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**AGREEMENT NO. CE 65/2013 (EP)
POST-CONSTRUCTION ECOLOGICAL
MONITORING OF RIVER IMPROVEMENT
WORKS IN UPPER LAM TSUEN RIVER
SHE SHAN RIVER AND UPPER TAI PO
RIVER – INVESTIGATION**

**DETAILED ECOLOGICAL MONITORING
REPORT (No.2)**

Prepared By:

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For:

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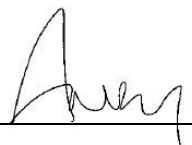
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**Agreement No. CE65/2013(EP)
Post-Construction Ecological Monitoring of River
Improvement Work in Upper Lam Tsuen River, She Shan
River and Upper Tai Po River – Investigation**

**Detailed Ecological Monitoring Report (No. 2)
Upper Lam Tsuen River**

September 2015

Prepared by: Mike pang



September 14, 2015

Validated by: Mark Shea

September 14, 2015

Ecology Team: China-Hong Kong Ecology Consultants

Detailed Ecological Monitoring Report (No. 2) Upper Lam Tsuen River

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1 Introduction

- 1.1 Agreement No. CE65/2013(EP) Post-Construction Ecological Monitoring of River Improvement Work in Upper Lam Tsuen River, She Shan River and Upper Tai Po River – Investigation required detailed ecological survey for Lam Tsuen River and She Shan River during dry season. The collected data are mainly used to compare with baseline parameters in order to assess ecological recovery process and effectiveness of ecological migration proposed and enforced during the construction period.
- 1.2 The scope of the ecological monitoring was detailed in EM & A Manual of the project. In brief, the survey aimed to collect data on abiotic factors such as water quality, substratum characteristics, water flow as well as flora and fauna.
- 1.3 China Hong Kong Ecology Consultants Ltd. was committed by Allied Environmental Consultants Ltd (AEC) to undertake the ecological monitoring tasks for the project since December 2014.
- 1.4 This is the number 2 detailed ecological monitoring report summarizing the data collected from detailed surveys of July and August in 2015. It contains the following subsections:
 - Summary of major points
 - Monitoring Methods and Results
 - Summary and Comments

2 Summary of Major Points

- Detailed monitoring surveys were undertaken in July and August of 2015;
- Flora recoded in Lam Tsuen River is in a normal growth and more abundant than baseline survey;
- The diversity and abundance of bird, macro-invertebrate were observed with no significant change comparing with baseline level ;
- More species and higher abundance of fish in Lam Tsuen River was observed comparing with baseline level;
- The population of Hong Kong Newt in Lam Tsuen River was significantly increased following with more colonization of vegetation within the river course; and
- Water parameters showed no difference to baseline level except nitrate level has decreased slightly.

3 Monitoring Methodology

3.1 Riparian Vegetation

Riparian vegetation, including aquatic and emergent, was sampled using line transects along the affected river channel and riparian habitat. Species, relative abundance and average heights were recorded. Vegetation surveys were conducted at four selected belt transects with two located at the lower portion (T3 and T4) of the river channel and another two at the upper section (T1 and T2) of the river respectively (**Figure 1**). The belt transects was run across the river channel in order to collect quantitative data of the vegetation, e.g.,

species inventory, height, percentage cover. Qualitative data of plants was collected by recording plant species, relative abundance along line transect. Nomenclature and protection status of the species followed those documented in Lai *et al* (2004) and Hong Kong Herbarium (2015).

3.2 Avifauna

Avifauna survey was conducted during post construction monitoring period. Special attention was given to the river channel and corridor area which birds used as feeding and foraging habitat. Avifauna surveys were undertaken in the early morning plus species recorded in the rest of the day when conducting other taxonomic groups (benthic, fish, insect) monitoring. Numerical abundance was recorded at fixed count points within a radius of 30-50m according to landscape feature and visual penetration extent. The duration of the point count of birds was standardized for 10 minutes at each location in order to collect comparable data. Transect count along accessible section of river channel were used in order to collect qualitative data. Binoculars and digital camera were the main items of equipment used. Nomenclature and protection status of the species follows the AFCD website (www.hkbiodiversity.net) and Carey *et al* (2001).

The point count was conducted at four locations with two located at the lower portion of the river channel (T3&T4) and the other two located at the upper section of the river (T1&T2). The point count and survey transect locations for the bird survey and sampling sites for surveys of other faunal groups and flora were presented in **Figure 1**.

3.3 Adult Odonata Survey

Adult Odonata survey was conducted along transects (**Figure 1**). Binoculars, digital camera and hand net were utilized to aid identification. Numerical abundance, species identity and other notable behavior were recorded. Nomenclature and protection status of the species followed those documented in the AFCD website (www.hkbiodiversity.net), Wilson *et al* (2004) and Tam *et al* (2011). Adult Odonata survey was conducted along line transects in parallel with river channel within the works area where access was permitted.

3.4 Aquatic Macro-invertebrates

Macro-invertebrates in the river channel were surveyed. Sampling was conducted at five sampling locations including two sites located at the lower portion (T3 and T4) of the river channel and another two sites at the upper section (T1 and T2) of the river, as well as the reference site. Those sampling sites covered major type of river habitats, e.g. river pool and riffle (**Figure 1**) Five replicates were taken at each sampling point and pool together for further sample sorting and identification. Kick sampling and hand netting were the survey methodologies for river organisms. Dissection microscope and digital camera were used to aid identification and enumeration. Numerical abundance and species identity were recorded. Nomenclature and protection status of the species has followed those documented in the AFCD website (www.hkbiodiversity.net) and other literatures such as Dudgeon (1994).

3.5 Fish and Newt

Fish community and *Paramesotriton hongkongensis* at the specified river channel was monitored by live trapping, hand netting and direct observation methods.

Sampling was conducted at five sampling locations including two sites located at the lower portion (T3 and T4) of the river channel and another two sites at the upper section (T1 and T2) of the river, as well as reference site. Those sampling sites covered major type of river habitats, e.g. river pool and riffle (**Figure 1**). The number of the observed fish and newt was estimated and recorded. Nomenclature and protection status of the species followed those documented in the AFCD website (www.hkbiobiodiversity.net) and Lee *et al* (2004).

3.6 Abiotic Data Collection

3.6.1 Water Quality Monitoring

Dissolved oxygen level, pH value, conductivity, salinity, BOD and nutrient level (nitrate and ammonium) were measured and analyzed by conventional methods in situ or in laboratory. The instruments for measuring dissolved oxygen level, pH value, conductivity, salinity were model: DO-5510, AZ8685, AZ8361 and AZ8374 respectively. All the instruments were calculated every monitoring month according to the operation manuals in order to obtain the precise result. BOD test took 5 days to complete within darkness incubator with stable temperature at 20°C and was performed using model: DO-5510 for measuring dissolved oxygen. Nutrient levels including nitrate and ammonia were performed in laboratory by applying the In-house method SOP056 (FIA) and SOP057 (FIA) respectively.

3.6.2 Sediment Characteristics

Sediment/substrate characteristics were recorded of sediment cover in percentage e.g. mud, sand, rock, boulder and cemented bottom in the river bed at sampling sites.

3.6.3 Water Flow

Water flow rates in river channel were measured by recording the time taken for a floating object (e.g. floating ball) to cover a measured distance.

The sampling locations for surveys were presented in **Figure 1**.

4 Monitoring Results

4.1 Vegetation

Detailed surveys were undertaken along the transect at Upper Lam Tsuen River. A total of 63 species were recorded from the survey and the result was more diverse than baseline level, in which only 21 species of vegetation were record. The increased vegetation abundance indicated that the improved river has provided a more suitable environment for establishment of vegetation, especially for the design of natural river bed, where vegetation could hold

tightly on the rough surface to avoid being washing out by flooding. Most recorded species were wetland species with a few floating aquatic species such as *Lemna minor*, *Pistia stratiotes* and submerged plants such as *Hydrilla verticillata*. An invasive species *Brachiaria mutica* was the dominant species along the river (Photo 1). It was found that vegetation has generally covered gabion and river bed in most of the area (Photo 2). Most of the plants are in good health, the average height of plant is significantly increasing comparing with the data measured in baseline, the highest plant of 2m was recorded along the survey transect. Dominant flora species were shown in the **Table 4.1** marked with relative abundance sign “+++”. Results of vegetation survey and belt transect survey were presented in **Table 4.1** and **Table 4.2**.



4.2 Fauna

4.2.1 Avifauna

An avifauna detailed surveys were undertaken along survey transects and at four selected point count locations. Over 30 species of birds were recorded during the bird surveys. Bird’s species composition in Lam Tsuen River has changed in terms of abundance and species richness towards the data collected from baseline to post-construction monitoring, more species and higher abundance recorded were related to the improved river, where provided dense vegetation as their habitats, as well as food source. Two species of conservation interest were recorded during the detailed surveys including *Egretta garzetta* and *Ardeola bacchus*, they are both listed as “Regional Concern” by Fellowes *et al.* (2002) and observed foraging in the river. Transect and Point Count locations were shown on **Figure 1**. Result of bird survey was presented in the **Table 4.3**.

4.2.2 Adult Odonata Survey

Odonata detailed surveys were performed and a list of recorded odonata species at Upper Lam Tsuen River is shown in **Table 4.4**. 16 species of odonata were recorded along the river transect, all recorded species were common and wide spread in Hong Kong. Species richness increased significantly compared with the data collected from approximate season in baseline level. Mating behavior of odonata was commonly seen in the river

and their larvae were usually collected from kicking sampling. Sampling location was shown in **Figure 1**.

4.2.3 Aquatic Macro-invertebrates

Upper Lam Tsuen River was flowing with constant water during survey. Aquatic-net and kick sampling were performed at the river. The river benthic fauna collected was mainly comprised of insects, molluscs and crustaceans. Species composition recorded in detailed surveys was similar to baseline survey. Details of recorded of river benthic fauna refers to **Table 4.5**. Sampling location was shown on **Figure 1**.

4.2.4 Hong Kong Newt

Detailed Surveys of Hong Kong Newt were conducted at Upper Lam Tsuen River. Adult *Paramesotriton hongkongensis* was observed at the Lam Tsuen River with low abundance during current non-breeding season. Only few individuals were found around their potential habitats where consisted of riparian vegetation. Although low abundance of newt was found, the decrease in abundance is not related to any impacts raised from the river, assuming that most of the newts are back to the terrestrial area during the current non-breeding period. The abundance is expected to redevelop in coming breeding season from September to March (Dudgeon, 2003). According to last year capture survey, more newts were found along the river indicating that the improved river is capable to carry more individuals than baseline level. The increased colonization of vegetation in river bed was the main reason of increased abundance of Hong Kong Newt as riparian vegetation grown along the channel especially along water margin could provide shelter and breeding habitat for Hong Kong Newt (Photos 3-4). Record of Hong Kong Newts can be referred to **Table 4.6**.



Photo 3: Dense vegetation coverage in Lam Tsuen River



Photo 4: Hong Kong Newt

4.2.5 River Fish Fauna

Fish detailed surveys were performed at Upper Lam Tsuen River. 18 species of freshwater fish, including species recorded from reference site, were recorded. Comparing with baseline data, more species were recorded assuming river is

in a process of restoration and becoming more mature and stable. *Oreochromis niloticus* and *Zacco platypus* were the dominated species in the river. *Acrossocheilus parallens* were recorded at upper, middle and lower river sections. *Acrossocheilus parallens* is a rare freshwater fish species in Hong Kong. Except *Acrossocheilus parallens*, *Parazacco spilurus* is considered with conservation interest. Fish counting at 2 x 2 meter area were performed and number of fish individuals was lower than baseline survey. Details of recorded of fish fauna refers to **Table 4.6**. Sampling location was shown on **Figure 1**.

4.3 Abiotic Data

Data on water quality and major river hydrological feature (water flow and substratum) of the river were collected and are presented in the **Table 4.7**.

Generally, there were no significant change on most of the parameters measured from baseline and detailed surveys respectively. Lower level of nitrate was measured during detailed survey indicating that water quality was improved due to nitrate absorption by abundant vegetation or decreased sewage discharge. Results of water test were presented in the **Table 4.7**.

The river substratum was comprised of over 85-90% stones or rocks in most of the river sections with moderate water flow (up to 0.2m/second at pool and 0.5m/second at riffle).

