AECOM

Drainage Services Department

Agreement No. DP 04/2012

Post-Construction Ecological Monitoring

of Drainage Improvement Works in Southern Lantau

Implemented under 4128CD in Contract DC/2006/11

Monthly EM&A Report – October 2012

November 2012

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Pursuant to Condition 4.3 of Environmental Permit No. EP-237/2005/B, this monthly EM&A Report for post-construction ecological monitoring during October 2012 has been certified by the Environmental Team Leader (ETL) and verified by the Independent Environmental Checker (IEC)

Certified by:

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EXECUTIVE SUMMARY

This is the first post-construction ecological monitoring for “Drainage Improvement in Southern Lantau” conducted by AECOM. This report concludes the post-construction phase ecological monitoring for the activities undertaken during the period of 1 October 2012 to 31 October.

Ecological monitoring was performed on 29 October 2012 and 31 October 2012. Results obtained are presented in this report.

Ecological water quality monitoring was not performed in the reporting month in October due to the delayed issue of access permit until mid October and unsuitable weather conditions in late October. It has been re-scheduled for November 2012.

The ET will continue to implement the environmental monitoring & audit programme in accordance with the EM&A Manual and Environmental Permit requirement. The report is available for public inspection and will be uploaded to the dedicated project website.

1. INTRODUCTION

1.1. Background

1.1.1. The Drainage Services Department (DSD) has implemented Contract No. DC/2006/11 "Drainage Improvement in Southern Lantau and Construction of Mui Wo Village Sewerage Phase 1". The monitoring requirements of the drainage improvement works are subject to the conditions specified in Environmental Permit (EP) No. EP-237/2005/B issued by the Environmental Protection Department (25 January 2006). In compliance with the EP, an Environmental Monitoring and Audit (EM&A) programme was established during the construction and post-construction phases of the project. The operation of the project is subject to the conditions in EP No. EP-434/2012.

1.1.2. The Post-Construction Ecological Monitoring of Drainage Improvement Works in Southern Lantau under Agreement No. DP 04/2012, commenced in January 2012. AECOM Asia Co. Ltd. was appointed by DSD as the Environmental Team to conduct the above captioned monitoring project from October 2012 onwards. This is the first post-construction ecological monitoring report under that appointment.

1.2. Project Description

1.2.1. The project site is located in Pak Ngan Heung River (PNH) and Luk Tei Tong River (LTT) in southern Lantau, west of Mui Wo. The works for which the post-construction monitoring applies include construction:

- Construction of approximately 80 m long gabion with natural bed in PNH, approximately 180m of three cells 3 m x 2 m box culvert and approximately 100 m of rectangular channel at PNH; and
- Construction of bypass channel of about 350 m and 240 m long of gabion channels at LTT respectively.

1.2.2. Both PNH and LTT are part of the Silver River in Lantau Island. These two tributaries of Silver River, together with Tai Tei Tong River, then joined and connected to Silver Mine Bay next to Mui Wo.

1.3. Report Objectives

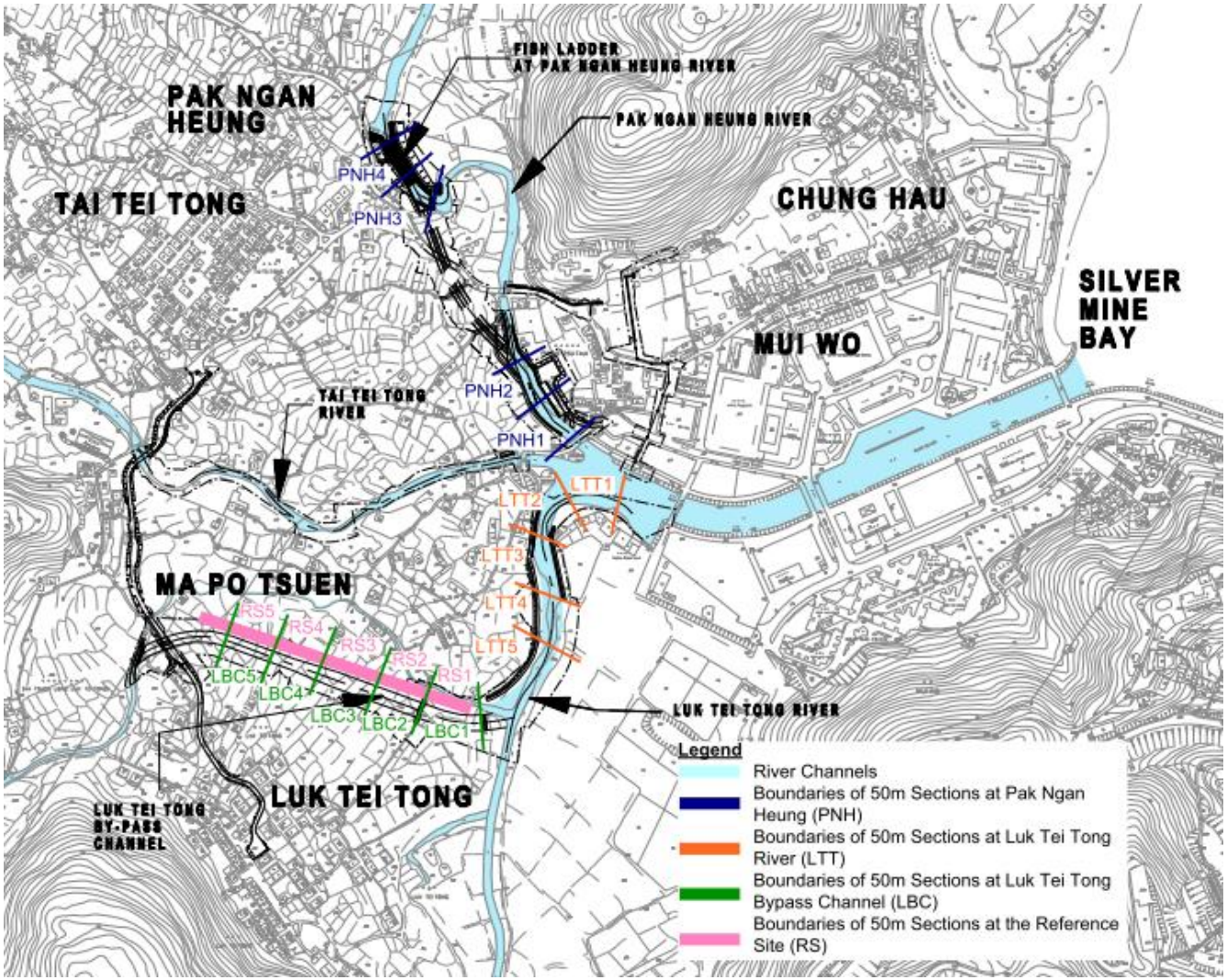
1.3.1. This report presents the findings of ecological monitoring conducted in October 2012. The ecological water monitoring will be conducted in November 2012 and a separate report provided.

