3 ECOLOGY

3.1 INTRODUCTION

3.1.1.1 This section describes the ecological baseline of the Eastern Main Drainage Channel for San Tin, and assesses the potential ecological impacts associated with that project, based on the alignment and design assumptions presented in *Section 2*. Mitigation measures are recommended where necessary, and residual impacts are assessed.

3.1.1.2 This section does not discuss in detail the ecological impacts of the PVPS-35CD construction projects, as those were addressed in the Working Paper for 35CD Works (dated 24 October 1997) which was produced at an earlier stage of this EIA study. However, this report does address mitigation for ecological impacts of those projects, as specified in the Working Paper. The reason for separation of the impact assessment from the mitigation proposals is that the PVPS-35CD works contracts had been finalised and works were underway prior to commencement of this EIA study.

3.1.1.3 Ecological impacts of the Western Main Drainage Channel for San Tin are dealt with separately and at a lower level of detail, in *Annex 1-C* of this report. That project is as yet non-itemized and is not subject to a full Environmental Impact Assessment under this study.

3.2 ENVIRONMENTAL LEGISLATION AND GUIDELINES

3.2.1.1 Many international and local regulations, ordinances and guidelines provide the framework for the protection of species and habitats of ecological importance. Those related to the current project are presented in this section.

3.2.1 Hong Kong Legislation and Guidelines

3.2.1.2 Hong Kong government ordinances and regulations relevant to the present project include the following:

- **The Forests and Countryside Ordinance (Cap. 96)**, which protects both natural and planted forests (including mangroves). The Forestry Regulations, subsidiary legislation, protect listed local wild plant species.

- **The Wild Animals Protection Ordinance (Cap. 170)**, which provides for protection of listed species of wild animals by prohibiting the disturbance, taking or removal of animals or their nests or eggs. The Ordinance also provides for habitat and wildlife protection at certain sites, Yim Tso Ha and the Mai Po Marshes, via restriction of human entry.

- **The Town Planning Ordinance (Cap. 131)**, which provides for the drawing up of statutory plans to control development, including the conservation of areas such as Sites of Special Scientific Interest (SSSIs), Conservation Areas, and Coastal Protection Areas to protect natural features, and includes the prohibition of pond filling without planning permission for some zones.

- **The Environmental Impact Assessment Ordinance (Cap. 499)**, which provides a legislative foundation for the EIA process. The associated **Technical Memorandum on Environmental Impact Assessment Process** (the "TMEIAP") provides guidance on the criteria and methodology for ecological impact assessment in Hong Kong, and provides criteria for assessing the ecological importance of sites, habitats and species.

3.2.1.3 The study also makes reference to the following guidelines and other documents of Hong Kong Government:

- **Hong Kong Planning Standards and Guidelines** (HKPSG) Chapter 10, "Conservation", which provides guidelines on incorporating nature conservation objectives into landuse planning and new development.

- **Guidelines for Implementing the Policy on Off-site Ecological Mitigation Measures** (PELB Technical Circular 1/97, Works Branch Technical Circular 4/97, dated 17 February 1997). This Technical Circular sets out guidelines for implementation of Government policy on ecological mitigation measures, both on-site and off-site.

- The **Deep Bay Guidelines**, prepared as part of the Deep Bay Environmental Management Review, which outline measures intended to ensure that dredging, reclamation and drainage works in Deep Bay respect the environmental value and sensitivity of the area.

- **Town Planning Board Guidelines for Application for Developments Within Deep Bay Area Under Section 16 of the Town Planning Ordinance** (Town Planning Board 1999), which provides development guidelines for development proposals within the Deep Bay Wetland Conservation Area and Wetland Buffer Area.

3.2.2 *Mainland Legislation*

3.2.2.1 The People's Republic of China in 1988 ratified the Wild Animal Protection Law of the PRC, which lays down basic principles for protecting wild animals. The law prohibits killing of protected animals, controls hunting, and protects the habitats of wild animals, both protected and non-protected (Article 34). The law also provides for the creation of lists of animals protected at the state level, under Class I and Class II. Class I provides a higher level of protection for animals considered to be more threatened. In 1988 the State Council of the PRC ratified the State Protected Terrestrial Wildlife List (Hua and Yin 1993), which included 96 animal species in Class I and 156 in Class II. Many of these species occur in Hong Kong.

3.2.3 *International Conventions*

3.2.3.1 The study takes note of the following international agreements:

- *Ramsar Convention;*
- *Bonn Convention;* and
- *United Nations Convention on Biological Diversity.*

Ramsar Convention

3.2.3.2 The Convention on Wetlands of International Importance Especially as Waterfowl Habitat (the *Ramsar Convention*) currently applies to Hong Kong as a

Special Administrative Region of the PRC. The Convention requires parties to conserve and make wise use of wetland areas, particularly those supporting waterfowl populations (Article 3.1). "Wise use" of wetlands is defined as "their sustainable utilization for the benefit of mankind in a way compatible with the maintenance of the natural properties of the ecosystem". The primary concern of the Convention is the welfare of wetlands and the waterfowl dependent on them.

3.2.3.3 Article 1 of the Convention defines wetlands as 'areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters'. All river, stream, pond, marsh, mangrove and mudflat habitats upstream of, within and downstream of the study area, whether natural or artificial, qualify as wetlands under this definition.

3.2.3.4 Hong Kong's first Ramsar Site, or Wetland of International Importance under the Ramsar Convention, was declared at Mai Po Marshes and Inner Deep Bay in 1995.

Bonn Convention

3.2.3.5 The Convention on the Conservation of Migratory Species of Wild Animals (the *Bonn Convention*) has two major objectives:

- to provide strict protection for species listed in Appendix I of the Convention (migratory species in danger of extinction throughout all or a significant portion of their range); and
- to encourage Range States for such species to conclude agreements for the conservation and management of Appendix II species (migratory species which have an unfavorable conservation status and require international agreements for their conservation, or which have a conservation status which would significantly benefit from international co-operation).

3.2.3.6 The first objective includes obligations to conserve and restore those habitats which are important in removing the species from danger of extinction, and to prevent, remove, compensate for or minimize the adverse effects of activities or obstacles that impede or prevent migration of the species. The 5 species below are listed in Appendix I of the Bonn Convention and occur in the Deep Bay area of Hong Kong:

Dalmatian Pelican	*Pelecanus crispus*
Chinese Egret	*Egretta eulophotes*
Oriental White Stork	*Ciconia boyciana*
Relict Gull	*Larus relictus*
Saunders' Gull	*Larus saundersi*

3.2.3.7 The second objective deals with agreements for conservation of Appendix II species. At present no agreements of this type are relevant to Hong Kong.

3.2.3.8 Hong Kong was originally a Party to the Convention through the United Kingdom. The Convention continues to apply to Hong Kong after 1 July 1997 by agreement of the Sino-British Joint Liaison Group, though the PRC is not a party thereto.

Convention on Biological Diversity

3.2.3.9 The PRC is a Contracting Party to the Convention on Biological Diversity of 1992. The present study takes note primarily of Article 8 of the Convention, which states (Para (c)) that each Contracting Party shall regulate or manage biological resources important for the conservation of biological diversity whether within or outside protected areas, with a view to ensuring their

conservation and sustainable use. Paragraph (d) of Article 8 adds that each Contracting Party shall promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings.

3.2.3.10 The UK did not extend application of the Convention to Hong Kong, and the PRC has not yet extended its application to Hong Kong. However, the Hong Kong Government has stated that it is "committed to meeting the environmental objectives" of the Convention (PELB 1996).

3.3 STUDY METHODOLOGY

3.3.1.1 The purpose of the ecological studies was to establish an ecological baseline for the area adequate to allow assessment of its ecological value and to predict ecological impacts of the project. The following methods were used to determine and evaluate baseline ecological conditions.

3.3.1 Literature Review

3.3.1.2 A literature review was conducted to identify and summarise previous ecological studies of the area. Literature reviewed which described the project area and adjacent Deep Bay area included Irving and Morton (1988), Melville and Morton (1983), Scott (1989), Lu (1990), ERM (1996), Hyder (1997), Peking University (1995) and Young (1995). Literature review was used to identify key ecological issues, sites of potential ecological interest, and potential sources of cumulative impacts.

3.3.1.3 Baseline data on avifauna at San Tin were reviewed in work by Britton (1993), Chu (1995), Melville *et al.* (1994), Wong (1991), Young (1993), Young and Cha (1995), Young and Chan (in press) and Collar *et al.* (1994). Data collected from winter waterfowl counts by the Hong Kong Bird Watching Society for the years 1990 through 1995 (except 1991) were also reviewed.

3.3.2 Ecological Field Survey

3.3.2.1 The baseline ecological surveys conducted for this study were focused on the following objectives:

- ground truthing and updating existing information in the study area on a seasonal basis; and
- providing detailed information on the habitats and species to be impacted directly by the construction and operation of the proposed channel on a localized scale (i.e. along the width of the proposed channel).

Channel Corridor Survey (CCS)

3.3.2.2 The purpose of the Channel Corridor Survey (CCS) was to provide specific information on the ecological resources which would be directly impacted by the Eastern MDC, in a format readily accessible to the designers. Because a key function of the wetlands within the area is the support of resident and migratory birds, the approach focused on habitat use by birds within the area.

3.3.2.3 The survey technique was adapted from the River Corridor Survey (RCS), which has been used widely in the UK (National Rivers Authority 1992), except that 1:1000 scale engineering maps were enlarged from 1:5000 plans due to unavailability of 1:1000 scale plans. Plans used to define the CCS survey area were the most updated available in spring 1997, immediately prior to commencement of the survey. All other definitions are the same as those used in the RCS, but the survey corridor width was set at 150 m (50 m from either side of the channel, which was 45 m wide). The channel was broken down into 9 sections for CCS purposes, as marked in red in *Figure 3.3a*. The overall CCS study area is shown in *Figure 3.3b*. The alignment has been revised slightly since the CCS sections were delineated, as shown by inspection of *Figure 3.3a*, but given the small degree of modification and the fact that almost the entire revised alignment falls within the CCS survey boundary, the survey results are considered to remain valid and adequate for baseline and impact assessment purposes. The entire channel alignment was surveyed twice, on 20 and 28 May 1997. Habitat and vegetation types, physical features and the presence of other features of ecological importance were marked along the proposed alignment. Ecologically sensitive receivers and areas of potential ecological importance were then identified from the CCS maps.

Habitat Mapping and Survey

3.3.2.4 Habitat mapping was based on 1997 Government aerial photographs, and validated in the course of 1997 and 1998 field surveys. Boundaries of the works areas were determined using Engineering Maps at 1:1000 and 1:20000 scale. Habitat maps were developed to cover the area within 500 m to either side of the Eastern MDC alignment.

3.3.2.5 Surveys to characterise habitats outside the immediate CCS area but within the works boundary were also conducted. Since the composition of the plant communities within the study area was considered unlikely to show prominent seasonal variation, surveys were conducted during summer (20, 22, 23 May; 4 June; 9 Sep. 1997) and winter (3 Feb. 1998) to account for structural changes in the communities (e.g. coverage). A stratified sampling approach was used to ensure coverage of all major habitat types found in the study area. Habitat types were delineated based on the most current government aerial photographs and field reconnaissance. Representative habitats were described according to predominant vegetation cover types using point transects.

3.3.2.6 Two representative sites from the Eastern MDC area were selected for focused survey and ecological evaluation. Site 1 was CCS Section 4 and Site 2 was CCS *Section 7*. Locations of these sites are shown in *Figure 3.3a*. Sites were selected based on the varied ecological habitats present and the representative nature of these habitats in terms of the mix of fish ponds, marsh, and tree belt woodland. Detailed habitat surveys were performed at these sites in summer (23 May, 4 June 1997) and winter (2, 3, 8 Feb. 1998). All plant species observed (including ferns, gymnosperms and angiosperms) were identified and recorded to species

level when possible. Quantitative sampling was used to estimate mean height of vegetation by measuring vegetation height at arbitrarily selected points within the habitat which were considered representative of the type. In pond bund and marsh habitats, cover of each species was estimated by sampling within 5 quadrats arbitrarily placed along a line transect. Each quadrat was square in shape, and measured 50 cm on a side.

3.3.2.7 Belt transects were sampled to characterise stands of trees in plantations along the San-Sham Road. Species, canopy height, planting distance and diameter at breast height (dbh) were observed and recorded.

Avifauna

3.3.2.8 Birds were chosen as a key indicator of the ecological importance of the San Tin area and made the subject of a 12-month field study because:

- the study area is close to the Mai Po Marshes, the Ramsar Site, and to Deep Bay which are all recognised as internationally important areas for avifauna;
- they represent the highest trophic level in the food web;
- they are present all year round and different parts of their annual cycle can be readily observed;
- they are easy to observe, and most are easy to identify;
- their current and historical status within the SAR is the best known of all wildlife groups; and
- they are generally considered to have high conservation value (for example, all wild birds are protected by law in Hong Kong).

3.3.2.9 Bird usage of the fish ponds within part of the study area was addressed to some extent in the Shenzhen River Regulation Project (SRRP) Stages 1 and 2 EIA (Peking University 1995). However, the SRRP Stages 1 and 2 EIA did not address the dynamics of bird abundance on fish ponds during the drainage cycle in winter months when birds are most abundant. More recently, Planning Department's Study on Ecological Value of Fish Ponds in Deep Bay Area investigated the ecology of the ponds in the San Tin area in greater detail. However, results of that study were not available for use in this study, and field studies were therefore designed specifically for this project.

3.3.2.10 Field studies for this study were designed to provide detailed, systematic bird sampling to supplement existing information. The key objective of sampling was to evaluate and where possible quantify bird usage of the study area on a local scale, particularly to note areas of high ecological value to birds. Field studies focused on wetland-dependent species. That bird use of areas is not homogeneous within predominantly fish pond habitats was recognised, and the extent of local variation was established as far as possible by recording data to relatively small areas (usually an individual pond). Seasonal changes in habitat utilisation were also assessed.

3.3.2.11 Within the bird community found on fishponds, ardeids (birds of the family Ardeidae, or herons and egrets) were selected as the primary indicators of ecological value because:

- they are the most abundant wetland dependent species group present within the study area;

- their high conservation value within the SAR is officially recognised (e.g. through designation of numerous egretries as SSSIs);

- they are present in the Deep Bay area throughout the year, utilising fishponds (and other wetland habitats) in different ways during the course of the year.

3.3.2.12 Bird surveys were carried out over a 12-month period to account for seasonality of avifauna presence and abundance. Bird surveys were conducted on the following dates: April 8, 16, 23, 30; May 8, 13, 21, 26; June 3, 10, 16, 26; July 1, 9, 21, 24; August 9, 14, 22, 28; Sep. 2, 11, 15, 25; Oct. 1, 8, 22, 29; Nov. 6, 11, 19, 30; Dec. 4, 10, 15, 21, 31, 1997; and Jan. 6, 16, 20, 30; Feb. 5, 13, 18, 25; Mar. 2, 9, 20, 24, 1998. Surveys were undertaken in an area delimited by a boundary 200 m from either side of the Eastern MDC alignment, as shown in *Figure 3.3b*. On each visit to the study area, all bird species present at each pond and selected non-fish pond habitats (streams/nullahs and open storage areas) were counted by species, and the counts were then recorded onto a data sheet. The sampling effort for each fish pond was standardised in terms of time spent observing. The same sampling techniques were employed to survey fish ponds along two alignment options for the proposed (but as yet non-itemized) Western MDC. For the purposes of this report, the Western MDC survey area is taken as a control site to which to compare the Eastern MDC. Surveys at the control site (Western MDC) included ponds in an area delimited by a boundary 200 m from the west edge of the western option and the east edge of the eastern option of the Western MDC, as these two options were identified at the outset of this study.

3.3.2.13 Each pond was taken to include any exposed bank and the surrounding bunds. Weather conditions were recorded for each visit, and once per season bund vegetation was recorded. Visits which were cut short due to adverse weather conditions were excluded from data analysis.