5 Summary and Commentary

Detailed ecological monitoring surveys were carried out in July and August 2015 and relevant biotic and abiotic data was collected according to project specification and EM & A Manual. Benthic fauna was temporally de-faunated in river sections due to river bed engineering works during construction period between 2008 and early 2013 and is under recovery process after that period. Abundant vegetation was generally established on the gabion and river bed along the river course, more species were recorded than baseline survey. Avifauna and macro-invertebrate were recorded with no significant change on their species richness and abundance between baseline and detailed survey. Species richness of odonata increased significantly compared with the data collected from approximate season in baseline level. Following the river became more stable and mature after the completion of construction, more fish species and higher abundance of newt could be found during the survey.

Major parameters measured from baseline and detailed surveys were similar and retaining in an acceptable level. Nitrate level was decreased in detailed survey. Overall water quality is good and contains low concentration of nutrients.

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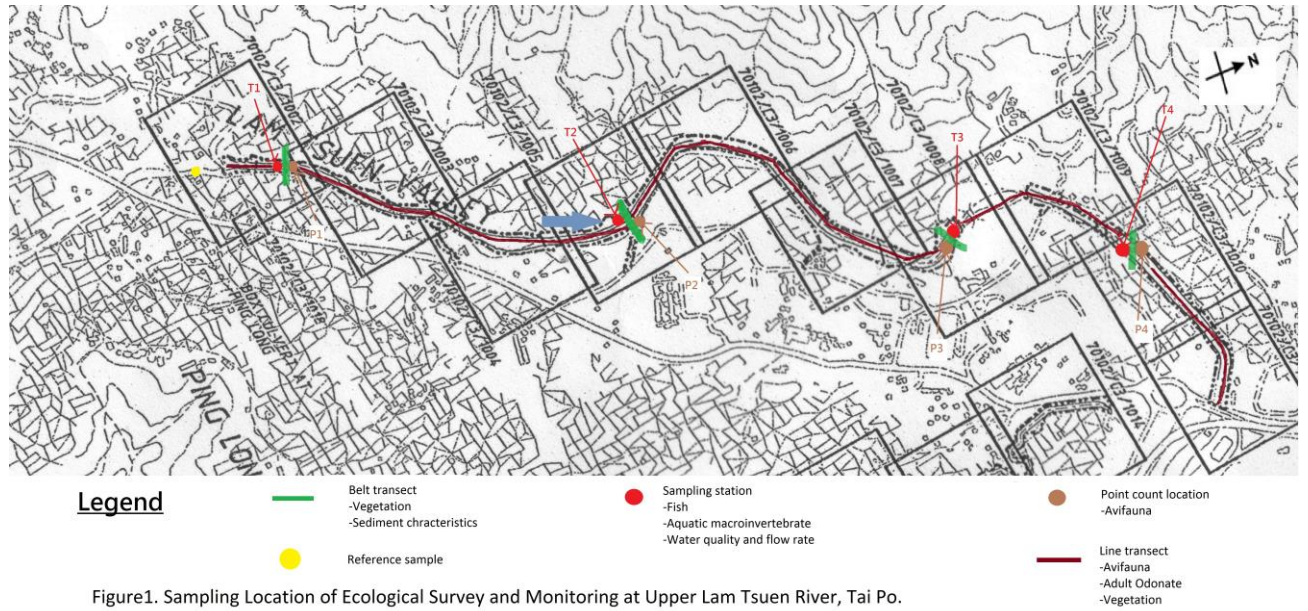
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FIGURES



TABLE

Table 4.1. Flora species recorded along the Lam Tsuen River including riparian habitat.

Family	Species name	Species name in Chinese	Baseline monitoring	Detailed Survey 1		Detailed Survey 2	
			Jul to Aug 08	Dec-14	Jan-15	Jul-15	Aug-15
Riparian Plant							
Acanthaceae	<i>Ruellia coerulea</i>	蘭花草		+			
Amaranthaceae	<i>Celosia argentea</i>	青葙	+	++	+	+	+
Amaranthaceae	<i>Amaranthus viridis</i>	野苋		+	+	+	+
Amaranthaceae	<i>Alternanthera philoxeroides</i>	空心蓮子草		++	+	+	+
Amaranthaceae	<i>Alternanthera sessilis</i>	蓮子草		+	+		
Anacardiaceae	<i>Rhus hypoleuca</i>	白背漆			+		
Annonaceae	<i>Uvaria macrophylla</i>	紫玉盤		+			
Apiaceae	<i>Oenanthe javanica</i>	水芹			+	+	+
Apiaceae	<i>Centella asiatica</i>	崩大碗		+			
Araceae	<i>Alocasia odora</i>	海芋	+	+	+	+	+
Araceae	<i>Colocasia esculenta</i>	芋	+	+	+	+	+
Araceae	<i>Pixia stratiotes</i>	大漚		+			
Arecaceae	<i>Rhapis excelsa</i>	棕竹		+			
Asteraceae	<i>Bidens alba</i>	白花鬼針草	+	++	++	++	++
Asteraceae	<i>Mikania micrantha</i>	蕪甘菊	++	+++	++	++	++
Asteraceae	<i>Ageratum conyzoides</i>	勝紅菊		+	+	+	+
Asteraceae	<i>Emilia sonchifolia</i>	一點紅		+	+	+	+
Asteraceae	<i>Wedelia chinensis</i>	柳娘菊		++	+	+	+
Asteraceae	<i>Erechites hieracifolia</i>	革命菜		+			
Asteraceae	<i>Conyza canadensis</i>	小蓬草		+	+	+	+
Asteraceae	<i>Youngia japonica</i>	黃鹌菜		+	+	+	+
Asteraceae	<i>Eclipta prostrata</i>	鱧腸		+	+	+	+
Asteraceae	<i>Spilanthes paniculata</i>	金鈕扣		+	+	+	+
Athyriaceae	<i>Callipteris esculenta</i>	菜蕨		+			
Blechnaceae	<i>Blechnum orientale</i>	烏毛蕨		+			
Brassicaceae	<i>Cardamine flexuosa</i>	碎米蕒		+	+	+	+
Brassicaceae	<i>Nasturtium officinale</i>	西洋菜		++	+	+	+
Brassicaceae	<i>Rorippa indica</i>	塘葛菜		+	+	+	+
Brassicaceae	<i>Capsella bursa-pastoris</i>	蔞菜		+	+	+	+
Buddlejaceae	<i>Buddleja asiatica</i>	白背楓		+			
Caesalpiniaceae	<i>Cassia alata</i>	翅葉決明	+	+	+	+	+
Caryophyllaceae	<i>Drymaria cordata</i>	荷蓮豆		+	+	+	+
Caryophyllaceae	<i>Myosoton aquaticum</i>	鵝腸菜		+	+	+	+
Commelinaceae	<i>Commelina diffusa</i>	節節草	+	++	+++	++	++
Convolvulaceae	<i>Ipomoea cairica</i>	五爪金龍		++	++	++	++
Convolvulaceae	<i>Pharbitis nil</i>	牽牛		+			
Convolvulaceae	<i>Ipomoea aquatica</i>	蕪菜		+			
Cucurbitaceae	<i>Solenia amplexicaulis</i>	茅瓜		+			
Cuscutaceae	<i>Cuscuta australis</i>	南方菟絲子			+	+	+
Cyperaceae	<i>Cyperus flabelliformis</i>	風車草		+	+	+	+
Cyperaceae	<i>Cyperus sp.</i>	莎草		+	+	+	+
Euphorbiaceae	<i>Macaranga tanarius</i>	血桐	+	+	+	+	+
Euphorbiaceae	<i>Bischofia javanica</i>	秋楓		+	+	+	+
Fabaceae	<i>Pueraria lobata</i>	野葛	++	+	+	+	+
Fabaceae	<i>Crotalaria pallida</i>	豬屎豆		+			
Fabaceae	<i>Sesbania cannabina</i>	田菁		+			
Fabaceae	<i>Pueraria lobata var. thomsonii</i>	粉葛		+	+	+	+
Magnoliaceae	<i>Michelia alba</i>	白蘭	+	+			
Malvaceae	<i>Hibiscus rosa-sinensis</i>	大紅花		+			
Mimosaceae	<i>Acacia confusa</i>	台灣相思	+	+			
Mimosaceae	<i>Leucaena leucocephala</i>	銀合歡		+	+	+	+
Mimosaceae	<i>Mimosa pudica</i>	含羞草		+			

Table 4.1. Flora species recorded along the Lam Tsuen River including riparian habitat.

Family	Species name	Species name in Chinese	Baseline monitoring	Detailed Survey 1		Detailed Survey 2	
			Jul to Aug 08	Dec-14	Jan-15	Jul-15	Aug-15
Mimosaceae	<i>Callandra haematocephala</i>	紅絨球		+	+	+	+
Moraceae	<i>Ficus hispida</i>	對葉榕	+	+	+	+	+
Moraceae	<i>Ficus variegata</i>	青果榕			+	+	+
Musaceae	<i>Musa paradisiaca</i>	大蕉	+	+	+	+	+
Myrtaceae	<i>Cleistocalyx nervosum</i>	水翁		+			
Nyctaginaceae	<i>Bougainvillea spectabilis</i>	勒杜鵑	+				
Oleaceae	<i>Ligustrum sinense</i>	山指甲			+	+	+
Onagraceae	<i>Ludwigia erecta</i>	美洲水丁香		++	+	+	+
Oxalidaceae	<i>Oxalis corniculata</i>	酢漿草		+	+	+	+
Plantaginaceae	<i>Plantago major</i>	車前草		+			
Poaceae	<i>Panicum repens</i>	枯骨草	+	+			
Poaceae	<i>Pennisetum purpureum</i>	象草	+	+	++	+	+
Poaceae	<i>Pennisetum alopecuroides</i>	狼尾草				+	+
Poaceae	<i>Rhynchelytrum repens</i>	紅毛草	+	+			
Poaceae	<i>Microstegium ciliatum</i>	剛秀竹	++	+	+	+	+
Poaceae	<i>Brachiaria mutica</i>	巴拉草	++	+++	+++	+++	+++
Poaceae	<i>Miscanthus floridulus</i>	五節芒		+	+	+	+
Poaceae	<i>Arundinella nepalensis</i>	石珍芒		+	+	+	+
Poaceae	<i>Panicum maximum</i>	大黍		+			
Poaceae	<i>Coix lacryma-jobi</i>	薏苡		+	+	+	+
Poaceae	<i>Arundo donax</i>	蘆竹		+			
Poaceae	<i>Chloris virgata</i>	虎尾草		+			
Polygonaceae	<i>Rumex crispus</i>	假菠菜		++	+	++	++
Polygonaceae	<i>Polygonum chinense</i>	火炭母		+	+	+	+
Polygonaceae	<i>Polygonum hydropiper</i>	水蓼		+	+	+	+
Polygonaceae	<i>Polygonum glabrum</i>	光蓼				+	+
Polygonaceae	<i>Polygonum perfoliatum</i>	紅板歸		+			
Polygonaceae	<i>Polygonum lapathifolium</i>	大馬蓼		+			
Portulacaceae	<i>Portulaca oleracea</i>	馬齒莧		+			
Ranunculaceae	<i>Ranunculus sceleratus</i>	石龍芮			+	+	+
Rubiaceae	<i>Adina pilulifera</i>	水團花		+			
Sapindaceae	<i>Dimocarpus longan</i>	龍眼		+			
Scrophulariaceae	<i>Scoparia dulcis</i>	野甘草		+			
Scrophulariaceae	<i>Lindernia anagallis</i>	長蒴母草		+			
Solanaceae	<i>Solanum nigrum</i>	龍葵		+			
Solanaceae	<i>Lycopersicon esculentum</i>	番茄					
Solanaceae	<i>Solanum torvum</i>	水茄		+	+	+	+
Sterculiaceae	<i>Sterculia lanceolata</i>	假蒴葵		+			
Sterculiaceae	<i>Byttneria aspera</i>	刺果藤		+			
Thelypteridaceae	<i>Cyclosorus parasiticus</i>	華南毛蕨		+	+	+	+
Thelypteridaceae	<i>Macrothelypteris torresiana</i>	普通針毛蕨		+	+	+	+
Ulmaceae	<i>Celtis sinensis</i>	朴樹	+	+	+	+	+
Ulmaceae	<i>Trema orientalis</i>	黃色山黃麻		+	+	+	+
Ulmaceae	<i>Trema tomentosa</i>	山黃麻		+			
Urticaceae	<i>Pilea microphylla</i>	透明草		+	+	+	+
Verbenaceae	<i>Duranta erecta</i>	假連翹			+	+	+
Urticaceae	<i>Boehmeria nivea</i>	苧麻		+	+	+	+
Verbenaceae	<i>Lantana camara</i>	馬纓丹	+	+	+	+	+
Floating Plant							
Lemnaceae	<i>Lemna minor</i>	浮萍		+	+	+	+
Submerged Plant							
Hydrocharitaceae	<i>Hydrilla verticillata</i>	黑藻		+	+	+	+

