



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 – August 2015

September 2015

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Pursuant to Condition 4.4 of Environmental Permit No. EP-237/2005/B (amended by EP-237/2005/C), this monthly EM&A Report for post-construction ecological monitoring and ecological water monitoring during August 2015 has been certified by the Environmental Team Leader (ETL) and verified by the Independent Environmental Checker (IEC)

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EXECUTIVE SUMMARY

This is the eighteenth bi-monthly post-construction ecological monitoring and audit exercise for "Drainage Improvement in Southern Lantau" conducted by AECOM. This report concludes the post-construction phase ecological monitoring and audit requirement for the activities undertaken during the period of 1 August 2015 to 31 August 2015.

Ecological monitoring and ecological water quality monitoring were performed on 10 August 2015 and 12 August 2015, respectively. Results obtained are presented in this report.

The Environmental Team (ET) will continue to implement the environmental monitoring & audit (EM&A) 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 (<http://www.envproject.com/sldiwema.htm>).

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 response to the latest approval to Variation of an Environmental Permit (VEP) application (VEP-465/2015) regarding Drainage Improvement in Southern Lantau (17 February 2015), the former EP-237/2005/B has been amended to EP-237/2005/C; however, this has not changed the original monitoring requirements. 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. In response to the latest approval to VEP application (VEP-464/2015), the former EP-434/2012 has been amended to EP-434/2012/A.
- 1.1.2. The Post-Construction Ecological Monitoring and Audit 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 (ET) to conduct the above captioned monitoring project from October 2012 onwards. This is the eighteenth bi-monthly post-construction ecological monitoring and audit report under that appointment.

1.2. Project Description

- 1.2.1. Under Contract No. DC/2006/11, the improvement works were undertaken at Pak Ngan Heung River (PNH), Luk Tei Tong River (LTT) and Tai Tei Tong River (TTT) in Southern Lantau, west of Mui Wo. The works for which the post-construction ecological monitoring required by EP No. EP-237/2005/B (amended to EP-237/2005/C) included:
- the drainage channel and a three-cell box culvert at PNH;
 - the drainage channel at LTT; and
 - the bypass channel at LTT.
- 1.2.2. No ecological monitoring and ecological water monitoring was required following the drainage improvement works at TTT and village sewerage works in Mui Wo.
- 1.2.3. Both PNH and LTT are part of the Mui Wo River (also named as Silver River) in Lantau Island. These two tributaries of Mui Wo River, together with Tai Tei Tong River, then joined and connected to Silver Mine Bay next to Mui Wo.

1.3. Report Objectives

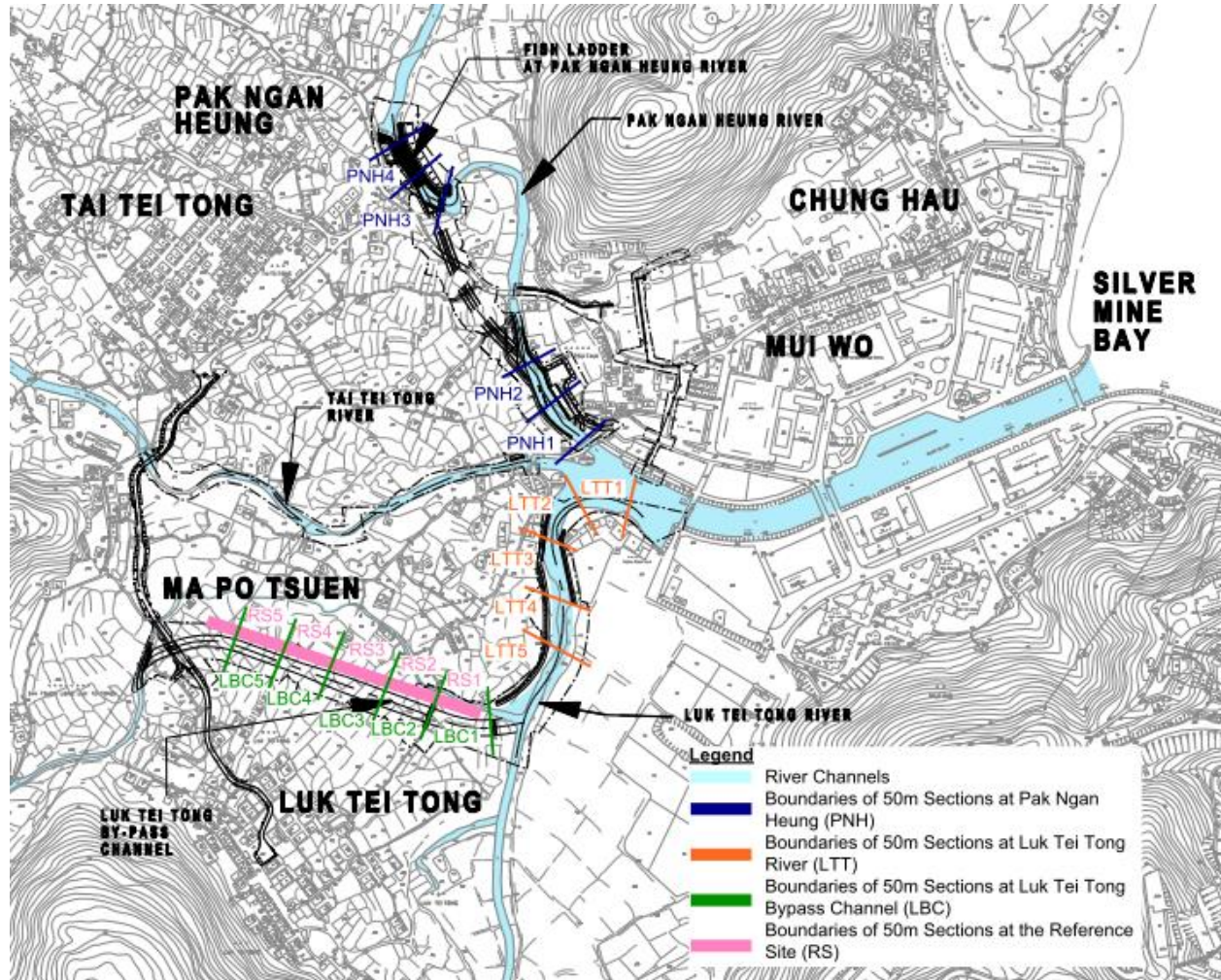
- 1.3.1. This report presents the findings of the ecological monitoring and the ecological water monitoring conducted in August 2015.

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 section of PNH, LTT, LTT 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 50 m sections and comprised the following:

- 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 location plan is shown in **Figure 1** for reference.

2.1.4. 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. This does not apply to species that rarely land and are associated with specific habitats (e.g. Barn Swallow).
- (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 odonates 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

2.1.5. The ecological survey for the Luk Tei Tong Bypass Channel (LBC) and its Reference Sites (RS) were carried out in every 50 m section and comprised the following:

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

2.1.6. The location plan is shown in **Figure 1** for reference.

2.1.7. 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. This does not apply to species that rarely land and are associated with specific habitats (e.g. Barn Swallow).
- (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 the 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 plant 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 were 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.
- 2.1.8. 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).
- 2.1.9. 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, 2015), and for specific faunal groups, these have included: Avifauna – Carey *et al.* (2001), Viney *et al.* (2005); 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 al.* (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 was carried out. Ten locations were selected and comprised the following:
- 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. The location plan for ecological water quality monitoring is shown in **Figure 2**.
- 2.2.3. Water Quality Monitoring along PNH, LTT, LBC and RS included the monitoring parameters shown below:
- Biochemical Oxygen Demand (BOD₅)
 - Dissolved Oxygen (DO)

- Nitrate
- Ammonia
- Reactive Phosphorus
- Total Suspended Solids (SS)
- Temperature
- Water Depth* and Water Flow Rate
- Conductivity
- pH
- Salinity
- Sediment Characteristics

Note:

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

2.2.4. 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. The limit of reporting for the laboratory analysis is summarized in **Table 2.1**.

Table 2.1 Limit of Reporting for Water Quality Parameters

Parameters	Limit of Reporting (mg/L)
Total Suspended Solids	2
Biochemical Oxygen Demand (BOD ₅)	2
Nitrate	0.01
Ammonia	0.01
Reactive Phosphorus	0.01

2.2.5. The instrument for in-situ measurement of pH, temperature, DO, salinity and conductivity is a portable and weather proof Multifunctional Meter complete with cable and uses a DC power source. Calibration certificates are attached in **Appendix 1**. The instruments are capable of measuring:

