

## 10 ECOLOGICAL IMPACT

### 10.1 Introduction

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This chapter presents the Ecological Impact Assessment on any direct and indirect potential ecological impacts arising from the construction, operation, restoration and aftercare of the Project. Potential losses, damages, and impacts to flora, fauna and natural habitats, have been mitigated by means of compensation and rehabilitation of the natural environment. The potential ecological impact on the identified species and habitats was assessed to be acceptable with the implementation of mitigation measures such as woodland plantation, transplantation of species of conservation value, and habitat creation for bird species of conservation interest.

The ecological impact assessment has been conducted in accordance with the requirements of Annexes 8 and 16 of the TM-EIAO and the EIA Study Brief for the Project.

### 10.2 Relevant Legislation and Guidelines

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The HKSAR ordinances and regulations relevant to ecological assessment of this Project include the following:

- Forests and Countryside Ordinance (Cap. 96) and its subsidiary legislation, the Forestry Regulations (Cap. 96A);
- Town Planning Ordinance (Cap. 131);
- Wild Animals Protection Ordinance (Cap. 170);
- Protection of Endangered Species of Animals and Plants Ordinance (Cap. 586);
- Country Parks Ordinance (Cap. 208) and its subsidiary legislation;
- Marine Parks Ordinance (Cap 476); and
- Environmental Impact Assessment Ordinance ("the EIAO", Cap. 499) and the associated TM (EIAO-TM).

Ecological assessment will also make reference to the following guidelines and standards as well as international conventions:

- Hong Kong Planning Standards and Guidelines (HKPSG) Chapter 10, "Conservation";
- Ecological Baseline Survey For Ecological Assessment (EIAO Guidance Note No. 7/2002);
- Methodologies for Terrestrial and Freshwater Ecological Baseline Surveys (EIAO Guidance Note No. 10/2004);
- Methodologies for Marine Ecological Baseline Surveys (EIAO Guidance Note No. 11/2004);
- PELB Technical Circular 1/97 / Works Branch Technical Circular 4/97, "Guidelines for Implementing the Policy on Off-site Ecological Mitigation Measures";
- ETWB Technical Circular (Works) No. 5/2005, "Protection of natural streams/rivers from adverse impacts arising from construction works";
- Relevant wildlife protection laws in PRC;

- Convention on Wetlands of International Importance Especially as Waterfowl Habitat (the "Ramsar Convention"), which requires parties to conserve and make wise use of wetland areas, particularly those supporting waterfowl populations;
- United Nations Convention on Biological Diversity, which requires parties to regulate or manage biological resources important for the conservation of biological diversity, to promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings;
- International Union for Conservation of Nature and Natural Resources (IUCN) Red List of Threatened Species.

### **10.3 Key Ecological Issues**

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Key ecological issues of the EIA as stipulated in the EIA Study Brief include but not be limited to the following:

Important Habitats:

- Inter-tidal mudflat;
- Mangrove;
- Seagrass bed;
- Woodlands including the semi-mature woodland near Tsang Kok Stream;
- CLP ash lagoons;
- Natural stream courses and rivers (e.g. Tsang Kok Stream); and
- Inter-tidal and sub-tidal benthic communities.

Species of Conservation Concern:

- Sedge (*Carex leucochlora*);
- Pitcher's Plant (*Nepenthes mirabilis*); and
- Any other habitats and wildlife groups identified as having special conservation interests by this EIA study.

### **10.4 Results of Literature Review**

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#### **10.4.1 General**

In accordance with the EIA Study Brief, the ecological baseline shall include the following:

- Review and incorporate the findings of relevant studies;
- Carry out necessary field surveys, the duration of which shall be at least 6 months (covering wet and dry seasons), and investigation to verify the information collected, fill the information gaps identified and fulfil the objectives of the EIA study; and
- Establish an ecological profile of the study area based on data of relevant previous studies/surveys and results of additional ecological field surveys, and describe the characteristics of each habitat found.

The relevant studies include but are not limited to those listed in Section 3.4(i) to (iii) of the EIA Study Brief. These are:

- Planning Department's study on Sustainable Development for the 21st Century;
- Environmental baseline and monitoring & audit data of existing WENT Landfill;

- Final Strategic Environmental Assessment Report on Extension of Existing Landfills and Identification of Potential New Waste Disposal Sites conducted by Scott Wilson Ltd. (2003) (hereafter as Landfill SEA);
- EIA of Feasibility Study of Waste-to-Energy Facilities (WEF) conducted by CDMI (2000) (hereafter as WEF EIA);
- EIA of Additional Study of Waste-to-Energy Facilities (WEF) conducted by MWH (2003) (hereafter as Additional WEF EIA );
- Sludge Treatment Facilities (STF) - Environmental Study conducted by Metcalf and Eddy (2006) (hereafter as STF ES );
- Sludge Treatment Facilities (STF) - Feasibility Study conducted by Metcalf and Eddy (2008) (hereafter as STF EIA);
- EIA of Animal Carcass Treatment Facilities (ACTF) EIA conducted by ERM (2003) (hereafter as ACTF EIA);
- EIA of Liquefied Natural Gas (LNG) Receiving Terminal and Associated Facilities by ERM (2007) (hereafter as LNG EIA);
- Register of Sites of Special Scientific Interest (SSSIs). Loose-leaf document maintained by Planning Department, Hong Kong;
- The Terrestrial Biodiversity Survey conducted by HKU;
- Annual report and other publications of The Hong Kong Bird Watching Society (HKBWS);
- Memoirs of Hong Kong Natural History Society;
- Porcupine! – Newsletter of Department of Ecology & Biodiversity of University of Hong Kong;
- Hong Kong Biodiversity – Newsletter of AFCD;
- Databases for Chinese White Dolphin and Finless Porpoise from relevant literature and AFCD's routine cetacean surveys;
- The "Consultancy Study on Marine Benthic Communities in Hong Kong" commissioned by AFCD;
- Recent publications of AFCD;
- Ecological impact assessment and ecological monitoring of a strategic landfill: a case study in Hong Kong (Shea et al. 1995); and
- Waterfowl Count data of HKBWS.

#### **10.4.2 Recognised Site of Conservation Importance**

No recognised sites of conservation importance are located within the Study Area (**Figure 10.1**). The nearest Protected Areas are the Sha Chau and Lung Kwu Chau Marine Park which is over 4km to the south west and Pak Nai SSSI located at 3.5km to the north east.

#### **10.4.3 Habitats and Vegetation**

The study area of STF ES (Metcalf and Eddy 2006) was within the study area of the current EIA. The study recorded eight types of habitats of low to moderate conservation values and no plant species of conservation interest during their field surveys. The habitats recorded included secondary woodland, grassland/shrubland, plantation, streams, wasteland/developed area, ash lagoons, mangroves and seawall.

The study area of STF EIA (Metcalf and Eddy 2008) was within the study area of the current EIA. The study recorded nine habitat types including ash lagoons, secondary woodland, grassland/shrubland, plantation, watercourse, developed area/disturbed area, seawall, orchard and coastal waters. Three plant species protected under Forestry Regulations (Cap. 96A) were recorded: *Arundina graminifolia*, *Nepenthes mirabilis*, and *Aquilaria sinensis*.

The study area of ACTF EIA (ERM 2003) was also within the study area of the current EIA. It also recorded 8 types of habitats in the vicinity of the ash lagoons including secondary forest, shrubland-grassland mosaic, plantation woodland, streams, wasteland, developed area, ash lagoons, and mangroves, and two plant species protected under Forestry Regulations (Cap. 96A): *Arundina graminifolia* and *Nepenthes mirabilis*.

Habitat recorded by the Additional WEF EIA Study (MWH 2003) included grassland/low shrubland, tall shrub/young secondary woodland, marsh, tidal channel, marine water, urbanised/disturbed, and ash lagoons (which were subdivided into ash slurry fill with water, open water with marsh and islands, ash lagoon marsh, open water and dry ash fill). Because the ash lagoons are still under active operation and the environmental conditions vary considerably, they are collectively classified as “ash lagoons” in the current study. *Nepenthes mirabilis* was also recorded in the WEF study.

Chau and Siu (1998) recorded Indian Orchid (*Zeuxine strateumatica*) at the ash lagoons. All orchids are protected under the Forestry Regulations (Cap. 96A). This orchid was not recorded in the subsequent EIAs conducted at the ash lagoons.

According to the Study Brief of the current project, Pitcher Plants (*Nepenthes mirabilis*) were previously recorded at ravines and on open cut slopes along Nim Wan Road and in the Tsang Kok valley (**Figure 10.1**). The project (including diversion of Nim Wan Road) may have direct impacts on the population which is assessed during the current study. *Carex leucochlora* (name now corrected as *Carex breviculmis*) is a very rare sedge found in forest in Hong Kong. It was previously recorded in Cheung Sheung and Sha Lo Wan.

The local distribution and ecology of Pitcher Plants was described by Weatherhead (undated). Pitcher Plants are common in Hong Kong and are confined to Northwest New Territories and some islands (*ibid.*). Pitcher Plants prefers open, wet and granitic sites. Large colonies was observed in Castle Peak Firing Range (*ibid.* and Ng, per. comm.) and even on artificial rocky cut slopes catchwater of Tai Lam Chung Reservoir and Tuen Mun Highway where seepages are present (Yau, per. obs.) Other areas where Pitcher Plants were recorded included Siu Lam, So Kwun Wat, Tai Tong, Lung Kwu Tan and Lantau. Pitcher Plants were previously successfully transplanted to Tai Tam Country Park, which is now the only site on Hong Kong Island where the species was found (Weatherhead, undated). Regional distribution of Pitcher Plant includes Hainan, Guangdong, Indochina peninsula and Malaysia (AFCD herbarium web site).

#### **10.4.4 Ash Lagoon**

The CLP ash lagoons at Tsang Tsui (**Figure 10.1**) were constructed in the mid-late 1980s for receiving pulverized fly ash (PFA) mainly produced by the Castle Peak Power Station. They have been progressively filled since 1989. Artificial habitats were temporarily formed when these lagoons were fed with rainwater and freshwater discharged from the Castle Peak Power Station to the middle ash lagoon for storage since 1997. The water would then be pumped back to the power station when needed. A review of historical photos from 1986 to present shows that all lagoons appeared dry most of the time due to ash dumping, while the water level in the middle lagoons fluctuated substantially since 1997, which were governed by ash dumping and water storage activities as well as precipitation. Water could cover up to 60-70% of the lagoon surface in summer while it could drop to less than 30% at the southern half of the lagoon in dry season. The open water frequently appeared greenish, probably due to high concentration of metals and minerals released from the PFA to the water.

In the latest STF EIA study (Metcalf and Eddy 2008), the habitat conditions of ash lagoons were still described as “unstable” and were “governed by two major factors: the CLP’s pulverised fuel ash (PFA) filling activities and rainfall”. During their surveys, the northern part of the east lagoon was flooded while the southern part was occupied by dunes of PFA. The water coverage in the middle lagoon also varied considerably from about 50% during dry season with several small pools to fully flooded in June 2008 due to heavy rain and dropped again gradually probably due to evaporation.

Ecological values of these ash lagoons were assessed in the WEF studies (CDMI 2000 and MWH 2003) previously due to its usage by some avifauna of some conservation significance in these transient “wetlands” (see below). The ecological importance of the site to these avifauna and the potential impacts of the project on these avifauna is further assessed in this section.

#### 10.4.5 Avifauna

The bird communities of part of the Study Area of the Project were surveyed in some previous EIA studies. The findings and discussions of these studies were reviewed. The bird species recorded in these surveys would be judged whether is of conservation concern based on the criteria including protection status (e.g. fauna protected under WAPO (except birds), and flora and fauna protected under regional/global legislations/conventions), species distribution (e.g. endemic), and rarity (e.g. rare or restricted). These criteria are relevant to those in Table 3, Annex 8 of the EIAO-TM. The level of concern of the fauna species was also made reference to Fellowes *et al.* (2002).

Bird species recorded during the WEF EIA (CDMI 2000), Additional WEF EIA (MWH 2003), ACTF EIA (ERM 2003), STF ES (Metcalf and Eddy 2006) and STF EIA (Metcalf and Eddy 2008) were reviewed. 60 bird species of conservation concern were identified within the current Study Area and its vicinity and are summarised in **Table 10.1**.

**Table 10.1 Avifauna of conservation concern recorded previously within the current Study Area and its vicinity**

Common Name	Scientific Name	Level of Concern	Protection Status in China	Previous Studies				
				WEF EIA	Add WEF EIA	ACTF EIA	STF ES	STF EIA
Little Grebe	<i>Tachybaptus ruficollis</i>	LC		x	x	x	x	x
Great Cormorant	<i>Phalacrocorax carbo</i>	PRC		x	x	x	x	
Grey Heron	<i>Ardea cinerea</i>	PRC		x	x	x	x	x
Purple Heron	<i>Ardea purpurea</i>	RC				x		
Great Egret	<i>Casmerodius alba</i>	PRC(RC)		x	x	x	x	x
Intermediate Egret	<i>Egretta intermedia</i>	RC		x	x			
Little Egret	<i>Egretta garzetta</i>	PRC(RC)		x	x	x	x	x
Pacific Reef Egret	<i>Egretta sacra</i>	(LC)	II					x
Cattle Egret	<i>Bubulcus ibis</i>	(LC)		x		x	x	x
Chinese Pond Heron	<i>Ardeola bacchus</i>	PRC(RC)		x	x	x	x	x
Black-crowned Night Heron	<i>Nycticorax nycticorax</i>	(LC)						x
Striated Heron	<i>Butorides striatus</i>	(LC)					x	
Yellow Bittern	<i>Ixobrychus sinensis</i>	(LC)				x		
Common Teal	<i>Anas crecca</i>	RC		x	x			
Spot-billed Duck	<i>Anas poecilorhynchos</i>	RC			x			
Northern Pintail	<i>Anas acuta</i>	RC					x	
Red-breasted Merganser	<i>Mergus serrator</i>	LC				x		
Osprey*	<i>Pandion haliaetus</i>	RC	II			x		x
Black Kite*	<i>Milvus migrans</i>	(RC)	II	x	x	x	x	x
Crested Serpent Eagle*	<i>Spilornis cheela</i>	(LC)	II				x	

Common Name	Scientific Name	Level of Concern	Protection Status in China	Previous Studies				
				WEF EIA	Add WEF EIA	ACTF EIA	STF ES	STF EIA
Eastern Marsh Harrier*	<i>Circus spilonotus</i>	LC	II			x		
Crested Goshawk*	<i>Accipiter trivirgatus</i>	-	II				x	
Greater Spotted Eagle*	<i>Aquila clanga</i>	GC	II				x	
Imperial Eagle*	<i>Aquila heliaca</i>	GC	II		x			
Common Kestrel*	<i>Falco tinnunculus</i>	-	II			x	x	
Peregrine Falcon*	<i>Falco peregrinus</i>	(LC)	II	x				
Eurasian Coot	<i>Fulica atra</i>	RC		x	x			
Common Buzzard*	<i>Buteo buteo</i>	-	II					x
Red-breasted Merganser**	<i>Mergus squamatus</i>					x		
Black-winged Stilt	<i>Himantopus himantopus</i>	RC		x	x		x	
Grey-headed Lapwing	<i>Vanellus cinereus</i>	LC					x	
Little Ringed Plover	<i>Charadrius dubius</i>	(LC)		x	x	x	x	x
Kentish Plover	<i>Charadrius alexandrinus</i>	RC			x			
Marsh Sandpiper	<i>Tringa stagnatilis</i>	RC					x	
Common Greenshank	<i>Tringa nebularia</i>	RC			x			
Wood Sandpiper	<i>Tringa glareola</i>	LC		x	x	x		x
Pintail/ Swinhoe's Snipe	<i>Gallinago sternura/megala</i>	LC				x		
Common Snipe	<i>Gallinago gallinago</i>	LC			x	x		
Caspian Tern	<i>Sterna caspia</i>	RC			x			
Oriental Cuckoo**	<i>Cuculus saturates</i>					x		
Greater Coucal	<i>Centropus sinensis</i>	-	II	x		x		x
Lesser Coucal	<i>Centropus bengalensis</i>	-	II	x		x		
Pacific Swift	<i>Apus pacificus</i>	(LC)						x
Pied Kingfisher	<i>Ceryle rudis</i>	(LC)					x	x
White-Breasted Kingfisher	<i>Halcyon Smyrnenis</i>	(LC)		x	x	x	x	x
Black-capped Kingfisher	<i>Halcyon pileata</i>	(LC)				x	x	x
Blue-tailed Bee-eater**	<i>Merops philippinus</i>	-						x
Emerald Dove**	<i>Chalcophaps indica</i>					x		
Red-throated Pipit	<i>Anthus cervinus</i>	LC		x	x			
Black-winged Cuckoo-shrike**	<i>Coracina melaschistos</i>	-						x
Bluethroat	<i>Luscinia svecica</i>	LC				x		
Hwamei	<i>Garrulax canorus</i>	-	II	x				
Zitting Cisticola	<i>Cisticola juncidis</i>	LC			x	x	x	
Chinese Penduline Tit	<i>Remiz consobrinus</i>	RC				x		
Yellow-breasted Bunting	<i>Emberiza aureola</i>	RC				x		
Red-billed Starling	<i>Sturnus sericeus</i>	GC				x	x	
White-cheeked Starling	<i>Sturnus cineraceus</i>	PRC		x				
White-shouldered Starling	<i>Sturnus sinensis</i>	(LC)		x		x		x
Black-naped Oriole	<i>Oriolus chinensis</i>	LC				x		
Russet bush Warbler**	<i>Bradypterus seebohmi</i>	-					x	

Notes:

Level of concern:

LC = local concern; RC = regional concern; PRC = potential regional concern; GC = global concern

Letters in parentheses indicate that the assessment is based on restrictedness in breeding and/or roosting sites rather than in general occurrence

Previous Studies:

WEF EIA = WEF EIA Report (CDMI 2000); Add WEF EIA = Additional WEF EIA Report (MWH 2003); ACTF EIA = ACTF Report (ERM 2003); STF ES = STF ES Report (Metcalf & Eddy 2006); STF EIA = STF Feasibility Study EIA Report (Metcalf & Eddy 2008)

\* Listed in Appendix II of CITES; \*\* Locally rare species

The abundance of these bird species of conservation concern recorded by the Additional WEF EIA Report (MWH 2003), the ACTF EIA Report (ERM 2003) and the STF ES Report (Metcalf & Eddy 2006) was very low, and made up a small proportion of the local population

of that species. The importance of the ash lagoons and adjacent areas to these species was further reviewed by Metcalf & Eddy (2006 and 2008) using the abundance of that species in the site, and the number of breeding sites of that species in Hong Kong as the major criteria. Five species was recognised with population of conservation interest in the ash lagoons and adjacent areas (**Table 10.2**). These were Little Grebe, Osprey, Little Ringed Plover, White-breasted Kingfisher and Pied Kingfisher.

**Table 10.2 Avifauna Previously Recorded from the Ash Lagoons and Vicinity with Populations of Conservation Importance (adopted from Metcalf & Eddy 2008)**

Common Name	Importance of the Ash Lagoons and Vicinity to the Species
Little Grebe	Little Grebes have restricted breeding range in Hong Kong. Several pairs of this species have been recorded breeding in the ash lagoons.
Osprey	The ash lagoons and vicinity support a significant proportion of the migrant population of Osprey that is declining in Hong Kong.
Little Ringed Plover	Little Ringed Plover have restricted breeding range in Hong Kong. Several pairs of this species have been recorded breeding in the ash lagoons.
White-breasted Kingfisher	White-breasted Kingfishers have a declining breeding range in Hong Kong. The ash lagoons and adjacent areas form a probable breeding site for this species.
Pied Kingfisher	Pied Kingfishers are uncommon, localized residents in Hong Kong. The ash lagoons and adjacent areas may provide a potential breeding habitat for this species.

Of these five species, observations of confirmed breeding (i.e., chicks observed) were only recorded for Little Grebe and Little Ringed Plover. Breeding observations of Little Grebe and Little Ringed Plover came from the ash lagoons. No breeding was recorded for White-breasted Kingfisher, Pied Kingfisher, or Osprey.

Breeding of Little Grebe was recorded in the EIA studies by MWH (2003) and Metcalf & Eddy (2006, 2008). Observations of breeding of Little Grebe are summarised in **Table 10.3**. The relative importance of nesting pairs of Little Grebe in the ash lagoon was estimated in MWH (2003). Since the breeding population of Little Grebe in Hong Kong was not regularly censused, the observations of “breeding bird survey” between 1993 and 1996 was referenced. Carey *et al.* (1995) considered the 31-38 pairs of Little Grebe at Nam Sang Wai possibly accounted for 40% of the Hong Kong breeding population. It was estimated that the ash lagoons supported some 12% of the winter population and 6-10% of the total breeding population of Little Grebe in 2001 (MWH 2003).

**Table 10.3 Breeding Activities of Little Grebes Previously Recorded From Ash Lagoons**

Literature	Date	Location	Breeding Activities	Abundance
Additional WEF (MWH 2003)	August-September 2000	East Lagoon	Full grown immature birds	4
			Recently hatched young birds	3
	June 2001	East Lagoon	Nest	1
		Middle Lagoon	Breeding pairs	5 pairs
	West Lagoon	Breeding pairs	3 pairs	
			Breeding pairs	At least 1 pair

Literature	Date	Location	Breeding Activities	Abundance
ACTF EIA Report (ERM 2003)	August-December 2001	Open water of Lagoon	Birds foraging and loafing	Up to 11
STF ES Report (Metcalf and Eddy 2006)	September-October 2004	Middle Lagoon	Juvenile birds	3
STF EIA Report (Arup 2008)	Wet season 2008	East Lagoon	Two juveniles from two broods	2
		Middle Lagoon	A breeding pair with 4 recently hatched chicks	6

Two nests of Little Grebe recorded in the east ash lagoon in June 2001 were separated from each other less than 50m (MWH 2003). The distances between nests could be reduced by higher vegetation cover (Masterson *et al.* 1994 in MWH 2003): mean inter-nest distance in areas with 8% cover of emergent vegetation is 465m, and 121m in area with 67% cover. The smallest inter-nest distance recorded by Masterson *et al.* (1994) was 13m. Nests separated by a few metres had been reported by Cheng (1993).

Little Grebe feeds on small fishes, prawns and aquatic insects (Cheng 1993). The breeding density of this species is considered to be related to abundance of Corixidae water beetles and chironomids (MWH 2003). The breeding ecology of Little Grebe was described in details by Zhang (1995). The nest of Little Grebe is a floating platform built on emergent grasses on localities of slow water flow. According to the description in Zhang (1995), the emergent grass is usually between 40 and 50cm in height, and the water depth between 0.8 and 2.3 m at localities when nests of Little Grebe are found. Nests are usually 5 – 6 cm above water surface.