Note:

+, occurred; ++, common; +++, Species abundant/dominant in the study area

Table 4.2. Flora species recorded from belt transect survey at the Upper Lam Tsuen River (T1 - Upper stream sampling site T4 - Lower stream sampling site)

Family	Species	Chinese name	Baseline monitoring								Detailed Survey - 1								Detailed Survey - 2																											
			Jul-08				Aug-08				Dec-14				Jan-15				Jul-15				Aug-15																							
			P1		P4		P1		P4		T1		T2		T3		T4		T1		T2		T3		T4		T1		T2		T3		T4													
Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%															
Poaceae	<i>Microstegium ciliatum</i>	剛秀竹	0.4	40			0.4	40																																						
Fabaceae	<i>Pueraria lobata</i>	野葛	0.5	30			0.5	30						0.6	10																															
Poaceae	<i>Pennisetum purpureum</i>	象草	3	20			3	20																																						
Araceae	<i>Alocasia odora</i>	海芋	1	10			1	10																																						
Caesalpiniaceae	<i>Cassia alata</i>	翅葉決明			1.2	10			1.2	10																																				
Magnoliaceae	<i>Michelia alba</i>	白蘭			6	10			6	10																																				
Poaceae	<i>Bracharia mutica</i>	巴拉草			1.2	70			1.2	70	1	10	1.5	15	1.3	30	1	5	1	20	1	20	1.3	20	1	10	0.9	30	1.5	30	0.5	70	1	15	1	30	1.5	30	0.8	#	1	15				
Moraceae	<i>Ficus hispida</i>	野薔薇																																												
Asteraceae	<i>Mikania micrantha</i>	薇甘菊									0.3	18	0.3	18	0.3	18	0.3	18	0.4	10	0.4	15	0.3	5	0.3	20	0.3	5	0.2	5	0.3	5	0.4	5	0.3	5	0.2	5	0.3	5	0.4	5				
Musaceae	<i>Musa paradisiaca</i>	大蕉																																												
Ulmaceae	<i>Celtis sinensis</i>	朴樹			6	10			6	10																																				
Araceae	<i>Pistia stratiotes L.</i>	大漂																																												
Urticaceae	<i>Boehmeria nivea</i>	芋麻																																												
Asteraceae	<i>Bidens alba</i>	白花鬼針草									0.5	5	0.8	12	0.7	10			1	10	0.4	15	1	15																						
Poaceae	<i>Coix lacryma-jobi</i>	薏苡									2	5																																		
Solanaceae	<i>Solanum nigrum</i>	龍葵																																												
Cyperaceae	<i>Cyperus flabelliformis</i>	風車草																																												
Poaceae	<i>Miscanthus floridulus</i>	五節芒																																												
Euphorbiaceae	<i>Macaranga tanarius</i>	血桐																																												
Asteraceae	<i>Wedelia chinensis</i>	蟛蜞菊																																												
Commelinaceae	<i>Commelina diffusa</i>	箭筈草									0.3	12	0.8	22			0.3	20	0.4	10	0.4	20					0.3	20	0.2	10			0.4	20	0.3	20	0.2	20	0.2	20	0.2	20	0.2	5	0.4	20
Asteraceae	<i>Erechtites hieracifolia</i>	革命菜																																												
Thelypteridaceae	<i>Cyclosorus parasiticus</i>	華南毛蕨																																												
Convolvulaceae	<i>Pharbitis nil</i>	牽牛																																												
Verbenaceae	<i>Lantana camara</i>	馬纒丹																																												
Mimosaceae	<i>Leucaena leucocephala</i>	銀合歡																																												
Brassicaceae	<i>Nasturtium officinale</i>	西洋菜																																												
Onagraceae	<i>Ludwigia erecta</i>	美洲水丁香									2	25	2	13	2	10	1.8	5	2	30	2	10	2	5	1.8	5																				
Poaceae	<i>Pennisetum alopecuroides</i>	狼尾草																																												
Amaranthaceae	<i>Celosia argentea</i>	青葙																																												
Bare Ground											25		20		15		40		20		20		30		19		15	35		13		55		15	35		#				55					

P1 - Point count location 1; P4 - Point count location 4

Table 4.3 Avifauna recorded along survey transects and at four selected point count locations of Lam Tsuen River.

(T1 - located at upper river channel sampling site - T4 - located at lower river Channel sampling site)

Common Name	Species name	Chinese name	Status	Commonness	Baseline monitoring		Detailed Survey - 1								Detailed Survey - 2																		
					Jul-08			Aug-08			Dec-14				Jan-15				Jul-14				Aug-14										
					Abundance	P1	P4	Abundance	P1	P4	C	T1	T2	T3	T4	C	T1	T2	T3	T4	C	T1	T2	T3	T4	C	T1	T2	T3	T4			
Barn Swallow	<i>Hirundo rustica</i>	家燕	PM	C	+	1	1																										
Black Drongo	<i>Dicrurus macrocerus</i>	黑卷尾	Sv	C																													
Black Kite	<i>Milvus lineatus</i>	黑鷹	R, RC, Cap.586	C				+				+																					
Black-faced bunting	<i>Emberiza spodocephala</i>	灰頭鵲	WV&PM	C								+																					
Black-necked Staring	<i>Sturnus nigricollis</i>	黑頸椋鳥	R	C	+++	2	1	++	2			++	2		3	2	++	2		2		++	2	2		2	++	4	3	3			
Black-winged Cuckoo-shrike	<i>Coracina melaschistos</i>	暗灰鶇鶇	PM	C																													
Buzzard (Common Buzzard)	<i>Buteo buteo</i>	普通鵟	WV, Cap.586	C																													
Chinese Bulbul	<i>Pycnonotus sinensis</i>	白頭鶇	R	C	++	2	3	+++	4	5	++	2	2	3			++	2		3	1	++		2	1	2	++	3		2	2		
Chinese Pond Heron	<i>Ardeola bacchus</i>	田螺	R, RC	C	+			++	3	1	+	2	1	3			+	2	2		1	+	1							1			
Common Kingfisher	<i>Alcedo atthis</i>	普通翠鳥	R	C								+	1																	1			
Common Koel	<i>Eudynamis scolopacea</i>	噪鶇	R	C	++	1		+				+																					
Common Sandpiper	<i>Actitis hypoleucos</i>	磯鶇	WV&PM	C								+																					
Common Tailorbird	<i>Orthotomus sutorius</i>	長尾縫紉鶇	R	C	+	1	1	+	1		++	1		1	++	1		1		1		++	2		2		++	1	2	2			
Crested bulbul	<i>Pycnonotus jocosus</i>	紅耳鶇	R	C	+++	2	3	++	3	4	+++	4	3	2	+++	3	2	3		+++	8	3	3	5	+++	7	5	5	5				
Crested Goshawk	<i>Accipiter trivirgatus</i>	鳳頭鷹	R, CR, Cap.586	U																													
Crested Myna	<i>Acridotheres cristatellus</i>	八哥	R	C	++	2		++	2		++	2	3	5		++	3	4	2	++	3	2	3	3	++		2	4					
Crested Serpent Eagle	<i>Spilornis cheela</i>	蛇鵟	R, VU, LC	U																													
Daurian redstart	<i>Phoenicurus auroreus</i>	北紅尾鶇	WV	U							++	1	1	1	+	1																	
Domestic pigeon	<i>Columba sp.</i>	鴿	R	C	+			+	3	2																							
Dusky Warbler	<i>Phylloscopus fuscatus</i>	袍鵯鶇	WV	C								+	1	1																			
Eurasian tree sparrow	<i>Passer montanus</i>	麻雀	R	C	++	2		+			++	3	2		++	3	2	1	++	3		++	3	2	3	++	3	2	2	3			
Great Coucal	<i>Centropus sinensis</i>	褐翅鴉鵂	R, VU	C							+	1		1	+																		
Great Tit	<i>Parus major(commistus)</i>	大山雀	R	C																										2			
Green Sandpiper	<i>Tringa ochropus</i>	白腰草鶇	PM&WV	U								+																					
Grey Heron	<i>Ardea cinerea</i>	蒼鶇	WV, PRC	C	+																												
Grey Wagtail	<i>Motacilla cinerea</i>	灰鶇鶇	WV	C								+	1	2	1	+	1	1	1		+		1		+	1	1						
Japanese White Eye	<i>Zosterops japonica(simp)</i>	暗綠繡眼鳥	R	C	+		+				++	3	4	5		++	3		3		++	3	3	2	5	++	4	2	3	2			
Jungle Crow	<i>Corvus macrorhynchos</i>	大嘴烏鶇	R	C																													
Large Hawk Cuckoo	<i>Cuculus sparveroides</i>	鷹鶇	SV	U																													
Lesser Coucal	<i>Centropus bengalensis</i>	小鴉鵂	R, VU	C																													
Little Egret	<i>Egretta garzetta</i>	小白鶇	R, RC	C				+			++	2	1	3	1	++	1	2	3	2	+	1	1	1		+	1	1	1				
Great Egret	<i>Ardea alba</i>	大白鶇	R, WV, RC	C																	+		1										
Little Swift	<i>Apus affinis</i>	小白腰河燕	R, SpM	C	++	3																							4				
Maggie	<i>Pica pica</i>	喜鵲	R	C				+				+																					
Maggie Robin	<i>Copsychus saularis</i>	鶇鶇	R	C	++	1	1	+	1	1	++	1	1	2	2	++	1	1	2	2	++	2	1	1	1	2	++	2	2				
Mandarin Duck	<i>Aix galericulata</i>	鸞	WV	U																													
Masked Laughing Thrush	<i>Garrulus perspicillatus</i>	黑臉噪鶇	R	C								++		2	2	++	2													4			
Night Heron	<i>Nycticorax nycticorax</i>	夜鶇	R&WV, LC	C																										1			
Northern Shoveler	<i>Anas clypeata</i>	琵嘴鶇	WV	C																													
Olive Backed Pipit	<i>Anthus hodgsoni</i>	樹鶇	WV	C	+	1						+																					
Plaintive Cuckoo	<i>Cacomantis merulinus</i>	八聲杜鵑	SV	C																													
Red-billed Blue Magpie	<i>Urocissa erythrorhynchos</i>	紅頭藍鶇	R	C																													
Red-flanked Bluetail	<i>Tarsiger cyanurus</i>	紅胸藍尾鶇	PM&WV	C																													
Rufous Turtle Dove	<i>Streptopelia orientalis</i>	山斑鶇	R	C																													
Rufous-backed Shrike	<i>Lanius schach</i>	棕背伯勞	R	C			+			+	1		1														+	1	1				
Rufous-capped Babbler	<i>Stachyridopsis ruficeps</i>	紅頭穗鶇	R	C											++																		
Scarlet Minivet	<i>Pericrocotus flammeus</i>	赤紅山椒鳥	R	C																													
Siberian Stonechat	<i>Saicala maurus</i>	黑喉石鶇	WV	U							++	1		1	++		1	1															
Sooty-headed Bulbul	<i>Pycnonotus aurigaster</i>	白喉紅背鶇	R	U																													
Spotted Dove	<i>Streptopelia chinensis</i>	珠頸斑鶇	R	C	+	1	1	+	1		+++	2	3	3	2	+++	2	3	5	2	++	2	2	2	4	++	1	2	2	4			
Spotted Munia	<i>Lonchura punctulata</i>	斑文鳥	R	C							+++	5		7		++	5		8														
Velvet-fronted Nuthatch	<i>Sitta frontalis</i>	絨鶇	R	C																													
White Wagtail	<i>Motacilla alba</i>	白鶇鶇	WV	C								++	1	1	2	1	++	1	2	3	2	++			2		+++			8			
White-breasted Waterhen	<i>Amaurornis phoenicurus</i>	白胸苦惡鳥	R	C	+			+																									
White-throated Kingfisher	<i>Halcyon smyrnensis</i>	白胸翡翠	R, LC	C																													
Yellow Bellid Prinia	<i>Prinia flaviventris</i>	黃腹鶇鶇	R	C	+		1	+				+	1		1												+		1				
Yellow Wagtail	<i>Motacilla flava</i>	黃鶇鶇	WV&PM	U																													
Zitting cisticola	<i>Cisticola juncidis</i>	棕尾鵲	WV&PM	C								+																					
Number of birds						19	12			20	13			29	26	49	17			27	23	42	14			27	19	38	34	14	27	36	26
No. of species						18	12	8	19	9	5	33	15	15	18	12	29	14	13	15	9	21	10	11	16	11	23	10					