3.3.2.14 Differences in ardeid distribution and pattern of use were analysed as follows:

- by species
- as a comparison of the fish ponds in the Eastern MDC and the control site (proposed Western MDC area);
- per fishpond

3.3.2.15 For each season, the mean number of ardeids counted per visit was calculated by species to yield a mean number of birds per visit per season. This enabled assessment of patterns of temporal variation in the abundance of some ardeids. The mean per season was calculated for both the Eastern MDC fishponds and those in the control site. It should be noted that there are considerably more fish ponds in the control site area (47) than the Eastern MDC area (18). To eliminate this difference the mean per fish pond per season (mean per pond) for all ponds of both channel areas was calculated. Comparison of the mean count per pond enabled analysis of spatial and, to a degree, temporal changes in ardeid abundance within the study area.

Other Vertebrates

3.3.2.16 Surveys were conducted to document the presence of reptile, amphibian, mammalian and aquatic fauna in the study area. The entire channel alignment

was covered during surveys. Field and stream channel surveys covered spring 1997 through winter 1997-98. Survey dates were 6 Mar.; 20, 22, 28 May; 4 June; 24 Aug.; Sept. 9, 1997; and 2 Feb. 1998.

3.3.2.17 Fauna was recorded during field surveys by walking pond and stream bunds. Animals seen or heard were identified to species. Signs of animals (e.g. tracks, burrows and droppings) were also noted and identified where possible. The presence of large or medium-sized mammals was investigated through searching for tracks, droppings and burrows during summer and winter months. Both daytime and nighttime surveys were undertaken, to record diurnal and nocturnal species. A boom microphone and tape recorder were used to record amphibian calls, which were later identified to species. Searches for herpetofauna were also made along pond margins, and in and around buildings. Local residents were also consulted regarding presence of mammals and other wildlife. Field data were analysed to investigate abundance and habitat utilization of wildlife species in the study area.

Invertebrate Fauna

3.3.2.18 Invertebrate surveys were conducted on 28 May, 4 June and 9 Sep. 1997. Invertebrate surveys focused on Odonata (dragonflies and damselflies), as key wetland representative species. Non-systematic surveys of adult odonates were conducted through visual observation and photography. Lepidopterans (butterflies only) were also surveyed by visual observation along the channel alignment. Odonata and Lepidoptera are readily identifiable groups of species for which species rarity and habitat requirements are relatively well known in Hong Kong. Butterflies were recorded by visual survey along the channel alignment.

3.3.2.19 Surveys were conducted for chironomid flies, an important food resource for birds (Cheng 1993). Chironomids were collected in sweep nets with a 1.5 mm mesh size. Fifteen sweeps were made at arbitrarily selected locations within two grass and two reed habitats along the channel alignment. Chironomid sampling sites for the Eastern MDC are shown in *Figure 3.3a*.

3.4 BASELINE CONDITIONS

3.4.1 *Protected Areas and Recognised Sites of Conservation Importance*

Restricted Area

3.4.1.1 The Mai Po Marshes together with associated mangroves and mudflats are a Restricted Area under the Wild Animals Protection Ordinance. This area lies approximately 3 km west of the project site. Entry to this area is restricted year-round to holders of permits issued by AFD, to protect waterbirds and other wildlife. It is thus the best-protected nature conservation area in Hong Kong.

Ramsar Site

3.4.1.2 In September 1995 the Hong Kong Government declared the Mai Po Marshes and Inner Deep Bay a Wetland of International Importance, or Ramsar Site. On the landward side, the Ramsar Site covers the Mai Po Marshes and considerable areas of fish ponds around Inner Deep Bay. On the seaward side, the Ramsar Site extends to the southern edge of the main navigation channel serving the

Shenzhen River. Designation of this area as a Ramsar Site was based on a number of criteria under the Ramsar Convention:

- the Deep Bay mangroves are the sixth largest remaining on the China coast;
- the area supports a number of rare or endangered species;
- the area holds over 20,000 waterbirds; and
- the area holds over 1% of the world populations of 11 species of waterbirds.

3.4.1.3 The SAR Government has obligations to protect the integrity of the Ramsar Site, as well as other important wetlands within its boundaries, under the Ramsar Convention, and a Management Plan for the Ramsar Site has recently been completed. A monitoring programme for the Ramsar Site is currently under development.

3.4.1.4 The Ramsar Site lies downstream from the study area, approximately 1.5 km distant at the nearest point. It is potentially subject to impacts arising from water quality or sediment quality degradation resulting from construction or operation of the project.

3.4.1.5 Birds and other fauna which occupy the Ramsar Site also use the surrounding wetlands of the North-west New Territories (Peking University 1995), thus are potentially subject to impacts such as habitat loss or degradation resulting from construction or operation of the project. For example, in January 1998 18.4% of the world population of Black-faced Spoonbill *Platalea minor* wintered at the Ramsar Site. This species has been shown to have a foraging radius of 8-9 km from primary roost sites (Kuo in press) in Taiwan. The whole of the San Tin area lies within 8 km from the Hong Kong population's roost site at Mai Po, and Black-faced Spoonbills have been recorded in fish ponds in western San Tin. This species is ranked in the "Critical" category (survival most threatened) by Collar *et al.* (1994), with an estimated world population of only 613 in 1998 (Dahmer and Felley in prep.).

Sites of Special Scientific Interest (SSSIs)

3.4.1.6 The designation of SSSI is given in Hong Kong in order to mark sites of special biological or geological value. The designation, if made under the relevant statutory town plans, has legal status under the Town Planning Ordinance. SSSIs lying close to the study area are, in rough order of increasing distance from the site:

3.4.1.7 Mai Po Village (SSSI No. 16) lies approximately 2 km west of the project site. This site is an egretry of at least 40 years continued occupation (Young and Cha 1995). Possible direct threats to this site were identified in Anon.(1995) as "road widening, building and similar development". Young and Cha (1995) identify the most significant threat to this egretry as "loss of the birds' fish pond feeding habitat", a trend which has been related to a decline in the numbers of breeding Little Egrets *Egretta garzetta* at the egretry.

3.4.1.8 Mai Po Marshes (SSSI No. 10) lies approximately 3 km west of the project site at its closest point (Anon. 1995). The site includes Hong Kong's largest stands of mangroves, most extensive mudflats and largest annual influxes of migratory and overwintering waterbirds. The ecological importance of this area has been exhaustively documented (e.g. Peking University 1995). Nearby housing developments and infilling of fish ponds are two threats to the SSSI cited in Anon. (1995) which are still relevant. In addition, the welfare of this SSSI

depends heavily on the condition of the Shenzhen River and other streams feeding Deep Bay.

3.4.1.9 Inner Deep Bay (SSSI No. 46), at 2300 ha Hong Kong's largest SSSI, lies approximately 3 km west of the Eastern MDC. Its landward boundary is adjacent to the seaward boundary of the Mai Po Marshes SSSI. This SSSI is of ecological importance for its mangroves, mudflats and shallow water habitats and of economic importance for its aquaculture activities. Inner Deep Bay, together with the Mai Po Marshes SSSI, is essential to the survival of tens of thousands of migrating, overwintering or breeding waterbirds (Peking University 1995). Potential direct threats to this SSSI are identified in Anon. (1995) as mangrove felling and dredging; indirect threats are identified as discharge of pollutants into the bay.

Other Planning Categories

3.4.1.10 A Wetland Conservation Area (WCA) and Wetland Buffer Area (WBA) have been designated around the SAR side of Inner Deep Bay and the lower Shenzhen River by the Town Planning Board in order to protect the important ecological value of fish ponds and other wetland habitats in the Deep Bay Area from incompatible development. The WCA covers "all existing continuous and adjoining active/abandoned fish ponds in the Deep Bay Area", while the WBA "generally comprises the strip of land of about 500m wide along the landward side of the WCA" (*ibid.*). Under the Town Planning Board guidelines on developments in these areas, new development in the WCA "would not be allowed unless it is required to support the conservation of the ecological value of the area or the development is an essential infrastructural project with overriding public interest" (*ibid.*). The latter category can include drainage projects. The guidelines also require wetland compensation for "any development involving pond filling" (*ibid*). The scope of allowable developments in the WBA is wider, though such developments should not have unmitigable negative impacts on the ecological value of the WCA. The northernmost three quarters of the Eastern MDC would lie within the WCA, and the remainder would lie within the WBA (*Figure 2.5a*).

3.4.1.11 Statutory landuse zones of Conservation Area and Green Belt occur in and around the study area. Like the SSSI, these categories derive their legal status from the Town Planning Ordinance Cap. 131 and are indicated on Development Permission Area (DPA) plans or Outline Zoning Plans (OZPs).

- Conservation Area is intended "to retain existing natural features and rural use" (Planning Dept. 1995).

- Green Belt is intended "to define the limits of urban development area by conserving landscape features" (*ibid.*), and as such is not strictly an ecological category.

3.4.1.12 The Outline Zoning Plan (OZP) that covers the study area is San Tin OZP S/YL-ST/1.

3.4.2 *Baseline Conditions of the Eastern MDC Area*

Channel Corridor Survey and Habitat Survey

3.4.2.1 The Eastern MDC alignment (as it stood at spring 1997) was divided into 9

sections, each approximately 200 m in length, for purposes of the CCS. Field surveys were conducted to 50 m either side of each section to identify key habitats and fauna that could be affected by the alignment. CCS record sheets and accompanying photographs for the 9 sections are presented in *Annex 3-A*, identifying the major ecological features of the sections. A map of the channel alignment showing the location of each section and each focused study site is given in *Figure 3.3a*.

3.4.2.2 As shown in the CCS record sheets, the southernmost end of the survey area was characterised by sites of minimal ecological interest (Sections 1, 2), while the remainder of the alignment was of moderate ecological interest (Sections 3-9). The reduced ecological value of the southernmost areas was due to construction works, channelisation and concrete reinforcement of nullahs, and high levels of pollution and human disturbance. This gradient of ecological importance was reflected in such findings as lower bird species richness at the southern vs. the northern end of the channel, and the absence of fish from all but the northernmost areas of stream and nullah, probably due to pollution.

3.4.2.3 The CCS area consisted of habitats which were predominantly man-made or man-modified. These included fish ponds, stream, marsh, and plantation woodland. The different habitat types identified through field survey are discussed in turn below.

Fish Ponds

3.4.2.4 Fish ponds were divided into "active", i.e. ponds in active operation (including ponds being drained down), and "abandoned", i.e. ponds not in active operation. Many of the fish ponds within the Eastern MDC study area were active and stocked with carp. Other species stocked included mullet, tilapia and snakehead. A few abandoned fish ponds were located in Sections 8 and 9. The abandoned pond in Section 9 had been drained for SRRP Stage 2 construction, which was underway during the course of field studies for this project.

3.4.2.5 Most pond bunds were grassy and appeared to be actively managed by spraying and trimming of vegetation. Some pond bunds were planted with trees including *Melia azedarach* and *Albizia lebbeck*. Various fruit trees including *Clausena lansium* and *Dimocarpus longan*, along with grasses and weeds including *Paspalum* spp. and *Bidens pilosa*, were also present on pond bunds.

3.4.2.6 Some fish ponds located in Section 4 were filled by earth works during mid- to late 1998, while ponds nearby in Section 3 and 5 were abandoned. Some of those ponds were filled illegally, and some under short-term permits for temporary use as container storage sites until the year 2001, when they will be required for construction of the Eastern MDC.

Stream/Nullah

3.4.2.7 The existing drainage network in the area consisted of constructed channels or nullahs which were subject to tidal influence via the Shenzhen River. These were lined with concrete in Sections 1 and 2 and unlined in the other sections. During the course of survey, water quality was poor along the whole stream; the water was black, odorous, stagnant, and overgrown with *Eichhornia crassipes* which dominated the aquatic zone. In the unlined sections the stream and its banks supported a dense cover of grasses and herbs such as *Panicum maximum* and *Mikania micrantha*.

Marsh

3.4.2.8 The stream channel in Sections 3 to 7 was bordered mainly by marshes. In Section 8, the marsh was maintained by tidal backflow from the Shenzhen River. Although the marshes were fed by the highly polluted stream, they appeared to have slightly better water quality than the stream. This may have been partly attributable to the natural water quality purification process which is typical of marsh habitats. Dominant species were *E. crassipes, Phragmites communis* and *Panicum* spp.

Woodland

3.4.2.9 A belt of plantation woodland dominated by *Casuarina equisetifolia* was recorded along the border road on the east of the proposed channel. The trees were planted as part of the landscaping project for the Lok Ma Chau border crossing. A small woodland of mixed native and exotic species was located in Section 8. The characteristics of the habitat are described in the results of the Focused Habitat Surveys, below.

Focused Habitat Survey

3.4.2.10 Sections 4 and 7 of the CCS were chosen for focused habitat survey based on the varied ecological habitats present at these two sections, and the representative nature of the habitats in terms of the mix of fish ponds, marsh, and tree belt woodland (*Figure 3.3a*).

Site 1 (CCS Section 4)

3.4.2.11 A survey undertaken in May 1997 identified the dominant habitats at Site 1 as stream and nullah, pond bund, marsh, and woodland belt (adjacent land use). These habitats are characterised below.

3.4.2.12 The physical condition of the stream at Site 1 was characteristic of the whole stream channel as discussed above. The stream was shallow (less than 10 cm at time of survey), with a muddy bed. No aquatic invertebrates were recorded in the stream.

3.4.2.13 Plant species recorded at Site 1 are listed in *Annexes 3-B* and *3-C*. Four species of grasses, herbs and shrubs were recorded on the grassy bunds of fish ponds, with a total coverage of more than 100%. Most of the pond bunds were dominated by *Panicum maximum*. A few pond bunds were sparsely planted with *Ipomoea batatas*, which formed a low, even cover. Average height of the vegetation was approximately 1 m, and the stands of vegetation were dense and lush.

3.4.2.14 The marsh was similar to the stream in terms of species composition. *E. crassipes* grew in areas of standing water, whilst *Panicum* sp. and *Mikania micrantha* dominated the drier margins.

3.4.2.15 Trees in the *C. equisetifolia* plantation woodland at Site 1, planted at about 1.5 m spacing, had a canopy height of about 7 m, and averaged approximately 8 cm dbh. A second tree species, *Hibiscus tiliaceus*, had been interplanted in small numbers, while herbs including *Chenopodium album* and *Commelina nudiflora* colonised the ground.

3.4.2.16 Site 1 was re-sampled on 2nd February 1998. At that time the site was disturbed

by earthworks. The fish ponds had been filled and partially concreted. The marginal zone of the stream and the pond bund vegetation had been denuded. The woodland belt was also partially cleared, while the remaining plantation was covered with dust, probably from construction traffic. The stream and marsh at Site 1, however, were left intact. The stream bed was still overgrown with *E. crassipes*.

Site 2 (CCS Section 7)

3.4.2.17 Habitats at Site 2 included fish pond, marsh and woodland. Most of the fish ponds at Site 2 were active, and the bund vegetation also appeared to be actively managed.

3.4.2.18 Plant species recorded at Site 2 are listed in *Annexes 3-B* and *3-D*. Fourteen species of common grasses and herbs were recorded on grassy pond bunds, with a total coverage of more than 100%. Average height of the vegetation was approximately 0.3 m in summer and 0.15 m in winter. Number of species, percentage cover and average height of the vegetation at the pond bunds decreased in winter, probably due to seasonal variations in air temperature and precipitation. *Digitaria* sp. dominated the bunds during the summer survey, but was replaced by *Cynodon dactylon* and *Imperata cylindrica* during the winter survey.

3.4.2.19 Five species of grasses and herbs were recorded near the marsh with a coverage similar to that of the grassy pond bund. Average height of the vegetation in the marsh was about 1.5 m, indicating the dominance by tall grasses and reeds including *Panicum maximum* and *Phragmites communis*. Number of species, percentage cover and average height of the vegetation in the marsh decreased in winter, probably due to seasonality of air temperature and precipitation. The inflorescences of two dominant species *P. maximum* and *P. communis* contributed to the height of the plots in summer, but not winter.

3.4.2.20 The *Casuarina equisetifolia* woodland belt at Site 2 had been planted at about 1 m spacing and had grown to a canopy height of about 7-10 m with an average dbh of about 14 cm. Another tree species, *Hibiscus tiliaceus*, had been interplanted in small numbers while some weeds and climbers such as *Ipomoea cairica* colonised the ground. The woodland belt remained the same during the winter survey, with the exception that the trees were covered with dust from nearby road traffic and earthworks.

