



Contract No. M1070-13C
Ecological Monitoring and Adaptive Management Advice Services
for Lok Ma Chau and West Rail Wetlands

Lok Ma Chau Habitat Creation and Management Plan

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Lok Ma Chau
Habitat Creation and Management Plan

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Verified by: *Leung Ki Chi*

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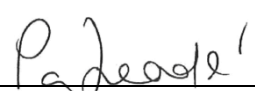
Grace Leung

Independent Environmental Checker

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	Name	Signature
Prepared by:	Elizabeth WU	
Reviewed by:	Dr. Michael LEVEN	
	Paul LEADER	
Date:	11th October 2019	

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Executive Summary

Background

The Environmental Impact Assessment (EIA) for the Sheung Shui to Lok Ma Chau (LMC) Spur Line (the Project) was approved, and an Environmental Permit (EP) for the construction of the Project was issued to Kowloon-Canton Railway Corporation (KCRC) in 2002. MTR obtained a further EP for operation of the Project in 2007 (EP No. FEP-06/129/2002/F) and the current version is FEP-06/129/2002/H issued on 22nd January 2015.

Condition 2.10 (b) of the current further EP, requires "a Five-yearly Review programme for the approved HCMP, which shall include both qualitative and quantitative review of management objectives and targets, together with measures necessary to accomplish any revised objectives, and target that are set, shall be submitted for the Director's approval". Condition 2.10 (c) notes that this Review "shall be prepared in consultation with stakeholders including, but not limited to relevant Government Departments and the Advisory Council on the Environment".

A second five-yearly review was undertaken for the period 2012 – 2016. Management Review Report (MRR) was prepared and submitted to the Environmental Protection Department, the Agriculture, Fisheries and Conservation Department (AFCD) and members on the Environmental Committee; comments from AFCD were received on 27th November 2017 and the MRR was revised. The revised MRR was issued on 27th December 2017 and no further comments were then received. In view of the findings, evaluation and assessment of the management practices in the HCMP approved in 2014 and the subsequent proposed changes in the 2017 MRR, this updated HCMP is prepared to incorporate the proposed changes.

Management and Maintenance Responsibilities of the LMC EEA

No change is proposed to the management and maintenance responsibilities of the LMC EEA.

Management Objectives of the LMC EEA

No change is proposed in the total area, habitats and total areas of habitats to be managed.

Following a systematic review of target species in the 2017 MRR, the LMC EEA is now proposed to be managed and maintained for a target list which comprises 2 mammal species, 32 bird species (including two new species added for conservation purposes in the 2017 MRR), 4 herpetofauna species (including one species added for conservation purposes) and the diversity and general abundance of dragonfly species.

Species/Fauna Group	Current Conservation Status	
	IUCN (2018)	Fellowes <i>et al.</i> (2002)
Mammal		
Eurasian Otter	Near Threatened	Regional Concern
Leopard Cat	-	-
Bird		
Eurasian Wigeon*	-	Regional Concern
Eurasian Teal	-	Regional Concern
Japanese Quail	Near Threatened	Local Concern
Little Grebe*	-	Local Concern
Black-faced Spoonbill	Endangered	Potential Global Concern
Yellow Bittern*^	-	Local Concern for breeding population
Cinnamon Bittern*	-	Local Concern
Black-crowned Night Heron*	-	Local Concern for breeding population
Chinese Pond Heron	-	Potential Regional Concern and Regional Concern for breeding population
Grey Heron	-	Potential Regional Concern
Great Egret	-	Potential Regional Concern and

Species/Fauna Group	Current Conservation Status	
	IUCN (2018)	Fellowes <i>et al.</i> (2002)
		Regional Concern for breeding population
Intermediate Egret*	-	Regional Concern
Little Egret	-	Potential Regional Concern and Regional Concern for breeding population
Great Cormorant	-	Potential Regional Concern
Greater Spotted Eagle	Vulnerable	Global Concern
Eastern Imperial Eagle	Vulnerable	Global Concern
Eurasian Coot	-	Regional Concern
Black-winged Stilt	-	Regional Concern
Greater Painted-snipe	-	Local Concern
Pheasant-tailed Jacana	-	Local Concern
Pintail Snipe	-	-
Swinhoe's Snipe	-	Local Concern
Common Snipe	-	-
Wood Sandpiper*^	-	Local Concern
Pallas's Grasshopper Warbler	-	Local Concern
Zitting Cisticola	-	Local Concern
Red-billed Starling	-	Global Concern
White-cheeked Starling*	-	Potential Regional Concern
White-shouldered Starling*	-	Local Concern for breeding population
Bluethroat	-	Local Concern
Yellow-breasted Bunting*	Endangered	Regional Concern
Japanese Yellow Bunting	Vulnerable	Global Concern
Herpetofauna		
Chinese Bullfrog	-	Potential Regional Concern
Reeves' Turtle^	Endangered	Global Concern
Chinese Soft-shelled Turtle	Vulnerable	Global Concern
Burmese Python	Vulnerable	Potential Regional Concern
Dragonfly		
Dragonfly (Diversity and General Abundance)	n/a	n/a

Key:

* Non-numerical bird target species.

^ Target species added in the 2017 MRR.

No numerical targets are set for mammal target species.

Numerical targets are required for 22 bird target species which were impacted by the Project (see the table above), for which the LMC EEA should support a density of target species twice that of the Control Areas (CAs) in order to demonstrate that the predicted potential impacts to these species due to the Project have been compensated at the LMC EEA. No numerical targets are set for 10 bird conservation target species.

There are no target levels for herpetofauna targets and diversity and general abundance of dragonflies.

As of 1st January 2006, the LMC EEA is divided into three Management Compartments, which are managed for different faunal targets:

- Compartment A is managed at a relatively low intensity, for which the major targets include the establishment of an egretty and Eurasian Otter;
- Compartment B is managed relatively intensively with regular drain-down and provision of trash fish to attract large waterbirds; and
- Compartment C is managed for a suite of marsh and reedbed fauna including amphibians, dragonflies and bird species requiring marsh vegetation. This compartment will be kept free of fish as far as possible.

Management Requirements of the LMC EEA

In order for the LMC EEA to perform for the target species, several key elements are to be managed; these include the structural components for water management (i.e. the arterial pipe system, the uPVC pipe system, the mobile pump system and the 4" pipe system), water quality and water capacity management, fish stocking (winter stocking, spring stocking and herbivorous fish stocking) and vegetation management (tree/shrub, bund, emergent vegetation). It is also required to control the spread of identified invasive plants and animals. Access to the LMC EEA is strictly controlled.

Monitoring Requirements of the LMC EEA

The following monitoring items are required for the LMC EEA:

- Mammal: through cameras and small mammal live trapping (suggested to be conducted on an "as needed" basis in the 2017 MRR);
- Bird: weekly morning counts (tower and transect count at the LMC EEA, and transect count at the CAs), monthly afternoon counts (tower and transect count at the LMC EEA during late summer/winter drain-down period; suggested to conduct in one drain-down period in the 2017 MRR), roost counts at the LMC EEA (monthly roost count, as suggested in the 2017 MRR for 1 year, and egretry monitoring), nest box monitoring at the LMC EEA, trapping at the LMC EEA and Black-faced Spoonbills Roost Count at Mai Po Nature Reserve;
- Herpetofauna: night-time surveys during the wet season at the LMC EEA;
- Dragonfly: transect surveys during the wet season at the LMC EEA;
- Vegetation: once a year in the late dry season within Compartment C and twice per year for the whole LMC EEA;
- Tree/Shrub: annual monitoring;
- Fish: once every two months at all stocked ponds for stock status and measure standard fish size for 50 random samples for each consignment;
- Water: monthly water quality checking, prior to the monthly management inspection, and only pH is measured (suggested in the 2017 MRR), and twice per month for water capacity/level.

Adaptive Ecological Monitoring

The following adaptive ecological management items are required for the LMC EEA:

- Weekly review of conditions of the LMC EEA;
- Weekly review of wildlife monitoring activities in the LMC EEA;
- Monthly management inspection and prescriptions for the LMC EEA;
- Monthly works progress meeting.

Implementation of the 2017 MRR

There are a number of changes on the management and monitoring measures proposed in the 2017 MRR and was also briefly mentioned above. In additional, creation of seasonal ponds is also proposed.

Reporting Requirement

The following submissions are required for the LMC EEA:

- Update of HCMP;
- Biannual meeting with the Environmental Committee.

GLOSSARY

Boundary Fence

The Frontier Closed Area (Mai Po to Ma Tso Lung section) was opened as of 15th February 2012 and as result the Lok Ma Chau Ecological Enhancement Area (LMC EEA) (see “Ecological Compensation Area” and “Ecological Enhancement Area” below) and adjacent ponds are no longer in a restricted area. In order to prevent unauthorised access by the public, erection of a boundary fence to delineate the site was completed in 2013.

Conservation Status

Conservation status as noted in this report generally follows that of Fellowes *et al.* (2002) and the latest IUCN Red List of Threatened Species except stated otherwise. The following abbreviations are used in this report for IUCN Listing: CR = Critically Endangered, EN = Endangered, VU = Vulnerable, NT = Near Threatened; and Fellowes *et al.* (2002) listing: GC = Global Concern, PGC = Potential Global Concern, RC = Regional Concern, PRC = Potential Regional Concern, LC = Local Concern, any letters in parentheses indicate that the assessment is based on the basis of restrictedness in breeding and/or roosting sites rather than in general occurrence.

Control Area (CA)

CA refers to a selected site to which the performance of the LMC EEA for target species would be compared. Two CAs, Mai Po San Tsuen (MPST) and San Tin (ST), are monitored that are considered to represent typical commercial fishponds in the Deep Bay area.

Ecological Compensation Area (ECA)

The current Further Environmental Permit (FEP) EP No. FEP-06/129/2002/H states that the ECA should provide not less than 26.2 ha of fishponds and 0.9 ha of marshland as described in Clause 2.8. Furthermore, Clause 2.9 of the same FEP states not less than 4.2 ha of marshland and 0.7 ha of reedbed should also be maintained (Figure 4 of the FEP). ECA is also referred to as Ecological Enhancement Area under Condition 2.4 of the EPs.

Ecological Enhancement Area (EEA)

A variation of Ecological Compensation Area; see above.

Environmental Committee (EC)

An advisory committee set up to advise on and monitor the effectiveness of the proposed mitigation measures of the LMC EEA in accordance with the Habitat Creation and Management Plan (HCMP).

Fish Size

Fish size refers to body measurement of a fish. The standard length, which is measured from the most anterior tip of the body to the posterior end of the vertebral column, of a fish is used when assessing the size of the fish at LMC EEA.

Frontier Closed Area (FCA)

The Frontier Closed Area was previously known as the Boundary Closed Area before 2006, and is an area bordering Hong Kong and China. Access to this area is restricted and a Closed Area Permit is required for anyone wishing to enter these areas. With the opening of the FCA (the Mai Po to Mai Tso Long section was opened on 15th February 2012), access to the LMC EEA is no longer controlled by the Closed Area Permit.

Habitat Creation and Management Plan (HCMP)

The HCMP is a report documenting the detailed measures and recommendations on the habitats and ecological function to be provided at the LMC EEA and the long-term management and ecological monitoring and audit requirements.

Initial Enhancement Areas (IEA)

An area of fishpond of no less than 15 ha, which was required in Figure 6 of EP No. EP-129/2002, was provided prior to the commencement of site formation works of the Lok Ma Chau Station. The area was subsequently incorporated into the LMC EEA.

LMC Pond 1

LMC Pond 1 refers to a pond to the west of Pond 2. This former fishpond is managed to compensate for the ecological loss due to the construction and operation of the LMC Public Transport Interchange, and is currently managed and maintained by Agriculture, Fisheries and Conservation Department (AFCD).

Management Compartment

A management compartment refers to an area within the LMC EEA for which management objectives are defined. According to the HCMP approved in 2014, the LMC EEA is divided into three management compartments, namely Management Compartments A, B and C.

Primary Target

A primary target refers to a target species within a particular Management Compartment of the LMC EEA where habitat conditions or management actions are optimal for that species.

Secondary Target

A secondary target refers to a target species of the LMC EEA in relation to the management action of a particular Management Compartment. Management measures within a particular Compartment will not aim to maximise the condition of the habitats for that species, but are anticipated to be of benefit.

Target Level

Target level refers to the requirement by which the performance of the LMC EEA should be maintained in order to demonstrate that the LMC EEA functions as designed and that the impacts of the Lok Ma Chau Spur Line project are fully mitigated.

Target Species

Species identified during the Environmental Impact Area (EIA) process as species of importance and potentially impacted by the construction and operation of the Lok Ma Chau Spur Line project, and for which mitigation measures are required. These were reviewed in the five-yearly reviews and additional species added in 2014 and more to be added after the approval of this HCMP.

Trash Fish

Trash fish refers to fish of low market value that are often discarded and rarely consumed as human food; this largely refers to small sized Tilapia.

1 INTRODUCTION

1.1 Project Background

1.1.1.1 The Environmental Impact Assessment (EIA) for the Sheung Shui to Lok Ma Chau (LMC) Spur Line (the Project) was approved, and an Environmental Permit (EP) for the construction of the Project was issued to Kowloon-Canton Railway Corporation (KCRC) in 2002 (EP No. EP-129/2002). MTR obtained a further EP for operation of the Project in 2007 (EP No. FEP-06/129/2002/F) and the current version is FEP-06/129/2002/H issued on 22nd January 2015.

1.2 Requirement of the Further EP

1.2.1.1 In accordance with the current EP No. FEP-06/129/2002/H, the habitats in LMC EEA should include *“not less than 26.2 hectares of fishponds, 0.9 hectares of marshland and not less than 4.2 hectares of marshland and 0.7 hectares of reedbed”* as illustrated in **Appendix 1**.

1.2.1.2 Condition 2.10 (b) of the current FEP, requires *“a Five-yearly Review programme for the approved HCMP, which shall include both qualitative and quantitative review of management objectives and targets, together with measures necessary to accomplish any revised objectives, and target that are set, shall be submitted for the Director’s approval”*. In addition, Condition 2.10 (c) notes that this Review *“shall be prepared in consultation with stakeholders including, but not limited to relevant Government Departments and the Advisory Council on the Environment”*.

1.2.1.3 The LMC EEA and LMC Spur Line have been in operation since 2007. The first five-yearly review, covering 2007 – 2011, was approved by the Environmental Protection Department (EPD) in August 2014. A second five-yearly review was undertaken covering 2012 – 2016. The Management Review Report (MRR) for the second review was submitted to the EPD, the Agriculture, Fisheries and Conservation Department (AFCD) and members on the Environmental Committee (EC); comments from AFCD were received on 27th November 2017, while there was no comment received from EPD and the EC members, and the MRR was revised accordingly. No further comments were received.

1.2.1.4 In view of the findings, evaluation and assessment of the management practices in the approved HCMP approved in 2014 and the subsequent proposed changes in the 2017 MRR, there is a need to update the HCMP to incorporate the proposed changes.

1.3 Location and Area of the LMC EEA

1.3.1.1 The location of the LMC EEA and LMC Spur Line and Station area shown in **Figure 1**.

1.4 Purpose of the HCMP

1.4.1.1 The HCMP serves as a blueprint for the management and maintenance measures and monitoring required for the LMC EEA, to mitigate for the ecological impacts arising from the operation of the LMC Spur Line as identified in the approved EIA (BBV 2002) and to further enhance the ecological opportunities of the site as identified in the 2017 MRR.

1.4.1.2 This HCMP details specifications for the habitats and ecological functions to be provided by the LMC EEA and defines management, monitoring and reporting requirements for these habitats, and the resources requirement for its implementation. Management, ecological monitoring and

audit are subject to the ongoing requirement to review these on an annual basis in accordance with the requirements of the EP.

1.5 Content of the HCMP

1.5.1.1 Content of the HCMP includes:

- Details of the management objectives of the LMC EEA, including faunal targets and habitat condition targets (**Sections 3 and 4**);
- Monitoring methodology of the targets and habitat attributes (**Section 5**);
- Specific measures required for the implementation of the 2017 MRR (**Section 7 and Appendix 3**);
- Reporting requirement (**Section 8**);
- A summary of habitat requirements and associated management measures required by target species (**Appendix 2**).

2 MANAGEMENT AND MAINTENANCE RESPONSIBILITIES OF THE LMC EEA

2.1.1.1 The management and maintenance of the LMC EEA is a requirement of the EP for the operation of the LMC Spur Line and it is currently managed and maintained by MTR. Habitats to be managed and maintained within the LMC EEA is shown in **Figure 1**.

3 MANAGEMENT OBJECTIVES OF THE LMC EEA

3.1 Habitat Area

3.1.1.1 According to Conditions 2.8 and 2.9 of the FEP, EP No. FEP-06/129/2002/H, the habitats to be provided should include “not less than 26.2 hectares of fishponds and 0.9 hectares of marshland as indicated in Figure 3...”, and “not less than 4.2 hectares of marshland and 0.7 hectares of reedbed at locations indicated in Figure 4”. Figures 3 and 4 of FEP, EP No. FEP-06/129/2002/H, are attached in **Appendix 1**.

3.2 Faunal Targets

3.2.1 List of Faunal Targets

3.2.1.1 The mitigation objective for the LMC EEA is the provision of suitable habitats for the target species of ecological importance regularly occurring within and adjacent to the LMC Spur Line and Station rather than the restoration of specific habitats of intrinsic ecological value. Accordingly, the habitat target for the mitigation area is the enhancement, creation and maintenance of the habitats listed in **Section 3.1** above.

3.2.1.2 Abundance and number of target species could be recorded will be a reflection of habitat factors, such as water conditions, food availability and freedom from disturbance. Accordingly, other targets have been set based on the habitat requirements of the target species. Such targets include the increase in shallow feeding areas, water quality, fish stocks and vegetation status and disturbance. These habitat-related targets are described in **Section 3.3**.

3.2.1.3 Following a systematic review of target species in the 2017 MRR, the LMC EEA is managed and maintained for a target list which comprises 2 mammal species, 32 bird species, 4 herpetofauna species, and diversity and abundance of dragonfly species (**Table 1**).

Table 1 Target list for LMC EEA.

Fauna Group/Common Name	Scientific Name	Current Conservation Status	
		IUCN (2018)	Fellowes <i>et al.</i> (2002)
Mammal (2 species in total)			
Eurasian Otter	<i>Lutra lutra</i>	Near Threatened	Regional Concern
Leopard Cat	<i>Prionailurus bengalensis</i>	-	-
Bird (32 species in total, in which 22 are numerical targets and 10 are non-numerical)			
Eurasian Wigeon*	<i>Anas penelope</i>	-	Regional Concern
Eurasian Teal	<i>Anas crecca</i>	-	Regional Concern
Japanese Quail	<i>Coturnix japonica</i>	Near Threatened	Local Concern
Little Grebe*	<i>Tachybaptus ruficollis</i>	-	Local Concern
Black-faced Spoonbill	<i>Platalea minor</i>	Endangered	Potential Global Concern
Yellow Bittern* [^]	<i>Ixobrychus sinensis</i>	-	Local Concern for breeding population
Cinnamon Bittern*	<i>Ixobrychus cinnamomeus</i>	-	Local Concern
Black-crowned Night Heron*	<i>Nycticorax nycticorax</i>	-	Local Concern for breeding population
Chinese Pond Heron	<i>Ardeola bacchus</i>	-	Potential Regional Concern and Regional Concern for breeding population
Grey Heron	<i>Ardea cinerea</i>	-	Potential Regional Concern
Great Egret	<i>Ardea alba</i>	-	Potential Regional Concern and Regional Concern for breeding population
Intermediate Egret*	<i>Egretta intermedia</i>	-	Regional Concern
Little Egret	<i>Egretta garzetta</i>	-	Potential Regional Concern and Regional Concern for breeding population
Great Cormorant	<i>Phalacrocorax carbo</i>	-	Potential Regional Concern
Greater Spotted Eagle	<i>Clanga clanga</i>	Vulnerable	Global Concern
Eastern Imperial Eagle	<i>Aquila heliaca</i>	Vulnerable	Global Concern
Eurasian Coot	<i>Fulica atra</i>	-	Regional Concern
Black-winged Stilt	<i>Himantopus himantopus</i>	-	Regional Concern
Greater Painted-snipe	<i>Rostratula benghalensis</i>	-	Local Concern
Pheasant-tailed Jacana	<i>Hydrophasianus chirurgus</i>	-	Local Concern
Pintail Snipe	<i>Gallinago stenura</i>	-	-
Swinhoe's Snipe	<i>Gallinago megala</i>	-	Local Concern
Common Snipe	<i>Gallinago gallinago</i>	-	-
Wood Sandpiper* [^]	<i>Tringa glareola</i>	-	Local Concern
Pallas's Grasshopper Warbler	<i>Locustella certhiola</i>	-	Local Concern
Zitting Cisticola	<i>Cisticola juncidis</i>	-	Local Concern
Red-billed Starling	<i>Spodiopsar sericeus</i>	-	Global Concern
White-cheeked Starling*	<i>Spodiopsar cineraceus</i>	-	Potential Regional Concern
White-shouldered Starling*	<i>Sturnia sinensis</i>	-	Local Concern for breeding population
Bluethroat	<i>Luscinia svecica</i>	-	Local Concern
Yellow-breasted Bunting*	<i>Emberiza aureola</i>	Endangered	Regional Concern
Japanese Yellow Bunting	<i>Emberiza sulphurata</i>	Vulnerable	Global Concern
Herpetofauna (4 species in total)			
Chinese Bullfrog	<i>Hoplobatrachus rugulosus</i>	-	Potential Regional Concern
Reeves' Turtle [^]	<i>Mauremys reevesii</i>	Endangered	Global Concern
Chinese Soft-shelled Turtle	<i>Pelodiscus sinensis</i>	Vulnerable	Global Concern
Burmese Python	<i>Python bivittatus</i>	Vulnerable	Potential Regional Concern
Dragonfly			
Dragonfly (Diversity and General Abundance)	n/a	n/a	n/a

Key:

* Non-numerical bird target species.