Table 4.4. Odonata species recorded at the Upper Lam Tsuen River

Species	Common name	Chinese name	Status	Common-ness	Baseline monitoring		Detailed Survey -1		Detailed Survey -2	
					Jul-08	Aug-08	Dec-14	Jan-15	Jul-15	Aug-15
<i>Acisoma panorpoides panorpoides</i>	Asian Pintail	錐腹蜻	NP	VC					+	
<i>Brachythemis contaminata</i>	Asian Amberwing	黃翅蜻	NP	VC						
<i>Ceriagrion auranticum ryukyuanum</i>	Orange-tailed Sprite	琉球橘黃蟳	NP	VC				+	+	+
<i>Coeliccia cyanomelas</i>	Blue Forest Damsel	黃紋長腹蟳	NP	VC						
<i>Copera marginipes</i>	Yellow Featherlegs	黃狹扇蟳	NP	VC	+				+	+
<i>Crocothemis servilia servilia</i>	Crimson Darter	紅蜻	NP	VC	+	+	+	+	+	+
<i>Euphaea decorata</i>	Black-banded Gossamerwing	方帶幽蟳	NP	VC						+
<i>Ictinogomphus pertinax</i>	Common Flangetail	霸王葉春蜓	NP	C					+	+
<i>Ischnura senegalensis</i>	Common Blue Jewel	褐斑異痣蟳	NP	VC						
<i>Mnais lacteola</i>	Indochinese Copperwing	煙翅綠色蟳	P, LC	C						
<i>Nannophya pygmaea</i>	Scarlet Dwarf	侏紅小蜻	P, LC	C						
<i>Neurobasis chinensis</i>	Chinese Greenwing	華艷色蟳	NP	VC			+		+	+
<i>Neurothemis fulvia</i>	Russet Percher	網脈蜻	NP	VC					+	+
<i>Neurothemis tullia tullia</i>	Pied Percher	截斑脈蜻	NP	C						
<i>Orthetrum chrysis</i>	Red-faced Skimmer	華麗灰蜻	NP	VC	+	+				+
<i>Orthetrum glaucum</i>	Common blue skimmer	黑尾灰蜻	NP	VC						
<i>Orthetrum luzonicum</i>	Marsh Skimmer	呂宋灰蜻	NP	VC					+	+
<i>Orthetrum pruinosum neglectum</i>	Common Red Skimmer	赤褐灰蜻	NP	VC					+	+
<i>Orthetrum sabina sabina</i>	Green Skimmer	狹腹灰蜻	NP	VC						
<i>Pantala flavescens</i>	Wandering Glider	黃蜻	NP	VC	+	+	+		+	+
<i>Paracercion calamorum duyeri</i>	Dusky Lilysquatter	葦尾蟳	P, LC	C						
<i>Prodasineura autumnalis</i>	Black Threadtail	烏齒原蟳	NP	VC					+	+
<i>Pseudagrion rubriceps rubriceps</i>	Orange-faced Sprite	丹頂斑蟳	NP	UC		+				
<i>Rhinocypha perforata perforata</i>	Common Blue Jewel	三斑鼻蟳	NP	VC		+			+	+
<i>Rhyothemis variegata arria</i>	Variegated Flutterer	斑麗翅蜻	NP	C						
<i>Trithemis aurora</i>	Crimson Dropwing	曉褐蜻	NP	VC			+	+	+	+
<i>Trithemis festiva</i>	Indigo Dropwing	慶褐蜻	NP	VC					+	+
<i>Zygonyx iris insignis</i>	Emerald Cascader	彩紅蜻	P,PGC	VC						

Note: NP – Not protected in Hong Kong; P-Protection in Hong Kong

“VC” – Very Common; “UC” – Uncommon; “C” - Common

“+” – Species exists in the study area

“++” – Species common in the study area

“+++” – Species abundant/dominant in study area

Commonness and status were decided according to AFCD biodiversity website (www.hkbiodiversity.net)

LC- Local Concern - Fellowes *et al* (2002)

PGC - Potential Global Concern - Fellowes *et al* (2002)

Table 4.5 Aquatic Macro invertebrates recorded at Lam Tsuen River (T1- upper river channel sampling site . T4 - lower river channel sampling site)

Species	Chinese name	Sampling point	Baseline monitoring				Detailed Survey - 1								Detailed Survey - 2														
			Jul-08		Aug-08		Dec-14				Jan-15				Jul-15				Aug-15										
			Status	Com mon	Upper stream	Lower stream	Upper stream	Lower stream	Reference point	T1	T2	T3	T4	Reference point	T1	T2	T3	T4	Reference point	T1	T2	T3	T4	Reference point	T1	T2	T3	T4	
Molluscs																													
<i>Biomphalaria sp.</i>	--	NP	VC		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
<i>Brotia hainanensis</i>	--	NP	VC	+++	++	++	++	++	++	+	+	+	+	++	++	+	+	++	++	+	++	++	++	++	++	++	++	++	
<i>Melanoides tuberculata</i>	瘤擬黑螺	NP	VC		+		+			+	+				+	+				+	+						+	+	
<i>Pomacea canaliculata</i>	蘋果螺	NP	VC		+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
<i>Radix plicatulus</i>	羅白螺	NP	VC		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
<i>Sinotaia quadrata</i>	田螺	NP	VC		+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Insects																													
<i>Baetis sp.</i>	--	NP	VC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
<i>Caenis sp.</i>	--	NP	VC																										
<i>Chironomus sp.</i>	蠓幼虫	NP	VC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
<i>Electrogenas sp.</i>	--	NP	VC					+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
<i>Hydropsyche sp.</i>	--	NP	VC					+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
<i>Indobaetis sp.</i>	--	NP	VC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
<i>Mnais sp.</i>	--	NP	VC						+	+				+	+				+								+	+	
<i>Orthetrum sp.</i>	--	NP	VC	+	+			+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Crustaceans																													
<i>Caridina cantanensis</i>	廣東米蝦	NP	VC	+	+	+	+	+	++	++	++	++	+	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++	++
<i>Cryptopotamon anacoluthon</i>	鯉刺溪蟹	NP	VC	+		+					+					+											+		
<i>Macrobrachium hainanense</i>	海南沼蝦	NP	VC	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
<i>Somamiathelphusa zanklon</i>	束腰蟹	NP	VC	+		+																							

Note: NP – Not protected in Hong Kong; P - Protected in Hong Kong
 “VC” – Very Common; “UC” – Uncommon; “C” - Common; “R” - Rare
 +, occurred; ++, common; +++, abundant/dominant Species in the the study area
 Reference point was the sampling location outside the works area.

Table 4.6 Fish species and amphibians at Upper Lam Tsuen River
(T1- upper river channel sampling site . T4 - lower river channel
sampling site)

Species	Chinese name	Status	Sampling point	Baseline monitoring				Detailed Survey - 1								Detailed Survey 2												
				Jul-08		Aug-08		Dec-14				Jan-15				Jul-15				Aug-15								
				Upper stream	Lower stream	Upper stream	Lower stream	Reference	T1	T2	T3	T4	Reference	T1	T2	T3	T4	Reference	T1	T2	T3	T4	Reference	T1	T2	T3	T4	
Fish																												
<i>Acrossocheilus parallens</i>	側條光唇魚	P, PGC	R		+		+			++	++	++	++		++	++	++	++		+	+	+	+		+	+	+	+
<i>Channa maculate</i>	斑鱧	NP	Common				+																				+	
<i>Cirrhina molitorella</i>	鯪魚	NP	C																									
<i>Clarias fuscus</i>	胡子鯰	NP	C											+														+
<i>Cyprinus carpio var. viridivulaceus</i>	錦鯉	NP	C																									+
<i>Gambusia affinis</i>	食蚊魚	NP	VC			+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Liniparhomaloptera disparis</i>	擬平鰍	NP	C							+	+	+	+		+	+	+	+		+	+	+	+		+	+	+	
<i>Misgurnus anguillicaudatus</i>	泥鰍	NP	Common	+		+				+	+	+	+		+	+	+	+		+	+	+	+		+	+	+	+
<i>Oreochromis niloticus</i>	尼羅口孵非鯽	NP	C		+		+			+	+	+	+		+	+	+	+		++	++	++	++		+	++	++	++
<i>Parazacco spilurus</i>	異鱺	V and	Common	+		+				+	+	+	+		+	+	+	+		+	+	+	+		+	+	+	+
<i>Poecilia reticulata</i>	孔雀花魚將	NP	VC			+	+				+	+				+					+	+	+			+	+	+
<i>Pseudogastromyzon myersi</i>	麥氏擬腹吸鰍	NP	C		+	+	+			+	+	+	+		+	+	+	+		+	+				+	+		
<i>Pterocryptis cochinchinensis</i>	黃鯰	NP	C							+	+	+			+						+					+		
<i>Puntius semifasciolatus</i>	七星魚	NP	C	++	+	++	+			+	+	++	++	+	+	+	++	++	+	+	+	++	++	+	+	+	++	++
<i>Rhinogobius spp.</i>	鰕虎魚	NP	C/UN/R		+	+	+			+	++	++	++	+	+	++	++	++	++		+	++	++	++		+	++	++
<i>Schistura fasciolata</i>	橫紋南鰍	NP	C		+	+	+			+	+	+			+	+					+	++	++			+	++	++
<i>Xiphophorus hellerii</i>	劍尾魚	NP	C	+	+	+	+			+	++	++	+		+	++	++	+		+	+	++	+	+		+	++	+
<i>Xiphophorus variatus</i>	雜色劍尾魚	NP	C			+	+					+	+			+					+	+				+	+	
<i>Zacco platypus</i>	寬鰭鱈	NP	C	+	++	+	++			+	++	++	+	+	+	++	++	+	+		+	++	++	+	+	+	++	++
2x2m fish counting		Number of fish		70	60	75	60	60	60	60	50	50	50	50	50	60	60	60	12	15	18	8	7	15	12	16	10	10
Amphibian																												
<i>Paramesotriton hongkongensis</i>	香港瘰螈	P (Cap 170, NT, PGC)	R	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Fejervarya limnocharis</i>	澤蛙	NP	VC																									

Note: NP – Not protected in Hong Kong

“VC” – Very Common; “UC” – Uncommon; “C” - Common; "R" - Rare

+, occurred; ++, common; +++, abundant/dominant Species in the the study area

-V – Listed as vulnerable in China Fish Red Data Book

-Reference point was the sampling location outside the works area used to compare the with the data within works area.