Although Little Grebe is common in the Deep Bay area, records of the size of breeding habitat is generally lacking. Local examples and field observations concerning the sizes of wetlands within which Little Grebe nested are summarised in **Table 10.4**.

**Table 10.4 Sizes of ponds with Little Grebe nests**

Location	Size (ha)	Date	Remarks	Source
The Jockey Club Kau Sai Chau Public Golf Course	0.5	Sep 2000	1 nest and nestlings seen	Ecosystems Ltd. unpubli. data
Sam Po Shue, adjacent to FCA road along Shenzhen River	0.24	May 2000	1 nest with eggs	Ecosystems Ltd. unpubli. data
Sam Po Shue, adjacent to FCA road along Shenzhen River	0.89	Jul 2000	1 nest with eggs	Ecosystems Ltd. unpubli. data
Nam Chung, Northeast New Territories	1	August 2006	8 pairs nesting (after habitat enhancement*)	Wong 2007

\*by draining to allow natural recolonisation of vegetation before refilling

Breeding of Little Ringed Plover was recorded in the ash lagoon during EIA study by MWH (2003). Three pairs of Little Ringed Plovers with chicks/fledged young were present at the ash lagoons in June 2001 (*ibid.*). This species is known to nest in drained down fishponds and reservoirs, and is considered opportunistic in habitat uses as this species generally occurs on reclaimed, infilled or temporarily clear land (*ibid.*). Breeding activities of Little Ringed Plover was not recorded in the ash lagoons in recent surveys (Metcalf & Eddy 2006, 2008).



#### 10.4.6 Mammal

Japanese Pipistrelle *Pipistrellus abramus* was sighted from the Assessment Area of the STF EIA study (Metcalf & Eddy 2008). It is the most common bat species in Hong Kong, and occurs in many types of habitats. Japanese Pipistrelle is protected under WAPO in Hong Kong.

Two species of bat, Japanese Pipistrelle and Short-nosed Fruit Bat *Cynopterus sphinx*, was recorded within the assessment area of STF ES (Metcalf & Eddy 2006). Footprints or scats of three mammal species Masked Palm Civet *Paguma larvata*, Leopard Cat *Prionailurus bengalensis* and Small Asian Mongoose *Herpestes javanicus* was also made from areas of wet ash in the Middle Lagoon. All these species are protected under WAPO in Hong Kong. Masked Palm Civet is considered of conservation concern (potential regional concern) by Fellowes *et al.* (2002).

Small Indian Civet *Viverricula indica*, Small Asian Mongoose *Herpestes javanicus* and Leopard Cat *Prionailurus bengalensis* were reported in and near the study area by Shek (2006). All three species are protected under WAPO in Hong Kong, but not considered of conservation concern by Fellowes *et al.* (2002). Small Indian Civet usually inhabits slight wooded area, while Small Asian Mongoose and Leopard Cat inhabit a wide range of habitats (e.g., lowland wetlands, woodland). Small Asian Mongoose is mainly reported from Northern New Territories, while Leopard Cat and Small Indian Civet from widespread localities.

Signs of Small Indian Civet were found on grassland/shrubland near the existing WENT landfill and in the east ash lagoon during the ACTF EIA study (ERM 2003). Possible hoofprints of Red Muntjac *Muntiacus muntjak* (protected under WAPO) were found in ravine habitats of Tseng Kok Stream during the same period. Red Muntjac is considered of “potential regional concern” by Fellowes *et al.* (2002). This species is widely distributed in Hong Kong, and mainly found in woodland (Shek 2006). This type of habitat only exists as small fragments near the Study Area of the present proposed project.

Ryukyu Mouse *Mus caroli* was recorded from the east ash lagoon in 2001 (MWH 2003). This species has a restricted distribution in Hong Kong (Shek 2006). The records of this species come from Mai Po Marshes Nature Reserve and the Hong Kong Wetland Park. This species inhabits cultivated lands and other grassy areas (*ibid.*). Ryukyu Mouse is considered of ‘local concern’ by Fellowes *et al.* (2002).

#### 10.4.7 Herpetofauna

The majority of herpetofauna recorded in previous studies were of low conservation interest in Hong Kong. Herpetofauna of conservation concern recorded in previous studies included Copperhead Racer *Elaphe radiata* and Burmese Python *Python molurus*.

A Copperhead Racer was recorded at the seawall of east lagoon by the STF EIA (Metcalf & Eddy 2008). This species is common in Hong Kong and occurs in many types of habitats (Karsen *et al.* 1998). Copperhead Racer is considered of “potential regional concern” by Fellowes *et al.* (2002).

Burmese Python was found in the drainage channel next to the Black Point Power Station in October 2005 (ERM 2006). Burmese Python is Class I Protected Animal of PRC and listed in Appendix I of CITES (Zhao 1998). This species is considered of “potential regional concern” by Fellowes *et al.* (2002).

#### 10.4.8 Dragonflies and Butterfly

The majority of butterfly recorded in previous studies were of low conservation interest in Hong Kong. Two butterfly species of conservation concern were recorded in previous studies. These were Danaid Eggfly *Hypolimnys misippus* and Glassy Bluebottle *Graphium cloanthus*.

Danaid Eggfly and Glassy Bluebottle were recorded during the STF EIA study (Metcalf & Eddy 2008). These two species are considered as “local concern” by Fellowes *et al.* (2002). Glassy Bluebottle is rare in Hong Kong (Yiu 2004). Glassy Bluebottle was recorded in secondary woodland, while Danaid Eggfly in secondary woodland, shrubland and watercourse. Glassy Bluebottle is only recorded from a few localities in Hong Kong and occurs in forests (Lo *et al.* 2004). Danaid Eggfly usually occurs in agricultural land and fishponds (*ibid.*).

The majority of dragonfly recorded in previous studies was of low conservation interest in Hong Kong. Only one dragonfly species of conservation concern were recorded in previous studies.

An uncommon dragonfly species Coastal Glider *Macrodiplax cora* was reported in the ash lagoons in the ACTF EIA Report (ERM 2003). This species is considered of “local concern” by Fellowes *et al.* (2002). Coastal Glider is also recorded from Lai Chi Wo, Hong Kong Wetland Park, Sam Po Shue and Luk Keng marsh (Wilson 1997, 2004, Cheung 2006). The larvae of Coastal Glider are salt tolerant (Wilson 2004). Therefore, this species can inhabit brackish habitats (e.g., estuaries, *gei wais*). Together with Wandering Glider *Pantala flavescens*, these two species are considered most successful in terms of current numbers and distribution (*ibid.*).

#### **10.4.9 Aquatic Fauna**

There are over 2500km of natural streams and rivers in Hong Kong, and 33 streams/rivers are considered as of ecological importance (ETWB 2005). None of these Ecologically Important Streams/Rivers (EIS) is located in the west/northwest New Territories. It is also noted that the western New Territories was not included in the Hong Kong-wide stream fish survey conducted by Chong & Dudgeon (1992). Stream courses in western New Territories are usually of lower conservation concern when compared with natural streams in other areas in Hong Kong. Many streams in western New Territories are either heavily polluted (like most large-sized stream/river in Yuen Long Plain), or affected by sedimentation due to erosion in the catchments (Binnie 1992).

It was reported in the EIA study for Shenzhen Western Corridor (Arup 2002) that there were a number of small, steep streams draining the severely eroded and frequently burned uplands of the Deep Bay catchments. The streams were affected by erosion and sedimentation. Spate events during the wet season move large quantities of coarse, granular sediment into these streams, cover stable hard surfaces to which flora or fauna could attach, frequently change the topography of the stream beds, and prevent the accumulation of leaf litter. Under these conditions aquatic organisms do not readily become established on stream beds, and limit the abundance and diversity of aquatic fauna.

A stream in Ha Pak Nai (i.e. Stream C in the present study) and Tai Shui Hang Stream were surveyed during 1998 to 1999 under WEF EIA (CDMI 2000). Only common aquatic invertebrates of low diversity and abundance and dominated by chironomids were found in the stream in Ha Pak Nai. Small size individuals of common species of estuarine fish (such as mullets, therapon) and crustaceans (*Eriocheir* sp. & *Varuna litterata*) were also collected in Tai Shui Hang Stream during that study.

A freshwater fish *Acrossocheilus parallens* was reported to be found in the main stream about 2 km upstream of Pak Nai (to the west and southwest of the existing WENT landfill) (Wilson 2001), which was the first record of this species in Hong Kong. This species distributes in Zhujiang area of South China. Although it is an endemic species of China, it is neither on the China Redlist nor IUCN Redlist. In Hong Kong, it was reported in a few locations only (in reservoir catchments on Hong Kong Island, Tuen Mun and Tai Po, see Lee *et al.* 2004), and thus considered of conservation concern.

Tsang Kok Stream in the current Study Area has natural banks only at its middle section. Its headwater and part of the catchment area were lost to the existing landfill (see Section 10.6.1 under Stream/Channel), while the estuary section has been converted to vertical concrete drainage channel. According to the Landfill SEA Report (Scott Wilson Ltd. 2003), the natural section of Tsang Kok Stream supported some aquatic invertebrate fauna which indicated a fair water quality but few fishes were observed.

Tsang Kok Stream was also surveyed during ACTF EIA (ERM 2003), and a freshwater fish *Squaliobarbus curriculus*, which was considered the first record in Hong Kong, was reported in a concrete silt-trap pool at the channelized section of this stream near the sea and in the channelised section of another unnamed stream within the current Study Area near the ash lagoon (i.e. Stream A in the present study), both of which are subject to tidal influence and are thus brackish. *Squaliobarbus curriculus* naturally inhabits streams and rivers. Its distribution range covers China, western Korea and Vietnam. It is an economic species for both freshwater capture fisheries and aquaculture in Mainland, commonly cultured in ponds and reservoirs. In South China region, its wild population could be found in Zhujiang in Guangdong (PRFRI 1991). Although Hong Kong is close to Zhujiang, the water courses in Hong Kong are not connected with Zhujiang tributaries, and this species is not found in Hong Kong water courses except during the aforementioned study. The channelised sections within the Project Area where this fish was reported were under tidal influence and not similar in environmental conditions with their known habitats in Mainland (freshwater/non-brackish environment). The lack of further records from the Project Area also indicates that these channels are not their typical habitat. The occurrence of this species within the Project Area or in Hong Kong is thus doubtful.

From the same survey for the ACTF EIA (ERM 2003), an unconfirmed cyprinid species suspected possibly to be *Osteochilus vittatus* was found in the channelised section of another unnamed stream within the current Study Area near the ash lagoon (i.e. Stream A in the present study). It was described as very rare in Hong Kong in that survey report (ERM 2003), but was considered in a later publication an introduced species and mostly having been recorded in a few local reservoirs (Lee *et al.* 2004). This species was also reported in other locations, including Wu Kau Tang (Reels 2001), a water tunnel in Nam Chung, New Territories (Yam *et al.* 2002), and Qixingkeng, Guangdong (KFBG 2002). These two species are neither on the China Redlist nor IUCN Redlist.

The occurrence of *Osteochilus vittatus* individual in the channelised sections within the Project Area has never been confirmed since ERM (2003). Though its distribution range covers China, Vietnam and Laos, this species is known as an introduced species to Hong Kong, and are currently found in a few local reservoirs, including Tai Lam Chung Reservoir. Given the distance however, the possibility that *Osteochilus vittatus* individuals could escape from Tai Lam Chung Reservoir and colonise minor streams in outer Deep Bay is very low. This species usually inhabit small streams with slow flow, and thus the channelised sections within the Project Area which are under tidal influence are not their typical habitat. The lack of further records from the Project Area also indicates that these channels are not their typical habitat. The occurrence of this species within the Project Area is therefore considered unlikely.

Flagtail *Kuhlia marginata* was reported in Stream A in a survey for STF ES (Metcalf and Eddy 2006). This species was first discovered in Hong Kong a few years ago and at that time was known locally from only a few sites including Pak Ngan Heung River, Mui Wo (Metcalf and Eddy 2006). Members of the Kuhlidae are mainly marine fish, widely distributed and ranging from Indonesia to Japan. Some of them are able to migrate into freshwater. *Kuhlia marginata* is categorised as “Lower Risk”, i.e. least concern in the Redlist. Recently this species was also recorded in a stream course near Tung Chung in North Lantau, during the EIA study for the Hong Kong–Zhuhai–Macao Bridge: Hong Kong Link

Road (ARUP, unpublished data). This species was not recorded during the surveys for STF EIA (2008)

#### **10.4.10 Intertidal Fauna**

The man-made seawall bordering the ash lagoons supported a low diversity of intertidal fauna; only five epifauna species were recorded during the survey for the Additional WEF EIA (MWH 2003). The dominant species included Rock oyster *Saccostrea cucullata* and isopod *Ligia exotica*.

Similar finding was obtained by the STF ES Report (Metcalf and Eddy 2006), where very poor species diversity was recorded in the intertidal zone. No species were found on the upper shore of the seawall. The mid-low shore was dominated by *Nerita yoldii* and low shore was dominated by *Saccostrea cucullata*. A crab species *Metapograpsus quadridentatus* common in western waters was recorded in high abundance. All of the recorded species are common.

An intertidal survey at the seawall was also conducted during the STF EIA (Metcalf and Eddy 2008). The result of intertidal fauna survey was similar to those obtained in the STF ES Report (Metcalf and Eddy 2006). The habitat supported low species diversity with a total of 30 common intertidal species including *Saccostrea cucullata*, *Nerita albicilla*, *Balanus amphitrite* and *Ligia exotica*, with no special conservation importance recorded.

Intertidal mudflats with mangroves were present at Ha Pak Nai near the eastern boundary of the study area (**Figure 10.1**). Seagrasses and horseshoe crabs were recorded in Ha Pak Nai in previous studies (CDMI 2000). Recently under a horseshoe crab study, Ha Pak Nai was considered as one of the important nursery grounds for juvenile horseshoe crabs as it had a higher abundance of horseshoe crabs among the sites surveyed (Shin *et al.* 2007)

The STF ES Report (Metcalf and Eddy 2006) documented that the substratum at the mouth of tidal channel was dominated by oysters (*Crassostrea gigas*) and mudskippers (*Periophthalmus* spp.). All species recorded are common and widespread in Hong Kong. The ACTF EIA Report (ERM 2003) recorded six gastropods, four bivalves, eight crustacean taxa and the mudskipper (*Periophthalmus cantonensis*) in the soft substrate intertidal zone near the ash lagoon. All species recorded are common and widespread in Hong Kong.

#### **10.4.11 Marine Mammals**

There are only two species of marine mammals regularly sighted in Hong Kong and considered as resident species, i.e. Finless Porpoise *Neophocaena phocaenoides* and Chinese White Dolphin *Sousa chinensis*.

The habitat use of Finless Porpoise within Hong Kong, as indicated by the majority of sightings during previous AFCD annual monitoring, concentrates in the southern and eastern Hong Kong waters (i.e. Southwest Lantau, Southeast Lantau, Lamma, Po Toi and Ninetips) (AFCD 2008). The Project Site is located in outer Deep Bay, and basically outside the distribution range of Finless Porpoise in Hong Kong.

Chinese White Dolphin *Sousa chinensis* is present throughout the Indo-pacific, from Australia and China in the east to South Africa in the west. Off the coast of south China, at least seven separate populations were identified from Guangxi up to the mouth of the Yangtze River, and all coincide with the presence of river mouths.

In Pearl River Estuary, there is a Chinese White Dolphin population which occurs extensively across the entire Pearl River Estuary, from the Hong Kong waters, to southwest of Macao and near the Hu Men mouth of the Pearl River to the north (Jefferson 2000). The population size estimated using line-transect methods was about 1200 individuals (AFCD 2007).

In Hong Kong, Chinese White Dolphin is also concentrated in the more estuarine-influenced waters. They are found in all the waters of western Hong Kong (Jefferson 2000). Western

and Northern Lantau waters are the most important range of the Chinese White Dolphin in SAR waters. This has been concluded from systematic boat surveys for *Sousa chinensis* in Hong Kong waters (AFCD 2008) (**Figure 10.4**).

North Lantau waters is the first area recognised as important habitats for Chinese White Dolphin in Hong Kong, and the dolphins found there are in moderately high densities year round (Jefferson 2000). Besides the North Lantau waters, the coast of West Lantau area has been found recently to be a very high density area for Chinese White Dolphin.

Several hotspots were consistently used by dolphins since 2002, including the waters around Lung Kwu Chau, near Black Point, around the Brothers Islands, and the entire stretch of West Lantau waters from Tai O Peninsula to Fan Lau (AFCD 2008).

From the dolphin annual monitoring in 2007-2008, dolphin sightings were still widely distributed throughout North and West Lantau waters, while dolphins were rarely observed in Deep Bay waters (see Figure 3 in AFCD 2008), including where the Project Site is located (see **Figure 10.3**).

The dolphins appear to shift their grounds seasonally with the extent of river influence, moving farther south and east from the Pearl River in the wet season, and farther into the estuary proper in the dry season. They are thus more common in winter and spring months in the outer Deep Bay area.

Besides having the highest adult dolphin sighting frequency in Hong Kong, there are also frequent sightings of young calves and juveniles in the coast of West Lantau area. Most of the sightings of young calves and juveniles in the 2007-2008 monitoring programme were made in Lung Kwu Chau and West Lantau waters (between Tai O to Fan Lau), while only a few other sightings were made in waters near the Brothers Islands, and in south Lantau waters (AFCD 2008).

Breeding appears to occur throughout the entire year, but there is a peak in the occurrence of births between the months of March and August (Jefferson 2000). This corresponds to an observed increase in apparent sexual and aerial behaviour in the late summer and autumn months.

Quantitative analyses of habitat use by dolphins have been conducted in recent years. Instead of solely the sighting records (cumulative or in one particular year), sighting densities have been calculated in terms of number of on-effort sightings per unit area (i.e. per km<sup>2</sup>). The western Hong Kong waters were overlaid with a 1km by 1 km grid, and the sighting densities are presented as Sighting Per Survey Effort (SPSE) values in each grid cell (see **Figure 10.5**).

The Project Site is located at outer Deep Bay, where dolphins were rarely observed, including the latest 2007-2008 monitoring programme. There was no dolphin sighting recorded in the grid cells offshore to the Project Site during 2007-2008. Using data from 2002-2007, the density of dolphin sightings (SPSE, i.e. on-effort dolphin sightings per 100 units of survey effort) in the grid cells offshore to the Project Site is also zero. The habitat use of this area by dolphin is minimal when compared with other locations in western Hong Kong waters.

#### **10.4.12 Subtidal Benthos**

The subtidal benthic community adjacent to the ash lagoons is near to the navigation channel which is subject to periodic maintenance dredging to ease vessels moving to/from the existing WENT landfill (MWH 2003).

In a territory-wide benthic survey commissioned by AFCD (CCPC 2002), information on the subtidal benthic communities, with respect to spatial distribution, abundance, and species composition, was collected at 120 sampling stations over the territorial waters of Hong Kong which was divided into 5 strata (regions). One of the strata, Western waters with 29

sampling stations, covers Urmston Road, Deep Bay and North Lantau, and is more relevant with the works areas of the Project. Stations 6, 7 and 8 are located in outer Deep Bay offshore to the Project Site (**Figure 10.6**).

In summer, the number of species recorded ranged from 19 to 37. The diversity index,  $H'$ , were between 0.89 and 2.54, and evenness,  $J$ , between 0.29 and 0.86. The number of species recorded in winter ranged between 23 to 61. The diversity index,  $H'$ , were between 1.74 and 2.70, and evenness,  $J$ , between 0.56 and 0.80.

Species richness, diversity and evenness indices are inter-related. A diversity index integrates two components: the total number of species ( $d$ ) and the distribution of individuals among species, into a single number ( $H'$ ).  $H'$  is usually high (e.g.  $>3$  or  $4$ ) in environmentally undisturbed benthic communities, and low (e.g.  $<1$ ) in highly disturbed communities (see Gray et al. 1989 in CCPC 2002). Values for diversity, and evenness would be high, with  $H'>3$  and  $J$  (evenness)  $>0.8$  for a diverse community structure. In benthic habitats where organic matter is concentrated or dissolved oxygen is low, such values are low, with  $H'<2$ , and  $J<0.5$ .

The variations on the diversity and evenness for the benthos at Stations 6, 7 and 8 therefore is higher in summer ( $H'$  ranged from below 1 to over 2,  $J$  ranged from below 0.5 to over 0.8), while these variations reduced in winter. In general, the benthic communities in these stations are of moderate diversity and evenness in both summer and winter seasons.

No benthic species of conservation concern was recorded in these stations. The only known benthic infauna of conservation interest in Hong Kong, the cephalochordate *Branchiostoma belcheri*, was not found in this station, nor the western Hong Kong waters. This area is therefore not of special conservation importance in terms of benthic communities.

Grab samplings were also conducted in Urmston Road and Black Point at both wet and dry seasons during the EIA study for LNG Black Point option (ERM 2007). No species of conservation concern was recorded and the species diversity of the benthic community at Black Point and Urmston Road was similar to other locations in Hong Kong (*ibid*).

Corals in Hong Kong exhibit strong gradients in distribution, species diversity and abundance. Hard corals are vulnerable and prefer clear oceanic water. The geographical distribution of hard corals in Hong Kong is affected by the salinity of the water. Hard coral cover and diversity decrease from east to west, toward the influence of the Pearl River (Scott 1984), as the estuarine environment was thought unsuitable for the existence of scleractinians (reef-building corals).

The waters around the Project Site are within the estuarine northwestern waters. In contrast to the oceanic eastern waters, Northwestern waters are characterized by domination of gorgonian and soft corals. Soft corals, sea pens and gorgonian corals (sea fans) were also reported to be present throughout the Northwestern waters (Mouchel 2002, 2004).

Hard and soft corals are also different in terms of vertical distribution. The vertical distribution of hermatypic corals is largely controlled by the requirements of their photosynthesising zooxanthellae which require strong light and hence shallower water, whereas many of the soft corals that do not possess symbiotic algae can survive at greater depths (Morton and Morton 1983).

AFCD commissioned intensive underwater surveys in 2001-2002 to survey corals at 240 sites covering about 70 km of coastline in territorial waters. Corals were found in western waters of Hong Kong (southern and eastern Lantau), but only sparse colonies or low-coverage communities, composed of extremely tolerant and hardy species, were found. The coverage of corals in this region is very low (less than 5%, and usually  $< 1\%$ , the lowest compared with other regions in Hong Kong). For some western waters locations, there were even no hard coral colonies in the hard substrate subtidal zone. The “near-total or complete

absence” of reef-building hard corals was considered attributable to the high turbidity and low salinity.

Dive surveys were conducted in Northwest waters during an EIA study (ERM 1995), and have found that only a few hermatypic hard corals were recorded within the subtidal zone.

