# Agreement No. CE 79/96
# Yuen Long Bypass Floodway
# Feasibility Study

## Ref. 0136/EIA/1 Issue 2

## Final
## EIA Study Report

**June 1998**

| | |
|---|---|
| Report Authorized For Issue By: | For and on Behalf of<br>Binnie Consultants Limited |


**Binnie Consultants Limited**
**11/F, New Town Tower**
**Pak Hok Ting Street**
**Shatin**
**New Territories**
**Hong Kong**

*in association with*
**Danish Hydraulic Institute**
**Earthasia Limited**

**For**
**Territory Development Department**
**NT North Development Office**
**1-2/F, Sha Tin Government Offices**
**6 Tung Lo Wan Hill Road**
**Shatin**
**New Territories**
**Hong Kong**

**CONTENTS**



| | Name | Signature | Date |
|---|---|---|---|
| Prepared | A.H. Sewell | [signature] | 10.6.98 |
| Checked | R.C. Deacon | R.C. Deacon | 10. June '98 |
| Reviewed | N.R. Townsend | NRT | 16/6/98 |

## CONTENTS
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## CONTENTS
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APPENDICES



FIGURES

**CONTENTS**
*(continued)*

**CONTENTS**
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# 1. INTRODUCTION

## 1.1 Background to Study

1.1.1 Serious flooding has occurred in and around Yuen Long Town at least seven times over the last fifteen years. Government studies including the Northwest New Territories (NWNT) Base Strategy Studies, TELADFLOCCOSS I and II and the NWNT Village Flood Protection Study have identified the major causes of flooding and recommended appropriate mitigation measures. The studies identified that the capacity of the Yuen Long Nullah drainage system was inadequate mainly due to rapid urban growth over the last 20 years which has reduced the flood plain storage capacity and increased runoff volumes. In addition, Yuen Long Town has been built at a relatively low level and the drainage design standards and methods used at the time were less rigorous than present design requirements. The studies recommended the construction of a Bypass Floodway as the most cost-effective option for providing additional drainage capacity to cater for present needs and to provide additional capacity for new development in the area to the south of Yuen Long.

1.1.2 The Yuen Long Bypass Floodway is therefore to be designed to divert part of the flows entering the Yuen Long drainage system from the south of Yuen Long into the Kam Tin River, which is at present under construction, to reduce the risk of flooding in Yuen Long Town.

1.1.3 A Preliminary Project Feasibility Study (PPFS) and Preliminary Environmental Review (PER) was undertaken by Binnie Consultants Limited in 1995 in respect of the proposed Yuen Long Bypass Floodway. The PPFS noted that *There will be environmental and ecological impacts arising from the construction and operation of the Yuen Long Bypass Floodway if not mitigated* and recommended that *a full environmental impact assessment be undertaken during the feasibility study stage to address the potential construction and operation impacts* of the project.