2. ECOLOGICAL MONITORING PARAMETERS

2.1. Ecological Surveys

2.1.1. Details of the monitoring parameters and survey methodology are described below. According to the Final EM&A Manual, a specific ecological monitoring programme of the improved sections of PNH, LTT, Luk Tei Tong Bypass Channel (LBC) and its Reference Site (RS) is recommended.

Figure 1 Ecological Monitoring Locations at Pak Ngan Heung River, Luk Tei Tong River, Luk Tei Tong Bypass Channel and the Reference Site



Pak Ngan Heung River and Luk Tei Tong River

2.1.2. The ecological survey for these two rivers was divided into nine 50m sections. The location plan is shown in **Figure 1** for reference.

- Two sections for downstream of PNH (PNH1 and 2), two sections for upstream of PNH (PNH3 and 4)
- Five sections for LTT (LTT1 to 5)

2.1.3. The monitoring parameters and survey methodology for each section are described below:

(a) Bird species in each 50 m section were surveyed quantitatively using transect count method. Birds within the river channel and on the riverbank were identified to species and their abundance was recorded. Birds that flew over/across the river channel without landing were not considered to be utilising the area and thus excluded from the records.

(b) Surveys on aquatic macroinvertebrate focused on determination of the diversity and abundance. Sampling methods included active searching, direct observation, hand netting and kick sampling. In each section, the macroinvertebrate species composition was identified and their relative abundance was recorded.

(c) Surveys on fish focused on determination of the diversity and abundance of fish communities. Sampling methods included active searching, direct observation, and hand netting, and were determined in accordance with site conditions. In each section, the fish species composition was identified and their relative abundance was recorded.

(d) Adult odonate community in each 50 m section were surveyed quantitatively by transect count method. Adult odonate within the river channel and on the riverbank were identified to species and their abundance was recorded. Species requiring close examination were netted.

(e) Aquatic, emergent and riparian vegetation community was recorded by walk-through survey. Plant species composition and their relative abundance were recorded.

Luk Tei Tong Bypass Channel

2.1.4. The ecological survey for the Luk Tei Tong Bypass Channel (LBC) and its Reference Sites (RS) were carried out in every 50 m section. The location plan is shown in **Figure 1** for reference.

- Five sections for LBC (LBC1 to 5)
- Five sections for RS (RS1 to 5)

2.1.5. The monitoring parameters and survey methodology are described below:

(a) Bird species in each 50 m section were surveyed quantitatively using transect count method. Birds within the river channel and on the riverbank were identified to species and their abundance was recorded. Birds that flew over/across the river channel without landing were not considered to be utilising the area and thus excluded from the records.

(b) Where/when water was present, surveys of aquatic macroinvertebrate focused on determination of their diversity and abundance of stream aquatic communities. Sampling methods included active searching, direct observation, hand netting and kick sampling. In each section, macroinvertebrate species composition was identified and their relative abundance was recorded.

(c) Where/when water was present, surveys of fish focused on determination of their diversity and abundance. Sampling methods included active searching, direct

observation, and hand netting, were determined in accordance with site conditions. In each section, fish species composition was identified and their relative abundance was recorded.

(d) Adult odonate community in each 50 m section were surveyed quantitatively by transect count method. Adult dragonflies within river channel and on the riverbank were identified to species and their abundance was recorded. Species requiring close examination were netted.

(e) Line-intercept method was adopted to determine the relative plant cover of aquatic, emergent and riparian vegetation. One line transect of 10 m was set perpendicular to the stream channel at each section, and five 1 m x 1 m quadrats were placed along the transect. Relative coverage and plants species intercepting the transect line was recorded. Percentage cover of each species within the quadrat was recorded to the nearest 10% (except "1" = present but insignificant cover, normally 1 to 2 individuals, and 5% = up to 5%). The conditions of vegetation will be described.