In a more recent EIA study at Pillar Point (ERM 2006), the results of dive survey indicated that the boulders (which provide hard surface for colonisation of hard or soft corals) were covered with a thick layer of sediments. Only small-sized isolated gorgonians *Echinomuricea*, which are considered to be common in Hong Kong, were found in low abundance in the area.

## **10.5 Field Survey Scope and Methodology**

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### **10.5.1 Survey Area**

The study area for the purpose of terrestrial ecological assessment include all areas within 500m from the site boundary of the land based works areas (assuming the worst case scenario) or the area likely to be impacted by the Project (**Figure 10.1**). For aquatic ecology, the study area is the same as the water quality impact assessment or the area likely to be impacted by the Project. However, it should be noted that, except maintenance dredging at the existing barging area, there is no marine work required for the WENT Landfill Extension.

Six-month ecological field surveys (covering dry and wet seasons) were undertaken from March to August 2007 to record ecological data within the study area and establish the ecological profile, for incorporation into the EIA. Additional field surveys were conducted between November 2007 and May 2008 to supplement data collected for the study area, in particular, the ash lagoons and the existing WENT Landfill (**Appendix 10.1**). In addition to day-time surveys, night-time surveys were conducted to record nocturnal fauna including birds, herpetofauna and mammals. Surveys focused primarily on the project site (Project Area) and secondarily on the area within 500 m from the project site boundary (Study Area). Data analyses and discussions described habitats and species found in the study area, highlighting those that are rare, of conservation importance, or protected by law. Sampling locations of fauna group were included in **Figure 10.1**. The sampling locations were focused on northern part of the study area where habitats are more diverse and less on the southern part of the study area which are less accessible and represented by homogenous upland habitats of relatively lower quality. Habitat and vegetation surveys were conducted non-systematically on foot along accessible roads, trails and paths by observation and covered a large extent of area with the aid of binoculars and therefore not represented by transects. Species groups surveyed and survey methods were described as below.

### **10.5.2 Field Survey**

***Habitat and vegetation.*** Habitats were mapped based on the latest government aerial photos and field ground truthing. Non-systematic walk-over surveys were conducted at representative areas of each habitat type. Plant species of each habitat type encountered and observed by binoculars and their relative abundance, with special attention to rare or protected species, were recorded. Colour photographs of all habitats encountered on site and of ecological features of special importance were provided. Habitat maps of the site were produced at the required scale using GIS software.

***Mammals.*** Mammals within the Study Area were surveyed qualitatively. All sightings, tracks, and signs of mammals found were recorded. Nomenclature of mammal follows Shek (2006). As some mammal species (e.g., bats) are nocturnal, night surveys were conducted during wet and dry seasons. Nocturnal Mammals were actively searched using spot-light. Number of flying bats observed during dusk was estimated.

Avifauna. The bird communities of selected habitats within the Study Area were surveyed quantitatively using the transect count method. All birds seen or heard from transects were identified and counted. Bird species outside survey sampling transects but within the Study Area were also recorded to produce a complete species list. Signs of breeding (e.g. nests, recently fledged juveniles) were also recorded. As some birds (e.g., owls, nightjars) are nocturnal, night surveys were conducted during wet and dry seasons. Nocturnal birds were identified by active searching using spot-light and their calls. Ornithological nomenclature in this report follows Carey *et al.* (2001).

Herpetofauna. Herpetofauna within the Study Area were surveyed qualitatively. All reptiles and amphibians sighted were recorded. Nomenclature of amphibian follows Chan *et al.* (2005) and reptile follows Karsen *et al.* (1998). As herpetofauna are mostly nocturnal and active during wet season, night surveys were carried out in wet season. Potential microhabitats of herpetofauna such as wall, fallen logs, litter, channel/nullah, fishpond margins, underneath of stones or other materials, artificial container (e.g., pots) were searched to located cryptic or secretive herpetofauna species during surveys. Amphibians were also identified by their calls during night surveys.

Dragonflies and butterflies. Dragonflies and butterflies of selected habitats within the Study Area were surveyed quantitatively using the transect count method. Dragonflies and butterflies observed from transect were identified and recorded. Individuals needed to be identified in close distance were netted. Dragonflies and butterflies encountered outside survey transects but within the Study Area were also recorded in order to produce a complete species list. Nomenclature of dragonfly follows Wilson (2004) and nomenclature of butterfly follows Yiu (2004).

Aquatic fauna. Aquatic fauna were studied by active searching and direct observation at streams and the ash lagoons. Boulders in the stream were overturned to locate aquatic animals beneath. Hand net was used to collect organisms along the stream. All encountered organisms were identified to the lowest possible taxon and recorded.

Intertidal fauna. Intertidal surveys were performed to describe the intertidal ecology within the Study Area. Natural coastlines as well as artificial seawalls were surveyed in both dry and wet seasons. Initial observations on the intertidal habitats were made at the onset of the survey programme to collect information on the habitats and to locate representative sites for quantitative surveys. Two 100 m transects (i.e. Transect S and Transect N) were established on the mudflats at Ha Pak Nai near the Tai Shui Hang outlet. 0.5 m x 0.5 m quadrats were deployed starting at 10 m on the transect and at a 10 m interval (a total of 10 quadrats on each transect). Within each quadrat, the epifauna and burrows were counted, and a core of 15 cm diameter and 20 cm depth was collected inside each quadrat. Burrows were also excavated to investigate the occupying organisms. In addition, active search surveys with particular attention on horseshoe crabs were conducted on the mudflats. Two locations of the artificial seawalls at ash lagoon were also surveyed by transects (two transects at each location) between high water mark to low water mark. 0.5 m x 0.5 m quadrats were deployed at 1m intervals. Intertidal species were identified to the lowest identifiable taxon, and their abundance was reported, with special attention to rare or protected species. Photos of selected locations were taken.

Marine Mammals and Subtidal Fauna: In the earlier stage of the project, the project potentially might involve reclamation or other marine construction works which would lead to marine habitat loss. In light of this potential impact, though not required in the EIA study brief, land-based dolphin surveys and other subtidal surveys were considered and proposed (see the Working Paper on Ecological Survey Methodology for the study). However, it has been recently confirmed that the project would not involve any marine construction works or reclamations. The marine impacts are thus greatly reduced. The only potential marine impacts would be the maintenance dredging on muddy seabed at the barging area alongside the vertical seawall within the existing WENT landfill, which is currently being



used by the refuse transfer vessels and has been already under a regular maintenance dredging programme. After the WENT Landfill Extension is put into operation, the same barging area would continuously be utilised by refuse transfer vessels and the same navigation channel will be maintained under a similar maintenance programme.

AFCD has performed regular territory-wide dolphin monitoring for over 10 years. The transects in this monitoring programme also cover the outer Deep Bay, i.e. the coastal waters outside our project site. The results from AFCD monitoring programme thus provides the most comprehensive and updated information on the dolphin ecology, and would be the basis for establishing the dolphin baseline condition for our assessment. Given the minor potential marine impacts, and the availability of existing relevant information, the land-based dolphin survey previously proposed by the consultant is thus not considered necessary.

Sufficient information is also available for subtidal benthic fauna in the outer Deep Bay area, including the “Consultancy Study on Marine Benthic Communities in Hong Kong” commissioned by AFCD, and other relevant EIA studies such as “Liquefied Natural Gas (LNG) Receiving Terminal and Associated Facilities”. Field surveys are not necessary for these faunal groups.

## 10.6 Results of Field Surveys

### 10.6.1 Habitat and Vegetation

Major habitat types recorded within the 500m boundary include woodland, plantation, orchard/village, grassland/shrubland, fish pond, mangroves/mudflats, stream/channel, ash lagoon, artificial seawall, urbanised/disturbed and coastal waters (**Figure 10.2 and Figure 10.3**).

**Table 10.5: Habitats Recorded within the 500m Boundary**

Habitat	Size (ha/m)			
Woodland	4.26 ha			
Plantation	13.68 ha			
Orchard/Village	19.34 ha			
Grassland/Shrubland	342.26 ha			
Fish Pond	9.68 ha			
Mangroves/Mudflat	5.24 ha			
Ash Lagoon	48.16 ha			
Artificial seawall	2426 m			
Urbanised/Disturbed	167.31 ha			
Coastal Waters	203.29 ha			
Stream/Channel		Natural (m)	Channel (m)	Total (m)
	Tsang Kok Stream	563	720	833
	Tai Shui Hang Stream	-	590	590
	Stream A	1537 (including 839 m of seasonal tributary)	700	2667
	Stream B	720	239	959
	Stream C	650	-	650

A total of 202 plant species was recorded (**Appendix 10.2**), 30% of which were exotic species. Two species protected under Forestry Regulations (Cap. 96A), *Nepenthes mirabilis* and *Arundina graminifolia*, and one species recorded in China Plant Red Data Book, *Ixonanthes reticulate*, were recorded. The species of conservation interest, *Carex breviculmis* and *Aquilaria sinensis* identified in the Study Brief and other EIAs respectively were not recorded during the surveys for the present study.

The tree survey (including both individual and the group tree survey) estimated a total of about 6000 no. trees with dbh>95mm, Tree groups were mainly located at the woodland and plantation on engineering slopes. Trees identified mainly consisted of exotic plantation and pioneer native trees.

### **Woodland**

Woodland in the Study Area was formed of a few small stands scattered along the tidal creek of Stream A, at the foothill behind the Tang Clan grave site, and at the edge of the east ash lagoon. Woodland along the tidal creek and at the east ash lagoon was young and simple in structure and composed of a mixture of common native pioneer trees including *Macaranga tanarius*, *Celtis sinensis*, *Sterculia lanceolata*, and backshore species including *Hibiscus tiliaceus* and *Pandanus tectorius*. Woodland behind the grave site was also of similar species composition and structure, while it was also mixed with orchard and plantation species of the nearby orchard, indicating that the pioneer native tree species might have established upon abandonment of the orchard. A few large and mature individuals of *Ficus microcarpa* were also recorded in this woodland. Woodland canopy varied from 6-10 (to 12) m. The understorey was dense and mainly composed of young trees and shrubs. Species diversity was low to moderate.

All species recorded in woodland habitat are common in Hong Kong. No species of conservation interest was recorded within the woodland habitat.

### **Plantation**

Plantation was mainly located on the engineering slopes within the existing WENT landfill, along major roads and behind the CLP Black Point Power Station. It was young with a 8-12m canopy dominated by exotic species including *Acacia confusa*, *Eucalyptus citriodora*, *Leucaena leucocephala* and *Pinus elliottii*. The understorey was moderately colonised with native shrubs and trees including *Macaranga tanarius*, *Schefflera heptaphylla* and *Microcos paniculatus*. The plant diversity was low with no plant species of conservation concern was recorded in this habitat.

### **Grassland/Shrubland**

Grassland/shrubland, probably maintained by hillfires from scattered grave sites, occupied about half of the study area dominating the natural hillsides and hydroseeded slope. Major species recorded included *Dicranopteris pedata*, *Neyraudia reynaudiana*, *Rhodomyrtus tomentosa*, *Rhaphiolepis indica*, and *Schefflera heptaphylla*.

Three plant species of conservation concern were recorded in this habitat. Individuals of Pitcher's Plant *Nepenthes mirabilis* were found at 7 locations in this habitat along the ravines. The plants occurred as single or few individuals in most locations, with one a large colony recorded in Tsang Kok Valley (**Figure 10.2**). This species is protected under Forestry Regulations (Cap. 96A) and is listed under Category LR/lc of the IUCN Red Plant Data List (i.e. taxa which do not qualify for Conservation Dependent or Near Threatened) and CITES Appendix III. It is common in Hong Kong. A few individuals of Bamboo Orchid, *Arundina graminifolia* were found along Tsang Kok Stream. This species also protected under Forestry Regulations (Cap. 96A). It is commonly found in ravines and exposed grassland/shrubland habitats in Hong Kong. A few individuals of a tree species *Ixonanthes reticulata* were also recorded at Tsang Kok Valley. This species is listed as "vulnerable" by China Plant Red Data Book, but is not protected in Hong Kong and is quite common locally.

There was also a small grassland beside the tidal creek portion of Stream A. This area was formed of hard substrates probably as a result of reclamation and is not subject to daily tidal influence probably due to the high elevation, although some individuals of mangrove trees could be found on its fringe. This area is therefore classified as grassland habitat. This is also where an individual of *Aquilaria sinensis* was recorded by STF EIA Study (2008).

### **Orchard/Village**

Orchards were scattered on hillsides and ravines and at Ha Pak Nai Village within the study area. It appeared that most of these orchards were still actively maintained as understorey was cleared, water pipes for irrigation were still in place, and new seedlings/saplings were planted. Litchi (*Litchi sinensis*), Longan (*Dimocarpus longan*) and Mango (*Mangifera indica*) were the major fruit trees planted, while some native pioneer trees colonised the understorey. Other species recorded at Ha Pak Nai Village included a variety of fruit tree and landscape species. No plant species of conservation concern recorded in this habitat.

### **Fish Ponds**

Fish ponds were located at Ha Pak Nai Village. Most of these fish ponds were abandoned and grown with ruderal and weedy species, or converted to ponds for recreational fishing and were void of vegetation. The ecological value is limited due to lack of management or high human disturbance and activities.

### **Mangrove/Mudflats**

Small area of mudflat was found at the estuary of Tai Shui Hang Stream Channel and Ha Pak Nai on the fringe of the 500m study area. Most of the mudflat surface was void of vegetation with exception of *Kandelia obovata* and *Zoysia* sp. scattered at the shoreward side of the mudflat.

### **Ash Lagoons**

Similar to the findings from literature review, the conditions of the ash lagoon varied considerably during the field surveys. Compared to the March surveys, more open water was observed on the middle ash lagoon covering up to 60-70% of the surface during summer when extra water from the power station was pumped in and precipitation was higher. The water level dropped again after summer when less than 30% of the middle lagoon surface was covered with greenish water (probably due to high concentration of metals and minerals released from PFA in water), leaving the whitish bank and bottom (remnants of minerals and fly ash) exposed (**Figure 10.3**). The east and west ash lagoons were relatively dry where fly ash were actively deposited and were colonised with weedy vegetation where ash dumping ceased. Most plant species recorded on the ash lagoons were pioneer, exotic and ruderal species established along access road (e.g. *Macaranga tanarius*, *Panicum maximum*, *Sesbania* sp., *Mikania micrantha*, *Bidens pilosa*), and alkaline-tolerant on the fly ash (e.g. *Tamarix chinensis*, *Fimbristylis* spp.). Aquatic species including *Phragmites australis* and *Typha angustifolia* established in the middle ash lagoon where freshwater was more abundant. Species of conservation interest recorded previously in the ash lagoon including the Indian Orchid *Zeuxine strateumatica* was not observed since 2000 in other EIAs and during the current surveys.

### **Artificial Seawalls**

The seaward boundaries of the ash lagoons and the exiting WENT landfill were fringed by artificial seawalls. The full length of the seawall in the ash lagoon and part of the existing WENT seawall were of sloping boulder form, while a section of about 600m WENT seawall was in vertical form, which is currently being used as the barging area of the refuse transfer vessels. A few species of wind-tolerant pioneer trees including *Celtis sinensis* and *Ficus microcarpa* colonised the seawall.

### **Urbanised/Disturbed**

The existing landfill site, CLP Black Point Power Station, roads and sprayed engineering slopes constituted this habitat. Most of the surface was concrete or void of vegetation. Exceptions are planter box or roadside trees for landscaping purposes. This area has little ecological value.

### **Streams/Channels**

There were several stream courses within the Study Area, including Tsang Kok Stream, and a few others referred as Stream A, Stream B and Stream C in this study. Tsang Kok Stream and Stream A lied within the Project Area.

Tsang Kok Stream (**Figure 10.1**) is a small stream flowing from Castle Peak Range into the southern part of Deep Bay. It is described as one of minor streams in Deep Bay Water Control Zone monitored in the EPD regular river water quality programme (EPD 2007). This stream was located immediately adjacent to the existing WENT landfill and subject to modifications previously. The headwater of Tsang Kok Stream, which is immediately outside the existing WENT landfill together with part of its catchment area was found to be filled, probably during the construction of the existing landfill. The middle section of this stream was basically in natural conditions, while its lower section had been modified into a concrete drainage channel. The connecting point of the lower section drainage channel and the natural middle section was a steep and smooth concrete slope with structures for dispersing the energy during flushing flow. This slope prevents the upstream movement of aquatic life, and thus the stream was fragmented. The concrete drainage channel ran northward along the western boundary of the existing WENT landfill, passed Nim Wan Road through box culverts, and finally joined the Tsang Kok Stream Outfall which separated WENT and the CLP ash lagoon site.

While the headwater area was filled, the middle section of this stream was covered by large-sized boulders and rocks. The stream flow in Tsang Kok Stream was low year round and found murky and mostly beneath the boulders, and the stream bed was covered by sediment which was likely brought into the stream by sedimentation within the catchments.

Stream A originated on the hill slope immediately to the southeast of Nim Wan Road. It had box culvert modification at its middle section during the construction of Nim Wan Road and was thus more or less fragmented. After passing Nim Wan Road, the stream substratum was mainly bare bedrock of fairly steep gradient until it passed through an orchard, flowing northward and joining Tsang Kok Stream Outfall. Flow volume of the perennial section of Stream A was fair in wet season and low in dry season. A few seasonal tributaries of Stream A joined the main course at different locations. They were either fragmented by Nim Wan Road or of narrow channel width, and all without surface flow during dry season.

Another stream course (Stream B) within the Study Area was located at the east side of Lung Kwu Tan Road. This stream ran westbound, with its lowland section modified into drainage channel, and finally flew into the sea at Lung Kwu Sheung Tan. Similar to Tsang Kok Stream, the upper and middle sections of this stream were covered by large-sized boulders and rocks.

Besides the above stream courses, the lowland section of Tai Shui Hang and a small section of stream course in Ha Pak Nai (Stream C) also fell within the eastern corner of the 500 Assessment Area boundary. These two courses were however far away from the project site where the Tai Shui Hang catchment was separated from the project site by the existing WENT landfill. The lowland section of Tai Shui Hang was basically a tidal creek rather than a stream course. This could be indicated by the presence of mudflats with intertidal fauna on its eastern bank. Stream C was located further eastward of Tai Shui Hang and was mainly of sandy substratum.

### **Coastal Waters**

Coastal waters comprised the northern part of the Study Area. It is within outer Deep Bay, where dolphins were rarely observed.

The subtidal benthic community adjacent to the ash lagoons is near the navigation channel which is subject to periodic maintenance dredging to ease vessels moving to/from the existing WENT landfill (MWH 2003).

The coastal waters around the Project Site are within the estuarine northwestern waters. In contrast to the oceanic eastern waters, the northwestern waters are characterized by domination of gorgonian and soft corals.

### 10.6.2 Avifauna

The majority of the Study Area is covered by grassland/shrubland (42.1% of total area), coastal waters (25% of the total area) and urbanised/disturbed areas (20.6% of the total area). Fauna diversity in grassland/shrubland is generally low (Thrower 1984, Dudgeon and Corlett 1994, 2004, Kwok and Dahmer 2002, Chan *et al.* 2005). This is related to low vegetation cover and food abundance, and frequent disturbance by hill fires in this type of habitat. The other habitats (e.g., plantation, woodland, mangroves/mudflat) in the Study Area are mostly small and fragmented. There are a few fishponds on the northeast corner of the Study Area. Some of these fishponds are used for amenity fishing, and are under high level of human disturbance. The ash lagoons are man-made habitats for dumping of PFA and are under high level of human disturbance due to ash filling activities. The surface of west and east ash lagoons are mostly dry and colonised with weedy vegetation while the surface of the middle ash lagoon was composed of both exposed ash surface and some 5 ha of open water, with water level varied seasonally.

A total of 56 species of birds were recorded within the Study Area during the quantitative surveys (**Appendix 10.3**). Most of the recorded species (e.g., Black Kite *Milvus lineatus*, Chinese Bulbul *Pycnonotus sinensis*) are typical of disturbed areas (e.g., Large-billed Crow *Corvus macrorhynchus*, Crested Myna *Acridotheres cristatellus*), young secondary growths (e.g., Yellow-bellied Prinia *Prinia flaviventris*, Common Tailorbird *Orthotomus sutorius*) and coastal areas (e.g., Little Egret *Egretta garzetta*, Common Sandpiper *Actitis hypoleucos*). Five additional species were recorded between transects. These were Richard's Pipit *Anthus richardi*, Yellow Wagtail *Motacilla flava*, Pallas's Leaf Warbler *Phylloscopus proregulus*, White-backed Munia *Lonchura striata* and Black-faced Bunting *Emberiza spodocephala*. All are common and widespread in Hong Kong (Carey *et al.* 2001). The total species recorded within the study area is 61 species.

The Study Area was largely composed of degraded, fragmented habitats and urbanised/disturbed area with little vegetation cover and therefore is not a major breeding site for the bird species recorded. Bird species recorded breeding within the Study Area included Little Grebe, Chinese Bulbul *Pycnonotus sinensis*, Common Tailorbird *Orthotomus sutorius*, Long-tailed Shrike *Lanius schach*, Crested Myna *Acridotheres cristatellus*, Eurasian Tree Sparrow *Passer montanus* and Spotted Munia *Lonchura punctulata*. All these species are common and widespread in Hong Kong (Carey *et al.* 2001). Apart from Little Grebe which breeding activities were recorded in the middle ash lagoon, other breeding records came from woodlands and plantations. Breeding of Little Grebe will be discussed in later sections. No breeding of Osprey, Little Ringed Plover, White-breasted Kingfisher, or Pied Kingfisher were observed during the current study.

Bird abundance was low in all habitats except the ash lagoons within the Study Area. Bird abundance was low to moderate in the ash lagoons. Most waterbirds, including those considered of conservation interest, were recorded in the ash lagoons. However, the three ash lagoons within the Study Area are of different value as habitats to waterbirds. The east ash lagoon is heavily covered by weedy vegetation. The value of this lagoon as habitats for waterbirds favouring open water area is hence very low. This lagoon was mainly inhabited by habitat generalist (e.g., Chinese Bulbul, Long-tailed Shrike). The west ash lagoon is mostly devoid of vegetation and subjected to active dredging of fly ash. This lagoon is of little value as habitat for waterbirds and other wildlife. Waterbird abundance was higher in the middle ash lagoon, which is larger and with more open water area. Abundance of waterbirds in this lagoon was higher during wet season when the flooded area is larger.

Large area of open water is only found in the middle ash lagoon. The ash lagoons are artificial habitats and the area of open water area is subjected to the amount of cooling water from the power station and rainfall. The area of open water area is larger in wet season when both rainfall and input of cooling water are high, and is smaller in dry season when both rainfall and input of cooling water are low. Both species richness and abundance of waterbird are high in Hong Kong during winter, when the amount of open water area in the ash lagoon is low. During the surveys for the current study, about 60-70% of the middle lagoon were covered with water during summer, but water coverage dropped to less than 30% during dry season when the lagoon surface was covered with greenish water (probably due to high concentration of metals released from fly ash after evaporation) and the whitish bank and bottom (remnants of minerals and fly ash) exposed. The condition and quality of the ash lagoon as waterbird habitat is unstable, volatile and somewhat hazardous to wildlife. Therefore, the ecological value of the ash lagoons to waterbirds is not considered high.

