAU KOK SEWAGE TREATMENT WORKS
- PROPOSED RELOCATION SITE FOR POLICE OPERATION BASE
- PROPOSED UPGRADING OF SEWAGE PUMPING STATION
- PROPOSED TEMPORARY WORKS AREA
- PROPOSED SURVEY POINTS FOR EGRETRY SURVEY

Reference drawings

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	MAR 14	MING	FIRST ISSUE	GC	AFK

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ECOLOGICAL SURVEY FOR THE PROPOSED EXPANSION OF SHA TAU KOK SEWAGE TREATMENT WORKS

Title

Major Indicative Flight Paths of the Ardeids Flying to A Chau Egretry

Designed	JT		Eng check	GC	
Drawn	MING		Coordination	GC	
Dwg check	JT		Approved	AFK	
Scale at A1 1:5500		Status PRE		Rev P1	

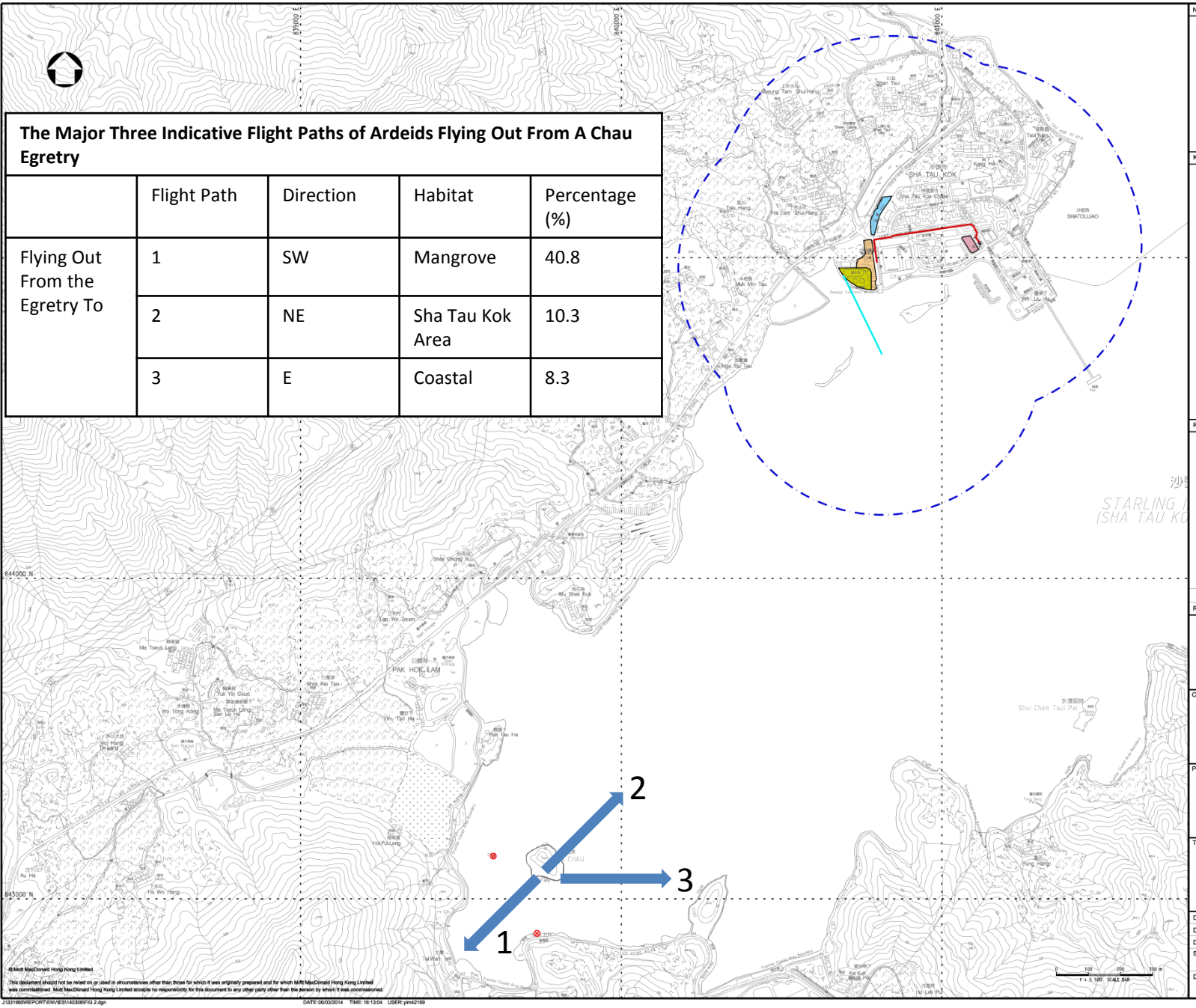
Drawing Number

FIGURE 4

J:\331965\REPORT\ENVIES\140306\FIG 2.dgn DATE:06/03/2014 TIME:16:13:04 USER:ymi42169

The Major Three Indicative Flight Paths of Ardeids Flying Out From A Chau Egretry

	Flight Path	Direction	Habitat	Percentage (%)
Flying Out From the Egretry To	1	SW	Mangrove	40.8
	2	NE	Sha Tau Kok Area	10.3
	3	E	Coastal	8.3



Notes

Key to symbols

- PROPOSED 500m ECOLOGY SURVEY AREA
- PROPOSED UPGRADING OF EXISTING RISING MAINS
- PROPOSED SUBMARINE OUTFALL
- PROPOSED MODIFICATION / UPGRADING OF SEWAGE TREATMENT WORKS
- PROPOSED SITE FOR EXPANSION OF SHA TAU KOK SEWAGE TREATMENT WORKS
- PROPOSED RELOCATION SITE FOR POLICE OPERATION BASE
- PROPOSED UPGRADING OF SEWAGE PUMPING STATION
- PROPOSED TEMPORARY WORKS AREA
- PROPOSED SURVEY POINTS FOR EGRETRY SURVEY

Reference drawings

Rev	Date	Drawn	Description	Ch'k'd	App'd
P1	MAR 14	MING	FIRST ISSUE	GC	AFK

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Project

ECOLOGICAL SURVEY FOR THE PROPOSED EXPANSION OF SHA TAU KOK SEWAGE TREATMENT WORKS

Title

Major Indicative Flight Paths of the Ardeids Flying Out From A Chau Egretry

Designed	JT		Eng check	GC	
Drawn	MING		Coordination	GC	
Dwg check	JT		Approved	AFK	
Scale at A1 1:5500		Status PRE		Rev P1	

Drawing Number

FIGURE 5

J:\331965\REPORT\ENVIES\140306\FIG 2.dgn DATE:06/03/2014 TIME:16:13:04 USER:ym42169