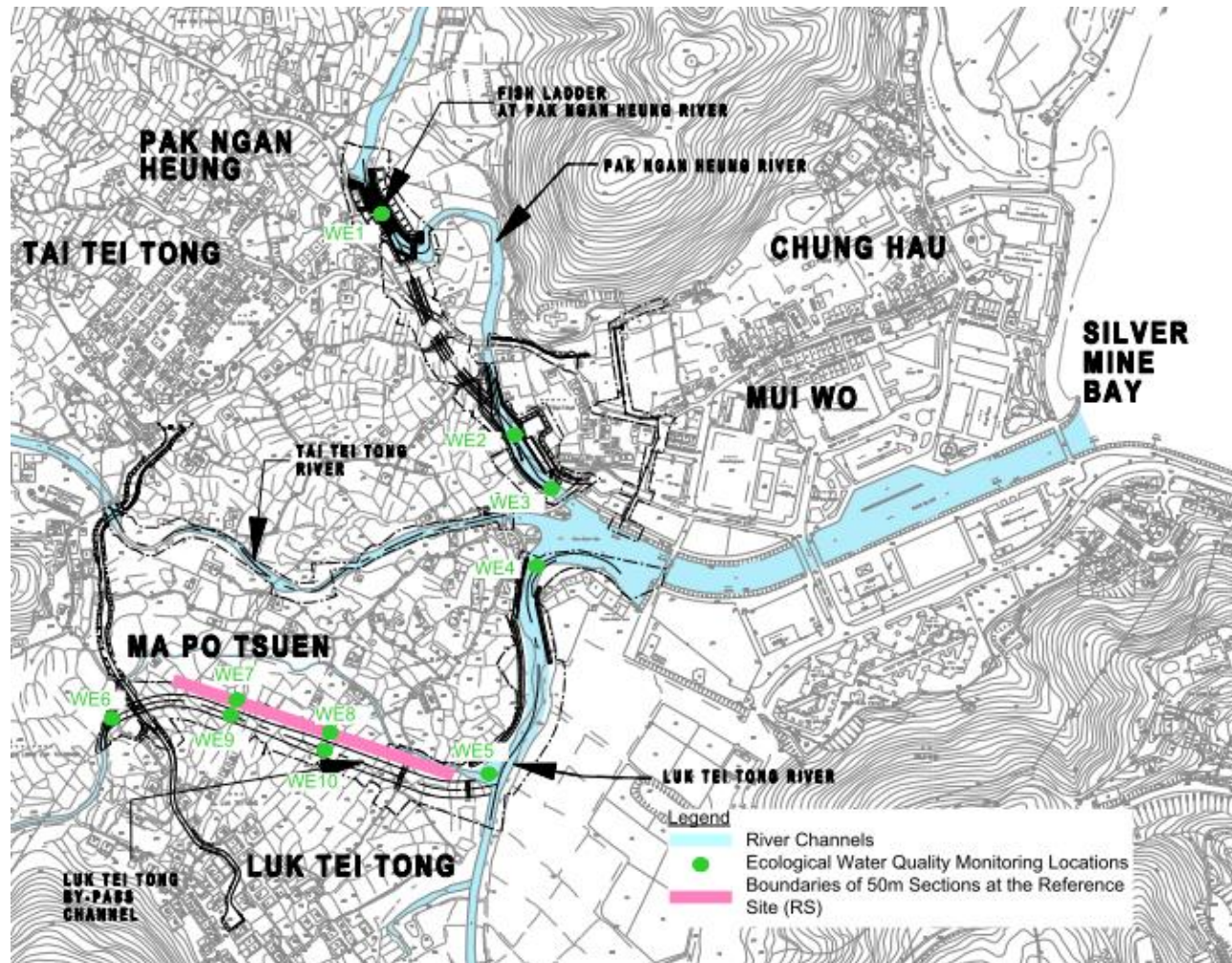
- pH in the range of 0 to 14
- Temperature of -5 to +65⁰C
- DO in the range of 0 to 20 mg/L and 0 to 200% saturation
- Salinity in the range of 0-80ppt
- Conductivity in the range of 0 to 4999 µS/cm

2.2.6. 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 was discarded and a further reading taken.

2.3. Limitations

- 2.3.1. No water was present at LBC2 to LBC5 at the time of ecological survey (10 August 2015), therefore aquatic fauna surveys were not undertaken in these locations.
- 2.3.2. No water was present at WE7 to WE10 at the time of water quality monitoring (12 August 2015), therefore water quality monitoring was not undertaken at these locations.

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 (PNH1 and PNH2) 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 PNH2 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 PNH4). PNH3 and PNH4 are adjacent to each other. PNH4 comprised a man-made cascade, including a fish ladder, while PNH3 comprised a pool below the cascade and was bounded by a bridge at its downstream end. Small boulders and sandy substrate were the main component in the middle streambed which allowed water flow and pool formation, whereas big boulders were scattered on both sides of the streambed and had an absence of water. The width of the fish ladder at PNH4 is approximately 7 m.
- 3.1.3. The cascade/fish ladder at PNH4 was designed to allow open water flow and should be free of vegetation in order to allow fish movement.

Vegetation

- 3.1.4. At PNH1, no plant species were recorded within the river channel. The vegetation recorded on the vertical wall included *Wedelia trilobata* and Opposite-leaved Fig (*Ficus hispida*) at PNH1. At PNH2, two seedlings of *Kandelia obovata* were recorded. No significant changes to the plant species were observed compared with last monitoring in June 2015. During the monitoring, the water level at lower PNH was approximately 50 cm during ebbing tide.
- 3.1.5. At PNH3 and PNH4, a total of 23 plant species were recorded. Exotic Mile-a-minute (*Mikania micrantha*) was still the dominant species on the banks of the PNH3 pool, the gabion of the PNH4 and the two edges of the cascade/fish ladder. Although Mile-a-minute was overgrown at the edges of the PNH4 cascade/fish ladder, free water flow was still observed. In addition, herb species such as *Bidens alba*, Diffuse Day-Flower (*Commelina diffusa*) and *Wedelia trilobata* were also commonly recorded along the gabion of the PNH3, along the sides of PNH3 pool and PNH4 cascade.
- 3.1.6. The list of plant species is presented in **Appendix 2a**.

Terrestrial Fauna

- 3.1.7. Eight avifauna species were recorded at PNH, all of which are common or abundant in Hong Kong, except uncommon Green Sandpiper (*Tringa ochropus*) (AFCD, 2015) (**Table 3.1**). No avifauna species of conservation importance were recorded.
- 3.1.8. Four avifauna species were recorded at lower PNH (PNH1 and PNH2) including generalist species (e.g. Crested Myna, *Acridotheres cristatellus*) and waterbird species (Green Sandpiper). There was no evidence of breeding or nesting activities during the monitoring period.
- 3.1.9. Four avifauna species were recorded at upper PNH (PNH3 and PNH4), using the banks of the river channel or the trees near the channel, and generally included generalist species, such as Eurasian Tree Sparrow (*Passer montanus*).
- 3.1.10. Six odonate species, all of which are abundant in Hong Kong (AFCD, 2015), were recorded at upper PNH during the monitoring (**Table 3.2**). Black Threadtail (*Prodasineura autumnalis*) was dominant odonate species and no odonate species of conservation importance were recorded during the monitoring.
- 3.1.11. No herpetofauna were recorded at PNH during the monitoring.

Aquatic Macroinvertebrate and Fish

- 3.1.12. A total of 13 species were recorded within the PNH river, including four fish species and nine aquatic macroinvertebrate species such as worms, snails and insects (**Table 3.3**). Most of the recorded species are commonly found in freshwater and estuarine habitats of Hong Kong (Chan *et al.*, 2003; Williams, 2003; AFCD, 2015). One fish species of conservation importance, Predaceous Chub (*Parazacco spilurus*), was recorded at the pool of PNH3 in low abundance during the monitoring. This species is listed as “Vulnerable” in China Red Data Book.

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

Common Name ⁽¹⁾	Scientific Name	Distribution in Hong Kong ⁽²⁾	Principal Status ⁽³⁾	Level of Concern ⁽⁴⁾	Protection Status in China ⁽⁵⁾	China Red Data Book ⁽⁶⁾	IUCN Red List ⁽⁷⁾	PNH1	PNH2	PNH3	PNH4
Green Sandpiper ⁽⁸⁾	<i>Tringa ochropus</i>	Uncommon	W	-	-	-	-		1		
Spotted Dove	<i>Streptopelia chinensis</i>	Abundant	R	-	-	-	-		1		
Large-billed Crow	<i>Corvus macrorhynchos</i>	Common	R	-	-	-	-		2		
Common Tailorbird	<i>Orthotomus sutorius</i>	Common	R	-	-	-	-				1
Masked Laughingthrush	<i>Garrulax perspicillatus</i>	Abundant	R	-	-	-	-			3	
Crested Myna	<i>Acridotheres cristatellus</i>	Common	R	-	-	-	-	10			
Oriental Magpie Robin	<i>Copsychus saularis</i>	Abundant	R	-	-	-	-				1
Eurasian Tree Sparrow	<i>Passer montanus</i>	Abundant	R	-	-	-	-			4	

Note:

- (1) All wild birds are protected under Wild Animals Protection Ordinance (Cap. 170).
- (2) AFCD (2015). Hong Kong Biodiversity Database.
- (3) R=resident; W=winter visitor.
- (4) Fellowes *et al.* (2002).
- (5) List of Wild Animals Under State Protection (promulgated by State Forestry Administration and Ministry of Agriculture on 14 January, 1989).
- (6) Zheng and Wang (1998).
- (7) IUCN (2015). IUCN Red List of Threatened Species. Version 2015.2.
- (8) Wetland-dependent species (including wetland-dependent species and waterbirds).

Table 3.2 Number of Odonate Recorded at Pak Ngan Heung River (PNH)

Common Name	Scientific Name	Distribution in Hong Kong ⁽¹⁾	Level of Concern ⁽²⁾	Protection Status in China ⁽³⁾	China Red Data Book ⁽⁴⁾	IUCN Red List ⁽⁵⁾	PNH1	PNH2	PNH3	PNH4
Common Bluetail	<i>Ischnura senegalensis</i>	Abundant	-	-	-	-				1
Black-kneed Featherlegs	<i>Copera ciliata</i>	Abundant	-	-	-	-				1
Yellow Featherlegs	<i>Copera marginipes</i>	Abundant	-	-	-	-			1	
Black Threadtail	<i>Prodasineura autumnalis</i>	Abundant	-	-	-	-			5	2
Russet Percher	<i>Neurothemis fulvia</i>	Abundant	-	-	-	-				1
Crimson Dropwing	<i>Trithemis aurora</i>	Abundant	-	-	-	-				1

Note:

(1) AFCD (2015). Hong Kong Biodiversity Database.

(2) Fellowes *et al.* (2002).

(3) List of Wild Animals Under State Protection (promulgated by State Forestry Administration and Ministry of Agriculture on 14 January, 1989).

(4) Zheng and Wang (1998).

(5) IUCN (2015). IUCN Red List of Threatened Species. Version 2015.2.