"Cap 170" - List in Wild Animals Protection Ordinance (Cap.170)

"NT" - Near Threatened in IUCN Red List Status

"PGC"-Potential Global Concern by Fellowes *et al* (2002)

Table 4.7 Abotic data for Upper Lam Tsuen
River(T1- upper river channel sampling site . T4
- lower river channel sampling site)

Parameter / date	Baseline monitoring	Detailed Survey -1								Detailed Survey - 2							
	8-Aug	Dec-14				Jan-15				Jul-15				Aug-15			
Replicate		T1	T2	T3	T4	T1	T2	T3	T4	T1	T2	T3	T4	T1	T2	T3	T4
DO (mg/L)	9.2	7.2	8.1	8.2	8.2	8.9	9.2	9.3	9.2	8.3	8.2	8.0	8.3	8.4	8.3	8.3	8.3
pH	7.49	8.5	8.4	8.2	8.2	7.9	8.2	8.3	7.9	7.7	7.8	7.8	7.8	7.7	7.7	7.6	7.7
Nitrate (mg N/L)	0.36	0.9	1	0.9	0.9	0.9	0.9	0.9	0.9	0.8	0.8	0.8	0.9	0.8	0.8	0.8	0.9
Ammonia (mg/L)	<0.01	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Salinity (ppt)	<0.1	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Conductivity (µS/cm)	60	112	92	86	67	156	153	152	163	42	32	35	55	36	42	46	38
BOD (mg/L)	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Water flow at pool	0.1-0.3	0.03-0.2				0.03-0.2				0.03-0.2				0.03-0.2			
Water flow at riffle	0.4-0.7	0.2-0.5				0.2-0.5				0.2-0.5				0.2-0.5			
Sand (%)	15	5	5	8	10	5	5	8	10	5	5	8	10	5	5	8	10
Stone (%)	80	93	90	90	75	93	90	90	75	93	90	90	75	93	90	90	75
Mud (%)	5	2	5	2	15	2	5	2	15	2	5	2	15	2	5	2	15

**Agreement No. CE65/2013(EP)
Post-Construction Ecological Monitoring of River
Improvement Work in Upper Lam Tsuen River, She Shan
River and Upper Tai Po River – Investigation**

**Detailed Ecological Monitoring Report (No. 2)
She Shan River**

September 2015

Prepared by: Mike Pang



September 16, 2015

Validated by: Mark Shea



September 16, 2015

Ecology Team: China Hong Kong Ecology Consultants

Post-Construction Ecological Monitoring of River Improvement Work in Upper Lam Tsuen River, She Shan River and Upper Tai Po River – Investigation

Agreement No. CE65/2013(EP) Detailed Ecological Monitoring Report (No. 2) She Shan River

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Photo 1: Vegetation Clearance

Photo 2: Photo: Dominant species - *Brachiaria mutica*

TABLE

Table 4.1: Flora species recorded along the She Shan River including riparian habitat.

Table 4.2: Flora species recorded from belt transect survey at the She Shan River.

Table 4.3: Avifauna recorded along survey transects and at three selected point count locations at She Shan River.

Table 4.4: Odonata species recorded at the She Shan River

Table 4.5: Aquatic Macro invertebrates and other fauna recorded at She Shan River.

Table 4.6: Fish species and Hong Kong Newt recorded at She Shan River.

Table 4.7: Abiotic data for She Shan River.

1 Introduction

- 1.1 Agreement No. CE65/2013(EP) Post-Construction Ecological Monitoring of River Improvement Work in Upper Lam Tsuen River, She Shan River and Upper Tai Po River – Investigation required a post-construction ecological monitoring programme when the project completed. The collected data are mainly used to assess ecological recovery process and effectiveness of ecological migration proposed and enforced during the construction period.
- 1.2 The scope of the ecological monitoring was detailed in EM & A Manual of the project. In brief, the survey aimed to collect data on abiotic factors such as water quality, substratum characteristics, water flow as well as flora and fauna.
- 1.3 China Hong Kong Ecology Consultants Ltd. was committed by Allied Environmental Consultants Ltd (AEC) to undertake the ecological monitoring tasks for the project from December 2014.
- 1.4 This is the number 2 detailed ecological monitoring report summarizing the data collected from detailed surveys of July and August in 2015. It contains the following subsections:
 - Summary of major points
 - Monitoring Methods and Results
 - Summary and Comments

2 Summary of Major Points

- Detailed monitoring surveys were undertaken in July and August of 2015
- Fauna and flora along the drainage project sections is in a process of re-establishing or restoration;
- All fauna are recorded increase in abundance and species richness compared with baseline level; and
- *Paramesotriton hongkongensis* abundance was not found due to seasonality.

3 Monitoring Methodology

3.1 Riparian Vegetation

Riparian vegetation, including aquatic and emergent, was sampled using line transects along the affected river channel and riparian habitat. Species, relative abundance and average heights were recorded. Vegetation survey was conducted at three selected belt transects located at the upper (T1), middle (T2) and lower portion (T3) of the river channel respectively (**Figure 1**). The belt transects was run across the river channel in order to collect quantitative data of vegetation, e.g., species inventory, height, percentage cover. Qualitative data of plants was collected by recording plant species along line transect, e.g., species inventory, relative abundance. Nomenclature and protection status of the species has followed those documented in the Lai *et al* (2004) and Hong Kong Herbarium (2015).

3.2 Avifauna

Avifauna survey was conducted during the post construction monitoring period. Special attention was given to those stream channel area which birds used as feeding and foraging habitat. Avifauna surveys were undertaken in the early morning plus species recorded in the rest of the day when conducting other taxonomic groups (benthic, fish, insect) monitoring. Numerical abundance was recorded at fixed count points within a radius of 30 to 50m according to landscape feature and visual penetration extent. The duration of the point count of birds was standardized for 10 minutes at each location in order to collect comparable data. Transect count along accessible section of river channel were used in order to collect qualitative data. Binoculars and digital camera were the main items of equipment used. Nomenclature and protection status of the species has followed in the AFCD website (www.hkbiodiversity.net) and Carey *et al* (2001).

The point count was conducted at three locations located at the lower (T3), middle (T2) and upper (T1) portion of the river channel respectively. The point count and survey transect locations for the bird survey and sampling sites for surveys of other faunal groups and flora were presented in **Figure 1**.

3.3 Adult Odonata Survey

Adult Odonata survey was conducted along transects (**Figure 1**). Binoculars, digital camera and hand net were utilized to aid identification. Numerical abundance, species identity and other notable behavior were recorded. Nomenclature and protection status of the species has followed those documented in the AFCD website (www.hkbiodiversity.net), Wilson *et al* (2004) and Tam *et al* (2011). Adult Odonata survey was conducted along line transects in parallel with river channel within the works area where access was permitted.

3.4 Aquatic Macro-invertebrates

Macro-invertebrates in the riverbed were surveyed. Four sampling sites were selected to collect necessary macro-invertebrate fauna for ecological monitoring information, which covered upper (T1), middle (T2) and lower (T3) sections of the river respectively, as well as reference site (**Figure 1**). Five replicates were taken at each sampling point and pool together for further sample process. Kick sampling and hand netting were the survey methodologies for stream organisms. Dissection microscope and digital camera were used to aid identification and enumeration. Numerical abundance, species identity was recorded. Nomenclature and protection status of the species has followed those documented in the AFCD website (www.hkbiodiversity.net), and other literatures such as Dudgeon (1994).

3.5 Fish Population and Hong Kong Newt

Fish community at the specified river channel was monitored by live trapping, hand netting and direct observation methods. The Hong Kong newt was surveyed by direct observation and hand netting as well.

Sampling was conducted at four proposed sampling locations at upper (T1),

middle (T2), lower (T3) sections and reference site respectively. Those sampling sites covered major type of stream habitats, e.g. river pool and riffle (**Figure 1**). The number of the observed fish was estimated and recorded. Nomenclature and protection status of the species has followed those documented in the AFCD website (www.hkbiodiversity.net) and Lee *et al* (2004).

3.6 Abiotic Data Collection

3.6.1 Water Quality Monitoring

Dissolved oxygen level, pH value, conductivity, salinity, BOD and nutrient level (nitrate and ammonium) were sampled and analyzed by conventional methods in situ or in laboratory. The instruments for measuring dissolved oxygen level, pH value, conductivity, salinity were model: DO-5510, AZ8685, AZ8361 and AZ8374 respectively. All the instruments were calculated every monitoring month according to the operation manuals in order to obtain the precise result. BOD test took 5 days to complete within darkness incubator with stable temperature at 20°C and was performed using model: DO-5510 for measuring dissolved oxygen. Nutrient levels including nitrate and ammonia were performed in laboratory by applying the In-house method SOP056 (FIA) and SOP057 (FIA) respectively.

3.6.2 Sediment Characteristics

Sediment/substrate characteristics were recorded of sediment cover in percentage e.g. mud, sand, rock, boulder and cemented bottom in the stream bed at sampling sites.

3.6.3 Water Flow

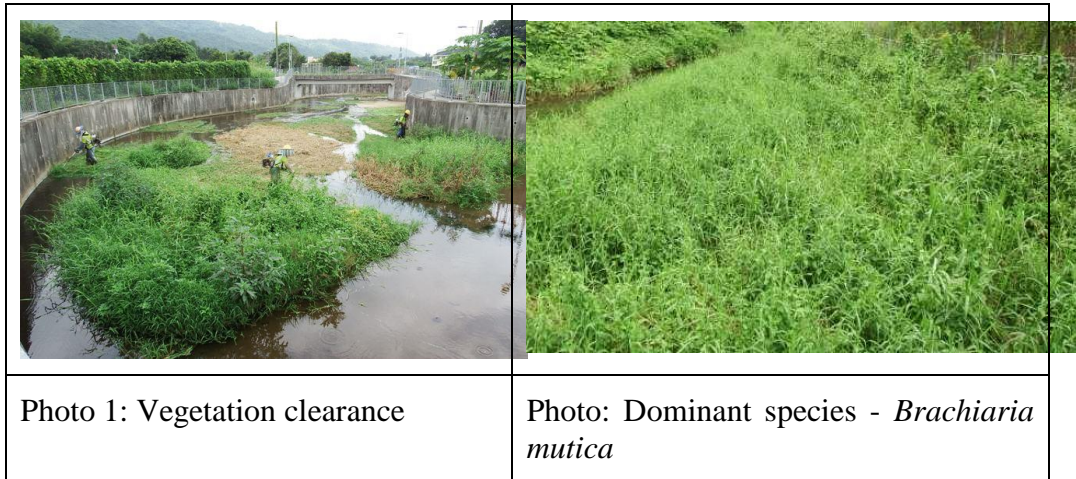
Water flow rates in river channel were measured by recording the time taken for a floating object (e.g. floating ball) in a measured distance. The sampling locations for surveys were presented in **Figure 1**.

4 Monitoring Results

4.1 Vegetation

Detailed surveys were undertaken along the transect at She Shan River. In total, 59 flora species was recorded within the survey transects along the river course. With the comparison of 50 species recorded in baseline level, there are only few more species recorded. It is assumed that middle to lower section of the river was made up with concrete so that only species with good acceptability could establish onto the river bed. In addition, vegetation in these sections were regularly got cleared by the workers (Photo 1). Only upper section could support more diverse vegetation, however, upper section is currently dominated by an invasive species *Brachiaria mutica* (Photo 2). The surveys period was within wet season, frequent flooding events could also possibly wash the vegetation out of the river. Most recorded species were wetland species. The height of the dominated riparian grass and herb species were in a range from 0.3m to 1.5m as observed along survey transect. Dominant flora species were shown in the **Table 4.1** marked with relative abundance sign “+++”. Vegetation has generally covered the riverbed and

riparian habitat in upper sections and partially covered the riverbed in middle to lower section.



4.2 Fauna

4.2.1 Avifauna

An avifauna detailed surveys were undertaken along survey transects and at four selected point count locations. Over 25 species of birds were recorded during the bird surveys. Bird's species composition in She Shan River has changed in terms of abundance and species richness towards the data collected from baseline to post-construction monitoring, more species and higher abundance recorded were related to the improved river, where provided dense vegetation as their habitats, as well as food source. Some of wetland dependent species including *Ardeola bacchus* and *Egretta garzetta* are considered as Regional Concern by Fellowes *et al.* (2002), they were always found foraging in the river. *Spilornis cheela* was recorded hovering above middle section of the river, which is listed under Endangered Species of Animals and Plants Ordinance (Cap. 586) and considered as Vulnerable and Local Concern in China Red Data Book Status and by Fellowes *et al.* (2002) respectively. *Centropus sinensis* is also considered as Vulnerable in China Red Data Book Status, was observed staying above the tree in middle section of the river. In addition, two species were the first time to be recorded in She Shan River including *Eurystomus orientalis* and *Chalcophaps indica*, in which *Eurystomus orientalis* is the uncommon passage migrant in Hong Kong, while *Chalcophaps indica* is the scarce resident in Hong Kong and listed as Vulnerable in China Red Data Book Status.. Transect and Point Count locations were shown on **Figure 1**. Result of bird survey was presented in the **Table 4.3**.

4.2.2 Adult Odonata Survey

Odonata detailed surveys were performed and a list of recorded odonata species at Upper Lam Tsuen River is shown in **Table 4.4**. 13 species of odonata were recorded along the river transect, all recorded species were common and wide spread in Hong Kong. Species richness increased significantly compared with the data collected from approximate season in baseline level. Mating behavior of odonata was commonly seen in the river

and their larvae were usually collected from kicking sampling. Sampling location was shown in **Figure 1**.