Vegetation

3.4.2.21 Thirty plant species, consisting mainly of common and widespread species, were recorded from field surveys along the bunds sampled. Plant species recorded are listed in *Annexes 3-B - 3-D*. No plant species known to be protected, rare or endangered were recorded within the study area. Overall, there was a lack of plant community structure due to frequent clearance of the bunds for pond maintenance. This conclusion supported that reached in earlier studies of lowland vegetation in the North-west New Territories, as reported by Chu (1995).

Avifauna

Wetland-dependent Birds Recorded during Bird Surveys

3.4.2.22 Wetland-dependent bird species recorded in the Eastern MDC survey area are listed in *Annex 3-E(2)*. A total of 48 wetland-dependent species were recorded. Half of these, or 24 species, are considered uncommon and 1 species is considered rare in Hong Kong (Viney *et al.* 1994). The rare species, Tufted Duck *Aythya fuligula*, is reported to be declining locally due to habitat loss (*ibid.*).

3.4.2.23 Four wetland-dependent species were recorded breeding on the site: Little Grebe, White-breasted Waterhen, Common Kingfisher and Pied Kingfisher. Other observations were of foraging or roosting birds.

Birds Recorded during Channel Corridor Survey

3.4.2.24 Birds observed during the CCS for the Eastern MDC are recorded in the Record Sheets (*Annex 3-A*). Species records reflect the difference between the southern part of the alignment, where human disturbance, degree of stream channelisation and water pollution were highest, and the northern part, where environmental conditions were better. The most disturbed and polluted areas at the southernmost end of the alignment supported only species such as Tree Sparrow and Crested Myna, opportunists which are able to exploit a wide diversity of habitats. The more northerly areas, which had generally lower disturbance and less polluted water conditions, supported a higher level of bird species richness.

3.4.2.25 Wetland-dependent birds were recorded during CCS surveys along the channel alignment, primarily in and around fish ponds. Species recorded included White-breasted Waterhen, Pheasant-tailed Jacana, Common Kingfisher, and the following ardeid species: Yellow Bittern, Night Heron, Chinese Pond Heron, and Little Egret. Night Heron, Chinese Pond Heron and Little Egret breed at the Mai Po Village egretry (Young and Cha 1995).

3.4.2.26 The most notable bird record made during the CCS was a Pheasant-tailed Jacana *Hydrophasianus chirurgus*, recorded at Section 7 on 20 May 1997. The record was of a single immature bird on a fish pond bund. This was one of only four sites where the species was recorded in 1997 (the others being Ho Sheung Heung, Mong Tseng and Ngam Pin (H. Kwok, T. Dahmer, and P. Leader, unpubl. data)). Pheasant-tailed Jacanas formerly bred in Hong Kong, but they no longer do so due to destruction of marshes which provided suitable breeding habitat (Viney *et al.* 1994). The species is now considered rare in Hong Kong and is also rare in Guangdong (Wu *et al.* 1988).

3.4.2.27 Insectivorous bird species which made use of fish ponds, pond bunds and other habitats supporting abundant insect fauna were House Swift, Barn Swallow, prinias, Common Tailorbird and Rufous-backed Shrike.

Background: Bird Communities in the San Tin Area as a Whole

3.4.2.28 The Eastern MDC occupies only a moderate area, but is part of one of the largest expanses of wetlands remaining in Hong Kong. This section discusses the importance of the San Tin area as a whole to birds, based on literature review and field studies that covered both the Eastern MDC and areas to the west thereof.

3.4.2.29 Literature review: Birds recorded in the Lok Ma Chau and San Tin areas as reported in the Hong Kong Bird Report for 1990-1995 are listed in *Annex 3-E*. The designation "Lok Ma Chau" in the Hong Kong Bird Report refers generally

to the area between San Tin and Ma Tso Lung. Species which were recorded along the San Tin drainage channels in late March 1996 (Hyder 1997) are listed in the second-to-last column of *Annex 3-E(1)*.

3.4.2.30 This study: Species recorded in the San Tin area (including both the Eastern MDC and the non-itemized Western MDC area) during bird surveys for this project are listed in the last column of *Annex 3-E(1)*. (This annex lists results of bird surveys, which were conducted separately from the CCS surveys reported in paragraphs 3.4.2.24 to 3.4.2.27 above.) These surveys recorded a total of 126 bird species in the Eastern and Western MDC study areas at San Tin. This represents 28% of the 450 bird species recorded within the SAR since 1958. Of these, 61 (48%) are wetland dependent species and 24 (19%) were recorded breeding (Annex 3-E(3) and 3-E(4) respectively). The high percentage of non-resident species recorded (69%) attests to the high ecological value of fishpond habitat for migratory birds. The most apparent value of the fishpond habitat is for piscivorous species, notably ardeids that forage in fish ponds throughout the year.

3.4.2.31 In terms of bird species richness, the value of the San Tin area as a whole is high. The only available comparison is with Mai Po Marshes (MPM). During 1995, 223 species were recorded by ten observers on frequent visits to the MPM. The 126 species recorded in the San Tin area represent 56% of the total recorded at Mai Po Marshes during 1995. In view of the lower habitat diversity at San Tin as compared to MPM (absence of extensive mangroves and intertidal mudflats at San Tin), and the protected status of MPM afforded by its designation as a Restricted Area, the fact that San Tin supports over half the species richness of MPM is testament to the high quality of bird habitat at San Tin. Given the differences in habitats at the two areas; differences in coverage and number of observers; and in particular the fact that Mai Po Marshes is managed primarily for wildlife, the San Tin area is considered to have a high bird species richness.

3.4.2.32 *Table 3.4a* lists important bird species which have been recorded in the San Tin area under this study or previous work, and discusses their conservation significance based on the criteria set forth in *Table 3, Annex 8* of the TMEIAP: protection status, distribution and rarity. Species recorded on the Eastern MDC alignment during surveys for this project are marked with an asterisk (*).

Table 3.4a ***Conservation Significance of Bird Species Recorded in the San Tin Area***

Species	Ecological Conservation Significance
Bittern	Locally rare [1]
Chinese Pond Heron *	Locally declining [1]
Little Egret *	Regionally declining [2]
Great Egret *	Globally declining [1]
Cattle Egret *	Locally declining [1]
Black-faced Spoonbill	Critical [3]
Tufted Duck *	Locally rare and declining [1]
Imperial Eagle *	Uncommon [1]; Vulnerable [3]; Class I protected species under Mainland law
Greater Spotted Eagle *	Vulnerable [3]; Class II protected species under Mainland law
Bonelli's Eagle	Class II protected species under Mainland law
Black-eared Kite	Class II protected species under Mainland law
Black-shouldered Kite	Uncommon [1]; Class II protected species under Mainland law
Northern Sparrowhawk	Class II protected species under Mainland law
Crested Goshawk	Class II protected species under Mainland law

Species	Ecological Conservation Significance
Kestrel	Class II protected species under Mainland law
Eastern Marsh Harrier	Class II protected species under Mainland law
Common Buzzard *	Class II protected species under Mainland law
Grey-faced Buzzard Eagle	Class II protected species under Mainland law
Peregrine Falcon	Class II protected species under Mainland law
Osprey *	Class II protected species under Mainland law
Black Vulture	Near-threatened [3]; Class II protected species under Mainland law
Grey-headed Lapwing	Near-threatened [3]; locally declining [1]; Class II protected species under Mainland law
Pheasant-tailed Jacana *	Locally uncommon; locally extinct as breeding species [1]
Lesser Coucal	Class II protected species under Mainland law
Asian Barred Owlet	Class II protected species under Mainland law
Hoopoe	Locally uncommon [1]
White's Thrush	Locally uncommon [1]
Pallas's Grasshopper Warbler *	Locally uncommon [1]
Booted Warbler	Vagrant (sole Hong Kong record at San Tin)
Black-naped Oriole	Locally uncommon, declining [1]
Red-billed Starling	Globally near-threatened [3]
Purple-backed Starling	Locally uncommon [1]
All birds and their nests	Protected under Wild Animals Protection Ordinance (Cap. 170).

*: recorded on Eastern MDC alignment during field surveys for this project.

Sources:
1: Viney *et al.* (1994)
2: Young and Cha (1995)
3: Collar *et al.* (1994)

Ardeid Use of the Study Site

3.4.2.33 Fish ponds provide important food resources to a variety of birds, particularly piscivorous species. Study of bird use of fish ponds focused on ardeids, since these species forage in the study area all year round. Their reliance on ponds is best known during the breeding season, and access to productive, undisturbed feeding areas during the breeding season is essential for a successful ardeid colony, such as the one located at Mai Po Village (SSSI).

3.4.2.34 The mean number of ardeids in winter (mean per visit during winter) was compared between the Eastern MDC alignment and the control site (Western MDC area) to establish whether the control site supported more ardeids than the Eastern MDC during winter, or whether the two areas supported equal numbers. Analysis showed that the ardeid abundance was higher in the control site during winter.

3.4.2.35 The greater winter abundance of ardeids in the control site could be attributable to the much larger number of fish ponds along the alignment rather than to the lower levels of disturbance. To account for this possibility, the mean numbers of birds per pond per visit during winter in the Eastern MDC alignment and the control site were compared. Results of comparison showed that the abundance of ardeids per pond per visit was higher at the control site than along the Eastern MDC alignment during winter.

3.4.2.36 In summary, fewer ardeids utilised the fishponds in the Eastern MDC area, and the abundance of ardeids was significantly higher in the control site during winter. Given the complex nature of factors affecting the ecological value of fishponds, it is impossible to isolate a single factor to explain why one area

supported more birds than another even when an attempt was made to take into account the relative sizes of the areas. A number of factors are considered relevant in the present case, including:

- Disturbance from the Lok Ma Chau Border Crossing (much higher at the Eastern MDC than at the control site);
- Distance from the nearest egretry (Mai Po Village egretry, much closer to the control site); and
- Habitat fragmentation (more significant at the Eastern MDC due primarily to the San-Sham Road and the Lok Ma Chau border crossing).

3.4.2.37 The reader is referred to *Annex 3-F* for a fuller discussion of these points.

3.4.2.38 Given the operation of these three factors and the fact that the Western MDC survey area was some 2 to 3 times the size of the Eastern MDC survey area, the Western MDC is far from an ideal control site for bird survey purposes. However, given the initial design of the bird survey work to compare the relative ecological importance of these two areas, it was decided to retain the findings of the comparison in this final report for information purposes. It must be emphasized that the obvious relatively higher importance of the Western MDC area to herons and egrets does not imply a lack of value in the Eastern MDC, and indeed the latter area was shown through survey work to provide foraging habitat for these species.

Mammals

3.4.2.39 This study: Small burrows indicating rodent presence were found along the ridges of pond bunds in CCS Section 3 and throughout the Eastern MDC corridor. The diameters of the burrow entrances (3-4 cm) suggested that the burrows were excavated by rats (probably Buff-bellied Rat *Rattus rattus flavipectus*). On bunds where vegetation had been cleared by fire or by herbicide application, burrows were readily visible and quite numerous. Rodent burrows were most numerous on pond bunds where bags of commercial fish food were stored, indicating that the rodents took advantage of this readily available food source.

3.4.2.40 San Tin area: The Javan Mongoose *Herpestes javanicus* was recorded in the San Tin area (though not during Channel Corridor Surveys) on numerous occasions during 1997-98 field surveys.

3.4.2.41 Potential species: Species that may occur along the Eastern MDC but which were not recorded during field surveys include the Small Indian Civet *Viverricula indica* and Leopard Cat *Felis bengalensis*. These species occur at MPNR and may forage nocturnally at San Tin, given the proximity of Mai Po Marshes to San Tin and the high mobility of these species. The availability of fish in ponds at San Tin may also attract Chinese Otters *Lutra lutra chinensis* for nocturnal feeding, though the relatively poor habitat cover at San Tin would probably discourage daylight use of the area by this species.

3.4.2.42 Literature review: Chu (1995) reported that 5 mammal species were recorded in the Lin Barn Tsuen area, some 2 km west of the Eastern MDC alignment. Species recorded were the Greater Short-nosed Fruit Bat *Cynopterus sphinx*, Noctule Bat *Nyctalus noctula*, Japanese Pipistrelle *Pipistrellus abramus*, Ryukyu Mouse *Mus*

caroli and Lesser Ricefield Rat *Rattus losea*. The House Shrew *Suncus murinus* was reported as expected to occur at this site.

Amphibians and Reptiles

3.4.2.43 This study: A road-killed snake was recorded on the border road at CCS Section 5 on 22 May 1997. Photographs were taken but the specimen was too damaged to be identified by a local specialist (M. Lau, Hong Kong Univ. Dept. Ecology & Biodiversity, pers. comm.). The absence of clean freshwater marsh habitat may preclude use of the area by most frogs, since tadpoles are considered unlikely to survive in the available wetland habitats due to water quality problems (M. Lau, Hong Kong Univ. Dept. Ecol. & Biodiversity, pers. comm.). The only suitable frog habitat in the area would thus be fish ponds.

3.4.2.44 San Tin area: The common and widespread Gunther's Frog *Rana guentheri*, which is known to breed in slightly brackish ponds and marsh habitats, was recorded in the San Tin area in field surveys on 20 and 28 May 1997.

3.4.2.45 Literature review: For comparison purposes, Chu (1995) listed 20 species of amphibians and reptiles which had been reported or were expected to occur in the nearby Lin Barn Tsuen area in various EIA studies. One reptile species, Chinese Soft-shelled Turtle *Trionyx sinensis*, which is expected to occur at Lin Barn Tsuen is protected under the Wild Animals Protection Ordinance (Cap. 170). This species was not recorded during field surveys of the Eastern MDC area.

Aquatic Vertebrates

3.4.2.46 Aquatic fauna of fish ponds in the North-west New Territories was described by Wong (1991) and Young (1993). In addition to the commercially stocked Carp (Cyprinidae), Mullet (Mugilidae) and Tilapia, fish ponds supported non-commercial fish including Mosquitofish *Gambusia affinis*, the young of which are considered important prey for piscivorous birds which feed in the area.

3.4.2.47 A single catfish, probably *Clarias fuscus*, was seen in a channel at Section 8 of the CCS, where the shallow water was backed up by the tidal flow of the Shenzhen River. No other aquatic vertebrates were observed. The absence of fauna in other parts of the stream was probably due to poor water quality, shallowness, and dense aquatic vegetation growth. Other fish species that have been recorded in the marshes and nullahs at San Tin and in the Shenzhen River near the site include the exotic catfish *Silurus glanis* and Tilapia. Both, like the native catfish *C. fuscus*, are fairly to highly tolerant of a wide range of water quality.

Invertebrate Fauna

Odonata

3.4.2.48 Three species of damselflies (family Coenagrionidae), eight species of libellulid dragonflies, and one species of gomphid dragonfly were recorded during sweep net surveys. The gomphid dragonfly was probably *Stylogomphus chunliuae*, a riverine species with a fairly limited distribution in Hong Kong according to Wilson (1995); however, this identification could not be confirmed. It was recorded twice at Sections 7 and 8. Two additional libellulid dragonflies (*Orthetrum sabina, Diplacodes trivialis*) were not captured during sweep netting,

but were recorded visually in summer 1997 throughout the study area. All recorded species are listed in *Annex 3-G*. Except for *Orthetrum luzonicum*, all recorded dragonflies are common and widespread in Hong Kong (Wilson 1995). *O. luzonicum* is restricted in geographic distribution by the distribution of suitable habitat. Suitable habitats for *O. luzonicum* are swamps, bogs, ponds and marshes, which are patchily distributed in Hong Kong. Where these habitats occur the species is relatively common.

Lepidoptera

3.4.2.49 Twelve species of butterflies belonging to three orders were recorded along the Eastern MDC area. All are common and widespread in Hong Kong (*Annex 3-H*).

Diptera

3.4.2.50 Chironomids were surveyed at focused study Sites 1 and 2 (CCS Sections 4 and 7). During the spring survey, chironomids were found in areas covered by grass or reed. This is typical of fish pond habitats in the North-west New Territories, where spring season hatches of chironomids are frequently very abundant. More chironomids were present over grassy regions than over reeds (*Annex 3-I*), but the difference in mean abundance was not significant due to high variability in chironomid numbers over grass.