(f) Herpetofauna community within LBC and RS were surveyed by active searching in potential habitats. Reptiles were identified and their abundance was recorded. Amphibians were identified by their calls and the number of calling males in each section was recorded.

2.1.6. For all surveys, identification of plant species and distribution status in Hong Kong were made with reference to Corlett *et al.* (2000), Hu *et al*. (2003), Hong Kong Herbarium (2012), and Hong Kong Herbarium and South China Botanical Gardens (2007; 2008; 2009; 2011).

2.1.7. In terms of assessing geographical distribution, published references specializing in the distribution of specific faunal groups in Hong Kong have been utilized. For general status, these have included Fellowes *et al*. (2002) and the Hong Kong Biodiversity Database (AFCD, 2011), and for specific faunal groups, these have included: Avifauna – Carey *et al.* (2001), Viney *et al.* (2006); Dragonflies – Tam *et al.* (2011); Butterflies – Lo (2005); and Chan *et al*. (2011); Amphibians – Chan *et al.* (2005); Reptiles – Chan *et al.* (2006), Chan *et al*. (2009), and Karsen *et al.* (1998); Terrestrial Mammals – Shek (2006); Freshwater Fish – Lee *et a*l. (2004); and Freshwater Community – Dudgeon (2003). The status and rarity of vascular plants has been based on Hu *et al*. (2003) and Corlett *et al*. (2000).

2.2. Ecological Water Quality Monitoring

2.2.1. Ecological water quality monitoring along PNH, LTT, LBC, and RS will be carried out. Ten locations were selected. The location plan for ecological water quality monitoring is shown in **Figure 2** for reference.

- Three locations for existing PNH (WE1 to 3)
- Three locations for existing LTT (WE4 to 6)
- Two locations for RS (WE7 to 8)
- Two locations for existing LBC (WE9 to 10)

2.2.2. Water Quality Monitoring along PNH, LTT, LBC and RS included the monitoring parameters shown below:

- Biochemical Oxygen Demand (BOD)
- Nitrate
- Ammonia
- Reactive Phosphorus
- Dissolved Oxygen (DO)
- Water Depth* and Water Flow Rate
- Conductivity
- pH

- Suspended Solids (SS)
- Salinity
- Temperature
- Sediment Characteristics

Note:

*As referred to the Final EM&A Manual, Water Depth is required only for LBC.

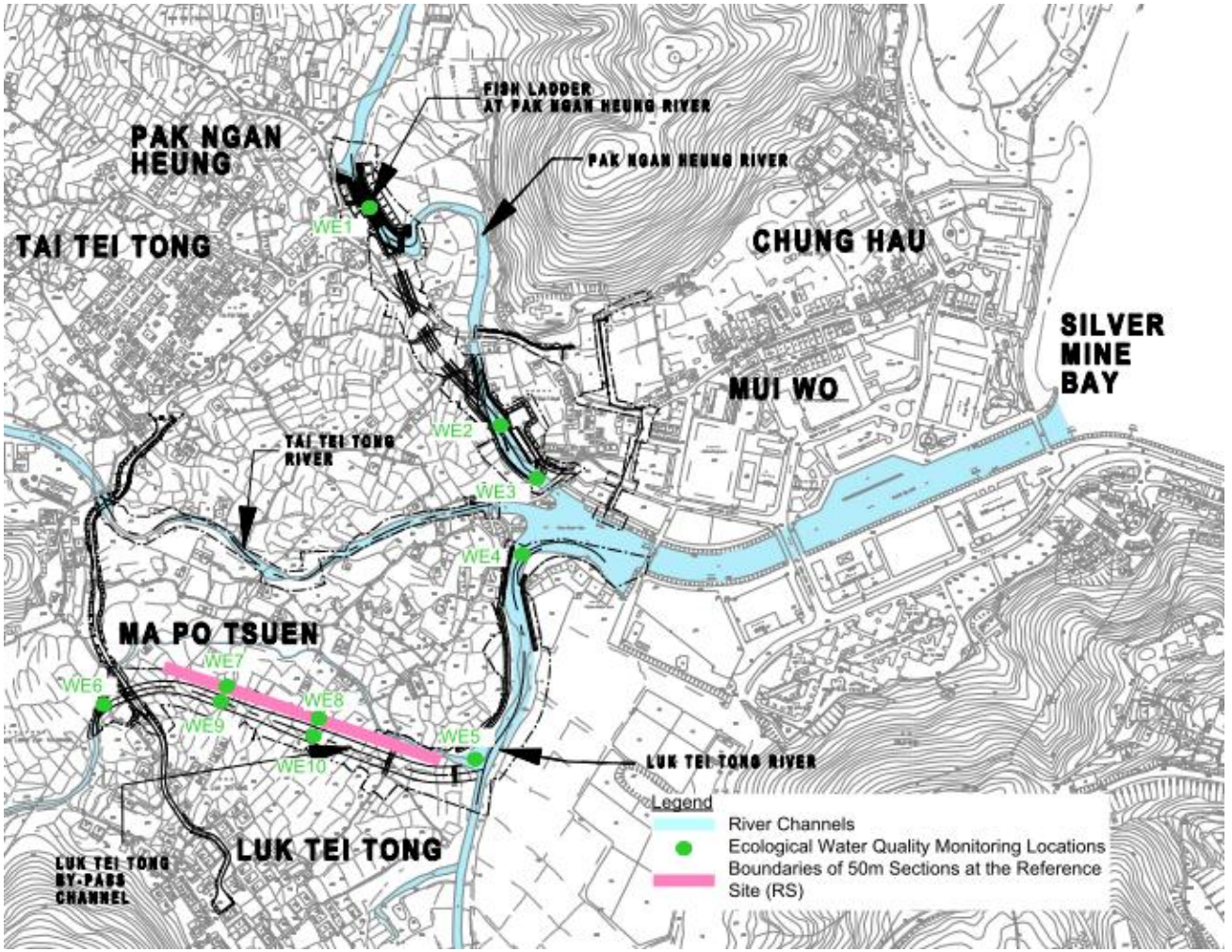
2.2.3. The DO, water depth and water flow rate, conductivity, pH, temperature, salinity and sediment characteristics were measured in-situ while the other water samples were analyzed in a HOKLAS accredited laboratory and the analyses followed the standard methods according to APHA Standard Methods for the Examination of Water and Wastewater, 20th Edition, or equivalent.