4.2.3 Aquatic Macro-invertebrates

The river benthic fauna collected was mainly comprised of insects, molluscs, crustaceans and as well as fish. Details of recorded benthic fauna refer to **Table 4.5**. Sampling location was shown on **Figure 1**.

4.2.4 Hong Kong Newt

From the detailed surveys, no newt was recorded in those potential habitats in She Shan River. Newts normally breed from September to March, they usually spend their time on terrestrial area during their non-breeding period. Thus, the disappearance of newt in the river is mainly related to seasonality, but not impacts raised from the river. Record of Hong Kong Newts can be referred to **Table 4.6**.

4.2.5 Fish Fauna

Fish surveys were performed at She Shan River and total 13 species of freshwater fish were recorded. Native fish *Zacco platypus* and *Oreochromis niloticus* were abundant species dominating in the river channel. Among the recorded fish, *Parazacco spilurus* is classified as “Vulnerable” in Red China Data Book, it was commonly observed along the river with low abundance. The composition of fish species was similar to baseline level with slightly increased by few species indicating that the improved river is stable and mature enough to support more species. Details of recorded of fish fauna refers to **Table 4.6**. Sampling location was shown on **Figure 1**.

4.3 **Abiotic Data**

Data on water quality and major stream hydrological feature (water flow and substratum) of the stream were collected and are presented in the **Table 4.7**.

The overall data collected from detailed survey and baseline lever were similar except the river substratum has changed significantly. The river substratum was comprised of over 30-80% stones or rocks in large proportion of the river sections with slow water flow (up to 0.2m/second at pool and 0.5m/second at riffle). Generally, the water was clean and nutrient levels were moderate as a result of effluent from nearby cultivation lands, but the impact from the effluent is anticipated. Results of water test are presented in the **Table 4.7**.

5 **Summary and Commentary**

Detailed ecological monitoring surveys were carried out in July and August 2015 and relevant biotic and abiotic data was collected according to project specification and EM & A Manual. *Paramesotriton hongkongensis* was not recorded due to seasonality. Following the river became more stable and mature after the completion of construction, the species richness and abundance of fauna have increased compared with baseline level.

Aquatic plants and riparian vegetation were generally established at new drainage channel. Vegetation has completely covered the gabion wall mainly in upper sections River and partially covered the river bed along the river channel. Vegetation diversity is similar to baseline level due to human disturbance, design structure and seasonality.

The water quality of the river was generally good along river channel and most of the parameters are similar to baseline level except greatly change in river substratum.

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FIGURE

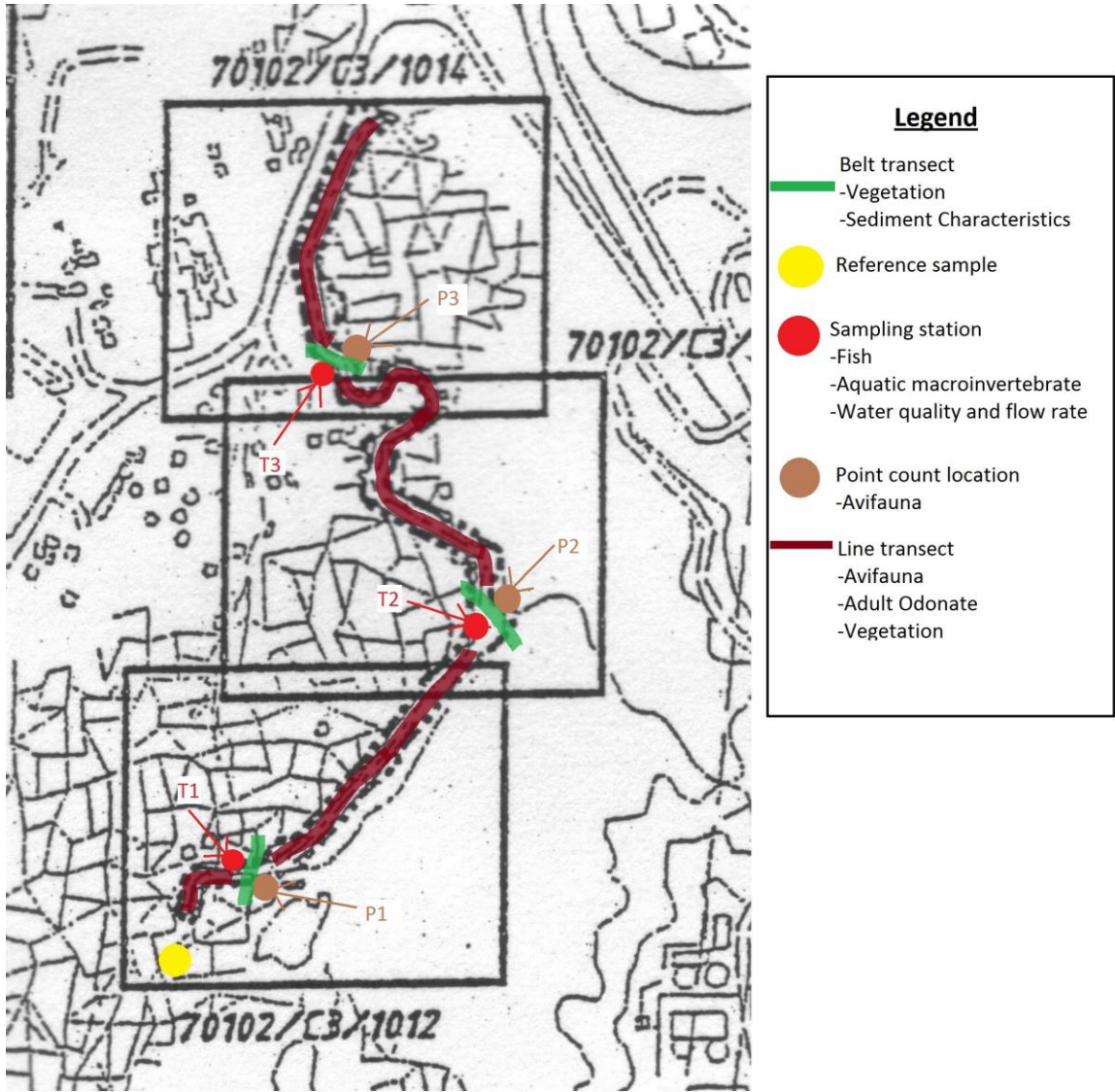


Figure 1. Sampling Location of Ecological Survey and Monitoring at She Shan River, Tai Po.

TABLE

Table 4.1. Flora species recorded along the She Shan River including riparian habitat.

Family	Species name	Species name in Chinese	Baseline monitoring	Detailed Survey 1		Detailed Survey 2	
			Jul to Aug 08	Dec-14	Jan-15	Jul-15	Aug-15
Riparian Plant							
Acanthaceae	<i>Dicliptera chinensis</i>	狗肝菜		+			
Acoraceae	<i>Acorus gramineus</i>	金錢蒲		+			
Amaranthaceae	<i>Alternanthera philoxeroides</i>	空心蕨子草	+	+			
Amaranthaceae	<i>Celosia argentea L.</i>	青葙		+			
Apiaceae	<i>Oenanthe javanica</i>	水芹					
Aquifoliaceae	<i>Ilex rotunda</i>	鐵冬青	+				
Araceae	<i>Alocasia odora</i>	海芋	+	+	+	+	+
Araceae	<i>Colocasia esculenta</i>	芋	+	+	+	+	+
Araceae	<i>Syngonium podophyllum</i>	合果芋	+	+			
Araceae	<i>Pistia stratiotes</i>	大薺			+	+	+
Asteraceae	<i>Bidens alba</i>	白花鬼針草	+	++	+	++	++
Asteraceae	<i>Synedrella nodiflora</i>	金腰箭	+	+		+	+
Asteraceae	<i>Mikania micrantha</i>	微甘菊	+	++	++	++	++
Asteraceae	<i>Erigeron karvinskianus</i>	加勒比飛蓬	+	+		+	+
Asteraceae	<i>Eclipta prostrata</i>	鱧腸	+	+	+	+	+
Asteraceae	<i>Gynura divaricata</i>	白子菜		+		+	+
Asteraceae	<i>Ageratum conyzoides</i>	勝紅薊		+	+	+	+
Asteraceae	<i>Emilia sonchifolia</i>	一點紅		+	+	+	+
Asteraceae	<i>Erechtites hieracifolius</i>	梁子菜		+		+	+
Asteraceae	<i>Youngia japonica</i>	黃鹼菜		+	+	+	+
Asteraceae	<i>Spilanthes paniculata</i>	金鈕扣		+	+	+	+
Athyriaceae	<i>Callipteris esculenta</i>	菜蕨	+	+	+	+	+
Begoniaceae	<i>Begonia cucullata var. hookeri</i>	四季秋海棠		+			
Blechnaceae	<i>Blechnum orientale</i>	烏毛蕨		+			
Brassicaceae	<i>Nasturtium officinale</i>	西洋菜	+	+	+	+	+
Brassicaceae	<i>Rorippa indica</i>	塘葛菜		+	+	+	+
Brassicaceae	<i>Capsella bursa-pastoris</i>	蔞菜		+			
Caesalpiniaceae	<i>Bauhinia championii</i>	缺葉藤			+	+	+
Caryophyllaceae	<i>Drymaria diandra</i>	荷蓮豆	+		+	+	+
Caryophyllaceae	<i>Myosoton aquaticum</i>	鵝腸菜		+	+	+	+
Chenopodiaceae	<i>Chenopodium ficifolium</i>	小藜		+		+	+
Commelinaceae	<i>Commelina diffusa</i>	節節草	+	+++	+++	++	++
Convolvulaceae	<i>Pharbitis nil</i>	牽牛	+	+			
Convolvulaceae	<i>Ipomoea cairica</i>	五爪金龍	+	+	+	+	+
Cucurbitaceae	<i>Solena amplexicaulis</i>	茅瓜					
Cuscutaceae	<i>Cuscuta australis</i>	南方菟絲子			+	+	+
Cyperaceae	<i>Cyperus sp.</i>	莎草		+	+	+	+
Cyperaceae	<i>Cyperus involucratus</i>	風車草		+	+	+	+
Euphorbiaceae	<i>Macaranga tanarius</i>	血桐	+	+	+	+	+
Euphorbiaceae	<i>Aporosa dioica</i>	銀柴	+				
Fabaceae	<i>Pueraria lobata</i>	野葛	+	++	+	++	++
Fabaceae	<i>Sesbania cannabina</i>	田菁		+			
Lauraceae	<i>Cinnamomum burmannii</i>	陰香	+	+			
Lygodiaceae	<i>Lygodium japonicum</i>	海金沙		+			
Magnoliaceae	<i>Michelia alba</i>	白蘭	+	+			
Malvaceae	<i>Hibiscus rosa-sinensis</i>	大紅花			+	+	+
Mimosaceae	<i>Mimosa pudica</i>	含羞草	+	+			

Table 4.1. Flora species recorded along the She Shan River including riparian habitat.

