



Kwan Lee - Kuly Joint Venture

7 September 2010

Your ref.: (DC/2009/22)/M45/800(0031)
Our ref.: KLKJV/DC200922/E10/0645

AECOM
8/F, Grand Central Plaza, Tower 2,
138 Shatin Rural Committee Road
Shatin,
Hong Kong

By hand

Attn.: Mr. Luk Chi Kin, Eddie (Resident Engineer)

Dear Sir,

Contract No. DC/2009/22
Drainage Improvement Works in Shuen Wan, Tai Po – Contract 1
Environmental Permit Submission –Habitat Compensatory Plan (HCP) (Revision 2)

We refer to your above referenced letter dated 19 Aug 2010 enclosing with EPD letter ref no. (7) in EP2/G/1/117 Pt. 5 dated 13 Aug 2010.

In response to EPD's comments, we would like to enclose herewith the followings:

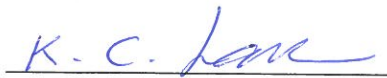
- a) the Response-to-Comment table to EPD's letter, and
- b) the Habitat Compensatory Plan (HCP) (Revision 2) for Ecological Compensation Area

for your onward action and submission.

The no. of copies enclosed for various parties are as follows:

- i) 4 hard copies and 1 electronic copy for submission to EPD,
- ii) 1 hard copy to AECOM for record, and
- iii) 1 hard copy for your onward submission to DSD for record.

Yours faithfully,
For and on behalf of
Kwan Lee - Kuly Joint Venture


K.C. Lau
Site Agent

KCL/ KCL/cl
Encl. (6-Hard copies and 1- electronic copy)

c.c.

AECOM head office	-	Attn.: Mr. Joseph Ho	(w/o encl.)
Asia Ecological Consultants Ltd.	-	Attn.: Mr. Michael Leven	(w/e)
Environmental Pioneers & Solutions Ltd.	-	Attn: Mr. William Law	(w/e)
Environ Hong Kong Ltd.	-	Attn: Mr. Tony C.M. Cheng	(w/e)

**Responses to EPD’s comments on Habitat Compensatory Plan (HCP) for
 Ecological Compensation Area (Revision 1) (July 2010)
 (Letter reference no.: (7) in EP2/G/1/117 Pt.5)**

Highlighted item	Description	AEC’s responses
1.	<p><u>Section 4.1.8</u> A strip of area of 0.09 ha at the northeastern boundary of the ECA is proposed for woodland planting as well as serving as receptor site for transplanted trees. While there were already trees existed in the area and in view of the small size of the area, the consultants should review to confirm if the area is large enough for the purposed.</p>	<p>According to the submitted Landscape Plan for works area under Contract 1 (first submission to EPD in June 2010), around 30 existing trees in the ECA and 20 small- to moderate-sized (with height less than 7.5m) will be retained and transplanted to this strip of 0.09ha of land. The final receptor site will be justified on-site during the transplantation but the receptor site for these transplanted trees will mainly concentrate in areas with more open space in the northern and northeastern parts of this area. Besides, approximately 10 – 15m will be retained for these trees according to the current estimated tree number in this land, hence the area should be enough for the retained and transplanted trees.</p>
2.	<p><u>Section 4.1.9</u> Regarding the proposal of sitting the entrance of the ECA in LCSD’s nursery, prior consent of LCSD should be sought.</p>	<p>A formal letter was issued to inform LCSD for the details of the location of the entrance point to the ECA. The exact entrance location to the ECA will be finalized upon receipt of LCSD’s confirmation. Please refer to Figure 7 for details.</p>
3.	<p><u>Section 6.1.1</u> AFCD had agreed with DSD in the past that AFCD would only take up the maintenance of the ECA for the first five years after its establishment period. After that, the need of maintenance of the ECA would be subject to further review and availability of resources. As such, “After the establishment period management and maintenance...” should be revised to read as “After the establishment period, maintenance will be undertaken by AFCD, and a statement “The need for extension of the maintenance of the ECA would be</p>	<p>Noted. Text amendment has been made.</p>

Highlighted item	Description	AEC’s responses
	subject to further review.” Should be added at the end of the section.	
4.	<p><u>Table 5</u> <i>Paederia scandens</i> is native plant species, which could provide nectar source for butterflies. As such, it should not be considered as undesirable plant species.</p>	<p>Noted. Text amendment has been made to exclude <i>Paederia scandens</i> as undesirable plant species.</p>
5.	<p><u>Figures 1 to 3</u> It is gathered from the figures that the woodland tree and shrub planting area is rather steep and uneven, which may be difficult for planted trees and shrubs to establish. The consultants should consider to reprofile the planting area and reduce its gradient as far as possible.</p>	<p>In order to fulfill the EP condition and Particular Specification Section 30 of the captioned project, the ECA should be designed to include an area of wetland (including an open pool and shallow marshy area) not less than 0.8ha. As such, a wetland area of 0.75ha (including open water, intertidal mudflat, mangrove and brackish marsh herbs) is proposed in the HCP. Due to this design constraint, only a total of 0.37ha of land is remained for planting and transplanting trees and shrubs for compensation of tree loss and landscape purpose. Reducing the slope gradient by increasing the wooded area towards the wetland habitats is not preferred due to the abovementioned design constraint. Besides, the wooded area is designed with a maximum gradient of 1 in 6, which is suitable for pit planting of trees. Please refer to the updated Figures 3.1 and 3.2 for clearer illustration of the cross-section of the ECA.</p>

KWAN LEE – KULY JOINT VENTURE

Ref: Condition 2.5 of Environmental Permit No. EP – 303/2008

Submission of
Habitat Compensatory Plan (HCP)
for
Ecological Compensation Area
under
Environmental Permit Requirements
(Revision 2)

Prepared by: Michael Leven (Date: 31/8/2010)
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Cheng Chi Ming
Independent Environmental Checker
Environ Hong Kong Limited

**CONTRACT NO. DC/2009/22 -
DRAINAGE IMPROVEMENT WORKS IN
SHUEN WAN, TAI PO, CONTRACT 1 -
DESIGN & CONSTRUCTION OF
ECOLOGICAL COMPNSATORY AREA**

**HABITAT COMPENSATORY PLAN
(REVISION 2)
August 2010**

**CONTRACT NO. DC/2009/22 -
DRAINAGE IMPROVEMENT WORKS IN SHUEN
WAN, TAI PO, CONTRACT 1 -
DESIGN & CONSTRUCTION OF ECOLOGICAL
COMPNSATORY AREA**

**HABITAT COMPENSATORY PLAN
(REVISION 2)**

August 2010

Prepared by: Dr Michael Leven

Verified by: Dr Michael Leven

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Date: 31/8/2010

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1 INTRODUCTION

1.1 Background

- 1.1.1 The Sha Tin and Tai Po Drainage Master Plan Study, which was completed in October 1999, indicated the hydraulic capacity of some stormwater drains and natural watercourses in the Sha Tin and Tai Po areas did not meet the flow requirement. Various construction and improvement works were proposed to reduce the risks and fulfil the development needs as identified in the Study, including the drainage improvement work at Shuen Wan.
- 1.1.2 The proposed drainage improvement work at Shuen Wan involves a construction of twin-cell box-culvert along Tung Tsz Road which leads to the loss of marsh (0.3 ha) and secondary woodland (0.08 ha) and impact on several individuals of Hong Kong Pavetta *Pavetta hongkongensis*. Compensation for the habitat loss is required and Hong Kong Pavetta is proposed to be transplanted. It was decided to use an existing recreational fishpond of low ecological value as the Ecological Compensatory Area (ECA) (as shown in **Figure 7.2** of the EIA report (Register No. AEIAR-110/2007)).
- 1.1.3 The compensatory pond was proposed to be re-profiled to provide an area of shallow water (with water depth at about 15-50 cm) and open water area (with water depth at about 50-150 cm). Trees and shrubs were also proposed to be planted along the south-eastern bund of the pond to reduce disturbance to wildlife from the adjacent recreational fishpond. The design of the ECA should be self sustainable in the long term with inter-tidal characteristics.

2 DESCRIPTION OF THE PROJECT AREA

2.1 Location and Environs

- 2.1.1 The ECA will be formed from an existing recreational fishpond to the northeast of Shuen Wan Conservation Area, which consists mainly of marsh and pond. The pond is located to the north of Wai Ha River. It is bordered to the north, east and west by a tree nursery, a recreational fishpond and an area of natural mangrove forest respectively.

2.2 Existing Site Conditions

- 2.2.1 Currently, the site of the ECA comprises a man-made fish pond and its immediate surroundings. The bottom of the pond is formed of semi-natural sandy silt sediment. This permeable sediment allows groundwater to seep into the pond. The pond banks are artificial vertical brick/concrete walls and the surroundings of the pond are paved with concrete. The concrete extends to the site boundary on all but the north side where there is a strip of woodland comprising a mixture of planted and self-sown native and exotic tree species.

2.3 Topography and Hydrology

- 2.3.1 The pond bottom is generally flat and varies between -0.04 and +0.53 mPD. The

surrounding concrete footpath is at +2.02 to +2.73 mPD; which surrounds the pond. The site boundaries are generally at +3.5 to + 4.0 mPD on the north side and +2.9 to +3.5 mPD on the east side. However, on the south side (adjacent to Wai Ha River), although the river banks are at +3.3 to +3.6 mPD, part of the site boundary does not follow the banks but instead bisects the concrete platform around the pond and hence is as low as +2.5 mPD. Similarly, on the west side, where the concrete platform is more extensive, the site boundary is at about +2.3 to +2.7 mPD, rising to c. +3.1 mPD in the southwest. Because of this existing topography it is proposed to acquire additional land by extending the site boundary to the crest of the pond where necessary.

- 2.3.2 Water level of this pond is currently managed by pumping water in and out of the tidal Wai Ha River, input of rainwater and seepage of groundwater.

2.4 Habitats

- 2.4.1 One single habitat type, which was pond, was identified within the ECA in the EIA report (AECOM, 2007). This pond is a recreational fishpond and a concrete footpath/boardwalk entirely covers the pond bunds. Vegetation recorded in this area is limited to planted and self-sown native and exotic trees in tree pits and along the northern boundary and no species of conservation interest was recorded.

3 PERMIT REQUIREMENTS AND PLAN OBJECTIVES

3.1 Permit Requirements

- 3.1.1 As stipulated under the Environmental Permit No. EP-303/2008, the Permit Holder is required to establish the ECA within twelve months after the commencement of the construction of the Project, and conforming to the criteria and requirements set out in the approved Habitat Compensatory Plan. The guiding principles are:

- Provision of a ECA with an area not less than 0.8 ha;
- Establishment of the ECA to be completed within the first 12 months after commencement of the construction.

3.2 Plan Objectives

- 3.2.1 The primary objective of this Habitat Compensatory Plan is to detail the specifications for the habitats and ecological functions to be provided by this area. The ECA will comprise an area of shallow water (with water depth at approximately 15 - 50 cm) and of open water (with water depth at approximately 50 - 150 cm) with brackish marsh and mangroves planted. The design will incorporate inter-tidal characteristics which can support the growth of mangrove and brackish marsh species and should be largely self-sustaining in the long term and management should largely be limited to maintenance works. This would still allow for adaptive management, whereby management practices change in

response to on-site conditions. The water level will be kept below +3.2 mPD during the wet season to avoid flooding to the surrounding infrastructure.

- 3.2.2 The habitat design proposed in this Habitat Compensatory Plan also aims to blend with the surrounding wetland area (i.e. Shuen Wan Marsh), enhance habitat suitability for fauna and diversify the wetland and terrestrial habitats in Shuen Wan Area. In the EIA Report of *Drainage Improvement in Sha Tin and Tai Po* (Register No.: EIA-130/2007), no target species were identified for mitigation for the proposed construction. The designed wetland habitats (i.e. open water, intertidal mudflat, brackish marsh and mangrove) and terrestrial habitats (i.e. woodland and shrub planting) in the ECA would facilitate fauna colonization in the long-term. Ecological monitoring of vegetation and fauna and predicted fauna utilization in the proposed wetland and terrestrial habitats are detailed in **Section 4**.

4 PROPOSED DESIGN FOR THE CREATED WETLAND

4.1 Proposed Design for the Created Wetland

4.1.1 The size of the created wetland will be 1.12 ha. Concept design is shown in **Figure 1** (habitat plan). Within the recreated wetland there will be a gradation in vegetation height, with the tallest vegetation at the fringe of the proposed scheme (to serve as a screen for disturbance from the surrounding area) grading into shorter vegetation at the central part of the recreated wetland area to form a shallow marshy area.

4.1.2 The proposed habitat scheme comprises:

- Open water up to 1.5m in depth with shallow water margins (15 – 50 cm depth);
- Woodland area with a mixture of tree and shrub planting;
- Wooded area with a mixture of existing and transplanted trees;
- Mangrove area with a mixture of local mangrove species;
- Brackish marsh; and
- Intertidal mudflat

Table 1. Proposed habitats in the created wetland.

Habitat	Area (ha)	% of total
Open water (0 – 50cm at low tide)	0.20	17.71
Open water (50 – 150cm at low tide)	0.19	17.06
Intertidal mudflat	0.23	20.28
Mangrove	0.05	4.57
Brackish marsh herbs	0.08	7.00
Wetland subtotal	0.75	66.96
Woodland (trees retained and additional trees transplanted)	0.09	8.28

Habitat	Area (ha)	% of total
Woodland (tree and shrub-planting (including transplants))	0.28	25.10
Woodland sub-total	0.37	33.04
Total	1.12	100.00

Open water

- 4.1.3 An area of open water (0.39 ha) will form a permanent tidal open pool fed with water from the adjacent Wai Ha River. This habitat will be maintained with water up to 1.5 m in depth during low tide. Brackish water will enter the open pool through an opening (channel width 7.6 m and at +1.5 – 2.0 mPD) created on the pond bund along the southwestern side. No emergent or floating vegetation will be planted in this open water area. Once colonised by intertidal invertebrate fauna and fish; the area will be suitable for foraging (and roosting) waders and other wetland birds (such as Egrets).

Intertidal mudflat

- 4.1.4 An intertidal mudflat of 0.23 ha will be formed to create a gentle gradient from the shallow water margin (at +1.5 mPD) to the proposed brackish marsh habitat. An island of intertidal mudflat (at +1.5 mPD) will be formed and surrounded by the open water habitat. Depending upon tide height some or, all, of this habitat will be flooded during high tides. No vegetation will be planted in the intertidal mudflat and this habitat will provide suitable foraging and roosting places for waders and intertidal invertebrates. **Table 2** lists the potential intertidal fauna species that are anticipated to colonize the created intertidal mudflat habitat.