[^] Target species added in the 2017 MRR.

3.2.2 Target Levels

Mammal Target Level

3.2.2.1 Due to the difficulty of detecting this, largely nocturnal, faunal group, there are no numerical targets for Eurasian Otter.

3.2.2.2 There is no target level for Leopard Cat since it is not a species originally impacted by the Project. However, the number of sightings of the species will be reported to facilitate long-term management of the LMC EEA.

Bird Target Level

3.2.2.3 Numerical targets are required for bird target species (except those marked with an asterisk in **Table 1**) to demonstrate that the predicted potential impact to these species have been compensated for at the LMC EEA. Accordingly, in order to demonstrate that targets have been achieved, it is necessary to demonstrate that the LMC EEA supports a density per ha of the target species twice of that in commercial fishponds (i.e. CAs).

3.2.2.4 In order to demonstrate that numerical targets are achieved, densities of target species in the LMC EEA are compared with those in representative areas of commercial fishponds monitored. The groups of fishponds selected as CAs are at Mai Po San Tsuen and San Tin and are shown in **Figure 2** with area presented in **Table 2**.

Table 2 The number of ponds and pond area of the Mai Po San Tsuen and San Tin Control Areas.

Site	Number of Fishpond	Area (ha)
Mai Po San Tsuen	13	21
San Tin	45	60
Total	61	81

Note: Number of ponds is counted from the latest information on GeoInfo Map <http://www2.map.gov.hk/gih3/view/index.jsp>.

3.2.2.5 The method for calculating the numerical targets for birds is provided in **Appendix 4**. In the 2017 MRR, it was suggested to include the abundance of bird species which roost on site in calculating the bird density. Accordingly, in the week when a roost count/afternoon count is undertaken, the count utilised to calculate bird ratio is whichever of the tower/transect count and the afternoon bird count/roost count for each species which is highest.

3.2.2.6 Those bird species marked with an asterisk in **Table 1** do not require numerical target level as they are not the species which were originally impacted by the Project. However, the number of sightings of the species will be reported to facilitate long-term management of the LMC EEA.

Herpetofauna Target Level

3.2.2.7 There are no target levels for herpetofauna targets (Chinese Bullfrog, Reeves' Turtle, Chinese Soft-shelled Turtle and Burmese Python). However, the number of sightings of these species will be reported to facilitate long-term management of the LMC EEA.

Dragonfly Diversity and Abundance

3.2.2.8 There are no target level for dragonfly diversity and abundance. However, the number of species and abundance of each species will be reported to facilitate long-term management of the LMC EEA.

3.3 Management Compartments

3.3.1.1 Due to the large number and diversity of fauna targets, as of 1st January 2006, the LMC EEA was divided into three Management Compartments; reflecting management practices for the habitat and faunal targets in these different units (**Figure 3**).

3.3.2 Habitat Requirement of Target Species

3.3.2.1 The definition of favourable habitat condition varies among species; and details are provided in **Appendix 2**. All habitats listed should be provided, managed and maintained in the LMC EEA.

Compartment A (Ponds 2a and 2b)

3.3.2.2 These ponds will be managed at a relatively low intensity and water levels will be permitted to fluctuate naturally except when a particular management measures is required to address a particular issue. Limited fish stocking will be undertaken in late winter or when required e.g. for controlling vegetation. Bunds and some islands will be wooded. The compartment has incorporated elements to attract the establishment of an egretty and for Eurasian Otter; hence, the reduction of disturbance (human and dogs) is of prime importance to this compartment. A list of primary and secondary target species is provided in **Table 3**.

Table 3 Primary and secondary targets for Management Compartment A.

Group	Primary Target	Secondary Target
Mammal	Eurasian Otter	-
Bird	Chinese Pond Heron Grey Heron Great Egret Little Egret Great Cormorant Eurasian Coot Red-billed Starling	Eurasian Wigeon Eurasian Teal Little Grebe Yellow Bittern Black-crowned Night Heron Intermediate Egret Greater Spotted Eagle Eastern Imperial Eagle Black-winged Stilt White-cheeked Starling White-shouldered Starling
Herpetofauna	-	Chinese Soft-shelled Turtle

3.3.2.3 Hence, the habitat condition and management actions should be implemented:

Habitat Condition

- Minimise disturbance (by humans/dogs) by providing dog-proof fence and controlled access (particularly unauthorised access);
- To be managed at a relatively low intensity and allowed water levels to fluctuate naturally (except when problems of potential flooding and water quality arise);
- Manage and maintain the fruiting trees/shrubs for starling species;
- Manage and maintain a secure site for roosting and/or breeding egrets and roosting Great Cormorant in the winter.

Overview of Required Management Action

- Implement routine grass cutting;
- Manage and maintain the site boundary fence, with dog-proof design, to reduce human and dog intrusion;

- Manage the tree cover under the annual tree monitoring of the LMC EEA.

Compartment B (Ponds 3 – 11, 13)

3.3.2.4 Ponds in this compartment will be managed relatively intensively with regular drain-down and the provision of trash fish to attract large waterbirds, notably Great Cormorant, Grey Heron, Great Egret, Little Egret and Black-faced Spoonbill. Fish stocks will be maintained by stocking with trash fish following drain down and refilling. Hence, water level management, particularly during the wintering and migratory season, will be critical in this compartment. A list of primary and secondary target species is provided in **Table 4**.

Table 4 Primary and secondary targets for Management Compartment B.

Group	Primary Target	Secondary Target
Mammal	-	Eurasian Otter Leopard Cat
Bird	Eurasian Teal Black-faced Spoonbill Chinese Pond Heron Grey Heron Great Egret Little Egret Great Cormorant Greater Spotted Eagle Eastern Imperial Eagle Black-winged Stilt Zitting Cisticola Red-billed Starling	Eurasian Wigeon Japanese Quail Little Grebe Yellow Bittern Cinnamon Bittern Black-crowned Night Heron Intermediate Egret Eurasian Coot Common Snipe Pallas's Grasshopper Warbler White-cheeked Starling White-shouldered Starling Japanese Yellow Bunting
Herpetofauna	-	Chinese Bullfrog Chinese Soft-shelled Turtle Burmese Python

3.3.2.5 The following habitat condition and management actions are required:

Habitat Condition

- Minimise disturbance (by humans/dogs) by providing dog-proof fence and controlled access (particularly unauthorised access) (suggested in the 2017 MRR);
- Shallow water available for Black-faced Spoonbills and ardeids;
- At least one fish pond with fish of suitable size (mean size of 10cm) available (i.e. drained or partially drained) for target species at all times during the migratory and wintering period;
- Lengthen drain down schedule to cover peak count of Little Egret in the Deep Bay area (i.e. July to September) (suggested in the 2017 MRR);
- Repeated stocking with trash fish during the winter months to maintain the ponds in a suitable condition for large waterbird targets for extensive periods of time;
- Minimise disturbance to roosting ardeids and Black-faced Spoonbills during day-to-day management and monitoring activities;
- Manage and maintain trees for raptors and starlings;
- Manage and maintain nest boxes for starlings;
- Manage and maintain refugia and areas of short grass (20 – 40cm) at bunds between Ponds 9/10, 10/11 and 12/15;

- Maintain bankside and emergent vegetation on selected ponds to provide refuges for fish and appropriate conditions for invertebrates which will themselves provide food for birds;
- Maintain floating platforms or delay refilling one or two ponds for breeding Black-winged Stilt and partial drain-down the ponds if breeding is confirmed;
- Ponds with recently flooded grasses for duck species during the winter period.

Overview of Required Management Action

- Manage and maintain the site boundary fence, with dog-proof design, to reduce human and dog intrusion (suggested in the 2017 MRR);
- Implement routine grass cutting;
- Manage the tree cover under the annual tree monitoring of the LMC EEA;
- Manage and maintain nest boxes for starlings;
- Prolong drain-down of one to two ponds should egretry be established, and drain down of pond commences in July and throughout the winter (suggested in the 2017 MRR);
- Partially drain one or more ponds prior to stocking with trash fish to maximise availability of food to shorter legged species (e.g. Little Egret) (suggested in the 2017 MRR);
- Regular provision of fish during the pond drain down period;
- Implement the water management objective regarding water control system, water quality, and water carrying capacity as outlined in **Section 4.1**;
- Implement the fish stocking management objective as outlined in **Section 4.2**;
- Identify areas of temporary access where a roosting and/or a breeding site for target species, particularly Black-faced Spoonbill and egretry, is located;
- Adjust water level where breeding activities were noted for target species e.g. Black-winged Stilt (suggested in the 2017 MRR).

Compartment C (Ponds 12, 14 – 22)

3.3.2.6 Marsh and reedbed areas with a variety of shallow water microhabitats managed for amphibians, dragonflies and bird species requiring marsh vegetation (Great Painted-snipe, *Gallinago* snipe, Pheasant-tailed Jacana and wetland dependent passerines). Ponds will generally be kept free of fish as far as possible in order to benefit amphibians and invertebrates. Ponds 12 will primarily function as a reservoir for other ponds within Compartment C, although extensive emergent vegetation will be permitted to grow in the shallow margins around the pond to provide habitat for certain target bird species. Primary targets include reedbed and/or marsh species, Eurasian Teal, Chinese Bullfrog and dragonflies. A list of all target species is provided in **Table 5**.

Table 5 Primary and secondary targets for Management Compartment C.

Group	Primary Target	Secondary Target
Mammal	-	Leopard Cat
Bird	Eurasian Teal Eurasian Coot Black-winged Stilt Greater Painted-snipe Pheasant-tailed Jacana Pintail Snipe Swinhoe's Snipe Common Snipe Pallas's Grasshopper Warbler Bluethroat	Eurasian Wigeon Japanese Quail Little Grebe Yellow Bittern Cinnamon Bittern Chinese Pond Heron Intermediate Egret Little Egret Greater Spotted Eagle Eastern Imperial Eagle Wood Sandpiper Zitting Cisticola White-shouldered Starling Yellow-breasted Bunting Japanese Yellow Bunting
Herpetofauna	Chinese Bullfrog	Reeves' Turtle Chinese Soft-shelled Turtle Burmese Python
Dragonfly	Dragonfly diversity and abundance	-

3.3.2.7 The following habitat condition and management actions are required:

Habitat Condition

- Minimise disturbance (by humans/dogs) by providing dog-proof fence and controlled access (particularly unauthorised access) (suggested in the 2017 MRR);
- Shallow water (less than 20cm) and/or exposed wet mud is available for target species during the migratory and wintering season, and also for breeding marsh species;
- Marsh ponds are free of fish (other than temporary stocking of selected species for vegetation and pest control) and invasive pests (especially Apple Snail);
- Manage and maintain refugia and areas of short grass (20 – 40 cm) at selected areas.

Overview of Required Management Action

- Manage and maintain the site boundary fence, with dog-proof design, to reduce human and dog intrusion (suggested in the 2017 MRR);
- Implement routine grass cutting;
- Undertake mechanical rather than hand removal of vegetation on bunds;
- Mechanical removal (using a mini-backhoe) of weed at selected ponds in March (i.e. at the end of the dry season and prior to the breeding season);
- Manage and maintain nest boxes for starlings;
- Adjust water level where breeding activities were noted for target species or during peak autumn passage period in late wet season (suggested in the 2017 MRR).

3.3.2.8 In addition to the above compartment specific habitat condition targets, the following management actions should be implemented:

- Undertake an annual tree monitoring for the LMC EEA;
- Routine weeding of climbers such as *Mikania micrantha*, especially along the site boundary fence.

4 MANAGEMENT REQUIREMENTS

4.1 Water Management

4.1.1 Arterial Pipe System

4.1.1.1 **Figure 1** shows the locations of the arterial pipe system. To effectively utilise the underground arterial pipe system, it is important to have all the associated facilities in good working conditions. Hence, the condition (and number) of the following should be inspected and reported every six months:

- Large mobile pumps (6" inlet/outlet);
- Suction hoses and delivery hoses;
- Electric supply panels.

4.1.1.2 In addition, the following items should be at stand-by prior to the onset of pond drain-down for the attraction of migratory and wintering target species:

- A minimum of two functional large mobile pumps (6" inlet/outlet) and the required associated suction hoses and delivery hoses;
- All electric supply panels.

4.1.1.3 Any malfunctioning part of this system is to be reported to MTR and restored to proper condition within one month.

4.1.1.4 In the 2017 MRR, it was proposed to replace large pumps which are worn out or do not function properly.

4.1.2 uPVC Pipe System

4.1.2.1 **Figure 1** shows the locations of the uPVC pipe system. The positions (height of outlet pipes) and condition of the uPVC pipes should be checked by the Wetland Maintenance Contractor on a weekly basis. Any vegetation or debris obstructing the proper functioning of these pipes is to be cleared on a weekly basis.

4.1.2.2 The Ecological Consultant should inspect all uPVC pipes on a monthly basis and after any flooding, heavy rainfall (such as red or black rainstorm warnings), lowering of typhoon Signal No. 8 unless local condition proves to differ significantly from elsewhere in Hong Kong where these warnings are issued.

4.1.2.3 Any damage to the uPVC pipes are to be reported to MTR and the Ecological Consultant, and restored to proper condition within two weeks.

4.1.3 Mobile Pump System

4.1.3.1 As a back-up, a minimum of six working mobile pumps with a minimum capacity of 900L/min (as in 2" or 3" pump) should be stored on-site at all times. The condition of the stand-by small pumps and all associated electric wires and pipes with these pumps are to be monitored by the Wetland Maintenance Contractor and reported to MTR and the Ecological Consultant on a monthly basis.

4.1.3.2 All malfunctioned pumps or insufficient quantities of associated wires and pipes are to be repaired and provided within two weeks.

4.1.4 4" Pipe System

4.1.4.1 A 4" pipe system (see **Figure 1**) was installed in 2017 to improve the water level adjustment in Compartment C. The pumps (in Ponds 12 and 15) and the associated pipes should be inspected, at least, every six months. Any vegetation or debris obstructing the proper functioning of the system is to be cleared on a weekly basis.

4.1.5 Water Quality

4.1.5.1 A suitable storage facility for lime is to be provided on-site. Such facility should be kept dry such that the quality of stored lime is not affected. A minimum of 2,000kg of lime is to be maintained on-site at all times.

4.1.6 Water Capacity

4.1.6.1 The water capacity of the site should be reviewed on a monthly basis and throughout the dry season. Should water capacity fall below 40% of the overall water carrying capacity at the LMC EEA, the site condition should be reviewed and appropriate action to conserve water on-site should be devised by the Ecological Consultant and implemented by the Wetland Maintenance Contractor.

4.1.6.2 The condition of the water level markers is to be monitored once every two weeks. These markers should be cleaned and cleared of vegetation/other obstruction on a monthly basis.

4.1.6.3 In the 2017 MRR, it was proposed to take rainfall forecast into account and plan ahead to avoid water deficiency.

4.2 Fish Stock Management

4.2.1 Winter Stocking (trash fish)

4.2.1.1 Fish (such as Tilapia) should be stocked repeatedly during the winter months to provide food for large waterbird targets. Frequency and quantities to be stocked should be determined taking into account fish stock already present on-site, pond condition and bird numbers.

4.2.1.2 Winter stocking should comprise fish of a mean length of 10cm or less based on standard length of a sample of 100 fish per consignment of which 95% should be smaller than 15cm, and should not comprise any highly invasive fish species (such as catfish, snakehead and Climbing Perch).

4.2.1.3 The following is proposed in the 2017 MRR:

- Investigate the possibility to source and stock smaller trash fish of approximately 5cm, which is considered suitable for some target species e.g. Black-faced Spoonbills and Little Egrets;
- Measure standard length of fish to be stocked for 50 fish samples in each stocking event.

4.2.2 Spring Stocking (breeding fish)

4.2.2.1 All ponds drained or partially drained during the winter months should be re-stocked before the end of April each year or the peak breeding/spawning period. Fish stocked in spring should have

a mean length of at least 20cm based on standard length of a sample of 100 fish. 95% of the fish stocked should be species which are known to breed in local fishponds and should not comprise any fish species which are highly invasive (such as catfish, snakehead and Climbing Perch).

4.2.2.2 In the 2017 MRR, it was proposed that fish standard length of 50 fish samples should be measured in each stocking event (revised from a sample of 100 fish in the HCMP approved in 2014).

4.2.3 Herbivorous Fish

4.2.3.1 Ponds with extensive unwanted emergent vegetation should be stocked with large herbivorous fish species. Herbivorous carp species, particularly large individuals, should be transferred from any draining pond to other ponds.

4.3 Vegetation Management

4.3.1 Tree/Shrub Management

4.3.1.1 Tree/shrub management at the LMC EEA should involve minimal horticultural practices. All management should be driven by the following objectives:

- Maintaining tree/shrub at specific locations for target species (i.e. Greater Spotted Eagle, Eastern Imperial Eagle, ardeids species, and starling species);
- Identifying hazardous trees or tree parts which might pose a safety concern for the site/workers; this relates particularly to trees or tree parts along major access road, areas used by staff and visitors, or in the vicinity of power lines;
- Identifying tree/shrub management measures required for the facilitation of management or monitoring activities;
- Identifying factors which might be harmful to tree growth (such as diseases or unwanted climbers).

4.3.1.2 Annual management measures required for trees and shrubs at the LMC EEA should follow the survey findings from the annual tree survey (**Section 5.6**). More frequent review and management measures might be required at selected locations (such as locations with unwanted and fast-growing species).

4.3.1.3 All marked tree/shrubs in the annual tree/shrub review should be treated as recommended; any tree/shrub management measures undertaken should be supervised by a Certified Arborist and conducted outside the peak breeding period of starlings, as nest boxes are installed on trees, unless imminent danger is found.

4.3.1.4 Unwanted, weedy species include *Acacia* spp., *Leucaena leucocephala* and, in some locations, *Melia azedarach*. Any seedlings, saplings or trees of *Leucaena leucocephala* at the LMC EEA should be removed as a routine vegetation management practice during monthly grass cutting (see below).

4.3.2 Bund Vegetation Management

4.3.2.1 Routine grass cutting at the entire site (except for refugia areas marked in **Figure 4**) should be undertaken as described in sections below. Areas marked in **Figure 4** should be maintained; these include:

- Refugia area: herbaceous vegetation over 40cm in height;
- Long grass area: herbaceous vegetation over 20cm but less than 40cm in height;
- Short grass area: herbaceous vegetation less than 20cm in height.

4.3.2.2 Any unwanted climbers e.g. *Mikania micrantha* (including the site boundary fence) should be removed on a monthly basis.

4.3.2.3 The bunds should be checked for areas of bare ground where vegetation fails to establish on a routine basis (monthly). Hydroseeding may be considered if erosion is of concern.

4.3.2.4 In the 2017 MRR, it was proposed to simplify the grass cutting programme to grass cut the whole site monthly throughout the year (in the previous programme, the fish ponds were cut monthly and the marsh ponds monthly in wet season and once every two months in the dry season). It was also proposed to increase the resources for vegetation management.