Eighteen of the recorded bird species were considered of conservation concern (**Table 10.6, Figure 10.2**), about half of which were waterbirds recorded in the middle lagoon. Both previous and the present studies, however, show that except Little Grebe, most of these bird species were present in low abundance and were not regularly recorded from the ash lagoon, and therefore their uses of the ash lagoon were considered infrequent. The observations of these species in the Study Area and ecology and conservation importance of each species are discussed and evaluated.

**Table 10.6 Bird species of conservation concern within the Assessment Area.**

Common name	Level of Concern	Protection Status in China	CITES	Commonness & Distribution
Little Grebe	LC	-	-	CW
Little Egret	PRC(RC)	-	-	CW
Chinese Pond Heron	PRC(RC)	-	-	CW
Great Egret	PRC(RC)	-	-	CL
Grey Heron	PRC	-	-	CL
Black Kite	(RC)	II	II	CW
Common Buzzard	-	II	II	CL
White-bellied Sea Eagle	(RC)	II	II	CL
Eurasian Woodcock	-	-	-	R
Little Ringed Plover	(LC)	-	-	CW
Common Redshank	RC	-	-	CL
Eurasian Coot	RC	-	-	CL
Greater Coucal	-	II	-	CW
Collared Scops Owl	-	II	II	CL
White-throated Kingfisher	(LC)	-	-	CW
Black-capped Kingfisher	(LC)	-	-	CL
Pied Kingfisher	(LC)	-	-	CL
Emerald Dove	-	-	-	R

Level of concern: LC = local concern; RC = regional concern; PRC = potential regional concern; GC = global concern. Letters in parentheses indicate that the assessment is based on restrictedness in breeding and/or roosting sites rather than in general occurrence

Protection Status in China: I = Class I Protected Animal; II = Class II Protected Animal

CITES: I = Appendix I; II = Appendix II

Commonness and distribution: CW = common and widespread, CL = common/uncommon and localised, R = uncommon/rare and localised.

### **Little Grebe**

Little Grebe is considered of “local concern” by Fellowes *et al.* (2002). Little Grebe is common in the Deep Bay area (Carey *et al.* 2001). The preferred habitats of this species include inter-tidal shrimp ponds (*gei wais*) and fishponds, particularly those with emergent or submerged vegetation.

The number of Little Grebe in the ash lagoons (middle and west lagoons) ranged between 18 and 22 birds during breeding season (March – August). Peak count in the middle and west lagoon was 18 and 4 birds respectively. No Little Grebe was recorded from the east lagoon throughout the study.

Little Grebe is an opportunist breeder (Metcalf and Eddy 2008). Abundance of Little Grebe in the ash lagoons was higher in wet season when water coverage was relatively high and facilitating its breeding and drastically reduced to 2-3 birds during dry season when little open water was left.

Nests of Little Grebe were only found in the middle lagoon during surveys in wet season (**Figure 10.2**). Adults with juveniles but no nest were sighted in the west lagoon in wet season of 2007. The distances between nests recorded by the present study ranged between 135m and 173m. The east lagoon was dry and covered by weedy vegetation in wet season of 2007, and did not provide nesting habitat for Little Grebe. Open water area of the ash lagoon expanded in wet season when both rainfall and input of cooling water from power plant are higher. Together with limited human disturbance and presence of emergent plants, the ash lagoon provided breeding habitats to Little Grebe. The past and present studies indicate that the open water area with emergent plant at southern part of the middle lagoon, which made up to 3 ha of the area of whole lagoon, provide the major nesting habitat of Little Grebe. The same distribution pattern was also recorded in the STF EIA study (Metcalf & Eddy 2008).

The previous and present studies showed that the ash lagoons are of certain importance as habitat of Little Grebe. Little Grebe was the only species of conservation concern bred in the ash lagoons, and this species also nested in the ash lagoons regularly.

### **Ardeids**

Four species of ardeids were recorded within the Study Area. These were Little Egret *Egretta garzetta*, Chinese Pond Heron *Ardeola bacchus*, Great Egret *Casmerodius albus* and Grey Heron *Ardea cinerea*.

All these ardeid species are considered of “potential regional concern” by Fellowes *et al.* (2002). The breeding population of Little Egret, Chinese Pond Heron and Great Egret are considered of “regional concern” by Fellowes *et al.* (2002). However, no breeding of these species was recorded within the Study Area.

Apart from Chinese Pond Heron, these ardeid usually forage in open water areas (e.g., fishponds, mudflat, *gei wais*). Chinese Pond Heron usually forage in edge of emergent plants in wetland habitats.

Little Egret was the most numerous ardeid species within the Study Area. Most Little Egrets were recorded from the middle lagoons, with a peak count of 27 birds. Other records came from mangroves (5 birds), stream (1 bird) and fishponds (1 bird). The number of Little Egret recorded in the lagoons only made up a very small proportion of the average winter peak of 1763 birds (data from The Hong Kong Bird Watching Society) in the Deep Bay area. The population of Little Egret in the ash lagoons was therefore not considered of conservation importance.

The other three ardeid species were present in very low numbers within the Study Area. Only one Great Egret and one Grey Heron were recorded from the middle lagoon. Another Grey Heron was recorded from the mangroves/mudflat. Chinese Pond Heron was recorded from the middle lagoon (6 birds) and fishpond (1 bird). The abundance was low when compared to the average winter peak (Great Egret: 958 birds; Grey Heron: 847 birds; Chinese Pond Heron: 219 birds) (data from The Hong Kong Bird Watching Society) of this species in the Deep Bay area. Abundance of the species within the Study Area only made up an insignificant proportion of the local population.

### **Raptors**

Four species of raptors were recorded within the Study Area. These were Black Kite *Milvus lineatus*, Common Buzzard *Buteo buteo*, White-bellied Sea Eagle *Haliaeetus leucogaster* and Collared Scops Owl *Otus lettia*.

Black Kite is the commonest resident raptor in Hong Kong. This species is considered of “regional concern” by Fellowes *et al.* (2002) due to its restricted breeding range. Black Kite occurs in many types of habitats, including urban areas and landfills. One Black Kite was recorded soaring over each of these habitats within the Study Area: urbanised/disturbed, ash lagoon, stream/channel and grassland/shrubland. No breeding of this species was recorded within the Study Area.

Common Buzzard is a common winter visitor in Hong Kong. This species is not considered of conservation concern by Fellowes *et al.* (2002). Common Buzzard occurs in many types of habitats, including urban areas. One bird was recorded flying over grassland/shrubland within the Study Area.

Collared Scops Owl is a common resident in Hong Kong. This species is widely found in wooded areas. Collared Scops Owl is not considered of conservation concern by Fellowes *et al.* (2002). One Collared Scops Owl was recorded roosting at plantation near Black Point within the Study Area.

White-bellied Sea Eagle is considered of “regional concern” due to the restricted breeding range. This resident species is maritime, and mainly occurs in coastal waters. One White-bellied Sea Eagle was recorded flying over the middle lagoon and grassland/shrubland respectively within the Study Area. White-bellied Sea Eagle was not recorded in Outer Deep Bay during a survey of this species conducted by AFCD between November 2001 and May 2003 (Tsim *et al.* 2003) and was not recorded in previous EIA studies. Hence, the sightings in the Study Area and nearby areas are considered atypical. Most breeding pairs of White-bellied Sea Eagle are located in eastern waters of Hong Kong (Tsim *et al.* 2004). Sheltered coastal area with numerous bays and small islands are considered optimal habitats of this species (Tsim *et al.* 2004, Griffiths and Tsim 2004). This type of habitat, however, is absent within or near the Study Area. No breeding of this species was observed within the Study Area.

### **Waders**

Two species of waders of conservation concern were recorded within the Study Area. These were Little Ringed Plover *Charadrius dubius* and Common Redshank *Tringa totanus*. Little Ringed Plover is considered of “local concern” by Fellowes *et al.* (2002) due to its restricted breeding range. Common Redshank is considered of “regional concern” by Fellowes *et al.* (2002).

Three Little Ringed Plovers were recorded from mangroves in Ha Pai Nai. Little Ringed Plover is a common winter visitor and rare breeding species. This species is widespread in Hong Kong, but most records come from Northwest New Territories. Little Ringed Plover breed in low-lying locations, including reclaimed, infilled or temporarily cleared land. No breeding of Little Ringed Plover was recorded within the Study Area.



Three Common Redshanks were recorded once from the middle lagoon. Common Redshank is a common winter visitor feeding on mudflat and loaf on drained fishponds and *gei wais*. The majority of records of this species come from Deep Bay. It was not recorded in previous studies and its record in the Study Area was considered sporadic.

### **Kingfishers**

Three species of kingfishers of conservation concern were recorded within the Study Area. These were White-throated Kingfisher *Halcyon symmensis*, Black-capped Kingfisher *Halcyon pileata* and Pied Kingfisher *Ceryle rudis*. The breeding population of these kingfishers are considered of “local concern” by Fellowes *et al.* (2002). All these species of kingfishers were present in low abundance (1 or 2 birds) within the Study Area. No breeding of these species was recorded within the Study Area.

White-throated Kingfisher is common and widespread in Hong Kong. This species occurs in many types of wetlands, e.g., fishponds, stream, or habitats near waters. No breeding of White-throated Kingfisher was observed within the Study Area.

Black-capped Kingfisher is common in Hong Kong, and mainly found in coastal areas (e.g., mangroves, mudflat, *gei wai*) in Hong Kong. No breeding of Black-capped Kingfisher was observed within the Study Area. In fact, no occupied nest-hole has ever been found in Hong Kong (Carey *et al.* 2001).

Pied Kingfisher is uncommon in Hong Kong. This species inhabits fresh, brackish and salt water and is found at fish ponds, *gei wai*, reservoirs, sheltered bays. Pied Kingfisher breeds in or near reservoirs (e.g., Plover Cove Reservoir, Tai Lam Chung Reservoir) or big tidal creeks (e.g., Nam Chung). No breeding of Pied Kingfisher was observed within the Study Area.

### **Other species**

The other bird species of conservation concern included Eurasian Woodcock *Scolopax rusticola*, Eurasian Coot *Fulica atra*, Greater Coucal *Centropus sinensis* and Emerald Dove *Chalcophaps indica*. Eurasian Coot is considered of “regional concern” by Fellowes *et al.* (2002). All these species were present in low abundance (< 2 birds).

One Eurasian Woodcock was recorded in the middle lagoon during night survey. Eurasian Woodcock is mainly found singly along sheltered streams/water courses. The stream/nullah within the Study Area were either channelized or with open canopy, and were not considered optimal habitat of this species.

Two Eurasian Coots were observed in the middle lagoon. This species mainly occurs in the Deep Bay area, and inhabit open water areas with some emergent plants.

One Greater Coucal was observed in the middle lagoon. This species is a common and widespread resident, and occurs in many types of habitats.

Only one Emerald Dove was recorded flying across a ravine near Nim Wan Road in the study area. The optimal habitat of this species is large woodland, which is absent from the Study Area.

### **10.6.3 Dragonflies and Butterflies**

A total of 15 species of dragonfly species, including 13 by quantitative surveys (e.g., Green Skimmer *Orthetrum sabina*, Crimson Dropwing *Trithemis aurora*, see **Appendix 10.4**) and two additional between transects (Orange-tailed Midget *Agriocnemis femina* and Wandering Midget *A. pygmaea*) – were recorded within the Study Area. All are common and widespread in Hong Kong (Wilson 2004). Larval exuviae of dragonfly were found on the shore of the lagoons. This showed that dragonfly breed in the ash lagoons. None of the recorded dragonfly species is considered of conservation concern. Previously recorded

dragonfly species of conservation concern, Coastal Glider, was not found during the surveys.

A total of 29 species of butterfly (e.g., Paris Peacock *Papilio paris*, Common Grass Yellow *Eurema hecabe*) were recorded in the Study Area during quantitative surveys (**Appendix 10.5**). Seven additional species were recorded between transects. These were Chestnut Angle *Odontoptilum angulatum*, Common Straight Swift *Parnora guttata*, Chinese Dart *Potanthus confucius*, Common Bluebottle *Graphium sarpedon*, Lime Butterfly *Papilio demoleus*, Common Gull *Cepora nerissa* and Long-tailed Blue *Lampides boeticus*. All are common in Hong Kong (Yiu 2004).

Most recorded butterfly species are common and widespread in Hong Kong (Yiu 2004). A rare species, Red Lacewing *Cethosia biblis*, was recorded. This species is not considered of conservation concern by Fellowes *et al.* (2002). One Red Lacewing was recorded from orchard in Lung Kwu Tan, on the margin of the study area. The biggest population of this species in Hong Kong is found in Lung Kwu Tan (Yiu 2004). The larval foodplant of Red Lacewing is *Passiflora cochinchinensis* (Bascombe *et al.* 1999), which was not recorded within the Study Area during the current survey.

#### **10.6.4 Herpetofauna**

Three species of amphibian were recorded in the Study Area (**Appendix 10.6**). These included Asian Common Toad *Bufo melanostictus*, Gunther's Frog *Rana guentheri* and Brown Tree Frog *Polypedates megacephalus*. Eggs of Brown Tree Frog were found in streams within the Study Area. All the three species are common and widespread in Hong Kong (Chan *et al.* 2005).

Four species of reptile were recorded in the Study Area (**Appendix 10.6**). These were Changeable Lizard *Calotes versicolor*, Chinese Skink, *Eumeces chinensis*, Checkered Keelback *Xenochrophis piscator* and Copperhead Racer *Elaphe radiata*. All are common and widespread in Hong Kong (Karsen *et al.* 1998).

A Copperhead Racer was recorded at the middle lagoon. This species is common in open, dry, hilly, rocky habitat of mixed grassland and shrubland (Karsen *et al.* 1998). Copperhead Racer is considered of "potential regional concern" by Fellowes *et al.* (2002).

#### **10.6.5 Mammals**

Three species of bats were recorded in the Study Area during night surveys (**Appendix 10.6**). These were Leschenault's Rousette *Rousettus leschenaulti*, Short-nosed Fruit Bat *Cynopterus sphinx* and Japanese Pipistrelle *Pipistrellus abramus*. The bats were catching aerial insects near planters within the existing landfill. All three species are widely distributed in Hong Kong. All bats are protected under WAPO in Hong Kong. All these bat species are not considered of conservation concern by Fellowes *et al.* (2002).

A Small Asian Mongoose was sighted on the access road of ash lagoon during night survey. This species is protected under WAPO in Hong Kong, but not considered of conservation concern by Fellowes *et al.* (2002). Small Asian Mongoose inhabits a wide range of habitats (e.g., lowland wetlands, woodland) and is mainly reported from Northern New Territories (Shek 2006).

Scats of Small Indian Civet were found on the seawall of ash lagoon. This showed that this species used the habitats in the ash lagoon. Small Indian Civet is widely distributed in Hong Kong (Shek 2006). It is absent from Lantau Island. This species usually inhabits slight wooded area, and their diet consists of small vertebrates, insects and fruits (*ibid.*). Small Indian Civet is protected under WAPO in Hong Kong.

The present study showed that the diversity and abundance of terrestrial fauna within the Study Area was generally low. This was because the majority of the Study Area was covered by grassland/shrubland and urbanised/disturbed, which are of low vegetation cover

and high disturbance level and are not optimal habitats for these fauna. The low diversity of amphibian and dragonfly was also attributed to the poverty of aquatic habitats within the Study Area, sedimentation of some stream courses and the presence of predatory fishes in the ash lagoons and fish ponds.

#### **10.6.6 Aquatic Fauna**

Aquatic fauna recorded during the survey are summarised in **Appendix 10.7**. In general, the stream courses within the Study Area were of low diversity and low abundance in terms of aquatic fauna. Aquatic fauna mostly concentrated in the channelised sections in particular where under tidal influence. Species recorded were common species. No aquatic species of conservation concern were found in any stream courses within the study area.

##### *Tsang Kok Stream*

Aquatic life in the upper course of Tsang Kok Stream was low in both diversity and abundance. No fish was sighted during the survey. Only limited aquatic insects (Small Pond-skaters) were found during the wet season but they were also sparse. The majority of the channelised section of the Tsang Kok Stream inside the existing landfill was dry or had a very low surface flow during the survey, and no aquatic life were observed.

##### *Stream A*

Aquatic fauna found at the perennial stream section of Stream A included Atyid shrimps *Caridina cantonensis*, small pond skaters, *Macrobrachium* shrimp and crabs *Varuna litterata*. Estuarine fish species recorded at the lowland section including mullet *Mugil cephalus*, Jarbua *Therapon jarbua* and other estuarine species invaded into the stream such as mangrove mud crabs *Scylla paramamosain*. No aquatic fauna were found in the seasonal tributaries of Stream A.

Species recorded at the channel section of Stream A included mullet *Mugil cephalus* and Mudskipper *Periophthalmus cantonensis*.

##### *Stream B*

The condition of the Stream B was similar with Tsang Kok Stream. The diversity and abundance of aquatic fauna was very low. No fish was sighted during the survey, and only limited aquatic insects were found.

##### *Tai Shui Hang Stream*

During the survey in November 2007, the mid section of Tai Shui Hang Stream (which is outside the Study Area) was also covered to conduct a further search for the fish species of conservation concern. Predaceous chub *Parazacco spilurus* was found in abundance along the midstream section of Tai Shui Hang Stream. Three individuals of the freshwater fish *Acrossocheilus parallens* were found in one of the rock pools. Other than this sighting, this fish was not recorded in any stream courses within the Study Area. It should be noted that the WENT Landfill Extension is separated from the Tai Lang Shui catchment area (which is considered one of the distribution ranges of this fish species in Hong Kong) by the hill ridge to the south of Nim Wan Road..

##### *Ash Lagoons*

Besides stream courses, the ash lagoons consisted of some water bodies within the Study Area. The aquatic plants in the middle ash lagoon might support some aquatic fauna. Predatory aquatic invertebrates including Back-swimmer and dragonfly nymphs were found during hand net sampling. Tilapia was sighted in the middle ash lagoon. During the field sampling in a previous study conducted in the ash lagoon, Tilapia had been collected in the middle ash lagoon by gill net (MWH 2003).

#### 10.6.7 Intertidal Communities

There were two types of intertidal communities occurring within the Study Area, i.e. the hard shore communities on the artificial seawalls and the soft shore communities on the mudflats and mangroves. The artificial seawalls at the ash lagoon and in the existing WENT landfill were surveyed in both wet and dry seasons. Species recorded both along and between transects are shown in **Appendix 10.7**. The hard shore communities were very low in both diversity and abundance. The only dominant organisms were rock oyster *Saccostrea cucullata*, but even this species was in low abundance. No species of conservation importance was recorded on the artificial seawalls.

Except those in lower tidal levels, the majority of the boulders on the seawalls at ash lagoon had no epifauna colonised. All of the species recorded are common and widespread in Hong Kong.

Other intertidal fauna found on the seawalls near Tai Shui Hang included *Nerita yoldii*, and *Ligia exotica*.

The soft shore communities were surveyed in both wet and dry seasons, and were found more diverse and higher in abundance, when compared with the hard shore fauna. The narrow mudflat along the modified lowland section of Tai Shui Hang supported populations of *Uca* spp. (including *Uca arcuata* and *Uca lactea*) and *Ilyoplax* spp. There were also *Metopograpsus* sp. among the boulders inside the gabion along the channel, and *Perisesarma bidens* among the mangroves. Empty shells of Large Mangrove Clam *Geloina erosa* were also found. Further seaward, the mudflat expands eastward and formed part of the coastal mudflat along Deep Bay coastline. Crab burrows of *Uca* spp. and *Macrophthalmus* sp., which is a mudflat species, were found. Mudskippers *Periophthalmus cantonensis* was also sighted.

Two transects were deployed on the mudflat at Ha Pak Nai during wet season, and quadrat and core sampling were performed. The core samples were processed with sieves of 0.5 mm mesh size and preserved for identification and counting. The results of the core samples are shown in **Appendix 10.7**. A total of three species of infauna (all were polychaetes) was found in the core samples. All species found are common mudflat species and with no special conservation importance. There were only burrows and the common snails *Nassarius festivus* recorded in the results of the quadrats. But the active search revealed more faunal species, including *Macrophthalmus* sp., *Charybdis affinis*, *Hemigrapsus penicillatus*, and *Hemigrapsus sanguineus*.

Individuals of horseshoe crab juveniles were not found during the present study, but a fragment of a horseshoe crab moult was sighted during the survey in November 2007, and a carcass of a juvenile *Tachypleus tridentatus* (with the maximum prosomal width at 13cm) was also found during the survey in April 2008, indicating that the nearby area is used by horseshoe crab juveniles. There was also no seagrass found during the surveys.

Small number of common mangrove-associated and estuarine fauna (including Mudskippers *Periophthalmus cantonensis*, *Perisesarma bidens*, *Cerithidia djajdariensis* and *Terebralia* sp.) were also found on the fringe of a small grassland beside the tidal creek portion of Stream A. Other typical mudflat fauna was not found in this area, probably due to its higher elevation and harder substrates.

#### 10.6.8 Evaluation of Habitats and Species

The ecological importance of the habitats within the assessment area was evaluated in accordance with the criteria stipulated in Annex 8 of EIAO TM and are given in Tables 10.7 to 10.14.

In accordance with Table 3, Annex 8 of the EIAO-TM, the ecological value of species was assessed in terms of protection status (e.g. fauna protected under WAPO (except birds), and flora and fauna protected under regional/global legislations/conventions), species

distribution (e.g. endemic), and rarity (e.g. rare or restricted). The list and evaluation of the flora and faunal species of conservation concern recorded within the assessment area by both the current study and the STF EIA (2008), according to the TM-EIAO, are given in Tables 10.15 to 10.16.