Brackish marsh

- 4.1.5 Four patches of brackish marsh of a total of 0.08 ha will be created along the northeast of the ECA. This area will be gently sloping and bounded by intertidal mudflat, mangrove and wooded area. This habitat will be created to provide additional shallow marshy areas to match with the vegetation characteristic of marshy habitats in Shuen Wan Conservation Area and provide suitable habitats for wetland birds and dragonflies. **Table 2** lists the potential intertidal fauna species that are anticipated to colonize the created brackish marsh habitat. As with the intertidal mudflat, depending upon tide height some, or all, of this habitat will be flooded during high tides.

Mangrove

- 4.1.6 A mixture of mangrove species will be planted in groups along the northeast of the ECA and occupy a total of 0.05 ha of area. This mangrove habitat will be periodically flooded and will provide additional intertidal habitat for brackish fauna and macroinvertebrates. Mangrove species identified in the adjacent Shuen Wan Conservation Area will be selected for planting in the proposed mangrove habitat in the ECA in order to maintain the vegetation characteristics and structure in the area. The size of planted mangrove patches in the ECA is relatively small as

mangrove is not a threatened habitat in the Shuen Wan area and it is considered that more ecological benefit will be derived from creation of the open water and intertidal mudflat habitats. **Table 2** lists the potential intertidal fauna species that should colonize the created mangrove habitat.

Woodland area with trees and shrubs

- 4.1.7 A strip of woodland with an area of 0.28 ha will be formed along the gentle slopes (from +2.0 mPD to +3.5 mPD) surrounding the proposed wetland habitats (including intertidal mudflat, mangrove and brackish marsh). This woodland area will be planted with a mixture of trees and shrubs that can accept occasional flooding and waterlogged soils and are native species commonly found in local wetland areas and the adjacent Shuen Wan Conservation Area, together with individual native trees transplanted from elsewhere in the project area. This habitat will also provide visual screening from human disturbance. The retained and planted trees and shrubs would provide suitable roosting and foraging sites for birds (including egrets and terrestrial birds), reptiles and dragonflies.

Wooded area with retained and (trans)planted trees

- 4.1.8 In a strip of area (0.09 ha) located on the northeastern boundary of the ECA and adjacent to the existing Tung Tsz Nursery, the existing trees (around 30 trees) with comparatively high ecological value (such as *Macaranga tanarius* and *Celtis sinensis*) will be retained. Any trees proposed to be transplanted or for compensation from the latest landscape plan under the first Contract of the Project “Contract No. DC/2009/22 Drainage Improvement Works in Shuen Wan, Tai Po” will be planted in this habitat and an area of approximately 0.03 ha will be retained in reserve as a receptor site for any trees to be transplanted under the second contract of the project. The latter will mainly include any Hong Kong *Pavetta* *Pavetta hongkongensis* which requires to be transplanted as a consequence of the project.

Table 2. Potential Intertidal Fauna in the ECA.

Specific Name	Common Name	Mangrove	Brackish Marsh	Intertidal Mudflat
Chordate	Fish	+	+	+
Echinoderm	Starfish			+
Crustacean				
<i>Alpheus</i> spp.	Pistol Shrimp			+
<i>Balanus</i> spp.	Barnacle	+		+
<i>Hemigrapsus</i> spp.	Grapsid Crab	+	+	+
<i>Mictyris longicarpus</i>	Soldier Crab			+
<i>Scopimera globosa</i>	Sand Bubbler Crab			+
<i>Scylla paramamosain</i>	Mangrove Mud Crab	+	+	+
<i>Uca</i> spp.	Fiddler Crab			+
Various species	Sesarmine Crab	+	+	+
Mollusc				
<i>Saccostrea cucullata</i>	Rock Oyster	+		+
<i>Grafrarium pectinatum</i>	Mangrove Clam			+
<i>Isognomon isognomum</i>	Hammer Oyster	+		+
<i>Septifer virgatus</i>	Purplish Bifurcate	+		+

Specific Name	Common Name	Mangrove	Brackish Marsh	Intertidal Mudflat
	Mussel			
<i>Batillaria</i> spp.	Sand Snail	+	+	+
<i>Clithon</i> spp.	Clithon	+	+	+
<i>Cerithidea</i> spp.	Mud Snail	+	+	+
<i>Littoraria sinensis</i>	Periwinkle	+		
<i>Nerita</i> spp.	Nerita	+	+	+
<i>Terebralia sulcata</i>	Large Mangrove Snail	+		
Annelid	Polychaete			+
Echiuran	Innkeeper Worm			+
Nemertean	Ribbon Worm			+
Turbellarian	Flatworm			+
Cnidarian	Sea Anemone			+

Note:

- It should be noted that recolonization is a dynamic process and the above list is indicative only.

- 4.1.9 For maintenance purposes and to prevent unauthorized access into the ECA after the completion of the wetland construction, a proposed chain-link fence will be established to surround the boundary of the whole ECA (**Figure 7**). The existing Tung Tze Nursery fence along the northeastern and eastern boundaries of ECA will be shared with the ECA in the future. A gate is proposed to be formed at this northeastern boundary for future pedestrian access for regular maintenance and monitoring of the ECA, and the exact location of the entrance gate will be finalized upon receipt of LCSD's confirmation. The existing fence along the southeastern boundary of the ECA belongs to the pond owner of the adjacent recreational fishpond. An additional boundary fence surrounding the southeastern boundary of the ECA will be erected here and will run in parallel with this existing fence. New fences will be constructed along the remaining northern, western and southern sides of the ECA.

5 IMPLEMENTATION

5.1 Substrate Investigation

- 5.1.1 Quantities of materials to be moved, removed or imported from the site are currently based on estimates from visual inspection. Prior to commencement of construction works the following investigation of substrate should be conducted:

- Soil test pits 0.5 m diameter and 0.25 m² should be dug at five locations on the pond floor (as shown in **Figure 1**) to check that there is at least 10 cm of wetland soil and that there are no significant quantities of other foreign materials (e.g. metals, plastics, glass, construction waste etc.) present.

Check of soil in the test pits will be conducted by the Wetland Ecologist and will comprise a simple visual inspection to verify that underlying soils are of similar physical characteristics to those which are exposed on the pond surface. No *in situ* or laboratory physical or chemical tests are necessary.

Note that soil test pits are indicative only of soil conditions and presence of foreign materials. Once the concrete pavement/boardwalk has been removed and once recontouring work commences it may be necessary to adjust requirements for excavation or removal of materials depending upon actual observed conditions at the time.

5.2 Protection of existing trees

5.2.1 During the course of works in the ECA all trees which are to be retained in situ or transplanted should be preserved/protected following practices detailed in the General Specification for Civil Engineering Works (GS), 2006 Edition.

5.3 Removal of foreign materials

5.3.1 Foreign materials (e.g. timber, metals, plastics, glass etc.) should be removed from the site. In order to reduce pressure on landfills, inert construction waste (concrete, brick etc.) may be buried on site subject to the following:

- construction waste is broken up such that no dimension is greater than 10 cm;
- Burial of construction waste shall not be carried out in proposed intertidal areas (i.e. those areas where final elevation will be between +1.5 and +2.0 mPD);
- Burial of construction waste could be carried out where there will be at least 50 cm cover of soil, topsoil or wetland soil once final site levels have been achieved following recontouring.

5.4 Excavation of concrete pavement/boardwalk

5.4.1 All of the existing concrete footpath/boardwalk within the site shall be excavated and the concrete and brickwork removed from site and/or broken up and buried as detailed in **Section 5.3.1** (above).

5.5 Recontouring

5.5.1 Recontouring should be undertaken to meet the levels shown in **Figures 2 and 3.1 - 3.2**.

5.5.2 Prior to commencement of recontouring, existing wetland soil in those areas where proposed future levels are above existing levels should be excavated to a depth of 0.5m and stockpiled for later re-use. The extent of the area from which wetland soils should be excavated is detailed in **Figure 4**.

5.5.3 Desired levels should be achieved by the following means:

- Where proposed levels are existing pond floor levels pond mud should be left *in situ* (Soil Mix 1):
- Where proposed levels are < 0.5 m above existing levels and final levels are to be < +2.0 mPD (i.e. high water mark), required levels should be achieved by

filling with stockpiled wetland soils (Soil Mix 2);

- Where proposed levels are > 0.5 m above existing levels and final levels are to be < +2.0 mPD, required levels should be achieved by filling with subsoil to 0.5 m below required levels covered with 0.5 m depth of stockpiled wetland soils (Soil Mix 3);
- Where proposed levels are < 0.5 m above existing level and final levels are to be > +2.0 mPD (i.e. high water mark), existing material should be removed to a depth of 0.5 m below final levels and final levels should be achieved by filling with topsoil 0.5 m in depth (Soil Mix 4);
- Where proposed levels are > 0.5 m above existing level and final levels are to be > +2.0 mPD (i.e. high water mark), required levels should be achieved by filling with subsoil to 0.5 m below required levels covered with topsoil 0.5 m in depth (Soil Mix 5).

5.5.4 For the connection to the Wai Ha River desired levels will be achieved by excavating from the landward side and finishing as follows:

- Where proposed final levels are < +2.0 mPD excavate to 0.3 m below desired final levels and line with rubble stone (granite) irregular in shape with all dimensions not less than 100 mm and not more than 300 mm (Soil Mix 6);
- Where proposed levels are > +2.0 mPD excavate to 0.5 m below desired levels and final levels should be achieved by filling with topsoil 0.5 m in depth (Soil Mix 4).

Excavated material may be re-used on site so long as it meets the specifications for subsoil and is re-used as sub-soil.

5.5.5 Areas for each Soil Mix and specifications are detailed in **Figure 4** and **Annex 1**.

5.4.6 Once connection has been made with the Wai Ha River a water level marker should be erected in the deepest point of the pool to check that water levels are as predicted. Similarly, water levels should be measured at least three high and three low spring and neap tides to check that the intertidal area is flooding to the desired depths. If necessary, levels will be adjusted to accord with the desired habitat design concept. If such adjustment requires a departure from the contour plan the achievement of the desired habitat concept (i.e. permanently flooded, intertidal and terrestrial zones) will take precedence.

5.6 Planting

5.6.1 Terrestrial and wetland planting to create the required habitats will be undertaken as detailed in **Annex 2**. Some of these plants will be stored in the temporary site nursery area prior to planting. Specifications concerning the preparatory and planting work are given in **Annex 1**.

5.7 Implementation Programme

5.7.1 Wetland construction and planting programme is primarily driven by two factors. Firstly, recontouring work and forming a connection with the Wai Ha River has to be undertaken during the dry season for three reasons: to provide sufficiently dry conditions for earthmoving work; to avoid the need to pump stormwater off the site after heavy rain and to ensure that the formation of the connection with the river is not interrupted by flooding. Secondly, planting is likely to prove much more successful during the wet season. Wetland plants, in particular, are very vulnerable to drying out and planting in the dry season is highly likely to be unsuccessful. The implementation programme is provided in **Table 3** below.

Table 3. Construction and planting programme.

Tasks	2010								2011			
	M	J	J	A	S	O	N	D	J	F	M	A
HCP completion												
HCP approval												
Substrate investigation												
Site clearance												
Main recontouring works												
Check water levels on site												
Final contour adjustments												
Planting												

6 FUNDING AND MANAGEMENT STRATEGY

6.1 Responsibility for Funding, Habitat Creation, Establishment and Management

6.1.1 The Contractor will be responsible for the creation, establishment and management of the ECA during the construction and establishment phases. After the establishment period, maintenance will be undertaken by Agriculture, Fisheries and Conservation Department (AFCD). Funding for annual maintenance cost of \$60,000 will be provided by Drainage Services Department (DSD) for the first 5 years upon completion of the wetland habitat. The need for extension of the maintenance of the ECA would be subject to further review.

6.1.2 The Contractor will employ an appropriately qualified ecologist with wetland design

and management experience who will be responsible as a member of the Environmental Team for supervising implementation of the ECA and for the monitoring during the establishment phase.

7 ECOLOGICAL MONITORING AND MANAGEMENT

7.1 Establishment Phase Ecological Monitoring and Management

7.1.1 Establishment Phase Monitoring in the ECA will be conducted by the ecologist to cover the ecological attributes detailed below. This Establishment Phase Monitoring, which will be conducted by the ecologist employed by the Contractor is required for two reasons (i.e. to inform the Contractor of any remedial measures which he requires to undertake and to provide a baseline for future monitoring and management protocols). This is quite distinct from, albeit complementary to, the Ecological Monitoring and Audit Requirements detailed in **Section 6.14 – 6.17** of the Environmental Monitoring and Audit Manual which cover all area of ecological importance including Shuen Wan Marsh (i.e. Shuen Wan Conservation Area) and Wai Ha River that may be impacted by the Project, and which are required to be undertaken by the Independent Environmental Checker (IEC). Monitoring by IEC will also include verification of monitoring the ECA conducted by the Contractor's ecologist.

Monitoring of habitats types and vegetation cover

7.1.2 Monitoring of habitat types and vegetation cover, as specified in **Table 4**, will be conducted twice during the 12 month establishment period; specifically at the end of the wet season (September 2011) and the end of the subsequent dry season (March 2012) after completion of the planting work. This monitoring aims to determine the exact extent of the wetland habitats and vegetation cover (i.e. open water, intertidal mudflat, brackish marsh and mangrove) during the establishment period and control any excessive colonization of unwanted vegetation in specific habitats. The monitoring data would provide baseline habitat characteristics for the subsequent management agency after the handover of the ECA.

Monitoring of vegetation health

7.1.3 Monitoring on the growth and health conditions of the planted vegetation in various habitats (i.e. brackish marsh, mangrove, woodland areas of planted trees and shrubs, and wooded areas with retained and (trans)planted trees), as specified in **Table 4**, will be conducted on a monthly basis for 12 months following the completion of the planting work in the ECA. This monitoring aims to inspect the growth and health of the planted vegetation, and implement any necessary pest control treatment if an outbreak occurs.

7.1.4 A fixed transect line will be run through the wetland habitats (i.e. intertidal mudflat, brackish marsh and mangrove) and the ecologist will inspect the general growth and health of the planted vegetation along both sides of the transect. Any adverse plant health such as dieback of planted species will be noted and supplemental planting will be arranged. Any signs of pests which cause adverse health problems to the plants will be identified and recorded. Appropriate

treatment would be undertaken if required.