4.3.3 Emergent Vegetation Management

4.3.3.1 Mechanical weeding (using a mini-backhoe or similar) of areas where unwanted vegetation is rampant should be undertaken at the end of the dry season (such as March).

4.3.3.2 Routine manual removal of highly aggressive species should be undertaken on a monthly basis. These include:

- *Typha angustifolia* (including root removal);
- *Phragmites australis* (Compartment C only, including root removal);
- Parrot Feather *Myriophyllum aquaticum* (careful removal by hand or using hand nets).

4.4 Undesired Animal Management

4.4.1 Feral Dogs

4.4.1.1 Feral dogs regularly appear on site and are undesirable as they have direct adverse impacts on other wildlife (including mammals) and also may cause extensive disturbance. All sightings and locations of feral dogs on site are to be logged.

4.4.1.2 The dog trap (on loan from AFCD) should be checked on a daily basis when baited and set. In addition, the effectiveness of the site boundary fence in excluding dogs from entering the site should be monitored on a weekly basis by the Ecological Consultant based on the number and location of dog sightings. The site boundary fence should be maintained according to **Section 4.7.1**.

4.4.1.3 In the 2017 MRR, no particular management measures were identified for feral dogs, but it was suggested to consider extending the dog-proof fence, with the provision of mammal passes for small mammals, to the whole LMC EEA.

4.4.2 Red Imported Fire Ant

4.4.2.1 Treatment of Fire Ant nests is to be undertaken on a routine basis (once every two weeks) by the Wetland Maintenance Contractor using approved treatment method. No treatment is permitted if rain is forecasted within the following four days.

4.4.2.2 Adequate stock (for two months' application) of the approved treatment (bait or pesticide) should be maintained on-site at a safe location. Sufficient warning against potential health hazard of these materials should be placed at strategic locations near the maintained stock.

4.4.2.3 In the 2017 MRR, no particular management measures were identified for Fire Ant, but efforts should be made to treat Red Imported Fire Ant nests once every two weeks when there is no rain forecasted in the following four days, especially in the dry season.

4.4.3 Red-eared Slider

4.4.3.1 The number of this species increased within the LMC EEA. However, this species is believed to compete with Reeves' Turtle (Karsen *et al.* 1998), which is a newly added target species.

4.4.3.2 In the 2017 MRR, it was suggested to investigate the possibility of trapping Red-eared Slider (to reduce competition with Reeves' Turtle). The following items will be considered:

- Trapping method;
- Humane disposal of trapped Red-eared Sliders;
- Partners (for consultation, research etc.).

4.4.4 Apple Snail

4.4.4.1 Manual removal of Apple Snails (adult, juvenile and egg masses) on a daily basis in the wet season (April to September) and weekly in the dry season (October to March) in all marsh areas (Compartment C; **Figure 3**). All collected Snails (adult and juvenile) are to be disposed off-site in a sealed container or plastic bags.

4.4.4.2 In the event of heavy infestation, the following procedure is to be followed:

- Partial drain down over a period of about four days so that about 50% of the pond bottom is shallow water;
- Hand removal of all adult and large juvenile Apple Snails until most have been removed;
- Off-site disposal of all Apple Snails collected;
- Hand removal of all egg masses (these can be placed in standing water or pushed into wet mud to destroy them);
- Full drain-down of the pond with final check for Apple Snails, liming (if appropriate depending upon site conditions) and further removal as required;
- Refilling with fish-free water.

4.4.4.3 When re-profiling of ponds where a flat bottom to the ponds/land is maintained, excavate a small ditch at a location closest to the arterial pump system (**Figure 1**) from which the pond/land can be drained more effectively.

4.4.4.4 It is suggested in the 2017 MRR to use baited Apple Snail trap as a trial for collecting Snails. In addition, the potential use of an organic molluscicide, such as Camellia seed, is under investigation.

4.4.5 *Dimorphopterus spinolae*

4.4.5.1 Reeds at the LMC EEA and the Clean-up Reedbed (see **Figure 2**) are to be checked for presence of the species on a monthly basis from May to September. Remedial actions are to be devised and undertaken should significant die-off of reed be observed in an infested reedbed.

4.4.5.2 The reedbed within the LMC EEA was relocated from Ponds 22 to 14, as suggested in the 2013 MRR, to avoid massive infestation. There was healthy stand of reed in Pond 14 and creation of internal bunds were made in August/September 2015 to allow independent water level adjustment of different cells.

4.5 Control of Access

4.5.1.1 Access to the LMC EEA is limited to authorised personnel. Warning signs are placed at access points and at strategic locations (such as at gates and bunds between the LMC EEA and other potential access points) to deter pedestrian trespassers.

4.5.1.2 In the 2017 MRR, it was proposed that the site security should be enhanced to reduce illegal access.

4.5.2 Vehicular Access

4.5.2.1 Lockable gates at vehicular access points prevent vehicular access to the LMC EEA by unauthorized personnel. Vehicular gates within the LMC EEA are to be locked at all times. Access from the Border Fence Road is controlled by the Hong Kong Police.

4.5.2.2 Vehicular access is restricted to bunds with grasscrete tracks (**Figure 5**) unless otherwise authorized. The chains across these bunds should be in place and locked (or hooked to the posts using karabiners) at all times (**Figure 5**).

4.5.3 Access for Site Contractors and Other Maintenance Works

4.5.3.1 Access should be restricted to between 0900 and 1800 in the months between April and September and between 1300 and 1700 in October to March, with the exception of ecological monitoring works which require access outside these hours (i.e. bird monitoring, night-time herpetofauna monitoring and winter roost count).

4.5.3.2 Unless otherwise authorized and management activities described in **Sections 4.4** above, no removal or trapping of wild animals is allowed.

4.5.3.3 Temporary access restrictions might be required upon reviewing the usage of the site by wildlife (such as breeding birds).

4.6 Avian Influenza and Botulism

4.6.1 Avian Influenza Prevention Guideline

4.6.1.1 The following procedures should be followed as a standard procedure:

- Physical contact with wild bird and their excreta should not be undertaken except when carrying out bird trapping or permitted bird surveys;
- Wash hands thoroughly with detergent hand rub or wet tissue (with alcohol) upon physical contact with wild bird, feather or excreta;

- All staff entering the wetlands from October to March should sign in and out on the log book and should wash hands using the disinfectant kit at the LMC EEA entrance(s) before leaving the site.

4.6.2 Handling of Sick or Dead Birds

4.6.2.1 Physical contact with sick or dead birds should not be undertaken unless with sufficient protective gear and by trained personnel. Collection of dead birds should be undertaken by authorized persons only.

4.6.2.2 The number and species of sick or dead birds should be monitored, particularly during the migratory and wintering months and periods of warm weather during the dry season. Records of sick or dead birds should be reported to MTR promptly and should massive die-offs or sick birds be present, the following protocol against avian influenza and botulism should be adopted:

- During a disease outbreak, sick or dead birds should be collected daily by AFCD staff until the outbreak has abated;
- Close liaison with WWFHK staff at Mai Po Nature Reserve in the event of any disease outbreaks;
- Minimise bird attraction to the LMC EEA should there be any unusually high numbers of sick or dead birds tested positive for Avian Influenza.

4.6.3 Wetland Avian Influenza Warning Classifications and Response Actions

4.6.3.1 A 3-level response to outbreak or incident of avian influenza confirmation within the LMC EEA are classified as follows; and details are provided in **Appendix 5**:

- Incident: one or more isolated case of confirmed avian influenza in birds. Management and monitoring activities at the LMC EEA will not be affected. Daily inspection for any sick or dead birds is to be undertaken;
- Outbreak: several cases in quick succession, but localised occurrence, in birds. Management activities of the LMC EEA are suspended. Access to the LMC EEA is restricted to essential staff. All persons entering should wear sufficient personal protective gear;
- Epidemic: large scale die-off of birds in Hong Kong and Shenzhen region at several locations. No entry to the LMC EEA is permitted.

4.7 Structural Management

4.7.1 Site Boundary Fence

4.7.1.1 The boundary fence (**Figure 5**) should be checked on a monthly basis, by the Wetland Maintenance Contractor, against damage and other conditions which might affect the effectiveness of the fence in exclusion of unauthorised access and intrusion by dogs.

4.7.1.2 Any damage to the fence should be reported to the MTR and Ecological Consultant, who should devise remedial measures against the potential threat (human or dog intrusion) to the LMC EEA.

4.7.2 Bird Tower

4.7.2.1 The bird tower is to be inspected by registered personnel on a regular basis according to Cap. 591 "Construction Sites (Safety) Regulations" reg 38F Inspection of scaffolds.

4.7.2.2 The tower is to be cleaned on a weekly basis to maintain hygiene.

4.7.3 Bund (including grasscrete track)

4.7.3.1 The conditions of these should be inspected at a minimum of a monthly basis. Damage to these structures should be rectified prior to the onset of the wet and dry season.

4.7.3.2 In the 2017 MRR, it was proposed that the rectification works of bund damage should be undertaken as soon as practicable.

5 MONITORING METHODOLOGY

5.1 Mammal

5.1.1 Eurasian Otter and Leopard Cat (target species)

5.1.1.1 Monitoring of Eurasian Otter and Leopard Cat is primarily camera-based. A minimum of five camera traps should be deployed at all times. These should be set up in semi-permanent positions (i.e. they may be moved occasionally for operational reasons or in response to previous survey findings). Cameras should always be in place in Compartment A where Eurasian Otter is a primary target species and artificial holts have been constructed; cameras should also be located in Compartments B and C to monitor the effects of the fence on both wild mammals and domestic dogs.

5.1.1.2 Cameras should be fixed at an appropriate height (the detective range of the cameras should be referred to) to maximise the chances of obtaining photographs of small mammals. Cameras should be checked and memory cards changed once every two weeks.

5.1.2 Small Mammal (non-target species)

5.1.2.1 Small mammal is not a target species of the LMC EEA, but it was recommended in the 2013 MRR to investigate small mammal usage (abundance and diversity) of the LMC EEA. Monitoring of small mammal usage of the site should be undertaken by means of live trapping (and/or marking). Details should be discussed and approved by the relevant Government Department (e.g. AFCD) upon application for a special permit to trap live animals.

5.1.2.2 In the 2017 MRR, it was proposed to conduct the small mammal trapping on an “as needed” basis and not to schedule it in mid-summer to avoid heat stress to the trapped animals.

5.2 Bird

5.2.1.1 **Table 6** outlines the bird species to be monitored at the LMC EEA and the CAs (MPST and ST; see **Figure 2**). Target levels are described in **Section 3.2.2**.

Table 6 Monitoring methodology for bird targets at LMC EEA and CAs.

Species	Count Methodology		
	LMC EEA ¹		CAs (MPST and ST)
	Tower Count (A, B) and Transect (C) ²	Transect (A, B, C)	Transect
Numerical Target Species			
Eurasian Teal		✓	✓
Japanese Quail		✓	✓
Black-faced Spoonbill	✓		✓
Chinese Pond Heron		✓	✓
Grey Heron	✓		✓
Great Egret	✓		✓
Little Egret	✓		✓
Great Cormorant	✓		✓
Greater Spotted Eagle	✓		✓
Eastern Imperial Eagle	✓		✓
Eurasian Coot		✓	✓
Black-winged Stilt		✓	✓
Greater Painted-snipe		✓	✓
Pheasant-tailed Jacana		✓	✓
Pintail Snipe		✓	✓
Swinhoe's Snipe		✓	✓
Common Snipe		✓	✓
Pallas's Grasshopper Warbler		✓	✓
Zitting Cisticola		✓	✓
Red-billed Starling		✓	✓
Bluethroat		✓	✓
Japanese Yellow Bunting		✓	✓
Non-numerical Target Species			
Eurasian Wigeon		✓	✓
Little Grebe		✓	✓
Yellow Bittern ³		✓	✓
Cinnamon Bittern		✓	✓
Black-crowned Night Heron		✓	✓
Intermediate Egret	✓		✓
Wood Sandpiper ³		✓	✓
White-cheeked Starling		✓	✓
White-shouldered Starling		✓	✓
Yellow-breasted Bunting		✓	✓

Note:

1. A, B, and C refers to the Management Compartments A, B and C respectively.
2. As Pond 11 is far away and cannot be properly counted from the tower, monitoring of bird usage of this pond is included in the transect count.
3. Additional target species proposed in the 2017 MRR.

5.2.2 Tower Count

5.2.2.1 Monitoring should be conducted by a single observer using a tripod-mounted telescope and binoculars. Tower count survey is required on a weekly basis. During each survey (circa 0700 – 1000), five counts of relevant target bird species at the ponds in Compartments A and B should be undertaken. Only birds actually using the LMC EEA shall be counted and flying birds except foraging raptors should be ignored.

5.2.3 Transect Count

5.2.3.1 Transect counts are required at the LMC EEA to supplement tower counts and in the CAs to count all target species on a weekly basis. During each survey, the surveyor should visit each pond between 0700 – 1000 hrs. All target bird species, all waterbirds, species of conservation importance (following Fellowes *et al.* 2002) and any other unusual bird species should be

recorded (to pond) and enumerated. Each pond should be surveyed along at least two bunds to ensure that most cryptic species are recorded (whilst taking care to avoid double counting).

- 5.2.3.2 If it is considered that birds have already been counted on other ponds, these should be ignored. If ponds contain large number of birds, these should be surveyed at a distance if possible to avoid disturbing birds and to further reduce the possibility of double counting. In general, flying birds should not be recorded unless they are clearly foraging and associated with the habitat.
- 5.2.3.3 Areas of dense vegetation within the marsh ponds in the LMC EEA should be walked through to flush skulking species. This aspect of the transect surveys should be suspended during the wet season if there are any concerns regarding disturbance to breeding birds.

5.2.4 Afternoon Count

- 5.2.4.1 In the 2017 MRR, it was proposed to conduct monthly afternoon bird survey consisting of one tower count and one transect count. It was suggested to conduct this late-afternoon survey monthly during the late summer/winter drain-down (from July to March). It was also suggested to conduct this survey in one late summer/winter period as a trial, and then the results will be reviewed to decide if surveys should be continued. In order to avoid disturbance, which affecting the counts, this survey will not be conducted on the same day as the roost count (see below). This trial will commence in July 2018, subject to the approval of this HCMP.

5.2.5 Roost Count

Winter Roost Monitoring

- 5.2.5.1 Roost count should be conducted once per month between November and March in early morning (before sunrise) or at dusk. The number or percentage of birds roosting at the LMC EEA should be recorded and the location of the roost mapped.
- 5.2.5.2 In the 2017 MRR, it was proposed to conduct monthly roost counts for one year, as a trial, to gain a better understanding of the bird usage and its seasonality within the LMC EEA. After the one year trial, the results will be reviewed to decide if the roost count should be conducted throughout the year or remain in the winter period only. This trial will commence in 2018, subject to the approval of this HCMP.

Egretry Monitoring

- 5.2.5.3 Should an egretry become established within the LMC EEA, egretry monitoring should be undertaken twice per month between April and July. All nests should be counted and mapped, and the species using that nest identified.

5.2.6 Nest Box Monitoring

- 5.2.6.1 Monitoring of nest boxes should comprise confirmation of nest box occupancy, the identification of species using the box and whether the eggs were successfully hatched. Since all bird nests are protected by law under Cap. 170 Wild Animals Protection Ordinance, personnel undertaking the monitoring should be sufficiently trained to ensure that the nests are not unduly disturbed.
- 5.2.6.2 Nest boxes should be checked approximately once every two weeks during the breeding season by means of photographic records obtained by less obtrusive means such as endoscope. In order to reduce the disturbance, the focus of the surveys should be the occupancy of the nest

boxes such that when chicks are recorded, that nest box will not be surveyed again in that season.

5.2.6.3 Nest boxes should be cleaned and maintained prior to the wet season each year.

5.2.6.4 A special permit is required if ringing of the chicks to be undertaken.

5.2.7 Trapping

5.2.7.1 Bird trapping is not required as a routine monitoring protocol. However, for cryptic target bird species, including Greater Painted-snipe, Bluethroat and Pallas's Grasshopper Warbler, this may provide more systematic data regarding numbers, distribution and habitat utilisation. If such information is required, trapping will be undertaken using mist nets operated by experienced personnel holding a valid permit to trap birds for scientific purposes (issued by AFCD under Section 15 of the Cap 170 Wild Animals Protection Ordinance). At times when such species are meeting targets, trapping is unlikely to be necessary but remains an option should the situation change or for other reasons.

5.2.8 Black-faced Spoonbills Roost Count at Mai Po Nature Reserve

5.2.8.1 Surveys are conducted covering the whole of Mai Po Nature Reserve, during which time all Black-faced Spoonbills present are counted. The timing of the counts should coincide with the periods when high numbers of Spoonbills are likely to be present, such as dawn, the middle part of the day or over the high tide period.

5.2.8.2 Counts should be conducted once per week from mid-October to the end of May.

5.3 Herpetofauna

5.3.1.1 Two night-time (1800 to 2200) surveys per month should be conducted during March to August within the LMC EEA. During surveys, a fixed route should be walked and all reptiles and amphibians observed or heard should be identified, and their abundance recorded. Habitat use and breeding activity should be recorded where possible and data should be recorded to individual ponds.

5.3.1.2 Observations of herpetofauna during other surveys and inspections are also recorded.

5.4 Dragonfly

5.4.1.1 Dragonflies should be surveyed within the LMC EEA twice per month from April to August during which a fixed survey route should be followed. All dragonfly species observed should be identified and counted, and signs of breeding recorded (such as presence of exuviae).

5.4.1.2 In the 2017 MRR, it was proposed to conduct exuviae emergence monitoring on traps/screens if seasonal ponds are created.

5.5 Vegetation

5.5.1 Marsh Floristics

5.5.1.1 Monitoring of marsh areas should be undertaken once per year in the late dry season (December to February) so that the data are available prior to undertaking any late dry season (March) mechanical weeding. The following should be undertaken:

- Record and map unvegetated areas;
- Record and map the dominant vegetation types in each marsh pond;
- Record and map presence and location of unwanted exotic species (even where not dominant).

5.5.1.2 Dominant vegetation type is defined as a species or species mix making up 50% or more of the vegetation cover.

5.5.2 Vegetation Cover

5.5.2.1 Monitoring of vegetation cover should be conducted twice yearly (end of wet and dry season) and should map the distribution of the following habitat parameters:

- Woody vegetation (trees and shrubs);
- Herbaceous vegetation over 40cm in height in terrestrial areas;
- Herbaceous vegetation over 20cm but less than 40cm in height in terrestrial areas;
- Herbaceous vegetation less than 20cm in height in terrestrial areas;
- Bare ground;
- Emergent vegetation in ponds and whether reed *Phragmites australis* or other species;
- Open water in ponds.

5.6 Tree and Shrub

5.6.1.1 Annual tree survey and monitoring of all existing tree species (including planted or naturally established young/semi-mature trees and seedlings) should be undertaken. The following parameters should be recorded:

- All tree specimens (including young/semi-mature trees, sapling and seedlings) should be recorded and their locations mapped;
- All tree specimens should be identified, numbered and assessed by recording their overall height, DBH, crown spread, growth from (seedlings/saplings ($\leq 1.5\text{m}$) and young/semi-mature trees ($> 2\text{m}$)), health condition (good/fair/poor) and any further remarks should be noted (e.g. any potential tree hazard on the major access road/area due to tree failure resulting from structural/health defects).

5.6.1.2 Tree density, species and form (young/semi-mature trees, saplings and seedlings) within LMC EEA and a forecast of the tendency of tree growth and space occupied by tree crown spread should be used in formulating the management protocol in the following 6 months (e.g. removal of specific exotic tree seedlings and reducing tree height and spread for tree groups in front of the bird tower at Pond 2).

5.6.1.3 Shrub species within the LMC EEA are to be identified; the approximate locations and numbers of shrubs (both planted and naturally established) should be mapped and recorded.

5.6.1.4 In the 2017 MRR, the following changes are proposed for the tree/shrub monitoring:

- Conduct comprehensive tree monitoring as instructed by the MTR;
- Identify hazardous trees, particularly those on the major access tracks, and those requiring immediate management actions (e.g. growth may affect power lines) annually;

- Conduct tree monitoring in the early dry season.