2.2.4. According to the requirement of the Final EM&A Manual, two consecutive measurements for parameters of DO concentration, and DO saturation are required to be taken at each monitoring location. When the difference in value between the first and second reading of DO is more than 25%, the reading will be discarded and further reading will be taken.

2.3. Limitations

2.3.1. PNH4 was overgrown with exotic plant species which restricted access and therefore no aquatic fauna surveys were conducted at this location. In addition, no water was present at LBC2 to 5 at the time of survey, therefore aquatic fauna surveys were not undertaken in this location.

Figure 2 Ecological Water Quality Monitoring Locations at Pak Ngan Heung River, Luk Tei Tong River, Luk Tei Tong Bypass Channel and the Reference Site



3. MONITORING RESULTS

3.1. Ecological Survey Findings

Pak Ngan Heung River (PNH)

3.1.1. The lower stream of PNH (PNH 1 & 2) is subject to tidal influence from Silver Mine Bay. Vertical concrete retaining wall formed the banks of the river channel. The two sections were located at the mouth of the PNH. PNH1 and 2 were adjacent to each other. The bridge formed the southern boundary of PNH1 whereas the box-culvert formed the northern boundary of PNH2. Small boulders and sandy substrate formed the main component of the streambed.

3.1.2. Rock-filled gabion formed the eastern bank and the gabion and a vertical concrete retaining wall formed the western bank of the upper stream (PNH3 and 4). PNH3 and 4 are adjacent to each other. A man-made cascade formed the northern boundary of PNH4 and the bridge formed the southern boundary of PNH3. Water flows in a direction from north to south. The substrate of PNH3 was concrete and that of PNH4 was sandy interspersed with boulders. The width of the fish ladder at PNH 4 is around 7m.

3.1.3. No evidence of maintenance works (including those relevant to Conditions 2.1 to 2.4 of EP No. EP-434/2012) was observed during the monitoring period.

Vegetation

3.1.4. At PNH3 and 4, a total of 26 flora species were recorded along the river banks and within the river channel, of which most of them were not riparian or emergent species, instead, trees and vegetation (e.g. Chinese Hackberry, *Celtis sinensis*; Opposite-leaved Fig, *Ficus hispida*) grew on the bank. The majority (20 species) were native. Of the six exotic species, the invasive Mile-a-minute (*Mikania micrantha*) and weedy *Bidens alba* spread over the PNH4, interspersed with occasional native grass species (e.g. Chinese Silver grass, *Miscanthus sinensis*) and tree seedlings (e.g. Elephant's Ear, *Macaranga tanarius*), leaving only a narrow flow of water in the centre of the PNH4. At the centre of the PNH4, Diffuse Day-flower (*Commelina diffusa*), a common emergent species, occurred, however, it was covered by Mile-a-minute.

3.1.5. At PNH1 and 2, no plant species were recorded within the river channel. On the vertical concrete retaining wall, four species were recorded, including *Bidens alba*, Wild Kudzu Vine (*Pueraria phaseoloides*), *Praxelis clematidea*, and seedlings of Opposite-leaved Fig (*Ficus hispida*).

3.1.6. The list of plant species is presented in **Appendix 1a**.

Terrestrial Fauna

3.1.7. Eight avifauna species were recorded at the four monitoring locations at PNH, all of which are common in Hong Kong (Table 3.1). Little Egret (*Egretta garzetta*) was the only species of conservation interest recorded. Lower PNH (PNH1 and 2) supported waterbirds such as Little Egret and Common Kingfisher (*Alcedo atthis*) while upper PNH (PNH3 and 4) supported mostly woodland birds (e.g. Spotted Dove, *Streptopelia chinensis*, and Great Tit, *Parus major*). During the monitoring, the water levels at lower PNH were around 0.5 m and thus allowed waterbird species to forage within the drainage channel. Woodland birds recorded at upper PNH were mostly observed in the vegetation along the banks of the river channel.

3.1.8. No dragonflies were recorded at PNH during the monitoring.

Aquatic Macroinvertebrate and Fish

3.1.9. Two fish species, one crab species and four species of other aquatic invertebrates were recorded at the three sections of PNH (PNH1 to PNH3) (Table 3.2). PNH4 was not surveyed as it was covered with invasive climbing herb, Mile-a-Minute, and therefore not accessible.