**Table 10.7: Evaluation of Woodland Habitat within the Study Area**

Criterion	Description
Naturalness	Semi-natural habitat, consisted of a mixture of pioneer native tree species and orchard species.
Size	A total 4.26 ha scattered in various parts of the study area
Diversity	Low to moderate flora diversity. Low fauna diversity.
Rarity	No rare terrestrial flora or fauna recorded.
Re-creatability	Quite easy to recreate as it was formed of common species
Fragmentation	Fairly fragmented within the study area.
Ecological linkage	Not functionally linked to habitats of conservation importance
Potential value	High with protection
Nursery/breeding ground	No significant record, but can provide breeding habitats for birds, reptiles and butterflies
Age	Young, mostly about 5-15 years,
Abundance/richness of wildlife	Low bird and butterfly abundance, very low dragonfly abundance
Overall ecological value	Low to moderate

**Table 10.8: Evaluation of Plantation Habitat within the Study Area**

Criterion	Description
Naturalness	Man made (planted) with some natural colonisation
Size	A total of 13.68 ha scattered in various parts of the study area
Diversity	Low to moderate flora diversity. Low fauna diversity.
Rarity	No rare plant species recorded by current study. Fauna of conservation concern included Collared Scops Owl
Re-creatability	Easy to recreate
Fragmentation	Formed thin belts on engineering slopes
Ecological linkage	Not functionally linked to habitats of conservation importance
Potential value	Moderate with active management including thinning and interplant with native species
Nursery/breeding ground	No significant record. Value as breeding habitat for terrestrial fauna is low due to sparse canopy and made up of exotic tree species.
Age	Young
Abundance/richness of wildlife	Low bird and butterfly abundance, very low dragonfly abundance
Overall ecological value	Low

**Table 10.9: Evaluation of Grassland /Shrubland Habitat within the Study Area**

Criterion	Description
Naturalness	Mostly natural but frequently disturbed by fire
Size	342.26 ha
Diversity	Low to moderate flora diversity. Low fauna diversity.
Rarity	Two protected but common plant species included <i>Nepenthes mirabilis</i> and <i>Arundina graminifolia</i> . One tree species <i>Ixonanthes reticulata</i> locally common but recorded in China Red Data Book. One tree species <i>Aquilaria sinensis</i> common in Hong Kong but protected in China recorded by STF EIA Study. Fauna species of conservation concern included Black Kite, Common Buzzard, White-bellied Sea Eagle

Criterion	Description
Re-creatability	Maintained by hillfire
Fragmentation	Isolated stands on grassy hillsides
Ecological linkage	Not functionally linked to habitats of conservation importance
Potential value	Low due to presence of grave sites
Nursery/breeding ground	No significant record. Value as breeding habitat for terrestrial fauna is low due to high level of disturbance and low vegetation cover
Age	N/A
Abundance/richness of wildlife	Low bird and butterfly abundance, very low dragonfly abundance
Overall ecological value	Low

**Table 10.10: Evaluation of Stream /Channel within the Study Area**

Criterion	Description		
	Stream (perennial)	Tributaries (seasonal)	Channel
Naturalness	Semi-natural. Stream sections with fairly natural bedrock and banks but subject to various modifications including lost headwater, box culverts, concrete steps. Flow volume was generally low.	Semi-natural. Mainly upstream reaches of stream courses or seasonal tributaries. Some flow during wet season and no flow during dry season.	Artificial. Mainly converted from the mid and lowland sections of stream courses.
Size	Tsang Kok Stream: 563m Stream A: 698m Stream B: 720m Stream C: 650m	Stream A: 839 m	Tsang Kok Stream: 720 m Stream A: 700m Stream B: 239m Tai Shui Hang: 590m
Diversity	Low to Medium	Low	Low
Rarity	Common habitat. Common aquatic species recorded from the present study. No aquatic species of conservation concern recorded.	Common habitat. No aquatic species recorded.	Common habitat. A few fish species considered of conservation concern were reported in previous studies but were not found in the present survey. Fauna species of conservation concern included Little Egret.
Re-creatability	Not re-creatable	Not re-creatable	Readily recreatable
Fragmentation	The natural sections of Tsang Kok Stream and Stream A were fragmented.	Fragmented by Nim Wan Road construction.	Connected with open sea, but fragmented with stream courses.
Ecological linkage	Not observed. Fragmented to different levels.	Not observed. Fragmented to different levels.	Some estuarine species might invade the low land modified sections.
Potential value	Low	Low	Low
Nursery/breeding ground	No special record found.		Estuaries are potential nursery grounds for marine species.
Age	N/A		
Abundance/richness of wildlife	Low bird and butterfly abundance, low dragonfly abundance	Absence on aquatic fauna and low on other fauna	Low bird and butterfly abundance, very low dragonfly abundance, moderate abundance of

Criterion	Description		
	Stream (perennial)	Tributaries (seasonal)	Channel
	Very low abundance of aquatic fauna		estuarine aquatic fauna
Overall ecological value	Low to moderate	Low	Low

**Table 10.11: Evaluation of Orchard/Village and Fishponds Habitat within the Study Area**

Criterion	Description	
	Orchard/Village	Fishponds
Naturalness	Man-made habitat	Man-made habitat
Size	19.34 ha	9.68 ha
Diversity	Low for flora and fauna	Low for flora and fauna
Rarity	Fauna species of conservation concern included Red Lacewing	Fauna species of conservation concern included Little Egret and Chinese Pond Heron
Re-creatability	Easy to recreate	Easy to recreate
Fragmentation	Small stands near villages and on hillsides	Isolated at Ha Pak Nai
Ecological linkage	Not functionally linked to habitats of conservation importance	Not functionally linked to habitats of conservation importance
Potential value	Low	Low
Nursery/breeding ground	No significant record, but orchard/village habitats can provide breeding habitats for birds, reptiles and butterflies.	No significant record
Age	-	-
Abundance/richness of wildlife	Low bird and butterfly abundance, very low dragonfly abundance	Low bird and butterfly abundance, very low dragonfly abundance
Overall ecological value	Low	Low

**Table 10.12: Evaluation of Intertidal (Mangrove/Mudflat Habitat and Artificial Seawall) and Coastal Waters Habitats within the Study Area**

Criterion	Description		
	Mangrove/mudflat	Artificial Seawall	Coastal Waters
Naturalness	Semi-natural habitat for those along tidal creeks, sediments deposits at estuary of stream channels Natural habitat for the mudflat seaward to Ha Pak Nai	Artificial habitats, vertical seawalls or sloping boulder seawalls	Natural habitat
Size	5.24 ha	2,426 m	203.29 ha
Diversity	Low flora and terrestrial fauna diversity, moderate intertidal fauna diversity	Low or even no epifauna found	Moderate for benthos, low for coral and gorgonians.
Rarity	Horseshoe crab (carcass) recorded on the mudflat at Ha Pak	No rare species recorded	No rare species recorded. Scanty sightings of Chinese White Dolphins

Criterion	Description		
	Mangrove/mudflat	Artificial Seawall	Coastal Waters
	Nai ; fauna species of conservation concern included Little Egret, Grey Heron and Little Ringed Plover		over past 10 years
Re-creatability	Difficult to recreate	Readily recreate	Difficult to recreate
Fragmentation	N/A	N/A	N/A
Ecological linkage	Functionally linked to marine habitats as mangroves and mudflats provide nursery grounds for some marine fauna including horseshoe crabs.	Not functionally linked to habitats of conservation importance	Linkage with the open sea further southwest.
Potential value	Low for those along tidal creeks due to limited size, moderate for the mudflat seaward to Ha Pak Na	Low due to the nature of the substrate	Low
Nursery/breeding ground	Horseshoe crab juveniles were recorded on the mudflat seaward to Ha Pak Nai Mangroves and mudflats provide nursery grounds for some marine fauna.	No record	Not known as important nursery grounds for marine fauna.
Age	N/A	N/A	N/A
Abundance/richness of wildlife	Low bird and butterfly abundance, very low dragonfly abundance, moderate for intertidal fauna abundance	Low bird and butterfly abundance, very low dragonfly abundance, very low intertidal fauna abundance	Moderate for benthic infauna and low for corals or gorgonians.
Overall ecological value	Moderate to those along Tai Shui Hang channel. High for the mudflat seaward to Ha Pak Nai.	Low	Low

**Table 10.13: Evaluation of Ash Lagoon Habitat within the Study Area**

Criterion	Description		
	West Ash Lagoon	Middle Ash Lagoon	East Ash Lagoon
Naturalness	Man made habitat for dumping of PFA. Surface mostly dry with ash deposits and some colonised with weedy vegetation. Active ash dumping/dredging works observed during surveys	Man made habitat for dumping of PFA. The amount of water coverage varied with the amount of rainfall from 60% in wet season to 20% in dry season. No active ash dumping during surveys, but remnants of ash exposed especially during dry	Man made habitat for dumping of PFA. Surface mostly dry and colonised with weedy vegetation during survey.



Criterion	Description		
	West Ash Lagoon	Middle Ash Lagoon	East Ash Lagoon
		season.	
Size	15.38 ha	20.75 ha, about 5 ha of the southern part with open water, 3 ha of which was core area for Little Grebe	12.03 ha
Diversity	Low flora and fauna diversity	Low flora and terrestrial fauna diversity and moderate bird diversity	Low flora and fauna diversity
Rarity	None recorded; fauna species of conservation concern included Little Grebe	Fauna species of conservation concern included Little Grebe, Little Egret, Chinese Pond Heron, Great Egret, Chinese Pond Heron, Grey Heron, White-bellied Sea Eagle, Eurasian Woodcock, Common Redshank, Eurasian Coot, Greater Coucal, White-throated Kingfisher, Black-capped Kingfisher, Pied Kingfisher, Small Asian Mongoose and Small Indian Civet	No rare fauna species recorded; fauna species of conservation concern included Small Indian Civet, Black Kite, and Little Grebe
Re-creatability	Easy to recreate	Easy to recreate	Easy to recreate
Fragmentation	None	None	None
Ecological linkage	Not functionally linked to habitats of conservation importance	Not functionally linked to habitats of conservation importance	Not functionally linked to habitats of conservation importance
Potential value	Low due to high disturbance and variation of site conditions	Low due to high disturbance and variation of site conditions	Low due to high disturbance and variation of site conditions
Nursery/breeding ground	None recorded	Breeding sites and nursery site for Little Grebe and dragonfly at the core area of on the southern part of lagoon	None recorded*
Age	N/A	N/A	N/A
Abundance/richness of wildlife	Low	Low to moderate abundance of birds, Low butterfly abundance. Very low dragonflies abundance	Low
Overall ecological value	Low	Low to moderate	Low

\*none recorded during the survey for the present EIA, although breeding of Little Grebe were recorded by the STF study after heavy rain in June 2008.

**Table 10.14: Evaluation of Urbanised/Disturbed Habitat within the Study Area**

Criterion	Description
Naturalness	Man made habitat
Size	168.26 ha
Diversity	Low fauna diversity
Rarity	No rare terrestrial fauna recorded; fauna species of conservation concern included Black Kite, Leschenault's Roussette, Short-nosed Fruit Bat and Japanese Pipistrelle
Re-creatability	Easy to recreate
Fragmentation	None
Ecological linkage	Not functionally linked to habitats of conservation importance
Potential value	Low
Nursery/breeding ground	No significant record. Value as breeding habitat for terrestrial fauna is low due to high level of disturbance and low vegetation cover
Age	N/A
Abundance/richness of wildlife	Low bird and butterfly abundance, very low dragonfly abundance
Overall ecological value	Low

**Table 10.15: Evaluation of floral species of conservation importance within the Study Area**

Common Name	Scientific Name	Locations	Protection Status	Distribution	Rarity
Pitcher's Plant	<i>Nepenthes mirabilis</i>	Grassland/shrub land at ravines	Forestry Regulations (Cap. 96A), IUCN Red List of Threatened Species (Category LR/lc), CITES Appendix III	wet, open places on granite and sedimentary rocks (western New Territories)	common
Bamboo Orchid	<i>Arundina graminifolia</i>	Grassland within the Project Area	Protected under Forestry Regulations (Cap. 96A)	grassland and streamsides	Very common
Ixonanthes	<i>Ixonanthes reticulata</i>	Grassland/shrub land at ravine	Listed as vulnerable in China Plant Red Data Book	In thickets or thin forests	common
Incense Tree*	<i>Aquilaria sinensis</i>	Grassland-shrubland near the mouth of Stream A	Not protected locally but Category III nationally protected species in China and is listed as vulnerable in the China Plant Red Data Book and by IUCN (2002).	Lowland forests and fung shui woods	Locally common

\*recorded by STF EIA study (Metcalf and Eddy 2008) within the current Study Area

**Table 10.16: Evaluation of Faunal Species of Conservation Importance within the Study Area**

Common name	Locations	Protection Status	Distribution	Rarity
Japanese Pipistrelle	Urbanised/ disturbed area in landfill	WAPO	Widely distributed in Hong Kong	Commonest bat in Hong Kong
Leschenault's Rousette	Urbanised/ disturbed area in landfill	WAPO	Widely distributed in Hong Kong	Common in Hong Kong
Short-nosed Fruit Bat	Urbanised/ disturbed area in landfill	WAPO	Widely distributed in Hong Kong	Common in Hong Kong
Small Asian Mongoose	Ash lagoon	WAPO	Mainly reported from Northern New Territories	Uncommon in Hong Kong
Small Indian Civet	Scats found on seawall of Ash lagoon	WAPO	Widely distributed in Hong Kong, absent on Lantau	Very common in Hong Kong
Little Grebe	Middle and West Ash Lagoons	WAPO	Mainly reported from Northern New Territories	Common in Hong Kong
Little Egret	Mainly in Middle Ash Lagoon, also in stream, mangroves and fishpond	WAPO	Widely distributed in Hong Kong	Common in Hong Kong
Chinese Pond Heron	Middle Ash Lagoon and fishpond	WAPO	Widely distributed in Hong Kong	Common in Hong Kong
Great Egret	Middle Ash Lagoon	WAPO	Widely distributed in Hong Kong	Common in Hong Kong
Grey Heron	Middle Ash Lagoon and mangroves	WAPO	Mainly reported from Northern New Territories	Common in Hong Kong
Cattle Egret*	Watercourse south of the lagoons.	WAPO	Widely distributed in Hong Kong	Common in Hong Kong
Pacific Reef Egret*	Watercourse on the south of the lagoons.	WAPO; Class 2 Protected Animal of PRC	Mainly found in rocky shores in southern areas of Hong Kong island	Common in Hong Kong
Black-crowned Night Heron*	Grassland/shrubland and east lagoon	WAPO	Widely distributed in Hong Kong	Common in Hong Kong
Common Buzzard	Grassland/shrubland near the existing landfill	WAPO; Class 2 Protected Animal of PRC; Appendix 2 of CITES	Widely distributed in Hong Kong	Common in Hong Kong
White-bellied Sea Eagle	Middle Ash lagoon, grassland/shrubland near the existing landfill	WAPO; Class 2 Protected Animal of PRC; Appendix 2 of CITES	Mainly found in eastern waters of Hong Kong	Uncommon, about 8 pairs breed in Hong Kong

Common name	Locations	Protection Status	Distribution	Rarity
Black Kite	East Ash lagoon, Urbanised/ disturbed area in landfill, ravine habitat, grassland/shrubland near the existing landfill	WAPO; Class 2 Protected Animal of PRC; Appendix 2 of CITES	Widely distributed in Hong Kong	Common in Hong Kong
Osprey*	East lagoon.	WAPO; Class 2 Protected Animal of PRC; Appendix 2 of CITES	Mainly reported from Inner Deep Bay	Uncommon in Hong Kong
Collared Scops Owl	Plantation near Black Point	WAPO; Class 2 Protected Animal of PRC; Appendix 2 of CITES	Widely distributed in Hong Kong	Common in Hong Kong
Eurasian Woodcock	Middle Ash lagoon	WAPO	Widely distributed in Hong Kong	Rare in Hong Kong
Little Ringed Plover	Mangroves of Ha Pak Nai	WAPO	Widely distributed in Hong Kong	Common in Hong Kong
Common Redshank	Middle Ash Lagoon	WAPO	Mainly reported from Northern New Territories	Common in Hong Kong
Wood Sandpiper*	Middle lagoon	WAPO	Widely distributed in Hong Kong	Common in Hong Kong
Eurasian Coot	Middle Ash Lagoon	WAPO	Mainly reported from Northern New Territories	Common in Hong Kong
Emerald Dove	Stream near Nim Wan Road	WAPO	Widely distributed in Hong Kong	Rare in Hong Kong
Pacific Swift*	East Lagoon and grassland/shrubland	WAPO	Widely distributed in Hong Kong	Common in Hong Kong
White-throated Kingfisher	Middle Ash Lagoon	WAPO	Widely distributed in Hong Kong	Common in Hong Kong
Black-capped Kingfisher	Middle Ash Lagoon	WAPO	Mainly reported from coastal areas with mangroves	Uncommon in Hong Kong
Pied Kingfisher	Middle Ash Lagoon	WAPO	Mainly reported from Northern New Territories	Uncommon in Hong Kong
Blue-tailed Bee-eater*	Grassland/shrubland	WAPO	Mainly reported from the Deep Bay area	Scarce passage migrant in Hong Kong
Black-winged Cuckoo-shrike*	Grassland/shrubland	WAPO	Widely distributed in Hong Kong	Rare winter visitor and passage migrant in Hong Kong
Greater Coucal	Middle Ash lagoon	WAPO; Class 2 Protected Animal of PRC	Widely distributed in Hong Kong	Common in Hong Kong

Common name	Locations	Protection Status	Distribution	Rarity
White-shouldered Starling*	East Lagoon	WAPO	Mainly occurs in open country (e.g., rural village areas)	Common passage migrant, and scarce winter visitor in Hong Kong
<i>Acrossocheilus parallens</i>	Rock pool in Tai Shui Hang Stream outside the assessment area	NA	Distributes in Zhujiang area of South China; in Hong Kong a few locations only (in reservoir catchments on Hong Kong Island, Tuen Mun and Tai Po)	Rare in Hong Kong
Copperhead Racer	Middle Lagoon	No	Widely distributed in Hong Kong	Common in Hong Kong
Red Lacewing	Orchard in Lung Kwu Tan	NA	Widely distributed in Hong Kong	Rare in Hong Kong
Danaid Eggfly*	Secondary woodland along Tsang Tsui Road	NA	Restricted distribution in Hong Kong	Uncommon in Hong Kong
Glassy Bluebottle*	Shrubland around the East Lagoon; Secondary woodland along Tsang Tsui Road	NA	Restricted distribution in Hong Kong	Rare in Hong Kong
Horseshoe crab	Ha Pak Nai (only carcass recorded during current study)	NA	Mainly in Northwest Hong Kong and Lantau	Uncommon in Hong Kong

\*recorded by STF EIA study (Metcalf and Eddy 2008) within the current Study Area

## 10.7 Impact Identification and Evaluation

A detailed comparison of the ecological benefits and dis-benefits of all possible extension areas was made in the early stage of this EIA study (e.g. Value Management and the Option Assessment) and the results were summarised in Chapter 2 of this report, which recommended Option 4 as the preferred option. After the option assessment, the design was further developed and other issues such as the Nim Wan Road diversion, are included in this EIA.

The potential terrestrial and aquatic ecological impacts arising from the construction works of the preferred option together with the proposed Nim Wan Road diversion, including loss of habitats, removal of vegetation, and disturbance to animals were quantitatively assessed in accordance with Annexes 8 and 16 of the TM-EIAO. As the project area of STF EIA was located within the Study Area of the present Project, and the study period was very close to the current study, the potential impact of this project would also take into account the fauna species of conservation concern addressed by the STF EIA report. Particular attention was paid to the following:

- Habitat loss & removal of vegetation;
- Disturbance to wildlife;
- Impacts on fauna due to loss of habitats;
- Impacts to the aquatic life due to the accidental leakage of leachate and/or other wastewater;
- Impacts to the wildlife due to the accidental leakage of landfill gas;

- Cumulative impacts due to STF projects.

### 10.7.1 During Excavation and Landfill Operation

#### Direct Impacts

##### **Recognised Sites of Conservation Importance**

Since there is no sites of conservation importance defined within the study area, no direct impacts regarding this aspect is anticipated.

##### **Habitats and Vegetation**

The direct ecological impact of excavation for WENT Landfill Extension and Nim Wan Road diversion would be loss of habitats and associated vegetation. The proposed project component would cause losses of 172.95ha of grassland/ shrubland, 28.4ha of ash lagoon, 3.76 ha of woodland, 3.64ha of plantation, 1.05ha of orchard/village, 27.57ha of urbanised/disturbed area, 1251m of stream sections, 839m of seasonal tributaries and 1420m of channel (Table 10.17).

**Table 10.17: Habitat loss due to WENT Landfill Extension**

Habitat type	Caused by Option 4 (Landfill Extension and Nim Wan Road Diversion)
	Area (ha)
Grassland/Shrubland	172.95
Ash Lagoon	28.40
Woodland	3.76
Plantation	3.64
Orchard/Village	1.05
Urbanised/Disturbed	27.57
Stream/channel	
Stream A	Natural section (perennial): 698m Natural section (seasonal tributaries): 839m Channelised section: 700m
Tsang Kok Stream	Natural section (perennial): 563m Channelised section: 720m
Total (except stream/channels)	237.37 ha

Most habitats to be lost are of low ecological values, with the exception of woodland, middle ash lagoon and natural stream section which are of low to moderate ecological value. Loss of these habitats would occur in 6 phases from the mid 2010s to the end 2020s due to progressive change in topography of the site during the construction and operation phases of the WENT Landfill Extension development over 10 years and therefore the extent of impacts would be diluted.

According to Annex 8 of the EIAO-TM, mature woodland larger than 1 ha is considered as an important habitat. Although a total of 3.76 ha of woodland would be lost, the woodland was young and composed of a mixture of common native pioneer and planted species with low to moderate diversity and therefore relatively easy to recreate. Loss of woodland would also be progressive and mainly occur in the last phase of site formation, and therefore the potential impact is ranked as low to moderate. However, due to irreversible nature, long duration and moderate magnitude of impacts, mitigation measures are required and should include compensatory woodland planting for the woodland loss and transplantation of flora of conservation importance.

The two recorded plant species of conservation interest, *Arundina graminifolia* and *Nepenthes mirabilis* which were mainly recorded on grassland/shrubland habitat near Tsang Kok valley would be directly impacted by the project. Although common in Hong Kong, both species are protected under Forestry Regulations and therefore transplantation is proposed. Previous successful examples of transplantation of *Nepenthes mirabilis* (Weatherhead, undated) demonstrate that this species is transplantable, and the survival rate was high with

careful selection of receptor site, correct season for transplanting and proper handling of the plant materials. Since the recorded location would be subject to site formation during Phase 1 in 2016, mitigation by transplantation before commencement of site formation is required. The tree species of concern, *Aquilaria sinensis* recorded in woodland by STF EIA study would also be directly affected by the project. Mitigation by transplantation is proposed. Another recorded tree species of concern, *Ixonanthes reticulata*, although recorded in the "China Plant Red Data Book", can be found in "various localities in Hong Kong and the populations are not under any particular threat" (AFCD 2003). Also, as the individuals recorded grew in ravine, they would probably have deformed root system which results in low survival rate upon transplantation. Therefore, transplantation is not recommended. This species can be included as one of the native species for compensatory planting.

### **Avifauna**

The potential impacts to each avifauna species of conservation concern were detailed in evaluated in **Table 10.20b** and summarised below.