5.7 Fish Stock Management

5.7.1 Fish Stock Status

5.7.1.1 Throw and drag-netting should be carried out every two months at each stocked pond. A fishing throw-net with a mesh size of 30mm, a diameter of 4.22m and a surface area of about 14m² should be used to catch larger fish and a drag net of mesh size <10mm should be used to sample smaller fish and shrimps. Five randomly-placed replicates with each net should be conducted in each pond. Fish should be identified to species and the weight and length (standard length) recorded (if fish length is greater than 10cm) and then released back into the pond.

5.7.2 Fish Size

5.7.2.1 A random sample of 50 specimens from each consignment should be measured prior to stocking to ensure that fish size accords with stocking requirements.

5.7.2.2 In the 2017 MRR, it was suggested that measuring the standard length of 50 fish samples in each stocking event is sufficient, rather than 100 specimens as required under the previous protocol.

5.8 Water Management

5.8.1 Water Quality

5.8.1.1 Water quality should be measured in each pond once before the monthly management inspection (see **Section 6.3.1**) for the following parameters:

- Temperature
- pH
- Salinity
- Dissolved oxygen

5.8.1.2 Water quality should also be checked in special circumstances, such as, when ponds are filled following drain-down, in response to events which may be linked to water quality (e.g. fish die-off) etc.

5.8.1.3 After a review on the measured water quality parameters in the past five years for the 2017 MRR, it was suggested to discontinue the routine monthly monitoring of temperature, salinity and dissolved oxygen, which to be measured only under special circumstances.

5.8.2 Water Capacity

5.8.2.1 Water level readings should be taken from all ponds twice monthly (one of which should be carried out prior to the monthly site inspection; see **Section 6.3.1**), using the water level markers that are required to be placed in suitable locations in all ponds.

5.8.3 Other Habitat Conditions and Ecological Monitoring Items

5.8.3.1 Subject to site condition, management requirement and other potential concern, additional monitoring items might be required to address particular issues. These are provided in **Appendix 6**.

6 ADAPTIVE ECOLOGICAL MANAGEMENT

6.1 Weekly Review of Conditions in the LMC EEA

6.1.1.1 The Ecological Consultant should conduct on, at least, a weekly basis an inspection visit to the LMC EEA to verify the maintenance works of the Wetland Maintenance Contractor and to confirm that the LMC EEA is being operated correctly. Inspection visits should focus, in particular, the following:

- The Wetland Maintenance Contractor's management activities and progress in the implementation of maintenance works, planting etc. during the previous week;
- Conditions of the LMC EEA, in particular where active management (e.g. fish stocking, drain-down, refilling) is underway, has recently been completed or may be required to commence shortly;
- Any reportable incidents during the previous week, including human disturbance, adverse weather events, damage to the LMC EEA, leakages and water quality problems;
- Opportunities presented for changes to or refinement of the management regime to better meet mitigation targets.

6.1.1.2 The progress of the Wetland Maintenance Contractor is to be updated to MTR on a weekly basis.

6.2 Weekly Review of Wildlife Monitoring Activities in the LMC EEA

6.2.1.1 The Ecological Consultant should review on a weekly basis the wildlife monitoring activities. This review should cover the following:

- Monitoring data on utilisation of the LMC EEA and the CAs by target bird species, together with any observations of note;
- Monitoring data of other wildlife monitoring activities (including Black-faced Spoonbill roost counts, camera trapping of mammals, bird, bird nest boxes, herpetofauna and dragonflies etc.).

6.3 Monthly Management Inspection and Prescriptions for the LMC EEA

6.3.1 Monthly Management Inspection

6.3.1.1 Monthly management inspection (at the beginning of each month) and ad-hoc inspection with the Wetland Maintenance Contractor and the MTR's Representative at the LMC EEA.

6.3.1.2 The Ecological Consultant shall be responsible for issuing instructions in the form of "Works Programme" for the LMC EEA as follows:

- Instructions to the Wetland Maintenance Contractor (through MTR) covering monthly management and maintenance requirements, including routine management activities such as drain-down and refilling, fish stocking, vegetation management and response to events such as adverse weather, fires or other damage to habitats and equipment.

6.3.1.3 Prescriptions should be issued within one week after the monthly site inspection, but where appropriate may be issued more frequently. Prescriptions issued and their implementation should be described and explained in the Quarterly Reports.

6.3.2 Monthly Works Progress Meeting

6.3.2.1 The Ecological Contractor shall attend the monthly wetland works progress meeting with the Wetland Maintenance Contractor and the MTR's Representative.

7 IMPLEMENTATION OF THE 2017 MANAGEMENT REVIEW REPORT

7.1 Revised Management Objectives and Monitoring Methodology

7.1.1.1 The changes to the management and monitoring objectives relative to the HCMP approved in 2014 are provided in **Appendix 3**, while revised management objectives and monitoring methodologies are provided in **Sections 3 to 5**. All of the measures proposed will be further investigated (e.g. for feasibility)/implemented once the approval of this HCMP is granted.

7.1.1.2 Seasonal pond(s) is suggested to be created in the 2014 and 2017 MRRs. This pond is primarily created for Chinese Bullfrogs but would also benefit dragonflies (see **Appendix 2, Sections A2.3.1 and A2.4**), as the seasonal pond(s) will dry out in the dry season which can kill any fish – this can be achieved by adjusting the profile of existing marsh ponds and proper water level adjustment. The exact pond(s) to be converted to seasonal pond(s) and the design will be considered in more detail later, but potential ponds are the marsh ponds, Ponds 16, 17 and 18.

8 REPORTING REQUIREMENT

8.1 Report

8.1.1 Update of HCMP

8.1.1.1 Subject to the findings of the annual report and five-yearly review, the HCMP should be reviewed and modification(s) to the document made such that the management of the LMC EEA can be improved, and/or set alternative wetland targets. Consultation will be undertaken with the relevant government departments (EPD/AFCD) and the Advisory Council on the Environment (ACE) and submitted to EPD for approval.

8.1.2 Biannual Meeting with Environmental Committee

8.1.2.1 The following should be presented to the Environmental Committee (EC) on a biannual basis:

- Monitoring results;
- Adaptive management works that have been carried out;
- Any other ecological concern or opportunities arisen.

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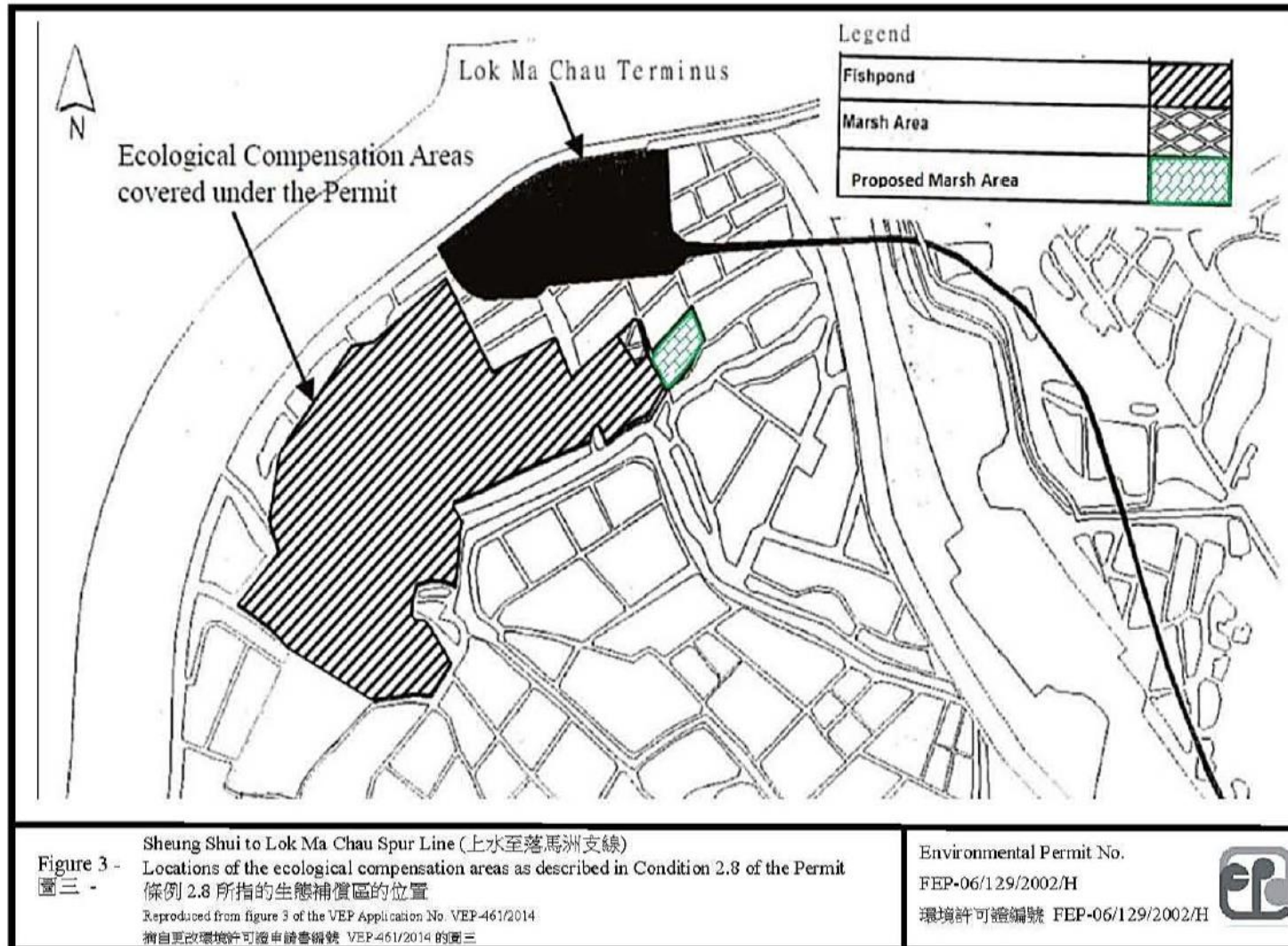
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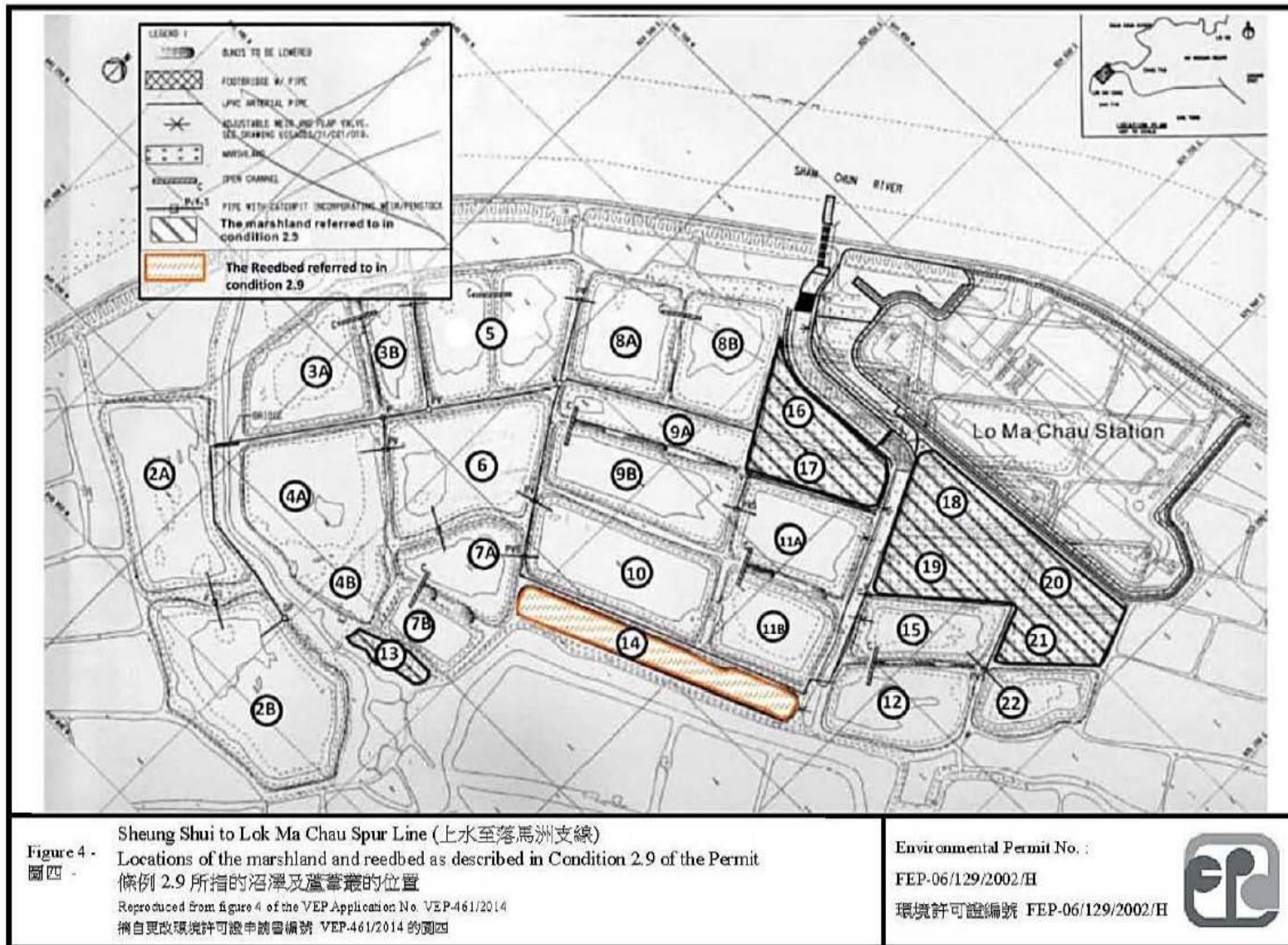
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Appendix 1 Figures extracted from Further Environmental Permit EP No. FEP-06/129/2002/H showing the locations of the ecological compensation area, and marshland and reedbed as described in Conditions 2.8 and 2.9 of the Permit.





Appendix 2 Summary of habitat requirements and associated management measures required by target species.

Table A2-1 Management Compartments for target species.

Common Name	Management Compartment [@]	Habitat [#]						
		Deep Water	Shallow Water	Bare, Muddy Margins	Emergent/Marsh Vegetation	Bare or Sparsely Vegetated Bunds	Vegetated Bunds	Trees/Channels
Mammal								
Eurasian Otter	A, b	F	F	F	F			B
Leopard Cat*	b, c			F	F	F		F
Bird								
Eurasian Wigeon*	a, b, c	F	F, r	f	F, R			
Eurasian Teal	a, B, C	F	F, r	f	F, R	f, r		
Japanese Quail	b, c						F, R	
Little Grebe*	a, b, c	F, R	F, R		F, R, B			
Black-faced Spoonbill	B		F	F		R		
Yellow Bittern* ^	a, b, c				F, R, B			
Cinnamon Bittern*	b, c				F, R, B			
Black-crowned Night Heron*	a, b		F	F	F, R			R, B
Chinese Pond Heron	A, B, c		f	f	F, r			R
Grey Heron	A, B		F		f	R		R
Great Egret	A, B		F		F	R		R
Intermediate Egret*	a, b, c		F	F	F, R	R		R
Little Egret	A, B, c		F	f	F	r		R
Great Cormorant	A, B	F	f					R
Greater Spotted Eagle	a, B, c		F		F	F		R
Eastern Imperial Eagle	a, B, c		F		F	F		R
Eurasian Coot	A, b, C	f	f					f, r
Black-winged Stilt	a, B, C		F	F	F, b	R, B		
Greater Painted-snipe	C			F	F, R, B			
Pheasant-tailed Jacana	C				F, R, B			
Pintail Snipe	C			f	F, R			
Swinhoe's Snipe	C			f	F, R			
Common Snipe	b, C			F	F, R			
Wood Sandpiper* ^	c		f	F, R				
Pallas's Grasshopper Warbler	b, C				F, R		F, R	
Zitting Cisticola	B, c				F, R		F, R	
Red-billed Starling	A, B			F	f	F		F, R, B

Common Name	Management Compartment@	Habitat#						
		Deep Water	Shallow Water	Bare, Muddy Margins	Emergent/Marsh Vegetation	Bare or Sparsely Vegetated Bunds	Vegetated Bunds	Trees/Channels
White-cheeked Starling*	a, b			F	f	F		F, R, B
White-shouldered Starling*	a, b, c			F	f	F		F, R, B
Bluethroat	C			f	F, R		F, R	
Yellow-breasted Bunting*	c				F, R	f	F, R	
Japanese Yellow Bunting	b, c				f, r	F	f, r	f, R
Herpetofauna								
Chinese Bullfrog	b, C		F, R, B		F, R, B			
Reeves' Turtle* ^	a, b, c	r	F	R, B				
Chinese Soft-shelled Turtle	a, b, c	r	F	R, B				
Burmese Python	b, c		F, B	F, B	f, r		f, r	f, r
Dragonfly (Diversity and Abundance)								
Dragonfly	C				F, R, B		f, r	

Key:

* Indicates new target species following the 2013 MRR and 2017 MRR but were not originally impacted by the Project, and for which no numerical target is required under the EP.

^ Target species added in the 2017 MRR.

@ Capital letters refer to primary target of the corresponding compartment and small letters refer to secondary target of the corresponding compartment.

F = foraging, R = loafing/roosting, B = breeding; capital letters refer to the main habitat of the respective activity.

A2.1 Mammal Targets

A2.1.1 Eurasian Otter *Lutra lutra*

A2.1.1.1 Eurasian Otter is a species impacted by the Project. It is a primary target species in Compartment A and a secondary target species in Compartment B.

A2.1.1.2 Eurasian Otters are restricted to the Deep Bay area in Hong Kong (Shek 2006). This species is considered to be Regional Concern by Fellowes *et al.* (2002). The species was once considered a Vulnerable species under the IUCN (between 2000 and 2004 (Roos *et al.* 2015)), but was re-evaluated in 2004 and 2008 and it is now considered a Near Threatened species. In the absence of data concerning the home ranges of this species in southern China, it is not clear how many individuals are present.

A2.1.1.3 Eurasian Otters feed largely on fish and amphibians. As is shown in BBV (2002), in Hong Kong, otters are known to make use of fishponds, *gei wai* and river channels. The former are probably largely used for feeding, whilst the latter appear to provide important movement corridors. This species will benefit from the appropriate management of river channel fringes by providing cover, prevention of burning of vegetation (the traditional way in which rank grassland along river channels is cleared by fish farmers), together with the provision of appropriate natural and artificial sites for holt formation. Otters will also be able to take advantage of the habitat provision (including food available) in marsh areas.

A2.1.1.4 Within the LMC EEA, management of the river channel will be undertaken with a view to the requirements of this species. Tree and shrub vegetation will be retained on the banks and large expanses of rank grassland will be cleared (by cutting). Artificial holts are provided on the bund on the east side of Pond 2b and on the island between Pond 2a and 2b (see **Plate A2.1**). This island has also been planted with woody vegetation to provide cover for otters.

Plate A2.1 Locations of artificial otter holts at LMC EEA (indicated by green dots).



- A2.1.1.5 There is no numerical target for the species due to scarcity of records. The following management measures are proposed for the species in the 2017 MRR:
- Investigate the current international best practice in detail with a view to future provision of one or more new artificial holts in the LMC EEA;
 - Investigate options for fence improvement of Compartments B and C to exclude dogs;
 - Review the findings of an on-going PhD study on Eurasian Otters, which covers the LMC EEA and is currently in progress, once they are available and taken into account where appropriate.

A2.1.2 Leopard Cat *Prionailurus bengalensis*

A2.1.2.1 Leopard Cat qualifies as a conservation target species based on the importance of the LMC EEA for the species. It is a secondary target in Compartments B and C.

A2.1.2.2 Leopard Cats are known to utilize a wide range of habitats, including plantation, shrubland, forests and suburban areas such as agricultural fields. This species is a small ambush predator, can swim and is a good climber. They are carnivorous and their primary prey consists of small terrestrial vertebrates but they are also known to attack aquatic prey, birds and bats. At the LMC EEA, the species is often seen on scarcely vegetated bunds or in lower branches on trees near water in all Compartments.

A2.1.2.3 There is no numerical target for the species and no particular management measures proposed. However, investigate options for fence improvement of Compartments B and C to exclude dogs for Eurasian Otter would also benefit Leopard Cat.

A2.2 Bird Targets

A2.2.1 Eurasian Wigeon *Anas penelope*

A2.2.1.1 Eurasian Wigeon is included as a conservation target since the LMC EEA supports relatively high numbers of the species. It is a secondary target species in all compartments.