- 7.1.5 A monthly survey on all planted, retained and transplanted trees and shrubs will be conducted within the ECA. All these trees and shrubs will be surveyed and evaluated for their growth and health. Any signs of pest and poor growth of planted, retained and transplanted trees and shrubs will be recorded. Appropriate treatment or removal of pest will be implemented if necessary. Supplemental planting will be arranged if needed.

Monitoring of Water Quality

- 7.1.6 Since there will be free movement of brackish river water in and out of the ECA, water quality in the ECA will be largely dependent on water quality in the river. In this open system it is not appropriate to set specific targets for water quality parameters. Nevertheless, baseline data on water quality, in particular seasonal patterns, would potentially be useful in informing long term management of the ECA. Accordingly, *in-situ* water quality will be measured by the ecologist once per month during the establishment period (i.e. for 12 months) during the establishment period. The following parameters will be monitored:

- Temperature
- pH
- Salinity
- Turbidity
- Dissolved oxygen

- 7.1.7 Additional measurements of these parameters should also be made by the ecologist in response to unexpected events (e.g. algal blooms or fish die-offs) in order to inform remedial management measures.

Monitoring of intertidal fauna

- 7.1.8 As the ECA would largely comprise an intertidal mudflat, monitoring for intertidal fauna will be conducted. Recolonization will take time: accordingly monitoring will be conducted in August 2011 and February 2012 (the fourth and the tenth months after the ECA has been constructed). In general, intertidal survey can be conducted in either a quantitative (i.e. record and count organisms in quadrats along fixed transects) or qualitative manner (i.e. walk through the site with species and relative abundance recorded). In this case, since the most important aim of monitoring is to examine the diversity of the colonising community, it is considered that a walk-through survey is appropriate. In addition, however, besides walk-through surveys, core sampling will also be conducted at different levels to record infauna. It is proposed to collect three samples at each level (low, middle and high) during each monitoring event. The monitoring will be conducted at low tide.

Monitoring of other fauna

- 7.1.9 In addition to intertidal fauna the following fauna groups will be monitored: i avifauna, herpetofauna, fish, odonate and butterflies (aquatic invertebrates will be covered by the intertidal surveys). A specific survey for wild mammals is

considered not necessary; however, if signs of wild mammals are observed (such as footprints) during any field surveys, these should be recorded. Since the site will be intertidal, it is considered not suitable for local amphibian species. Therefore no nighttime survey for detecting mating calls of amphibians is necessary and only daytime surveys are necessary. The monitoring of these faunal groups will generally be conducted on a walk-through survey basis. The surveyor will walk through the site, recording and counting the fauna observed. Microhabitats for herpetofauna will be actively searched. Binoculars will be used to aid identification. As with intertidal surveys, this monitoring will be conducted twice within the establishment period (once in the wet season (August 2011) and once in the dry season (February 2012)).

Table 4. Construction and Establishment Phase Ecological Monitoring by the ecologist for the Shuen Wan ECA.

	Construction Phase Ecological Monitoring	Establishment Phase Ecological Monitoring
Habitat types	Not required.	At six monthly intervals at the end of the wet season (i.e. September 2011) and the end of the dry season (i.e. March 2012) when tide height is <1.5 mPD.
Vegetation cover	Not required.	At six monthly intervals at the end of the wet season (i.e. September 2011) and the end of the dry season (i.e. March 2012) when tide height is <1.5 mPD.
Vegetation health	Monthly check of planted, retained and transplanted trees and shrubs, and planting (once this has commenced).	Monthly check of planted, retained and transplanted trees and shrubs.
Water Quality	Following filling with water monthly for <i>in situ</i> water quality.	Monthly for <i>in situ</i> water quality.
Intertidal fauna	Not required.	At six monthly intervals in wet season (August 2011) and dry season (February 2012).
Other fauna (include avifauna, herpetofauna, fish, odonate and butterfly)	Not required.	At six monthly intervals in wet season (August 2011) and dry season (February 2010).
Site Inspections	Weekly.	Twice per month.

7.2 Review of monitoring programme and consequent adaptive management

7.2.1 Findings of the habitat and vegetation monitoring programme detailed above will be reviewed on a monthly basis (or more frequently if or habitat targets are not being met) during the establishment phase by the ecologist to identify necessary adjustments to the management regime.

7.2.2 In addition, weekly inspections of the ECA and adjacent areas will be conducted during the construction phase and fortnightly during the establishment phase by the ecologist and any events detrimental to the operation of the wetland will be identified and suitable remedial action taken.

7.2.3 The monitoring programme will be sufficiently flexible to allow additional inspections following events which may materially affect wetland function (e.g. typhoons, flooding, pollution events) and the monitoring of subsequent remedial actions.

7.3 Contingency Plan

7.3.1 Should the construction and establishment phase monitoring programme identify that certain criteria (e.g. area of preferred habitats) are not being met; actions will be conducted to improve the habitats. **Table 5** describes the action and limit levels and the action plan. This table is also applicable as a management plan after the establishment phase monitoring. This proposed contingency plan will be subsequently reviewed to maintain the wetland functions and ecology.

7.3.2 The ECA will be influenced by regular tidal movement and stream flow that may wash trash and rubbish into the ECA. The inlet point connecting between Wai Ha River and the southwestern part of the ECA will be lined with rubble stones of irregular shape to reinforce the bank and prevent scour. The presence of these rubble stones would prevent some general solid domestic waste washed into the ECA. However, regular habitat management (e.g. in a quarterly basis) of unwanted vegetation clearance and debris clean-up within the ECA and at the inlet point is required to maintain the health of ECA. Debris clean-up at the inlet point will also be conducted after heavy rainfall and typhoons.

Table 5. Contingency Plan.

Parameters	Action Level	Limit Level	Action
Flooding/storm damage	N.A.	N.A.	Review damage in conjunction with short-term weather forecast. Review damage (e.g. vegetation condition) and determine severity and undertake repairs/modifications to the design.
Area of water in the open water pond at tide height of < 1.5 mPD	< 70 & > 95%	< 60 & 100 %	Action level exceedance: double the monitoring frequency, identify and review the problem. If the problem is likely to deteriorate, the action plan for limit level exceedance should be implemented. Limit level exceedance: re-profiling as required.
Emergent or floating vegetation in the open water pond at tide height of < 1.5 mPD(although it is not proposed to plant emergent or floating vegetation as part of	> 10 %	> 20 %	Action level exceedance: double the monitoring frequency, identify and review the problem. If the problem is likely to deteriorate, the action plan for limit level exceedance should be implemented. Limit level exceedance: manual or mechanical vegetation clearance.

Parameters	Action Level	Limit Level	Action
the restoration process, it is to be expected that these will colonise the wetland over time)			
Woodland area with a mixture of planted trees and shrubs; wooded area with retained and/or (trans)planted trees	< 80%	< 70%	Action level exceedance: review tree status and growth. If the problem is likely to deteriorate (such as dead trees, shrubs or >50% diseased leaves in tree canopy), the action plan for limit level exceedance should be implemented. Limit level exceedance: undertake supplemental tree and/or shrub planting.
Emergent, mangrove propagules or unwanted vegetation in the intertidal mudflat (it is expected that such vegetation will colonize the wetland over time)	> 20%	> 30%	Action level exceedance: double the monitoring frequency, identify and review the problem. If the problem is likely to deteriorate, the action plan for limit level exceedance should be implemented. Limit level exceedance: manual or mechanical vegetation clearance.
Brackish marsh vegetation cover	< 80%	< 70%	Action level exceedance: double the monitoring frequency, identify and review the problem. If the problem is likely to deteriorate (such as dead plants or invasion of undesirable plant species), the action plan for limit level exceedance should be implemented. Limit level exceedance: carry out weeding or planting.
Undesirable plant species (all wetland) including unwanted terrestrial species and exotics (including but not limited to exotic, invasive climbers <i>Mikania micrantha</i> , <i>Ipomoea aquatica</i> , <i>Ipomoea cairica</i> , <i>Eichhornia crassipes</i> and <i>Typha angustifolia</i> .	> 10% of vegetation in the ECA	> 20% of vegetation in ECA	Action level exceedance: removal by weeding. Limit level exceedance: removal by weeding, if problem is likely to return/deteriorate review design and management regime.
Undesirable fauna including invasive/exotic aquatic invertebrates (including but not limited to Red Imported Fire Ant)	Presence	Negatively impacting wetland function	Action level exceedance: treatment or removal (or other method if suitable). Limit level exceedance: increase frequency of treatment or removal (or other method if suitable), review management protocols and design.

7.4 Monthly Monitoring Reports

- 7.4.1 The data obtained from the establishment monitoring programme will be used to inform adaptive management measures. Monitoring data and information regarding adaptive management measures undertaken will be submitted to the Environmental Team Leader for inclusion in Monthly and other EM&A Reports, as detailed in the EM&A Manual of the EIA Report (Register No. AEIAR-110/2007).

7.5 Post-establishment Phase Ecological Monitoring and Management

- 7.5.1 Characteristics for habitats to be maintained within the ECA following the Establishment Phase are provided below. These prescriptions for habitat characteristics are based on the guiding concepts listed in **Section 3.2**, the surrounding habitat characteristics (such as Shuen Wan Conservation Area and Wai Ha Stream) and habitat conditions which have been successfully followed in managed wetland elsewhere in Hong Kong. These prescriptions are intended to provide clear directions to inform the practical adaptive habitat management process. Thus, the values proposed do not represent exact targets which must be reached in order to achieve a specific threshold; rather they are indicative of workable objectives which it is known can be achieved on a regular and replicable basis by the management agency. They are, moreover, carefully selected in order to determine the proportion of each habitat on site so that the required balance of habitats (for example between intertidal mudflat and open water) can be monitored and maintained.

Open water

- area of open water within the ECA is partially dependent on the tidal movement;
- shallow water zone maintained at 0 – 0.5m deep at low tide;
- deep water zone maintained at 0.5 – 1.5m deep at low tide;
- naturally established emergent or floating vegetation < 10 % cover;
- undesirable flora species < 10% of vegetation cover.

Intertidal mudflat

- > 80% bare intertidal mudflat;
- < 20% vegetation cover of which <10 % undesirable flora species;
- requires quarterly removal of seedlings of any naturally established mangrove species.

Brackish marsh

- at least 80% with vegetation cover of which the emergent and other wetland species would be the dominant species;
- undesirable flora species < 10 % of vegetation cover and quarterly removal of any naturally established mangrove seedlings and other unwanted vegetation as required.

Mangrove

- at least 80% of area covered by mangrove species;
- undesirable flora species < 10 % of vegetation cover.

Woodland area with trees and shrubs

- > 80 % tree canopy cover, with planted shrubs underneath;

- undesirable flora species < 10 % vegetation cover.

Wooded area with retained and (trans)planted trees

- > 80 % tree canopy cover;
- undesirable flora species < 10 % vegetation cover.

Fauna colonization of the ECA

- Bi-annual fauna monitoring of intertidal fauna, avifauna, herpetofauna, fish, odonate and butterfly will be conducted to examine the colonization and utilization of the created wetland. The long-term monitoring would provide a useful measure of success of the habitat creation. Survey protocol will follow the same protocol as in the establishment period (See **Section 7**).

- 7.5.2 Habitat characteristic prescriptions will be reviewed in the light of experience gained during the Establishment Phase and, if appropriate will be adjusted prior to handover to the long-term management agency.

7.6 Hydrological Management

- 7.6.1 Water level and quality in the ECA will depend on the water input of rainwater, water diverted from Wai Ha River (by connection of the ECA and the River) and the groundwater table. Water level will reach approximately + 2.0 mPD during spring tides; water level will remain at up to +1.5 mPD within the ECA during low tide forming a permanent open water pool.

- 7.6.2 Operational water levels will be between 1.5 m and 2.0 m depth. Maximum water depth in the deepest part of the pond will be 2.0 m when the wetland is at full water capacity during spring tides, while up the minimum depth in the deepest part of the pond will be 1.5 m at low tides. Rubble stone will be placed at the linkage of ECA to Wai Ha River where it is exposed to frequent tidal action to prevent the wash-off of sediment (see **Figure 5**) and ground level of +1.5 mPD can be maintained.

- 7.6.3 As is shown in **Figure 2**, a bund will be formed on the three sides of the ECA not facing the Wai Ha River. Maximum bund height on these sides of the ECA will be +3.5 mPD. Thus, even in a scenario where rain and/or exceptionally high tides result in water levels being temporarily higher than the designed maximum operational level of approximately +2.0 mPD there will be no additional flood risk to surrounding areas caused by the wetland; indeed flood risk will be reduced slightly as a function of the wetland's water retention capacity. Tree and shrub species proposed to be planted in the woodland area are species which can tolerate waterlogged saline soils and occasional flooding.

7.7 Vegetation management

- 7.7.1 Vegetation management will be required to achieve two fundamental aims; to maintain a suitable wetland plant community and to prevent colonization of terrestrial plants and/or unwanted exotics. For monitoring intensity and programme, see **Section 7.8**.

- 7.7.2 In accordance with the guiding concept of creating the ECA as a largely self-sustaining system with minimal maintenance works, vegetation management in the ECA will be limited to periodic inspection of vegetation composition and removal of unwanted plant species as required.
- 7.7.3 The control of emergent/floating vegetation and unwanted flora species in the open water and intertidal mudflat will be required on a quarterly basis in order to maintain the habitat characteristics described in **Sections 4.1** and **7.5**. Without such management, common and rapidly colonizing vegetation such as mangrove propagules (widespread mangrove and mangrove associate species such as *Kandelia obovata* and *Acanthus ilicifolius*), grass (such as *Brachiaria mutica* and *Panicum maximum*) and other floating herbs such as *Ipomoea aquatica* and *Eichhornia crassipes* may become established. Uncontrolled colonization by such vegetation will reduce the habitat diversity in the ECA and subsequently influence faunal colonization. Some of these species (especially mangrove propagules) may also invade the adjacent brackish marsh and further change the overall habitat characteristics. Hence, such quarterly vegetation management is required (to minimize disturbance as it is preferable to have low levels of regular disturbance than intermittent high levels of disturbance).
- 7.7.4 Quarterly vegetation management in the brackish marsh habitat is required. This will involve manual removal of unwanted creeping climbers (such as *Mikania micrantha*, *Ipomoea aquatica* and *Ipomoea cairica*), mangrove propagules and invasive herbs such as *Typha angustifolia*. Colonization by reed *Phragmites* spp. should be also carefully controlled by regular removal as it would out-compete the established brackish marsh areas in time. Since the brackish marshy species could spread into the intertidal mudflat through seeding and vegetative reproduction, any new colonization by the brackish marsh in the intertidal mudflat should be managed in a biannual basis and control of its spread is required if necessary.
- 7.7.5 Any unwanted invasive climbers such as *Mikania micrantha* and *Ipomoea cairica* found in the proposed mangrove habitat should be removed manually (including removal of roots) on a quarterly basis. Pruning of trees and shrubs in the proposed woodland areas will be required in order to prevent encroachment into adjacent habitats. This will be required on an annual basis and will be undertaken at the end of the wet season. Wherever possible, dead trees, branches and shrubs will be retained. Cuttings from trees and shrubs will be placed in neat piles where they will be permitted to decompose naturally, providing refugia for reptiles and amphibians.
- 7.7.6 One aim of the vegetation management will be for all cut vegetation to be recycled on site with no vegetation being sent to landfills; as discussed above this will be achieved through decomposition.