Family	Species name	Species name in Chinese	Baseline monitoring	Detailed Survey 1		Detailed Survey 2	
			Jul to Aug 08	Dec-14	Jan-15	Jul-15	Aug-15
Mimosaceae	<i>Leucaena leucocephala</i>	銀合歡	+	+		+	+
Mimosaceae	<i>Calliandra haematocephala</i>	紅絨球		+	+	+	+
Moraceae	<i>Broussonetia papyrifera</i>	構樹	+				
Moraceae	<i>Ficus hispida</i>	對葉榕	+	+	+	+	+
Moraceae	<i>Ficus pumila</i>	薊蕒	+	+			
Moraceae	<i>Ficus variolosa</i>	變葉榕	+				
Moraceae	<i>Ficus variegata</i>	青果榕			+	+	+
Musaceae	<i>Musa paradisiaca</i>	大蕉	+	+		+	+
Myrsinaceae	<i>Maesa perliarius</i>	鯽魚胆	+				
Myrtaceae	<i>Cleistocalyx operculatus</i>	水箭	+	+		+	+
Onagraceae	<i>Ludwigia hyssopifolia</i>	草龍		+		+	+
Onagraceae	<i>Ludwigia erecta</i>	美洲水丁香		++	+	+	+
Oxalidaceae	<i>Averrhoa carambola</i>	楊桃	+				
Oxalidaceae	<i>Oxalis corniculata</i>	酢醬草				+	+
Plantaginaceae	<i>Plantago major</i>	車前草		+			
Poaceae	<i>Panicum maximum</i>	大黍	+	+	+	+	+
Poaceae	<i>Panicum repens</i>	枯骨草	+	+	+	+	+
Poaceae	<i>Brachiaria mutica</i>	巴拉草		+++	+++	+++	+++
Poaceae	<i>Pennisetum purpureum</i>	象草	++	+	++	+	+
Poaceae	<i>Coix lacryma-jobi</i>	薏苡	+	+	+	+	+
Poaceae	<i>Microstegium ciliatum</i>	剛秀竹	++	++	+	+	+
Poaceae	<i>Miscanthus floridulus</i>	五節芒		+	+	+	+
Poaceae	<i>Pennisetum alopecuroides</i>	狼尾草		+		+	+
Poaceae	<i>Digitaria radicata</i>	紅尾翎			+	+	+
Polygonaceae	<i>Polygonum hydropiper</i>	水蓼	+	+	+	+	+
Polygonaceae	<i>Polygonum glabrum</i>	光蓼				+	+
Polygonaceae	<i>Polygonum chinense</i>	火炭母	+	+		+	+
Polygonaceae	<i>Rumex crispus</i>	假菠菜		+	+	+	+
Polygonaceae	<i>Polygonum lapathifolium</i>	大馬蓼		+		+	+
Rubiaceae	<i>Hedyotis hedyotideae</i>	牛白藤	+				
Sapindaceae	<i>Dimocarpus longan</i>	龍眼	+				
Solanaceae	<i>Solanum torvum</i>	水茄	+	+	+	+	+
Solanaceae	<i>Solanum americanum</i>	少花龍葵		+			
Thelypteridaceae	<i>Cyclosorus parasiticus</i>	華南毛蕨			+	+	+
Ulmaceae	<i>Celtis sinensis</i>	朴樹	+	+		+	+
Ulmaceae	<i>Celtis timorensis</i>	樟葉朴	+				
Ulmaceae	<i>Trema orientalis</i>	黃色山黃麻		+			
Ulmaceae	<i>Trema tomentosa</i>	山黃麻		+			
Urticaceae	<i>Boehmeria nivea</i>	苧麻	+	+			
Urticaceae	<i>Pilea microphylla</i>	透明草	+	+		+	+
Urticaceae	<i>Pouzolzia zeylanica</i>	露水葛	+	+			
Verbenaceae	<i>Vitex quinata</i>	山牡荊	+				
Polygonaceae	<i>Polygonum perfoliatum</i>	紅板腳		+	+	+	+
Verbenaceae	<i>Lantana camara</i>	馬纓丹	+	+	+	+	+
Floating Plant							
Lemnaceae	<i>Lemna minor</i>	浮萍		+			
Submerged Plant							
Hydrocharitaceae	<i>Hydrilla verticillata</i>	黑藻		+		+	+

Note:

“+” – Species exists in the study area

“++” – Species common in the study area

“+++” – Species abundant/dominant in study area

Table 4.2. Flora species recorded from belt transect survey at the She Shan River

(T1- Upper stream section,T2 - middle stream section and T3 - Lower stream section)

Family	Species	Stream Transect Chinese name	Baseline monitoring							
			Jul-08				Aug-08			
			P1		P3		P1		P3	
Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%			
Commelinaceae	<i>Commelina diffusa</i>	節節草			0.2	20			10	6
Poaceae	<i>Panicum repens</i>	枯骨草	0.3	5						
Asteraceae	<i>Mikania micrantha</i>	薇甘菊							0.2	7
Brassicaceae	<i>Nasturtium officinale</i>	西洋菜								
Moraceae	<i>Ficus microcarpa</i>	細葉榕			0.7	5			0.6	7
Moraceae	<i>Ficus hispida</i>	對葉榕			3	10			3	10
Poaceae	<i>Microstegium ciliatum</i>	剛秀竹	0.5	5			0.5	3		
Fabaceae	<i>Pueraria lobata</i>	野葛			0.3	5	0.5	3	0.3	5
Araceae	<i>Colocasia esculenta</i>	芋							0.2	5
Urticaceae	<i>Boehmeria nivea</i>	苧麻	1.5	30			2	7		
Asteraceae	<i>Bidens alba</i>	白花鬼針草								
Poaceae	<i>Pennisetum purpureum</i>	象草	3	50	1	60	3	80	2	60
Poaceae	<i>Coix lacryma-jobi</i>	薏苡								
Amaranthaceae	<i>Alternanthera philoxeroides</i>	空心蓮子草	0.2	10			0.2	7		
Poaceae	<i>Panicum maximum</i>	大黍								
Moraceae	<i>Broussonetia papyrifera</i>	構樹								
Polygonaceae	<i>Polygonum chinense</i>	火炭母								
Onagraceae	<i>Ludwigia hyssopifolia</i>	草龍								
Cyperaceae	<i>Cyperus sp.</i>	莎草								
Poaceae	<i>Miscanthus floridulus</i>	五節芒								
Poaceae	<i>Brachiaria mutica</i>	巴拉草								
Blechnaceae	<i>Blechnum orientale</i>	烏毛蕨								
Poaceae	<i>Pennisetum alopecuroides</i>	狼尾草								
Araceae	<i>Alocasia macrorrhizos</i>	海芋								
Lemnaceae	<i>Lemna minor</i>	浮萍								
Polygonaceae	<i>Polygonum hydropiper</i>	水蓼								
Cyperaceae	<i>Cyperus involucratus</i>	風車草								
Onagraceae	<i>Ludwigia erecta</i>	美洲水丁香								
Convolvulaceae	<i>Ipomoea cairica</i>	五爪金龍								
Bare Gound										

P1 – Point count location 1; P3 – Point count location 3

Table 4.2. Flora species recorded from belt transect survey at the She Shan River
(T1- Upper stream section,T2 - middle stream section and T3 - Lower stream section)

Family	Species	Stream Transsect Chinese name	Detailed Survey 1												Detailed Survey 2											
			Dec-14						Jan-15						Jul-15						Aug-15					
			T1		T2		T3		T1		T2		T3		T1		T2		T3		T1		T2		T3	
Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%	Height(m)	%			
Commelinaceae	<i>Commelina diffusa</i>	節節草	1	10	1	50	0.1	2	0.5	10	0.8	70	0.3	40			0.3	25			0.3	15				
Poaceae	<i>Panicum repens</i>	枯骨草																								
Asteraceae	<i>Mikania micrantha</i>	薇甘菊	0.3	5	1	15	0.3	2	0.4	10	0.5	15			0.4	10	0.4	10			0.5	10	0.4	5		
Brassicaceae	<i>Nasturtium officinale</i>	西洋菜																								
Moraceae	<i>Ficus microcarpa</i>	細葉榕																								
Moraceae	<i>Ficus hispida</i>	對葉榕																								
Poaceae	<i>Microstegium ciliatum</i>	剛秀竹																								
Fabaceae	<i>Pueraria lobata</i>	野葛																								
Araceae	<i>Colocasia esculenta</i>	芋																								
Urticaceae	<i>Boehmeria nivea</i>	苧麻																								
Asteraceae	<i>Bidens alba</i>	白花鬼針草	1	2	0.5	5	0.8	10							0.9	15			0.3	2	0.9	15		0.5	2	
Poaceae	<i>Pennisetum purpureum</i>	象草																								
Poaceae	<i>Coix lacryma-jobi</i>	薏苡				1.5	1							1	2					1	2					
Amaranthaceae	<i>Alternanthera philoxeroides</i>	空心蓮子草																								
Poaceae	<i>Panicum maximum</i>	大黍																								
Moraceae	<i>Broussonetia papyrifera</i>	構樹																								
Polygonaceae	<i>Polygonum chinense</i>	火炭母																								
Onagraceae	<i>Ludwigia hyssopifolia</i>	草龍																								
Cyperaceae	<i>Cyperus sp.</i>	莎草																								
Poaceae	<i>Miscanthus floridulus</i>	五節芒																								
Poaceae	<i>Brachiaria mutica</i>	巴拉草	1.8	70	1.8	25	1.5	8	1.5	80	1	5	1	25	0.8	60	1	50	0.8	10	0.9	60	1	35	0.9	10
Blechnaceae	<i>Blechnum orientale</i>	烏毛蕨																								
Poaceae	<i>Pennisetum alopecuroides</i>	狼尾草	2	10	3	2																				
Araceae	<i>Alocasia macrorrhizos</i>	海芋																								
Lemnaceae	<i>Lemna minor</i>	浮萍																								
Polygonaceae	<i>Polygonum hydropiper</i>	水蓼			1	1																				
Cyperaceae	<i>Cyperus involucratus</i>	風車草			1.7	1				1.5	5				1.2	5					1.2	5				
Onagraceae	<i>Ludwigia erecta</i>	美洲水丁香	1.5	1			2	5				2	10			1.5	50					1.5	50			
Convolvulaceae	<i>Ipomoea cairica</i>	五爪金龍													0.3	5					0.3	5				
Bare Gound				2		1		72		0		5	25		13		10		38		13		40	38		

P1 – Point count location 1; P3 – Point count location 3

Table 4.3 Avifauna recorded along survey transects and at three selected point count locations at She Shan River.

(T1- Upper stream section, T2 - middle stream section and T3 - Lower stream section)

Common Name	Species name	Chinese name	Status	Commonness	Baseline monitoring			Detailed Survey 1				Detailed Survey 2							
					Jul-08			Aug-08			Dec-14				Jan-15				
					Abundance			Abundance			Abundance				Abundance				
					C	P1	P3	C	P1	P3	C	T1	T2	T3	C	T1	T2	T3	C
Barn Swallow	<i>Hirundo rustica</i>	家燕	PM	C															
Black Drongo	<i>Dicrurus macrocerus</i>	黑卷尾	Sv	C															
Black Kite	<i>Milvus lineatus</i>	黑鷹	R, RC, Cap.586	C			+			+			+						
Black-necked Starling	<i>Sturnus nigricollis</i>	黑領椋鳥	R	C	+			+	2			+	2			+	2	2	++
Black-throated Laughingthrush	<i>Garrulax chinensis</i>	黑喉噪鶇	R	C															+
Buzzard (Common Buzzard)	<i>Buteo buteo</i>	普通鵟	WV, Cap.586	U										+					
Chinese Bulbul	<i>Pycnonotus sinensis</i>	白頭鶇	R	C	+		2	+			+	2	2		+	1		3	++
Chinese Pond Heron	<i>Ardeola bacchus</i>	池鷺	R,RC	C	++		3	+	1	2	+		1		++	1	2	2	+
Common Emerald Dove	<i>Chalcophaps indica</i>	綠翅金鳩	R,VU	S															+
Common Kingfisher	<i>Alcedo atthis</i>	普通翠鳥	R	C															
Common Koel	<i>Eudynamis scolopacea</i>	噪鶇	R	C															
Common Sandpiper	<i>Actitis hypoleucos</i>	磯鶇	WV&PM	C															+
Common Tailorbird	<i>Orthotomus sutorius</i>	長尾縫葉鶇	R	C	+	1		+	1			++	1	1		++	2	1	1
Crested bulbul	<i>Pycnonotus jocosus</i>	紅耳鶇	R	C			++	3	2	+++	2	3	2	+++	3	2	4	+++	5
Crested Goshawk	<i>Accipiter trivirgatus</i>	鳳頭鷹	R, CR, Cap.586	U										+					
Crested Myna	<i>Acridotheres cristatellus</i>	八哥	R	C			+		2	+	1			+		3	++	2	2
Crested Serpent Eagle	<i>Spilornis cheela</i>	蛇鵟	R, VU, LC, Cap.586	U															+
Domestic pigeon	<i>Columba sp.</i>	鴿	R	C	+	2		+	1	2	++			++					
Dusky Warbler	<i>Phylloscopus fuscatus</i>	褐柳鶇	WV	U						++				++	1	2	1	1	+
Eurasian tree sparrow	<i>Passer montanus</i>	麻雀	R	C			+	2		+++		5	3	+++	2	4	3	++	3
Fork-tailed Sunbird	<i>Aethopyga christinae</i>	叉尾太陽鳥	R	C															+
Great Coucal	<i>Centropus sinensis</i>	褐翅鴉鵂	R,VU	C	+	1	2	+	1	1	+			+		1			+
Great Egret	<i>Ardea alba</i>	大白鷺	R,RC	U										+					
Great Tit	<i>Parus major(commixtus)</i>	大山雀	R	C															
Green Sandpiper	<i>Tringa ochropus</i>	白腹草鶇	PM&WV	U															
Grey Heron	<i>Ardea cinerea</i>	蒼鷺	WV,PRC	C															
Grey Wagtail	<i>Motacilla cinerea</i>	灰鶇鶇	WV	C						+		1		+		1	2	+	
Japanese White Eye	<i>Zosterops japonica(simplex)</i>	暗綠繡眼鳥	R	C						+		3		+		4	+	3	3
Large Hawk Cuckoo	<i>Cuculus sparveroides</i>	鷹鶇	SV	U						+									
Little Egret	<i>Egretta garzetta</i>	小白鷺	R,RC	C	+			+		+	2	1	1	+	1	2	1	+	
Magpie Robin	<i>Copsychus saularis</i>	鶇鶇	R	C	+	1		+	1			+	1	1	1	2	+	2	2
Night Heron	<i>Nycticorax nycticorax</i>	夜鷺	R,LC	U															
Olive Backed Pipit	<i>Anthus hodgsoni</i>	樹鶇	WV	C															
Oriental Dollarbird	<i>Eurystomus orientalis</i>	三寶鳥	PM	U															+
Plaintive Cuckoo	<i>Cacomantis merulinus</i>	八聲杜鶇	SV	C															
Rufous-backed Shrike	<i>Lanius schach</i>	棕背伯勞	R	C	+			+						+		1			+
Rufous-capped Babbler	<i>Stachyridopsis ruficeps</i>	紅頭穗鶇	R	C						+				+		1			+
Scarlet Minivet	<i>Pericrocotus speciosus</i>	赤紅山椒鳥	R	C															
Sooty-headed Bulbul	<i>Pycnonotus aurigaster</i>	白喉紅臀鶇	R	C															
Spotted Dove	<i>Streptopelia chinensis</i>	珠頸斑鳩	R	C	+		1	+	2	1	+	1	2	2	+	2	3	4	++
Spotted Munia	<i>Lonchura punctulata</i>	斑文鳥	R	U						+	5			+		5			
White Wagtail	<i>Motacilla alba</i>	白鶇鶇	WV	C			+	1		++	1	2	2	++	1	2	2	+	1
White-breasted Waterhen	<i>Amurornis phoenicurus</i>	白胸苦惡鳥	R	C	+			+						+					
Yellow Bellid Prinia	<i>Prinia flaviventris</i>	黃腹鶇鶇	R	C												1	1	+	
Number of birds						5	8		15	10		15	19	15		15	16	17	
No. of species						11	4	4	16	10	6	21	9	11	7	24	10	13	14