3.4.2.51 Dipterans are a food base for many small insectivorous birds (Cheng 1993). The chironomids, present in breeding season (March to August), are an important food source for juvenile birds in particular for the Barn Swallow, prinias, and the passage migrant Great Reed Warbler (*ibid.*, Reels 1994). Reels (1994) documented seasonality in insect abundance in reed beds at Mai Po Marshes Nature Reserve, with peak abundance in spring (April), and lowest abundance in winter. Chironomids spend their larval stage in aquatic habitats, and the adults are seldom found away from water (Hill and Cheung 1988).

Summary of Baseline Conditions

3.4.2.52 Baseline surveys in the Eastern MDC study area showed the area to be dominated by man-made or man-modified wetlands. The ecological importance of wetlands on the site was primarily due to their provision of foraging sites for birds. The southernmost end of the survey area was characterised by sites of minimal ecological interest (Sections 1, 2), while the remainder of the alignment was of moderate ecological interest (Sections 3-9). The reduced ecological value of the southernmost areas was due to construction works, channelisation and concrete reinforcement of nullahs, and water pollution.

3.4.2.53 The area supported dense and lush vegetation on pond bunds, in marshes, and along streams and nullahs, but the botanical conservation interest of the site had been reduced by management for agriculture and fish culture. Vegetation recorded on the site was not found to be of conservation importance for its own sake, i.e. no protected, rare or endangered plant species were recorded. It was, however, important insofar as it provided food, shelter and breeding sites for invertebrates which are preyed upon by other wildlife, and to other wildlife species directly.

3.4.2.54 Birds using the site were a combination of generalist species, which exploit a wide variety of habitats, and wetland-dependent species. Some 49 wetland-dependent bird species were recorded along the Eastern MDC alignment (those

listed in *Annex 3-E(2)*, plus the Pheasant-tailed Jacana). This total included 9 species of ardeids. Insectivorous birds were also common around fish ponds.

One invertebrate species of conservation interest, the dragonfly *Orthetrum luzonicum*, was recorded. This species is restricted in local distribution by availability of bog/marsh habitat.

3.4.2.55 Ecological resources of conservation value identified within the Eastern MDC study area through surveys are summarised in *Table 3.4b*.

Table 3.4b ***Ecological Resources of Importance on the Eastern MDC Study Area***

Ecological Resource	Conservation Significance
Wetlands	provide prey base for piscivorous birds and habitat for wetland-dependent bird species
Pond bund vegetation	supports insect populations, providing prey base for insectivorous birds
Chinese Pond Heron	wetland-dependent; reported to be locally declining
Little Egret	wetland-dependent; reported to be regionally declining
Great Egret	wetland-dependent; reported to be globally declining
Cattle Egret	wetland-dependent; reported to be locally declining
Tufted Duck	wetland-dependent; locally rare, reported to be locally declining
Imperial Eagle	wetland-dependent; Vulnerable
Greater Spotted Eagle	wetland-dependent; Vulnerable
Pheasant-tailed Jacana	wetland-dependent; a rare visitor in the Deep Bay area
Pallas's Grasshopper Warbler	wetland-dependent; locally uncommon
Birds	all wild birds are protected by law in Hong Kong; a high proportion of wetland-dependent birds occur on the site
Dragonfly *Orthetrum luzonicum*	restricted to marsh/bog habitats

3.5 *EVALUATION OF ECOLOGICAL BASELINE CONDITIONS*

3.5.1.1 The Eastern MDC area consists of man-made and man-modified habitats dominated by wetlands, which were found to be of ecological importance primarily as foraging sites for birds. Active and abandoned fish ponds were found most important in this regard. Fish ponds, together with streams, nullahs, and marshes which tended to be degraded by residential and agricultural waste, were found to be important to local and in some cases regional conservation of wetland-dependent bird species. Remnant marshes and unlined riparian habitats on the site provided dense vegetation cover, of value to some wildlife groups. Overall, the middle and northern parts of the alignment were characterised by better environmental quality and higher ecological value than the southern part.

3.5.1.2 Excluding the plantation woodland along the edge of the eastern side of the Eastern MDC, the whole Eastern MDC study area is considered to be a wetland habitat based on generally accepted definitions (Davis 1994, Mitsch and Gosselink 1993). The ecological value of wetlands in the North-west New Territories is high (Chu 1995), and the fish ponds and associated wetlands of the San Tin area are of well documented importance to wetland-dependent and other bird species, supporting numerous species and large numbers of birds.

The Eastern MDC lies along the eastern edge of this extensive wetland area. Various factors operate upon the wetlands along the Eastern MDC alignment to limit their utility to birds and other wildlife: these include water pollution, disturbance from the nearby Lok Ma Chau border crossing area, and fragmentation of habitats due to the San-Sham Road, border crossing, and areas where fish ponds have recently been filled. Nonetheless, a number of species of conservation interest were recorded along the alignment, as highlighted in *Table 3.4b*.

3.5.1.3 *Table 3.5a* evaluates the ecological value of the habitats found in the Eastern MDC area based on the baseline conditions summarised in *Section 3.4*. The criteria used are those set forth in Table 2, Annex 8 of the TMEIAP ("Evaluating a site/habitat").

3.5.1.4 Based on the TMEIAP criteria, fishponds are the habitats of highest ecological value within the study area. They support a variety of wildlife including roosting, breeding and feeding avifauna. Active and inactive (abandoned) fish ponds are similar in value based on these criteria, and are of highest value among the individual habitats found on the study area. The only factors limiting their existing and potential value are disturbance and fragmentation due to neighbouring landuses such as the Lok Ma Chau border crossing, and in the southern half of the site "Container Backup" and "Service Station" zonings which could facilitate the conversion of ponds to dryland habitats.

3.5.1.5 Marsh areas are considered of secondary value as compared to fish ponds; they are prone to water pollution, a factor seriously limiting their current value, and tend to be more fragmented. On the southern half of the site, zonings which would support their conversion to dryland habitats will limit their potential value. Streams and nullahs are ranked as lower in overall value than marshes, again due to fragmentation and serious water pollution. Landuse zonings limit the potential value of streams and nullahs in the southern half of the site.

3.5.1.6 Urbanised areas are ranked as of low ecological value, and are of little or no use to most wild plant and animal species. Plantation woodland, on the other hand, is assessed as of low current ecological value but moderate potential value, which could be realized if the exotic trees were eventually succeeded by native species of greater importance to local ecology.

3.5.1.7 Species of particular conservation interest recorded on the site included the dragonfly *Orthetrum luzonicum*, which is locally restricted to bog/marsh habitats, and wetland-dependent bird species, particularly ardeid birds and the Pheasant-tailed Jacana.

3.5.1.8 The ecological value of the Eastern MDC site as a whole derives in large part from its physical location: it is adjacent throughout its length (roughly 2 km) to the main body of the Deep Bay wetlands, and is ecologically linked to the Ramsar Site via the intervening wetlands.

Table 3.5a ***Assessment of Ecological Value of Habitats Found in the Eastern MDC Area***

Criterion	Habitat					
	Active fish pond	**Inactive fish pond**	**Marsh**	**Stream/nullah**	**Urbanised**	**Plantation woodland**
Naturalness	low; man-made	low, but higher than active fish ponds, since vegetation colonises such ponds	moderate; mostly man-modified or man-made, but some areas may be remnants of natural habitats	low to moderate; mostly man-modified or man-made	low; man-made	low; man-made
Size	moderate % of site	moderate % of site	moderate to large % of site	small to moderate % of site	large % of site	small to moderate % of site
Diversity	supports a diverse bird community	supports a diverse bird community	supports a low to moderate diversity of species	supports a low diversity of species	supports a low diversity of species	supports a low diversity of species
Rarity	declining in area, but not yet "rare" in Hong Kong	declining in area, but not yet "rare" in Hong Kong	declining in area and becoming rare in Hong Kong	Lowland streams declining in area and becoming rare in Hong Kong; nullahs common and expanding in area in Hong Kong	increasingly common in Hong Kong	apparently stable or increasing in area in Hong Kong
Difficulty of recreation	can be readily recreated, given suitable sites	can be readily recreated, given suitable sites	moderately difficult to recreate	stream is difficult to recreate; nullah can be readily recreated	can be readily recreated	can be readily recreated
Lack of fragment-ation	on edge of large, unfragmented area of wetlands but faced on east side by major barrier (San-Sham Road, border crossing)	similar to active fish ponds	fairly fragmented	fairly fragmented	fairly unfragmented	highly fragmented; only small patches occur on the site
Ecological linkage	linked to Inner Deep Bay wetland system, including Ramsar Site; provides foraging sites for species of the Inner Deep Bay area	similar to active fish ponds	similar to fish ponds	local drainage systems are intertidal and permit energy flow/fish movements between Shenzhen River and local streams/nullahs	low; has little ecological linkage with surrounding areas	probably low

Criterion	Habitat					
	Active fish pond	Inactive fish pond	Marsh	Stream/nullah	Urbanised	Plantation woodland
Potential value	high in northern half of site, moderate in southern half of site due to landuse zoning favouring conversion of fish ponds to dryland habitats	high in northern half of site, moderate in southern half of site due to landuse zoning	moderate; improved water quality would, however, be required to realize this potential	limited by landuse zonings in southern half of site; moderate in northern half, improved water quality would, however, be required to realize this potential	low if areas are retained in active use for open storage and other high-disturbance uses	moderate; could be realized if native-species understorey were allowed to develop and eventually succeed the dominant exotic species
Nursery/ breeding ground	breeding ground for invertebrates, an important prey base for resident and migrant birds	breeding ground for invertebrates, an important prey base for resident and migratory birds	breeding ground for chironomid flies, a prey base for resident and migratory birds (see *Annex 3-I*)	field surveys did not document breeding or nursery function	no known utility	field surveys did not document breeding or nursery function
Age	moderate (largely unchanged since 1980s); fish ponds have replaced natural wetlands of great age in the NWNT	similar to active fish ponds	moderate; probably evolved from ponds, fields or natural wetlands	some may be of considerable age, but have been modified by human activity	young	low to moderate
Abundance/ richness of wildlife	support a variety of birds, including species of conservation importance	similar to active fish ponds, but bird species richness may be lower	support a low to moderate abundance and richness of wildlife	support a low abundance and richness of wildlife	support a low abundance and richness of wildlife	support a low abundance and richness of wildlife

3.6.1 *Construction Phase Impacts*

3.6.1.1 The significance of ecological impacts is evaluated based primarily on the criteria set forth in Table 1, Annex 8 of the TMEIAP:

- habitat quality;
- species affected;
- size/abundance of habitats/organisms affected;
- duration of impacts;
- reversibility of impacts; and
- magnitude of environmental changes.

3.6.1.2 The following discussion focuses on impacts to identified key sensitive resources: wetlands, wetland-dependent birds and their prey base.

Assumptions

3.6.1.3 Potential impacts to ecological resources were predicted based on the following engineering information:

- the channel will be of trapezoidal design, of variable width, and wider than the existing channels;
- the channel bottom and banks will be grasscrete lined throughout, with the exception of the dry weather flow (DWF) channel;
- the channel embankment slopes will be 1 in 2 inside the channels;
- embankment elevations will be above the surrounding existing ground levels;
- a maintenance access road will run atop the western MDC embankment; and
- the flood storage ponds for the San Tin and Chau Tau PVPS will be grasscrete-sided and concrete-bottomed with sides at a 1 in 2 slope.

3.6.1.4 The only significant ecological impacts predicted to be associated with the PVPS-35CD works were construction-phase losses of habitat at both Chau Tau and San Tin Villages. These are taken into account under the heading "Channel and PVPS Construction" below.

Potential Sources of Impact

3.6.1.5 For the Eastern MDC and PVPS-35CD, the following potential sources of impact were identified for the construction phase:

- channel construction;
- site runoff, sedimentation and water pollution; and
- human and equipment disturbance on the works site.

3.6.1.6 These are assessed in detail below.

Evaluation of Impacts

3.6.1.7 The key ecological issue associated with construction of the project is habitat loss, particularly loss of wetlands, and resultant impacts to wetland-dependent wildlife.

3.6.1.8 Habitat loss was calculated using the grid count method from 1:1000 engineering maps (Dwg. no. DDN/73CD/3802-05) on which habitat boundaries, mapped based on aerial photography supported by ground truthing, were delineated. Estimated permanent habitat loss due to the Eastern MDC and PVPS-35CD is given in *Table 3.6a.*

3.6.1.9 The Working Paper for 35CD Works (see *Annex 1-B*) stated that habitat loss due to the PVPS is to be considered as cumulative with habitat loss due to Eastern MDC construction, and the mitigation measures for losses from both projects are to be developed in the EIA report for this study. Therefore, habitat losses due to 35CD works are included in *Table 3.6a.*

Table 3.6a ***Permanent Habitat Losses due to the Eastern MDC and Poldered Village Protection Schemes (PVPS) for Chau Tau and San Tin***

Project	Habitat type (ha)							
	Active fish pond	**Abandoned fish pond**	**Illegally filled fish pond**	**Urbanised (legally filled fish pond)**	**Marsh**	**Stream/ vegetated nullah**	**Agri-culture**	**Plantation woodland**
Eastern MDC (73CD)	1.5	1.65	2.7	0.8	2.35	1.1		0.8
San Tin PVPS (35CD)	0.3	3.0			1.5	0.4		
Chau Tau PVPS (35CD)					0.7	0.01	1.1	
Total:	1.8	4.65	2.7	0.8	4.55	1.51	1.1	0.8
Value of habitat (see *Table 3.5a*)	moderate to high	moderate to high	moderate to high (pre-filling); low (current)	low	moderate	low-moderate	low	low

3.6.1.10 Approximately 2.7 ha of fish ponds located in CCS Sections 3-5 of the Eastern MDC were illegally filled during the baseline study period, in mid- to late 1998. Because these ponds were filled illegally and should be reinstated to their original condition under the law, the baseline for the study is considered to include those ponds as fishponds, though their active/abandoned status cannot be determined for obvious reasons. Their value prior to filling, and their predicted value following reinstatement as is required by law, would be similar to nearby fish ponds.

3.6.1.11 Permanent loss of active fish ponds to project construction would be 1.5 ha for the Eastern MDC and 0.3 ha for the PVPS, or a total of 1.8 ha. These ponds would not be reinstated following construction, because they would be occupied by permanent works. Permanent losses of other types of wetland (abandoned fish pond, illegally filled fish pond, marsh, stream, and vegetated nullahs) would be 7.8 ha for the Eastern MDC and 5.61 ha for the PVPS, or a total of 13.41 ha. Permanent losses of wetlands due to these projects would thus total 15.21 ha. Permanent loss of a total of 2.7 ha of dryland habitats (urbanised area, agricultural land, and plantation woodland) is also predicted.

3.6.1.12 In addition, temporary loss of an estimated 11.2 ha of active fish ponds would occur for the duration of the construction phase (approximately 2-3 years). 7.8 ha of these ponds would be leased from their current operators and dewatered for use as Temporary Occupation Areas (TOAs) during the construction phase, but would be reinstated and returned to their operators in their former condition. The location of TOAs is shown in *Figure 3.6e*. The remaining 3.4 ha consist of ponds on the west side of the Eastern MDC near its confluence with the Shenzhen River, which would be drained down during the construction phase in order to allow channel construction. These would be refilled (rewatered) upon completion of construction and return to their operators in their former condition. The location of these ponds, marked "fish ponds to be rewatered", is shown in *Figure 3.6e*. This impact is assessed as moderate due to its limited duration.

3.6.1.13 Loss of wetland habitats is identified as the most significant impact of the project. Overall, this impact is ranked as moderate to high based on the following factors:

- the Eastern MDC's location within the San Tin wetland area, within the Wetland Conservation Area and Wetland Buffer Area and close to the Ramsar Site;
- the importance of fish ponds at San Tin for wildlife, including protected species;
- the fact that the site supports wetland-dependent birds and invertebrates and that wetland area is decreasing in Hong Kong;
- the permanence (permanent losses of 15.21 ha of wetland, from columns 1, 2, 3, 5 and 6 of *Table 3.6a*) and probable irreversibility of the impact; and
- the presence of at least two rare species (Tufted Duck and Pheasant-tailed Jacana) on the site.