Table 3.3 Relative Abundance of Aquatic Macroinvertebrate and Fish Recorded at Pak Ngan Heung River (PNH)

Fauna Group	Common name	Scientific Name	Distribution in Hong Kong (1)(2)(3)	Level of Concern (4)	Protection Status in China (5)	China Red Data Book (6)	IUCN Red List (7)	PNH1	PNH2	PNH3	PNH4
Fish	Predaceous Chub	<i>Parazacco spilurus</i>	Common	-	-	Vulnerable	-			+	
Fish	Jarboa Terapon, Crescent-banded Grunter	<i>Terapon jarbua</i>	Common	-	-	-	-		+		
Fish	Redbelly tilapia	<i>Tilapia zillii</i>	Common	-	-	-	-			++	
Fish	Mudskipper	<i>Periophthalmus cantonensis</i>	Common	-	-	-	-	+			
Worms	-	Polychaetes	-	-	-	-	-			+	
Worms	Flatworm	Planaria	-	-	-	-	-			+	
Snails	-	<i>Nerita chamaeleon</i>	Common	-	-	-	-	+++	+++		
Snails	-	Thiaridae	-	-	-	-	-	+			
Insects	Caddisflies	Hydropsychidae	-	-	-	-	-	+		+	+
Insects	Non-Biting Midges	Chironomidae	-	-	-	-	-	+	+	+	
Insects	Mayfly	Baetidae	-	-	-	-	-			+	
Insects	Mayfly	Caenidae	-	-	-	-	-				+
Insects	Mayfly	Heptageniidae	-	-	-	-	-		+	+	

Note:

(1) AFCD (2015). Hong Kong Biodiversity Database.

(2) Williams, G. (2003). Hong Kong Field Guides – Rocky Shores.

(3) Chan *et al.* (2003). Hong Kong Field Guides – Sandy Shores.

(4) Fellowes *et al.* (2002).

(5) List of Wild Animals Under State Protection (promulgated by State Forestry Administration and Ministry of Agriculture on 14 January, 1989).

(6) Zheng and Wang (1998).

(7) IUCN (2015). IUCN Red List of Threatened Species. Version 2015.2.

Relative abundance: + = occasional, less than 5 individuals were found; ++ = common, 5-20 individuals were found; +++ = abundant, more than 20 individuals were found.
Species of conservation importance is noted in bold type face.

Luk Tei Tong River (LTT)

- 3.1.13. 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 riverbank of the LTT1 whereas rock-filled gabion formed the riverbank of LTT2 to LTT5. LTT1 was located at the confluence with Pak Ngan Heung River, Tai Tei Tong River and Luk Tei Tong River. Since it is subject to tidal flow, water flowed from south to north during the survey when the tide was going out. LTT1 and LTT2 had sandy substrate whilst LTT3 to LTT5 had muddy substrate. Clusters of boulders were present at both sides of the river channel. The width of the river channel was approximately 8-10 m.
- 3.1.14. No evidence of maintenance works (including those relevant to Conditions 2.1 to 2.4 of EP No. EP-434/2012 (amended to EP-434/2012/A) was observed during the monitoring period.

Vegetation

- 3.1.15. A total of 15 plant species were recorded in LTT. Seven out of 15 recorded species were exotic. The majority were herbs or climbers scattered along the gabion such as *Bidens alba*, Many-flowered Silvergrass (*Miscanthus floridulus*), Chinese Silvergrass (*Miscanthus sinensis*) and *Wedelia trilobata*. In addition to the mangrove stand supporting Spiny Bears Breech (*Acanthus ilicifolius*) and *Kandelia obovata* that has colonized inside the river channel at LTT2 and LTT3, several seedlings of *Kandelia obovata* have naturally regenerated at LTT1, LTT2, LTT3 and LTT5.
- 3.1.16. The list of plant species is presented in **Appendix 2a**.

Terrestrial Fauna

- 3.1.17. A total of 7 avifauna species were recorded at LTT, all of them are common or abundant in Hong Kong (AFCD, 2015) (**Table 3.4**). Waterbird (e.g. Little Egret *Egretta garzetta*) and generalists (e.g. Crested Myna) were recorded at LTT. One avifauna species of conservation importance, Little Egret, was recorded during the monitoring.
- 3.1.18. One individual of Little Egret was observed foraging at LTT1, LTT4 and LTT5 respectively. This species was listed as "Potential Regional Concern" by Fellowes *et al.* (2002).
- 3.1.19. No odonate species were recorded at LTT during the monitoring.
- 3.1.20. No herpetofauna species were recorded at LTT during the monitoring.

Aquatic Macroinvertebrate and Fish

- 3.1.21. A total of 14 species, including three fish species, three crustacean species and eight species of other aquatic macroinvertebrates were recorded from LTT (**Table 3.5**). Most of the recorded species are either common or very common in river mouth or estuarine habitats in Hong Kong (Chan *et al.*, 2003; Williams, 2003; AFCD, 2015). A rare crab species, *Uca crassipes*, was recorded at mangrove stand at LTT2 and LTT3. No fish or aquatic macroinvertebrates species of conservation importance were recorded during the monitoring.

Table 3.4 Number of Avifauna Recorded at Luk Tei Tong River (LTT)

Common Name ⁽¹⁾	Scientific Name	Distribution in Hong Kong ⁽²⁾	Principal Status ⁽³⁾	Level of Concern ⁽⁴⁾	Protection Status in China ⁽⁵⁾	China Red Data Book ⁽⁶⁾	IUCN Red List ⁽⁷⁾	LTT1	LTT2	LTT3	LTT4	LTT5
Little Egret⁽⁸⁾	<i>Egretta garzetta</i>	Common	P	PRC	-	-	-	1			1	1
Spotted Dove	<i>Streptopelia chinensis</i>	Abundant	R	-	-	-	-		3			
Common Kingfisher ⁽⁸⁾	<i>Alcedo atthis</i>	Common	AM,P	-	-	-	-	1				
Japanese White-eye	<i>Zosterops japonicus</i>	Abundant	R,?W	-	-	-	-	1				
Crested Myna	<i>Acridotheres cristatellus</i>	Common	R	-	-	-	-	8			5	1
Black-collared Starling	<i>Gracupica nigricollis</i>	Common	R	-	-	-	-	3				
White Wagtail	<i>Motacilla alba</i>	Common	W,R	-	-	-	-			1	1	

Note:

- (1) All wild birds are protected under Wild Animals Protection Ordinance (Cap. 170).
- (2) AFCD (2015). Hong Kong Biodiversity Database.
- (3) R=resident; AM=autumn migrant; W=winter visitor; ?W=the extent of immigration in winter is unclear ; P=present all year, exact composition unknown.
- (4) Fellowes *et al.* (2002): PRC=Potential Regional Concern.
- (5) List of Wild Animals Under State Protection (promulgated by State Forestry Administration and Ministry of Agriculture on 14 January, 1989).
- (6) Zheng and Wang (1998).
- (7) IUCN (2015). IUCN Red List of Threatened Species. Version 2015.2.
- (8) Wetland-dependent species (including wetland-dependent species and waterbirds).

Species of conservation importance is noted in bold type face.

Table 3.5 Relative Abundance of Aquatic Macroinvertebrate and Fish Recorded at Luk Tei Tong River (LTT)

Fauna Groups	Common Name	Scientific Name	Distribution in Hong Kong ⁽¹⁾⁽²⁾⁽³⁾	Level of Concern ⁽⁴⁾	Protection Status in China ⁽⁵⁾	China Red Data Book ⁽⁶⁾	IUCN Red List ⁽⁷⁾	LTT1	LTT2	LTT3	LTT4	LTT5
Fish	Jarboa Terapon, Crescent-banded Grunter	<i>Terapon jarbua</i>	Common	-	-	-	-	+++	++			++
Fish	Mozambique Tilapia	<i>Oreochromis mossambicus</i>	Common	-	-	-	Near Threatened ⁽⁸⁾	++	++			
Fish	Mudskipper	<i>Periophthalmus cantonensis</i>	Common	-	-	-	-				+	
Crustacean (Crabs)	-	<i>Uca crassipes</i>	Rare	-	-	-	-		++	+		
Crustacean (Crabs)	-	<i>Uca lactea</i>	Common	-	-	-	-		+++			
Crustacean (Barnacles)	-	<i>Balanus amphitrite</i>	Very common	-	-	-	-		+		+	
Worms	-	Polychaetes	-	-	-	-	-	+	+			
True Slugs	-	<i>Onchidium</i> spp.	Common	-	-	-	-		+			
Snails	-	<i>Nerita chamaeleon</i>	Common	-	-	-	-	+++				
Snails	-	Thiaridae	-	-	-	-	-					+
Bivalves	Rock oyster	<i>Saccostrea cucullata</i>	Very common	-	-	-	-	++	+++	+	+	
Amphipod	-	Amphipoda	-	-	-	-	-	+				
Insects	Sea Slater	<i>Ligia exotica</i>	Common	-	-	-	-		+++	+	+	
Insects	Non-Biting Midges	Chironomidae	-	-	-	-	-	+	+			+

Note:

(1) AFCD (2015). Hong Kong Biodiversity Database.

(2) Williams, G. (2003). Hong Kong Field Guides – Rocky Shores.

(3) Chan *et al.* (2003). Hong Kong Field Guides – Sandy Shores.

(4) Fellowes *et al.* (2002).

(5) List of Wild Animals Under State Protection (promulgated by State Forestry Administration and Ministry of Agriculture on 14 January, 1989).

(6) Zheng and Wang (1998).

(7) IUCN (2015). IUCN Red List of Threatened Species. Version 2015.2.

(8) Although this species is listed as "Near Threatened" in IUCN Red List, it is not classified as a species of conservation importance as it is exotic and invasive to local freshwater ecosystem.

Relative abundance: + = 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)

- 3.1.22. The LBC links to the end of LTT5 and runs east to west but the connection with LTT5 is blocked by a layer of gabion wall approximately 1 m in height, which allows water flow between LBC and LTT when water level is higher than the height of the gabion. It is located in the Luk Tei Tong Marsh to the west of the original LTT. Gabion walls formed both sides of the channel bank. A small pool of approximately 60 m² in size was located at the western 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.
- 3.1.23. The RS was located parallel to the northern side of the LBC. Next to the RS was village housing. The site was vegetated and did not have any free-standing water at the time of survey.