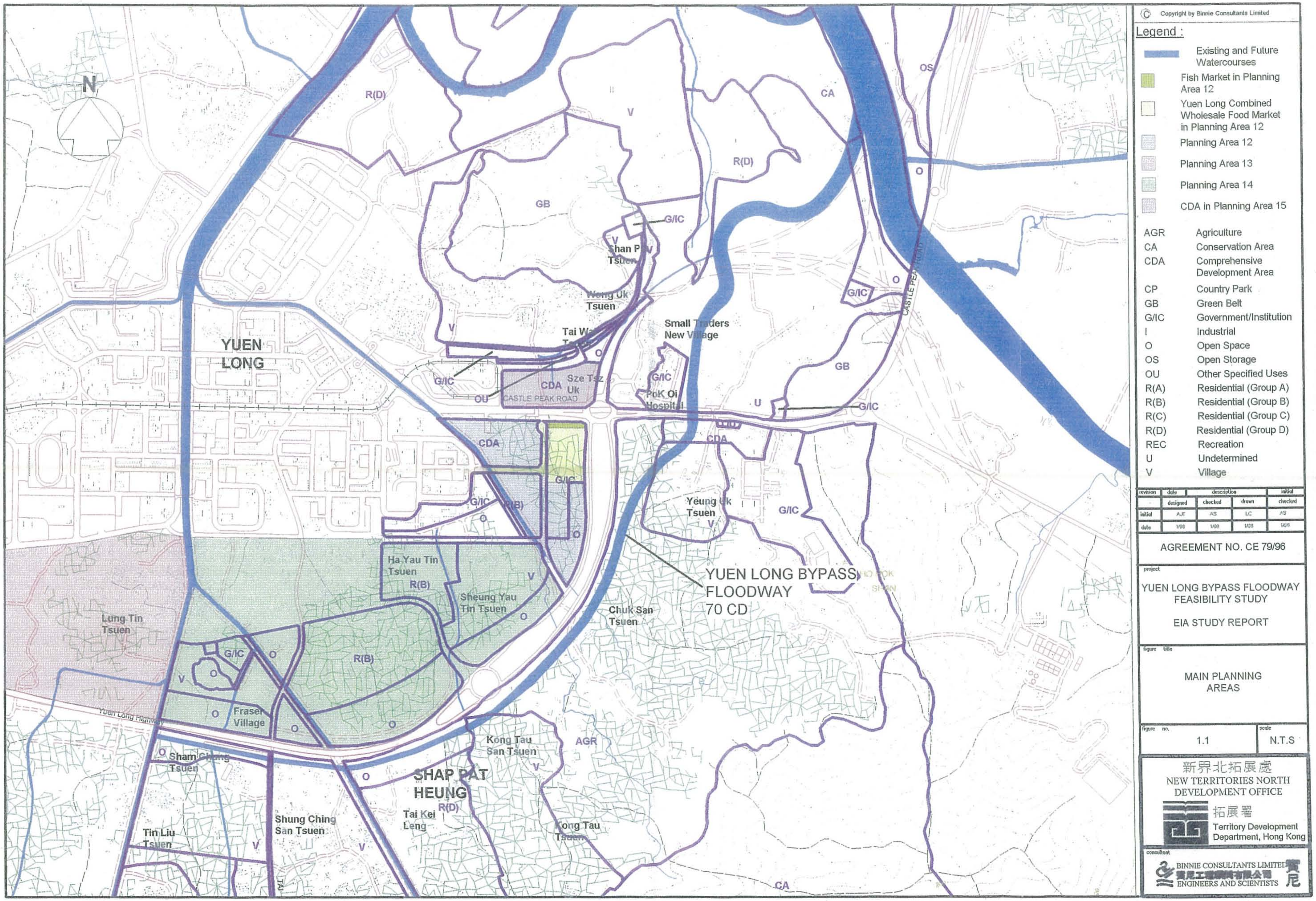
## 1.2 Evaluation of Alignment Options

1.2.1 As part of the Feasibility Study four potential alignment options were assessed on engineering, planning and environmental grounds. Plans showing the four alignment options are given in Appendix A. An evaluation of the various issues and constraints concluded that Option 3 was the most preferred alignment for the Yuen Long Bypass Floodway (YLBF). A summary of the constraints and key issues considered during the evaluation of the alignment options is given below. Table 1.1 presents a simple matrix showing the overall results of the evaluation. Figure 1.1 identifies the main planning areas which have influenced the evaluation of the options.

**Table 1.1**
**Evaluation Summary of Alignment Options**

| Evaluation Criteria | | | Options | | | | Insurmountable Impacts |
|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | |
| a | Planning Constraints | | 2 | 1.5 | 1 | 1 | Only for option 1 |
| b | Engineering/Hydraulic Constraints | | 2 | 1 | 0 | 1 | Only for option 1 |
| c | Air Impacts | *Construction*<br>*Operation* | 0<br>0 | 0<br>0 | 0<br>0 | 0.5<br>0 | None |
| d | Noise Impacts | *Construction*<br>*Operation* | 0.5<br>0 | 0.5<br>0 | 0.5<br>0 | 1<br>0 | None |
| e | Water Impacts | *Construction*<br>*Operation* | 0.5<br>0.5 | 0.5<br>0.5 | 0.5<br>0.5 | 1<br>1 | None |
| f | Ecological Impacts | *without mitigation* | 1 | 1.5 | 1.75 | 2 | None assuming equivalent ecological compensation can be implemented on site |
| g | Socioeconomic Impacts (agricultural land, housing, fishponds, lilyponds) | | 1 | 1 | 1 | 1.5 | None provided Government compensation is acceptable |
| h | Visual and Landscape Impacts | | 1.5 | 1.5 | 1 | 1.75 | |
| i | Residual Environmental Impact (c, d, e, f, g, h) | | 5 | 5.5 | 5.25 | 8.75 | |
| j | Overall Residual Impact (a, b, i) | | 9 | 8 | 6.25 | 10.75 | N/A |

Evaluation Ranking System
0 = low (impact)/high mitigation opportunity
1 = medium
2 = high/low mitigation opportunity


© Copyright by Binnie Consultants Limited
Legend :
Existing and Future Watercourses
Fish Market in Planning Area 12
Yuen Long Combined Wholesale Food Market in Planning Area 12
Planning Area 12
Planning Area 13
Planning Area 14
CDA in Planning Area 15
AGR Agriculture
CA Conservation Area
CDA Comprehensive Development Area
CP Country Park
GB Green Belt
G/IC Government/Institution
I Industrial
O Open Space
OS Open Storage
OU Other Specified Uses
R(A) Residential (Group A)
R(B) Residential (Group B)
R(C) Residential (Group C)
R(D) Residential (Group D)
REC Recreation
U Undetermined
V Village
AGREEMENT NO. CE 79/96
project
YUEN LONG BYPASS FLOODWAY FEASIBILITY STUDY
EIA STUDY REPORT
figure title
MAIN PLANNING AREAS
figure no. 1.1
scale N.T.S
新界北拓展處
NEW TERRITORIES NORTH DEVELOPMENT OFFICE
拓展署
Territory Development Department, Hong Kong
consultant
BINNIE CONSULTANTS LIMITED
ENGINEERS AND SCIENTISTS
N
YUEN LONG
YUEN LONG BYPASS FLOODWAY 70 CD
SHAP PAT HEUNG
Small Traders New Village
Pok Oi Hospital
Yeung Uk Tsuen
Chuk San Tsuen
Ha Yau Tin Tsuen
Sheung Yau Tin Tsuen
Lung Tin Tsuen
Fraser Village
Sham Chung Tsuen
Shung Ching San Tsuen
Tin Liu Tsuen
Tai Kei Leng
Kong Tau San Tsuen
Kong Tau Tsuen
Weng Uk Tsuen
CASTLE PEAK ROAD
Yuen Long Highway