3.6.1.14 Although the wetland and fish pond area affected at San Tin is small in relation to total wetland area in Hong Kong (approx. 15.21 ha permanent loss per *Table 3.6a*), the alignment lies within the Deep Bay Wetland Conservation Area and Wetland Buffer Area, and the project would affect habitats which are uncommon, declining in extent, and of restricted distribution in Hong Kong. Losses or modifications of wetland habitat (pond, marsh, and stream) would be expected to reduce the overall importance of the San Tin site and the North-west New Territories for wetland wildlife. The potential severity of the impact of wetland losses is demonstrated by Chen *et al.* (1997), who documented a 40% decline in the number of breeding bird species in 1995 due to the progressive destruction of fish ponds and gei wais at Neilingding Futian National Nature Reserve in Shenzhen Special Economic Zone.

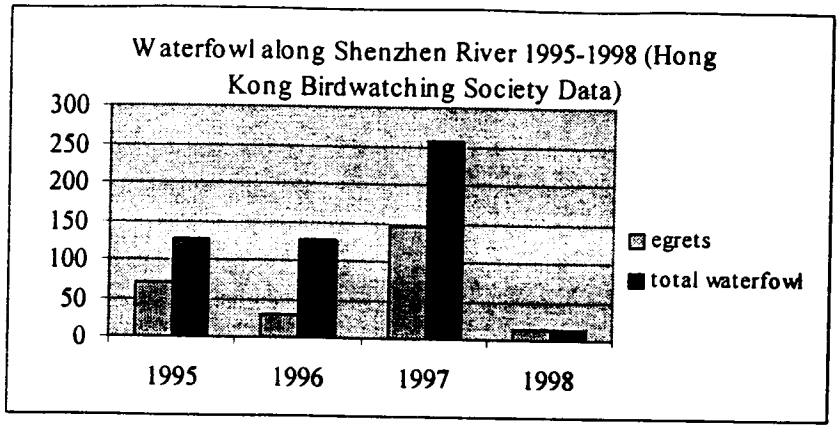
3.6.1.15 Impacts of habitat losses upon wildlife are discussed below, focusing on loss of wetlands.

3.6.1.16 Loss of wetland areas would mean loss of wetland foraging habitats for resident and migratory birds. Wetland-dependent bird species would be expected to suffer adverse impacts due to loss of wetland habitat (fish ponds and bunds) from MDC construction. At least one species occurring on the Eastern MDC site (Pheasant-tailed Jacana) is thought to be locally extinct as a breeding species due to loss of suitable wetland breeding habitat. Ardeid birds (herons and egrets) would also be significantly affected. The impact of wetland loss upon birds is ranked as moderate to high overall, based on the area of wetland affected and its documented importance to bird species, which are protected under Hong Kong law and some of which are locally rare or declining. The basis for this assessment is detailed in the following paragraphs.

3.6.1.17 A previous study has produced results which are relevant to assessing the effects on birds of replacing fish ponds with the Eastern MDC. Monitoring of the Shenzhen River Regulation Project (SRRP) Stage 1 has produced a rough quantification of the relative value to birds of (a) a constructed drainage channel and (b) fish ponds and associated wetlands. The monitoring programme systematically compares the numbers of birds supported by the constructed channel of the SRRP Stage 1 and by adjacent wetland habitats (fishponds, interspersed with marshes, streams and nullahs) in the San Tin-Sam Po Shue area. Comparison of bird census data for the two areas since 1997 shows that the river channel supports on average 20% of the bird numbers supported by the San Tin wetlands (Shenzhen River Regulation Project progress reports). It cannot be assumed that the Eastern MDC would support 20% of the birds that the fish ponds on site now support, due to differences in the design and operation plans for the two waterways. The Shenzhen River would maintain year-round flows, whereas most of the Eastern MDC would be watered only by groundwater intrusion; the Shenzhen River is earthen-bottomed and concrete-sided, with a bench of shallow muddy substrate along part of the embankment, whereas the Eastern MDC would be grasscrete-bottomed and grasscrete-sided along most of its length, except for an earthen bottom downstream of the inflatable dam.

3.6.1.18 Bird counts for the area of fish ponds drained for the Shenzhen River Regulation works between Pak Hok Chau and the Lok Ma Chau Crossing for the period-1995 - 1998 illustrate the decline in ardeids and other waterfowl due to drainage of these fish ponds during 1997 (Hong Kong Bird Watching Society unpubl. data). The study covered about 30 ponds each year (the same ponds being surveyed on each visit) of which approximately 26 were drained during 1997. The non-drained ponds are the only reason that the numbers of waterfowl remained above zero during the 1998 count. These data, shown in *Figure 3.6a*, show that numbers of waterfowl and ardeids peaked in 1997 at c.250 and c.150 respectively. After drainage during 1997, numbers of ardeids fell to below 20 and no other waterfowl were recorded.

Figure 3.6a *Waterfowl in ponds along Shenzhen River 1995 - 1998 (HKBWS)*



3.6.1.19 The project could affect the Ramsar Site by eliminating foraging areas for birds which fly from the Ramsar Site to San Tin. Wetland-dependent bird species occurring within the Ramsar Site but which forage beyond its boundaries could suffer losses of foraging habitats. One example is the critically endangered Black-faced Spoonbill; as noted in discussion of the Ramsar Site in *Section 3.4.1*, the foraging radius of this species in Taiwan exceeds 8 km. An 8 km radius from the preferred Black-faced Spoonbill roost at Mai Po would include all of the San Tin study area (*Figure 3.6b*). Based on the area of wetland to be affected by the proposed project, this impact is assessed as moderate.

3.6.1.20 Birds from the Mai Po Village egretry (SSSI) probably fly as far as the study area to feed (*Figure 3.6b*), and in this case the project would result in a loss of feeding habitat which would indirectly affect the egretry. Studies within Hong Kong by Young and Cha (1995) and Melville *et al.* (1994), and elsewhere by Fasola and Barbieri (1978), Gibbs *et al.* (1987), Gibbs (1991) and Hafner *et al.* (1987) have shown that numbers of ardeids at a colony are dependent on the area of feeding habitats around the colony. In Hong Kong, fish ponds have been shown to be an important feeding habitat for egrets (Young 1995, Melville *et al.* 1994). Young and Cha (1995) also identify the most significant threat to the Mai Po Village egretry as "loss of the birds' fish pond feeding habitat", a trend which has been related to a decline in the numbers of breeding Little Egrets *Egretta garzetta* at the egretry. Thus any loss of fish pond area due to the project would be predicted to have negative impacts upon survival of adults or production of young at the egretry. The impact would probably manifest itself as a reduction in numbers of:

- nests occupied;
- number of eggs hatching;
- number of young surviving to fledge; and
- number of fledglings surviving to breed in subsequent years.

3.6.1.21 An additional potential impact of continued loss of freshwater or brackish water feeding areas near the egretry is abandonment of the egretry. Young and Cha (1995) considered that the abandonment of the Tsim Bei Tsui egretry was largely due to the loss of fish ponds for development of Tin Shui Wai New Town. Overall, potential impacts to breeding productivity at the Mai Po Village egretry

are therefore ranked as moderate to high.

3.6.1.22 Losses of fish pond habitat would result in some reduction in local production of amphibians and some fishes. While rare species of amphibians and fishes were not recorded on site, some of these species are important as a food source for waterbirds, herons and egrets in particular (Young 1993). Since reduction in population numbers could affect breeding productivity of local ardeid populations, this impact is ranked as moderate.

3.6.1.23 The replacement of semi-natural stream channels and bunds with grasscrete-lined channels and engineered embankments could cause a reduction in structural habitat diversity which may result in reduction of some invertebrate populations. At least one species of dragonfly recorded on the site is restricted in range to marsh/bog habitats, and would be affected by habitat loss. Insect populations provide food sources for a range of insectivorous species (including some birds) which would be indirectly affected by reduction in prey base. Since the grasscrete banks of the channels are expected to be colonised by plants similar to those found along the existing streams and pond bunds, and the predicted groundwater level near the channel invert level should allow the bottom of the channel to support wetland plants, new habitats available on the site might provide suitable substitutes for existing habitats to be lost. Impacts to insects are therefore ranked as low.

3.6.1.24 Loss and fragmentation of habitat within the study area would not be expected to adversely affect large numbers of mammals or a wide array of species. The mammals recorded in the study area are either common and wide-spread (such as House Shrews and Buff-bellied Rat), or they are highly mobile (such as Javan Mongoose) and would not be expected to suffer local or regional population declines due to construction of the project. This impact is therefore ranked as low.

3.6.1.25 The other form of habitat loss of potential concern is loss of 0.8 ha of plantation trees. Due to the limited utility of planted species at these sites to wildlife and the relatively small area involved, this impact is ranked as low. Loss of urbanised areas (legally filled fish ponds) is not considered a negative impact of the project.

3.6.1.26 Channel construction could also cause direct mortality to less-mobile wildlife including rodents, shrews, reptiles and amphibians that inhabiting the channel area. The extent of mortality will be increased if initial works are carried out in winter when reptiles and amphibians are less active. Although the losses of animals could be large, no species of these groups of particular conservation concern were identified on the Eastern MDC study area, hence this impact is ranked as low.

Site Runoff, Sedimentation and Water Pollution

3.6.1.27 The Eastern MDC would drain into the Shenzhen River. Located farther downstream are the mudflats of Inner Deep Bay, an integral part of the Ramsar Site. Surface run-off from the village polder and channel construction areas would increase the sediment load in the Shenzhen River and Inner Deep Bay. Increased sedimentation in Inner Deep Bay could contribute to increasing sedimentation on the mudflats. Contamination from spills of construction materials, fuels and solvents could also be carried into Inner Deep Bay, with potential effects on aquatic ecology. Finally, dredging of channel areas could resuspend pollutants that have become bound to bottom sediments in existing

channels. Based on the conservation importance of Inner Deep Bay, this impact is assessed as moderate.

Human and Equipment Disturbance on the Works Site

3.6.1.28 The noise and disturbance associated with project construction would affect disturbance-sensitive wildlife by driving them away from the works area, at least during daylight hours and possibly altogether for the duration of the project. In light of the fact that habitats near the alignment will be unattractive or unavailable to wildlife during the construction phase due to the habitat impacts mentioned above, and given that wildlife using the area will be disturbance-habituated to some degree from ongoing projects such as SRRP, this impact is ranked as moderate despite the conservation importance of some affected species. The impact would persist only during the construction phase.

3.6.1.29 *Table 3.6b* summarises the impacts discussed above.

Table 3.6b ***Potential Construction Phase Impacts to Ecological Resources on the Eastern MDC and PVPS-35CD Study Area.***

Activity	Receiver	Potential Impacts	Severity	Mitigation Required
Channel construction and associated works	wetland habitats and dependent wildlife	Temporary loss of fish ponds for Temporary Occupation Areas	moderate	yes: reinstate all TOAs as fish ponds
	wetland habitats and dependent wildlife	Permanent loss of pond, marsh, stream, nullah habitat. Loss of foraging habitats for wetland-dependent birds and increased competition for forage resources. Potential reduction in nest productivity at Mai Po Village egretry. Loss of wetland habitat for amphibians and fish; reduction in population sizes.	moderate to high	yes: wetland habitat compensation
	insects	Loss of habitat	low	no
	mammals	Loss of habitat	low	no
	tree plantations	Loss of habitat	low	no
	non-mobile wildlife	Direct mortality due to works	low	no
Runoff, sedimentation, water pollution	aquatic fauna in local channels and Inner Deep Bay	Reduced survival, abundance and species richness	moderate	yes: site and works controls
	mudflat ecology of Inner Deep Bay	Contribution to rising of mudflats and reduction of intertidal area	moderate	yes: site and works controls
Disturbance on works site	resident and migrating birds and other wildlife	Reduced foraging efficiency/temporary reduction in usable habitat area	moderate	yes: minimise off-site activity, minimise noise

Cumulative Impacts (Construction)

3.6.1.30 This section discusses the cumulative impacts of this project together with other projects nearby. While developments of various kinds, including drainage projects, are affecting many parts of the New Territories, this assessment focuses in more detail on those developments that are planned or underway in the San Tin area.

3.6.1.31 HKGEPLG (1992) notes that "on the Hong Kong side of the Deep Bay catchments, extensive conversion of agricultural land into urban uses and the reduction of fish ponds would increase local flooding risks and seriously disturb the ecological environment in the catchments." The San Tin Eastern Main Drainage Channel and the two PVPS projects would add to the progressive loss of wetland habitats in the North-west New Territories which has resulted from or is predicted to result from various infrastructure and private development projects, including the Shenzhen River Regulation Project, Route 3 Highway, Main Drainage Channels for Ngau Tam Mei, Yuen Long and Kam Tin, Western Corridor Railway, and the Nam Sang Wai residential development. These projects have, however, been required to implement mitigation measures for habitat loss to keep residual impacts within acceptable levels.

3.6.1.32 The main projects currently proposed for the San Tin area are shown in *Table 3.6c*. It should be noted that these projects are subject to EIA process, and are required to mitigate significant habitat losses to acceptable levels. A large area currently occupied by fish ponds at San Tin is zoned for container backup uses. Proposed rezoning of the site to Conservation Area by the Town Planning Board on 23 April 1999 in considering objections to the OZP will probably preclude such development at this site and avoid a significant loss of wetlands.

Table 3.6c ***Projects Proposed for the San Tin Area, and Associated Wetland Loss***

Project	Estimated loss of pond/marsh (ha)
Expansion of Kiosks and Other Facilities at Lok Ma Chau Border Crossing (PWP No. BG/006)	negligible
KCRC Sheung Shui spur line to Lok Ma Chau (proposed)	to be determined in EIA

3.6.1.33 It will be essential for these proposed projects to take note of cumulative impacts, and for wetland mitigation planning to be coordinated carefully, in order to minimise habitat loss and fragmentation, and to maximise the value of mitigation sites, e.g. by locating mitigation sites to avoid fragmentary patches of created or enhanced wetland surrounded by developed areas, or to avoid siting water-quality sensitive mitigation sites close to potential sources of water pollution. The San Tin Eastern MDC and Lok Ma Chau Kiosk Expansion projects have begun coordinating mitigation efforts for loss of wetland, in order to maximise the ecological utility of their adjacent mitigation sites; this process will continue during the detailed design and construction of the two projects.

3.6.1.34 Coordinated planning will also be important in reducing short-term ecological impacts of project construction, such as short-term habitat loss, disturbance, and water pollution. The potential for interface between the San Tin area projects listed in *Table 3.6d* is high, given their construction periods as currently projected:

Table 3.6d *Scheduling of Projects Proposed for the San Tin Area*

Project	Scheduling
San Tin PVPS	Nov. 1996-Oct. 1999
Chau Tau PVPS	Apr. 1997-Aug. 1999
San Tin Eastern Main Drainage Channel	Jun. 2001-Dec. 2003
Shenzhen River Regulation Project, Stage 2 Phase 2	1997-end 2000
Lok Ma Chau Kiosk Expansion	Apr. 1999-Dec. 2002
Sheung Shui Lok Ma Chau Spur Line (proposed)	2001-2004

3.6.1.35 As currently planned, there is a high degree of overlap in scheduling. While this will result in a higher cumulative severity of disturbance, temporary habitat loss and other impacts than if the scheduling did not overlap, it may reduce the long-term repercussions of these impacts by restricting them to only a few breeding seasons for many wildlife species. Provided that all projects provide adequate mitigation for their individual short-term impacts, and give full consideration to the possibility of cumulative effects, short-term negative impacts should not be unacceptable.

3.6.1 *Operational Phase Impacts*

3.6.2 *Operational Phase Impacts*

Assumptions

3.6.2.1 Maintenance dredging/desilting in the Eastern MDC is assumed to cover the whole of the channel bottom including the DWF channel, and to take place on a need basis to maintain channel capacity.

3.6.2.2 It is assumed that the flood storage pond for the San Tin PVPS would be allowed to stay wet, except in exceptional circumstances (e.g. maintenance, or drought conditions). The flood storage pond for the Chau Tau PVPS would be kept dry.

Potential Sources of Impact

3.6.2.3 For the Eastern MDC and PVPS-35CD, the following potential sources of impact were identified for the operational phase:

- channel maintenance;
- presence of channels and embankments;
- hydrologic alteration of the channel and catchment; and
- human and vehicle presence on channelside road.

3.6.2.4 These are evaluated in detail below.

Evaluation of Impacts

Channel Maintenance

3.6.2.5 Maintenance dredging will clear sediment and rubbish from the channel bottom. It will also remove vegetation established on the channel bottom, interrupting development of flora and fauna communities in this zone. Periodic clearance of

vegetation on the grasscrete inner channel embankments, if required, would interrupt development of flora and fauna communities and would have impacts similar to those of maintenance dredging of the channel bottom. The impact of these activities upon ecology would be low to moderate, taking into consideration the planned function of the grasscrete channel area as compensation habitat.