Vegetation

- 3.1.24. A total of 39 plant species were recorded in LBC, of which 18 species were recorded in the quadrats sampled. The list of plant species is presented in **Appendix 2b**. Among all the recorded species, about 36% were exotic species (**Table 3.6**). Similar to the last monitoring survey in June, half of the LBC1 section included a patch of open water. Other sections were dry.
- 3.1.25. The habitat at LBC1 differed from the remaining LBC sections in terms of vegetation type. It adjoined LTT5 and had a pool of open water at the eastern tip. LBC1 may be subject to tidal influence during high tide because it is located immediately next to LTT. The sedge, Ferruginous-scale Fimbristylis (*Fimbristylis sieboldii*) dominated LBC1. Four saplings of *Kandelia obovata* were observed in LBC1. Native Leather Fern (*Acrostichum aureum*) was common at the dry section west to the open water at LBC1.
- 3.1.26. Exotic species *Wedelia trilobata* was the dominant species at LBC2 to LBC5. Other herbaceous species commonly encountered along the transects from LBC2 to LBC5 included Glutene-rice Grass (*Apluda mutica*), *Bidens alba*, and Panic Grass (*Panicum repens*). Tree seedlings (e.g. Taiwan Acacia, *Acacia confusa* and Chinese Tallow Tree, *Sapium sebiferum*) were occasionally recorded at the drier section near the bridge at LBC1, and near the gabion at LBC2 and LBC4. Wetland species such as Hairy Knotweed (*Polygonum barbatum*), Taro (*Colocasia esculenta*), Spiny Knotweed (*Polygonum perfoliatum*) and Ginger Lily (*Hedychium coronarium*) were occasionally recorded along LBC2 to LBC5.
- 3.1.27. A total of 48 plant species were recorded in the RS, of which 17 species were found in the quadrats (**Table 3.6**). Among all the recorded species, about 44% were exotic species. The list of plant species is presented in **Appendix 2b**. All sections were dry and were located next to the village housing. The dominant species was exotic *Wedelia trilobata*. *Bidens alba*, Hilo Grass (*Paspalum conjugatum*) and Sensitive Plant (*Mimosa pudica*); and native Ciliate Sasagrass (*Microstegium ciliatum*), Sida Hemp (*Sida rhombifolia*) and Rose Mallow (*Urena lobata*) were commonly recorded along the RS sections. The majority of vegetation recorded at the RS could typically be found in disturbed land. Records of wetland species such as Taro and Ginger Lily were occasional.

Table 3.6 Vegetation Coverage at Luk Tei Tong Bypass Channel (LBC) and Reference Site (RS)

	LBC	RS
No. of species recorded in quadrats	18	17
Total No. of species	39	48
Total No. of exotic species	14	21
Average vegetation coverage	100%	98%
Bare ground coverage	0%	2%

Note:

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

Terrestrial Fauna

- 3.1.28. Five species of avifauna were recorded at the LBC (**Table 3.7**) and five species of avifauna were recorded at the RS (**Table 3.8**). All recorded species are common or abundant in Hong Kong, except Green Sandpiper which is uncommon in Hong Kong (AFCD, 2015) and most were habitat specialists. The dominant avifaunal species in LBC was Crested Myna, while the dominant avifauna species in RS was Red-whiskered Bulbul (*Pycnonotus jocosus*). No species of conservation importance were recorded at LBC or RS.
- 3.1.29. One odonate species, Crimson Dropwing (*Trithemis aurora*), was recorded at LBC while no odonates were recorded at RS during the monitoring. This species is abundant in Hong Kong (AFCD, 2015) (**Table 3.9**). No odonate species of conservation importance was recorded during the monitoring.
- 3.1.30. No herpetofauna species were recorded at LBC and RS during the monitoring.

Aquatic Macroinvertebrate and Fish

- 3.1.31. A total of four species, including one fish species and three aquatic macroinvertebrates species were recorded at LBC1 (**Table 3.10**). The recorded species were either very common or common in Hong Kong (Chan *et al.*, 2003; Williams, 2003; AFCD, 2015). No fish and aquatic macroinvertebrate species of conservation importance were recorded during the monitoring.
- 3.1.32. No aquatic fauna was recorded at the RS or the remaining sections of the LBC2 to LBC5 as they were dry during the monitoring.

Table 3.7 Number of Avifauna Recorded at Luk Tei Tong Bypass Channel (LBC)

Common Name ⁽¹⁾	Scientific Name	Distribution in Hong Kong ⁽²⁾	Principal Status ⁽³⁾	Level of Concern ⁽⁴⁾	Protection Status in China ⁽⁵⁾	China Red Data Book ⁽⁶⁾	IUCN Red List ⁽⁷⁾	LBC1	LBC2	LBC3	LBC4	LBC5
Green Sandpiper ⁽⁸⁾	<i>Tringa ochropus</i>	Uncommon	W	-	-	-	-	1				
Chinese Bulbul	<i>Pycnonotus sinensis</i>	Abundant	R	-	-	-	-	2				
Common Tailorbird	<i>Orthotomus sutorius</i>	Common	R	-	-	-	-		1			
Crested Myna	<i>Acridotheres cristatellus</i>	Common	R	-	-	-	-		5			
Oriental Magpie Robin	<i>Copsychus saularis</i>	Abundant	R	-	-	-	-				1	

Note:

- (1) All wild birds are protected under Wild Animals Protection Ordinance (Cap. 170).
- (2) AFCD (2015). Hong Kong Biodiversity Database.
- (3) R=resident; W=winter visitor.
- (4) Fellowes *et al.* (2002).
- (5) List of Wild Animals Under State Protection (promulgated by State Forestry Administration and Ministry of Agriculture on 14 January, 1989).
- (6) Zheng and Wang (1998).
- (7) IUCN (2015). IUCN Red List of Threatened Species. Version 2015.2.
- (8) Wetland-dependent species (including wetland-dependent species and waterbirds).

Table 3.8 Number of Avifauna Recorded at Reference Site (RS)

Common Name ⁽¹⁾	Scientific Name	Distribution in Hong Kong ⁽²⁾	Principal Status ⁽³⁾	Level of Concern ⁽⁴⁾	Protection Status in China ⁽⁵⁾	China Red Data Book ⁽⁶⁾	IUCN Red List ⁽⁷⁾	RS1	RS2	RS3	RS4	RS5
Chinese Bulbul	<i>Pycnonotus sinensis</i>	Abundant	R	-	-	-	-	3				
Large-billed Crow	<i>Corvus macrorhynchos</i>	Common	R	-	-	-	-					2
Red-whiskered Bulbul	<i>Pycnonotus jocosus</i>	Abundant	R	-	-	-	-				6	
Black-collared Starling	<i>Gracupica nigricollis</i>	Common	R	-	-	-	-			4		
Masked Laughingthrush	<i>Garrulax perspicillatus</i>	Abundant	R	-	-	-	-					4

Note:

- (1) All wild birds are protected under Wild Animals Protection Ordinance (Cap. 170).
- (2) AFCD (2015). Hong Kong Biodiversity Database.
- (3) R=resident.
- (4) Fellowes *et al.* (2002).
- (5) List of Wild Animals Under State Protection (promulgated by State Forestry Administration and Ministry of Agriculture on 14 January, 1989).
- (6) Zheng and Wang (1998).
- (7) IUCN (2015). IUCN Red List of Threatened Species. Version 2015.2.

Table 3.9 Number of Odonate Recorded at Luk Tei Tong Bypass Channel (LBC)

Common Name	Scientific Name	Distribution in Hong Kong ⁽¹⁾	Level of Concern ⁽²⁾	Protection Status in China ⁽³⁾	China Red Data Book ⁽⁴⁾	IUCN Red List ⁽⁵⁾	LBC1	LBC2	LBC3	LBC4	LBC5
Crimson Dropwing	<i>Trithemis aurora</i>	Abundant	-	-	-	-	1				

Note:

(1) AFCD (2015). Hong Kong Biodiversity Database.

(2) Fellowes *et al.* (2002).

(3) List of Wild Animals Under State Protection (promulgated by State Forestry Administration and Ministry of Agriculture on 14 January, 1989).

(4) Zheng and Wang (1998).

(5) IUCN (2015). IUCN Red List of Threatened Species. Version 2015.2.

Table 3.10 Relative Abundance of Aquatic Macroinvertebrate and Fish Recorded at Luk Tei Tong Bypass Channel (LBC)

Fauna Groups	Common Name	Scientific Name	Distribution in Hong Kong ⁽¹⁾⁽²⁾⁽³⁾	Level of Concern ⁽⁴⁾	Protection Status in China ⁽⁵⁾	China Red Data Book ⁽⁶⁾	IUCN Red List ⁽⁷⁾	LBC1	LBC2	LBC3	LBC4	LBC5
Fish	Mozambique Tilapia	<i>Oreochromis mossambicus</i>	Common	-	-	-	Near Threatened ⁽⁸⁾	++				
Snails	-	<i>Nerita chamaeleon</i>	Common	-	-	-	-	++				
Snails	-	Thiaridae	-	-	-	-	-	++				
Snails	-	<i>Cerithidea cingulata</i>	Very common	-	-	-	-	+				

Note:

- (1) AFCD (2015). Hong Kong Biodiversity Database.
- (2) Williams, G. (2003). Hong Kong Field Guides – Rocky Shores.
- (3) Chan *et al.* (2003). Hong Kong Field Guides – Sandy Shores.
- (4) Fellowes *et al.* (2002).
- (5) List of Wild Animals Under State Protection (promulgated by State Forestry Administration and Ministry of Agriculture on 14 January, 1989).
- (6) Zheng and Wang (1998).
- (7) IUCN (2015). IUCN Red List of Threatened Species. Version 2015.2.
- (8) Although this species is listed as “Near Threatened” in IUCN Red List, it is not classified as a species of conservation importance as it is exotic and invasive to local freshwater ecosystem.

Relative abundance: + = occasional, less than 5 individuals were found; ++ = common, 5-20 individuals were found; +++ = abundant, more than 20 individuals were found.

3.2. Ecological Water Quality Monitoring (EWQM)

- 3.2.1. The post-construction phase EWQM was conducted on 10 August 2015. The monitoring results are presented in **Appendix 3** and summarised in **Table 3.11**, which includes reference to the key Water Quality Objectives (WQOs). Baseline surveys were conducted in 2007 prior to the start of the drainage improvement works. The baseline survey results are presented in **Table 3.12**.
- 3.2.2. The water quality monitoring results are discussed in **Section 5**.