*Engineering and Planning Constraints*

1.2.2 Option 1

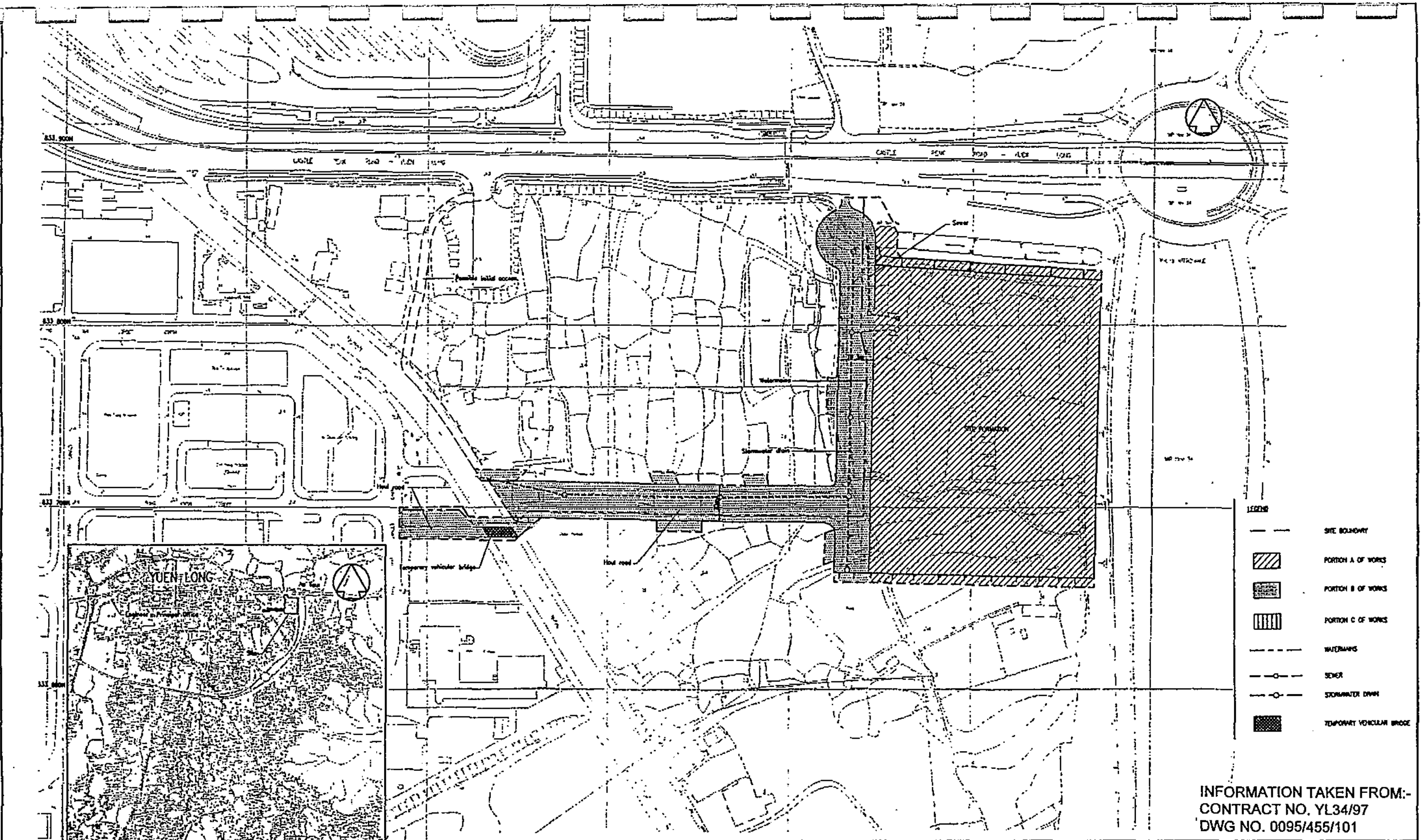
(i) The section south of Castle Peak Road (CPR) would sit in part in an existing buffer zone but also encroaches into newly planned development areas 12, 13 and 14 affecting existing and planned development. In particular, the alignment encroaches into the area set aside for the Yuen Long Combined Wholesale Food Market which has obtained planning approval and is about to commence site formation works. A general layout plan of the development is shown in Figure 1.2. Construction of the Yuen Long Combined Wholesale Food Market site formation and roads is scheduled to commence in March 1998 and is programmed to take one year. A second stage of construction will commence in March 1999 which will involve road paving and the construction of a bridge which is also expected to take one year. Thus, this market will be operational prior to the construction of the YLBF. In addition a Fish Market which is being reprovided by the Kowloon Canton Railway Corporation (KCRC) will be positioned in the small area directly to the north of the Yuen Long Combined Wholesale Food Market and south of CPR. This also will be operational prior to the construction of the YLBF. These planned developments therefore effectively rule out Option 1.