A2.2.1.2 Eurasian Wigeon is listed as of Regional Concern by Fellowes *et al.* (2002). It is a dabbling duck which feeds on aquatic vegetation and grazes on short grass on land. There are no particular management measures proposed for this species.

A2.2.2 Eurasian Teal *Anas crecca*

A2.2.2.1 Eurasian Teal is an impacted species by the Project. It is a primary target in Compartments B and C, and secondary target in Compartment A.

A2.2.2.2 Eurasian Teal is winter visitor to Hong Kong and are present between September and April. Though there are occasional records from other wetland sites; the majority of Eurasian Teal are found in Deep Bay. Within Deep Bay, favoured habitats are intertidal creeks amongst mangroves, *gei wai* and well-vegetated ponds, especially those with abundant growth of the facultative wetland grass *Paspalum distichum*. A common denominator in these preferences is the presence of mud or shallow water feeding areas in proximity to cover. More open wetland habitats such as active fishponds, intertidal mudflats and Deep Bay itself are less favoured by Eurasian Teal than most other duck species in Hong Kong – it is probably not co-incidence that this species is a frequent prey

item for raptors including Greater Spotted and Eastern Imperial Eagles.

A2.2.2.3 Diet of Eurasian Teal has not been studied in Hong Kong; however, elsewhere in its range, it is considered to be omnivorous, filtering invertebrates and seeds from water or soft mud whilst either walking or swimming. Seeds are often particularly important in winter (Cramp and Simmons 1977).

A2.2.2.4 The species has clearly benefited from the management measures such as the creation of shallow pond areas with emergent vegetation and limited supplementary feeding with suitable food (grains etc.), which should be continued. This would not only benefit Eurasian Teal but other duck species, which would in turn be beneficial to Greater Spotted and Eastern Imperial Eagles.

A2.2.3 Japanese Quail *Coturnix japonica*

A2.2.3.1 Japanese Quail is an impacted species by the Project. It is a secondary target in Compartments B and C.

A2.2.3.2 A scarce passage migrant and winter visitor to Hong Kong (Carey *et al.* 2001), with anecdotal information suggesting a decline in numbers in recent years. In recent years, the majority of records have come from low-lying grassy areas in the northern New Territories where it has favoured areas of dry, short (< 30 cm) vegetation, often broken up by small unvegetated areas, in areas such as abandoned agriculture or filled fishponds. Fishpond bunds covered with short grass are used occasionally, but are not primary habitat for this species. Areas of tall, dense grass are generally avoided.

A2.2.3.3 Management of vegetation on the bunds will provide suitable habitat for this species within the LMC EEA. If uncontrolled, *Brachiaria mutica/ Panicum maximum* will become too tall and dense for this species. Hence, regular cutting of grass to provide areas of short grass (10 – 30 cm tall) and also to encourage the growth of shorter grasses such as *Paspalum distichum* is required. The regular grass cutting protocol will be continued. However, since fishpond areas are not primary habitat for this species it is likely to continue to be of irregular occurrence.

A2.2.4 Little Grebe *Tachybaptus ruficollis*

A2.2.4.1 Little Grebe is included as a conservation target since the LMC EEA supports relatively high numbers of the species. It is a secondary target species in all compartments.

A2.2.4.2 Little Grebe is listed as a species of Local Concern by Fellowes *et al.* (2002). The majority of the population, which is present all year, occurs on freshwater ponds in the Deep Bay area (Carey *et al.* 2001).

A2.2.4.3 This species occurs on ponds throughout the LMC EEA but requires emergent vegetation on which to anchor its floating nest. Since the provision of emergent vegetation is an existing management measure for Chinese Pond Heron, there is no additional management measure for this species required.

A2.2.5 Black-faced Spoonbill *Platalea minor*

A2.2.5.1 Black-faced Spoonbill is an impacted species by the Project. It is a primary target in

Compartment B.

- A2.2.5.2 Black-faced Spoonbills are tactile foragers. Foraging takes place in turbid water bodies with a flat or gradually sloping fine sediment bottom with water depths from 5 – 23 cm (Yu and Swennen 2004). In Hong Kong, these requirements are met in the intertidal mudflats in Deep Bay, as well as in fishponds and *gei wai*. The relative importance of intertidal areas and *gei wai* and fish ponds is influenced by tidal regime and pond management, with the latter habitats being particularly important during adverse weather and when ponds are drained for harvesting (Yu and Swennen 2004). Black-faced Spoonbills largely feed on small prey items, especially shrimps *Palaemonetes* spp. and Mosquito Fish *Gambusia affinis*, but larger prey items such as tilapia *Oreochromis mossambicus* are also eaten, especially when these are readily available in partially drained ponds (Leader 1998, Yu and Swennen 2004).
- A2.2.5.3 Management of ponds in the LMC EEA has demonstrated that Black-faced Spoonbills are readily attracted to ponds in the LMC EEA. Stocking alone attracted birds; attraction increased when ponds were partially drained or maintained at a low level which permitted birds to wade over most of the pond. In addition, birds regularly took advantage of bunds and islands which were largely cleared of vegetation as daytime roosting and loafing sites.
- A2.2.5.4 Human disturbance is also an important limiting factor with regards to Black-faced Spoonbill numbers; and most birds will leave the LMC EEA completely if disturbed. Hence reducing access to the site during the dry season remains an important management tool. Access to the main site in the mornings should be limited to essential works during the months October to March (inclusive). Winter fish stocking should be maintained. There is no additional management measure proposed.

A2.2.6 Yellow Bittern *Ixobrychus sinensis*

- A2.2.6.1 Yellow Bittern is included as a conservation target in the 2017 MRR since the LMC EEA supports relatively high numbers of the species. It is a secondary target species in all compartments.
- A2.2.6.2 Yellow Bittern is listed as a breeding species of Local Concern by Fellowes *et al.* (2002) on account of a declining population and occurrence at a small number of sites. One or two pairs of this species probably breed in the LMC EEA in most years.
- A2.2.6.3 This species occurs on ponds throughout the LMC EEA but requires dense bankside and emergent vegetation, which are also the habitat requirements for other targets (e.g. Chinese Pond Heron, Pallas's Grasshopper Warbler). Since the provision of emergent vegetation is an existing management measure for other targets, there is no additional management measure for this species required.

A2.2.7 Cinnamon Bittern *Ixobrychus cinnamomeus*

- A2.2.7.1 Cinnamon Bittern is included as a conservation target since LMC EEA supports relatively high numbers of the species. It is a secondary target species in Compartments B and C.
- A2.2.7.2 Cinnamon Bittern is listed as of Local Concern by Fellowes *et al.* (2002) on account of a declining population and occurrence at a small number of sites. Carey *et al.* (2001) stated that while there was no evidence of breeding in Hong Kong, small numbers of the

Cinnamon Bittern were recorded over the summer. At the LMC EEA, the species has been regularly recorded over the summer since 2010, and up to two juveniles were recorded within the LMC EEA in each year between 2014 and 2016, indicating that breeding occurred on site or nearby.

- A2.2.7.3 It is anticipated that management measures for other species such as Pallas's Grasshopper Warbler would benefit the species. Thus, there are no particular management measures proposed for the species.

A2.2.8 Black-crowned Night Heron *Nycticorax nycticorax*

- A2.2.8.1 Black-crowned Night Heron is included as a conservation target since LMC EEA supports relatively high numbers, particularly as a day roost, of the species. It is a secondary target species in Compartments A and B.

- A2.2.8.2 Unlike other colonial heron species in Hong Kong, Black-crowned Night Heron is largely nocturnal and is not attracted in large numbers to drained ponds during the day. Since the LMC EEA already attracts a number of the species using the site as a day roost, management measures for the species include the continued provision and maintenance of suitable daytime roost sites, minimizing disturbance to roost areas and undertake night time surveys at times of pond drain down.

A2.2.9 Chinese Pond Heron *Ardeola bacchus*

- A2.2.9.1 Chinese Pond Heron is an impacted species by the Project. It is a primary target in Compartments A and B, and a secondary target in Compartment C as suggested in the 2017 MRR.

- A2.2.9.2 Chinese Pond Herons are found in Hong Kong throughout the year. Habitat utilisation has been studied in Hong Kong by Young (1994) who showed that birds breeding at the Mai Po Village egretty fed mainly around fishponds. Individuals typically forage solitarily along the edges of open water areas or areas within sparse or short vegetation. They utilise open areas such as intertidal mudflats or drained down ponds less than larger ardeid species in Hong Kong. Chinese Pond Herons breed colonially, either on their own or with other ardeid species. Nests are often placed in bamboos, especially *Bambusa eutuldoides*. Breeding adults largely forage within 3 km of their colonies (Young and Cha 1995).

- A2.2.9.3 Unlike the other target species of ardeids (and Black-faced Spoonbills), Chinese Pond Herons are not attracted in large numbers to drained-down ponds, neither do they make extensive use of *gei wai* (BBV 2002). Rather, this species is a solitary feeder which typically finds much of its prey in shallow water either in or on the edge of areas of emergent or pondside vegetation. Chinese Pond Herons eat small fish, but also feed extensively on invertebrates and amphibians. Within the LMC EEA, therefore, provision for this species must focus on creating suitable shallow water conditions with emergent vegetation where a range of small prey species is available.

- A2.2.9.4 Management measures include the creation of suitable shallow water conditions with emergent vegetation where a range of small prey species including invertebrates and amphibians is available. The establishment of mats of *Ipomoea aquatica*, which is known to be favoured as a feeding habitat for the species, should only be adopted should there is a clear mechanism to control spread into other ponds. In addition, measures to establish

roosting habitat between Ponds 2a and 2b is to be encouraged so as to provide suitable conditions for the species during both the breeding and non-breeding season.

A2.2.9.5 Additional management measures proposed in the 2017 MRR:

- Include this species as a secondary target species of Compartment C and consider foraging requirements of this species in management of vegetation and water levels.
- The current count methodology fails to take into account the importance of the LMC EEA as a secure roost site for this species, thus underestimating its ecological importance, and the success in meeting numerical targets. Accordingly, it is proposed to adjust count methodology to take into account roost counts.

A2.2.10 Grey Heron *Ardea cinerea*

A2.2.10.1 Grey Heron is an impacted species by the Project. It is a primary target in all Compartments A and B.

A2.2.10.2 Grey Heron is listed as of Potential Regional Concern by Fellowes *et al.* (2002). Grey Herons have bred in Hong Kong, but this species is primarily a winter visitor (Young and Cha 1995). Habitat utilisation has been studied in Hong Kong by Young (1994) who noted that this species is predominantly a crepuscular feeder in Hong Kong and primarily uses *gei wai* as a daytime roost; but also utilises fish ponds for feeding. Grey Herons usually feed by wading for fish, preferentially selecting those 10 – 16 cm in length (Cramp and Simmons 1977). As one of the larger target species, they can wade in water up to approximately 70 cm depth.

A2.2.10.3 Management of ponds in the LMC EEA has demonstrated that Grey Herons are readily attracted to ponds in the LMC EEA. Stocking alone attracts birds; attraction increases when ponds are partially drained or maintained at a low level which permits birds to wade over most of the pond. In addition, birds regularly take advantage of bunds which are largely cleared for vegetation as daytime roosting and loafing sites. No additional management measures are required.

A2.2.11 Great Egret *Ardea alba*

A2.2.11.1 Great Egret is an impacted species by the Project. It is a primary target in Compartments A and B.

A2.2.11.2 Great Egrets are one of the scarcer breeding ardeids in Hong Kong, but numbers are much greater in winter (Young and Cha 1995). Habitat utilisation has previously been studied in Hong Kong by Young (1994) showed that whilst this species feed on drained ponds and *gei wai*, intertidal mudflats are typically more important as feeding habitat. However, management of the LMC EEA has shown that Great Egret is strongly attracted to stocked and partially drained-down ponds.

A2.2.11.3 Habitat management measures in the LMC EEA included pond drain down with stocking of trash fish, coupled with minimising disturbance. While additional management measures are not required to attract Great Egret for meeting target, the following refinement of measures are proposed in the 2017 MRR :

- Prolonged drain-down of one to two ponds within Compartment B should egretry be established;
- Winter drain down of pond commences in September such that some of the trash fish

to be stocked in the winter months can be readily available to Great Egret (instead of largely consumed by Great Cormorant in the deeper ponds).

A2.2.12 Intermediate Egret *Egretta intermedia*

- A2.2.12.1 Intermediate Egret is included as a conservation target since LMC EEA supports relatively high numbers of the species. It is a secondary target species in all compartments.
- A2.2.12.2 Intermediate Egret is a non-breeding visitor, which occurs in relatively small numbers in the Deep Bay. This species appears to prefer ponds with extensive emergent vegetation; though they are also attracted to drained ponds.
- A2.2.12.3 No management measures specific to this species are proposed; though measures to attract Chinese Pond Herons will also benefit this species.

A2.2.13 Little Egret *Egretta garzetta*

- A2.2.13.1 Little Egret is a species impacted by the Project. It is a primary target species in Compartments A and B, and a secondary target species in Compartment C.
- A2.2.13.2 Little Egrets are found in Hong Kong throughout the year. In Hong Kong, this species feed primarily in fishpond and intertidal mudflat areas. Little Egrets feed opportunistically on fish remaining when ponds are drained and are often the most abundant ardeid species in such feeding concentrations. Breeding birds typically forage within 3 km of egretries (Young 1994), which may be situated either in bamboos or a variety of tree species.
- A2.2.13.3 Management measures included stocking of ponds with small prey items, use of small mobile pumps for the final stage of drain down, use of decoys to encourage roosting and breeding on site. Additional management measures are proposed in the 2017 MRR as follow:
- Undertake a review of water control system with a view to enhancing capacity to drain-down and otherwise manage water levels;
 - Partially drain one or more ponds prior to stocking with trash fish to maximise availability of food to shorter-legged species, including Little Egret, and reduce proportion of fish being consumed by Great Cormorant;
 - Lengthen drain down schedule to cover peak count of Little Egret in the Deep Bay area i.e. July to September;
 - Consider whether Compartment C management can be adjusted to improve its attractiveness to Little Egrets without compromising current management objectives;
 - Adjust count methodology to take into account numbers of Little Egrets using the LMC EEA as a secure roost site.

A2.2.14 Great Cormorant *Phalacrocorax carbo*

- A2.2.14.1 Great Cormorant is a species impacted by the Project. It is a primary target species in Compartment A (trees providing loafing and potential roosting sites) and in Compartment B (stocked and periodically drained-down ponds providing feeding areas and bare bunds providing daytime loafing areas).
- A2.2.14.2 Great Cormorants are winter visitors to Hong Kong and are economically important as some of the large numbers of this fish-eating species which occur in Deep Bay feed in

commercial fishponds. Studies of the wintering ecology of Great Cormorants and measures to reduce their impact on commercial fisheries including diversionary feeding and wiring ponds to prevent cormorant access have been sponsored by AFCD.

A2.2.14.3 Great Cormorants in Hong Kong roost communally. There are currently three main roosts in the Deep Bay area: Mai Po Nature Reserve, Nam Sang Wai and the LMC EEA. Cormorants disperse to feed; either in Deep Bay itself or on fishponds. They use both active and inactive ponds, but avoid small ponds, especially those surrounded by trees or adjacent to sources of human activity. They readily take advantage of fish concentrations, including the provision of “trash fish” (usually tilapia) to divert feeding pressure from commercial ponds.

A2.2.14.4 Great Cormorants feed by catching fish whilst swimming (usually underwater). Accordingly, they will utilise ponds when they are full or partly full of water. During the day, when not feeding, some birds return to the night time roosts whilst others use daytime loafing sites, usually isolated trees or tree lines or bare bunds or banks, especially those which isolated from disturbance and ground predators by being surrounded by water.

A2.2.14.5 Management measures included stocking ponds with fish, and provision of trees and bare bund for daytime loafing and roosting. The species is known to utilize ponds which are at their normal depth (1.5m) or partially drained to approximately 50cm. No additional management measures are required.

A2.2.15 Greater Spotted Eagle *Clanga clanga*

A2.2.15.1 Greater Spotted Eagle is a species impacted by the Project; it is a primary target of Compartment B, and a secondary target species in Compartments A and C.

A2.2.15.2 Greater Spotted Eagles are a winter visitor to Hong Kong and are present from late October to early April. Their distribution in Hong Kong is restricted to the Deep Bay area, with the notable exception that they roost at night in hills to the south; with most birds apparently roosting in the Castle Peak area during winter 2000-01 (Carey *et al.* 2001, BBV 2002). The pattern of occurrence was related to the presence of abundant waterbirds on ponds (especially wild ducks). Despite the presence of large numbers of waterbirds (including ducks), the intertidal zone is not utilised. Trees are required for daytime loafing or hunting perches, but in comparison with Eastern Imperial Eagle, this species is less likely to occur in extensive open active fish pond areas.

A2.2.15.3 Management measures for this species were identical to those for Eastern Imperial Eagle (see below). Further, improvement measures to enhance the site for Eurasian Teal and other duck species were considered to provide an indirect benefit to this species. No additional management measures are required.

A2.2.16 Eastern Imperial Eagle *Aquila heliaca*

A2.2.16.1 Eastern Imperial Eagle is a species impacted by the Project; it is a primary target of Compartment B, and a secondary target species in Compartments A and C.

A2.2.16.2 Eastern Imperial Eagle is a winter visitor to Hong Kong and is present from late October to early April. Their distribution in Hong Kong is restricted to the Deep Bay area, with the

notable exception that they roost at night in hills to the south. The pattern of occurrence was related to the presence of abundant waterbirds on ponds (especially wild ducks), with a secondary factor being an avoidance of developed and disturbed areas. Despite the presence of large numbers of waterbirds (including ducks), the intertidal zone is not utilised. Trees are required for daytime loafing or hunting perches, but ponds surrounded by continuous lines of large trees (as at parts of Nam Sang Wai) are avoided.

A2.2.16.3 Management measures included the provision of a broken line of trees (large isolated trees in Compartment B) for daytime loafing and hunting perches, and habitat enhancement to attract larger congregations of ducks, notably Eurasian Teal. No additional management measures are required.

A2.2.17 Eurasian Coot *Fulica atra*

A2.2.17.1 Eurasian Coot is a species impacted by the Project. It is a primary target species in Compartments A and C, and a secondary target of Compartment B.

A2.2.17.2 Eurasian Coot is considered a common winter visitor (Carey *et al.* 2001). Of this the vast majority occurred in Deep Bay and it was always rare within fishpond habitats, when they favoured ponds with extensive emergent vegetation.

A2.2.17.3 Management measures for this species at LMC EEA include the provision of marshes and reedbed to increase the habitat suitable for the species. Additionally, increasing areas with emergent vegetation, particularly lilies in Compartment C will benefit the species. No additional management measures are required.

A2.2.18 Black-winged Stilt *Himantopus himantopus*

A2.2.18.1 Black-winged Stilt is a species impacted by the Project. It is a primary target species in Compartments B and C and a secondary target species in Compartment A.

A2.2.18.2 Black-winged Stilts are recorded in Hong Kong throughout the year. They are restricted to fresh or brackish water habitats, favouring large disused fishponds in the Deep Bay area and bloodworm ponds in Long Valley. Until 2003 they had not been known to breed in the territory; the small numbers present in summer were considered to be non-breeding individuals or early returning migrants (Carey *et al.* 2001). However, in 2003, breeding was observed in Hong Kong for the first time. Breeding occurred in the LMC EEA in 2009 (one pair), 2010 (one pair) and 2011 (three pairs). Black-winged Stilts feed predominantly on aquatic invertebrates, especially insects. Food is taken by wading in open water and invertebrates are taken from on and below the water surface and from aquatic vegetation (Cramp and Simmons 1983).

A2.2.18.3 Management measures included the creation of shallow open water areas overlaying soft mud with sparse or no aquatic vegetation. In addition, the provision of elevated and/or floating islands provides breeding sites that are protected from ground predators and nests being flooded out, and partial drain-down of ponds if breeding occurs to provide suitable foraging habitat. In addition to these management measures, it was proposed, in the 2017 MRR, to delay refilling one or two ponds in Compartment B or drain down one or two marsh ponds in Compartment C in spring to encourage potential breeding birds to the LMC EEA.

A2.2.19 Greater Painted-snipe *Rostratula benghalensis*

A2.2.19.1 Greater Painted-snipe is a species impacted by the Project and is a primary target species in Compartment C.