7.8 Maintenance and Management Schedule during Post-establishment Phase

- 7.8.1 A list of standard maintenance and management actions that must be undertaken for the wetland is detailed in the Schedule in
- 7.8.2 **Table 6.**

Table 6. Maintenance and Management Schedule for the ECA during the Post-establishment Phase.

Action	Frequency	Notes
Structural maintenance		
Inspect condition of bunds and repair / maintain as necessary	Annual inspection.	Also after any flood events/ typhoons. Repair/maintenance of bunds will only be carried out if necessary.
Vegetation management		
Supplemental planting	Requirement to be assessed annually.	Supplemental planting will be required only by considering the health status of the wetland vegetation, trees and shrubs after the bi-annual monitoring. Planting to be restricted to the wet season; monthly inspection on any newly planted vegetation should be conducted in the first three months to monitor their survival and establishment rates in early planting period.
Monitoring the health of trees and shrubs, vegetation cover, pruning and removal	Bi-annual monitoring of vegetation cover and health; Annual pruning of trees and shrubs if necessary in the whole ECA.	Annual pruning of trees and shrubs will be conducted only if necessary.
Removal of exotic / undesirable invasive plants (including algae, unwanted terrestrial species and exotics) (weeding)	Quarterly checking of unwanted vegetation in particular wetland habitats (i.e. open water, intertidal mudflat, brackish marsh and mangrove) with removal to be scheduled in subsequent 30 days.	Aggressive exotics such as floating herb <i>Eichhornia crassipes</i> and emergent herb <i>Typha angustifolia</i> to be removed immediately. Any significant number of established mangrove seedlings in intertidal mudflat and open water to be removed immediately.
Control of excessive colonization of brackish marsh in the adjacent intertidal mudflat	Quarterly checking of any excessive colonization of brackish marsh vegetation with removal to be scheduled for subsequent 30 days.	Removal of excessive colonization of brackish marsh will be conducted on a case-by-case basis.
Monitoring of intertidal fauna, avifauna, herpetofauna, fish, odonate and butterfly	Bi-annually.	
Pest control	Quarterly check for presence of pests.	Review and consider appropriate treatment on a case-by-case basis.

7.9 Quarterly Monitoring Reports for Post-establishment Phase

- 7.9.1 Results of habitat and vegetation monitoring and management actions undertaken should be documented and reported on a quarterly basis.

8 REFERENCES

AECOM. 2007. Agreement No. CE 50/2001 Drainage Improvement in Shatin and Tai Po Design and Construction EIA Report. AECOM, Hong Kong.

Annex 1. Shuen Wan ECA Landscape Softworks & Establishment Works: Specification

1. MATERIALS

1.1 Trees shall have the following characteristics:

- a) Well-balanced branching head or well-defined straight and upright leader with branches growing out from the reasonable symmetric stem according to species;
- b) Well-developed vigorous root system;
- c) Stem diameter exceeding 75mm measured at a height of 1m from the root collar;
- d) Total height above the root collar exceeding 3500mm;
- e) A rootball of at least 750mm in diameter and 400mm deep;
- f) Grown and supplied in a container at least 750mm in diameter and 600mm deep;
- g) Free of any pest, fungi and disease.

1.2 Shrubs shall have the following characteristics:

- a) Well-developed vigorous root system;
- b) Height above soil level not less than 300mm;
- c) Grown and supplied in a container at least 125mm in diameter and 150mm deep;
- d) Free of any pest, fungi and disease.

1.3 Herbaceous plants shall have the following characteristics:

- a) Well-developed vigorous shoots;
- b) Well-developed vigorous root system;
- c) Healthy and well-developed bulbs, corms, rhizomes or tubers,
- d) Total height above soil level for the emergent wetland vegetation (such as *Acrostichum aureum*, *Cyperus malaccensis*, *Eleocharis dulcis*, *Scirpus mucronatus* and *Scirpus validus*) not less than 500mm; while height for other herbs (such as *Bacopa monnieri*, *Commelina diffusa* and *Lindernia crustacea*) not less than 50mm.
- e) Grown by propagation or as seedlings and supplied in a container at least 125mm in diameter and 150mm deep;
- f) Free of any pest, fungi and disease.

1.4 Grass seed

- a) Supplied true to species and variety and shall not contain impurities except as stated in (b) below. The origin of all the seed and the supplier shall be stated on the containers;
- b) the quality of the grass seed shall be gauged by purity, germination percentage and freedom from weeds. The total weed seed content shall not exceed 0.5% by mass and the total content of other seeds shall not exceed 1% by mass. The germination capacity of each constituent of the mixture over a 7-day test period shall not be less than 80%, and the purity of the mixture shall not be less than 90%.

1.5 Soil mix

- a) Any additional soil mix shall be ready and evenly mixed before delivery onto the Site.

- b) Topsoil mix shall consist of friable, completely decomposed granite and soil conditioner in the proportions of 3:1 by volume. Soil-mix shall be free from grass or weed growth, sticky clays, salt, stones exceeding 50mm in diameter, waste and other deleterious material.
- c) Any additional soil mix delivered and installed on the Site shall be tested for Nitrogen, Phosphorus and Potassium (N.P.K.) value, organic matter content, cation exchange capacity ratio, organic carbon, pH value, physical content of sand, silt and clay, and water content.

1.6 **Soil Conditioner**

Soil conditioner shall be organic material and shall be free from impurities and substances injurious to plants. Soil conditioner shall have the following properties:

- a) pH value between 5.0 and 7.5;
- b) moisture content between 30% and 50%;
- c) fine and freely flowing consistency;
- d) carbon/nitrogen ratio between 25 and 70;
- e) organic matter content not less than 85% (dry matter);
- f) comprise stable composted material not liable to decompose further generating heat, or peat moss from a specified sustainable source to be approved by the Engineer.

1.7 **Mulch**

Mulch is mainly used in the wooded area (including area of tree and shrub mixture and area of retained and (trans)planted trees). Mulch shall be a mixture of shredded bark and wood chips that are free from impurities and be heavy enough not to be blown or washed away.

Mulch for hydroseeding shall be a proprietary type approved by the Engineer and shall be a hydroseeding mulch manufactured from cellulose or paper-based materials.

1.8 **Fertilizer**

Pre-planting fertilizer shall be 15:9:15:2 (nitrogen/phosphorus/potassium/magnesium) slow-release granular fertilizer or an equivalent approved by the Engineer.

Post-planting fertilizer shall be 12:17:17 (nitrogen/phosphorus/potassium) granular fertilizer or an equivalent approved by the Engineer.

Hydroseeding fertilizer shall be 15:15:15 (nitrogen/phosphorus/potassium) or an equivalent approved by the Engineer.

Fertilizers shall be supplied in sealed waterproof bags under shelter away from water and direct sunlight.

1.9 **Soil binder**

Soil binder shall be a proprietary type approved by the Engineer and shall consist of a binding medium applied in aqueous suspension by spraying onto the surface of the soil. The binding agent shall not be injurious to plant health.

1.10 Stakes and ties

Bamboo tripod staking shall be used as a supplemental measures in soft planting areas for planted and (trans)planted trees. The staking shall comprise three nos. of 25mm diameter x 1800mm long bamboo poles secured to the tree as not to cause any chafing, running or abrasion of the tree or restrict its growth. No excess water shall be stored in the hollow of the bamboo tripod.

The bamboo tripod stakes shall be driven into the ground before planting as not to damage the rootball or aerial parts of the tree. The method of staking shall be subject to approval by the Engineer.

Ties shall be of dark colour and shall be of one of the following materials capable of adjustment after fixing. The ties shall be fitted with flexible rubber or plastic sleeves to prevent chafing, rubbing and abrasion of the plant.

- (a) 5mm diameter rot-proof rope,
- (b) 3mm overall diameter plastic coated wire, or
- (c) 3mm diameter stainless steel braided wire with 20mm adjustable stainless steel screw clamp.

1.11 Protective fabric material (for hydroseeded areas)

Protective fabric material for hydroseeded areas shall be a proprietary type of degradable fabric approved by the Engineer. The fabric shall not degrade within 100 days after application.

1.12 Notices and instruction

In respect to the Landscape Work, the Contractor shall give forty-eight hours notice to the Engineer's Representative, of his intention to commence any one of the following landscape works: soiling, setting out, planting, hydroseeding, fertilizing, visits to carry out Establishment Works.

The Contractor shall undertake any remedial Landscape Works within twenty-four hours of notice by the Engineer's Representative.

1.13 Materials Submissions

The following particulars of the materials for landscape softworks and establishment works shall be submitted to the Engineer at least 14 days before the relevant work commences or before the materials are delivered to site, as agreed by the Engineer:

- (a) origin of trees, shrubs and other plant materials;

- (b) details of nurseries, together with access to nurseries to permit inspection of plant material prior to transfer to site;
- (c) a certificate or a numbered seed analysis report for each grass seed mixture issued within 6 months before the date of use of the seed showing the species and variety of the seed, the date of testing and including results of tests for:
 - percentage germination of pure seed in a fixed time under standard laboratory conditions;
 - percentage composition by weight including details of impurities.
- (d) particulars of the proposed methods and materials for hydroseeding including:
 - species and rate of application of grass seed;
 - type and rate of application of fertilizer, mulch and soil binder;
 - type and colour of dye;
 - type of protective fabric material;
 - details of the equipment to be used.
- (e) a certificate of analysis for soil conditioner including details of the composition and results of tests for:
 - pH value;
 - moisture content;
 - carbon/nitrogen ratio.
- (f) source of water for watering (except rainwater retained and re-used on site);
- (g) a sample of mulch for inspection;

1.14 **Samples of materials**

Samples of the following proposed materials shall be submitted to the Engineer at the same time as particulars of the materials are submitted:

- a) each seed mixture;
- b) individuals of each plant species;
- c) soil mix;
- d) soil conditioner;
- e) mulch;
- f) fertilizer; and
- g) tree stake, tie, tree guy or guying stake.

2. HANDLING, STORAGE AND TRANSPORT

2.1 **Site nursery area**

A site nursery area shall be prepared within the ECA, and approved by the Engineer prior to any plant material being delivered to site. The site nursery area will comprise:

- a) a flat area with sufficient space to contain 10% of the container-grown/containerised stock at any one time;
- b) shade cloth or other cover to reduce exposure of plants to direct sunlight and wind;
- c) irrigation system;

Nursery area shall be kept free of weeds and any materials liable to be injurious to plant health.

2.2 Handling and transport of container-grown and containerised stock

Container grown and containerised stock shall be well watered before despatch from the nursery and shall remain in the containers until required for planting.

Plants shall be wrapped and protected to prevent mechanical damage during lifting and transportation. The trunks from soil level to the lower branches of trees in the heavy standard category shall be securely wrapped to prevent moisture loss using hessian, straw or other material agreed by the Engineer. All plant material which is to be moved while in leaf shall be suitably covered and protected during transport to reduce transpiration.

2.3 Storage of container-grown, containerised stock and herbs

Container-grown and containerised shall be stored upright in the nursery area in their containers until required for planting and regularly watered and checked for presence of parasites or disease. Aquatic herbs should be well-watered in cool, semi-shaded conditions before the planting.

2.4 Storage of trees and shrubs

Trees and shrubs which are not immediately planted in their permanent positions shall be supported upright on the level ground. They shall be maintained with regular watering and in good condition.

2.5 Storage of grass seed, peanut residue and fertilizer

Grass seed and peanut residue shall be stored in bags off the ground in a clean, dry, well-ventilated location free from vermin. Prolonged storage shall be carried out under controlled conditions of temperature and humidity.

Fertilizer shall be stored off the ground in sealed waterproof bags and shall be protected from exposure to conditions which may adversely affect the fertilizer.

3. PRE-PLANTING WORKS

3.1 Preparatory works

Before planting for landscape softworks and establishment works starts, preparatory works shall be carried out by the following methods:

- a) Weeds, rubbish, litter, stones exceeding 50mm diameter and all deleterious material shall be removed from the surface of the ground. Vegetation shall be removed without using herbicide unless permitted by the Engineer. If permitted, the herbicide shall be a proprietary type approved by the Engineer and shall be applied in accordance with the manufacturer's recommendations;
- b) Ground which is contaminated by oil, chemicals or other substances which in the opinion of the Engineer may affect plant growth adversely shall be excavated to 500mm below the contaminated depth and beyond the extent of the contamination. Voids left by excavation shall be filled with uncontaminated soil of the same type as existing.
- c) Soil mix shall be spread and levelled in planting areas as follows:

- **Mix 1**: retaining the existing wetland soil;
 - **Mix 2**: a depth of < 500mm additional stockpiled wetland soil
 - **Mix 3**: subsoil and a depth of 500mm stockpiled wetland soil
 - **Mix 4**: soil mix to a depth of 500mm topsoil
 - **Mix 5**: subsoil and soil mix to a depth of 500mm topsoil
 - **Mix 6**: rubble stone lining
- d) The depth of uncompacted soil mix shall be sufficient to allow the level of the area to comply with finished levels after natural settlement has taken place.
- e) All soiled areas shall be cultivated to a minimum depth of 150mm. Pre-planting fertilizer or soil conditioner shall be spread to a thickness of 50mm over the surface before cultivation;
- f) Stones exceeding 50mm diameter shall be removed from the surface of the soil after cultivation;
- g) Placing and spreading of soil mix shall not take place during periods of heavy rains, nor when the soil mix is saturated. The Contractor shall be responsible for ensuring that the soil mix maintains its specified quality between the time after deposition and the planting operations;
- h) Any excess soil generated from planting pits and not used as backfill, water basins, or in establishing final grades shall be removed by the Contractor from the Site;
- i) Prepared ground shall be protected from compaction, erosion and siltation and shall not be used by construction plant and other vehicular and pedestrian traffic.
- j) Prepared ground which becomes compacted, eroded, silted or otherwise damaged shall be replaced or restored in accordance with methods agreed by the Engineer.
- k) Weeds, rubbish, litter, stones exceeding 50mm and other deleterious material shall be disposed of by the Contractor by methods agreed by the Engineer.