(ii) The section north of CPR would affect planned development of CDA 15 and the Kau Hui development. Two existing villages including Tai Wai Tsuen and Wong Uk Tsuen would be directly affected, requiring resumption of existing houses;

(iii) The height of the crossing point under CPR would be restricted due to the low level of the existing road. This would cause a major constriction at the crossing point and increase headlosses requiring an inverted siphon or pumping. Such a solution is considered not practical.

(iv) Flows passing through box culverts under the Yuen Long Highway (YLH) would require tight transition curves if the YLBF is kept close to the toe of the road embankment, increasing hydraulic headlosses and requiring higher banks; and

(v) Option 1 removes and requires the rebuilding of an existing road with potential negative construction and operational complications in Area 14 including the likely addition of noise barriers;




YUEN LONG

COMBINED WHOLESALE FOOD MARKET

SITE FORMATION WORKS

GENERAL LAYOUT PLAN

TERRITORY DEVELOPMENT DEPARTMENT

YUEN LONG BYPASS FLOODWAY FEASIBILITY STUDY EIA STUDY REPORT

BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼

| Figure no. | 1.2 |
|---|---|
| Prepared AJT | Checked CWC |
| Date 2/98 | Scale NTS |

Option 2

(i) As described for Option 1 the section south of CPR encroaches into the area of the Yuen Long Combined Wholesale Food Market and Fish Market, thereby ruling Option 2 out at this point;

(ii) Option 2 would necessitate an additional crossing point under the YLH which would consist of eight traffic lanes/four carriageways by the time of the YLBF construction;

(iii) Option 2 removes and requires the rebuilding of an existing road with potential negative construction and operational complications in Area 14 including the likely addition of noise barriers;

(iv) More encroachment into Planning Area 12 would be necessary than under Option 1, thus further reducing potential development; and

(v) Alignment impacts on active "lotus" cultivation.

Option 4

(i) More land resumption required due to increased length of the YLBF and loss of beneficial use to be made of land already resumed under the YLH;

(ii) YLBF would form another barrier or constraint on future development plans;

(iii) Significant loss of village type housing (Shung Ching San Tsuen) and active agricultural land currently in use throughout the proposed alignment;

(iv) The alignment would bisect the existing agricultural and village land thus causing greater environmental problems; and

(v) Access to YLBF on one or both sides will offer opportunity for uncontrolled and unplanned change of land usage and degradation of existing environment.

Option 3

Option 3 has been clearly identified as the most preferred option for the following reasons:

(i) In terms of engineering constraints Option 3 as well as Option 2 and 4 provide the easiest point hydraulically to pass under CPR due to the higher road level at this point and the potential to raise the road level even further to accommodate utilities etc. This small section of CPR is the only feasible location to pass under the road to minimize the risk of a hydraulic constriction and obviate the use of an inverted siphon. However, immediately south of CPR the alignment passes through a CDA site. The low level of CPR west of the CDA site and the position of the Pok Oi Hospital also on the west side of the alignment restricts the location of the crossing point in this area such that the alignment cannot avoid passing through the western edge of the CDA site. The alignment of the YLBF has been moved as far west as possible in this area to minimise the impact on the CDA site but to also be acceptable to the Transport Department with respect to the necessary regrading work required when raising the road level. The Planning Department has agreed to reserve the area required by the YLH through the CDA site.

(ii) Easier transition curves are obtainable to divert flows from the existing nullahs and channels compared with options 1 and 2;

(iii) No restriction of flows in future would be anticipated unlike options 1 and 2 which would be subject to additional hydraulic losses if routed in channels and box culverts under the YLH;

(iv) Easiest point to collect incoming watercourses from the major catchments to the southeast as already channelled ready to pass under YLH;

(v) Does not affect existing development plans for areas north of YLH; and

(vi) Utilizes Route 3 box culvert which is presently under construction.