A2.2.19.2 This species is a passage migrant and winter visitor, with a small breeding population: extremely localised and much-declined (Carey *et al.* 2001). Although formerly once widespread, this species is largely restricted to freshwater agricultural land and in recent years is known to have bred at just four sites (Kam Tin, Long Valley, Mai Po and the LMC EEA). Greater Painted-snipe prefers areas with low, dense herbaceous vegetation and shallow water (0-10cm). It is an especially vagile species and is able to make use of suitable ephemeral wetlands, it is also regularly forced to abandon suitable habitat as it dries out during the dry season. However, areas of suitable habitat that contain even small areas that remain wet in the dry season tend to support relatively high numbers and often have birds throughout the year.

A2.2.19.3 Management measures included the creation of marshes with low, dense herbaceous vegetation and shallow water (<10cm), water level management throughout the winter to ensure some habitat is retained for the species, and reviewing (and where necessary adjusting) vegetation management and exotic species control measures during the wet season to reduce disturbance to the species. Additional management measures are not required.

A2.2.20 Pheasant-tailed Jacana *Hydrophasianus chirurgus*

A2.2.20.1 Pheasant-tailed Jacana is a species impacted by the Project. It is a primary target species in Compartment C.

A2.2.20.2 Pheasant-tailed Jacana is a scarce passage migrant, mainly in autumn, much decreased but previously bred (Carey *et al.* 2001). Breeding was last recorded in Hong Kong in 1974, and since then the status of this species has changed and it is now a scarce passage migrant, with almost no mid-summer records. This bird tends to favour freshwater or brackish wetlands that have extensive marginal and emergent vegetation.

A2.2.20.3 Management measures included the creation of marshes with extensive marginal and emergent vegetation, enlarging the establishment of areas with emergent vegetation, particularly that of lilies (which is particularly favourable to this species as a breeding ground), in Compartment C (resulting in reprofiling Ponds 20 – 22 to provide large lily pond), controlling access to the bunds of lily ponds before and during breeding season if the species is recorded, and controlling the spread and infestation of marshland with Golden Apple Snail. No further management measures are proposed in the 2017 MRR.

A2.2.20.4 The creation of a larger area of lily in Ponds 20 – 22 was an enhancement measure, as recommended in the 1st five-yearly review undertaken for the period from 2007 to 2011, aimed to create more habitat for Pheasant-tailed Jacana and to encourage that species to breed on site. Lily pond is also a habitat that supports other target species.

A2.2.21 Pintail Snipe *Gallinago stenura*

A2.2.21.1 Pintail Snipe is a species impacted by the Project. It is a primary target species in Compartment C.

A2.2.21.2 This is a common passage migrant, most common in autumn, and an uncommon winter visitor. It is very similar in appearance to Swinhoe's Snipe and is generally only separable from that species by examination in the hand (Carey *et al.* 2001). The preferred habitat for this species in Hong Kong is wet agricultural areas, especially recently abandoned or inactive areas of wet agriculture.

A2.2.21.3 Management measures included the creation of marsh areas, and any areas where the water levels are managed for Greater Painted-snipe. No further management measures are proposed in the 2017 MRR.

A2.2.22 Swinhoe's Snipe *Gallinago megala*

A2.2.22.1 Swinhoe's Snipe is a species impacted by the Project. It is a primary target species in Compartment C.

A2.2.22.2 Swinhoe's Snipe is a common passage migrant, most common in autumn in Hong Kong. It is very similar in appearance to Pintail Snipe and is generally only separable from that species by examination in the hand (Carey *et al.* 2001). The preferred habitat for this species in Hong Kong is wet agricultural areas, especially recently abandoned or inactive areas of wet agriculture.

A2.2.22.3 Management measures recommended in the HCMP included the creation of marsh areas, and any areas where the water levels are managed for Greater Painted-snipe. No further management measures are proposed in the 2017 MRR.

A2.2.23 Common Snipe *Gallinago gallinago*

A2.2.23.1 Common Snipe is a species impacted by the Project. It is a primary target species in Compartment C and a secondary target in Compartment B.

A2.2.23.2 Common Snipe is a passage migrant and winter visitor to Hong Kong. It requires marsh vegetation with muddy margins for feeding and, in Hong Kong, is much more abundant in freshwater than brackish water areas. Most feeding occurs at night and dense marshland areas are utilised for roosting during the day. Edges of fishponds are used by Common Snipe, but these are not a major habitat for this species (Carey *et al.* 2001).

A2.2.23.3 Management measures included the creation of marsh areas. In addition, the shallow ponds with emergent vegetation created for Chinese Pond Herons were considered to be beneficial for the species. The provision of recently cut reedbed during the dry season, particularly in the autumn, is anticipated to benefit the species. No additional management measure is required.

A2.2.24 Wood Sandpiper *Tringa glareola*

A2.2.24.1 Wood Sandpiper is included as a conservation target in the 2017 MRR since the LMC EEA supports relatively high numbers of the species. It is a secondary target species in Compartment C.

A2.2.24.2 Wood Sandpiper primarily occurs in the LMC EEA in spring and, especially, autumn passage with smaller numbers in winter, and mostly uses well-vegetated shallow ponds.

Compartment C is very suitable for this species, as long as water levels are appropriate.

A2.2.24.3 Management measures included fine-tuning water levels of some marsh ponds in Compartment C in peak autumn passage period in late wet season (August/September) to ensure that water is shallow enough for this species. This management measures will not compromise management measures for other target species using these ponds and will also benefit Black-winged Stilt and perhaps Chinese Pond Heron.

A2.2.25 Pallas's Grasshopper Warbler *Locustella certhiola*

A2.2.25.1 Pallas's Grasshopper Warbler is a species impacted by the Project. It is a primary target in Compartment C and secondary target of Compartment B.

A2.2.25.2 Pallas's Grasshopper Warbler is an autumn migrant to Hong Kong, with the vast majority of records occurring in September and the first ten days of October. This species occur in any wetland habitat, but most notably in areas of abandoned or inactive wet agriculture (Carey *et al.* 2001). However, it is a highly cryptic species, making it extremely difficult to monitor accurately.

A2.2.25.3 Management measures included the provision of marsh areas, areas of long-grass along the bunds in Compartment C during autumn, and reedbed within the LMC EEA, while the Clean-up Reedbed is also beneficial to the species. In the 2017 MRR, it was proposed to conduct trapping to investigate whether this species is systematically under-recorded on site.

A2.2.26 Zitting Cisticola *Cisticola juncidis*

A2.2.26.1 Zitting Cisticola is a species impacted by the Project. It is a primary target of Compartment B and a secondary target in Compartment C.

A2.2.26.2 Zitting Cisticola is a common winter visitor and passage migrant in Hong Kong and a rare breeding species. It favours areas of grass, especially in lowland wetland areas such as active and disused fishponds. Small numbers breed in Hong Kong, primarily in the Deep Bay area and the northeast New Territories (Carey *et al.* 2001).

A2.2.26.3 Management measures included the provision of fringe areas, such as the interface between the freshwater marsh and the reedbed, and retain areas of long grass throughout the year in Compartments B and C. While no further measure is suggested in the 2017 MRR, it was proposed to collect more precise data on microhabitat utilisation in the LMC EEA and the CAs.

A2.2.27 Red-billed Starling *Sturnus sericeus*

A2.2.27.1 Red-billed Starling is a species impacted by the Project. It is a primary target species in Compartments A and B.

A2.2.27.2 Management measures included short to medium term provision of artificial food (i.e. expired food for human consumption and used to feed fish (waste food), such as biscuits or equivalent) during the winter months, while medium to long term measures included planting of trees which produce suitable-sized fruits such as *Celtis sinensis*, *Ficus microcarpa*, *Ficus subpisocarpa* and *Sapium sebiferum*. No further management measures

proposed in the 2017 MRR.

A2.2.28 White-cheeked Starling *Sturnus sericeus*

A2.2.28.1 White-cheeked Starling qualifies as a conservation target species based on the importance of the LMC EEA for the species. It is a secondary target in Compartments A and B.

A2.2.28.2 White-cheeked Starling is largely a winter visitor to Hong Kong. They are regularly found in flock mixed with other starling species in the Deep Bay area; this species particularly favours wet agricultural land but also regularly seen at fish ponds (Carey *et al.* 2001), though in recent years small numbers have bred in the northwest New Territories in summer.

A2.2.28.3 Management measures for this species would, in any case, largely mirror those already adopted for Red-billed Starling and no additional measures are considered necessary.

A2.2.29 White-shouldered Starling *Sturnia sinensis*

A2.2.29.1 White-shouldered Starling is a conservation target of LMC EEA because of the significant numbers using the nest boxes provided for its use within LMC EEA in previous years. It is a secondary target in all compartments.

A2.2.29.2 White-shouldered Starling occurs throughout the year in Hong Kong; it was listed by Fellowes *et al.* (2002) as of Local Concern as a breeding species due to its localized and declining breeding population. Since then numbers have increased, largely because it has readily adopted nest boxes provided for its use within the LMC EEA (Carey *et al.* 2011).

A2.2.29.3 Management measures included continued provision and maintenance of nest boxes suitable for White-shouldered Starlings and monitoring of nest box use. There was no additional management measure proposed in the 2017 MRR.

A2.2.30 Bluethroat *Luscinia svecica*

A2.2.30.1 Bluethroat is a species impacted by the Project and is a primary target in Compartment C.

A2.2.30.2 Bluethroat is a winter visitor and spring migrant to Hong Kong, with most records occurring between the middle of November and late April. They were frequently found in wet agricultural areas and adjacent freshwater ditches and shrublands, and also reedbeds (Carey *et al.* 2001), but this is a cryptic and relatively mobile species, making it difficult to monitor accurately.

A2.2.30.3 Management measures included the provision of densely vegetated areas within the LMC EEA and within the Clean-up Reedbed. No additional measure is considered necessary for the species.

A2.2.31 Yellow-breasted Bunting *Emberiza aureola*

A2.2.31.1 Yellow-breasted Bunting is included as a conservation target of LMC EEA because of the increasing conservation concern over the plight of the species. This is a secondary target in Compartment C.

A2.2.31.2 Yellow-breasted Bunting is a common passage migrant and scarce winter visitor in Hong Kong (Carey *et al.* 2001). In Hong Kong, this species is mostly restricted to open country, wet and dry farmland, grassland in abandoned areas and landfill sites and the edges of reedbeds (Carey *et al.* 2001).

A2.2.31.3 No management measures specific for this species are proposed; though measures proposed for other species such as Burmese Python, Pallas's Grasshopper Warbler, Zitting Cisticola etc. would benefit the species.

A2.2.32 Japanese Yellow Bunting *Emberiza sulphurata*

A2.2.32.1 Japanese Yellow Bunting is a species impacted by the LMC Spurline and is a secondary target in Compartments B and C.

A2.2.32.2 This species is a scarce and irregular spring passage migrant (Carey *et al.* 2001), anecdotal evidence suggests that this species has declined since the 1990s. Records in Hong Kong have come from widespread areas but about half are from the Deep Bay area, the species occurs in a wide range of habitats including overgrown landfill sites, well vegetated fish pond bunds, in Horsetail Trees *Casuarina equisetifolia* with an extensive understorey of Lantana *Lantana camara*, in the edges of mangroves, agricultural land, and shrubland edges.

A2.2.32.3 Management measures included the provision of a mosaic of habitats in the form of marsh, well-vegetated bunds and reedbeds. However, given its wide variety of habitats and the sporadic nature of its occurrence in Hong Kong, the species is unlikely to be regular within the LMC EEA. No further management measure is proposed in the 2017 MRR.

A2.3 Herpetofauna Targets

A2.3.1 Chinese Bullfrog *Hoplobatrachus rugulosus*

A2.3.1.1 Chinese Bullfrog is impacted by the Project and is a primary target in Compartment C and a secondary target in Compartment B.

A2.3.1.2 Chinese Bullfrog is a large frog species thought to be in marked decline locally and in drastic decline regionally. It is a species closely associated with areas of wet agriculture, and breeds in ponds and marshes. Chinese Bullfrogs feed on insects and small frogs and rodents (Karsen *et al.* 1998). They will benefit from provision of permanent and, particularly, seasonal marsh habitat (from which predatory fish are absent), with good development of emergent and/or edge vegetation and variable, but generally shallow, depth. Presence of prey items such as odonate larvae and other frog species will also encourage establishment of this species.

A2.3.1.3 Management measures include the provision of marsh habitat, notably small seasonal ponds. As with the preceding species, a review of habitat conditions of ponds where this species is observed is proposed with a view to determining whether additional management measures would be beneficial. Suggestion made in the 2017 MRR was to provide small seasonal ponds, which was outstanding from the first five-yearly review.

A2.3.2 Reeves' Turtle *Mauremys reevesii*

- A2.3.2.1 Reeves' Turtle is included as a conservation target in the 2017 MRR since there was increasing number of records (although the number recorded is still low) within the LMC EEA. It is a secondary target species in all compartments.
- A2.3.2.2 Reeve's Turtle primarily inhabits reservoirs, ponds, rivers and slow-flowing streams in low-lying areas (Karsen *et al.* 1998). It feeds on fish and frogs and also carrion (Karsen *et al.* 1998).
- A2.3.2.3 This species is a very common food market species Hong Kong (Karsen *et al.* 1998) and has been suffered from over-exploitation for food and medicine, habitat degradation/loss (van Dijk 2011). It was once most common turtle in Hong Kong and has been largely replaced by the introduced Red-eared Slider (Karsen *et al.* 1998). Globally, this species was common and widespread, and now is considered as Endangered by IUCN (van Dijk 2011).
- A2.3.2.4 Existing habitats provided in the LMC EEA (e.g. ponds) are considered to be suitable for Reeves' Turtle. An additional management measure proposed in the 2017 MRR is to investigate the possibility of trapping Red-eared Slider to reduce the competition with Reeves' Turtle; however, it should be carefully considered (see **Section 4.4.3**).

A2.3.3 Chinese Soft-shelled Turtle *Pelodiscus sinensis*

- A2.3.3.1 Chinese Soft-shelled Turtle is impacted by the Project and is a secondary target in all compartments.
- A2.3.3.2 Chinese Soft-shelled Turtle is rare and localised in Hong Kong with a natural population restricted to fishponds around Deep Bay (Karsen *et al.* 1998). This species prefers ponds, reservoirs, slow-flowing lowland rivers and muddy places (Karsen *et al.* 1998); they are hard to detect as they spend much time buried in the mud but they also wander on land and will bask on mudbanks or floating logs. Eggs are buried in the mud banks of pond.
- A2.3.3.3 It was considered that by maintaining fishpond habitats within the LMC EEA, this would provide suitable conditions for this species. No further management measure is proposed in the 2017 MRR.

A2.3.4 Burmese Python *Python bivittatus*

- A2.3.4.1 Burmese Python is impacted by the Project and is a secondary target in Compartments B and C.
- A2.3.4.2 This species was considered a sub-species of *P. molurus* until 2009 when it was recognized as a full species (Jacobs *et al.* 2009). It is locally common in Hong Kong and prefers shrubland, woodland and the edges of mangroves (Karsen *et al.* 1998).
- A2.3.4.2 Management measures included the provision of well-vegetated bunds and island between Ponds 2a and 2b, around the western and northern portion of Compartment B, and retaining patches of longer grass and other herbaceous vegetation as refugia for this species and other less vagile taxa away from areas where routine-grass cutting is required. No additional management measures are proposed in the 2017 MRR.

A2.4 Dragonfly Targets

A2.4.1 Dragonfly Diversity

A2.4.1.1 Overall dragonfly diversity is a target for the LMC EEA but there are no species level targets for this group. Dragonflies are a primary target in Compartment C.

A2.4.1.2 Management measures included the provision of small seasonal ponds which dry out during the dry season, preventing the establishment of fish populations and removal of fish species from the marsh ponds. Where these small seasonal ponds are present, exuviae emergence should be monitored by means of exuviae traps/screens. The creation of small seasonal ponds, which was outstanding from the first five-yearly review, is proposed again in the 2017 MRR.

Appendix 3 Summary of the changes identified in the 2017 Management Review Report.

HCMP (Issue 16)	Proposed Changes in the 2017 MRR
Measures for Target Species	
Mammals	
Eurasian Otter <ul style="list-style-type: none"> • Evaluate usage of the artificial holts by the species, and/or construct an additional holt for the species. • Exclude dogs from entering the site. • n/a 	<ul style="list-style-type: none"> • Investigate current international best practice in detail with a view to future provision of one or more new artificial holts in the LMC EEA. • Improve the fencing of Compartments B and C to exclude dogs. • The findings of an on-going PhD study on Eurasian Otters, which covers the LMC EEA and is currently in progress, will be reviewed once they are available and taken into account where appropriate.
Leopard Cat <ul style="list-style-type: none"> • No particular management measures proposed but to evaluate the effect of the site boundary fence on its usage of the site. 	<ul style="list-style-type: none"> • Improve the fencing of Compartments B and C would also benefit Leopard Cat.
Birds	
Japanese Quail <ul style="list-style-type: none"> • Regular cutting of <i>Panicum maximum</i> to provide areas of short grass (10 – 30 cm tall) and also to encourage the growth of shorter grasses such as <i>Paspalum distichum</i> is required. 	<ul style="list-style-type: none"> • Grass cutting protocol in Section 5.6 should be followed.
Black-crowned Night Heron <ul style="list-style-type: none"> • Secondary target of Compartments B and C. 	<ul style="list-style-type: none"> • To be a secondary target species in Compartments A and B.
Chinese Pond Heron <ul style="list-style-type: none"> • Primary target of Compartments A and B. • n/a 	<ul style="list-style-type: none"> • Include the Chinese Pond Heron as a secondary target species of Compartment C. • To adjust count methodology to take into account roost counts.
Great Egret <ul style="list-style-type: none"> • n/a • n/a 	<ul style="list-style-type: none"> • Prolong drain-down of one to two ponds within Compartment B should egretry be established. • Winter drain down of pond commences in September such that some of the trash fish to be stocked in the winter months can be readily available

HCMP (Issue 16)	Proposed Changes in the 2017 MRR
	to Great Egret (instead of largely consumed by Great Cormorant in the deeper ponds).
<p>Little Egret</p> <ul style="list-style-type: none"> • Review drain down protocol in particular with the use of mobile pumps for the final stages of drain-down. • n/a • n/a • Establishment of marshland in Compartment C. • Monitored by tower and transect counts in the LMC EEA. 	<ul style="list-style-type: none"> • Undertake a review of water control system with a view to enhancing capacity to drain-down and otherwise manage water levels. • Partially drain one or more ponds prior to stocking with trash fish to maximize availability of food to shorter legged species, including Little Egret, and reduce proportion of fish being consumed by Great Cormorant. • Lengthen drain down schedule to cover peak count of Little Egret in the Deep Bay area i.e. July to September. • Consider whether Compartment C management can be adjusted to improve its attractiveness to Little Egrets without compromising current management objectives. • Adjust count methodology to take into account numbers of Little Egrets using the LMC EEA as a secure roost site.
<p>Eurasian Coot</p> <ul style="list-style-type: none"> • Secondary target of Compartment A. 	<ul style="list-style-type: none"> • Include as a primary target in Compartment A.
<p>Black-winged Stilt</p> <ul style="list-style-type: none"> • Provide elevated and/or floating islands as breeding sites and partial drain down of ponds if breeding occurs. 	<ul style="list-style-type: none"> • Delay refilling one or two ponds in Compartment B or drain down one or two marsh ponds in Compartment C in spring to encourage potential breeding birds to the LMC EEA.
<p>Pallas's Grasshopper Warbler</p> <ul style="list-style-type: none"> • It is a highly cryptic species and extremely difficult to monitor accurately. 	<ul style="list-style-type: none"> • Deploy trapping to investigate whether this species is systematically under recorded on site.
<p>Zitting Cisticola</p> <ul style="list-style-type: none"> • n/a 	<ul style="list-style-type: none"> • Collect more precise data on microhabitat utilisation in the LMC EEA and the CAs.
Herpetofauna	
<p>Chinese Bullfrog</p> <ul style="list-style-type: none"> • Provision of marsh habitat, notably small seasonal ponds 	<ul style="list-style-type: none"> • Provision of small seasonal ponds.