The present and previous surveys showed that Little Grebe bred in the Tsang Tsui ash lagoons (MWH 2003, Arup 2006, Metcalf & Eddy Ltd. 2008, this study). The ash lagoons potentially support significant proportion of local breeding population of this species (MWH 2003). Of the 15.38 ha of the ash lagoon area to be lost, only about 5 ha of surface were covered by water, and the major breeding habitat of Little Grebes was confined to the open water area with emergent vegetation on the southern part of the middle lagoon, which is estimated to be about 3 ha in size. During the field survey of the present EIA study in 2007, three pairs of Little Grebe nested in the middle ash lagoon, and adults with juveniles were sighted in the west ash lagoon. The east ash lagoon was not considered optimal habitat of Little Grebe due to overgrowth by vegetation. The STF EIA recorded one pair of breeding Little Grebe in the east lagoon and predicted that during construction phase of STF (2010 to 2012), the pair would continue their breeding activities in the middle ash lagoon until when the middle ash lagoon will be subject to site formation in the last phase, Although the impacts to Little Grebe would be diluted by delayed loss of habitats, the proposed project will inevitably cause loss of ash lagoons. Therefore, the impact due to loss of the middle ash lagoon is ranked as low to moderate, and mitigation measure to minimise the impact to Little Grebe is required.

Other bird species recorded breeding within the study area are common land birds including Chinese Bulbul, Common Tailorbird, Long-tailed Shrike, Crested Myna, Eurasian Tree Sparrow and Spotted Munia. The Study Area was composed of largely composed of degraded, fragmented habitats and urbanised/disturbed area with little vegetation cover and therefore is not a major breeding site for the bird species recorded. The breeding records of these species came from woodlands and plantations which are available in nearby localities, and together with compensatory woodland planting after restoration phase, there would be sufficient breeding habitats for these bird species. Therefore the potential impacts to these breeding bird species are ranked as minor.

Except Little Grebe, other bird species recorded of conservation concern were of low or very low abundance and made up a low proportion of their local abundance, and no breeding was recorded. Loss of the middle lagoon would occur in last phase (i.e. early 2020s), while alternative habitats are also available in nearby areas, e.g. Ha Park Nai. Other landbirds are mostly habitat generalists (e.g., Black Kite, Common Buzzard, Great Coucal and Pacific Swift) and can find alternative habitats in nearby areas. In addition, upon restoration of the landfill, a mosaic of ponds, woodland, shrubland and grassland would be reprovided (**see Section 10.8.3**) and available for these species. The potential impacts to these avifauna species are considered minor.

### **Other Terrestrial Fauna**

Habitats to be lost include grassland/shrubland, ash lagoons, urbanised/disturbed, stream/channel, orchard/village, woodland and plantation. The habitats to be lost are not the optimal habitats of the terrestrial fauna species of conservation importance, due to the disturbed and/or fragmented nature. The abundance of the terrestrial fauna species of conservation importance recorded within the study area were low, while loss of habitat will occur progressively in 6 phases over 10 years thereby further diluting the impacts. In addition, upon restoration of the landfill, a mosaic of ponds, woodland, shrubland and grassland would be reprovided (**see Section 10.8.3**) and available for these species. The potential impact to terrestrial fauna due to loss of habitats is anticipated to be minor.

### **Aquatic Habitat and Fauna**

The proposed option and Nim Wan Road diversion would involve no marine works or reclamation. Therefore, no loss of or impacts on marine or intertidal habitat, including mudflat, mangroves, seagrasses, horseshoe crab, intertidal and subtidal benthic communities which are listed as key issues for the current study, are anticipated. Mudflats at Ha Pak Nai, which are considered of high ecological value, are located further northward of Tai Shui Hang and isolated from the Project Area by the existing WENT landfill. Therefore no direct impacts caused by the project are anticipated.

The current landfill option would cause a loss of 698 m of Stream A, 563 m of Tsang Kok Stream, 893 m of seasonal tributaries of Stream A and 1420 m of channel within the proposed extension area (see **Table 10.17**). Among them, the 563m of Tsang Kok Stream is the remnant of its middle section, while the lower section of both streams have been channelized, including Tsang Kok Stream Outfall. The seasonal tributary and channel habitats within the Project Area (the boundary of the proposed extension) is of low ecological value while the perennial section of Stream A and Tsang Kok Stream is of low to moderate ecological value (see **Table 10.10**). According to Annex 8 of the EIAO-TM, natural stream courses and rivers longer than 500m are considered as important habitats. However, the stream courses (both seasonal and perennial) within the Study Area were all subject to fragmentation and disturbance of various levels due to previous modifications or channelisation works. Movement/migration of aquatic fauna along the courses had been limited or even had been cut off (the flow might disappear in modified sections during the dry season). It has been years since the modifications and no other major disturbance were observed since then, but the current diversity and abundance of aquatic fauna were still low, and no aquatic species of conservation importance were recorded. Therefore, the ecological value of the natural section of these streams is considered moderate ecological value due to the physical nature, but is low owing to its limited ecological function. The possibility of any significant elevation of the ecological values in these stream courses is not foreseen, and thus they are of limited potential value.

The rare freshwater fish *Acrossocheilus parallens* which was recorded during the present survey in Tai Shui Hang would not be affected by the Project as their habitats are outside the Project Site and located in a different catchment area separated by hill ridge. Impact on this species is not anticipated.

Given the above information, and similar habitats were available in the vicinity of the Project Site (such as Tai Shui Hang). The impact from the loss of stream/channel habitat is thus ranked as low, and no mitigation is required.

### **Indirect impacts**

#### **Changes in Water Qualities**

The proposed option and Nim Wan Road diversion would involve no marine works or reclamation. The potential construction phase impacts to marine water quality, hydrodynamic properties, sedimentation rates and patterns are thus avoided. Potential impacts to the two nearest marine (i.e. Sha Chau and Lung Kwu Chau Marine Park) and



intertidal (Pak Nai SSSI) sites of conservation importance, which are 3.5 km away from the study area, would be negligible. The existing berthing facilities of the existing WENT Landfill will be used for the WENT Landfill Extension. There are no additional berthing facilities / barging points, and thus no capital dredging will be required. Maintenance dredging will be conducted at the infrequency as for the existing WENT Landfill and no additional water impacts could be caused. Water quality impacts from the maintenance dredging on marine habitats and marine/intertidal species concerned, including mudflats at Ha Pak Nai, seagrasses, mangroves, intertidal and subtidal benthic communities, would be minimal.

During site formation, sedimentation may constitute an indirect impacts to water quality, in particular at Tsang Kok Stream Outfall which is in proximity of coastal waters. No dredging is required at Tsang Kok Stream Outfall during site formation. Sediments will be contained in permanent detention ponds/silt traps that will be constructed according to the landfill phasing. Where possible these sediment traps will be maintained during the operation of each phase to ensure the effective control of operational soil erosion problem. Construction phase precautionary measures following the Practice Note for Professional Persons on Construction Site Drainage, Environmental Protection Department, 1994 (ProPECC PN 1/94), and DSD Technical Circular TC14/2000 (see Section 5.5.3) will be performed. The construction runoff discharged from the landfill site shall fully comply with the standards stated in **Section 5**, otherwise the discharge shall be collected and conveyed to the on-site leachate treatment and eventually discharged via the existing submarine outfall at Urmston Road.

During the operation phase of the landfill the tipping face will remain substantially exposed. Due to contact with the waste material, all run-off generated from within it will be collected and treated. Groundwater will be protected by an impermeable barrier fully lined within the landfill. All leachate will be diverted to the leachate treatment plant for treatment within the landfill prior to being conveyed to be discharged via the existing submarine outfall at Urmston Road via the realigned Nim Wan Road.

Surface runoff of the capped areas in the WENT Landfill Extension will be collected through the installation of site drainage system and be discharged through the storm drains. The proposed site drainage will be designed with adequate capacity. It is anticipated that the surface runoff will not have adverse water quality impact to the environment.

#### ***Accidental Leakage of Landfill Gas***

Landfill gas (LFG) contains methane and carbon dioxide may have adverse effects on plant growth by suppressing the oxygen level in soil and thus the root establishment and therefore is identified as a potential impact on flora in the surrounding environment.

The WENT Landfill Extension would be implemented with LFG extraction system, which is currently adopted by existing WENT Landfill, to remove the LFG. With high quality of composite cap, leachate contamination and LFG migration to cover soil is unlikely, as proved by the existing WENT Landfill. A monitoring system would also be implemented to monitor any abnormal / accidental events such as leakage. The triggering levels are summarised below:

- CH<sub>4</sub>: > 10% of the Lower Explosion Limit (LEL);
- CO<sub>2</sub>: > 0.5% by volume; and
- O<sub>2</sub>: < 19% by volume

The future DBO contractor of the WENT Landfill Extension would also be requested to develop and implement an emergency contingency plan such that the responsibilities and tasks of all concerned parties during emergency are clearly defined. Hence, it is considered that any accidental leakage of LFG would only be temporary. Given the short duration for any temporary leakage, if any, its associated ecological impacts are also considered as temporary and thus minor.

### **Accidental Leakage of Leachate and/or Other Wastewater**

Leachate is the rain water that passes through the active tipping face of the landfill and picks up dissolved, colloidal, and suspended solids in concentrations that vary widely in different local conditions. It may contain high concentration of ammonia, nitrogen radicals, organic acids, dissolved salts, (sodium in particular), and various heavy metals, e.g. lead, zinc.

The WENT Landfill Extension would be implemented with a new leachate treatment plant to remove the leachate to acceptable level. It should also be noted that the amount of effluent from treatment plant would only be about 1% of the submarine outfall. Hence, any impacts during accidental leakage would be insignificant.

The total leachate generated from the existing WENT Landfill and its extension will be under controlled. All leachate would be collected and conveyed for treatment. The liner system of the existing WENT Landfill consists of a 2 mm high density polyethylene (HDPE) liner, a 6 mm bentonite matting and a leachate collection system to prevent leachate seeping / leaking into the natural groundwater system. The two layers of impermeable barriers (one layer on the bottom of waste filling, while the second layer on the top of the waste filling and beneath the cap soil) could effectively prevent any accidental leakage of leachate in case the collection system failed. Similar design was adopted in previous landfill sites including the existing WENT, and the performance of this design has been proven. A network of groundwater boreholes will also be established to monitor any leachate leakage. The existing contingency plan, including groundwater extraction, interception and diversion (see Section 5.6.8.1), will be used as basis for developing the Contingency Plan for the WENT Landfill Extension. Groundwater and surface water monitoring will be conducted with the below trigger levels.

Parameter	Trigger Levels (mg/L)	
	Groundwater	Surface Water
Ammonia Nitrogen	0.5	0.5
COD	20	30
BOD	5	20

In the event that the above trigger levels are exceeded, the DBO Contractor will implement a Corrective Action Programme, which shall include but not limited to the following:

#### Contingency Plan for Groundwater Contamination

- groundwater interception and diversion; and
- groundwater extraction (by active pumping of leachate from leachate and groundwater collection layers) and treatment prior to discharge.

#### Proposed Modifications to Contingency Plan for Groundwater Contamination

Potential actions to be taken in case of identification of groundwater contamination should also include:

- Installation of additional ground-water monitoring well;
- Increased frequency of ground-water quality testing;
- Installation of ground-water extraction wells to remove contaminated groundwater for treatment;
- Installation of subsurface barriers, such as bentonite; and

- Detailed investigation of the potential impact to be performed within six months of the first detection of the justified impact.

#### Contingency Plan for Surface Water Contamination

- Surface water interception and temporary storage of the contaminated surface water;
- Installation of surface barriers, such as sand bund along the surface water channel / site boundary to avoid overflow off-site;
- Active pumping of the contaminated surface water to the leachate lagoons / leachate recirculation system / on-site leachate treatment plant;
- Additional monitoring locations will be selected to determine the pollution source;
- Installation of surface barriers, such as intercepting bund to separate the active and inactive tipping area;
- Change of working methods to prevent surface water contamination; and
- Implementation of diversionary works.

Accidental leakage of leachate from the rupture of leachate pipeline, the failure of pipe joint sealing and the damage of geomembrane will cause water quality impact. These may result in the discharge of pre-treated leachate to the nearby streams and ultimately groundwater. The preliminary predicted groundwater flow paths in the vicinity of the site show that the groundwater flows towards the sea (i.e. northward). Tai Shui Hang Stream catchment is separated from the WENT Landfill Extension by the existing WENT Landfill. It is unlikely that the pre-treated leachate will migrate towards the west to Tai Shui Hang Stream through the natural groundwater transmission path. Therefore, the associated ecological impacts of accidental leachate to Tai Shui Hang catchment and the rare freshwater fish *Acrossocheilus parallens* are considered negligible.

Toxic substances in leachate might affect plant growth. A monitoring system would be implemented to monitor any abnormal / accidental events such as leakage. The future DBO contractor of the WENT landfill Extension would also be requested to develop and implement an emergency contingency plan such that the responsibilities and tasks of all concerned parties during emergency are clearly defined. Hence, it is considered that any accidental leakage of leachate would only be temporary. Given the short duration for any temporary leakage, if any, its associated ecological impacts are also considered as temporary and thus minor.

#### **Cumulative impacts with other proposed development projects**

According to the latest information from EPD, the only other major committed development within the study area is the Sludge Treatment Facilities (STF) on the northern part of the east ash lagoon. Both the IWMF and STF project sites are enclosed by the WENT Landfill Extension boundary. For IWMF, the EIA and site selection process is underway, and there is no implementation programme for this project. The cumulative impacts caused by the STF project and both go and no-go scenarios of IWMF project are assessed below.

The STF EIA was approved by EPD on February 2009. According to the STF EIA, the project would cause the loss of 6.04 ha of east ash lagoon, 1.59 ha of shrubland/grassland, 0.02 ha of plantation and 0.1 ha urbanised/disturbed area. Except the impacts of loss of east ash lagoon to Little Grebe which was evaluated as low to moderate, all other impacts to habitats and species of conservation concern were ranked as negligible to low. The current impact identification and evaluation has taken into account the impacts on Little Grebe caused by the STF project, and therefore no significant cumulative impacts are anticipated.

Should both STF and IWMF proceed, construction activities would cause constitute potential cumulative impact to Little Grebe in the southern part of the middle ash lagoon, including breeding activities before the commencement of the construction phase of WENT Landfill

Extension. The STF EIA proposed precautionary measures including provision of hoarding for the middle ash lagoon, inspection of hoarded area, and implementation of site practice to minimise disturbance to the middle ash lagoon. With implementation of such measures, no significant potential cumulative impacts are anticipated.

***"What if IWMF not proceed"***

Based on the current assumption, the northern half of the middle ash lagoon is selected as the final location of IWMF and the northern half of the middle ash lagoon would be lost prior to commencement of WENT Landfill Extension. If Shek Kwu Chau instead of the middle lagoon is selected as the final location of IWMF, the remaining middle ash lagoon would be included in and incorporated into part of the WENT Landfill Extension area, and therefore the magnitude of cumulative impacts would remain the same in both cases. The impact identification and evaluation process has taken into account the potential impacts on loss of the middle lagoon and its associated flora and fauna regardless of their recorded location (on northern half or southern half of the ash lagoon). In addition, the northern half of the lagoon was dry most of the time while open water habitat appeared to concentrate on the southern half of the lagoon where most sightings were made. Therefore, the potential cumulative impacts caused by either scenario (with or without IWMF on northern ash lagoon) would not be significant, and the mitigation measures proposed have addressed impacts to loss of the middle ash lagoon and its associated species as a whole.

**10.7.2 Upon Landfill Restoration and Afteruse Phases  
Terrestrial Habitat and Fauna**

Upon completion of operation and after restoration phase, the landfill site would be restored by planting of woodland, shrubland and grassland species (see Chapter 8). The planting and maintenance would be implemented by the DBO Contractor, who will take care of the site for 30 years after restoration. The mosaic of woodland, shrubland and grassland would provide habitats for various fauna and therefore would constitute a positive impact. No adverse ecological impact to the surrounding terrestrial habitats and associated fauna is anticipated.

**Aquatic Habitat and Fauna**

Upon completion of the landfill works, the site would be capped with a second impermeable barrier for afteruse. Any surface run-off generated over the area would then be collected by the stormwater drainage system. Given that it would have had no interaction with the underlying waste material, the surface run-off would be of a high enough quality to be discharged directly into Outer Deep Bay. New drainage channel will be provided along the site boundary and new Nim Wan Road to convey all the surface run-off through box culverts to the sea.

Seepage/leakage of leachate for a restored landfill would have less impact than an operating landfill, and the leachate collection system will still perform in the same standard as in operation phase. The ecological impacts due to changes in surface runoff are anticipated to be minor. No mitigation is required during the restoration phase.

The construction, operation and the restoration phases impacts are summarised in **Tables 10.18** and **10.19**.

The overall impacts to habitats are summarised in **Table 10.20a** while the overall impacts to species of conservation concern from the proposed project are summarised in **Table 10.20b**.

**Table 10.18: Construction and Operation Phases Impacts**

Activity	Source	Receiver	Nature of Impacts						Severity	Mitigation Required
			Habitat quality	Species affected	Size-abundance	Duration	Reversibility	Magnitude		
Site formation	Site preparation	Terrestrial habitat and associated flora and fauna	Woodland, stream (natural perennial section) and middle ash lagoon habitat are of low to moderate ecological value, while other habitats are of low value	Fauna and flora species recorded in the project area, including four plant species of conservation interest ( <i>Arundina graminifolia</i> , <i>Nepenthes mirabilis</i> , <i>Aquilaria sinensis</i> , <i>Ixonanthes reticulata</i> ) affected, bird species (Little Grebe) breed in the ash lagoons would be affected	A total of about 237 ha of the Project area to be affected	Long term and permanent	Irreversible	Moderate to Large	Low to moderate	Yes, detailed surveys and transplantation of species of conservation concern (under circumstance technically feasible), compensatory planting, habitat creation for Little Grebe, capture and translocation plan in streams
Noise, dust and visual disturbance	Works equipment and human activities	Faunal species on adjacent habitats	Terrestrial habitats affected are of low ecological importance	Disturbance sensitive fauna	Terrestrial habitats affected confined to areas adjacent to work areas.	Temporary	Reversible	Low	Minor	Yes, good site practice
Changes in Water quality	Site runoff and leachate	Aquatic fauna	Low or low to moderate for stream/channel; low or moderate for intertidal and marine.	Common species	N/A	Temporary	Reversible	Low (all runoff and leachate will be transferred offsite for treatment)	Minor	Yes, good site practice

**Table 10.19: Restoration and afteruse phase impacts**

Activity	Source	Receiver	Nature of Impacts						Severity	Mitigation Required
			Habitat quality	Species affected	Size/abundance	Duration	Reversibility	Magnitude		
Compensatory Planting	Planting activities	Existing*/New landfill site	Low on finished landfill site	Few/none on new capped surface	21 ha to be replanted with trees seedlings/whips and the rest planted with shrubland and grassland species	5 years of planting	Irreversible	Moderate	Positive impact	No
Habitat creation for Little Grebe	Pond construction	Existing/New landfill site	Low on finished landfill site	Few/none on new capped surface	A total of 5 ha of ponds to be created	Less than half a year of construction	Irreversible	Moderate	Positive impact	No

\*subject to agreement with the DBO contractor of existing landfill

**Table 10.20a Overall Impacts to Habitats**

Evaluation Criteria	Habitat Quality	Species	Size/abundance	Duration	Reversibility	Magnitude	Overall Impact Conclusion	Mitigation Required
Woodland	Low to moderate	The habitats support low to moderate floral diversity and low faunal diversity. No species of conservation interest affected	Small to moderate. About a total of 3.76 ha will be affected.	Habitat loss would be permanent. Loss would occur by phases in 12 years and hence impact diluted  indirect impact to wildlife resulting from works equipment and human activities would be temporary.	Habitat loss irreversible, Disturbance during site formation and landfill operation reversible	Moderate but progressive loss	Low to moderate	Yes, 5:1 ratio compensation, with advance planting of 5 ha of woodland on existing landfill site and 16 ha of woodland planting on the WENT Landfill Extension site after restoration phase
Plantation	Low	The habitats support low to moderate floral diversity and low faunal diversity. No	Small to moderate. About 3.64 ha will be affected.	Habitat loss would be permanent. Loss would occur by phases in 12 years	Habitat loss irreversible, Disturbance during site formation and	Small	Low	No, but compensatory woodland planting and

Evaluation Criteria	Habitat Quality	Species	Size/abundance	Duration	Reversibility	Magnitude	Overall Impact Conclusion	Mitigation Required
		species of conservation interest affected.		indirect impact to wildlife resulting from works equipment and human activities would be temporary.	landfill operation reversible			landscape planting proposed would be an enhancement measure .
Orchard/ Village	Low	The habitats support low biodiversity. No species of conservation interest affected.	Small. About 1.05 ha will be affected.	Habitat loss would be permanent. Loss would occur by phases in 12 years  Indirect impact to wildlife resulting from works equipment and human activities would be temporary.	Habitat loss irreversible , Disturbance during site formation and landfill operation reversible	Small	Negligible	No
Grassland/ Shrubland	Low	The habitats support low biodiversity. Four species of conservation interest affected.	Moderate to large. About 172.95 ha will be affected.	Habitat loss would be permanent. Loss would occur by phases in 12 years  indirect impact to wildlife resulting from works equipment and human activities would be temporary.	Habitat loss irreversible , Disturbance during site formation and landfill operation reversible	Moderate but this habitat is abundant locally and is maintained by fire disturbance	Low	No, grassland and shrubland will be planted after restoration phase
Fish Pond	Low	The habitats support low biodiversity. No species of conservation interest affected.	The habitat would not be directly affected.	indirect impact unlikely as it is far from the project area and separated by Tai Shui Hang Stream	N/A	N/A	Negligible	No
Mangroves/ Mudflat	Moderate to high	The habitats support low biodiversity. No species of	The habitat would not be directly affected.	Indirect impact unlikely as it is far from the project area and	N/A	N/A	Negligible	No

Evaluation Criteria	Habitat Quality	Species	Size/abundance	Duration	Reversibility	Magnitude	Overall Impact Conclusion	Mitigation Required
		conservation interest affected.		separated by Tai Shui Hang Stream				
Ash Lagoon	East and West Lagoon: low	The habitats support low biodiversity.	Moderate	Habitat loss would be permanent. Loss would occur in last landfill operation phase  Indirect impact to wildlife resulting from works equipment and human activities would be temporary.	Habitat loss irreversible, Disturbance during site formation and landfill operation reversible	Low to moderate	Low	No
	Middle lagoon: low to moderate,	The habitats support moderate diversity of birds. Breeding population of Little Grebe affected.	Moderate (5 ha of open water, 3 ha of which was breeding habitat of Little Grebe)	Habitat loss would be permanent. Loss would occur in last landfill operation phase  Indirect impact to wildlife resulting from works equipment and human activities would be temporary.	Habitat loss irreversible, Disturbance during site formation and landfill operation reversible	Low to moderate.	Low to moderate	Yes, advance creation of 3 ha of ponds on existing landfill site before demolition of middle ash lagoon and 2 ha of pond on WENT Landfill Extension after restoration phase
Artificial seawall	Low	The habitats support low biodiversity with no species of conservation interest recorded. No species of conservation interest affected.	The habitat would not be directly affected.	Indirect impact to wildlife resulting from human disturbance, construction activities and increased road traffic would be temporary.	Disturbance during site formation and landfill operation reversible	N/A	Negligible	No