3.1.10. Fish species of conservation interest, Predaceous Chub (*Parazacco spilurus*), was recorded at PNH3. More than 20 individuals were observed.

Table 3.1 Number of Avifauna Recorded at Pak Ngan Heung River (PNH)

Common Name	Scientific Name	Distribution in Hong Kong (1)	Principal Status (2)	Level of Concern (3)	Protection Status in China (4)	China Red Data Book (5)	IUCN Red List (6)	PNH1	PNH2	PNH3	PNH4
Little Egret (7)	*Egretta garzetta*	Common	P	PRC (RC)	-	-	-	1			
Spotted Dove	*Streptopelia chinensis*	Abundant	R	-	-	-	-			1	
Common Kingfisher (7)	*Alcedo atthis*	Common	A, M,P	-	-	-	-	1			
Great Tit	*Parus major*	Common	R	-	-	-	-			1	
Yellow-browed Warbler	*Phylloscopus inornatus*	Common	W	-	-	-	-			1	
Siberian Stonechat	*Saxicola maurus*	Common	W, M	-	-	-	-				1
Grey Wagtail	*Motacilla cinerea*	Common	W	-	-	-	-	1		1	
White Wagtail	*Motacilla alba*	Common	W, R	-	-	-	-	1			

Note:
(1) All wild birds are Protected under Wild Animal Protection Ordinance (Cap. 170).
(2) R=resident; W=winter visitor; M=migrant; A=autumn; P=present all year, exact composition unknown.
(3) Fellowes *et al*. (2002); RC=Regional Concern; PRC=Potential Regional Concern. Letters in parentheses indicate that the assessment is on the basis of restrictedness in breeding and/or roosting sites rather than in general occurrence.
(4) List of Wild Animals Under State Protection (promulgated by State Forestry Administration and Ministry of Agriculture on 14 January, 1989).
(5) Zheng and Wang (1998).
(6) IUCN (2012). IUCN Red List of Threatened Species. Version 2012.1.
(7) Wetland-dependent species (including wetland-dependent species and waterbirds).

Table 3.2 Relative Abundance of Aquatic Macroinvertebrate and Fish Recorded at Pak Ngan Heung River (PNH)

Fauna Group	Scientific Name	Distribution in Hong Kong	Level of Concern [1]	Protection Status in China [2]	China Red Data Book [3]	IUCN Red List [4]	PNH1	PNH2	PNH3	PNH4
Fish	*Parazacco spilurus*	Common [5]	-	-	Vulnerable	-			+++	
Fish	*Rhinogobius giurinus*	Common [5]	-	-	-	Least Concern	+			
Crab	*Varuna litterata*	-	-	-	-	-	+			
Snail (Limpets)	*Nipponacmea concinna*	Common [6]	-	-	-	-		+		
Snail (Nerites)	*Clithon* sp.	-	-	-	-	-		+		
Snail (Lymnaeidae)	Lymnaeidae	-	-	-	-	-	+++	+++		
Amphipod	Amphipoda	-	-	-	-	-	+++			

Note:
(1) Fellowes *et al.* (2002).
(2) List of Wild Animals Under State Protection (promulgated by State Forestry Administration and Ministry of Agriculture on 14 January, 1989).
(3) Zheng and Wang (1998).
(4) IUCN (2012). IUCN Red List of Threatened Species. Version 2012.1
(5) AFCD (2012). Hong Kong Biodiversity Database.
(6) Williams (2003), Rocky Shores.
+ = occasional, less than 5 individuals were found; ++ = common, 5-20 individuals were found; +++ = abundant, more than 20 individuals were found.

Luk Tei Tong River (LTT)

3.1.11. The LTT is subject to tidal influence from Silver Mine Bay and is estuarine in nature. It is a north-south running river. A vertical concrete retaining wall formed the river bank of the LTT1 whereas rock-filled gabion formed the river bank of LTT2 to 5. LTT1 was located at the confluence with Pak Ngan Heung River, Tai Tei Tong River and Luk Tei Tong River. LTT2 to 5 stretches southward. Since it is subject to tidal flow, water flowed from north to south during the survey when the tide ascended. LTT1 and 2 had sandy substrate whilst LTT3 to 5 had muddy substrate. Clusters of boulders occurred at both sides of the river channel. The width of the river channel was around 8-10 m.

3.1.12. No evidence of maintenance works (including those relevant to Conditions 2.1 to 2.4 of EP No. EP-434/2012) was observed during the monitoring period.

Vegetation

3.1.13. Several adult and seedlings of *Kandalia obovata*, a true mangrove species, was recorded colonized at the interception of LTT2 and 3. Along the rock-filled gabion, only Burma-reed (*Neyraudia reynaudiana*) was recorded at LTT 4. Other than these two species, no other plant species were recorded within the river channel or along the gabion bank in LTT sections.

3.1.14. The list of plant species is presented in **Appendix 1a**.

Terrestrial Fauna

3.1.15. A total of thirteen avifauna species were recorded at LTT, all of which are common in Hong Kong (**Table 3.3**). Recorded waterbirds included Black-crowned Night Heron (*Nycticorax nycticorax*), Grey Heron (*Ardea cinerea*), Little Egret, White-breasted Waterhen (*Amaurornis phoenicurus*) and Common Kingfisher.