Table 3.11 Summarized Ecological Water Quality Monitoring Results (August 2015)

Parameters	Key Water Quality Objectives ⁽¹⁾	WE1	WE2	WE3	WE4	WE5	WE6
Suspended Solids (mg/L)	<20	3.0	2.0	2.0	3.0	<2.0	<2.0
Nitrogen (Ammonia) (mg/L)	-	0.04	0.02	0.04	0.15	0.78	0.02
Nitrogen (Nitrate) (mg/L)	-	0.08	0.11	0.11	0.19	0.14	0.21
Reactive Phosphorous (mg/L)	-	0.03	0.03	0.02	0.03	0.10	0.01
5-day Biochemical Oxygen Demand (BOD ₅) (mg/L)	<5	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Dissolved Oxygen (mg/L)	>4	7.2	8.0	8.0	8.7	7.1	7.8
Temperature (°C)	-	29.6	27.7	27.7	31.5	30.7	30.0
pH	6.5 – 8.5	6.9	6.7	6.7	7.6	7.2	7.2
Salinity (ppt)	-	0.04	0.02	0.02	6.00	1.50	0.03
Conductivity (µs/cm)	-	98.8	68.9	64.2	10309.0	2528.0	70.5
Water Flow (m/s)	-	0.10	0.08	0.10	0.11	0.02	0.01
Water Depth (cm)	-	18.0	16.0	14.5	23.0	15.0	30.0

Note:

- (1) The available key Water Quality Objectives (WQOs) for River Monitoring Stations at Mui Wo River on Lantau Island (EPD, 2013).

Table 3.12 Baseline Results of Ecological Water Quality Monitoring Results (September 2007)

Parameters	WE1	WE2	WE3	WE4	WE5	WE6
Suspended Solids (mg/L)	1.0	2.0	3.0	3.0	<1.0	<1.0
Nitrogen (Ammonia) (mg/L)	0.07	0.12	0.11	0.23	0.03	0.02
Nitrogen (Nitrate) (mg/L)	0.12	0.13	0.13	0.31	0.04	0.05
Reactive Phosphorous (mg/L)	0.04	0.06	0.06	0.09	0.06	0.05
5-day Biochemical Oxygen Demand (BOD ₅) (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Dissolved Oxygen (mg/L)	6.58	6.82	6.37	7.61	6.87	5.70
pH	6.4	7.1	7.0	6.8	6.6	6.1
Salinity (ppt)	<0.1	0.1	0.3	7.6	0.1	<0.1

4. ECOLOGICAL MONITORING SCHEDULE

- 4.1. The next ecological surveys and ecological water quality monitoring are tentatively scheduled for mid-October 2015.

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 August 2015 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 for DSD's consideration.
- 5.3. Exotic species *Wedelia trilobata* was still the dominant species at LBC2 to LBC5. Marsh species including Hairy Knotweed, Taro and Ginger Lily were occasionally recorded at LBC2 to LBC5. The limited occurrence of these species suggested that the water levels/availability within the channel might not be adequate to sustain a marsh habitat.
- 5.4. LBC1 differed from LBC2 to LBC5 in terms of vegetation composition. LBC1 was dominated by wetland dependent species Ferruginous-scale *Fimbristylis* and was the best representation of re-established marsh habitat in LBC. Four saplings of *Kandelia obovata* were recorded at LBC1. While, LBC2 to LBC5 supported only limited marsh species and was dominated by flora species which typically occur in dry land habitats such as *Wedelia trilobata*. As any vegetation clearance at LBC1 would result in the removal of the established marsh habitat, it is recommended that future vegetation clearance avoids LBC1 to protect and maintain this habitat.
- 5.5. Tree seedlings (such as Taiwan Acacia and Chinese Tallow Tree) were recorded near the bridge at LBC1, and near the gabion at LBC2 and LBC4. Such tree species may hinder the re-establishment of marsh habitat.
- 5.6. Significant coverage of exotic Mile-a-minute (*Mikania micrantha*) is observed on the banks of PNH3 pool, the gabion of the PNH4 and the two edges of the cascade/fish ladder. Although Mile-a-minute was overgrown at the edges of the PNH4 cascade/fish ladder, free water flow was still observed. The presence of vegetation growing on the fish ladder can hinder the use and movement by fish or freshwater community along PNH3 and PNH4, therefore regular weed removal is recommended to keep the fish ladder open of vegetation.
- 5.7. Mangrove stands of Spiny Bears Breech and *Kandelia obovata* were observed inside the river channel at LTT2 and LTT3. Several *Kandelia obovata* seedlings were observed at LTT1, LTT2, LTT3, and LTT5 and LBC1. This indicated a natural re-colonization of mangrove.
- 5.8. A rare crab species, *Uca crassipes*, was recorded at the Spiny Bears Breech and *Kandelia obovata* mangrove stand at LTT2 and LTT3. This species inhabits mangroves or close to muddy coast (AFCD, 2015).
- 5.9. Whilst some differences between the original 2007 baseline surveys and the August 2015 monitoring surveys are evident, findings from water monitoring could be attributed to a range of factors including seasonal variations, and climatic conditions and/or the influence of tidal status at the time of survey. Taking this into account, the key Water Quality Objectives (WQOs) for River Monitoring Stations at Mui Wo River (EPD, 2013) have been included to provide a comparison with standard water quality goals applicable to the area (refer to **Table 3.11**).
- 5.10. The Environmental Protection Department (EPD) analyses and presents data from its annual water monitoring programme to express the level of compliance with the statutory WQOs including pH, Suspended Solids (SS), 5-day Biochemical Oxygen Demand (BOD₅), and Dissolved Oxygen (DO). These WQOs specify the long-term water quality goals that the Government is to achieve and maintain for individual rivers in Hong Kong, including the Mui

Wo River. As part of the programme five locations are sampled from the Mui Wo River, three of which are associated with the monitoring area for the drainage improvement works (MW1, MW2 and MW4). The objectives related to these sampling locations, have been used in this report. Water quality of the subject watercourses has met the WQOs during the survey.

- 5.11. No observable evidence of environmental changes such as odour, or discharge within the surveyed area were recorded. When compared with the EPD key water quality objectives for river monitoring (2013), the parameters (SS, BOD₅, DO and pH) complied with the statutory WQOs. When compared to the last monitoring period, nitrogen (ammonia) concentration increased slightly at WE1 and WE5; decreased slightly at WE2, WE3 and WE4, and remained unchanged at WE6. Suspended Solids concentration decreased significantly at WE2, WE3, WE5 and WE6, and remained unchanged at WE1 and WE4. Nitrogen (nitrate) concentration increased slightly at WE4 and WE6, while decreased slightly at WE1, WE2, WE3 and WE5. Conductivity was observed to decrease significantly at WE3, WE4 and WE5; while demonstrated minimal change at the other monitoring sites. Dissolved oxygen level increased significantly at all monitoring sites. The salinity level, reactive phosphorus and BOD₅ concentration demonstrated minimal change at all monitoring sites. Other monitoring parameters such as flow rate and pH value at all locations demonstrated minimal change compared to the last sampling record.
- 5.12. While fluctuations in water quality have been observed, no trend in water quality decline has been detected over the monitoring period. The water quality will continue to be monitored and findings will be presented in subsequent reports as additional information becomes available.

Table 5.1 Key Observations/Comments and Recommendations Arising from the August 2015 Monitoring Period

Location	Mitigation Measure	Observations/Comments	Recommendations
PNH and LTT	Construction of a small fish ladder at the upstream end of the PNH	Mile-a-minute (<i>Mikania micrantha</i>) is the dominant species at upper PNH, but free water flow was still observed at the fish ladder.	Continued retention of native species, particularly at the edges of the river channel, during any future maintenance activities is recommended, to maintain existing habitat and minimize the re-colonization of exotic species. Some pits have been incorporated into the gabion banks, but do not appear to have been planted up. Planting of riparian vegetation, preferably with native species suggested in the EIA report Section 7.8.17 and Table 2.6 (e.g. <i>Albizia lebbbeck</i> , <i>Sterculia lanceolata</i> , <i>Cinnamomum camphora</i> , <i>Polyspora axillaris</i> , and <i>Rhaphiolepis indica</i>) is recommended. On-going, regular weed management is recommended, as required, to maintain the open nature of the fish ladder.

Location	Mitigation Measure	Observations/Comments	Recommendations
		The fish ladder does not meet the lip of the weir at the up-stream end of PNH4 due to a drop of approximately 30 cm. This could limit the overall function of the fish ladder for fish passage/movement up and downstream.	As per the current design of the fish ladder, the gap from the top of the fish ladder and the bottom of the weir is 30-40cm - presenting an obstacle to fish passage. Some improvement may be achieved by stacking additional boulders resembling that in PNH4 to form pools at the top of the fish ladder, which could facilitate fish movement.
	Re-establishment of aquatic / riparian communities	<p>Fish species of conservation importance Predaceous Chub (<i>Parazacco spilurus</i>), which was recorded in the 2003-2004 EIA surveys, was recorded at PNH3 during current monitoring in August 2015.</p> <p>Another fish species of conservation importance, Flagtail (<i>Kuhlia marginata</i>), which was also recorded in the 2003-2004 EIA surveys, was not recorded during the current monitoring in August 2015.</p> <p>A rare crab species, <i>Uca crassipes</i>, was recorded at the Spiny Bears Breech and <i>Kandelia obovata</i> mangrove stand at LTT2 and LTT3 during the current monitoring in August 2015.</p>	The presence of species of conservation importance in both PNH and LTT including relative abundance will continue to be monitored.
LBC	Provision of suitable habitat compensation	<p>Marsh vegetation is supported by LBC1 including native species Leather Fern. Four saplings of <i>Kandelia obovata</i> were recorded at LBC1.</p> <p>Continued dominance by the exotic species, <i>Wedelia trilobata</i>, with limited marsh species were recorded from LBC2 to LBC5.</p> <p>The presence of regenerated tree seedlings at LBC1, LBC2 and LBC4 may hinder the re-establishment of a marsh habitat.</p>	<p>The establishment and the coverage of Leather Fern and <i>Kandelia obovata</i> species will continue to be monitored.</p> <p>Future vegetation clearance should avoid LBC1 to protect and maintain the marsh habitat</p> <p>The regeneration of marsh species in the LBC is to be monitored.</p> <p>Removal of tree seedlings (e.g. Taiwan Acacia and Chinese Tallow Tree) is suggested at LBC1, LBC2 and LBC4.</p>
		The limited occurrence of typical marsh plant species (although this was also limiting in the RS) suggests that the water levels/availability within the channel may not be adequate to sustain a marsh habitat.	On-going monitoring of water levels and species composition within the channel are required. Further assessment should take into account the timing of the surveys (wet/dry season).