Evaluation Criteria	Habitat Quality	Species	Size/abundance	Duration	Reversibility	Magnitude	Overall Impact Conclusion	Mitigation Required
Urbanised/ Disturbed Areas	Low	The habitats support low biodiversity. No species of conservation interest affected.	Moderate. About 27.57 ha would be affected.	Indirect impact to wildlife resulting from human disturbance, construction activities and increased road traffic would be temporary.	Disturbance during site formation and landfill operation reversible	Small. The size of habitat loss is small in comparison with the surrounding similar habitats.	Low	No
Coastal Waters	Low	The habitats support low biodiversity. No species of conservation interest affected.	The habitat would not be directly affected.	Indirect impact to wildlife resulting from marine traffic would be temporary.	Disturbance during site formation and landfill operation reversible	No direct impact is expected, and the area is currently subject to disturbance from heavy traffic in the nearby area.	Negligible	No
Stream/ Channel	Low to moderate for perennial streams, and low for seasonal tributaries	The habitats support low biodiversity.	698 m (Stream A) and 563 m (Tsang Kok Stream) of perennial stream, 839m (Stream A) of seasonal tributaries, to be affected.	<i>Construction and Operation Phase</i> Habitat loss would be permanent. Loss would occur during last phase of landfill operation	Habitat loss irreversible, Disturbance during site formation and landfill operation reversible	Low to moderate	Low	No, pond creation on existing and proposed landfill would provide habitats for some aquatic fauna and enhance the ecological value of the landfill site
	Channel: low	The habitats support low biodiversity. No species of conservation interest affected.	Moderate. About 1420m to be affected.	Habitat loss would be permanent. Loss would occur by phases in 12 years	Habitat loss irreversible, Disturbance during site formation and landfill operation reversible	Low to moderate.	Low	No, fish capture and translocation survey for fish species of concern proposed as a precautionary measure

**Table 10.20b Overall Impacts to Flora and Fauna Species of Conservation Concern During Construction and Operation Phases (fauna species recorded in STF EIA indicated by “\*”)**

Species of Conservation Interest				
Common Name	Scientific Name	Description	Evaluation of impacts	Mitigation Required
<b>Flora</b>				
Pitcher's Plant	<i>Nepenthes mirabilis</i>	Individuals of this species and a major colony at Tsang Kok Valley fall inside site formation area. Direct loss anticipated. This plant species however is wide spread in NWNT and considered locally common. Large colonies were also observed elsewhere. Transplantation is proposed.	Low to moderate	Yes. Transplantation of major colony to receptor site at Stream B.
Bamboo Orchid	<i>Arundina graminifolia</i>	Individuals of this species fall inside site formation area. Direct loss anticipated. This plant species is common in Hong Kong, and only 2 individuals observed inside site. Transplantation is proposed.	Low	Yes. Transplantation of individuals to receptor site at Stream B.
Incense Tree	<i>Aquilaria sinensis</i>	One tree falls inside site formation area. Direct loss anticipated. This plant species is common in Hong Kong but under threat due to illegal harvest. Transplantation is proposed.	Low	Yes, transplantation of individuals to peripheral area of New Leachate Treatment Facilities at the WENT Landfill Extension. This species is also included as one of the native species for compensatory planting.
Ixonanthes	<i>Ixonanthes reticulata</i>	A few individuals at ravine fall inside site formation area. Direct loss anticipated. This plant species is common in Hong Kong the populations and is not under any particular threat. Low survival rate after transplantation, and therefore transplantation is not recommended.	Low	No, but this species is also included as one of the native species for compensatory planting.
<b>Avifauna</b>				
Little Grebe	<i>Tachybaptus ruficollis</i>	Three nests of Little Grebe were recorded from the middle lagoon and adults with juveniles were sighted in the west lagoon. This is the only fauna species of conservation concern with breeding observations.  The preferred habitats of Little Grebe are <i>gei wais</i> and fishponds, especially those with emergent or submerged vegetations.  The ash lagoons, however, is a man-made habitat for ash dumping. The quality as breeding habitat for Little Grebe is affected by ash filling activities and water coverage. Water coverage in the ash lagoons are affected by rainfall and input of cooling water from the power station. The quality of the ash lagoons as breeding habitat of Little Grebe is therefore highly volatile.	Low to moderate	Yes. A total of up to 5 ha of ponds of higher habitat quality will be created, with 3 ha on existing landfill before demolition of middle ash lagoon and 2 ha on WENT Landfill Extension after restoration.

Species of Conservation Interest				
Common Name	Scientific Name	Description	Evaluation of impacts	Mitigation Required
		<p>The availability of the ash lagoon as breeding habitat of Little Grebe is also affected by vegetation cover. The east lagoon was nearly completely overgrowth by vegetation and no breeding of Little Grebe was observed during the study period. Of the 28.4 ha of the ash lagoon area to be lost, only about 5 ha of surface were covered by water, and the major breeding habitat of Little Grebes was confined to the open water area with emergent vegetation on the southern part of the middle lagoon, which is estimated to be about 3 ha in size.</p> <p>Due to the unstable nature of the lagoon habitat and frequent disturbance from ash filling activities, the impact due to loss of this habitat is not anticipated to be high. However, due to the presence of breeding population of the “local concern” bird species Little Grebe, the potential impact is low to moderate. Freshwater ponds will be created to mitigate the loss.</p>		
Grey Heron	<i>Ardea cinerea</i>	<p>Two birds were recorded within the Study Area, one from the middle lagoon and one from mangroves in Ha Pak Nai. The number is low when compared to the winter peak number of this species.</p> <p>Grey Heron mainly occurs in open waters. Records of this species mainly come from Mai Po and Inner Deep Bay.</p> <p>The proposed project will affect the potential habitats of this species. However, the number of individuals affected only account for a small proportion of the local population and alternative habitats are present nearby (e.g., Ha Pak Nai, Pak Nai). Ardeids are disturbance tolerant to certain degree (Lansdown <i>et al.</i> 2000). The impact is considered minor.</p>	Low	No
Great Egret	<i>Casmerodius alba</i>	<p>One bird was recorded from the middle lagoon. Great Egret mainly occurs in open wetlands, e.g., fishponds, mudflat. Records of this species mainly come from Mai Po and Inner Deep Bay.</p> <p>The proposed project will affect the potential habitats of this species. However, the number of individuals affected only account for a small proportion of the local population and alternative habitats are present nearby (e.g., Ha Pak Nai, Pak Nai). The impact is considered minor.</p>	Low	No
Little Egret	<i>Egretta garzetta</i>	<p>Little Egrets were recorded from ash lagoon, mangroves, stream and fishpond within the Study Area. A peak count of 27 birds was recorded from the middle lagoons. This number, however, is low when compared to the winter peak number of this species.</p> <p>Little Egret is common and widespread in Hong Kong. This species inhabits a wide range of wetland habitats, including stream, fishponds, <i>gei wais</i>.</p>	Low	No

Species of Conservation Interest				
Common Name	Scientific Name	Description	Evaluation of impacts	Mitigation Required
		The proposed project will affect the potential habitats of this species. However, the number of individuals affected only account for a small proportion of the local population and alternative habitats are present nearby (e.g., Ha Pak Nai, Pak Nai). Ardeids are disturbance tolerant to certain degree (Lansdown <i>et al.</i> 2000). The impact is considered minor.		
Pacific Reef Egret *	<i>Egretta sacra</i>	<p>This species was recorded during the STF EIA study. Only one bird was recorded from watercourse on the south of the lagoons.</p> <p>Pacific Reef Egret is mainly found in rocky shores in southern areas of Hong Kong island, e.g., Cape D' Aguilar, Chung Hom Kok. This species also forage in soft shores occasionally.</p> <p>The proposed project will affect the potential habitats of this species. However, the low number of individuals affected is small and alternative habitats are present nearby (e.g., Black Point, Lung Kwu Tan, Ha Pak Nai). In addition, ardeids are disturbance tolerant to certain degree (Lansdown <i>et al.</i> 2000). The impact is considered minor.</p>	Low	No
Cattle Egret *	<i>Bubulcus ibis</i>	<p>This species was recorded during the STF EIA study. Three birds were recorded from watercourse south of the lagoons.</p> <p>Cattle Egret is found in a wide range of habitats, including paddy field, fish pond, refuse landfill, golf courses and water sprinkler, and is widely distributed in Hong Kong.</p> <p>The proposed project will affect the potential habitats of this species. However, the number of individuals affected is small and alternative habitats are present nearby (e.g., Ha Pak Nai, Pak Nai). Ardeids are disturbance tolerant to certain degree (Lansdown <i>et al.</i> 2000). In addition, Cattle Egrets also forage in landfills (Carey <i>et al.</i> 2001, per. obs.) and therefore may utilise the existing landfill and the WENT Landfill Extension during construction and operation phases. The impact is considered minor.</p>	Very low	No
Chinese Pond Heron	<i>Ardeola bacchus</i>	<p>Six and one Chinese Pond Heron was recorded from middle lagoon and fishpond within the Study Area.</p> <p>Chinese Pond Heron is found in a wide range of wetland habitats, including paddy field, fish pond, and golf courses, and is widely distributed in Hong Kong.</p> <p>The proposed project will affect the potential habitats of this species. However, the number of individuals affected is small and alternative habitats (e.g., Ha Pak Nai, Pak Nai) are present nearby. In addition, ardeids are disturbance tolerant to certain degree (Lansdown <i>et al.</i> 2000). The impact is considered minor.</p>	Low	No

Species of Conservation Interest				
Common Name	Scientific Name	Description	Evaluation of impacts	Mitigation Required
Black-crowned Night Heron *	<i>Nycticorax nycticorax</i>	<p>This species was recorded during the STF EIA study. A single bird was recorded from grassland/shrubland habitat and east lagoon.</p> <p>Black-crowned Night Heron is common and widely distributed in Hong Kong. This species usually occurs in wetland with/near mangroves. Therefore, the lagoons are not considered optimal habitat of this species.</p> <p>The proposed project will affect the potential habitats of this species. However, the number of individuals affected is small and alternative habitats are present nearby (e.g., Ha Pak Nai, Pak Nai). The impact is considered minor.</p>	Low	No
Osprey *	<i>Pandion haliaetus</i>	<p>This species was recorded during the STF EIA study. A single bird was recorded flying over the east lagoon.</p> <p>The species is a winter visitor. Osprey mainly occurs in coastal areas, fishponds and reservoirs (Carey <i>et al</i>, 2001). Most records of this species come from Inner Deep Bay.</p> <p>The proposed project will affect the potential habitats of this species. Raptors usually have large home range. The ash lagoon only accounts for small proportion of the daily home range of Osprey. Foraging habitats of this species are present in nearby localities (e.g., Ha Pak Nai). Potential impact to this species is considered low.</p>	Low	No
Black Kite	<i>Milvus migrans</i>	<p>Single bird was recorded from urbanised/disturbed, east lagoon, stream/channel and grassland/shrubland. No breeding of this species was recorded.</p> <p>Black Kite is the most common raptor in Hong Kong, and occurs in many types of habitats (including urban areas).</p> <p>The proposed project will affect the potential habitats of this species. However, given the low number of individual affected, alternative habitats are present nearby and the ability of the Black Kite to use a wide range of habitats (including landfill). The impact is considered minor.</p>	Very low	No
Common Buzzard	<i>Buteo buteo</i>	<p>A bird was observed in flying over grassland/shrubland habitat within the Study Area.</p> <p>Common Buzzard is a common winter visitor in Hong Kong and occurs in many types of habitats (including urban areas).</p> <p>The proposed project will affect the potential habitats of this species. However, given the low number of individual affected, alternative habitats are present nearby and the ability of the Common Buzzard to use wide range of habitats. The impact is considered minor.</p>	Low	No

Species of Conservation Interest				
Common Name	Scientific Name	Description	Evaluation of impacts	Mitigation Required
White-bellied Sea Eagle	<i>Haliaeetus leucogaster</i>	<p>One bird was recorded from grassland/shrubland and middle lagoon within the Study Area. White-bellied Sea Eagle was never recorded within the Study Area in previous studies. The use of habitats within the Study Area by this species is considered very low.</p> <p>The proposed project will affect the potential habitats of this species. Raptors usually have large home range. The ash lagoon only accounts for small proportion of the daily home range of White-bellied Sea Eagle. Foraging habitats of this species are present in nearby localities (e.g., Ha Pak Nai, sea around the Study Area). Potential impact to this species is considered low.</p>	Low	No
Collared Scops Owl	<i>Ottus spilocephalus</i>	<p>Only one bird was recorded from plantation near Black Point within the Study Area. This species is common and widespread in Hong Kong. Collared Scops Owl main inhabit wooded areas.</p> <p>The proposed project will affect the potential habitats of this species. However, the number of individuals affected is small and alternative habitats are present nearby (e.g., Lung Kwu Tan, Ha Pak Nai). The impact is considered minor.</p>	Low	No
Little Ringed Plover	<i>Charadrius dubius</i>	<p>Three birds were recorded from mangroves in Ha Pak Nai. No bird was recorded from the ash lagoon. No breeding was recorded within the Study Area.</p> <p>Little Ringed Plover is widespread in Hong Kong, but most records come from Northwest New Territories. This species breeds in low-lying locations, including reclaimed, infilled or temporarily cleared land.</p> <p>Breeding of this species in the ash lagoon was recorded by MWH (2003), but not in subsequent studies (Metcalf &amp; Eddy 2006, 2008).</p> <p>The proposed project will affect the potential habitats of this species. However, the number of individuals affected is small and alternative habitats are present nearby (e.g., Ha Pak Nai, Pak Nai, Lung Kwu Tan). The impact is considered minor.</p>	Low	No
Wood Sandpiper *	<i>Tringa glareola</i>	<p>This species was recorded during the STF EIA study. A bird was recorded from the middle lagoon on three survey dates.</p> <p>Wood Sandpiper is common passage migrant and winter visitor and widespread in Hong Kong. This species occurs in a wide range of habitats including freshwater marsh, wet agriculture and fish ponds.</p> <p>The proposed project will affect the potential habitats of this species. However, the number of individuals affected is small and alternative habitats are present nearby (e.g., Ha Pak Nai, Pak Nai). The impact is considered minor.</p>	Low	No

Species of Conservation Interest				
Common Name	Scientific Name	Description	Evaluation of impacts	Mitigation Required
Common Redshank	<i>Tringa totanus</i>	<p>Common Redshank was not recorded in habitat within the Study Area in previous study. Three birds were recorded from middle lagoon. Common Redshank was never recorded within the Study Area in previous studies. The use of habitats within the Study Area by this species is considered very low. Common Redshank is mainly found in wetland habitats (e.g., mudflat) of the Deep Bay area.</p> <p>The proposed project will affect the potential habitats of this species. However, the number of individuals affected is small and alternative habitats are present nearby (e.g., Ha Pak Nai, Pak Nai). The impact is considered minor.</p>	Low	No
Eurasian Coot	<i>Fulica atra</i>	<p>Two birds were recorded from the middle lagoon.</p> <p>Eurasian Coot usually inhabits open waters with some emergent plants. The majority of records of this species come from the Deep Bay area.</p> <p>The proposed project will affect the potential habitats of this species. However, the number of individuals affected is small and alternative habitats are present nearby (e.g., Ha Pak Nai, Pak Nai). The impact is considered minor.</p>	Low	No
Eurasian Woodcock	<i>Scolopax rusticola</i>	<p>One bird was recorded from the middle lagoon during night survey.</p> <p>Eurasian Woodcock is mainly found singly along sheltered streams/water courses. The water channel near the middle lagoon has been channelized, and is not considered optimal habitat of this species.</p> <p>The proposed project will affect the potential habitats of this species. However, the number of individual affected is low, no optimal habitat of Eurasian Woodcock is affected and alternative habitats are present in nearby localities (e.g., Tai Shui Hang, Lung Kwu Tan). The impact is considered minor.</p>	Low	No
Greater Coucal	<i>Centropus sinensis</i>	<p>Only one bird was recorded from urbanised/disturbed within the Study Area.</p> <p>Greater Coucal can be found in many types of habitats in Hong Kong.</p> <p>The proposed project will affect the potential habitats of this species. However, given the low number of individual affected, alternative habitats are present nearby and the ability of the Greater Coucal to use wide range of habitats. The impact is considered minor.</p>	Low	No

Species of Conservation Interest				
Common Name	Scientific Name	Description	Evaluation of impacts	Mitigation Required
Pacific Swift *	<i>Apus pacificus</i>	<p>This species was recorded during the STF EIA study. A total of 23 birds were recorded at flight over the East Lagoon and 8 from grassland/shrubland habitat.</p> <p>Pacific Swift is common and widespread in Hong Kong. This species is mainly recorded from fishponds, coastal areas, hillsides and upland areas.</p> <p>The proposed project will affect the potential habitats of this species. However, alternative habitats of this species are present in nearby localities (e.g., Ha Pak Nai, Lung Kwu Tan, hillsides near the Study Area). The number of individuals affected is not high. The impact is considered minor.</p>	Very low	No
Pied Kingfisher	<i>Ceryle rudis</i>	<p>A bird was recorded from the middle lagoon in two survey days.</p> <p>Pied Kingfisher is an uncommon local resident that feeds in fresh, brackish and salt water and is found at fish ponds, gei wai, reservoirs, sheltered bays.</p> <p>The proposed project will affect the potential habitats of this species. However, alternative habitats of this species are present in nearby localities (e.g., Ha Pak Nai, Pak Nai). The impact is considered minor.</p>	Low	No
White-breasted Kingfisher	<i>Halcyon symmensis</i>	<p>One bird was recorded from middle lagoon. No breeding was observed.</p> <p>White-breasted Kingfisher is common and widespread in Hong Kong, and found in many types of wetland habitats, or habitats near water.</p> <p>The proposed project will affect the potential habitats of this species. However, the number of individual affected is low and alternative habitats are present in nearby localities (e.g., Ha Pak Nai, Pak Nai). The impact is considered minor.</p>	Low	No
Black-capped Kingfisher	<i>Halcyon pileata</i>	<p>One bird was recorded from middle lagoon. No breeding was observed. Black-capped Kingfisher mainly inhabits coastal areas.</p> <p>The proposed project will affect the potential habitats of this species. However, the number of individual affected is low and alternative habitats are present in nearby localities (e.g., Ha Pak Nai, Pak Nai). The impact is considered minor.</p>	Low	No
Blue-tailed Bee-eater *	<i>Merops philippinus</i>	<p>This species was recorded during the STF EIA study. A single bird was recorded from grassland/shrubland.</p> <p>Blue-tailed Bee-eater is a scarce passage migrant in Hong Kong. This species mainly occurs in open country, often near water.</p>	Very low	No



Species of Conservation Interest				
Common Name	Scientific Name	Description	Evaluation of impacts	Mitigation Required
		The proposed project might affect the potential habitats of this species. However, the impact is to be minor as the number of individual affected is small and alternative habitats (e.g., Lung Kwu Tan) are available in nearby localities.		
Emerald Dove	<i>Chalcophaps indica</i>	One individual was recorded from flying across the riparian habitat of a stream near Nim Wan Road.  Emerald Dove mainly occurs in large wooded area (e.g., Tai Po Kau). This type of habitat is absent from the Study Area.  The proposed project will not affect optimal habitats of this species. The impact is anticipated to be minor.	Very low	No
Black-winged Cuckoo-shrike *	<i>Coracina melaschistos</i>	This species was recorded during the STF EIA study. A single bird was recorded flying over grassland/shrubland habitat.  Black-winged Cuckoo-shrike is a rare winter visitor and passage migrant in Hong Kong. This species is widespread in Hong Kong, and mainly occurs in areas with some trees.  The proposed project might affect the potential habitats of this species. However, the impact is to be minor as the number of individual affected is small and alternative habitats (Lung Kwu Tan, Ha Pak Nai) are available in nearby localities.	Low	No
White-shouldered Starling *	<i>Sturnus sinensis</i>	This species was recorded during the STF EIA study. A peak count of 13 birds was recorded from the East Lagoon.  White-shouldered Starling is a common passage migrant and scarce winter visitor. The species is widespread in Hong Kong, and mainly occurs in open country (e.g., rural village areas).  The proposed project might affect the potential habitats of this species. However, the impact is to be minor as alternative habitats of this species are available nearby (e.g., Lung Kwu Tan, Ha Pak Nai).	Low	No
Reptile				
Copperhead Racer	<i>Elaphe radiata</i>	This species was recorded from the middle lagoon.  Copperhead Racer is widespread in Hong Kong. This species is common in open, dry, hilly, rocky habitat of mixed grassland and shrubland.  The proposed project might affect the potential habitats of this species. However, the impact is to be minor as alternative habitats of this species are available nearby (e.g., Lung Kwu Tan, Ha Pak Nai).	Low	No

Species of Conservation Interest				
Common Name	Scientific Name	Description	Evaluation of impacts	Mitigation Required
<b>Mammal</b>				
Japanese Pipistrelle	<i>Pipistrellus abramus</i>	<p>Around 20 individuals were recorded (at flight) from urbanised/disturbed. This is the commonest bat species in Hong Kong with no specialized habitat requirements.</p> <p>The proposed project might affect the potential habitats of this species. However, the impact is to be minor as Japanese Pipistrelle can use a wide range of habitats and alternative habitats are available in nearby localities (e.g., Lung Kwu Tan, Ha Pak Nai).</p>	Low	No
Leschenault's Rousette	<i>Rousettus leschenaulti</i>	<p>Around 4-5 individuals were recorded (at flight) from urbanised/disturbed. This species is found in a number of localities in Hong Kong. Leschenault's Rousette is fairly widespread in Hong Kong.</p> <p>The proposed project might affect the potential habitats of this species. However, the impact is to be minor as alternative habitats of this species are available in nearby localities (e.g., Lung Kwu Tan, Ha Pak Nai).</p>	Low	No
Short-nosed Fruit Bat	<i>Cynopterus sphinx</i>	<p>Around 4-5 individuals were recorded (at flight) from urbanised/disturbed. This species is common and widespread in Hong Kong. Short-nosed Fruit Bat inhabits many types of habitats, including urban.</p> <p>The proposed project might affect the potential habitats of this species. However, the impact is to be minor as alternative habitats of this species are available nearby (e.g., Lung Kwu Tan, Ha Pak Nai).</p>	Low	No
Small Asian Mongoose	<i>Herpestes javanicus</i>	<p>Only one individual was recorded in the middle lagoon during night survey. Small Asian Mongoose occurs in lowland wetlands and young secondary growths.</p> <p>The proposed project might affect the potential habitats of this species. However, the impact is to be minor as alternative habitats of this species are available nearby (e.g., Lung Kwu Tan, Ha Pak Nai).</p>	Low	No
Small Indian Civet	<i>Viverricula indica</i>	<p>Scats of this species were recorded in the east and middle lagoons. Small Indian Civet occurs in lowland wetlands and young secondary growths. This species is widely distributed in Hong Kong.</p> <p>The proposed project might affect the potential habitats of this species. However, the impact is to be minor as alternative habitats of this species are available nearby (e.g., Lung Kwu Tan, Ha Pak Nai).</p>	Low	No
<b>Butterfly</b>				
Red Lacewing	<i>Cethosia biblis</i>	<p>Only one individual was recorded from orchard in Lung Kwu Tan. The local biggest population of Red Lacewing is found in Lung Kwu Tan.</p> <p>This species was recorded outside the Project Area, and on the edge of the 500m boundary. Lung Kwu Tan, where the largest population of Red Lacewing was previously recorded, is located outside the 500m boundary</p>	Very low	No