3.1.16. Most waterbird species were observed near LTT1 and LTT2, as these locations were subject to greater tidal influence and therefore exposed during low tide

3.1.17. Conversely, avifauna species recorded at LTT4 and LTT5 mostly comprised of woodland birds which were observed along the gabion edges of the drainage channel.

3.1.18. No dragonflies were recorded at LTT during the monitoring.

Aquatic Macroinvertebrate and Fish

3.1.19. One fish species, one crab species and seven species of other aquatic invertebrates were recorded from the LTT (**Table 3.4**). A fish species, Grey Mullet (*Mugil cephalus*), a common and widespread species in estuaries in Hong Kong, was recorded throughout all five sections. A crab species *Perisesarma bidens*, was recorded along the edges of the banks where the waterline was. Mature and juvenile crabs were seen.

3.1.20. Rocky Oyster and Barnacles were recorded attached to the rocks within the drainage channel, these species were mostly recorded in sections closer to the large channel inlet from LTT1 to LTT4.

Table 3.3 Number of Avifauna Recorded at Luk Tei Tong River (LTT)

Common Name	Scientific Name	Distribution in Hong Kong (1)	Principal Status (2)	Level of Concern (3)	Protection Status in China (4)	China Red Data Book (5)	IUCN Red List (6)	LTT1	LTT2	LTT3	LTT4	LTT5
Black-crowned Night Heron (7)	*Nycticorax nycticorax*	Common	P	(LC)	-	-	-	1				
Grey Heron (7)	*Ardea cinerea*	Common	W	PRC	-	-	-	2				
Little Egret (7)	*Egretta garzetta*	Common	P	PRC (RC)	-	-	-	2				
White-breasted Waterhen (7)	*Amaurornis phoenicurus*	Common	R	-	-	-	-		1			1
Spotted Dove	*Streptopelia chinensis*	Abundant	R	-	-	-	-			1		
Lesser Coucal	*Centropus bengalensis*	Common	R	-	Class II	Vulnerable	-				1	
Common Kingfisher (7)	*Alcedo atthis*	Common	A, M, P	-	-	-	-					1
Large-billed Crow	*Corvus macrorhynchos*	Common	R	-	-	-	-					1
Plain Prinia	*Prinia inornata*	Common	R	-	-	-	-				1	
Crested Myna	*Acridotheres cristatellus*	Common	R	-	-	-	-				5	2
Black-collared Starling	*Gracupica nigricollis*	Common	R	-	-	-	-				2	4
Grey Wagtail	*Motacilla cinerea*	Common	W	-	-	-	-					2
White Wagtail	*Motacilla alba*	Common	W, R	-	-	-	-	1		1		

Note:

(1) All wild birds are Protected under Wild Animal Protection Ordinance (Cap. 170).
(2) R=resident; W=winter visitor; M=migrant; A=autumn; P=present all year, exact composition unknown.
(3) Fellowes *et al.* (2002); RC=Regional Concern; LC=Local Concern; PRC=Potential Regional Concern. Letters in parentheses indicate that the assessment is on the basis of restrictedness in breeding and/or roosting sites rather than in general occurrence.
(4) List of Wild Animals Under State Protection (promulgated by State Forestry Administration and Ministry of Agriculture on 14 January, 1989).
(5) Zheng and Wang (1998).
(6) IUCN (2012). IUCN Red List of Threatened Species. Version 2012.1.
(7) Wetland-dependent species (including wetland-dependent species and waterbirds).

Table 3.4 Relative Abundance of Aquatic Macroinvertebrate and Fish Recorded at Luk Tei Tong River (LTT)

Fauna Groups	Scientific Name	Distribution in Hong Kong	Level of Concern (1)	Protection Status in China (2)	China Red Data Book (3)	IUCN Red List (4)	LTT1	LTT2	LTT3	LTT4	LTT5
Fish	*Mugil cephalus*	-	-	-	-	Least Concern	+++	+++	+++	++	+
Crabs	*Perisesarma bidens*	-	-	-	-	-		+	+++	+++	+
Crabs and relatives (Sea Slaters)	Sea Slaters	-	-	-	-	-			+++		
Bivalves	*Saccostrea cucullata*	Very common	-	-	-	-		++	++		
Bivalves	*Scapharca cornea*	Rare	-	-	-	-			+		
Bivalves	*Septifer virgatus*	Very common	-	-	-	-			+		
Barnacles	*Balanus amphitrite*	Very common	-	-	-	-		++	++	+	
Amphipod	Amphipoda	-	-	-	-	-		+++			
Oligochaeta	Oligochaeta	-	-	-	-	-					++

Note:
(1) Fellowes *et al*. (2002).
(2) List of Wild Animals Under State Protection (promulgated by State Forestry Administration and Ministry of Agriculture on 14 January, 1989).
(3) Zheng and Wang (1998).
(4) IUCN (2012). IUCN Red List of Threatened Species. Version 2012.1
(5) Williams (2003), Rocky Shores.
+ = occasional, less than 5 individuals were found; ++ = common, 5-20 individuals were found; +++ = abundant, more than 20 individuals were found.