4. PLANTING

Planting for landscape softworks and establishment shall be carried out as stated below.

4.1 Timing of Planting

Unless otherwise permitted by the Engineer, planting shall be carried out between 1st March and 30th April 2011. During the period between planting and the commencement of establishment work, the Contractor shall perform all works for the healthy establishment of plants in accordance with the requirement of the specifications.

4.2 Use of Excavated Material

Material excavated from planting pits which complies with the specified requirements for decomposed granite may be used for soil mix. Material excavated from planting pits which does not comply with the specified requirements for decomposed granite shall be disposed of by the Contractor and shall be replaced by material which complies with the specified requirements for decomposed granite.

4.3 Planting Pits

Diameter of planting pits for heavy standard trees and shrubs should be respectively 200mm and 300mm greater than the rootball or container diameter. 150g and 50g of pre-

planting fertiliser shall be mixed into the soil mix for planting heavy standard trees and shrubs respectively.

The planting pit size for herbaceous plants shall be 100mm greater than the plants' rootball or container diameter and 50mm deeper than their rootballs and containers.

Pits excavated for planting on or adjacent to slopes shall not be left open during wet weather.

4.4 **Planting**

Plants shall be well watered and rootballs of heavy standard trees shall be thoroughly soaked with water for several hours before planting; the soil in the container rootball shall be moist and cohesive. Containers shall not be removed until the time of planting and the rootball shall not be disturbed by loosening or breaking. Planting time for the transplanted and planted trees, shrubs and herbs should be carefully programmed. The final dispatch of the aquatic plants should be arranged to coincide as closely as possible with the scheduled planting time for the aquatic vegetation, and they should be planted within two days of receipt.

Planting areas and planting pits for trees, shrubs and herbs should be accurately marked out before the actual planting work. At the time of planting aquatic herbs, water levels should be at or near the soil surface to facilitate the planting and avoid desiccation damage during the planting process. Each plant (including trees, shrubs and herbs) shall be placed upright in the pit and set at the same level as planted in the container. Soil mix shall be deposited and compacted in layers around the rootball until level with the surrounding ground in such a manner that the rootball is not disturbed. Aquatic plants should be planted and well firmed in the substrate so they are not prone to uprooting and do not float out when water levels are raised. All planted vegetation, especially for aquatic vegetation, shall be well watered to soak the rootball and soil mix immediately after planting.

Staking is not generally required but where, in the opinion of the Engineer, bamboo tripod staking is required for any planted or (trans)planted trees.

4.5 **Mulching**

After planting and watering, mulch shall be spread to a consolidated thickness of at least 50mm on areas of bare ground except in Mix 1, 2 and 3 areas where mulching is not required in the wetland habitats (i.e. open water, intertidal mudflat and brackish marsh).

5. **HYDROSEEDING**

Hydroseeding of grass *Cynodon dactylon* (in Marsh BM/E area) and *Paspalum paspaloides* (in Marsh BM/D area) will be carried out in brackish marsh habitat. The hydroseeded area should be accurately marked out before planting the aquatic vegetation in the same habitat. Hydroseeding for landscape softworks and establishment shall be carried out as stated below.

5.1 **Timing of Hydroseeding**

Unless otherwise permitted by the Engineer, hydroseeding shall be carried out between 1st March and 30st April 2011. If hydroseeding is permitted at other times, changes to the materials and methods of hydroseeding may be required and shall be submitted to the Engineer for approval.

5.2 Hydroseeding Cover

Hydroseeding shall achieve a cover by grass species of at least 90% of the surface area of each 10 m² of the area to be hydroseeded within 100 days from the date of hydroseeding. The grass cover shall be healthy and vigorous and free from perennial and other weeds.

Tests to determine the grass cover shall be carried out 100 days after grassing and at the end of the period for establishment works. The grass shall be cut to a height of 300mm if necessary over the parts of the area to be tested.

The number of tests shall be as instructed by the Engineer, who will conduct the tests.

Tests shall be carried out at locations which in the opinion of the Engineer are representative of the grassed area as a whole. At each test location, an area of 10m² shall be marked.

The percentage of bare ground in each of the test area shall be measured and at least 90% of the test area shall be covered with grass.

If the result of any test for grass cover of landscape softworks and establishment works does not comply with the specified requirements for grass cover, the area shall be hydroseeded or broadcast seeded, depending upon the size and accessibility of the defective area.

5.3 Surface conditions for hydroseeding

The surface to be hydroseeded shall be finished to a coarse open textured surface and shall not be smooth or glazed. Finishing work on slopes by machines shall be carried out across the slope. Vehicle track marks or other marks caused by construction machinery shall not be left parallel to the line of maximum gradient of the slope.

5.4 Application of hydroseeding

Hydroseeding shall be carried out using a proprietary type of hydroseeding equipment to be approved by the Engineer.

Materials for hydroseeding shall be well mixed on the site in the hydroseeding equipment immediately before spraying, ensuring that the seed is not damaged.

Soil binders shall be applied at the rate recommended by the manufacturer, modified as necessary to suit conditions on site. Dye shall be used to demonstrate that adequate cover has been achieved, unless in the opinion of the Engineer runoff may result in watercourses becoming coloured to an unacceptable level.

The hydroseeding mixture shall be constantly agitated during spraying to keep it homogeneous and avoid blockage to pipes. Measures shall be taken during application to ensure that material is not lost due to runoff.

Walking on hydroseeded areas shall be restricted to access for fixing protective material and for patching up.

The area to be treated shall be moistened immediately prior to hydroseeding. After spraying the seeds, the Contractor shall water the hydro seeded areas as often as is required to keep the ground evenly moist.

5.5 **Protective material**

Areas which have been hydroseeded shall be covered with protective material within two days after hydroseeding. The material shall be spiked or stapled to the soil surface with a minimum 150mm overlap.

5.6 **Patching up**

Immediately after germination and a general greening is apparent, areas where in the opinion of the Engineer germination has been unsuccessful shall be resprayed. Areas affected by repairs to washout and gullies and other erosion on slopes shall be resprayed.

Areas which in the opinion of the Engineer are not accessible or are too small for the use of a hydroseeder may be patched up by broadcasting seed. The area shall be lightly scarified with a rake or similar implement and the seed and fertilizer shall be broadcast over the area at a rate of not less than 75g/m². The seed shall be covered by lightly working into the surface or by spreading sufficient soil just to cover the seed. Broadcast seeding shall be carried out using *Paspalum paspaloides* and *Cynodon dactylon* in the respective brackish marsh habitat if the germination or growth of the hydroseeded grasses are unsatisfactory.

5.7 **Post-planting fertilizer**

Post-planting fertilizer shall be applied between 1 and 5 months after application of hydroseed and, unless otherwise permitted by the Engineer shall be applied between 1st June and 30th September 2011.

6. **ESTABLISHMENT WORKS**

Establishment works shall be carried out for the period specified in the Contract and as stated below. All necessary measures shall be taken to ensure that grass, trees and other plants become established and to keep the landscape softworks tidy and free from litter and rubbish.

6.1 **Inspection of establishment works**

An inspection of landscape softworks and establishment works shall be carried out jointly by the Contractor and the Engineer at monthly intervals to determine the establishment works which are required. The Engineer shall instruct the Contractor to carry out

establishment works which in the opinion of the Engineer are necessary; the work instructed shall be completed within 14 days of the Engineer's instruction unless otherwise agreed by the Engineer.

6.2 Replacement of plants and grass

Plants which in the opinion of the Engineer are dead, dying or otherwise unsatisfactory shall be replaced. Replacement planting shall be carried out in season as specified in **Section 4.1** and **5.1**. Plant material should be of a similar size to that already established. Measures shall be taken to ensure satisfactory establishment of the replacement plants before the end of the period for establishment works.

90% cover of the grass area shall be maintained throughout the period for establishment works and the grass shall provide effective cover of 90% of the area at the end of the period for establishment works. The grass shall be healthy, vigorous and free from perennial and other weeds. Areas which in the opinion of the Engineer are unsatisfactory shall be reseeded by hydroseeding or broadcasting. Measures shall be taken to ensure satisfactory establishment of the replacement grass before the end of the period for establishment works.

6.3 Stakes and ties

The Contractor shall be responsible for the security of any stakes and ties throughout the establishment period. An inspection of stakes and ties shall be carried out each month by the Contractor; broken, damaged and other unsatisfactory stakes and ties shall be replaced; ties which are causing chafing or abrasion to the plant shall be adjusted; ties and stakes which are no longer required shall be removed.

6.4 Firming up plants

Plants which become loose as a result of wind rock, soil erosion or activity of water shall be firmed up. The Contractor shall inspect the Site regularly for this purpose and after each storm or typhoon, to assess damage, which shall be reported to the Engineer. Any damaged branches shall be carefully pruned or as required by the Engineer.

6.5 Watering

Fresh water shall be used for watering landscape softworks (i.e. woodland of tree and shrub planting and wooded area of retained and (trans)planted trees). Water shall be applied using a rose or a sprinkler of a type agreed by the Engineer and in such a manner that compaction, washout of soil and loosening of plants will not arise; any damage resulting shall be made good immediately.

All planted areas shall be watered as required to ensure successful establishment of the plants. Plants reaching permanent wilting point shall be watered immediately.

Grass areas shall not be watered.

6.6 Weeding

All grassed and planted areas shall be kept free from weeds throughout the period for establishment works. Any unwanted plants including *Mikania micrantha* found within the Site is considered as weeds and shall be removed by the Contractor once it is identified or when instructed by the Engineer throughout the period for establishment works.

Weeding shall be carried out by hand or by mechanical methods agreed by the Engineer in such a manner that damage to the grass and planted areas will not be caused. All weeds, litter and other rubbish resulting from the weeding operation shall be disposed of by the Contractor.

Planted areas in bare ground shall be weeded to remove all unwanted vegetative growth, including both aerial parts and roots, over the complete area. Planted areas other than in bare ground shall be weeded to remove all competing and overhanging vegetative growth by cutting the growth down to 50mm above soil level.

6.7 **Pruning**

Pruning will generally be required only in order to remove dead, dying or damaged stems or to keep open paths.

Pruning and removal of branches shall be carried out using sharp, clean implements. Pruning shall be carried out with the cut just above and sloping away from an outward facing healthy bud. Removal of branches shall be carried out by cutting outside of a line drawn between the branch bark ridge and the branch collar in such a way that no part of the stem is damaged or torn, leaving no snags or stumps. All cuts shall be made to avoid splintering or tearing of bark that would catch water and encourage rot, and cracks, cavities or rotten wood shall be cut back with a clean, sharp implement to remove the dead, damaged and decayed tissue without damaging the living tissues. Topping shall not be carried out in any circumstances.

6.8 **Grass cutting**

Grassed areas close to and within the proposed wooded area shall be cut by manual or mechanical methods agreed by the Engineer and in a manner that does not cause pulling of roots or damage to planting in or near the grassed area. All cuttings shall be raked off and disposed of within 24 hours after cutting.

All litter exposed by grass cutting shall be gathered up and disposed of within 24 hours. Care must be taken to ensure that grass cuttings placed in open water areas of the ECA do not contain any litter.

6.9 **Post-planting fertilizer**

Post-planting fertilizer shall be applied in the proposed wooded area, as instructed by the Engineer. The fertilizer shall be applied at a rate of:

- a) 100g for each heavy standard tree;
- b) 50g for each shrub;
- c) 40g/m² on grassed areas.

6.10 Control of pests and diseases

The Contractor shall regularly check for any insect attack or fungal infestation particularly during known period of activity. The Contractor should bring to the attention of Engineer any incidents of pests and diseases damaging or threatening planting areas. The Engineer will instruct appropriate treatment, including use of pesticide and fungicide to be applied in accordance with manufacturer's recommendations, at his discretion. The Contractor shall not utilise any herbicide, pesticide or fungicide without the express approval of the Engineer.

6.11 Mulching

All mulch which is disturbed by replacement planting, weeding and watering shall be made good. Additional mulching shall be carried out if instructed by the engineer.

6.12 Completion of work

Immediately before the end of the establishment works:

- a) All tree, shrub and herb planting shall be free of weeds;
- b) All areas shall be free of litter;
- c) All replacement planting and patching up of grass shall be completed;
- d) All unnecessary stakes and ties shall have been removed and any remaining shall be secure; and
- e) All grassed areas shall be cut.

Annex 2. Proposed planting list and Planting Schedule for Shuen Wan Ecological Compensatory Area

Mangrove habitat

Mangrove (MG/A)	Percentage of species (%)
<i>Aegiceras corniculatum</i>	40
<i>Kandelia obovata</i>	60
Total	100

Mangrove (MG/B)	Percentage of species (%)
<i>Aegiceras corniculatum</i>	40
<i>Avicennia marina</i>	30
<i>Kandelia obovata</i>	30
Total	100

Brackish marsh

Marsh (BM/A)	Percentage of species (%)
<i>Cyperus malaccensis</i>	40
<i>Eleocharis dulcis</i>	30
<i>Scirpus mucronatus</i>	30
Total	100

Marsh (BM/B)	Percentage of species (%)
<i>Cyperus malaccensis</i>	15
<i>Eleocharis dulcis</i>	30
<i>Scirpus mucronatus</i>	30
<i>Scirpus validus</i>	25
Total	100

Marsh (BM/C)	Percentage of species (%)
<i>Acrostichum aureum</i>	100
Total	100

Marsh (BM/D)	Percentage of species (%)
<i>Bacopa monnieri</i>	40
<i>Commelina diffusa</i>	30
<i>Lindernia crustacea</i>	20
<i>Paspalum paspaloides</i>	30 (Hydroseeding)
Total	100

Marsh (BM/E)	Percentage of species (%)
<i>Commelina diffusa</i>	35
<i>Cynodon dactylon</i>	60 (Hydroseeding)
<i>Lindernia crustacea</i>	15
Total	100

Marsh (BM/F)	Percentage of species (%)
<i>Cyperus malaccensis</i>	60
<i>Eleocharis dulcis</i>	40
Total	100

Shrub planting

Shrub (SH/A)	Percentage of species (%)
<i>Bridelia tomentosa</i>	25
<i>Clerodendrum inerme</i>	30
<i>Scaevola taccada</i>	45
Total	100

Tree

Tree (TR/A)	Percentage of species (%)
<i>Celtis sinensis</i>	10
<i>Ficus superba</i> var. <i>japonica</i>	10
<i>Hibiscus tiliaceus</i>	30
<i>Litsea glutinosa</i>	15
<i>Macaranga tanarius</i>	15
<i>Sapium sebiferum</i>	20
Total	100

Note:

- 1). No vegetation will be planted in the areas of Open water and intertidal mudflat.
- 2). The sizes of all proposed plant species follow planting material requirement as specified in **Annex 1**.