Species of Conservation Interest				
Common Name	Scientific Name	Description	Evaluation of impacts	Mitigation Required
		of the current project. Potential impact is therefore considered minor.		
Danaid Eggfly *	<i>Hypolimnas misippus</i>	<p>This species was recorded during the STF EIA study. Five individuals were found in shrubland around the East Lagoon and one individual was recorded from secondary woodland habitat.</p> <p>The Glassy Bluebottle is locally rare and occurs only in dense forests. Woodlands in the Study Area were fragmented and under disturbance, and are not considered optimal habitat of Danaid Eggfly.</p> <p>There is no loss of important habitat of Danaid Eggfly. It is therefore anticipated that the impact from the proposed project would be minor.</p>	Very low	No
Glassy Bluebottle *	<i>Graphium cloanthus</i>	<p>This species was recorded during the STF EIA study. Seven individuals were found in grassland/shrubland and secondary woodland. Males of the Danaid Eggfly usually inhabit highland area and females are rather rare, occurring near agricultural land and fish ponds in the New Territories.</p> <p>The proposed project might affect the potential habitats of this species. However, the impact is to be minor as alternative habitats of this species are available nearby (e.g., Lung Kwu Tan, Ha Pak Nai).</p>	Very low	No
<b>Fish</b>				
-	<i>Acrossocheilus parallens</i>	<p>This species was recorded during the present study in the middle course of Tai Shui Hang Stream which is outside the assessment area.</p> <p>Tai Shui Hang would not be affected by the Project as their habitats are outside the Project Site and located in a different catchment area separated by hill ridge. There are also measures to protect and monitor the water quality of Tai Shui Hang Stream during the operation phase.</p>	Insignificant	No
<b>Invertebrate</b>				
Horseshoe crab	<i>Tachypleus tridentatus</i>	<p>Only a carcass was found during the present study in Ha Pak Nai at the far northern end of the assessment area.</p> <p>Horseshoe crab is uncommon in Hong Kong, and is mostly found in Northwest Hong Kong and Lantau. Ha Pak Nai is one of the sites considered important for horseshoe crab. However Ha Pak Nai is outside the project footprint and is not likely to be indirectly affected by the present project as there would be no major marine works.</p>	Insignificant	No

\*recorded in STF EIA Study (2008)

## 10.8 Impact Avoidance and Mitigation Measures

Following EIAO-TM Annex 16 guidelines, mitigation measures are discussed in this section to avoid, minimise and compensate for identified ecological impacts.

### 10.8.1 Impact Avoidance

Due to the large area required for the Project, loss of terrestrial habitats is unavoidable. However, important habitats have been largely avoided. Although located along the coast, all landfill extension options and diversion of Nim Wan Road have been carefully designed to avoid marine works such as reclamation and dredging. Direct impacts (i.e. habitat loss) and the majority of indirect impacts (e.g. the water quality impacts from dredging and filling during construction) on marine habitats and communities, including the mudflat, mangroves, seagrasses, horseshoe crab, intertidal and subtidal benthic communities, are avoided.

### 10.8.2 Impact Minimisation

Option 4 has been identified as the preferred design with favourable comparisons on waste management (achieving the target requirement), engineering considerations (no imported fill material required for the site formation works), and social acceptability (highest landfill areas with gentle slopes/ gradient, comparable unit cost for disposal).

The potential ecological impacts would be diluted by gradual loss of habitats in 6 phases from mid 2010s to end 2020s, where loss of major woodland patches and middle lagoon would occur in the last phase of work. This would significantly reduce the time lag between the habitat loss and re-provision of habitats by 50%. In addition, hoarding would be installed along the boundary of the major woodland patch to minimise disturbance to the woodland before the commencement of the construction activities.

Option 4 would cause a loss of 3.77 ha woodland. One option with less woodland loss by adjusting landfill boundary only result in a minor reduction in woodland loss but resulting in significant reduction of landfill capacity of more than 50%. This will affect the waste management needs and also drastically increase the unit disposal cost and therefore is not preferred.

Two plant species of conservation interest, *Nepenthes mirabilis* and *Arundina graminifolia* identified during the current EIA within the Project Site would be directly impacted by the WENT Landfill Extension and required transplantation. Another plant species, *Aquilaria sinensis*, recorded within the Project Site by the STF EIA study would also be directly impacted by the Project. To minimise the ecological impacts, the affected individuals of *Arundina graminifolia* and *Aquilaria sinensis* as well as the major colony of *Nepenthes mirabilis* near Tsang Kok Stream would be transplanted to suitable nearby habitats prior to the construction phase as far as practicable. Examples of potential receptor site include Stream B for *Arundina graminifolia* and peripheral area of new leachate treatment facilities at the WENT Landfill Extension for *Aquilaria sinensis*.

Local successful experience of Pitcher Plant transplantation (Weatherhead, undated), including site selection and propagation and transplantation methods were reviewed. A potential location for transplantation is at Stream B (see **Figure 10.7**). The receptor site at Stream B is sited on government land outside Castle Peak Firing Range accessible by footpaths along stream and on hillside. It resembles the impact site at Tsang Kok Stream where seepage and granitic sandy substrate colonised with mosaic of ferns-sedges-low shrub are present. A few individuals of Pitcher Plant are also observed, indicating that the site is suitable for transplantation of Pitcher Plant. Transplantation should be implemented between March and July. Nodal cutting must be conducted from March to May before flowering where vegetative growth is most prominent. The cuttings should have a minimum of three nodes with leaves and pitchers trimmed and nodes immediately inserted into damp peat moss in polythene bags. The potted cuttings should be put in a temporary on-site

nursery with shelter net for screening and keep in moist environment for two to three weeks until auxiliary roots establish. Then the potted cuttings can be transplanted to the recipient site. Transplantation must be completed before July in the same wet season to ensure survival and establishment of the plant. A detailed transplantation protocol and monitoring programme should be prepared by a suitably qualified ecologist or botanist appointed by the DBO contractor and submitted to AFCD for review and comments and EPD for approval prior to commencement of work. A detailed vegetation survey covered the affected habitats would be conducted by the qualified botanist / ecologist to identify and record the affected individuals in order to provide details for the transplantation scheme prior to the commencement of site clearance works. The requirements of detailed vegetation survey will be specified in the WENT Landfill Extension Contract.

Site formation and landfill operation would be implemented by phases where demolition of the middle lagoon would be placed at the last phase (Phase 6, early 2020s) to minimise the impacts of habitat loss to Little Grebe and other fauna utilizing the lagoon. It is anticipated that Little Grebe will continue to utilise the middle ash lagoon until site formation during Phase 6. To minimise disturbance to nesting Little Grebe by construction and operation of other phases, hoarding of 3 m high should be set up along the boundary of the works areas in the vicinity of middle ash lagoon to shield the Little Grebe from the disturbance impact of human activities during construction phase. The hoarded area should be inspected weekly for any damage by illegal access and to evaluate the effectiveness of the measures. Damage sighted should be reported to the site manager and damaged hoarding should be repaired by the contractor as soon as possible. Ecological monitoring would be conducted during the major breeding season (March - August) in the middle lagoon until commencement of Phase 6, and access to the middle lagoon should be restricted except with permission from the Engineer during this period. Demolition of the middle ash lagoon should avoid the breeding season, therefore minimise the disturbance to the breeding birds. Site inspection will be conducted before demolition of the middle ash lagoon to confirm that no breeding activities of Little Grebe in the middle ash lagoon would be affected by the works.

Good site practices and precautionary measures should be implemented to avoid encroachment onto the nearby natural habitats, minimise disturbance to wildlife, and ensure good water quality. Examples are detailed in various sections of the EIA report and they include:

- Placement of equipment or stockpile in designated works areas and access routes selected on existing disturbed land to minimise disturbance to natural habitats.
- Restriction of construction activities to the work areas that would be clearly demarcated.
- Reinstatement of the work areas immediately after completion of the works.
- Only well-maintained plant should be operated on-site and plant should be serviced regularly during the construction programme.
- Machines and plant (such as trucks, cranes) that may be in intermittent use should be shut down between work periods or should be throttled down to a minimum.
- Plant known to emit noise strongly in one direction, where possible, be orientated so that the noise is directed away from nearby NSRs.
- silencers or mufflers on construction equipment should be properly fitted and maintained during the construction works.
- mobile plant should be sited as far away from NSRs as possible and practicable.
- material stockpiles, site office and other structures should be effectively utilised, where practicable, to screen noise from on-site construction activities.

- use of “quiet” plant and working methods.
- construction phase mitigation measures in the Practice Note for Professional Persons on Construction Site Drainage.
- design and set up of the temporary on-site drainage system will be undertaken by the DBO Contractor prior to the commencement of construction.
- design and incorporation of silt/sediment traps in the permanent drainage channels to enhance deposition rates and regular removal of deposited silt and grit.
- minimization of surface excavation works during the rainy seasons (April to September), and in particular, control of silty surface runoff during storm events, especially for areas located near steep slopes.
- regular inspection and maintenance of all drainage facilities and erosion and sediment control structures to ensure proper and efficient operation at all times and particularly following rainstorms.

### **10.8.3 Impact Mitigation**

#### **Habitat Loss – Compensatory Planting**

A total of 21 ha compensatory woodland planting would be provided (see **Figure 8.12**).

Mitigation of woodland should include compensatory woodland planting at a ratio of at least 5:1 to woodland in terms of area. This high compensation ratio is justified to partly off-set impacts due to availability (which will be planted at a later phase) and survival (higher mortality in landfill site) of native species to be planted. To further off-set the time-lag between the site clearance (habitat destruction) and re-provision of compensatory planting on the proposed landfill after restoration phase (early 2030s), planting of 5 ha of woodland will be implemented on the existing WENT Landfill site after the restoration phase and completed before the complete loss of woodland in the last phase of the WENT Landfill Extension to ensure continuous provision of woodland habitat in the study area. The remaining 16 ha of woodland will be planted at WENT Landfill Extension. In addition, as woodland takes time to mature, 10% light standard trees would be included in the planting mix for the slope toe area to provide instant greening and cover for wildlife. Details of the woodland planting are described in Chapter 8 and are summarised as follows.

The 21 ha of compensatory woodland planting would compensate for the loss of 3.76 ha of woodland, resulting in a 5.6: 1 compensation ratio in terms of area. Most native trees had extremely high mortalities on the local test site in the first few years after the capping of landfill. After several years, the pioneer species provide shelter for the native species and the survival rate and growth of native species will improve. Natural ecological succession also takes place as the pioneer species establishes. Therefore, planting of tree seedlings is preferable to be carried out in two phases. The first phase involves planting of landfill pioneer tree species (see Chapter 8). The second phase, 3-5 years after the completion of first phase, involves the planting of seedlings/whips of native tree species of higher ecological values (also see Chapter 8).

Planting of woodland would not only mitigate the loss of habitats caused by the project but would re-provide habitats for terrestrial fauna and land bird species (e.g., Common buzzard, Greater Coucal, Pacific Swift) recorded on site and in the vicinity. Taxa benefited from the planting would include but not be limited to the species of conservation concern recorded on site (**Table 10.16**).

To ensure the survival and establishment of the compensatory planting, a 10 year ecological monitoring is proposed, i.e. early 2030s – early 2040s. Apart from the standard practices

and regular maintenance covered by the landscape contract, monitoring of survival, height, and health condition of species planted will be monitored. Detailed requirements will be given in the EM&A manual. The requirement of the 10 year ecological monitoring scheme will be specified in the WENT Landfill Extension Contract and will be implemented by the DBO Contractor.

### **Habitat Loss – Creation of Pond Habitats**

To mitigate the loss of 5 ha of water body including 3 ha of breeding habitats for Little Grebe, a total of 5 ha of freshwater ponds, with 3 ha will be created after the restoration phase of the existing WENT Landfill (**Figure 8.12**), and 2 ha provided after the restoration phase of the WENT Landfill Extension. Phasing of site formation on the WENT Landfill Extension will be controlled to ensure the provision of the 3 ha of ponds on the existing landfill before the demolition of the middle ash lagoon.

These 5 ha of ponds would be designed according to the habitat requirements of this species recorded in the literature and supplemented by field observation (**Section 10.4.3**). It is also anticipated that these ponds would also serve as an aquatic habitat to attract various waterbirds and aquatic fauna, and therefore enhance the ecological value of the site.

The number of nesting pairs in the east, middle and west lagoons between March 2007 and August 2008 were one, three and one respectively. Overall five pairs of Little Grebes might have nested in the three lagoons between March 2007 and August 2008. Therefore, the created ponds should provide breeding habitats for at least five pairs of Little Grebe.

Due to the moderate gradient of the terrain of existing landfill, it is technical more feasible to construct several small ponds than one large ponds. The size of each freshwater pond would be at least 0.5 ha, and each will accommodate at least one nesting pair of Little Grebe. This is supported by previous examples where Little Grebe bred in ponds with size ranged from 0.24ha to 0.89ha and eight pairs of Little Grebes nested in an enhanced fishpond of 1 ha in size (Table 10.4). Although the nesting distance recorded in the middle lagoon during the current study was larger (135m-173m), the condition of middle lagoon was not optimal due to ash deposits and large portion of dry surfaces even during breeding season. Nesting distance can be significantly reduced to 13m by higher vegetation cover (Masterson *et al.* 1994 in MWH 2003). Therefore, provision of 5 ha of ponds, each with at least 0.5 ha in size would be sufficient for compensation for Little Grebe habitats in terms of both area and function.

A schematic layout of the freshwater pond is provided in **Figure 10.8**. The pond slope will be profiled to gentle gradient of 1:4 to 1:6 to encourage the development of emergent plants. The gentle slope gradient also facilitates the use of the freshwater wetlands by wading birds (e.g., ardeids). Emergent plants could provide habitats for amphibian and dragonflies. Foraging perches for kingfishers could be provided by erected bamboo sticks on the pond shore. The ponds would be rain-fed with water depth of about 0.8 to 1.5m. The pond should be lined with hydric soil to ensure impermeability while allowing vegetation to develop. Drainage pipes or pumping systems should also be installed to adjust water level as needed. To maintain the water level of the ponds, a freshwater supply system and small water tank will be provided to refill the pond water due to evaporation. Automatic water level detection sensors will be installed at the ponds and tapped water will be pumped from the water tank to the ponds when the sensors hit the lower threshold point. In order to make tap water safe for pond life, pond water additives such as chlorine reduction agent and heavy metal neutralizer should be added. Native emergent aquatic vegetation (e.g. *Phragmites*, *Carex*, and *Scirpus* spp.) would also be planted on the pond slopes with water depths less than 0.5m. Tall grasses will be planted on the bund of the compensation wetland to provide some screening effect. These grasses could also provide nesting habitats for some passerines (e.g., prinias, munias). Emergent plants provide nesting substratum for Little Grebe. However, high coverage or overgrowth by emergent plants may

reduce the value of the pond as nesting habitat of Little Grebe. Spread of vegetation could be controlled through either the placing of deep ditches (1.5m deep) around vegetation stands or the placing of vertical barriers, e.g. concrete sheets, in the substrate, both of which should restrict rhizome creep.

Small rafts can be anchored within the pond to provide nesting sites for Little Grebe. This could significantly improve breeding success since in Hong Kong heavy seasonal rain not infrequently results in nests being flooded.

MWH (2003) suggested the nesting density of Little Grebe might be related to the abundance of aquatic insects. Wetland without fish, which prey on aquatic insects, may be optimal breeding habitat of Little Grebe. Aquatic invertebrate populations in the compensation wetland will be enhanced through the exclusion of fish. No fish will be stocked in the ponds, and management practice should include regular removal of fish in these ponds.

Although the freshwater ponds are designed to mitigate the loss of breeding habitats of Little Grebe, these ponds also provide suitable habitats and microhabitats for other wetland fauna (e.g., waterbirds, raptors, dragonflies and aquatic fauna (e.g. Atyid shrimps). Therefore provision of freshwater ponds would enhance the overall ecological values of both the existing WENT Landfill and the WENT Landfill Extension.

During the detailed design stage, other enhancement features, including connections between ponds allowing water flow to mimic stream features can be considered. If feasible and practicable, these features would provide further ecological enhancement to aquatic fauna.

A habitat creation and management plan (HCMP) should be prepared by a qualified ecologist during the design and construction phase for the pond creation mitigation measures and would be circulated to relevant departments including AFCD for review and comment and EPD for approval before implementation.

#### **Precautionary Measure – Fish capture and translocation survey**

Impacts to loss of streams and fish species of conservation concern is considered minor and insignificant, and no mitigation is required. Nevertheless, as a precautionary measure, a capture and translocation survey for fish species of conservation concern is recommended given their limited records in Hong Kong. Survey should be conducted at Tsang Kok Stream and Stream A prior to the commencement of construction works in the two streams. Fish species of conservation concern, if found during the survey, should be collected and translocated to suitable locations. A detailed fish capture and translocation plan should be prepared by a qualified ecologist and submitted by the DBO contractor to AFCD for comment and EPD for approval prior to commencement of work.

#### **Accidental Leakage of Leachate and Landfill Gas**

As mentioned above, leachate collection facilities and the impermeable barriers would effectively prevent water quality impacts. Monitoring during landfill operation and after use phase would verify the expected conditions. There would also be contingency plans for the accidental leakage of leachate and landfill gas.

The WENT Landfill Extension will be designed as a containment landfill with LFG collection and management systems to eliminate any off-site migration of LFG. The LFG risk assessment in Chapter 7 has identified that the overall risk level of LFG hazards to receivers (not ecological sensitive receivers) outside the WENT Landfill Extension, which is categorised as “Medium”, and there will be “semi-active” or enhanced passive gas controls and detection system for the receivers. Future landfill liner, leachate collection and treatment system, LFG control devices, landfill cap design will be designed with reference to the specifications of the existing WENT Landfill which is successful in LFG control throughout the years. Furthermore, the design of suitable level of contingency plans for the



potential receivers will be incorporated. An Emergency and Contingency Plan will be devised by the DBO Contractor for implementation of appropriate actions in case any LFG migration detected. Such measures include those currently being adopted in the existing WENT Landfill, e.g. installation of double layer liner, LFG extraction/collection/treatment/export systems, gas sensors, increasing monitoring frequency, connecting the affected monitoring point to the Landfill Gas Extraction System, passive venting of landfill gas, active extraction and flaring of landfill gas, and installation of additional barriers to gas movement. The existing WENT Landfill has been incorporated an efficient and effective LFG management system, in which a coordinated approach to LFG monitoring, collection, extraction, flaring and utilization is being implemented to achieve the elimination of the hazards to flora and fauna due to toxicity or asphyxiation effect of LFG presence external to the landfill site. The records of the compliance of LFG monitoring has proven the success of this LFG management system, and the protection of wildlife within and outside the WENT Landfill Extension is thus guaranteed.

A contingency plan on accidental leakage of leachate, which is based upon the current contingency plan of the existing WENT Landfill and modified for the WENT Landfill Extension, will be adopted to further protect surrounding habitats of the WENT Landfill Extension. The future monitoring programme will include surface and groundwater monitoring within and around the site. In the event that the water quality requirements are exceeded, Corrective Action Programmes will be implemented which include surface water/groundwater extraction and treatment prior to discharge, groundwater interception and diversion, installation of additional groundwater well for monitoring and for extraction of contaminated groundwater for treatment, increased frequency of ground-water quality testing, installation of subsurface barriers, changes of working methods, diversion, etc. Although Tai Shui Hang catchment will not be affected by the project, water quality monitoring stations will be set up in streams inside Tai Shui Hang catchment to monitor the conditions of the habitat for the rare freshwater fish, *Acrossocheilus parallens*.

With the above-mentioned careful design of control system, monitoring programme, preparation and implementation of contingency plan and successful example of existing landfill operation and management for leachate and LFG, it is anticipated that the potential impacts of leachate and LFG to flora and fauna within and in the vicinity of the WENT Landfill Extension site during operation and after restoration would be minimal.

## **10.9 Residual Ecological Impacts**

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With the implementation of the above mitigation measures, the residual impacts are considered minimal and acceptable.

## **10.10 Ecological Monitoring and Audits**

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Survival and growth of the compensatory woodland planting will require long term monitoring (at least for two years after the completion of planting programme under the landscape contract and 10 years for ecological monitoring) and should be specified in the planting and maintenance contract and the EM&A manual. Upon completion of transplantation of Bamboo Orchid, Pitcher Plants and other plants of conservation interest, monitoring should be implemented for 2 years. Monitoring frequency for Pitcher Plant would be monthly during first 6 months, and bi-monthly in the next 18 months. Use of created ponds by Little Grebe should also be monitored monthly during its major breeding season (March - August) for 3 years. The HCMP and EM&A manual should specify the details of the monitoring programme.

## **10.11 Conclusion**

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Ecological resources recorded within the 500m study area of WENT Landfill Extension include woodland, plantation, orchard/village, grassland/shrubland, fish pond, mangroves/mudflats, stream/channel, ash lagoon, artificial seawall, urbanised/disturbed areas and coastal waters and its associated flora and fauna species. Apart from mangroves/mudflat habitat which had moderate ecological values, other habitats had low or

low to moderate ecological values. Species of conservation interest recorded within the study area included four flora and thirty-eight fauna species (including bats, birds, butterflies and other fauna).

The WENT Landfill Extension area will largely occupy existing grassland/shrubland habitat. The overall impacts to terrestrial and freshwater habitats are ranked as low to moderate for woodland and ash lagoon habitat for Little Grebe, and low to negligible for other habitats and associated wildlife. This project would not involve any marine works and there would be no direct marine or intertidal habitat loss from the project. Mitigation measures include translocation of species of conservation interest, compensatory woodland planting, and creation of pond habitats. With the implementation of the above mitigation measures, the residual impacts are considered minimal and acceptable.

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