HCMP (Issue 16)	Proposed Changes in the 2017 MRR
Dragonflies	
Dragonfly Diversity <ul style="list-style-type: none"> Provision of small seasonal ponds; where these small seasonal ponds are present, monitor exuviae emergence by means of exuviae traps. 	<ul style="list-style-type: none"> Provision of small seasonal ponds and monitor exuviae emergence by means of exuviae traps in these ponds.
Revision on Target Species List and their Management Recommendations	
Yellow Bittern <ul style="list-style-type: none"> n/a 	<ul style="list-style-type: none"> Add as a target species.
Wood Sandpiper <ul style="list-style-type: none"> n/a n/a 	<ul style="list-style-type: none"> Add as a target species. Fine tune water levels of some marsh ponds in Compartment C in peak autumn passage period in late wet season (August/September) to ensure water is shallow enough.
Reeves' Turtle <ul style="list-style-type: none"> n/a n/a 	<ul style="list-style-type: none"> Add as a target species. Investigate trapping Red-eared Slider to reduce competition.
Survey Methodology	
Mammals <ul style="list-style-type: none"> n/a Traps should be set between June and September. 	<ul style="list-style-type: none"> Conduct small mammal trapping on an 'as needed' irregular basis. Schedule small mammal trapping other than the mid-summer to avoid heat stress to trapped animals.
Birds <ul style="list-style-type: none"> Roost count is undertaken once per month between November and March. n/a Monitored by tower and/or transect counts in the LMC EEA. Monitored by tower and/or transect counts in the LMC EEA. 	<ul style="list-style-type: none"> Conduct monthly roost count throughout the year as a trial for a year. Conduct monthly late-afternoon count (consists of one tower and one transect counts in the afternoon) as a trial for one late summer/winter period. Investigate the possibility to conduct trapping to record the cryptic bird species. Include the number of birds recorded during the tower and transect count, late-afternoon count and roost count into calculating the bird

HCMP (Issue 16)	Proposed Changes in the 2017 MRR
	density of LMC EEA.
Dragonflies <ul style="list-style-type: none"> • n/a 	<ul style="list-style-type: none"> • Conduct exuviae emergence monitoring on traps/ screens, if seasonal ponds are created.
Fish Stock <ul style="list-style-type: none"> • Mean standard length based on a sample of 100 fish. 	<ul style="list-style-type: none"> • Measure the standard length of 50 fish samples during the stocking events.
Tree Monitoring <ul style="list-style-type: none"> • Tree survey and monitoring of all existing trees, including planted or naturally established young/semi-mature trees and seedlings, should be undertaken annually. • Tree survey and monitoring of all existing trees, including planted or naturally established young/semi-mature trees and seedlings, should be undertaken annually. • n/a 	<ul style="list-style-type: none"> • Conduct comprehensive tree monitoring as instructed by MTR Corporation. • Identify hazardous trees, particularly those on the major access tracks, and those requiring immediate management actions (e.g. growth may affect power lines) annually. • Conduct tree monitoring in early dry season.
Water Quality and Hydrology <ul style="list-style-type: none"> • Water quality should be measured in each pond once before the monthly site meeting for temperature, pH, salinity and dissolved oxygen. 	<ul style="list-style-type: none"> • Discontinue routine monthly monitoring of temperature, salinity and dissolved oxygen; to be measured only under special circumstances.
Management Strategy	
Water Management <ul style="list-style-type: none"> • n/a 	<ul style="list-style-type: none"> • Replace large pumps which are worn out or do not function properly.
Water Capacity <ul style="list-style-type: none"> • n/a 	<ul style="list-style-type: none"> • Take rainfall forecast into account and plan ahead to avoid water deficiency.
Fish Stocks <ul style="list-style-type: none"> • n/a • Mean standard length based on a sample of 100 fish. 	<ul style="list-style-type: none"> • Investigate the possibility to source and stock smaller trash fish of approximately 5cm. • Measure standard length of 50 fish samples in each stocking event.
Bund Vegetation <ul style="list-style-type: none"> • n/a 	<ul style="list-style-type: none"> • Frequency of grass cutting of marsh area (Ponds 12, Ponds 14 – 22)

HCMP (Issue 16)	Proposed Changes in the 2017 MRR
<ul style="list-style-type: none"> • n/a 	changed to once per month during the dry season <ul style="list-style-type: none"> • Increase resources for vegetation management.
Structural Management <ul style="list-style-type: none"> • Damage to bund, including grasscrete track, should be rectified prior to the onset of the wet and dry seasons. 	<ul style="list-style-type: none"> • The rectification works of bund damage should be done as soon as practicable.
Control of Access and Prevention of Unauthorized Access <ul style="list-style-type: none"> • n/a 	<ul style="list-style-type: none"> • Enhance the site security to reduce illegal access.
Feral Dogs <ul style="list-style-type: none"> • n/a 	<ul style="list-style-type: none"> • Extend the dog-proof fence, with the provision of mammal passes for small mammals, to the whole LMC EEA.
Golden Apple Snail <ul style="list-style-type: none"> • n/a 	<ul style="list-style-type: none"> • Use of baited Apple Snail trap for collecting Apple Snails as a trial.

Appendix 4 Method of calculating bird target ratio.

A4.1 Data Collection

A4.1.1 Data are collected either from tower counts or on transects; survey methodologies detailed in **Section 5**.

A4.1.2 The area of the site used in calculations includes not only the surface area of the fishponds, but also the intervening bunds, which are considered integral to the ecological function of the wetland, and are the primary habitat for many of the species recorded. The areas used for calculation are provided in **Table 2**.

A4.2 Abundance at LMC EEA, MPST CA and ST CA

A4.2.1 The weekly value for the LMC EEA is the sum of the abundance recorded during the tower and transect counts. During the week when the afternoon bird count or roost count is undertaken, the count utilised to calculate bird ratio is whichever of the tower/transect count and the afternoon bird count/roost count for each species which is highest.

A4.2.2 The weekly abundance for Mai Po San Tsuen and San Tin is the total number of individuals recorded on the weekly site transect.

A4.3 Density at LMC EEA, MPST CA and ST CA

A4.3.1 The density of each site is the abundance recorded divided by the area of the corresponding site.

A4.3.2 For the overall CA density, the abundances at MPST and at ST are added and then divided by the total area of both CAs. This is not the same as the average of the densities at each CA, and takes into account the fact that ST is a larger site than MPST.

A4.4 Weekly Calculation of Achievement of Targets

A4.4.1 Achievement of targets is assessed by the ratio of the density at LMC EEA to the density in the CAs. For numerical target species (refer to **Table 1**), targets are achieved if this value is 2 or above.

A4.5 Annual Calculation of Targets

A4.5.1 A long-term running average is calculated for the mean density during the preceding year. Weekly densities are calculated as described above; the annual target level is calculated from the mean of these densities.

A4.6 Non-numerical Targets

A4.6.1 Since these species were not impacted by the project, no numerical target will be set for these species. The number of each target record will be reported for management decision.

Appendix 5 Three levels response to Avian Influenza at Lok Ma Chau Ecological Enhancement Area.

Wetland Avian Influenza Warning 濕地禽流感警告

Level I : INCIDENT 一級戒備：個別事件級別

- Individual Bird Infected
個別雀鳥感染到禽流感
- No Entry Permitted without Authorization
未有授權，不得內進



Avoid touching birds, bird nests,
eggs, feathers and droppings
避免接觸雀鳥、鳥巢、鳥蛋、
羽毛及雀鳥糞便



Wear protective gears, if
necessary
如有須要，載上保護裝備



Wash hands before leaving
離開前洗手



Sign in and out on logbook
進入或離開前簽寫日誌



Wetland Avian Influenza Warning 濕地禽流感警告

Level II : OUTBREAK 二級戒備 : 爆發級別

- Several Cases of Birds Infected
多隻雀鳥感染到禽流感
- Keep Away From Wetland
遠離濕地
- No Works Allowed
不得內進工作
- No Entry Permitted without Authorization
未有授權，不得內進



Wetland Avian Influenza Warning 濕地禽流感警告

Level III : EPIDEMIC 三級戒備：疫症級別

- Large Scale of Birds Infected
大規模雀鳥感染到禽流感
- Keep Away From Wetland
遠離濕地
- No Works Allowed
不得內進工作
- No Entry Permitted
不得內進



Appendix 6 Methodologies of additional ecological monitoring.

In the event where additional ecological monitoring is required, the monitoring methodologies should follow the sections below. The following items are covered in these appendix:

- Dragonfly emergence at the LMC EEA;
- Aquatic invertebrates at the LMC EEA;
- Benthic invertebrates at the LMC EEA;
- Pedology at the LMC EEA;
- Laboratory testing on water quality in the event of pollution or other conditions of concern.

A6.1 Monitoring of Dragonfly Emergence at the LMC EEA

A6.1.1 Habitat use and breeding activity of odonates should also be recorded, as well as evidence of breeding success in the form of final instar larval exuviae, which shall be collected and identified. Exuviae emergence traps/screens should be set up at created seasonal ponds or other suitable ponds (e.g. marsh ponds). Eight traps/screens are to be used in each pond, unless the ponds are too small in size where less traps/screens can be installed depends on site conditions. The traps/screens should be inspected twice per week between April and September and collect all exuviae for subsequent identification and counting.

A6.2 Monitoring of Aquatic Invertebrates

A6.2.1 Sweep-netting is used to sample aquatic species in the water column and clinging to vegetation at the water-bund interface. The sweep-net is a D-shaped net of 30cm diameter with a 1mm mesh. Each sample comprises two 2-metre sweeps of the net from which all captured specimens are collected for identification. The first sweep is carried out at the water surface and the second as close to the pond bed as possible. Each set of sweeps is taken along the water-bund interface. Five randomly located replicate samples are taken from each pond.

A6.2.2 The number of each macro-invertebrate species is ascertained for each replicate sample for all taxa groups. A total dry weight biomass is determined for each of the above groups.

A6.2.3 The number and species of any fish captured incidentally during the sampling are also recorded.

A6.2.4 The monitoring should be undertaken once per year at the end of the wet season (August/September) at each fish pond, and twice per year at the end of the wet season and the dry season (March/April) in the marsh and reedbed ponds.

A6.3 Monitoring of Benthic Invertebrates

A6.3.1 Cylindrical benthic cores 10cm in diameter and 10cm depth are taken from the substrate at the base of the ponds to obtain quantitative data on benthic invertebrate populations. Five randomly located replicate cores are collected from each pond shallows. Core contents are bagged and stored in a cooler for subsequent sorting. Samples are analysed

as for sweep netting.

A6.3.2 The monitoring should be undertaken once per year at the end of the wet season (August/September) at each fish pond, and twice per year at the end of the wet season and the dry season (March/April) in the marsh and reedbed ponds.

A6.4 Monitoring of Pedology

A6.4.1 If instructed, pond sediments shall be monitored in each pond yearly in the early wet season. At least three sediment samples shall be collected from each pond and sent to a HOKLAS accredited laboratory for analysis. The following parameters shall be monitored:

- Volatile solids (percent organic matter content);
- Oxidation/Reduction (Redox) potential (mV);
- pH;
- Total nitrogen (mg N/kg);
- Total organic carbon (mg/kg);
- Total phosphorus (mg/kg);
- Total reactive phosphorus (mg/kg).

A6.5 Laboratory Testing on Water Quality

A6.5.1 In the event of specific event/circumstance where detailed analysis of water quality is required, three samples from the pond(s) in question are to be collected and sent to a HOKLAS accredited laboratory for analysis. The following parameters shall be monitored:

- Ammoniacal nitrogen (mg/L);
- Biochemical oxygen demand (mg O₂/L);
- Total oxidised nitrogen (mg/L);
- Total phosphorus (mg/L);
- Total reactive phosphorus (orthophosphate) (mg/L);
- Turbidity (mg/L).

A6.5.2 If water pollution is suspected in any fish ponds, reedbeds or marshlands in the LMC EEA, and if instructed by the representative from the MTR Corporation, additional water samples will be taken and sent to a HOKLAS accredited laboratory for analysis which shall include monitoring the water quality parameters listed above and also some additional parameters, such as:

- % Volatile Solids (%)
- Ammonia-N (mg/L)
- Biochemical Oxygen Demand (mg O₂/L)
- Chemical Oxygen Demand (mg O₂/L)
- Flouride (mg/L)
- MBAS (mg/L)
- Hydrogen Sulphide (mg/L)
- Oil and Grease (mg/L)
- Sulphide (mg/L)
- Total Organic Carbon (mg/L)
- Total Aluminum (ug/L)
- Total Antimony (ug/L)
- Total Arsenic (ug/L)
- Total Barium (ug/L)
- Total Copper (ug/L)
- Total Cyanide (ug/L)
- Total Iron (ug/L)
- Total Lead (ug/L)
- Total Manganese (ug/L)
- Total Mercury (ug/L)
- Total Molybdenum (ug/L)
- Total Nickel (ug/L)
- Total Oxidised Nitrogen (mg/L)
- Total Phosphorous (mg/L)
- Total Reactive Phosphorus (mg/L)
- Total Silver (ug/L)
- Total Solids (mg/L)
- Total Suspended Solids (mg/L)

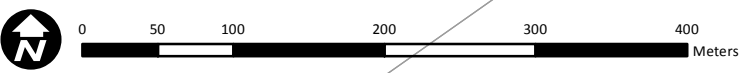
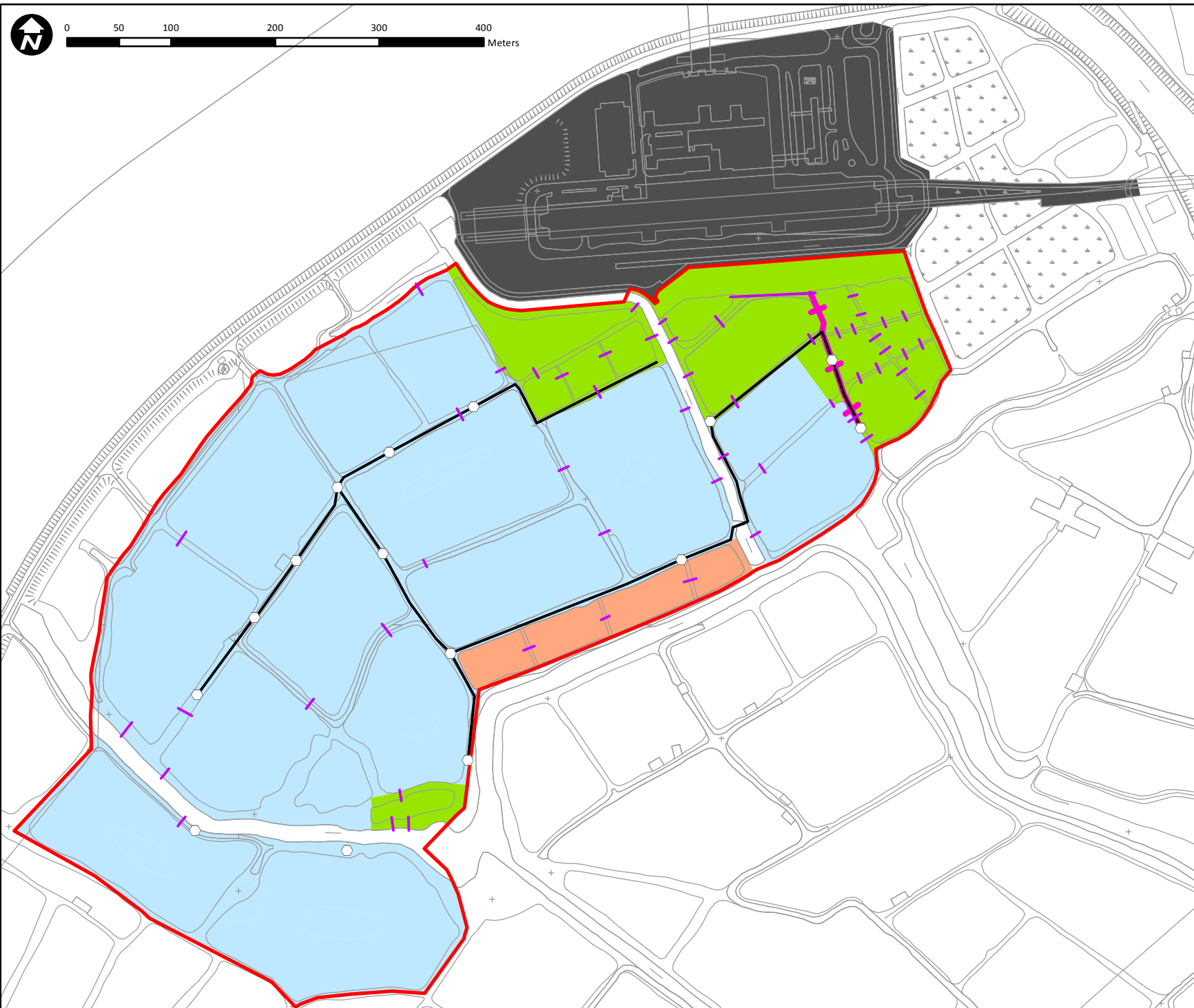
- Total Beryllium (ug/L)
- Total Boron (ug/L)
- Total Cadmium (ug/L)
- Total Chromium (ug/L)
- Total Thallium (ug/L)
- Total Vanadium (ug/L)
- Total Zinc (ug/L)

Appendix 7 Action and limit levels of ecological issues at LMC EEA.

Ecological Attribute	Action Level	Limit Level	Action Plan / Contingency Plan (where appropriate)
Habitats			
Proportion of LMC EEA consisting of wetland habitats	<90% with surface water, hydric soils and vegetation dominated by obligate or facultative wetland plants	<75% with surface water, hydric soils and vegetation dominated by obligate or facultative wetland plants	Adjust water management to increase wetland area/ regrade to enlarge ponds area
Proportion of ponds under an active drain-down regime in Compartments A and B	<70% of ponds under an active drain-down regime with conditions suitable for fish stocking	<50% of ponds under an active drain-down regime with conditions suitable for fish stocking	Bring ponds into active management regime by manipulation of water levels and water quality and fish stocking
Proportion of shallow water in ponds in Compartments A and B	<20% of the fishpond area (excluding bunds) consists of water <50 cm depth	<10% of the fishpond area (excluding bunds) consists of water <50 cm depth	Lower water levels in short term/ regrade bunds in long term
Vegetation Cover			
Percentage of bunds with vegetation cover	<20% of internal bunds with vegetation cover	<10% of internal bunds with vegetation cover	Planting or hydro-seeding
	>30% of internal bunds with vegetation cover > 10 cm height	>50% of internal bunds with vegetation cover > 10 cm height	Cutting
Percentage of pond sides with vegetation cover in Compartments A and B	<20% of pond sides with vegetation cover	<10% of pond sides with vegetation cover	Planting or hydro-seeding
	>40% of pond sides with vegetation cover	>50% of pond sides with vegetation cover	Cutting or stocking with herbivorous fish
Percentage of ponds with vegetation cover in Compartments A and B	<10% of pond area with vegetation cover	<5% of pond area with vegetation cover	Planting or hydro-seeding
	>20% of pond area with vegetation cover	>30% of pond area with vegetation cover	Cutting or stocking with herbivorous fish
Percentage of undesirable / exotic plant species	>10% of vegetation in ponds/ on pond sides or on bunds	>20% of vegetation in ponds/ on pond sides or on bunds	Cutting or stocking with herbivorous fish
Plant Community Composition and Structure			
Proportion of wetland plants in Compartment C	<80% of vegetation facultative or obligate wetland plants	<60% of vegetation facultative or obligate wetland plants	Amend vegetation management regime/ Planting
Numbers of Target Bird Species			
Numbers of target bird species	Performance target for any species not met for any three consecutive months	Performance target for any species not met in any twelve month period	Review adaptive management regime / accelerate attraction measures e.g. stocking / drain-down
Abundance / Diversity of Invertebrate			
Species richness and diversity of aquatic invertebrates	Numbers or diversity <75% sample in previous comparable season in any pond/ marsh/ reedbed area	Numbers or diversity <50% sample in previous comparable season in any pond/ marsh/ reedbed area	Adjust water quality/ vegetation cover/ adjust drain-down regime
Species richness and diversity of benthic invertebrates	Numbers or diversity <75% sample in previous comparable season in any	Numbers or diversity <50% sample in previous comparable season in any	Adjust water quality/ adjust drain-down regime