Summary of Plant Species and Quantities

Species	Form	Total quantities of plant in ECA
<i>Acrostichum aureum</i>	Herb (Fern)	1882
<i>Aegiceras corniculatum</i>	Shrub	618
<i>Avicennia marina</i>	Shrub	255
<i>Bacopa monnieri</i>	Herb	2245
<i>Bridelia tomentosa</i>	Shrub	80
<i>Celtis sinensis</i>	Tree	38
<i>Clerodendrum inerme</i>	Shrub	96
<i>Commelina diffusa</i>	Herb	1369
<i>Cynodon dactylon</i>	Herb (grass)	Hydroseed
<i>Cyperus malaccensis</i>	Herb	1928
<i>Eleocharis dulcis</i>	Herb	1809
<i>Ficus superba</i> var. <i>japonica</i>	Tree	38
<i>Hibiscus tiliaceus</i>	Tree	114
<i>Kandelia obovata</i>	Shrub	672
<i>Lindernia crustacea</i>	Herb	1319
<i>Litsea glutinosa</i>	Tree	57
<i>Macaranga tanarius</i>	Tree	57
<i>Paspalum paspaloides</i>	Herb (grass)	Hydroseed
<i>Sapium sebiferum</i>	Tree	76
<i>Scaevola taccada</i>	Shrub	143
<i>Scirpus mucronatus</i>	Herb	1061
<i>Scirpus validus</i>	Herb	609

Plant Species and Quantities in different planting zones

Mangrove habitat

Planting zones	Mix/ Species	% of plants	Density per m ²	Area (m ²)	Actual quantities (Individuals)
	Mangrove A				
MG/A/001	<i>Aegiceras corniculatum</i>	40	3	133.50	161
MG/A/001	<i>Kandelia obovata</i>	60	3	133.50	241
	Mangrove A				
MG/A/005	<i>Aegiceras corniculatum</i>	40	3	97.40	117
MG/A/005	<i>Kandelia obovata</i>	60	3	97.40	176
	Mangrove B				
MG/B/002	<i>Aegiceras corniculatum</i>	40	3	66.79	81
MG/B/002	<i>Avicennia marina</i>	30	3	66.79	61
MG/B/002	<i>Kandelia obovata</i>	30	3	66.79	61
	Mangrove B				
MG/B/003	<i>Aegiceras corniculatum</i>	40	3	95.11	115
MG/B/003	<i>Avicennia marina</i>	30	3	95.11	86
MG/B/003	<i>Kandelia obovata</i>	30	3	95.11	86
	Mangrove B				
MG/B/004	<i>Aegiceras corniculatum</i>	40	3	55.10	67
MG/B/004	<i>Avicennia marina</i>	30	3	55.10	50
MG/B/004	<i>Kandelia obovata</i>	30	3	55.10	50
	Mangrove B				
MG/B/006	<i>Aegiceras corniculatum</i>	40	3	63.52	77
MG/B/006	<i>Avicennia marina</i>	30	3	63.52	58
MG/B/006	<i>Kandelia obovata</i>	30	3	63.52	58

Brackish marsh

Planting zones	Mix/ Species	% of plants	Density per m ²	Area (m ²)	Actual quantities (Individuals)
	Marsh A				
BM/A/002	<i>Cyperus malaccensis</i>	40	16	34.46	221
BM/A/002	<i>Eleocharis dulcis</i>	30	16	34.46	166
BM/A/002	<i>Scirpus mucronatus</i>	30	16	34.46	166
	Marsh A				
BM/A/006	<i>Cyperus malaccensis</i>	40	16	18.78	121
BM/A/006	<i>Eleocharis dulcis</i>	30	16	18.78	91
BM/A/006	<i>Scirpus mucronatus</i>	30	16	18.78	91

Planting zones	Mix/ Species	% of plants	Density per m ²	Area (m ²)	Actual quantities (Individuals)
	Marsh A				
BM/A/009	<i>Cyperus malaccensis</i>	40	16	14.97	96
BM/A/009	<i>Eleocharis dulcis</i>	30	16	14.97	72
BM/A/009	<i>Scirpus mucronatus</i>	30	16	14.97	72
	Marsh B				
BM/B/005	<i>Cyperus malaccensis</i>	15	16	16.35	40
BM/B/005	<i>Eleocharis dulcis</i>	30	16	16.35	79
BM/B/005	<i>Scirpus mucronatus</i>	30	16	16.35	79
BM/B/005	<i>Scirpus validus</i>	25	16	16.35	66
	Marsh B				
BM/B/008	<i>Cyperus malaccensis</i>	15	16	21.35	52
BM/B/008	<i>Eleocharis dulcis</i>	30	16	21.35	103
BM/B/008	<i>Scirpus mucronatus</i>	30	16	21.35	103
BM/B/008	<i>Scirpus validus</i>	25	16	21.35	86
	Marsh B				
BM/B/012	<i>Cyperus malaccensis</i>	15	16	51.73	125
BM/B/012	<i>Eleocharis dulcis</i>	30	16	51.73	249
BM/B/012	<i>Scirpus mucronatus</i>	30	16	51.73	249
BM/B/012	<i>Scirpus validus</i>	25	16	51.73	207
	Marsh B				
BM/B/015	<i>Cyperus malaccensis</i>	15	16	33.43	81
BM/B/015	<i>Eleocharis dulcis</i>	30	16	33.43	161
BM/B/015	<i>Scirpus mucronatus</i>	30	16	33.43	161
BM/B/015	<i>Scirpus validus</i>	25	16	33.43	134
	Marsh B				
BM/B/018	<i>Cyperus malaccensis</i>	15	16	28.95	70
BM/B/018	<i>Eleocharis dulcis</i>	30	16	28.95	140
BM/B/018	<i>Scirpus mucronatus</i>	30	16	28.95	140
BM/B/018	<i>Scirpus validus</i>	25	16	28.95	116
	Marsh C				
BM/C/001	<i>Acrostichum aureum</i>	100	11	37.91	417
	Marsh C				
BM/C/004	<i>Acrostichum aureum</i>	100	11	28.04	309
	Marsh C				
BM/C/007	<i>Acrostichum aureum</i>	100	11	25.47	281
	Marsh C				
BM/C/010	<i>Acrostichum aureum</i>	100	11	44.91	495
	Marsh C				

Planting zones	Mix/ Species	% of plants	Density per m ²	Area (m ²)	Actual quantities (Individuals)
BM/C/020	<i>Acrostichum aureum</i>	100	11	34.52	380
	Marsh D				
BM/D/003	<i>Bacopa monnieri</i>	40	25	43.02	431
BM/D/003	<i>Commelina diffusa</i>	30	16	43.02	207
BM/D/003	<i>Lindernia crustacea</i>	20	25	43.02	216
BM/D/003	<i>Paspalum paspaloides</i>	30% (Hydro-seeding)	N/A	43.02	N/A
	Marsh D				
BM/D/016	<i>Bacopa monnieri</i>	40	25	181.31	1814
BM/D/016	<i>Commelina diffusa</i>	30	16	181.31	871
BM/D/016	<i>Lindernia crustacea</i>	20	25	181.31	907
BM/D/016	<i>Paspalum paspaloides</i>	30% (Hydro-seeding)	N/A	181.31	N/A
	Marsh E				
BM/E/011	<i>Commelina diffusa</i>	35	16	23.52	132
BM/E/011	<i>Cynodon dactylon</i>	60% (Hydro-seeding)	N/A	23.52	N/A
BM/E/011	<i>Lindernia crustacea</i>	15	25	23.52	89
	Marsh E				
BM/E/014	<i>Commelina diffusa</i>	35	16	15.55	88
BM/E/014	<i>Cynodon dactylon</i>	60% (Hydro-seeding)	N/A	15.55	N/A
BM/E/014	<i>Lindernia crustacea</i>	15	25	15.55	59
	Marsh E				
BM/E/019	<i>Commelina diffusa</i>	35	16	12.58	71
BM/E/019	<i>Cynodon dactylon</i>	60% (Hydro-seeding)	N/A	12.58	N/A
BM/E/019	<i>Lindernia crustacea</i>	15	25	12.58	48
	Marsh F				
BM/F/013	<i>Cyperus malaccensis</i>	60	16	64.62	621
BM/F/013	<i>Eleocharis dulcis</i>	40	16	64.62	414
	Marsh F				
BM/F/017	<i>Cyperus malaccensis</i>	60	16	52.13	501
BM/F/017	<i>Eleocharis dulcis</i>	40	16	52.13	334

Shrub planting

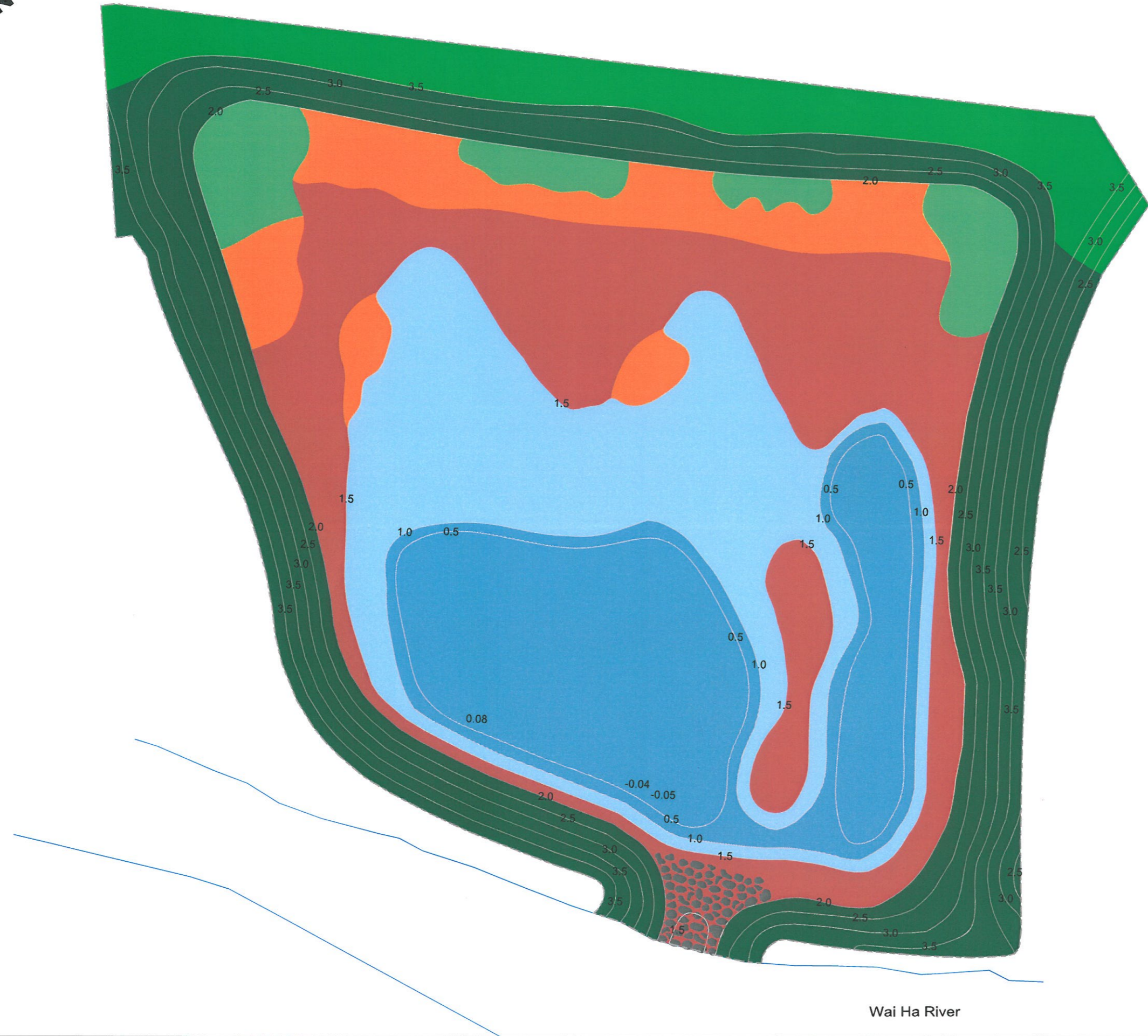
Planting zones	Mix/ Species	% of plants	Density per sq. m ²	Area (m ²)	Actual quantities (Individuals)
	Shrub A				
SH/A/001	<i>Bridelia tomentosa</i>	25	2	28.77	15
SH/A/001	<i>Clerodendrum inerme</i>	30	2	28.77	18
SH/A/001	<i>Scaevola taccada</i>	45	2	28.77	26
	Shrub A				
SH/A/002	<i>Bridelia tomentosa</i>	25	2	64.76	33
SH/A/002	<i>Clerodendrum inerme</i>	30	2	64.76	39
SH/A/002	<i>Scaevola taccada</i>	45	2	64.76	59
	Shrub A				
SH/A/003	<i>Bridelia tomentosa</i>	25	2	38.07	19
SH/A/003	<i>Clerodendrum inerme</i>	30	2	38.07	23
SH/A/003	<i>Scaevola taccada</i>	45	2	38.07	35
	Shrub mix				
SH/A/004	<i>Bridelia tomentosa</i>	25	2	25.31	13
SH/A/004	<i>Clerodendrum inerme</i>	30	2	25.31	16
SH/A/004	<i>Scaevola taccada</i>	45	2	25.31	23

Tree planting (trees to be planted in (1) woodland area of tree and shrub planting and (2) wooded area of retained and (trans)planted trees

Planting zones	Species	% of plants	Density per m ²	Area (m ²)	Actual quantities (Individuals)
TR/A/001	<i>Celtis sinensis</i>	10	0.12	3123.67	38
TR/A/001	<i>Ficus superba</i> var. <i>japonica</i>	10	0.12	3123.67	38
TR/A/001	<i>Hibiscus tiliaceus</i>	30	0.12	3123.67	114
TR/A/001	<i>Litsea glutinosa</i>	15	0.12	3123.67	57
TR/A/001	<i>Macaranga tanarius</i>	15	0.12	3123.67	57
TR/A/001	<i>Sapium sebiferum</i>	20	0.12	3123.67	76

Note:

Approximately 15% of land from the habitats of proposed woodland area of tree and shrub planting and wooded area of retained and (trans)planted trees (a total of 3577.67m² for both habitats) are reserved for (1) the transplanted trees (including the protected species *Pavetta hongkongensis* and other trees of high ecological value) from Contract 2 and Contract 1, and (2) the existing trees in Area C. Detailed transplanting schedule will be provided in the Landscape Plan for this Contract.