***Environmental Issues***

1.2.3 A summary of the relevant issues leading to the ranking in Table 1.1 is given below.

1.2.7 Comparing the degree of potential impacts of the four alignment options it is considered that there would be no appreciable difference between options 1, 2 and 3 in respect of both construction and operation. The channel alignments of these options are adjacent to the toe of the YLH embankment and would be subject to at least overflow drainage runoff from the highway. In addition, the treatment capacity afforded by the vegetated streams and agricultural land south and east (upstream) of YLH would mean that the water quality associated with runoff from this area would be similar for these three alignments. Furthermore, during the construction phase a greater number of agricultural sensitive receivers associated with the option 4 alignment could be impacted by potential site runoff particularly in respect of water resources used for agriculture. Thus the impact ratings for option 4 are slightly higher than for the other options.

Ecological Impacts

1.2.8 Ecological impacts related to the works involves loss of various habitats. Five main types of habitat are identified along the alignment options. These include Village area, Agricultural land (active/inactive), Stream/Riparian, Lotus ponds and Fish ponds. Our ecological evaluation summary arises from a qualitative comparison of the degree of potential impact that each alignment option could have on the different habitat types and is based on site inspections and study of maps and aerial photographs.

1.2.9 Table 1.2 characterises the relative potential impacts that each alignment option could have on the various habitats, (where "0" indicates no impact and "3" indicates potential significant impact). The total score for each option was used to determine the ecological impact rank for each option in Table 1.1.

**Table 1.2**

| **Habitat** | **Option 1** | **Option 2** | **Option 3** | **Option 4** |
|---|---|---|---|---|
| Village | 1 | 1 | 1 | 1 |
| Agricultural | 1 | 1 | 1 | 1.5 |
| Stream/Riparian | 0.5 | 0.5 | 1 | 1.5 |
| Lotus Pond | 0 | 2 | 2 | 2 |
| Fish Pond | 1.25 | 1.25 | 1.25 | 1.25 |
| **Score** | 3.75 | 5.75 | 6.25 | 7.25 |

Air Quality Impacts

1.2.4 Potential air quality impacts arising from the project in general are likely to be modest owing to the relatively small scale and temporary nature of the construction works. Operational air quality impacts associated with the project are likely to be insignificant provided adequate maintenance of the channels is undertaken and odorous organic rich sediments are not allowed to accumulate. With the implementation of EPD recommended pollution control clauses "Dust Suppression Measures" and good construction practices, the impact of dust and other air pollutants is likely to be low. There would be little difference in potential air quality impacts associated with options 1, 2 and 3 as south of Castle Peak Road their alignments run adjacent to the YLH and therefore would be subject to similar background air quality levels associated with traffic. In contrast, background air quality along the alignment of Option 4 would be significantly less influenced by traffic from the YLH and therefore a potentially higher construction impact on sensitive receivers in this area could be expected.

Noise Impacts

1.2.5 Potential noise impacts are likely during the construction phase. However, such impacts will be temporary and can be mitigated effectively through implementation of standard contract clauses and good site practices. No operational noise impacts are expected. As with air quality impacts the proximity of alignment options 1, 2 and 3 to the YLH means that these options would experience similar background noise levels heavily influenced by traffic noise. Such an influencing factor would lower the potential construction noise impact along these alignments relative to the Option 4 alignment which is significantly further away from the YLH. Hence Option 4 has been given a slightly higher impact rating.

Water Quality Impacts

1.2.6 Potential water quality impacts during construction of the channel could arise from site runoff, wastewater from workers and concrete washings during construction. Potential operational impacts include surface runoff and wastewater discharged into a concrete channel eliminating treatment capacity. Such impacts are mitigatable to acceptable levels through implementation of good site management practice. Advice on such practices is contained in the ProPECC Paper (PN 1/94) on Construction Site Drainage. Operational impacts can be mitigated through channel design taking every opportunity to use grasscrete or similar permeable materials and minimising the use of concrete.

1.2.10 Village type habitat is characterised by continuous anthropogenic disturbance, low species diversity, common species, many exotic species and artificially propagated species. The ecological value of this habitat is considered low. Village type habitat is located around the villages of Sham Chung Tsuen, Fraser Village, Shung Ching San Tsuen, Kong Tau San Tsuen Chuk San Tsuen, and Sheung Yau Tin Tsuen south of CPR and around Sze Tsz Uk, Tai Wai Tsuen, Wong Uk Tsuen and Small Traders Village north of CPR. The potential ecological impact on this habitat for all four options is considered low.

1.2.11 Agricultural land habitat is characterised by monocultured fields or remnants thereof (inactive), low lying often wet, colonisation by invasive species (inactive) and disturbance due to human activity/traffic. The ecological value of this habitat type along the alignment options is relatively low whether under active cultivation or inactive. The former would suffer more human disturbance but would be better irrigated and less subject to invasive species than the latter. Options 1 and 2 would have approximately the same potential impact as their alignments traverse the same area of agricultural land on the north side of YLH. Option 3 traverses approximately the same amount of area of agricultural land south of YLH. Owing to the close proximity to YLH, options 1, 2 and 3 are given the same ranking of "1" whilst Option 4, considerably more distant from YLH, is given a rank of "1.5" on the basis that the local ecology along the Option 4 alignment would suffer no disturbance from traffic on the YLH.