6. REFERENCES

AFCD (2015). Hong Kong Biodiversity Database. Available at <http://www.afcd.gov.hk/english/conservation/hkbiodiversity/database/resultlist.asp?lang=en> Accessed on 2 September 2015.

Carey, G. J., Chalmers, M. L., Diskin, D. A., Kennerley, P. R., Leader, P. J., Leven, M. R., Lewthwaite, R. W., Melville, D. S., Turnbull, M. and Young, L. (2001). The Avifauna of Hong Kong. Hong Kong Bird Watching Society, Hong Kong.

Chan, A., Cheung, J., Sze, P., Wong, A., Wong, E. and Yau, E. (2011). A Review of the Local Restrictedness of Hong Kong Butterflies. Hong Kong Biodiversity Newsletter 21: 1-6. Agriculture, Fisheries and Conservation Department, Hong Kong Special Administrative Region.

Chan, K. K. B. and Caley, K. J. (2003). Hong Kong Field Guides – Sandy Shores. The Department of Ecology and Biodiversity, The University of Hong Kong.

Chan, S. K. F., Cheung, K. S., Ho, C. Y., Lam, F. N., Tang, W. S., Lau, M. W. N. and Bogadek, A. (2005). A Field Guide to the Amphibians of Hong Kong. Agriculture, Fisheries and Conservation Department, Friends of the Country Parks and Cosmos Books Ltd.

Chan, S. K. F., Cheung, K. S., Ho, C. Y., Lam, F. N., Tang, W. S. and Tse, M. L. (2006). A Field Guide to the Venomous Land Snakes of Hong Kong. Agriculture, Fisheries and Conservation Department, Friends of the Country Parks and Cosmos Books Ltd.

Chan, S. K. F., Chan, A. S. W., Cheung, K. S., Ho, C. Y., Ng, C. K. Y. and Tang, W. S. (2009). The Skinks of Hong Kong. Hong Kong Biodiversity Newsletter: Issue 17.

Corlett, R., Xing, W. F., Ng, C. S., Chau, K. C. L. and Wong, M. Y. L. (2000). Hong Kong Vascular Plants: Distribution and Status. Memoirs of the Hong Kong Natural History Society, 23, 1-157.

Dudgeon (2003). Hong Kong Field Guides – Hillstreams. The Department of Ecology and Biodiversity, The University of Hong Kong.

Environmental Protection Department (2005). Wetland Restoration in Country Parks. Advisory Council on the Environment Nature Conservation Subcommittee. Committee Paper NCSC 2/05.

Environmental Protection Department (2013). River Water Quality in Hong Kong in 2012. The Government of the Hong Kong Special Administrative Region.

Fellowes, J. R., Lau, M. W., Dudgeon, D., Reels, G. T., Ades, G. W. and Carey, G. J. (2002). Wild Animals to Watch: Terrestrial and Freshwater Fauna of Conservation Concern in Hong Kong. Memoirs of the Hong Kong Natural History Society, 25, 123-159.

Hong Kong Herbarium and South China Botanical Garden (2007). Flora of Hong Kong. Volume 1. Agriculture, Fisheries and Conservation Department, Government of Hong Kong Special Administrative Region.

Hong Kong Herbarium and South China Botanical Garden (2008). Flora of Hong Kong. Volume 2. Agriculture, Fisheries and Conservation Department, Government of Hong Kong Special Administrative Region.

Hong Kong Herbarium and South China Botanical Garden (2009). Flora of Hong Kong. Volume 3. Agriculture, Fisheries and Conservation Department, Government of Hong Kong Special Administrative Region.

Hong Kong Herbarium and South China Botanical Garden (2011). Flora of Hong Kong. Volume 4. Agriculture, Fisheries and Conservation Department, Government of Hong Kong Special Administrative Region.

Hong Kong Herbarium (2012). Check List of Hong Kong Plants 2012. Agriculture, Fisheries and Conservation Department, HKSAR Government.

Hu, Q. M., Wu, T. L., Xia, N. H., Xing, F. W., Lai, P. C. C. and Yip, K. W. (2003). Rare and Precious Plants of Hong Kong. Agriculture, Fisheries and Conservation Department, Hong Kong Special Administrative Government.

IUCN (2015). IUCN Red List of Threatened Species. Version 2015.2. Available at www.iucnredlist.org. Accessed on 2 September 2015.

Lee, V. L. F., Lam, S. K. S., Ng, F. K. Y., Chan, T. K. T. and Young, M. L. C. (2004). Field Guide to the Freshwater Fish of Hong Kong. Agriculture, Fisheries and Conservation Department, Friends of the Country Parks and Cosmos Books Ltd. Hong Kong.

Lo, P. Y. F. (2005). Hong Kong Butterflies, 2nd edition. Agriculture, Fisheries and Conservation Department.

Karsen, S. J., Lau, M. W. N. and Bogadek, A. (1998). Hong Kong Amphibians and Reptiles. Urban Council, Hong Kong.

Shek, C. T. (2006). A Field Guide to the Terrestrial Mammals of Hong Kong. Agriculture, Fisheries and Conservation Department, Hong Kong.

Tam, T. W., Leung, K. K., Kwan, B. S. P., Wu, K. K. Y., Tang, S. S. H., So, I. W. Y., Cheng, J. C. Y., Yuen, E. F. M., Tsang, Y. M. and Hui, W. L. (2011). The Hong Kong Dragonflies. AFCD, Friends of Country Park and Cosmos Books Ltd. Hong Kong.

Tam, N. F. Y. and Wong, Y. S. (2000). Hong Kong Mangroves. Agriculture, Fisheries and Conservation Department. City University of Hong Kong Press.

Viney, C., Phillips, K. and Ying, L. C. (2005). The birds of Hong Kong. Information Service Department.

Wang, L. M., Mu, M. R., Li, X. F., Lin, P. and Wang, W. Q. (2010). Differentiation between true mangroves and mangrove associates based on leaf traits and salt contents. *Journal of Plant Ecology*, pp.1-10.

Williams, G. A. (2003). Hong Kong Field Guides: Rocky Shore. The Department of Ecology and Biodiversity, The Hong Kong University of Hong Kong, Hong Kong.

Zheng, G. M. and Wang, Q. S. (1998). China Red Data Book of Endangered Animals: Aves. Science Press, Beijing.

Appendix 1. Calibration Certificate of the Instrument (Multifunctional Meter)



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T: +852 2610 1044
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www.alsglobal.com

REPORT OF EQUIPMENT PERFORMANCE CHECK/CALIBRATION

CONTACT: MR MIKE SHEK
CLIENT: AECOM ASIA COMPANY LIMITED
ADDRESS: 1501-10, 15/F, TOWER 1,
GRAND CENTRAL PLAZA,
138 SHATIN RURAL COMMITTEE ROAD,
SHATIN, NEW TERRITORIES, HONG KONG

WORK ORDER: HK1527900
SUB-BATCH: 0
LABORATORY: HONG KONG
DATE RECEIVED: 04/08/2015
DATE OF ISSUE: 10/08/2015

COMMENTS

The performance of the equipment stated in this report is checked with independent reference material and results compared against a calibrated secondary source.
The "Tolerance Limit" quoted is the acceptance criteria applicable for similar equipment used by the ALS Hong Kong laboratory or quoted from relevant international standards.
The "Next Calibration Date" is recommended according to best practice principals as practised by the ALS Hong Kong laboratory or quoted from relevant international standards.

Scope of Test: Conductivity, Temperature, Dissolved Oxygen, Salinity, pH and Turbidity
Description: Multifunctional Meter
Brand Name: YSI
Model No.: 6820 V2
Serial No.: 12A101545
Equipment No.: W.026.35
Date of Calibration: 04 August, 2015

NOTES

This is the Final Report and supersedes any preliminary report with this batch number.
Results apply to sample(s) as submitted. All pages of this report have been checked and approved for release.


Mr Fung Lim Chee, Richard
General Manager -
Greater China & Hong Kong

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Page 1 of 3

REPORT OF EQUIPMENT PERFORMANCE CHECK / CALIBRATION

Work Order: HK1527900
Sub-batch: 0
Date of Issue: 10/08/2015
Client: AECOM ASIA COMPANY LIMITED



Description: Multifunctional Meter
Brand Name: YSI
Model No.: 6820 V2
Serial No.: 12A101545
Equipment No.: W.026.35
Date of Calibration: 04 August, 2015

Date of next Calibration: 04 November, 2015

Parameters:

Conductivity Method Ref: APHA (21th edition), 2510B

Expected Reading (uS/cm)	Displayed Reading (uS/cm)	Tolerance (%)
146.9	144.5	-1.6
6667	6630	-0.6
12890	12740	-1.2
58670	58200	-0.8
Tolerance Limit (%)		±10.0

Dissolved Oxygen Method Ref: APHA (21st edition), 4500O: G

Expected Reading (mg/L)	Displayed Reading (mg/L)	Tolerance (mg/L)
3.40	3.45	+0.05
5.60	5.63	+0.03
7.65	7.61	-0.04
Tolerance Limit (mg/L)		±0.20

Temperature Method Ref: Section 6 of International Accreditation New Zealand Technical Guide No. 3 Second edition March 2008: Working Thermometer Calibration Procedure.

Reading of Ref. thermometer (°C)	Displayed Reading (°C)	Tolerance (°C)
11.0	11.05	+0.1
23.5	23.57	+0.1
37.5	37.46	-0.0
Tolerance Limit (°C)		±2.0

Remark: "Displayed Reading" presents the figures shown on item under calibration / checking regardless of equipment precision or significant figures.