3.6.2.6 Channel dredging could increase sediment loads downstream, and could increase contaminant mobilisation. These sources of impact would affect the Shenzhen River and Inner Deep Bay areas more than the San Tin area, by contributing to the sedimentation of Inner Deep Bay mudflats and by releasing contaminants. These impacts are assessed as low, particularly in light of existing impacts due to dredging on the Shenzhen River.

3.6.2.7 Noise and disturbance during maintenance dredging may affect sensitive wildlife in and near the channel. This would be a short-term impact, and would probably recur only one or two times per year at the maximum. This impact is ranked as low.

Presence of Channel and Embankments

3.6.2.8 The drainage channel and embankments will act as a barrier to east-west movements of some species, primarily mammals, reptiles, amphibians and flightless invertebrates. It will also fragment areas of fish pond habitat to some extent. However, given that the San-Sham Road along much of the eastern edge of the channel already acts as such a barrier and has already fragmented fish pond habitats in this area, the additional impact of the channel and embankments is ranked as low.

Hydrological Alteration of the Channel and Catchment

3.6.2.9 Natural periodic flooding of the marsh habitats on the study area would be reduced in frequency and intensity following construction of the Eastern MDC because the floodwater would be contained within the new channel. Although the hydrologic impact of reduced flood frequency on local marshes has not been quantified, it would be expected to dry out areas which are now partly or periodically wet, and to reduce the quality of wetland habitats which are important to fauna recorded on the study area. Similar impacts will arise from operation of the village polder schemes; natural drainage from village areas to existing drainage channels and marshes will be cut off.

3.6.2.10 Operation of the inflatable dam would prevent tidal influence from the Shenzhen River along most of the length of the channel. This would eliminate opportunities for tidal flushing, nutrient transport and fish movement between the Shenzhen River and the San Tin area.

3.6.2.11 These impacts would be permanent. In light of their dramatic alteration of the catchment weighed against the limitations imposed by existing poor water quality in the Shenzhen River, are ranked as moderate in nature.

Human and Vehicle Presence on Channel Road

3.6.2.12 Pedestrian and vehicle movements on the embankment road would be a source of noise and disturbance to wildlife using the channel and nearby areas. Disturbance could reduce foraging efficiency, or eliminate some areas from the habitat of sensitive species. In light of existing disturbance from the San-Sham Road, this impact, though permanent, is ranked as low.

3.6.2.13 *Table 3.6e* summarizes the operational phase impacts discussed above.

Table 3.6e ***Potential Operational Phase Impacts to Ecological Resources on the Eastern MDC Study Area.***

Activity	Receiver	Potential Impacts	Severity	Mitigation Required
Channel maintenance	in-channel habitats	removal of sediments, cutting back of established vegetation	low to moderate	yes: minimise dredging frequency, minimise cutting of vegetation
	Inner Deep Bay mudflats	increased sedimentation on mudflats contributing to habitat change	low	yes: sediment control during dredging
	aquatic fauna on-site and downstream	re-suspension of pollutants from stream channel	low	yes: sediment control during dredging
	disturbance-sensitive wildlife	short-term alteration in distribution and behaviour	low	yes: minimise dredging frequency
Presence of channels and embankment	fauna of limited mobility	barrier effect; habitat fragmentation	low	yes: habitat compensation within channel
Hydrological alteration of channel and catchment	wetland habitats	reduction in marsh, other wetland area	moderate	yes: wetland habitat compensation
	intertidal wetlands	reduction in area of tidal influence	moderate	yes: wetland habitat compensation
Human and vehicle presence on channel road	avifauna	altered distribution or behaviour patterns; possible reduced foraging efficiency	low	yes: channel revegetation

Cumulative Impacts (Operation)

3.6.2.14 Operation of the Eastern MDC and the two PVPS projects will contribute to the hydrological alteration of the Deep Bay catchment. Other sources of this cumulative impact are channelisation works in the Shenzhen River, Shan Pui River, Kam Tin River, Indus River and Beas River, i.e. all the major feeders of Inner Deep Bay on the Hong Kong side. The main channels draining these catchments have been trained, lined and otherwise altered in order to increase their maximum flood capacity. As a result, there are now very few low-gradient watercourses or catchments in the Inner Deep Bay catchment that are not significantly altered by human engineering. The cumulative impact is a significant alteration of drainage systems, notably through a great reduction in frequency of seasonal flooding in off-channel areas. While this is a primary objective of such flood control projects, it has the effect of reducing the area of seasonally inundated wetland in Hong Kong.

3.6.3 *Approach to Mitigation*

3.6.3.1 Annex 16 of the TMEIAP states that the general policy for mitigation of significant ecological impacts is to pursue avoidance, minimisation, on-site compensation, and off-site compensation, in that order. At each stage, residual impacts are to be re-assessed to determine whether there is a need to proceed to the next stage of mitigation. The following measures have been developed in accordance with this approach to mitigate the impacts discussed in the preceding section.

3.6.4 *Mitigation of Construction Phase Impacts*

Channel Construction

3.6.4.1 The main objective of the following mitigation measures is to minimise losses of wetlands and reductions in wetland bird numbers. Other objectives are considered secondary to these, due to the importance of the San Tin site for wetlands and avifauna.

3.6.4.2 The predicted temporary losses of 11.2 ha of active and abandoned fish ponds can be minimised by reducing the area of ponds requiring drainage. Only a 50 m wide strip of these ponds adjacent to the Eastern MDC will be required for use during project construction. To allow the remainder of these ponds to remain undrained during construction, an earth bund will be formed at the 50 m limit (see *Figure 3.6e* for location of bund). Areas outside this limit will either not be drained during bund construction or will be refilled immediately following bund construction. This will reduce temporary losses of pond area from 11.2 ha to 4 ha (2.7 ha in the TOA and 1.3 ha in the ponds on Government land). The bunds will be removed and the 50 m wide working area portion of the ponds will be reinstated and rewatered upon completion of construction. If the remaining 7.2 ha of pond area will not be in active operation during project construction, consideration can be given to reducing their water level somewhat during the works period to increase their utility as feeding habitat for wading birds; this measure and other means to further reduce temporary impacts should be given all due consideration at the detailed design stage of the project.

3.6.4.3 The only remaining habitat losses of concern are the permanent losses associated with Eastern MDC and PVPS-35CD construction. Avoidance, minimisation and compensation for this impact are considered in turn below.

Avoidance

3.6.4.4 Avoidance of the impact of habitat loss, including wetland loss, would be possible only if the no-build alternative were viable. However, the Territorial Land Drainage & Flood Control Strategy Study - Phase II Study (TELADFLOCOSS II, Drainage Services Dept., 1993) established the requirement for the drainage schemes under consideration here, ruling out the no-build alternative.

Minimisation

3.6.4.5 One design measure used to minimise wetland loss was elimination of the maintenance access road on the eastern embankment, thereby reducing the site width by some 3.5 m.

3.6.4.6 *Flood Storage Pond at San Tin Villages*: The 35CD flood storage pond at San Tin Villages (see *Figure 3.6c* for location) will be maintained with water in the bottom due to village fung shui requirements. It will thus have some potential to provide compensation for wetland habitat loss. The pond will have grasscrete banks at a 1 in 2 slope, and a concrete bottom. As the pond is already under construction, there is no scope to alter the design or bottom composition. The limitations of the concrete bottom can be partly overcome by allowing a semi-natural bottom to develop through sedimentation.

3.6.4.7 Management measures recommended for the pond to enhance its ecological potential are as follows:

- allow a minimum bottom water level above the concrete bottom throughout year except during maintenance or exceptional conditions. The pond's pump is designed to automatically permit the water level to vary between 0.0 and 0.35 mPD; combined with bottom levels grading from -0.3 mPD to -0.5 mPD, this will allow water depths to range from 0.3 m to 0.85 m;
- allow sediment to accumulate on bottom up to 150 mm before sediment removal;
- when removing sediment, avoid clearing all the way back to the concrete bottom;
- allow grasses, reeds and sedges to colonise grasscrete banks naturally, as they do fish pond bunds;
- cut back vegetation on grasscrete banks on a need basis only; and
- allow fish to colonise the pond naturally.

3.6.4.8 The surface area of the San Tin pond would be approximately 2.2 ha. This area will provide wetland compensation provided the above management measures are carried out, under normal working conditions. The Chau Tau flood storage pond will be kept dry due to villager demands, and will provide only minimal compensation for wetland loss.

3.6.4.9 *Tsing Lung Tsuen Drainage Channel*: A 12 m wide trapezoidal drainage channel, approximately 0.14 ha in area, is under construction outside the western edge of the San Tin Villages polder (see *Figure 3.6c* for location). An indicative plan and cross-section of this channel are shown in *Figure 3.6d*. This channel would be kept wet, and is hydrologically connected with the drainage of Shek Wu Wai stream (upstream) and the western nullah draining San Tin (downstream). It should thus be subject to tidal influence. The channel will be mostly concrete-lined except for upper embankment areas, and this will severely limit its potential ecological value. As the channel is already under construction, however, there is no scope to alter its design. The only management measure proposed for this channel is not to cut back vegetation in the grasscrete areas along its edge except as required for channel maintenance. This will provide some shading to the channel and habitat structure at the channel edge. Due to its area and design limitations, this channel can provide only a very limited amount of compensation for wetland loss.

3.6.4.10 *Tidal Channel*: The section of the Eastern MDC downstream of the inflatable dam will be a tidal wetland due to its connection with the Shenzhen River (see *Figure 3.6e* for extent of tidally influenced zone). This area will provide some compensation for loss of natural wetlands on the site, since its hydrologic regime will vary naturally without human management (excepting controls of releases from the Shenzhen Reservoir, which are beyond the scope of this study). The area involved is approximately 1 ha (the actual area will vary from roughly 0.8 to 1.2 ha due to the natural tidal range). While it will be artificial in construction, having a regular trapezoidal shape, its earthen bottom will provide a natural substrate for colonisation by intertidal flora and fauna. The channel's inner embankments will be pitched at a 1 in 2 slope and lined with grasscrete, which will provide areas for colonisation by vegetation. The only management measure proposed for this area is minimisation of cutting back of vegetation developing in the grasscrete zone and minimisation of maintenance dredging, as far as compatible with maintenance of required flood capacity (see Paragraph 3.6.5.1).

3.6.4.11 *Constructed Wetland East of Eastern MDC*: Approximately 3.43 ha of land within the site boundary on the east side of the Eastern MDC will not be required for permanent works, and is available to provide wetland compensation via wetland creation and restoration. The extent of this area is shown in *Figure 3.6e* (marked as "East Channel Constructed Wetland". This area consists of remnants of fish ponds lost to channel construction, and intervening areas of dry land. This area will become available for mitigation use following completion of channel construction. The area is bounded on the eastern side by the expanded Lok Ma Chau kiosk site and on the west by the Eastern MDC.

3.6.4.12 The objective of creating and restoring wetlands on this site is to create freshwater and possibly brackish-water habitats, including small ponds and shallow marshes, useful to waterbirds currently or historically found at San Tin. To this end, the design of this wetland area will provide habitats attractive to waterbirds and also to invertebrates, amphibians and fish upon which they feed. Because different bird and prey species require different habitats, the objective of design will be to provide shallow (10-15 cm depth) marsh habitats with gently sloping bunds, some with emergent vegetation, in combination with open-water habitats with water depths up to 2 m. This will provide a diversity of habitat types within the limited area available. A second objective is to design the wetland as a self-sustaining system, requiring little or no maintenance beyond routine tasks such as removal of invasive vegetation. A third objective is to design the wetland area as a visually attractive feature which enhances the landscape. Details of the concept, design, construction, and management requirements for this constructed wetland are given in *Annex 3-J*.

3.6.4.13 *Grasscrete Lining of Eastern MDC*: A design measure introduced to add ecological value to the Eastern MDC was the use of grasscrete lining throughout the interior of the channel, with the exception of the DWF channel. A fully concrete-lined channel provides little ecological value; a grasscrete-lined channel, on the other hand, can provide some of the ecological value of the habitat it replaces. The total area of grasscrete lining is approximately 7 ha. Of this total, an estimated 4.5 ha (the bottom area of the channel) would function as seasonal or year-round wetland, because groundwater levels in the area are reported by DSD to be at the channel invert level. This wetland is expected to provide shallow freshwater or brackish water habitats of some value, which will be colonisable by wetland vegetation and potentially useful to a range of wildlife species. The remaining 2.5 ha, on the grasscrete inner banks of the channel, would provide

dry, grassy habitat which would support insects and to insect-, vegetation- and seed-eating birds and mammals. The channel will be trapezoidal in shape with the inner banks pitched at a 1 in 2 slope, allowing plants to colonise the grasscrete areas readily. The grasscrete area is shown in *Figure 3.6e.*

3.6.4.14 Active management of this site for ecological purposes is not required. Grasses, reeds and sedges should be allowed to colonise the grasscrete area naturally from the seedbank of the surrounding areas. Cutting back of vegetation during the operation phase should be kept to the lowest level compatible with maintenance of flood flow capacity, as should dredging (see Paragraph 3.6.5.1 for proposal of this measure).

3.6.4.15 *Plantings on Outer Embankments of Eastern MDC*: The tops and outer embankments of the Eastern MDC will require revegetation following completion of earthworks. The area involved is approximately 2.23 ha. The major vegetation effort on the outer embankments will be hydroseeding (indicated by area marked "vegetation on outer embankment" in *Figure 3.6e*), supported by planting of scattered stands of trees and bamboos for use by ardeid birds (at locations marked "egretry plantation" and "roost/perch plantation" in *Figure 3.6e*). Tree/bamboo plantation sites were selected to fall on lands resumed for the project or on government lands used for the project. Where possible, sites were also selected to coincide with isolated pond, marsh, and/or stream fragments. Plantings for the eastern embankment are discussed in *Annex 3-J*, in connection with the constructed wetland area east of the Eastern MDC. Plantings on the western embankment should be similarly designed and implemented, with hydroseeding using a standard mix supported by scattered planting of stands of trees and bamboo of the species listed in *Annex 3-J, Table 1* Tree whips or seedlings and bamboo shoots/seedlings should be planted at 1 to 1.5 m spacings. Any plantings that die within the one-year establishment period are to be replaced with species approved by TDD and AFD. Hydroseeded banks of village polders will also provide some area of dry, grassy habitats.

3.6.4.16 The habitat compensation measures outlined above, the areas involved and their ecological function are summarised in *Table 3.6f* and compared to the habitats lost from the site due to the project. Locations of compensatory habitats are shown in *Figures 3.6c* and *3.6e.*

Table 3.6f *Comparison of Habitats Lost and Habitats Created/Enhanced under the Project*

Habitat	Area (ha)	Ecological significance/function
Existing habitats		
Active fish pond	1.80	provides breeding habitat for insects, mammal habitat, foraging habitat for birds; ecological linkage to main body of Deep Bay wetlands, including Ramsar Site; moderate to high value
Abandoned fish pond	4.65	similar to active fish ponds although higher value for some species, lower for others; overall moderate to high value
Illegally filled fish pond	2.70	currently low value. Functions and value would be similar to active or abandoned fish ponds if restored
Urbanised	0.80	little or no ecological importance; low value
Marsh	4.55	provides breeding and foraging habitats for some wetland-dependent species; actual value limited by poor existing water quality; moderate value
Stream/vegetated nullah	1.51	provides habitat for aquatic species; actual value limited by poor existing water quality; low-moderate value
Agriculture	1.10	value depends on management regime, including crops grown; generally low value
Plantation woodland	0.80	little ecological importance; low value
Created/compensatory habitats		
Flood storage pond at San Tin Villages	2.20	Compensate for loss of fish ponds and other wetlands; moderate to high value
Tsing Lung Tsuen drainage channel	0.14	Compensate for loss of wetlands; utility limited by design and size; low value
Tidal portion of Eastern MDC	1.00	Compensate for loss of wetlands; retain tidal connection of part of the site with the Shenzhen River and Inner Deep Bay system; moderate to high value
Constructed wetland east of Eastern MDC	3.43	Compensate for loss of fish ponds, marshes, streams and nullahs, and provide habitat for wetland-dependent wildlife; moderate to high value
Grasscrete lined bottom of Eastern MDC	4.50	Provide shallow-water habitats for wetland plant and animal species; moderate to high value
Grasscrete lined sides of Eastern MDC	2.50	Provide habitat for insects and prey base for insect-eating and seed-eating wildlife species; moderate value
Plantings on outer channel embankments	2.23	Enhance habitat diversity on site, provide breeding habitat for insects, food source for insectivorous and graminivorous birds and mammals, potential roosting and nesting sites for ardeid birds; moderate value

3.6.4.17 According to *Table 3.6f*, 9.15 ha of moderate-high value wetland (fish ponds) would be lost due to the project, while habitat compensation measures would provide 11.13 ha of moderate-high value wetland (flood storage pond, tidal channel, constructed wetlands and grasscrete-lined bottom of Eastern MDC). The mitigation available for loss of moderate-high value wetland habitats is thus considered to be adequate.