Luk Tei Tong Bypass Channel (LBC) and Reference Site (RS)

3.1.21. The LBC is linked to the end of LTT5 and runs east to west. It is located in the Luk Tei Tong Marsh to the west of the original LTT. Gabion walls formed both sides of the river bank. Generally, all sections were heavily vegetated except in LBC1 where a small pool approximately 60 m^2 in size was located at the end of LBC1. The pool was separated from the LTT by a weir constructed from a single layer of rock-filled gabion. The substrate comprised soil which was translocated from the marsh area prior to construction of the bypass. The width of the bypass channel was approximately 15 m.

3.1.22. The RS was located parallel to the northern side of the LBC. Next to the RS were village housings. The site was vegetated and did not have any free-standing water at the time of survey. The substrate comprised of soil.

3.1.23. No evidence of maintenance works (including those relevant to Conditions 2.1 to 2.4 of EP No. EP-434/2012) was observed during the monitoring period.

Vegetation

3.1.24. A total of 25 plant species were recorded in LBC, of which 10 species were found in the quadrats sampled (**Table 3.5**). The list of plant species is presented in **Appendix 1b**. Almost half of the recorded species were exotic. During the survey, only LBC1 included a small patch of open shallow water. Other sections were dry.

3.1.25. The habitat at LBC1 differed from the remaining sections in terms of vegetation type. It may be subject to tidal influence during high tide because of its location immediately next to the Luk Tei Tong River. The sedge, Ferrugineous-scale Fimbristylis (*Fimbristylis sieboldii*), dominated LBC1 with a pool of open water forming the western part of the section next to Luk Tei Tong River. *Cyperus* sp. was recorded in LBC1 only.

3.1.26. The plant species recorded in the remaining sections of LBC were dominated by the exotic species *Wedelia trilobata*. Grass species commonly encountered along the transects were Hilo Grass (*Paspalum conjugatum*) and Glutene-rice Grass (*Apluda mutica*). Other species only formed a small proportion of the vegetation.

3.1.27. Several individuals of Chinese Tallow Tree (*Sapium sebiferum*), Taiwan Acacia (*Acacia confusa*), and Elephant's Ear (*Macaranga tanarius*) were recorded at LBC2, whereas a mature tree, Chinese Hackberry (*Celtis sinensis*) was recorded at LBC4. Marsh species such as Ginger Lily (*Hedychium coronarium*) was recorded only at LBC3 and LBC4 and Common Reedgrass (*Phragmites australis*) was recorded only at LBC1 and LBC2.

3.1.28. A total of 33 plant species were recorded in the RS, of which 15 species were found in the quadrats (**Table 3.5**). Fourteen species were exotic. All sections were dry and were located next to the village housing. A greater area of bare ground was recorded at all RS sections than at the LBC sections. The dominant species was exotic *Wedelia trilobata*, followed by exotic *Mimosa diplotricha* and Mile-a-minute. Other species such as Rose Mallow (*Urena lobata*) and *Aster subulatus* were scattered across the RS sections. The majority of vegetation recorded at the RS could typically be found in disturbed land. Marsh species (e.g. Ginger Lily) was recorded only at RS2 and 5.

3.1.29. The list of plant species is presented in **Appendix 1b**.

Terrestrial Fauna

3.1.30. Three species of avifauna were recorded at LBC (**Table 3.6**). Four species of avifauna were recorded at the RS (**Table 3.7**). The birds were roosting on the trees. All recorded species are common residents of Hong Kong.

3.1.31. One individual of dragonfly, Wandering Glider (*Pantala flavescens*), was recorded at LBC1. This species is abundant in Hong Kong (**Table 3.8**). No dragonflies and herpetofauna were recorded at the RS during the monitoring.

Aquatic Macroinvertebrate and Fish

3.1.32. Two species of fish and one species of invertebrate were recorded at LBC1 (**Table 3.9**). No aquatic fauna was recorded at the RS and the remaining sections of the LBC as they were dry during the monitoring.

Table 3.5 Vegetation Coverage at Luk Tei Tong Bypass Channel (LBC) and Reference Site (RS)

	LBC	RS
No. of species recorded in quadrats	10	15
Total No. of species	25	33
Total No. of exotic species	12	14
Average vegetation coverage	100%	75.5%
Bare ground coverage	0%	24.5%

Note:

(1) The transect was not laid along any open water, thus open water coverage was not provided in this table.

3.2. Ecological Water Quality Monitoring (EWQM)

3.2.1. The ecological water quality monitoring will be undertaken in November 2012, and the results will be issued in the December monitoring report for November 2012.

Table 3.6 Number of Avifauna Recorded at Luk Tei Tong Bypass Channel (LBC)

Common Name	Scientific Name	Distribution in Hong Kong (1)	Principal Status (2)	Level of Concern	Protection Status in China	China Red Data Book	IUCN Red List	LBC1	LBC2	LBC3	LBC4	LBC5
Yellow-bellied Prinia	*Prinia flaviventris*	Common	R	-	-	-	-				1	
Crested Myna	*Acridotheres cristatellus*	Common	R	-	-	-	-	17				
Black-collared Starling	*Gracupica nigricollis*	Common	R	-	-	-	-	4				

Note:
(1) All wild birds are Protected under Wild Animal Protection Ordinance (Cap. 170).
(2) R=resident.