- Legend
- Site boundary
 - Existing trees retained and additional trees (trans)planted
 - Woodland tree and shrub planting
 - Mangrove planting
 - Brackish marsh herbs
 - Intertidal mudflat
 - Shallow water 0-50 cm at low tide
 - Deep water 50-150 cm at low tide
 - Natural rubble stone to reinforce bank and prevent scour

Job Title
 Contract No. DC/2009/22 -
 Drainage Improvement Works in Shuen Wan, Tai Po, Contract 1-
 Design & Construction of Ecological Compensatory Area

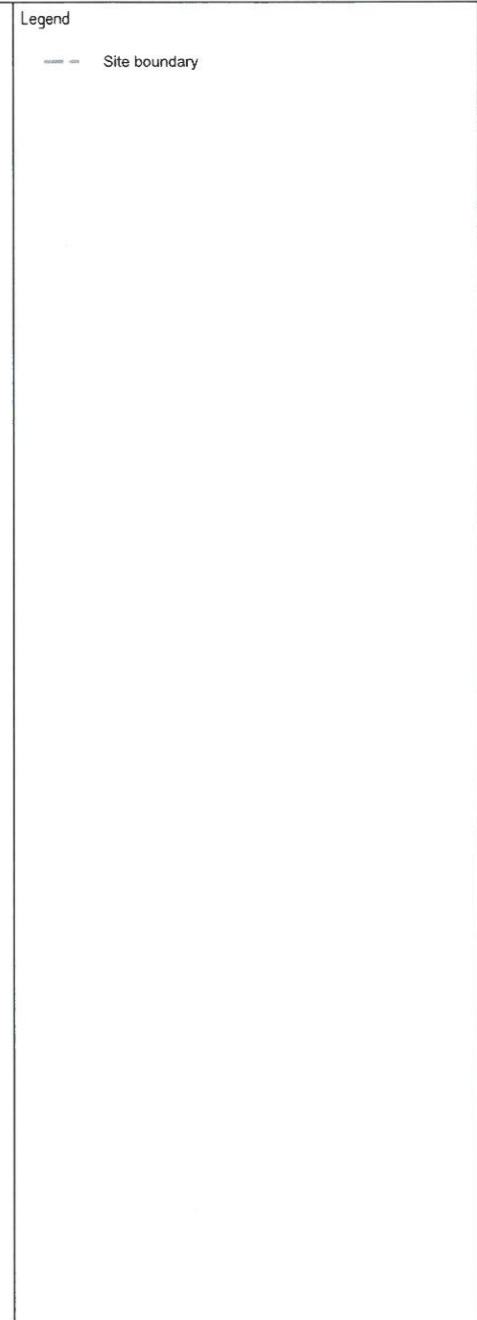
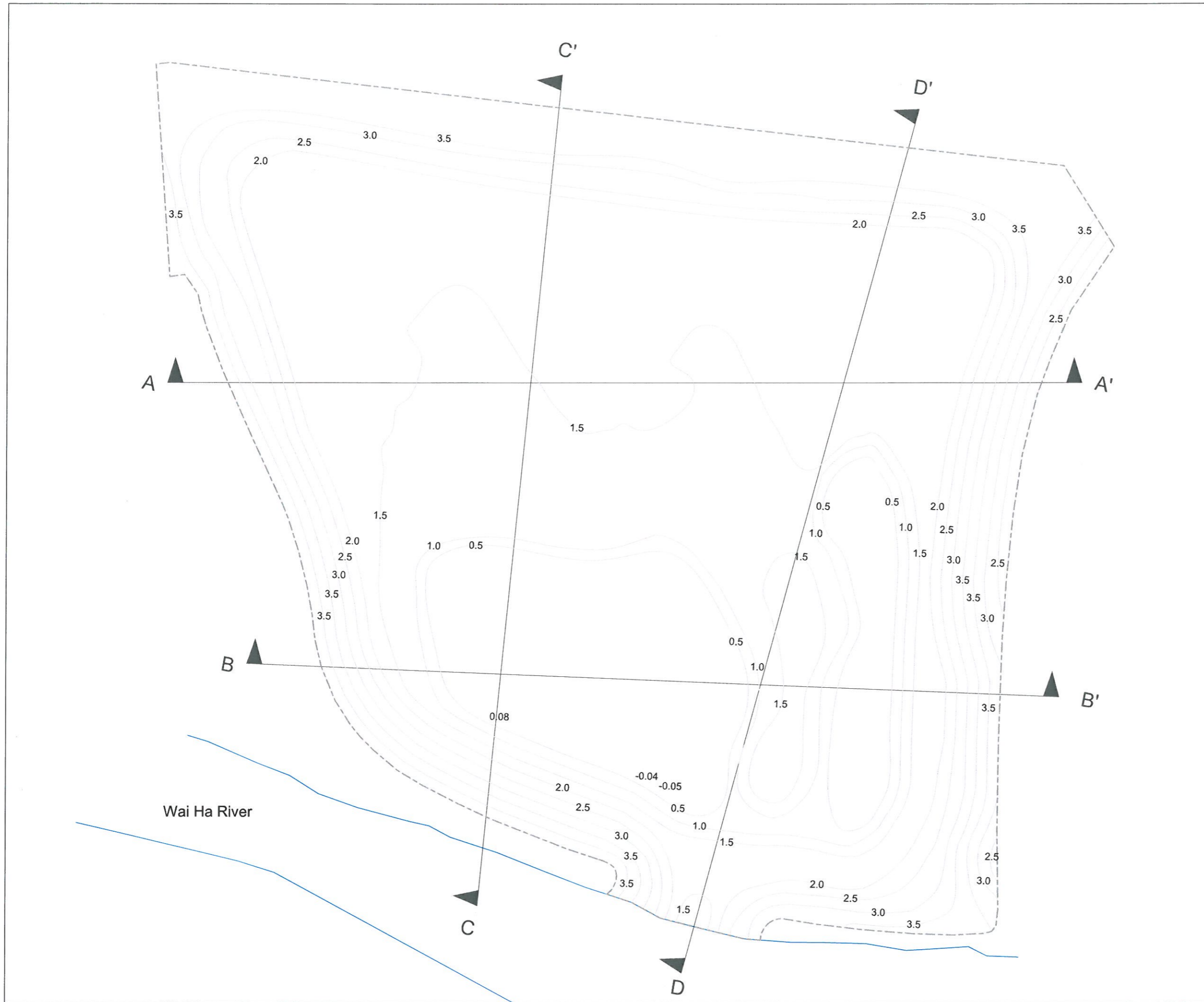
Drawing Title
 Proposed habitat plan of the Ecological Compensatory Area

Drawing No. Figure 1	Project No. 09/317/161
Scale 1:500 @ A3	Date May 2010
Drawn by EW	Rev A
	Checked by MRL

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Wai Ha River



Job Title
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 Drainage Improvement Works in Shuen Wan, Tai Po, Contract 1-
 Design & Construction of Ecological Compensatory Area

Drawing Title
 Proposed contour plan of the Ecological Compensatory Area

Drawing No. Figure 2	Project No. 09/317/161	
Scale 1: 500 at A3	Date May 2010	Rev A
Drawn by EW	Checked by MRL	

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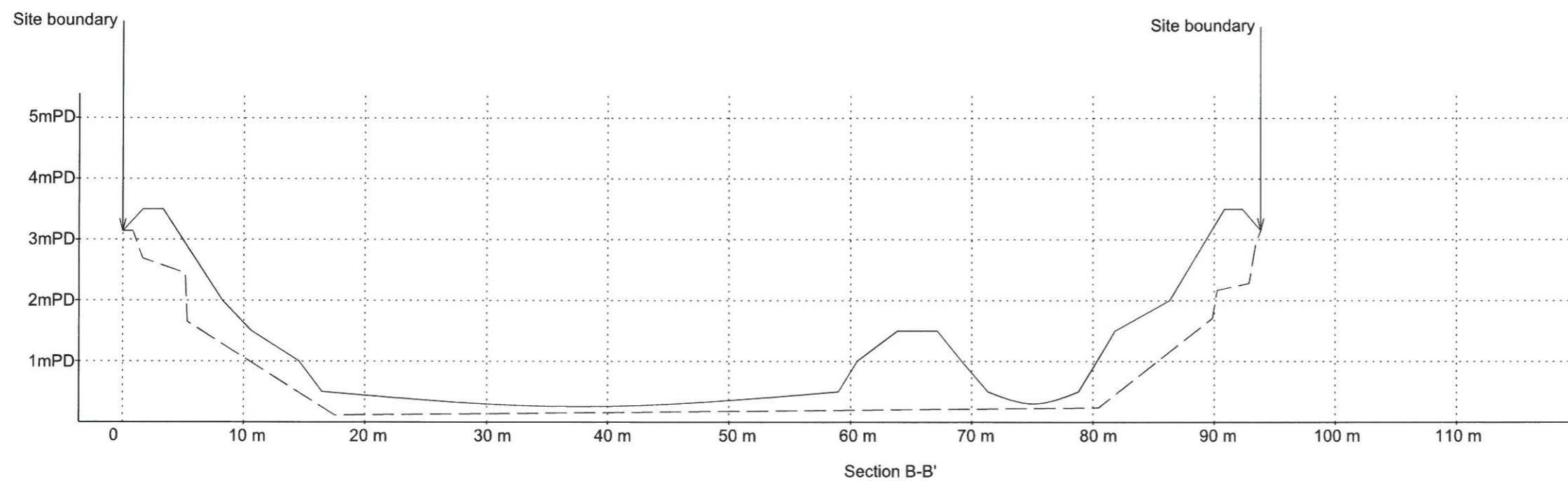
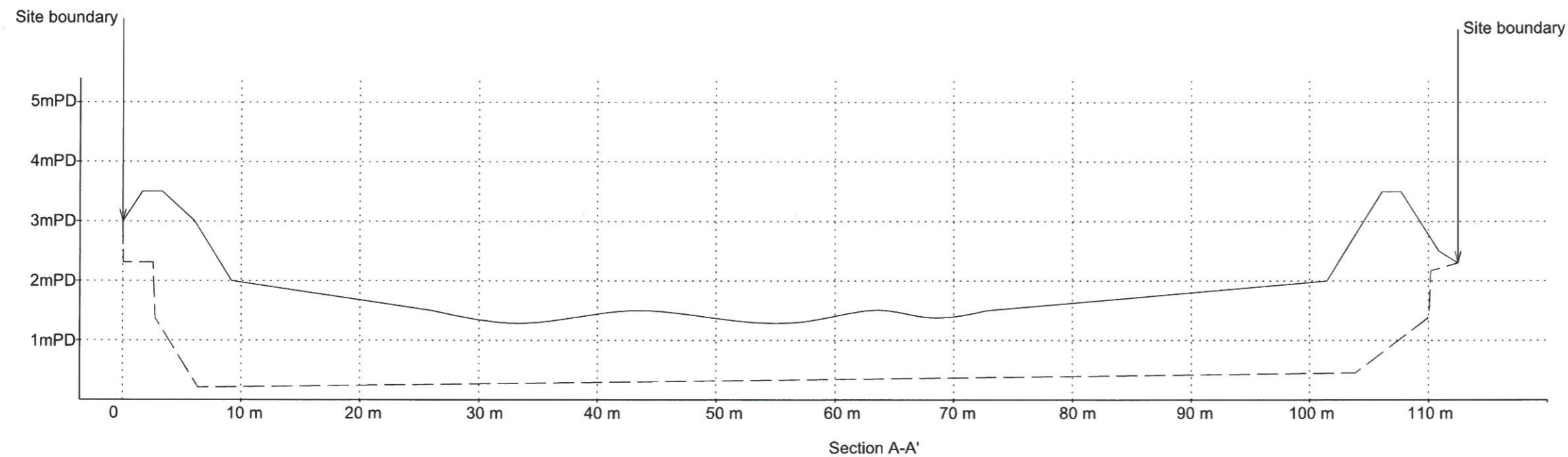
Legend

— Proposed level

- - Existing level

Note:

Vertical scale is exaggerated by a factor of 5 for clarity in setting out.