1.2.12 Stream/Riparian habitat potentially impacted by each alignment option is limited to the areas of the floodway intersected by a number of streams/nullahs draining the Shap Pat Heung hinterland. Four out of the five streams/nullahs affected are heavily polluted by organic or organic/light industrial waste and four out of five streams/nullahs are either engineered channels, have been recently dredged or are currently subject to engineering works. The habitat is characterised by low diversity and common species and has low ecological value. Options 1 and 2 have been given the same low impact rating due to the absence of riparian habitat on the north of YLH. Option 3 encompasses a small amount of riparian habitat and is ranked slightly higher than Options 1 and 2. Option 4 is given a ranking of "1.5" since there has been less disturbance by engineering works to some of the tributary streams and their riparian banks further to the south. In addition the stream courses and riparian habitats between the Option 4 alignment and the YLH will be largely lost.

1.2.13 An area of Lotus ponds under active cultivation exists in the lowlying area between Yeung Uk Tsuen and YLH close to the Pok Oi Interchange. Alignments 2, 3 and 4 traverse this area therefore affecting the lotus ponds. However alignment 1 does not affect them. Whilst manmade, this habitat was observed during field surveys to be a mixed habitat with the greatest onsite diversity of flora and fauna including lotus, willow, fruit trees, amphibians, small fish, birds and snails. However, interviews with pond operators revealed that pesticides are regularly used on the lotus plants and lotus is harvested periodically throughout the year. Such activities would have a significant effect on the local ecology. Despite this interference the habitat is still considered to be relatively rich with medium ecological value.

1.2.14 Northeast of Pok Oi Hospital the proposed alignment for all four options traverses an area of Fish ponds which are currently drained and used as stockpiling areas for the construction of Route 3 or are otherwise severely blighted by the construction works. It is understood that pond areas used by the Route 3 contractor will be reinstated following completion of the highway. Reinstatement of fish ponds by the Route 3 contractor will restore the fundamental ecological characteristics of the area but will be unlikely to result in a return to the same ecological value provided by the area prior to Route 3 construction. For example, the operation of Route 3 will impose a disturbance to the adjacent habitat which prior to the highway was a relatively quiet rural area. Fish ponds provide a habitat of relatively low diversity particularly when their surrounding bunds are regularly cleared of any vegetation other than grass. However, they do provide a significant food supply to wetland birds. The importance of the fish ponds around the Deep Bay area as a source of food and habitat for wetland and migratory birds is well established and as such fish ponds in this area are recognised to be of relatively high ecological value. Nevertheless, the fish ponds affected by the YLBF will be subject to significant disturbance by both the Route 3 highway and other encroaching development from the south. As such the ecological value of the ponds affected by the Route 3 works is considered to be relatively low.

1.2.15 When the results of this evaluation are transferred to Table 1.1 it can be seen that without mitigation the significance of the potential ecological impacts for all options is relatively high with Option 4 ranked least eco-friendly followed in decreasing order of significance by Options 3, 2 and 1.

Socioeconomic Impacts

1.2.16 Potential socioeconomic impacts of the project include: displacement of existing dwellings and loss of livelihood from resumption of or disruption to active agricultural land, lily ponds and fish ponds. Options 2, 3, & 4 will result in a similar socioeconomic impact north of CPR as their alignments across existing fishponds and residences would be approximately the same. However, Option 1 would result in a greater impact on existing housing since the alignment passes close to the villages of Wong Uk Tsuen and Tai Wai Tsuen. South of CPR Option 1 would have a slightly lower impact than the other three since option 1 avoids disruption of the lily ponds although it does pass through disused paddy fields where tethered water buffalo were observed. Options 1, 2 and 3 involve similar land resumption issues being immediately adjacent to the YLH. In this area maximum use is made of land already resumed for the YLH. In contrast, Option 4 would involve significantly greater land resumption and associated displacement of existing dwellings and loss of active agricultural land.

Visual and Landscape Impacts

1.2.17 The four alignment options traverse a lowlying floodplain to the south and east of Yuen Long Town which is village/suburban to rural in nature. The area has been physically subdivided by the YLH. North of the YLH the landuse is a mixture of small-to-medium industries, villages, active and fallow agricultural land, derelict livestock buildings, fishponds and heavily polluted concrete lined nullahs. South of YLH the area is noticeably less industrialised although a greater proportion of the agricultural area has fallen into disuse. However, the land west of Yeung Uk Tsuen is almost entirely cultivated as lotus ponds including fringing vegetable plots and a small plant nursery. North of CPR comprises a hotel, Pok Oi Hospital and an area of old village type housing (Sze Tsz Uk) to the east of the Pok Oi Interchange. West of the Pok Oi Interchange comprises an old village area that is currently subject to development under the Kau Hui development proposals. The northern end of the site traverses an area of fish ponds which are currently drained and used as stockpiling areas for the construction of Route 3 or are otherwise severely blighted by the construction works. Following project completion the fish ponds will be reinstated.