Table 3.7 Number of Avifauna Recorded at Reference Site (RS)

Common Name	Scientific Name	Distribution in Hong Kong (1)	Principal Status (2)	Level of Concern	Protection Status in China	China Red Data Book	IUCN Red List	RS1	RS2	RS3	RS4	RS5
Spotted Dove	*Streptopelia chinensis*	Common	R	-	-	-	-		1			
Crested Myna	*Acridotheres cristatellus*	Common	R	-	-	-	-		3			
Black-collared Starling	*Gracupica nigricollis*	Common	R	-	-	-	-			1		
White Wagtail	*Motacilla alba*	Common	W, R	-	-	-	-				1	

Note:
(1) All wild birds are Protected under Wild Animal Protection Ordinance (Cap. 170).
(2) R=resident; W=winter visitor.

Table 3.8 Number of Dragonfly Recorded at Luk Tei Tong Bypass Channel (LBC)

Common Name	Scientific Name	Distribution in Hong Kong [1]	Level of Concern	Protection Status in China	China Red Data Book	IUCN Red List	LBC1	LBC2	LBC3	LBC4	LBC5
Wandering Glider	*Pantala flavescens*	Abundant	-	-	-	-	1				

Note:
(1) AFCD (2012). Hong Kong Biodiversity Database

Table 3.9 Relative Abundance of Aquatic Macroinvertebrate and Fish Recorded at Luk Tei Tong Bypass Channel (LBC)

Fauna Groups	Scientific Name	Distribution in Hong Kong	Level of Concern [1]	Protection Status in China [2]	China Red Data Book [3]	IUCN Red List [4]	LBC1	LBC2	LBC3	LBC4	LBC5
Fish	*Mugil cephalus*	-	-	-	-	Least Concern	+				
Fish	*Terapon jarbua*	-	-	-	-	-	+++				
Insects	*Metrocoris* sp.	Common [1]	-	-	-	-	+++				

Note:
(1) AFCD (2012). Hong Kong Biodiversity Database.
+ = occasional, less than 5 individuals were found; ++ = common, 5-20 individuals were found; +++ = abundant, more than 20 individuals were found.

4. ECOLOGICAL MONITORING SCHEDULE

4.1. The next ecological surveys monitoring is tentatively scheduled on mid-December 2012 and ecological water quality is conducted in early November 2012.

5. DISCUSSION AND RECOMMENDATIONS

5.1. The aim of the monitoring programme is to provide data on the re-establishment of aquatic/riparian communities in the PNH and LTT, and allow an assessment of the relative success of the mitigation measures to be made. In addition, monitoring of the LBC will assess whether the proposed channel design has provided suitable compensation for the impacts to the Luk Tei Tong Marsh.

5.2. Key observations made during the October 2012 monitoring period in relation to the implemented mitigation measures are presented in **Table 5.1**. Where applicable, recommendations for improving the functionality of the mitigation measures have been made.

5.3. As the current reporting period occurs early in the post-construction monitoring programme, further monitoring is required to draw conclusions regarding the overall success of the mitigation measures implemented into the project. The assessment will be on-going over the course of the monitoring programme and will be presented in subsequent reports as additional information becomes available.

Table 5.1 Observations/Comments and Recommendations Arising from the October 2012 Monitoring Period

Location	Mitigation Measure	Observations/Comments	Recommendations
PNH and LTT	Construction of a small fish ladder at the upstream end of the PNH	The fish ladder was heavily vegetated by invasive plant species such as Mile-a-minute. The overgrown nature of this section would result in the loss of the fish ladder's function to facilitate movement of fish between the upstream and downstream sections of the river.	The timely removal of vegetation and the on-going management of Mile-a-minute in this section is recommended.
		The overgrown nature of the fish ladder at PNH4 restricted access and therefore monitoring for aquatic fauna and fish, and ecological water quality could not be undertaken.	Clearance of this vegetation is required to facilitate these surveys.
	Re-establishment of aquatic / riparian communities	Fish species of conservation interest, Predaceous Chub (*Parazacco spilurus*), was recorded at PNH3. More than 20 individuals were observed.	This species was not recorded during the baseline surveys in 2008. PNH3 appears to provide suitable aquatic habitat for Predaceous Chub. On-going monitoring of PNH3 for other species of conservation interest would be undertaken.

Location	Mitigation Measure	Observations/Comments	Recommendations
LBC	Provision of suitable habitat compensation	Vegetation composition along LBC2 to 5 was dominated by the exotic plant species, *Wedelia trilobata*, which spreads readily by rooting at the nodes. If left uncontrolled, it can form a dense thicket of vegetation which crowds out native and other plant species. It prevents regeneration and growth of desired species.	*Wedelia trilobata* should be managed along the length of LBC. Given its invasive nature, consideration should be given to planting suitable species, after *Wedelia* removal, to limit re-colonization and potentially limit management requirements.
		Trees were recorded regenerating in LBC2 and LBC4. If left unchecked, the spread of trees into the channel habitat could change the desired marsh habitat to a drier shrubland habitat and therefore failing to replace the habitat type that was originally lost. In addition, the growth of woody vegetation in the channel could impede the drainage capacity of the channel. The limited occurrence of typical marsh plant species (although this was also limiting in the RS) and the presence of naturally regenerating trees in the channel suggests that the water levels/availability within the channel may not be adequate to sustain a marsh habitat.	The control of woody species in the channel is recommended, particularly whilst most are still relatively young and easy to manage. On-going monitoring of water levels and species composition within the channel are required. Further assessment should take into account timing of the surveys (wet/dry season), the suitability of the current RS for drawing comparisons, etc.

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