Job Title

Contract No. DC/2009/22 -
Drainage Improvement Works in Shuen Wan, Tai Po, Contract 1-
Design & Construction of Ecological Compensatory Area

Drawing Title

Existing and proposed levels 1

Drawing No.
Figure 3.1

Project No.
09/317/161

Scale
As shown

Date
Aug 2010

Rev
A

Drawn by
EW

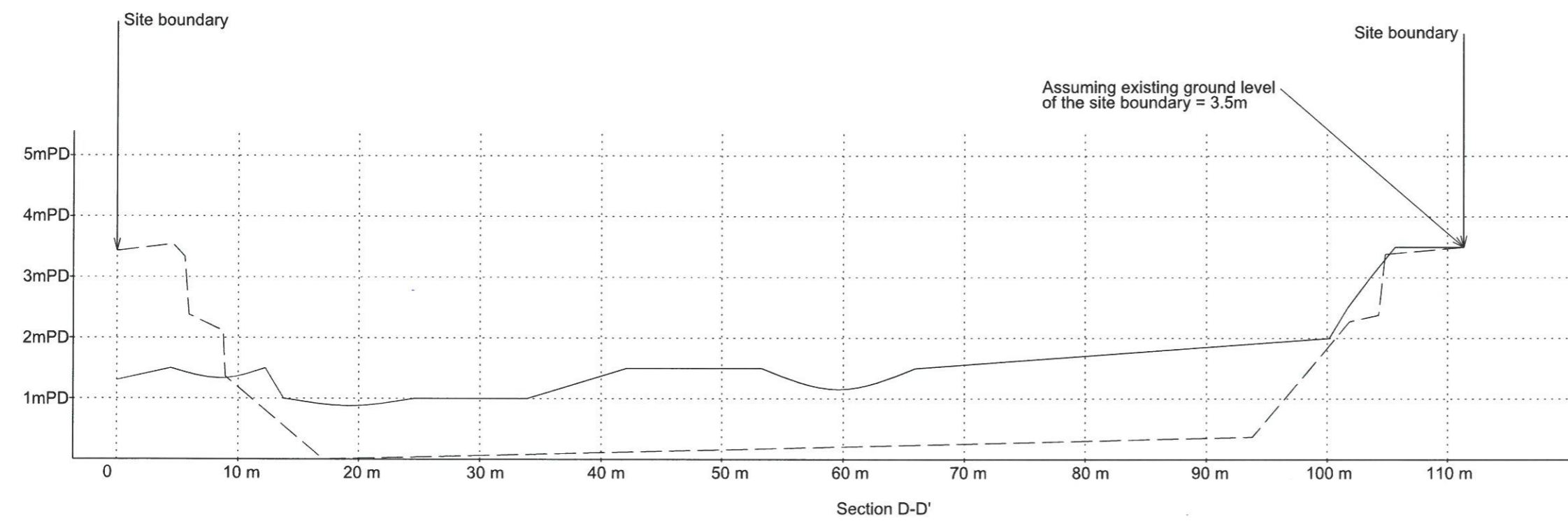
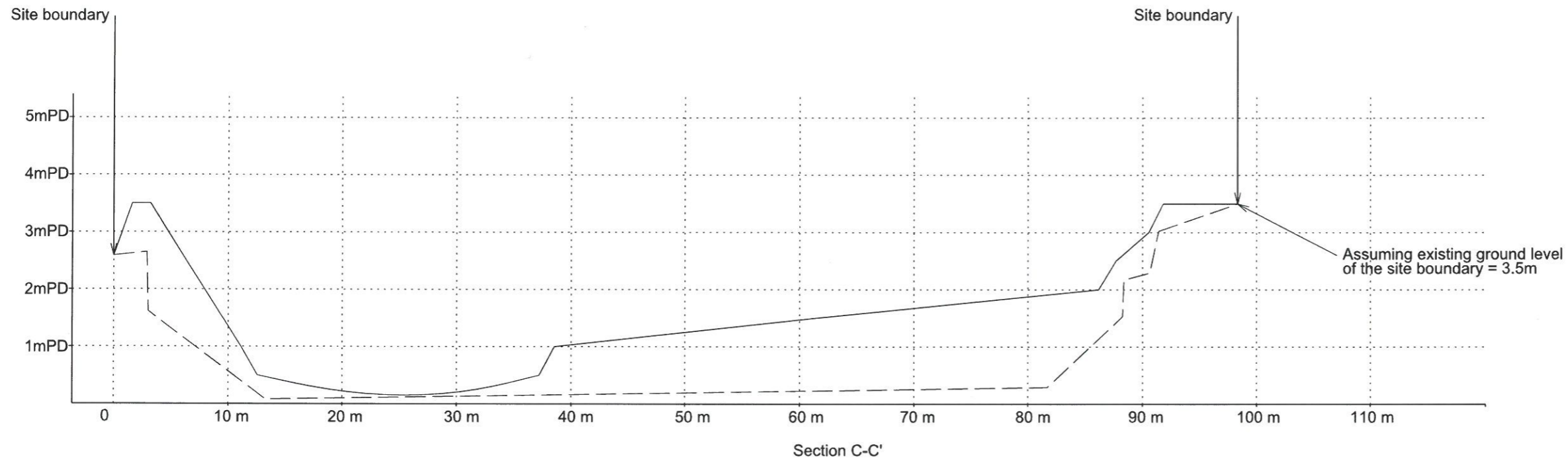
Checked by
MRL



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Legend
 — Proposed level
 - - Existing level

Note:
 Vertical scale is exaggerated by a factor of 5 for clarity in setting out.

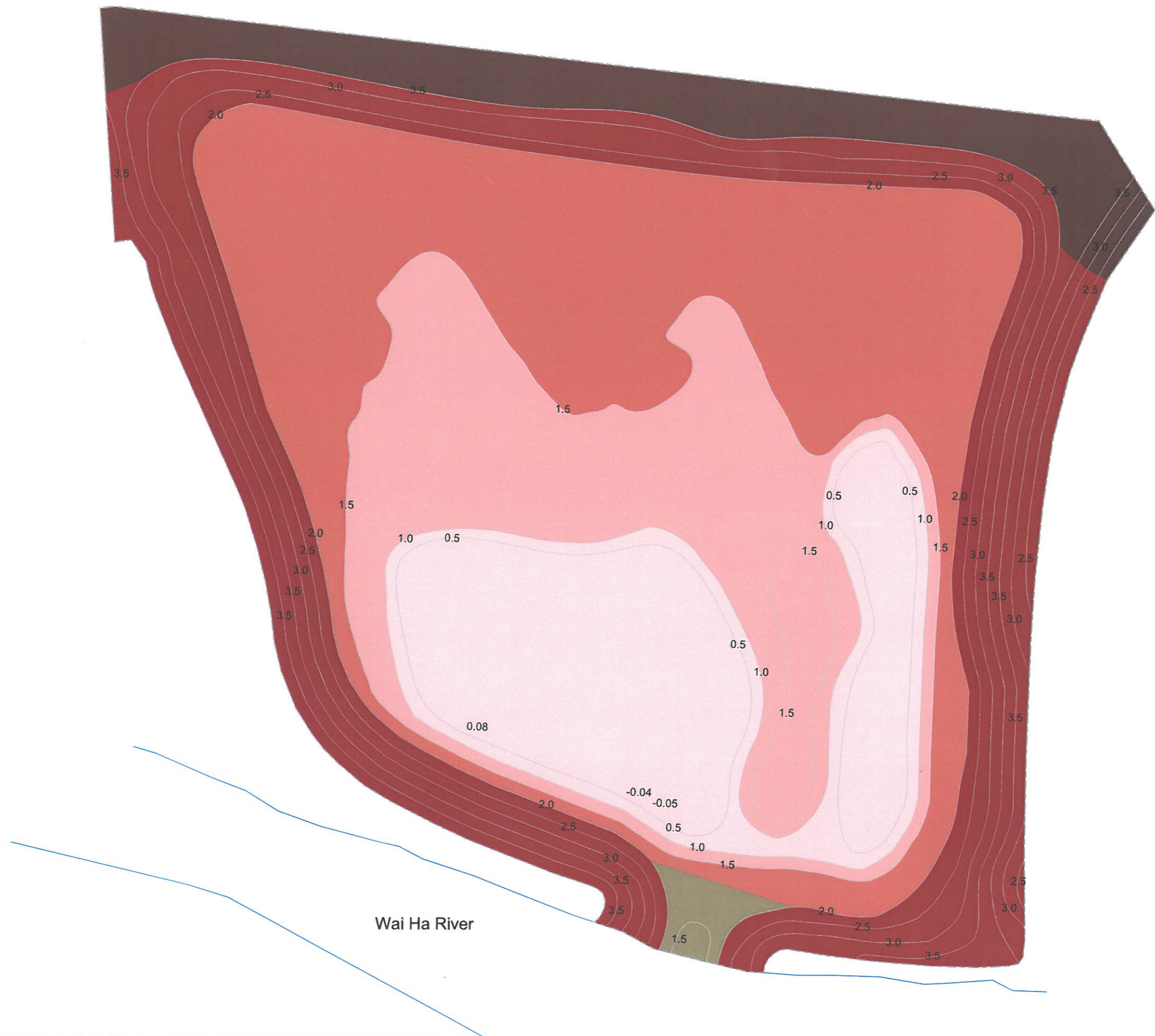
Job Title
 Contract No. DC/2009/22 -
 Drainage Improvement Works in Shuen Wan, Tai Po, Contract 1-
 Design & Construction of Ecological Compensatory Area

Drawing Title
 Existing and proposed levels 2

Drawing No. Figure 3.2	Project No. 09/317/161
Scale As shown	Date Aug 2010
Drawn by EW	Rev A
Checked by MRL	

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- Legend
- Site boundary
 - Mix 1: Existing wetland soil
 - Mix 2: <500mm additional stockpiled wetland soil
 - Mix 3: Subsoil and 500mm stockpiled wetland soil
 - Mix 4: 500mm topsoil
 - Mix 5: Subsoil and 500mm topsoil
 - Mix 6: Rubble stone lining

Job Title
Contract No. DC/2009/22 -
Drainage Improvement Works in Shuen Wan, Tai Po, Contract 1-
Design & Construction of Ecological Compensatory Area

Drawing Title
Proposed soil treatment zones of the
Ecological Compensatory Area

Drawing No. Figure 4	Project No. 09/317/161	
Scale 1: 500 at A3	Date May 2010	Rev A
Drawn by EW	Checked by MRL	

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- Legend
- Site Boundary
 - Existing Tree Removed
 - Existing Tree Retained (Tree Position Indicative Outside Site Boundary)
 - Natural Rubble Stone to Reinforce Bank and Prevent Scour
 - High Tide approx. 2m
 - Intertidal Zone
 - Permanent Pond

Scheduled trees to be removed
 C4 *Mangifera indica* on slope
 C5 *Citrus maxima* on slope
 C6 *Macaranga tanarius* on slope
 C8 *Mangifera indica*
 C9 *Clausena lansium* (undersized)

Wai Ha River

7.6 m

22.3 m

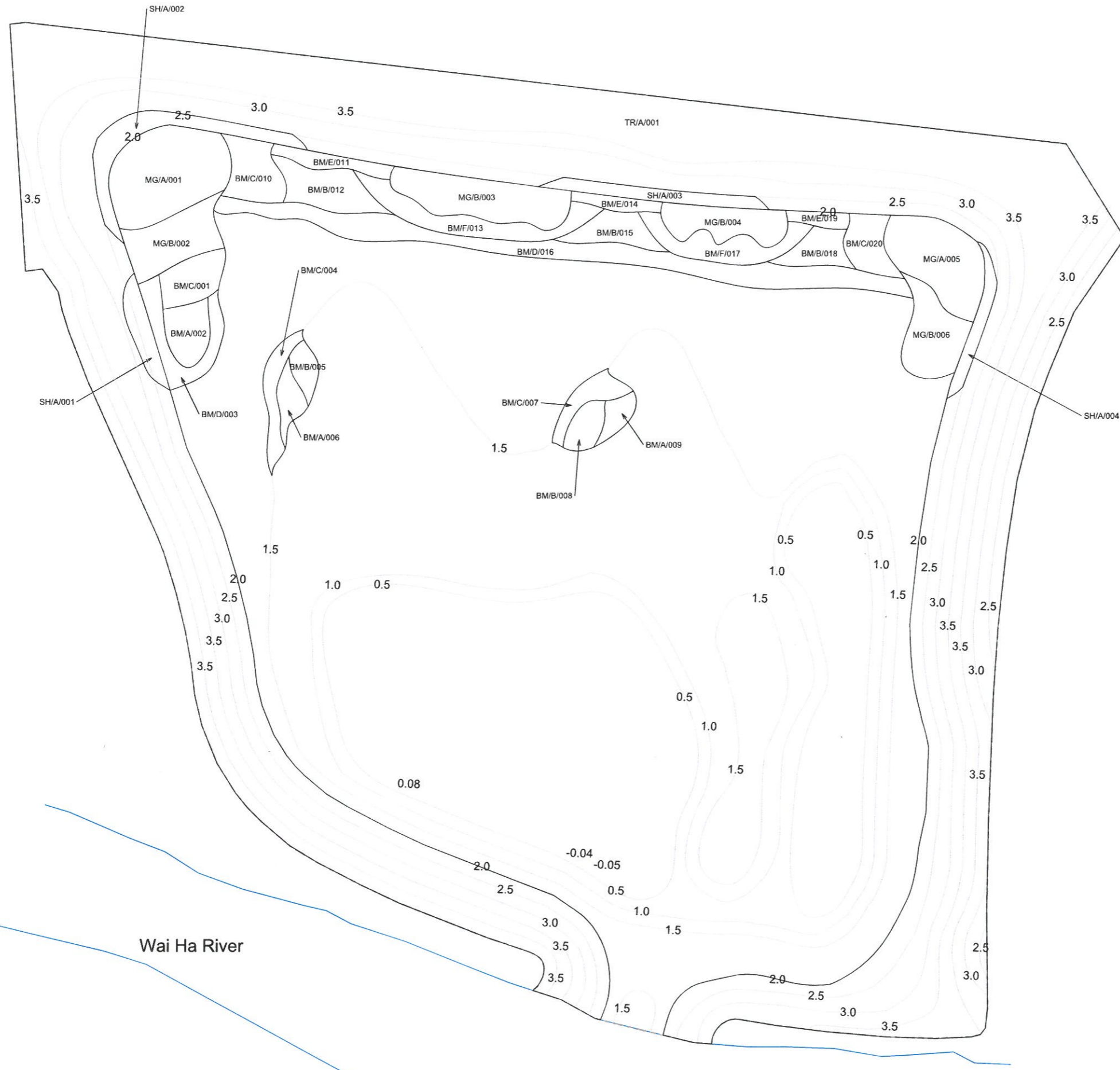
Job Title
 Contract No. DC/2009/22 -
 Drainage Improvement Works in Shuen Wan, Tai Po, Contract 1-
 Design & Construction of Ecological Compensatory Area

Drawing Title
 Proposed Linkage of Wetland to Wai Ha River

Drawing No. Figure 5	Project No. 09/317/161
Scale 1:300 @ A3	Date May 2010
Drawn by EW	Checked by MRL

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Legend

--- Site boundary

Job Title
Contract No. DC/2009/22 -
Drainage Improvement Works in Shuen Wan, Tai Po, Contract 1-
Design & Construction of Ecological Compensatory Area

Drawing Title
Proposed planting plan of the Ecological Compensatory Area

Drawing No. Figure 6	Project No. 09/317/161	
Scale 1: 500 at A3	Date May 2010	Rev A
Drawn by EW	Checked by MRL	

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Tung Tsz Nursery

Existing recreational fish pond

Connection of the Ecological Compensatory Area with Wai Ha River

Wai Ha River

- Legend
- Site boundary
 - Proposed location for the boundary fence
 - Proposed location for the access gate (the exact location will be adjusted depending on the existing structures and trees locations in the ECA and Tung Tsz Nursery)
 - Existing Tung Tze Nursery fence to be shared with the Ecological Compensatory Area in the future

Job Title
 Contract No. DC/2009/22 -
 Drainage Improvement Works in Shuen Wan, Tai Po, Contract 1-
 Design & Construction of Ecological Compensatory Area

Drawing Title
 Proposed locations for boundary fence and access
 gate of the Ecological Compensatory Area

Drawing No. Figure 7	Project No. 09/317/161
Scale 1: 800 at A3	Date Aug 2010
Drawn by EW	Rev A
	Checked by MRL

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