1.2.18 Key visual and landscape impacts associated with the project involve the transformation of existing village settlement areas, agricultural areas, fish ponds (reinstated) and lotus ponds into a trapezoidal flood channel with associated structures including maintenance access, footpaths and a pumping station.

1.2.19 Visual receptors along the various alignments include adjacent village houses, the existing and future residential buildings in Yuen Long South, YLH, the future West Rail, and Pok Oi Hospital. North of CPR there would be little difference in the visual and landscape impact associated with the four alignment options given that the area between Pok Oi Hospital and Route 3 is likely to be developed into a residential area (see Figure 3.2). South of CPR alignment Options 1 and 2 occupy an area zoned for Open Space along the northern toe of the YLH embankment and will be overviewed from existing and future developments in Yuen Long South. OZP S/YL/2 notes that this area has been set aside for providing recreational and sports facilities as well as serving as a buffer area between the highway and areas to the north. In contrast, the Option 3 alignment will be obscured from view to residential receptors in Yuen Long by the YLH embankment but will be viewed from village areas south of, but close to, the YLH. On the basis that a greater number of people will be affected by views of a channel north of YLH and that the planned buffer zone would be affected, Options 1 & 2 have been given a higher impact rating than Option 3. The Option 4 alignment south of YLH would result in further fragmentation of the agricultural land and could encourage unplanned development through the opening up of a hitherto inaccessible area. For example, land may be used for open storage which would have a negative impact on the current landscape and views from high rise residential areas in Yuen Long South. It would also affect the current rural character and views enjoyed by nearby villages. Option 4 is given the highest impact rating.

1.2.20 Thus, from a landscape/visual point of view Option 3 is the most preferred alignment followed by Options 1 & 2 with Option 4 the least preferred.

*Summary*

1.2.21 Our environmental evaluation of the four alignment options shows that on purely environmental grounds Option 1 is the most preferred. However, Options 1 and 2 have been ruled out primarily on planning grounds due to encroachment upon the area set aside for the new Yuen Long Combined Wholesale Food Market and reprovisioned Fish Market immediately south of CPR. Option 4 is the least preferred environmentally followed by Options 2 and 3. Combining planning and engineering constraints with the environmental evaluation, Option 3 is shown to be the optimal alignment.

# 2. EIA FOR PREFERRED ALIGNMENT

## 2.1 Scope of EIA Study

2.1.1 This EIA report forms part of the Yuen Long Bypass Floodway Feasibility Study currently being undertaken by Binnie Consultants Limited and addresses the environmental impacts of the preliminary design (Option 3) as recommended in the draft Review Report (0136/REP/2/Issue 1)[1]. Figure 2.1 shows the location plan of the study area and preliminary design alignment.

2.1.2 The assessment considers noise, air, water quality, waste management, ecology and landscaping and visual issues related to the proposed development.

## 2.2 Objectives of EIA Study

2.2.1 The specific objectives of the EIA study as given in the project Brief are as follows:

i) to describe the Project and associated works together with the requirements for carrying out the project;

ii) to identify and describe the elements of the community and environment likely to be affected by the Project, and/or likely to cause adverse impacts upon the Project, including both the natural and man-made environment;

iii) to identify and quantify emission sources and determine the significance of impacts on sensitive receivers and potential affected uses;

iv) to identify and quantify any potential losses or damage to flora, fauna and natural habitats;

v) to propose the provision of infrastructure or mitigation measures so as to minimise pollution, environmental disturbance and nuisance during construction and operation of the project;

vi) to identify, predict and evaluate the residual (ie after practical mitigation) environmental impacts and cumulative effects expected to arise during the construction and operation phases of the project in relation to the sensitive receivers and potential affected uses;