3.6.4.18 6.06 ha of low-moderate or moderate value wetlands and 2.7 ha of low value dry habitats would be lost due to the project. Habitat compensation measures would provide 0.14 ha of low value wetland (Tsing Lung Tsuen drainage channel) and 4.73 ha of moderate-value dry habitats (grasscrete banks and planted embankments of Eastern MDC). The grasscrete inner banks of the Eastern MDC and the outer embankment adjacent to the constructed wetland will provide functions similar to fish pond bunds currently found on the site and will thus provide important support to the ecological value of the wetland mitigation

areas. In addition, 1.86 ha of grassy area will be provided on the sloping banks of the village polders at San Tin and Chau Tau villages; this area will provide ecological functions, although it is not considered as part of the mitigation measures for habitat loss. Given that adequate compensation is provided for the highest value habitats on site as noted above, the losses and gains of low and moderate value habitats outlined here are considered to produce a net acceptable result, although there will be a net reduction in wetland and a small net gain in dryland habitat on the site.

3.6.4.19 An increased area of wetland habitat could be provided on the site by allowing the main body of the Eastern MDC to function as a tidal wetland. This could be accomplished by altering the management of the inflatable dam near the channel mouth, so that the majority of the channel is tidally inundated during most of the year. This measure would convert an area of shallow wetlands with limited potential for water and nutrient exchange into an wetland closely interconnected with the Inner Deep Bay system. It would also increase the variability of water levels in the Eastern MDC and increase the maximum wetland area in the channel during high tides. Strictly speaking, this is an operation-phase mitigation measure and is therefore also raised in Paragraph 3.6.5.4. It has been advised that this approach to dam operation cannot be implemented in the immediate future, due to Shenzhen River water quality and odour concerns of local residents. This mitigation measure is therefore not available at present. However, it should be kept open as a potential long-term solution.

Site Runoff, Sedimentation and Water Pollution

3.6.4.20 Impacts of site runoff and water pollution can be reduced to acceptable levels through implementation of the construction-phase site control measures outlined in *Section 4.4.4*, particularly those relating to dredging and excavation of the channel, control of construction runoff and drainage, and sewage effluents. These measures should be adequate to minimise pollution of surface waters surrounding the project site.

3.6.4.21 As noted in *Section 4.4.4*, appropriate scheduling of works will minimise the impact of sedimentation and resuspension of contaminants during channel construction. Despite the potential for disturbance to migratory birds, it is considered most appropriate to schedule earthworks during the dry season (winter) except under emergency conditions, in order to minimise the potential for sedimentation and resuspension. As the Eastern MDC site lies outside the Deep Bay Special Measures Zone, timing of earthworks during the dry season is not considered unacceptable.

Human and Equipment Disturbance on the Works Site

3.6.4.22 Controlling the degree of noise and disturbance from the works site will be beneficial to disturbance-sensitive wildlife in surrounding area. To achieve this goal, it is recommended to confine movements of construction equipment and site workers to areas within the site boundary (including Temporary Works Areas). Movements of site workers and equipment will be confined to the site and approved entry/exit points under the terms of contract; this restriction will be enforced through supervision by the contractor. The Environmental Team (ET) leader should brief site workers on the need to remain within the site and to avoid disturbance to surrounding habitats. These measures will be supported by taping off the boundary of excavation areas, where major equipment activity will take place; this measure is also required for safety reasons. In addition, the

measures recommended in *Section 7.4.4* should be implemented. These measures should reduce impacts during construction to acceptable levels.

3.6.5 *Mitigation of Operational Phase Impacts*

Channel Maintenance

3.6.5.1 It is recommended to reduce the frequency of maintenance dredging/desilting and of vegetation cutting in the Eastern MDC to the minimum levels commensurate with maintaining flood capacity. This will significantly reduce the degree of periodic disturbance and temporary habitat loss within the channel, and will provide a significant ecological gain. The channel bottom will be naturally colonised by plants such as grasses, reeds and sedges from nearby seedbanks, and such vegetation will quickly regenerate or be replaced through natural seeding following the short-term disturbance caused by dredging/desilting works. The appropriate balance between the maintenance and ecological objectives should be sought on an ongoing basis during the operation phase by DSD, through monitoring of water levels and flood capacity during channel operation.

3.6.5.2 To limit the potential for mobilisation and off-site transport of sediments and bound contaminants, dredging works required should be conducted during the dry season except under emergency conditions. The relevant guidelines for water quality control set forth in *Section 4.5.4* should also be adopted during all maintenance dredging.

Presence of Channel and Embankments

3.6.5.3 The barrier effect and habitat fragmentation imposed by the presence of the Eastern MDC can be reduced by appropriate restoration and enhancement works on and adjacent to the channel. These measures include grasscrete lining of the channel, revegetation of outer channel embankments, and restoration/creation of wetlands east of the channel, and are discussed in Paragraphs 3.6.4.11-3.6.4.15 above.

Hydrological Alteration of the Channel and Catchment

3.6.5.4 Alteration of local hydrology due to presence of the channel will be difficult to mitigate, since this can be considered an essential objective of the project. An important measure to mitigate in-channel effects would relate to operation of the inflatable dam. It is ecologically desirable to keep the inflatable dam of the Eastern MDC deflated for as much of the year as possible, so that the majority of the channel could be tidally inundated during most of the year (see also Paragraph 3.6.4.19 for ecological merits of this measure). This measure would keep the entire channel hydrologically connected with the Shenzhen River. As noted in Paragraph 3.6.4.19, this measure is considered not to be feasible at present due to water quality and odour nuisance concerns of local residents. However, it should be kept open as a potential long-term solution. Dam management, together with other aspects of Eastern MDC operation and maintenance, will be reviewed by TDD's appointed ecologist during the first three years of channel operation. The ecologist will make any necessary recommendations on altering the dam management regime during the first three years of channel operation, based on the findings of ecological monitoring. A recommendation will be made at the end of the monitoring period as to the authority to take responsibility for periodic review of dam operation thereafter, if

required for ecological purposes.

Human and Vehicle Presence on Channel Road

3.6.5.5 The disturbance effects of human and vehicle presence on the channel embankment road can be mitigated through the provision of vegetation on the outer channel embankments and through the natural establishment of vegetation in the inner, grasscrete-lined channel, as discussed in Paragraphs 3.6.4.13-3.6.4.15. This will reduce levels of visual disturbance and noise that might affect wildlife distribution and behaviour on the site.

3.6.6 Residual Impacts

3.6.6.1 The mitigation measures outlined above, if successfully implemented, are predicted to reduce the residual negative ecological impacts of the project to insignificant and acceptable levels. The major ecological concern is associated with wetland loss, and this has been mitigated as far as feasible given the site's geographic constraints and the nature of the project (flood control). Overall, residual losses of wetland habitats are considered to be insignificant and therefore acceptable when balanced off against the areas and quality of habitat gained.

3.7 CONCLUSIONS

3.7.1.1 The impact assessment has identified the key ecological issues associated with this project as loss of wetland and associated impacts to wetland-dependent species. The significance of these impacts is determined not solely by the site in isolation, but also by its proximity to the Ramsar Site and to breeding and wintering sites of bird species of conservation concern.

3.7.1.2 Mitigation measures have been recommended to reduce the ecological impacts arising due to the project (including both the Eastern MDC and the two Poldered Village Protection Schemes). The bulk of the measures recommended focus on mitigating the loss of wetland habitats. Measures include restoration of temporarily occupied areas, appropriate design and management of the channel and one of the village flood storage ponds, and restoration and creation of wetlands within the site boundary on lands not required for permanent works. Incorporation of these mitigation measures during the design process has significantly improved the project in ecological terms, and these measures are predicted to reduce the scale of impacts to an acceptable level.

3.7.1.3 An ecological monitoring and audit programme is proposed to monitor the success of ecological mitigation measures undertaken for the project, and to allow the recommendation of changes to the mitigation measures or project management regime as necessary to keep residual impacts within acceptable bounds.

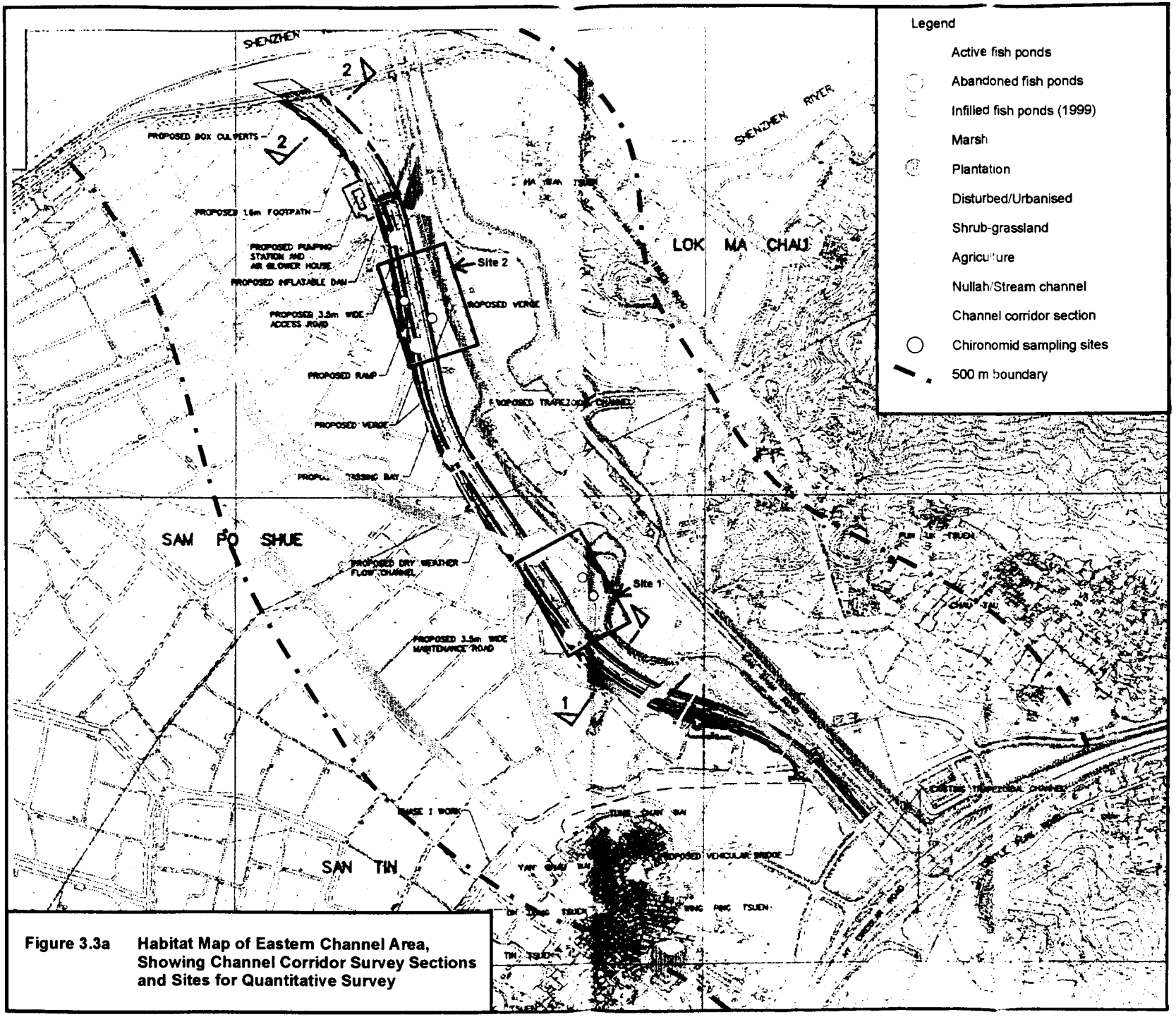
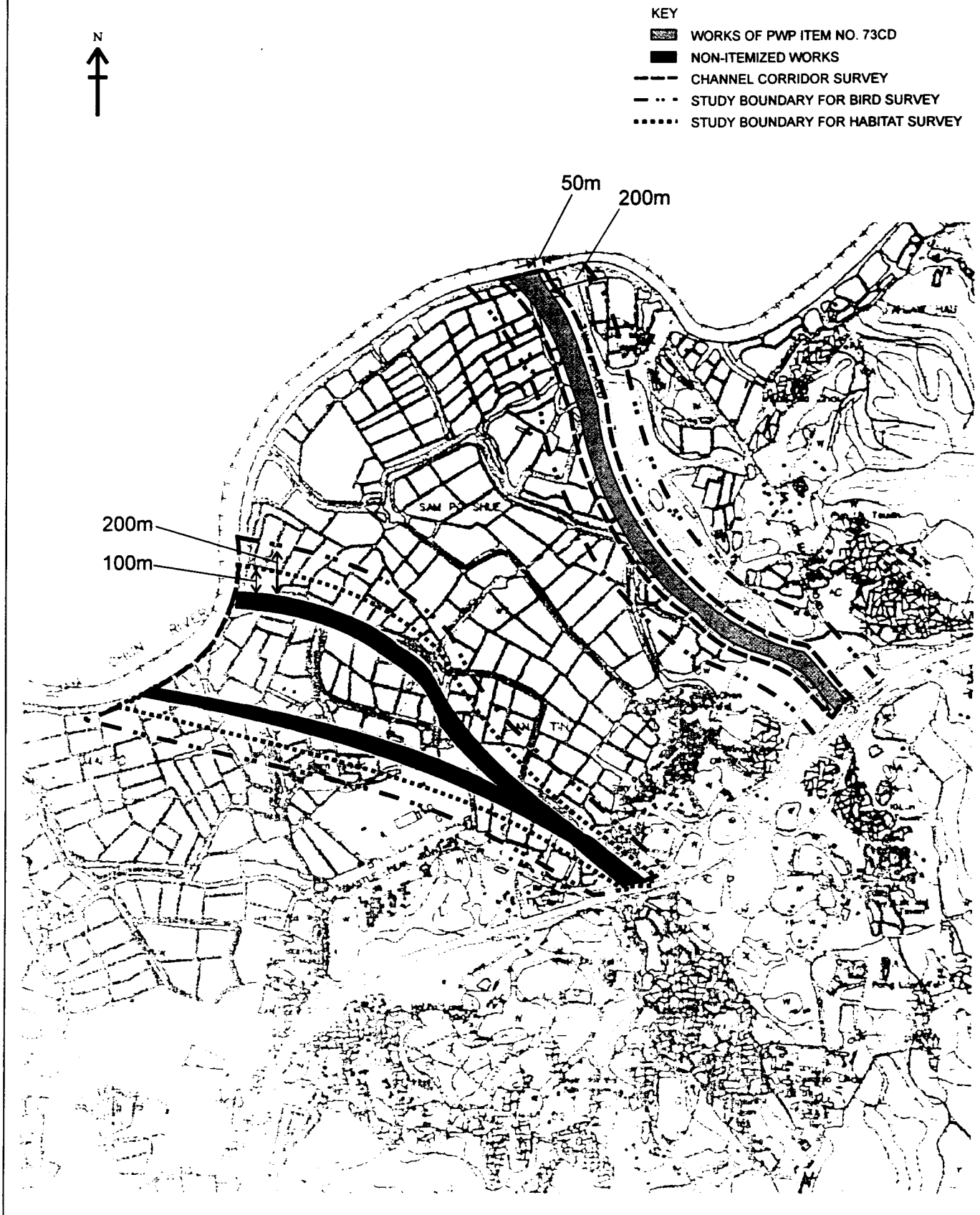