Note: R – Resident; WV – Winter visitor; PM – Passage migrant; C – Common; U – Uncommon; S – Scarce
 SpM – Spring migrant; Sv - Summer visitor – transect count; P1 – Point count location 1; P3 – Point count location 3
 +, occurred; ++, common; +++, abundant/dominant species in the study area
 Commonness and status were decided according to AFCD biodiversity website (www.hkbiodiversity.net)
 All bird species are under protection of Wild Animals Protection Ordinance (Cap. 170)
 Endangered Species of Animals and Plants Ordinance (Cap. 586)
 RC : Regional concern Fellowes *et al* (2002)
 LC : Local Concern Fellowes *et al* (2002)
 PRC: Potential regional concern Fellowes *et al* (2002)
 CR: Rare in China Red Data Book Status
 VU: Vulnerable in China Red Data Book Status

Table 4.4. Odonate species recorded at the She Shan River

Species	Common name	Chinese name	Status	Commonness	Baseline monitoring		Detailed Survey 1		Detailed Survey 2	
					Jul-08	Aug-08	Dec-14	Jan-15	Jul-15	Aug-15
<i>Agriocnemis pygmalis</i>	Wandering Midget	黃尾小蠋	NP	VC						
<i>Brachythemis contaminata</i>	Asian Amberwing	黃翅蜻	NP	VC						
<i>Ceragrion auranticum ryukyuanum</i>	Orange-tailed Sprite	琉球橘黃蠋	NP	VC					+	+
<i>Copera ciliata</i>	Black-knees Featherlegs	白狹扇蠋	NP	VC						
<i>Copera marginipes</i>	Yellow Featherlegs	黃狹扇蠋	NP	VC					+	+
<i>Crocothemis servilia servilia</i>	Crimson Darter	紅蜻	NP	VC	+	+	+	+	+	+
<i>Diplacodes trivialis</i>	Blue Percher	紋藍小蜻	NP	VC	+					
<i>Ictinogomphus pertinax</i>	Common Flangetail	霸王葉春蜓	NP	C					+	+
<i>Ischnura senegalensis</i>	Common Bluetail	褐斑異痣蠋	NP	VC						
<i>Nannophya pygmaea</i>	Scarlet Dwarf	侏紅小蜻	NP	C						
<i>Neurobasis chinensis chinensis</i>	Chinese Greenwing	華艷色蠋	NP	VC						+
<i>Neurothemis fulvia</i>	Russet Percher	網脈蜻	NP	VC					+	+
<i>Orthetrum chrysis</i>	Red-faced Skimmer	華麗灰蜻	NP	VC	+	+				+
<i>Orthetrum glaucum</i>	Common blue skimmer	黑尾灰蜻	NP	VC						
<i>Orthetrum luzonicum</i>	Marsh Skimmer	呂宋灰蜻	NP	VC					+	
<i>Orthetrum pruinosum neglectum</i>	Common Red Skimmer	赤褐灰蜻	NP	VC					+	
<i>Orthetrum Sabina sabina</i>	Green Skimmer	狹腹灰蜻	NP	C	+	+				
<i>Pantala flavescens</i>	Wandering Glider	黃蜻	NP	VC	+	+			+	+
<i>Prodasineura autumnalis</i>	Black Threadtail	烏齒原蠋	NP	VC					+	+
<i>Pseudagrion pruinosum fraseri</i>	Ferruginous-faced Sprite	赤斑蠋	NP	C						
<i>Pseudagrion rubriceps rubriceps</i>	Orange-faced Sprite	丹頂斑蠋	NP	UC	+					
<i>Rhinocypha perforata perforata</i>	Common Blue Jewel	三斑鼻蠋	NP	VC					+	+
<i>Rhyothemis variegata arria</i>	Variiegated Flutterer	斑麗翅蜻	NP	C					+	+
<i>Trithemis aurora</i>	Crimson Dropwing	曉褐蜻	NP	VC			+	+	+	+
<i>Trithemis festiva</i>	Indigo Dropwing	慶褐蜻	NP	VC					+	+
<i>Zygonyx iris insignis</i>	Emerald Cascader	彩虹蜻	P,PG	VC						

Note: NP – Not protected in Hong Kong ; P - Protected in Hong Kong

“VC” – Very Common; “UC” – Uncommon; “C” - Common

“+” – Species exists in the study area

“++” – Species common in the study area

“+++” – Species abundance in the study area

Commonness and status were decided according to AFCD biodiversity website (www.hkbiodiversity.net)

LC- Local Concern - Fellowes *et al* (2002)

PGC - Potential Global Concern - Fellowes *et al* (2002)

Table 4.5 Aquatic Macro invertebrates recorded at She Shan River.

(T1- Upper stream section, T2 - middle stream section, T3 - Lower stream section)

Species	Chinese name	Sampling location		Baseline monitoring				Detailed Survey 1								Detailed Survey 2								
				Jul-08		Aug-08		Dec-14				Jan-15				Jul-15				Aug-15				
				Status	Common -ness	Upper stream	Lower stream	Upper stream	Lower stream	Reference	T1	T2	T3	Reference	T1	T2	T3	Reference	T1	T2	T3	Reference	T1	T2
Mollusks																								
<i>Anodonta woodiana</i>	背角無齒蚌	NP	VC																					
<i>Biomphalaria sp.</i>	--	NP	VC	+	+	+	+		+				+	+				+	+	+		+	+	+
<i>Brotia hainanensis</i>	--	NP	VC	+	+	+	+		+	+	+		+	+	+			+	+	+		+	+	+
<i>Corbicula fluminea</i>	河蜆	NP	VC							+									+					+
<i>Melanoides tuberculata</i>	瘤擬黑螺	NP	VC	+	+	+	++		+	+	+	+		+	+	+		+	+	+	+	+	+	+
<i>Pomacea canaliculata</i>	蘋果螺	NP	VC	+	++	+	+		+	+	+	+		+	+	+		++	++	++	++	++	++	++
<i>Radix plicatulus</i>	--	NP	VC	+	+	+	+		+	+	+	+		+	+	+		+	+	+	+	+	+	+
<i>Sinotaia quadrata</i>	田螺	NP	VC	+	+	+	++		+	+	+	+		+	+	+		+	+	+	++	+	+	++
Insects																								
<i>Baetis sp.</i>		NP	VC	+	+	+	+			+				+						+				+
<i>Caenis sp.</i>	--	NP	VC	+	+	+	+																	
<i>Chironomus sp.</i>	蠓幼虫	NP	VC	+	+	++	++		+	+	+	+		+	+	+		+	+	+	+	+	+	+
<i>Euphaea sp.</i>		NP	VC							+				+					+	+			+	+
<i>Indobaetis sp.</i>	--	NP	VC	+	+	+	+		+	+				+	+	+		+	+	+		+	+	+
<i>Odonate larvae</i>		NP	VC																					+
<i>Orthetrum spp.</i>	--	NP	VC						+	+	+	+		+	+	+		+	+	+	+	+	+	+
<i>Pseudagrion spp.</i>	--	NP	UC						+	+				+	+	+			+	+			+	+
<i>Pseudocloeon sp.</i>	--	NP	VC	+	+	+	+		+					+		+								
<i>Serratella sp.</i>		NP	VC	+	+	+	+							+	+					+				+
Crustaceans																								
<i>Caridina cantanensis</i>	廣東米蝦	NP	VC																	+				+

Note: NP – Not protected in H.K. P - protected species in Hong Kong
 “VC” – Very Common; “UC” – Uncommon; “C” - Common
 “+” – Species exists in the study area
 “++” – Species common in the study area
 “+++” – Species abundance in the study area
 - Reference point was the sampling location outside the works area used to compare the with the data within works area.

Table 4.7 Abotic data for the Upper She Shan River (T1- Upper stream section, T2 - middle stream section and T3 - Lower stream section)

	Baseline monitoring	Detailed Survey 1						Detailed Survey 2					
Stream	Aug-08	Dec-14			Jan-15			Jul-15			Aug-15		
Replicate		T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3
DO (mg/L)	8.9	8.5	8.6	8.6	8.6	8.6	8.7	8.2	8.0	8.2	8.1	8.0	8.1
pH	7.29	8.2	8.5	8.4	9.0	8.8	8.8	7.8	7.7	7.9	7.6	7.7	7.6
Nitrate (mg N/L)	0.5	0.4	0.4	0.4	0.4	0.5	0.4	0.4	0.5	0.5	0.4	0.5	0.5
Ammonia (mg N/L)	0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Salinity (ppt)	<0.1	0.02	0.02	0.02	0.03	0.03	0.03	0.02	0.02	0.02	0.01	0.01	0.02
Conductivity (µS/cm)	90	127	132	121	156	162	147	39	45	28	32	38	46
BOD (mg/L)	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Water flow at pool (m/s)	0.1-0.3	0.1-0.2	0.1-0.2	0.1-0.2	0.1-0.2	0.1-0.2	0.1-0.2	0.1-0.2	0.1-0.2	0.1-0.2	0.1-0.2	0.1-0.2	0.1-0.2
Water flow at riffle (m/s)	0.4-0.5	0.2-0.5	0.2-0.5	0.2-0.5	0.2-0.5	0.2-0.5	0.2-0.5	0.2-0.5	0.2-0.5	0.2-0.5	0.2-0.5	0.2-0.5	0.2-0.5
Sand (%)	55	5	5	5	5	5	5	5	5	5	5	5	5
Stone (%)	25	80	80	30	80	80	30	80	80	30	80	80	30
Mud (%)	30	5	5	2	5	5	2	5	5	2	5	5	2
Concrete (%)	0	10	10	63	10	10	63	10	10	63	10	10	63