 Mr Fung Lim Chee, Richard
 General Manager
 Greater China & Hong Kong

REPORT OF EQUIPMENT PERFORMANCE CHECK / CALIBRATION

Work Order: HK1527900
Sub-batch: 0
Date of Issue: 10/08/2015
Client: AECOM ASIA COMPANY LIMITED



Description: Multifunctional Meter
Brand Name: YSI
Model No.: 6820 V2
Serial No.: 12A101545
Equipment No.: W.026.35
Date of Calibration: 04 August, 2015

Date of next Calibration: 04 November, 2015

Parameters:

Salinity

Method Ref: APHA (21st edition), 2520B

Expected Reading (g/L)	Displayed Reading (g/L)	Tolerance (%)
0	0.00	--
10	10.02	+0.2
20	20.05	+0.3
30	30.04	+0.1
Tolerance Limit (%)		±10.0

Turbidity

Method Ref: APHA (21st edition), 2130B

Expected Reading (NTU)	Displayed Reading (NTU)	Tolerance (%)
0	0.0	--
4	3.9	-2.5
10	10.4	+4.0
20	20.5	+2.5
50	50.6	+1.2
100	100.7	+0.7
Tolerance Limit (%)		±10.0

pH Value

Method Ref: APHA (21st edition), 4500H:B

Expected Reading (pH Unit)	Displayed Reading (pH Unit)	Tolerance (pH unit)
4.0	4.02	+0.02
7.0	7.03	+0.03
10.0	10.00	0.00
Tolerance Limit (pH Unit)		±0.20

Remark: "Displayed Reading" presents the figures shown on item under calibration / checking regardless of equipment precision or significant figures.


 Mr Fung Lim Chee, Richard
 General Manager
 Greater China & Hong Kong

Appendix 2a: Plant Species Recorded in Pak Ngan Heung River and Luk Tei Tong River in August 2015

Scientific Name	Growth Form	Native / Exotic to Hong Kong	Distribution in Hong Kong	PNH1	PNH2	PNH3	PNH4	LTT1	LTT2	LTT3	LTT4	LTT5
<i>Acanthus ilicifolius</i>	shrub	native	common						+	+		
<i>Alocasia odora</i>	perennial herb	native	very common			+	+					
<i>Bidens alba</i>	herb	exotic	very common			++	++		+	+	+	+
<i>Brachiaria mutica</i>	herb	exotic	common			+	+					
<i>Canavalia maritima</i>	climber	native	common							+		
<i>Celosia argentea</i>	herb	native	very common				+					
<i>Coix lacryma-jobi</i>	herb	native	common				+					
<i>Colocasia esculenta</i>	herb	native	-			+	+					
<i>Commelina diffusa</i>	herb	native	common			++	++					
<i>Cyperus</i> spp.	herb	-	-					+				
<i>Ficus hispida</i>	tree	native	very common	+		+	+					
<i>Ficus variegata</i>	shrub	native	common			+						
<i>Ficus variolosa</i>	tree or shrub	native	common			+						
<i>Hedychium coronarium</i>	shrub	exotic	-			+	+					
<i>Ipomoea cairica</i>	climber	exotic	very common			+					+	+
<i>Kandelia obovata</i>	shrub or small tree	native	common		+			+	++	+		+
<i>Lantana camara</i>	shrub	exotic	very common							+	+	
<i>Macaranga tanarius</i>	tree	native	common			+						
<i>Microstegium ciliatum</i>	perennial procumbent herb	native	very common			+	+					
<i>Mikania micrantha</i>	climber	exotic	very common			+++	+++					+
<i>Mimosa pudica</i>	herb	exotic	very common							+	+	
<i>Miscanthus floridulus</i>	perennial herb	native	common							+	+	+
<i>Miscanthus sinensis</i>	perennial herb	native	very common			+	+	+		+	+	+
<i>Neyraudia reynaudiana</i>	herb	native	very common			+	+			+	+	
<i>Panicum maximum</i>	herb	exotic	very common			+	+			+		
<i>Polygonum barbatum</i>	herb	native	common			+						
<i>Pueraria phaseoloides</i>	climber	native	very common			+				+	+	
<i>Rhus hypoleuca</i>	shrub	native	common			+						
<i>Stephania longa</i>	climber: vine	native	common			+						
<i>Wedelia trilobata</i>	perennial herb	exotic	common	+		+	++		+	+	+	+

Note:

Code for Abundance: +++=abundant; ++=occasional; +=scarce

Appendix 2b: Plant Species Recorded in Luk Tei Tong Bypass Channel and Reference Site in August 2015

LTT Bypass Channel (LBC)

Scientific Name	Growth Form	Native / Exotic to Hong Kong	Distribution in Hong Kong	LBC1	LBC2	LBC3	LBC4	LBC5	Average
Species recorded in the quadrats along the transects				Average Percentage Cover					
<i>Acrostichum aureum</i>	herb	native	restricted	0.17	0.00	0.00	0.00	0.00	0.03
<i>Apluda mutica</i>	herb	native	very common	0.00	0.00	0.00	0.39	0.21	0.12
<i>Bidens alba</i>	herb	exotic	very common	0.00	0.01	0.05	0.10	0.03	0.04
<i>Cyclosorus interruptus</i>	herb	native	common	0.00	0.00	0.12	0.00	0.00	0.02
<i>Fimbristylis sieboldii</i>	herb	native	common	0.52	0.00	0.00	0.00	0.00	0.10
<i>Ipomoea cairica</i>	climber	exotic	very common	0.02	0.03	0.01	0.00	0.00	0.01
<i>Ludwigia octovalvis</i>	perennial herb	native	common	0.00	0.00	0.00	0.02	0.04	0.01
<i>Mikania micrantha</i>	climber	exotic	very common	0.00	0.00	0.01	0.02	0.00	0.01
<i>Mimosa pudica</i>	herb	exotic	very common	0.00	0.00	0.00	0.00	0.01	0.00
<i>Panicum maximum</i>	herb	exotic	very common	0.00	0.00	0.00	0.00	0.03	0.01
<i>Panicum repens</i>	perennial herb	native	very common	0.00	0.26	0.10	0.00	0.00	0.07
<i>Paspalum orbiculare</i>	herb	native	-	0.05	0.00	0.00	0.00	0.00	0.01
<i>Phragmites vallatorius</i>	herb	native	very common	0.05	0.04	0.00	0.00	0.00	0.02
<i>Pueraria phaseoloides</i>	climber	native	very common	0.00	0.00	0.00	0.03	0.00	0.01
<i>Pycreus polystachyus</i>	herb	native	common	0.06	0.00	0.00	0.00	0.00	0.01
<i>Ruellia coerulea</i>	herb	exotic	-	0.13	0.00	0.00	0.00	0.00	0.03
<i>Urena lobata</i>	shrub	native	common	0.00	0.00	0.00	0.01	0.00	0.00
<i>Wedelia trilobata</i>	perennial herb	exotic	common	0.00	0.66	0.71	0.43	0.68	0.50
Species recorded during the walk-through survey				Occurrence of the Species					
<i>Acacia confusa</i>	tree	exotic	-	+	+				
<i>Acrostichum aureum</i>	herb	native	restricted	+					
<i>Aeschynomene americana</i>	herb	exotic	-	+		+			
<i>Alocasia odora</i>	perennial herb	native	very common				+		
<i>Apluda mutica</i>	herb	native	very common			+	+	+	
<i>Bidens alba</i>	herb	exotic	very common		+	+	+	+	
<i>Celosia argentea</i>	herb	native	very common					+	
<i>Celtis sinensis</i>	tree	native	common				+	+	
<i>Colocasia esculenta</i>	herb	native	-			+	+	+	
<i>Commelina diffusa</i>	herb	native	common	+		+			
<i>Crotalaria pallida</i>	herb	exotic	common		+	+	+	+	
<i>Cyclosorus interruptus</i>	herb	native	common		+	+	+	+	
<i>Cynodon dactylon</i>	perennial herb	native	very common				+		
<i>Cyperus flabelliformis</i>	herb	-	-	+					
<i>Desmodium heterocarpon</i>	herb	native	very common		+				
<i>Fimbristylis sieboldii</i>	herb	native	common	+					
<i>Hedychium coronarium</i>	shrub	exotic	-		+	+	+		
<i>Hibiscus tiliaceus</i>	tree	native	very common	+					
<i>Ipomoea cairica</i>	climber	exotic	very common	+	+	+	+	+	

Note:

Code: +=occurrence of the species

Appendix 2b: Plant Species Recorded in Luk Tei Tong Bypass Channel and Reference Site in August 2015

LTT Bypass Channel (LBC)

Scientific Name	Growth Form	Native / Exotic to Hong Kong	Distribution in Hong Kong	LBC1	LBC2	LBC3	LBC4	LBC5
Other species recorded during the walk-through survey (Continue)				Occurrence of the Species				
<i>Kandelia obovata</i>	shrub or small tree	native	common	+				
<i>Lantana camara</i>	shrub	exotic	very common	+				
<i>Ludwigia octovalvis</i>	perennial herb	native	common		+	+	+	+
<i>Microstegium ciliatum</i>	perennial procumbent herb	native	very common		+	+	+	+
<i>Mikania micrantha</i>	climber	exotic	very common		+	+	+	+
<i>Mimosa pudica</i>	herb	exotic	very common			+	+	
<i>Panicum maximum</i>	herb	exotic	very common				+	+
<i>Panicum repens</i>	perennial herb	native	very common		+	+	+	+
<i>Paspalum conjugatum</i>	perennial herb	exotic	common	+	+	+	+	+
<i>Paspalum orbiculare</i>	herb	native	-	+	+			
<i>Phragmites vallatorius</i>	herb	native	very common	+	+			
<i>Polygonum barbatum</i>	herb	native	common			+	+	+
<i>Polygonum perfoliatum</i>	climbing herb	native	common			+	+	+
<i>Praxelis clematidea</i>	perennial herb	exotic	very common					+
<i>Pueraria phaseoloides</i>	climber	native	very common		+	+	+	+
<i>Pycnus polystachyus</i>	herb	native	common	+	+			
<i>Ruellia coerulea</i>	herb	exotic	-	+				
<i>Sapium sebiferum</i>	tree	native	common		+		+	
<i>Urena lobata</i>	shrub	native	common		+	+	+	+
<i>Wedelia trilobata</i>	perennial herb	exotic	common	+	+	+	+	+