Figure 3.3a **Habitat Map of Eastern Channel Area, Showing Channel Corridor Survey Sections and Sites for Quantitative Survey**



NOT TO SCALE

FIGURE 3.3b

SURVEY AREAS FOR CHANNEL CORRIDOR SURVEY, HABITAT SURVEY AND BIRD SURVEY

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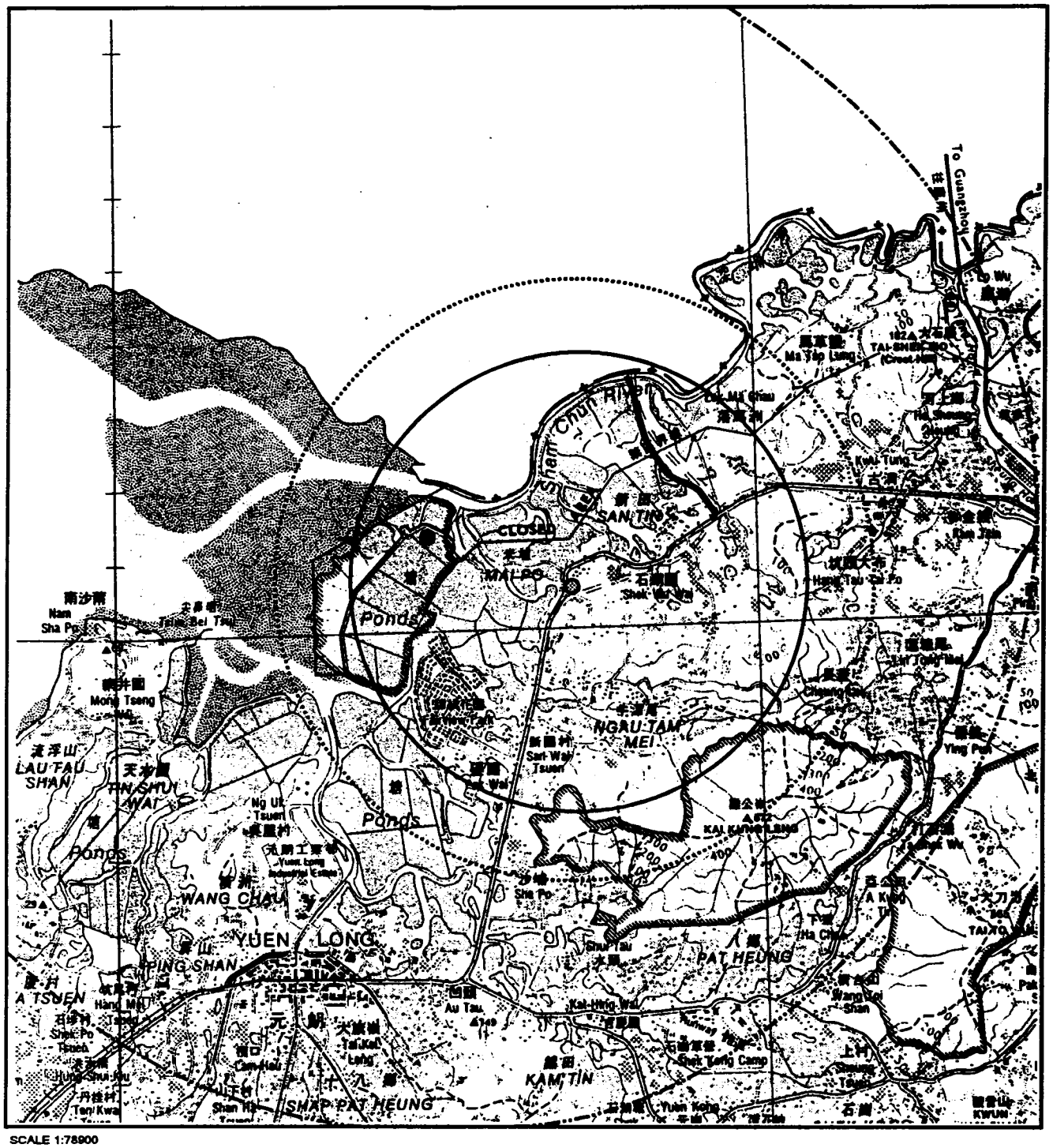


Figure 3.6b. 3 km (○) and 4 km (◌) feeding radii from Mai Po Village Egretry (◍), and 8km foraging radius (◌)of Black-faced Spoonbills from Roost Site at Mai Po Marshes (●).

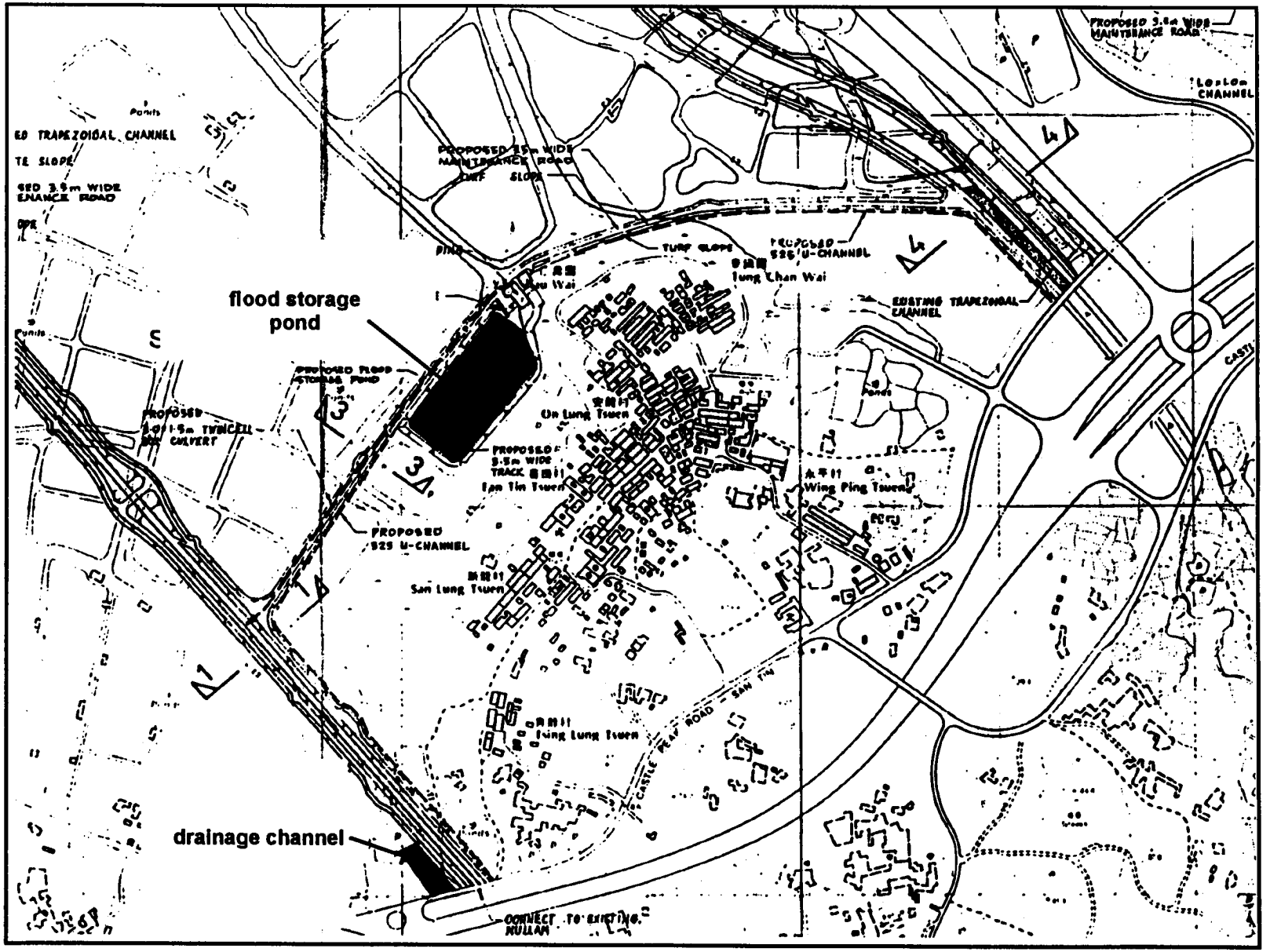
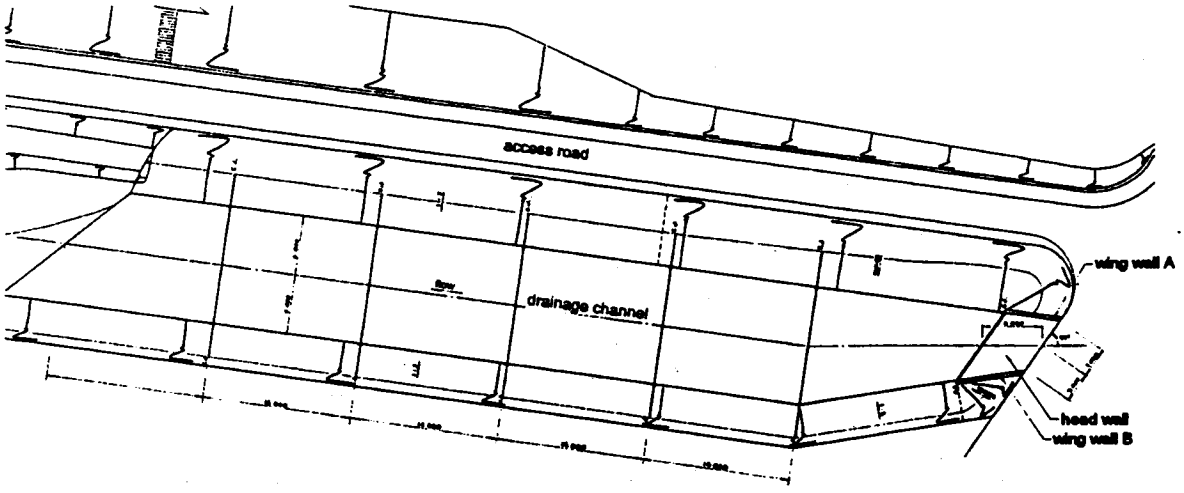
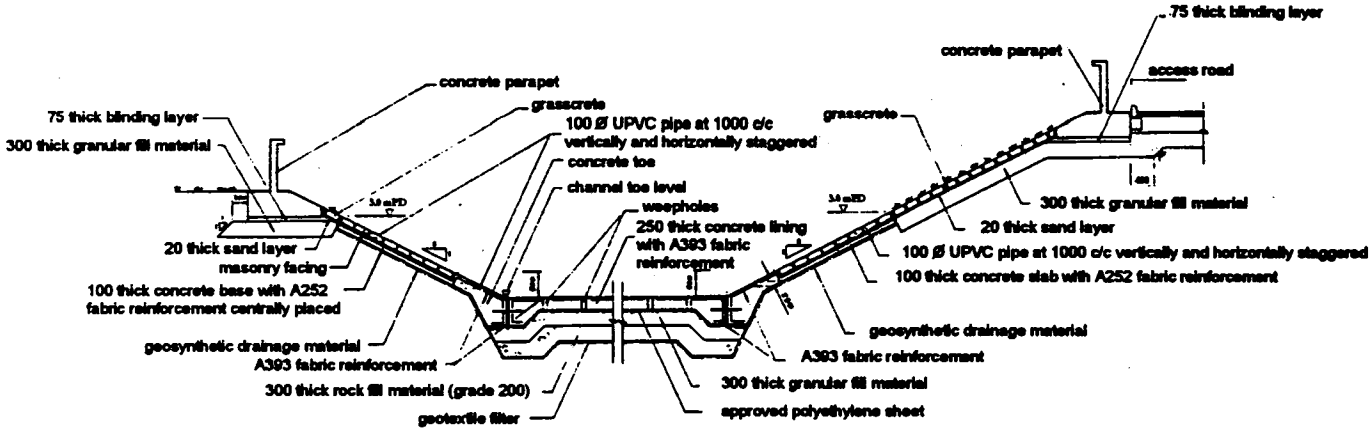


Figure 3.6c Locations of San Tin Polder Flood Storage Pond and Tsing Lung Tsuen Drainage Channel



Layout Plan



Typical Section of Drainage Channel

Figure 3.6d. Plan and Cross-Section of Tsing Lung Tsuen Drainage Channel

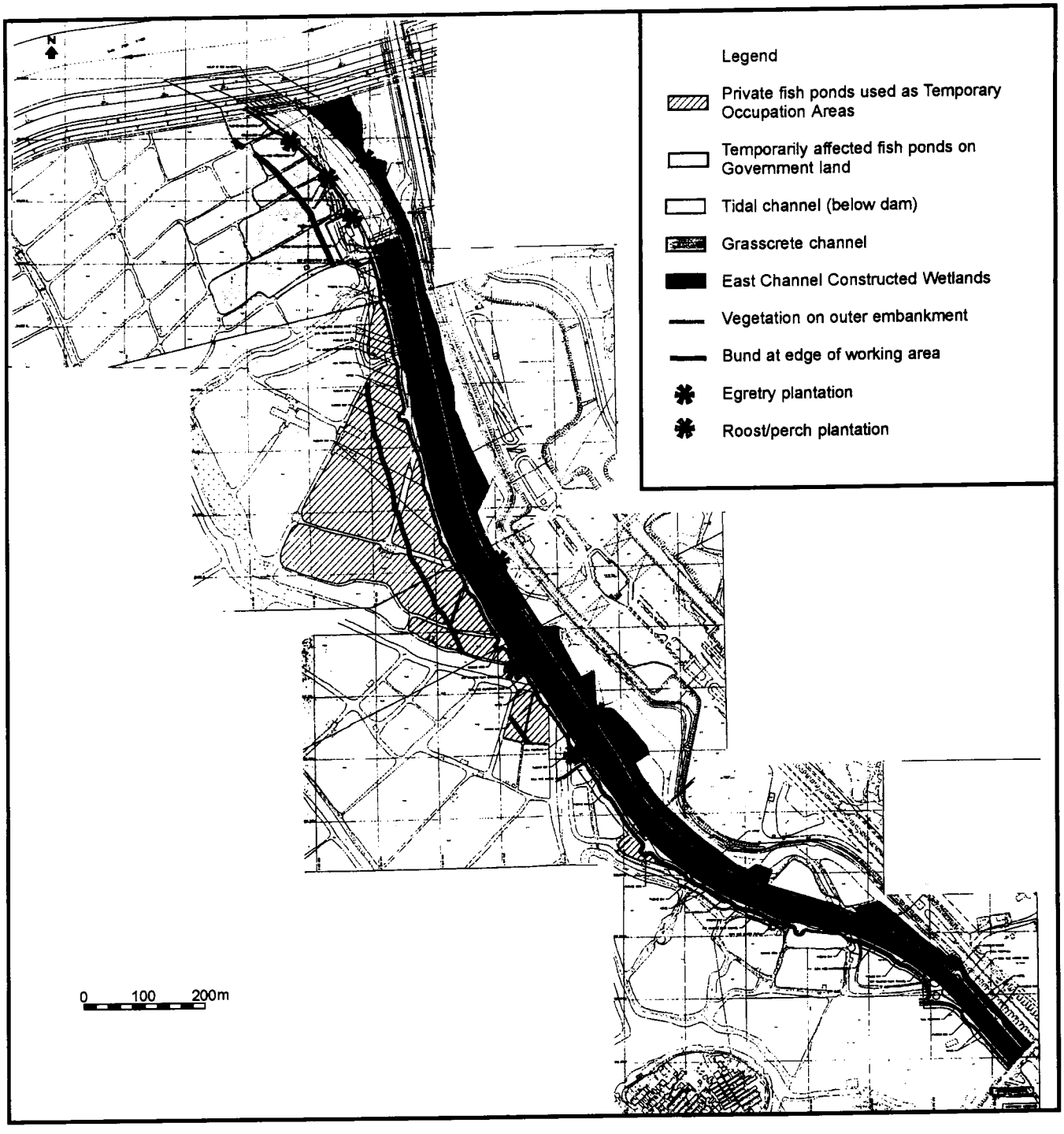


FIGURE 3.6e LOCATIONS OF MITIGATION SITES IN AND AROUND THE EASTERN CHANNEL

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