Ecological Attribute	Action Level	Limit Level	Action Plan / Contingency Plan (where appropriate)
	pond/ marsh/ reedbed area	pond/ marsh/ reedbed area	
Non-bird Fauna			
Species richness and diversity of dragonflies	Numbers or diversity <75% of previous wet season	Numbers or diversity <50% of previous wet season	Adjust water and vegetation management regime/ use experience to adjust LMC EEA design
Species richness and diversity of reptiles and amphibians	Numbers or diversity <75% of previous wet season	Numbers or diversity <50% of previous wet season	Adjust water and vegetation management regime/ use experience to adjust LMC EEA design
Hydrology			
Per cent surface water	Surface water is present over <90% of the pond area except during programmed drain-down periods	Surface water is present over <75% of the pond area except during programmed drain-down periods	Pumping to redistribute water
Wet and dry season surface water level for ponds	Water level in pond between 70 cm and 20 cm < lowest point on bund	Water level in pond between 40 cm and 10 cm < lowest point on bund	Pumping to redistribute water
Dry season water capacity	Water capacity <40%	Water capacity <30%	Conserve water; no discharge off-site until water capacity reaches above Action Level.
Water Management			
Mean salinity	Salinity >1 pp thousand	Salinity >3 pp thousand	Water mixing/ drain and refill; review causes of problem, prepare and implement contingency plan if problem persists
Mean pH – Compartments A and B	pH outside range 6.0 – 8.5	pH outside range 5.5 – 9.0	Lime/ add peanut residue/ mix water/ drain and lime
Mean pH – Compartment C	pH outside range 3.5 – 6.5	pH outside range 3.0 – 7.0	Lime/ add peanut residue/ mix water/ drain and lime
Mean dissolved oxygen	Dissolved oxygen <1.0 mg/l	Dissolved oxygen <0.5 mg/l	Amend fertilisation and stocking regime/ pump and mix water/ aeration
Mean ammonia concentration	>0.1 mg/l	>0.3 mg/l	Avoid fish stocking until restored, water mixing
Mean total oxidised nitrogen concentration	>0.1 mg/l	>0.3 mg/l	Avoid fish stocking until restored, water mixing, water changing
Mean total phosphorus concentration	>0.5 mg/l	>1.0 mg/l	Avoid fish stocking until restored, water mixing, water changing
Mean orthophosphate concentration	>0.01mg/l	>0.03 mg/l	Avoid fish stocking until restored, water mixing, water changing

Document Path: Y:\mtrc-lmwr2\4-Reporting\7-RCMP\LMC\Issue 17 (2018)\version 2\Figures\mxd\Figure 1_habitat_water_control_structures_20180330.mxd



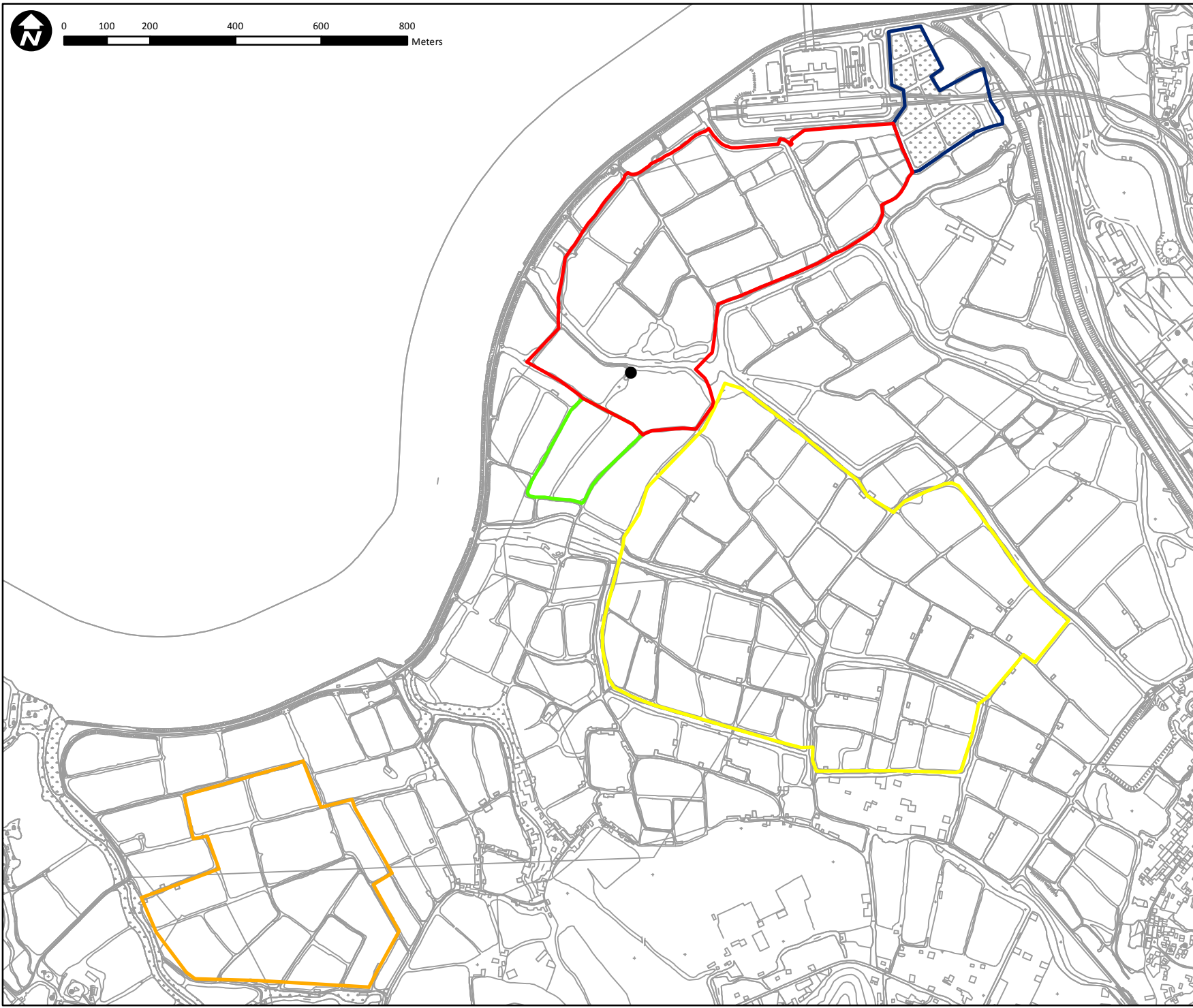
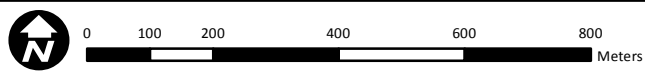
- LMC EEA Boundary
- Pond
- Marsh
- Reedbed
- LMC Spur Line and Station
- uPVC Overflow Pipe
- Metal Arterial Pipe
- 4" pipe (for marsh area)
- Catchpitch Incorporating Valve Pit Type I (depending on location in the system)



Project Title:
 Contract No. M1070-13C
 Ecological Monitoring and Adaptive Management
 Advice Services for Lok Ma Chau and West Rail Wetlands

Figure Title:
 Habitat Management and Water Control Structures
 within Lok Ma Chau Ecological Enhancement Area

Drawn by: JH	Scale: 1:5,000 on A4
Checked by: EW	Date: 02 May 2018
Approved by: MRL	
Figure Number: Figure 1	Revision: 0



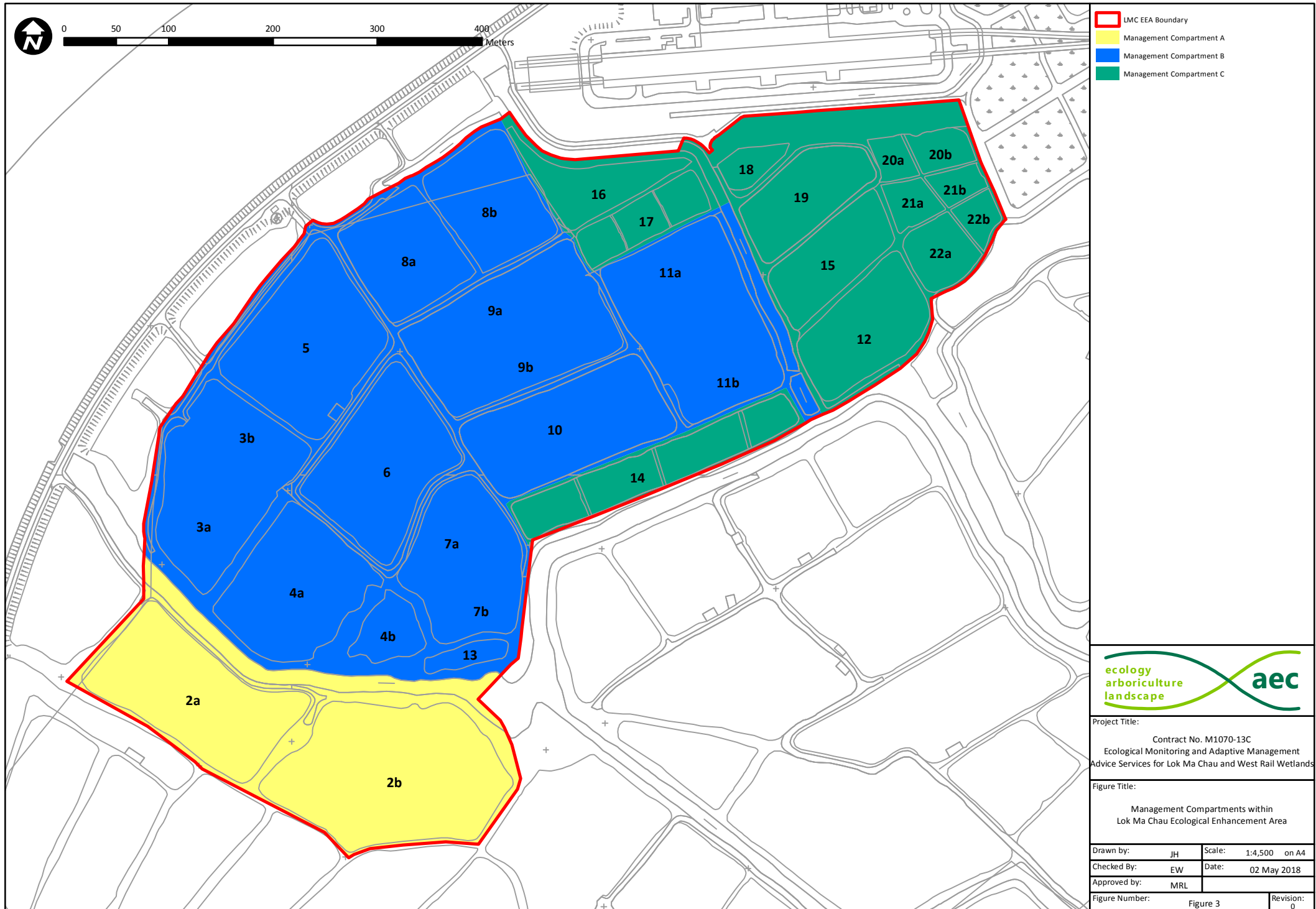
- LMC EEA Boundary
- LMC Pond 1
- San Tin Control Area
- Mai Po San Tsuen Control Area
- Clean-up Reedbed
- Observation Tower



Project Title:
Contract No. M1070-13C
Ecological Monitoring and Adaptive Management
Advice Services for Lok Ma Chau and West Rail Wetlands

Figure Title:
Locations of the LMC EEA, LMC Pond 1, Control Areas
and Clean-up Reedbed

Drawn by:	JH	Scale:	1:12,000 on A4
Checked By:	EW	Date:	02 May 2018
Approved by:	MRL		
Figure Number:	Figure 2	Revision:	0



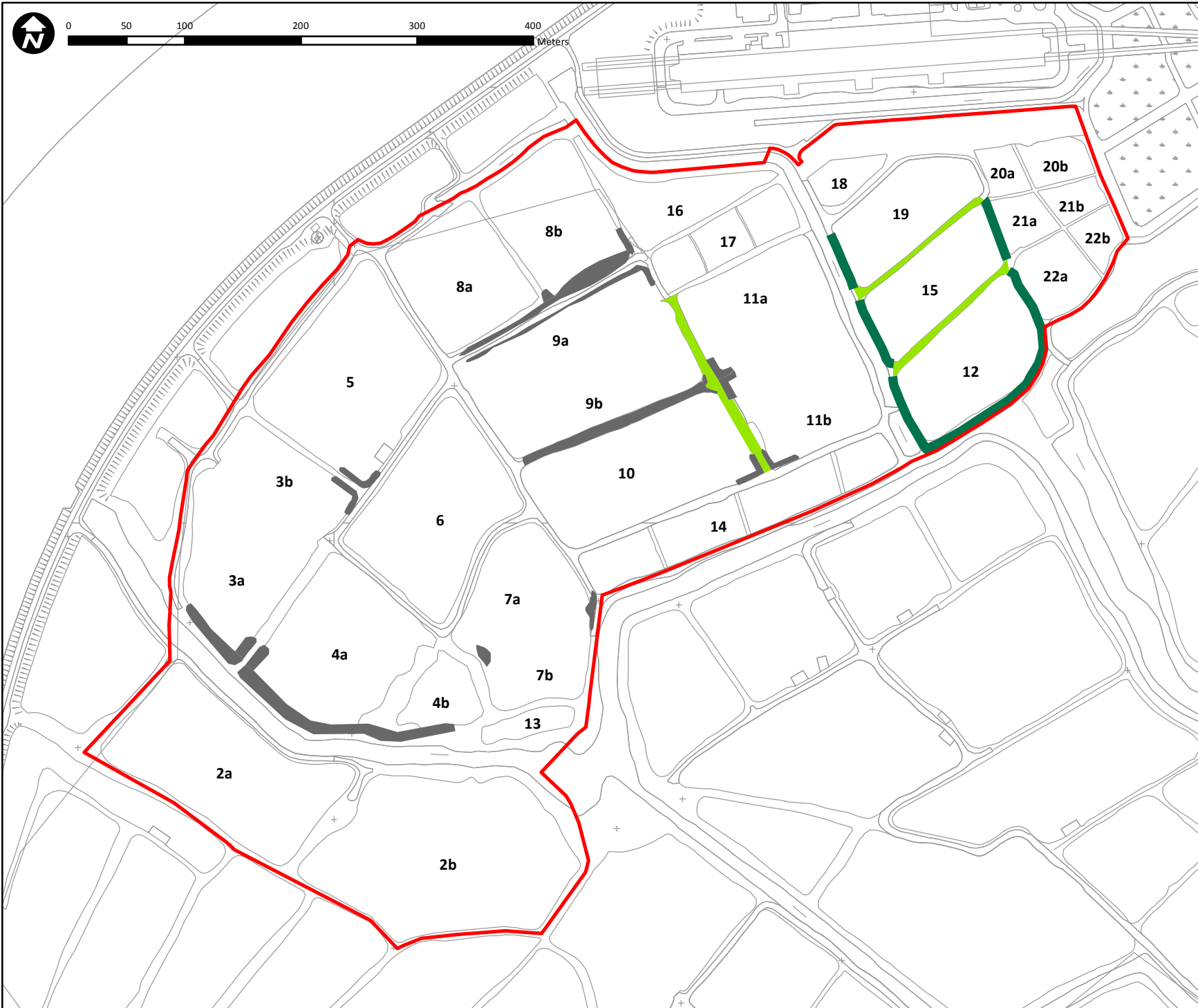
- LMC EEA Boundary
- Management Compartment A
- Management Compartment B
- Management Compartment C



Project Title:
 Contract No. M1070-13C
 Ecological Monitoring and Adaptive Management
 Advice Services for Lok Ma Chau and West Rail Wetlands

Figure Title:
 Management Compartments within
 Lok Ma Chau Ecological Enhancement Area

Drawn by:	JH	Scale:	1:4,500 on A4
Checked By:	EW	Date:	02 May 2018
Approved by:	MRL		
Figure Number:	Figure 3	Revision:	0



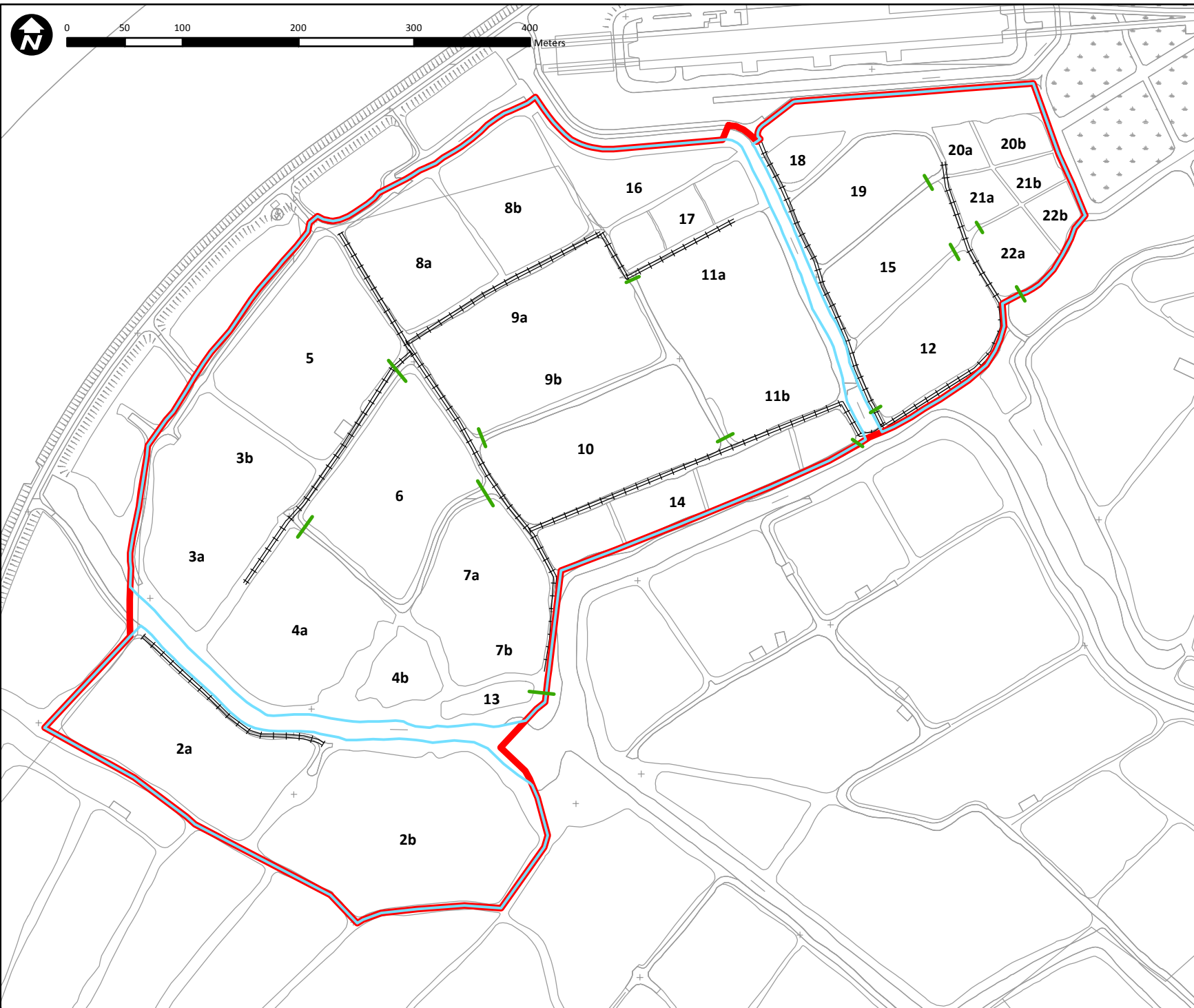
- LMC EEA Boundary
- Long Grass
- Short Grass
- Refugia Area







Project Title:
 Contract No. M1070-13C
 Ecological Monitoring and Adaptive Management
 Advice Services for Lok Ma Chau and West Rail Wetlands

Figure Title:
 Location of Refugia and Areas of Long and
 Short Grass to be Maintained within
 Lok Ma Chau Ecological Enhancement Area

Drawn by:	JH	Scale:	1:4,500 on A4
Checked By:	EW	Date:	02 May 2018
Approved by:	MRL		
Figure Number:	Figure 4		Revision: 0



-  Post and Chain Barrier
-  LMC EEA Boundary
-  Site Boundary Fence
-  Grasscrete Track



Project Title:
 Contract No. M1070-13C
 Ecological Monitoring and Adaptive Management
 Advice Services for Lok Ma Chau and West Rail Wetlands

Figure Title:
 Locations of Site Boundary Fence, Grasscrete Tracks
 and Chain and Post Barriers within Lok Ma Chau
 Ecological Enhancement Area

Drawn by:	JH	Scale:	1:4,500 on A4
Checked By:	EW	Date:	02 May 2018
Approved by:	MRL		
Figure Number:	Figure 5		Revision: 0