Note:

Code: +=occurrence of the species

Appendix 2b: Plant Species Recorded in Luk Tei Tong Bypass Channel and Reference Site in August 2015

Reference Site (RS)

Scientific Name	Growth Form	Native / Exotic to Hong Kong	Distribution in Hong Kong	RS1	RS2	RS3	RS4	RS5	Average
Species recorded in the quadrats along the transects				Average Percentage Cover					
<i>Apluda mutica</i>	herb	native	very common	0.01	0.00	0.00	0.00	0.00	0.00
<i>Bidens alba</i>	herb	exotic	very common	0.03	0.00	0.00	0.04	0.05	0.02
<i>Colocasia esculenta</i>	herb	native	-	0.00	0.00	0.00	0.01	0.00	0.00
<i>Desmodium heterocarpon</i>	herb	native	very common	0.02	0.00	0.02	0.00	0.00	0.01
<i>Ficus hispida</i>	tree	native	very common	0.00	0.02	0.00	0.00	0.00	0.00
<i>Hedychium coronarium</i>	shrub	exotic	-	0.00	0.00	0.02	0.00	0.00	0.00
<i>Ipomoea cairica</i>	climber	exotic	very common	0.00	0.00	0.02	0.00	0.00	0.00
<i>Kyllinga brevifolia</i>	herb	native	common	0.00	0.00	0.03	0.00	0.00	0.01
<i>Lantana camara</i>	shrub	exotic	very common	0.00	0.00	0.02	0.00	0.00	0.00
<i>Mimosa diplotricha</i>	herb	exotic	rare	0.07	0.00	0.18	0.00	0.00	0.05
<i>Mimosa pudica</i>	herb	exotic	very common	0.10	0.05	0.00	0.10	0.18	0.09
<i>Paspalum conjugatum</i>	perennial herb	exotic	common	0.00	0.02	0.01	0.05	0.10	0.04
<i>Pueraria phaseoloides</i>	climber	native	very common	0.05	0.03	0.00	0.01	0.00	0.02
<i>Sapium sebiferum</i>	tree	native	common	0.00	0.01	0.00	0.00	0.00	0.00
<i>Sida rhombifolia</i>	herb	native	common	0.02	0.10	0.00	0.03	0.05	0.04
<i>Urena lobata</i>	shrub	native	common	0.02	0.03	0.02	0.06	0.02	0.03
<i>Wedelia trilobata</i>	perennial herb	exotic	common	0.68	0.62	0.68	0.70	0.60	0.66
Other species recorded during the walk-through survey				Occurrence of the Species					
<i>Acacia confusa</i>	tree	exotic	-	+	+				
<i>Aeschynomene americana</i>	herb	exotic	-	+	+	+	+	+	
<i>Allamanda cathartica</i>	climbing shrub	exotic	-		+				
<i>Alocasia odora</i>	perennial herb	native	very common	+	+	+			
<i>Apluda mutica</i>	herb	native	very common		+	+			
<i>Bambusa ventricosa</i>	bamboo	exotic	-						+
<i>Bauhinia blakeana</i>	tree	native	common		+				
<i>Bidens alba</i>	herb	exotic	very common	+	+	+	+	+	
<i>Breynia fruticosa</i>	shrub	native	very common				+		
<i>Bridelia tomentosa</i>	tree	native	very common				+		
<i>Canna indica</i>	herb	exotic	-			+	+		
<i>Celosia argentea</i>	herb	native	very common		+	+	+	+	
<i>Celtis sinensis</i>	tree	native	common	+			+		
<i>Colocasia esculenta</i>	herb	native	-				+		
<i>Coryza canadensis</i>	herb	exotic	very common			+	+		
<i>Crotalaria pallida</i>	herb	exotic	common	+	+				
<i>Cynodon dactylon</i>	perennial herb	native	very common	+		+	+		
<i>Desmodium heterocarpon</i>	herb	native	very common	+		+			
<i>Diospyros kaki</i>	shrub	native	-		+				
<i>Duranta erecta</i>	shrub	exotic	common				+		
<i>Eucalyptus robusta</i>	tree	exotic	-	+					

Note:

Code: + = the occurrence of the species

Appendix 2b: Plant Species Recorded in Luk Tei Tong Bypass Channel and Reference Site in August 2015

Reference Site (RS)

Scientific Name	Growth Form	Native / Exotic to Hong Kong	Distribution in Hong Kong	RS1	RS2	RS3	RS4	RS5
Other species recorded during the walk-through survey (Continue)				Occurrence of the Species				
<i>Ficus hispida</i>	tree	native	very common	+	+	+	+	
<i>Ficus variegata</i>	shrub	native	common			+		
<i>Hedychium coronarium</i>	shrub	exotic	-			+	+	
<i>Hymenocallis littoralis</i>	herb	exotic	-			+		
<i>Ipomoea cairica</i>	climber	exotic	very common		+	+	+	
<i>Ipomoea pes-caprae</i>	perennial herb	native	common	+	+	+	+	+
<i>Kyllinga brevifolia</i>	herb	native	common		+		+	
<i>Lantana camara</i>	shrub	exotic	very common	+	+	+	+	+
<i>Ligustrum sinense</i>	tree	native	common				+	+
<i>Livistona chinensis</i>	tree	exotic	cultivated				+	
<i>Mallotus paniculatus</i>	tree	native	very common					+
<i>Microstegium ciliatum</i>	perennial procumbent herb	native	very common	+	+	+	+	+
<i>Mikania micrantha</i>	climber	exotic	very common			+	+	+
<i>Mimosa diplotricha</i>	herb	exotic	rare			+		+
<i>Mimosa pudica</i>	herb	exotic	very common	+	+	+	+	+
<i>Miscanthus floridulus</i>	perennial herb	native	common	+		+		+
<i>Miscanthus sinensis</i>	perennial herb	native	very common		+	+		+
<i>Panicum maximum</i>	herb	exotic	very common	+	+	+	+	+
<i>Panicum repens</i>	perennial herb	native	very common			+		+
<i>Paspalum conjugatum</i>	perennial herb	exotic	common	+	+	+	+	+
<i>Pueraria phaseoloides</i>	climber	native	very common	+	+	+	+	+
<i>Saccharum arundinaceum</i>	herb	native	-		+	+		+
<i>Sageretia thea</i>	shrub	native	very common					+
<i>Sapium sebiferum</i>	tree	native	common	+	+	+		
<i>Sida rhombifolia</i>	herb	native	common	+	+	+	+	+
<i>Urena lobata</i>	shrub	native	common	+	+	+	+	+
<i>Wedelia trilobata</i>	perennial herb	exotic	common	+	+	+	+	+

Note:

Code: +=occurrence of the species

Appendix 3: Ecological Water Quality Monitoring Raw Data (August 2015)

Date of Monitoring: 12 August 2015

Weather : Sunny

Monitoring Location ⁽¹⁾	Suspended Solids (mg/L)	Nitrogen (Ammonia) (mg/L)	Nitrogen (Nitrate) (mg/L)	Reactive Phosphorous (mg/L)	5-day Biochemical Oxygen Demand (BOD ⁵) (mg/L)	Dissolved Oxygen (mg/L)	
						M1	M2
WE1	3.0	0.04	0.08	0.03	<2.0	7.20	7.15
WE2	2.0	0.02	0.11	0.03	<2.0	8.05	7.99
WE3	2.0	0.04	0.11	0.02	<2.0	8.06	8.02
WE4	3.0	0.15	0.19	0.03	<2.0	8.71	8.64
WE5	<2.0	0.78	0.14	0.10	<2.0	7.16	7.12
WE6	<2.0	0.02	0.21	0.01	<2.0	7.83	7.77
WE7	No water - Not sampled						
WE8	No water - Not sampled						
WE9	No water - Not sampled						
WE10	No water - Not sampled						

Monitoring Location ⁽¹⁾	Temperature (°C)		pH	Salinity (ppt)		Conductivity (µs/cm)		Water Flow (m/s)		Water Depth (cm)
	M1	M2		M1	M2	M1	M2	M1	M2	
WE1	29.6	29.6	6.9	0.04	0.04	98.6	98.9	0.103	0.106	18.0
WE2	27.7	27.7	6.7	0.02	0.02	70.1	67.7	0.079	0.074	16.0
WE3	27.7	27.7	6.7	0.02	0.02	63.3	65.0	0.090	0.098	14.5
WE4	31.5	31.5	7.6	6.00	6.00	10309.0	10309.0	0.110	0.117	23.0
WE5	30.7	30.7	7.2	1.50	1.50	2526.0	2530.0	0.017	0.015	15.0
WE6	30.0	30.0	7.2	0.03	0.03	70.3	70.7	0.012	0.010	30.0
WE7	No water - Not sampled									
WE8	No water - Not sampled									
WE9	No water - Not sampled									
WE10	No water - Not sampled									

Note:

* Where more than one measurement was taken, the data is represented by Measurement M1 and M2.

⁽¹⁾ As no water was present at WE7 to WE10 at the time of survey, no water quality monitoring was undertaken at these water quality monitoring stations.



PNH1 and PNH2



PNH3 and PNH4



LTT1



LTT2



LTT3 and LTT4



LTT5



LBC1



LBC2 and LBC3



Post-Construction Ecological Monitoring
of Drainage Improvement Works in Southern Lantau

Representative Photographs taken during
the Ecological Monitoring

SCALE	N.T.S.	DATE	Aug-15
CHECK	McmillanSE	DRAWN	TSOIWYC
JOB NO.	60278381	DRAWING NO.	Appendix 4



LBC4 and LBC5



RS1



RS2



RS3 and RS4



RS5



Post-Construction Ecological Monitoring
of Drainage Improvement Works in Southern Lantau

Representative Photographs taken during
the Ecological Monitoring

SCALE

N.T.S.

DATE

Aug-15

CHECK

McmillanSE

DRAWN

TSOIWYC

JOB NO.

60278381

DRAWING NO.

Appendix 4