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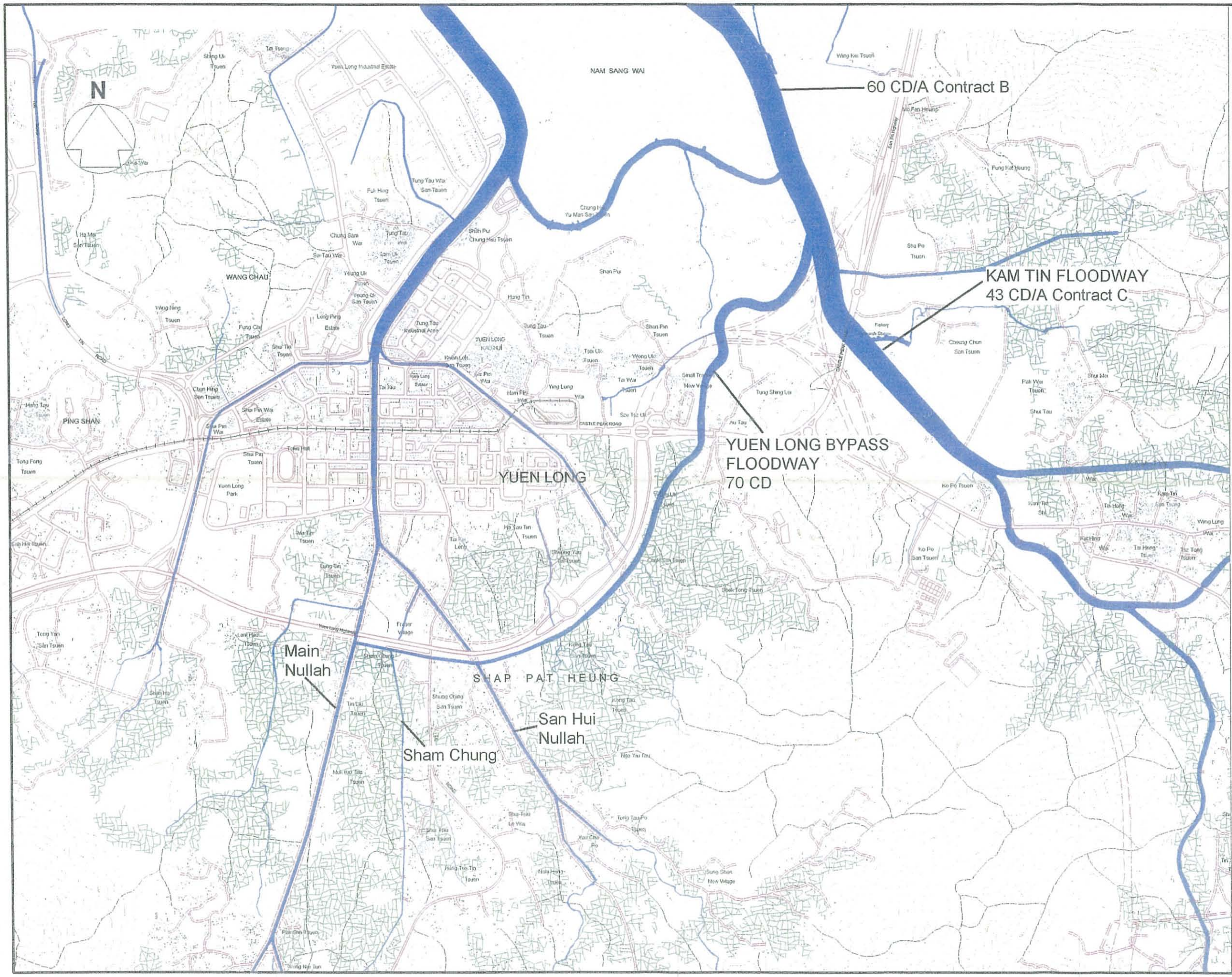
1 BCL (1997) Agreement No. CE 79/96 - Yuen Long Bypass Floodway Feasibility Study (Series of Engineering Reports). TDD, Hong Kong Government






Legend :

Existing and Future Watercourses

| revision | date | description | | | initial |
|---|---|---|---|---|---|
| | designed | checked | drawn | | checked |
| initial | GY | AJT | LC | | CWC |
| date | 1/98 | 1/98 | 1/98 | | 1/98 |

AGREEMENT NO. CE 79/96

project

YUEN LONG BYPASS FLOODWAY FEASIBILITY STUDY

ENGINEERING REPORT

figure title

LOCATION PLAN

figure no. 2.1

scale N.T.S

新界北拓展處
NEW TERRITORIES NORTH DEVELOPMENT OFFICE

拓展署
Territory Development Department, Hong Kong

consultant

BINNIE CONSULTANTS LIMITED
賓尼工程顧問有限公司
ENGINEERS AND SCIENTISTS




vii) to identify, assess and specify methods, measures and standards to be included in the detailed design, construction and operation of the Project which are necessary to mitigate these impacts and reduce them to acceptable levels;

viii) to design and specify the environmental monitoring and audit requirements necessary to ensure the implementation and effectiveness of the environmental protection and pollution control measures adopted;

ix) to investigate the extent of side-effects of proposed mitigation measures that may lead to other forms of impacts;

x) to identify constraints associated with the mitigation measures recommended in the Study; and

xi) to identify any additional studies necessary to fulfil the objectives of the requirements of this Environmental Impact Assessment Study.

## 2.3 Sources of Information

2.3.1 This EIA is based on information gathered through literature review and site visits. The literature review also provided an overall appreciation of the existing conditions within the areas affected by the project. Reference was made to the 1:5,000 map Outline Zoning Plan S/YL-TT/1 dated 8 July 1994, S/YL-NSW/1 dated 3 June 1994, S/YL/2 dated 3 November 1995, the *Environmental Impact Assessment for Highway Between Shap Pat Heung Interchange and Pok Oi Interchange - Pok Oi Flyover & Remaining Works*[1], the *EIA Final Assessment Report for Yuen Long South Development Engineering Works in Areas 13 and 14 Yuen Long*[2] and the *Detailed Environmental Impact Assessment for Route 3 Tai Lam Tunnel & Yuen Long Approach Northern Section*[3].

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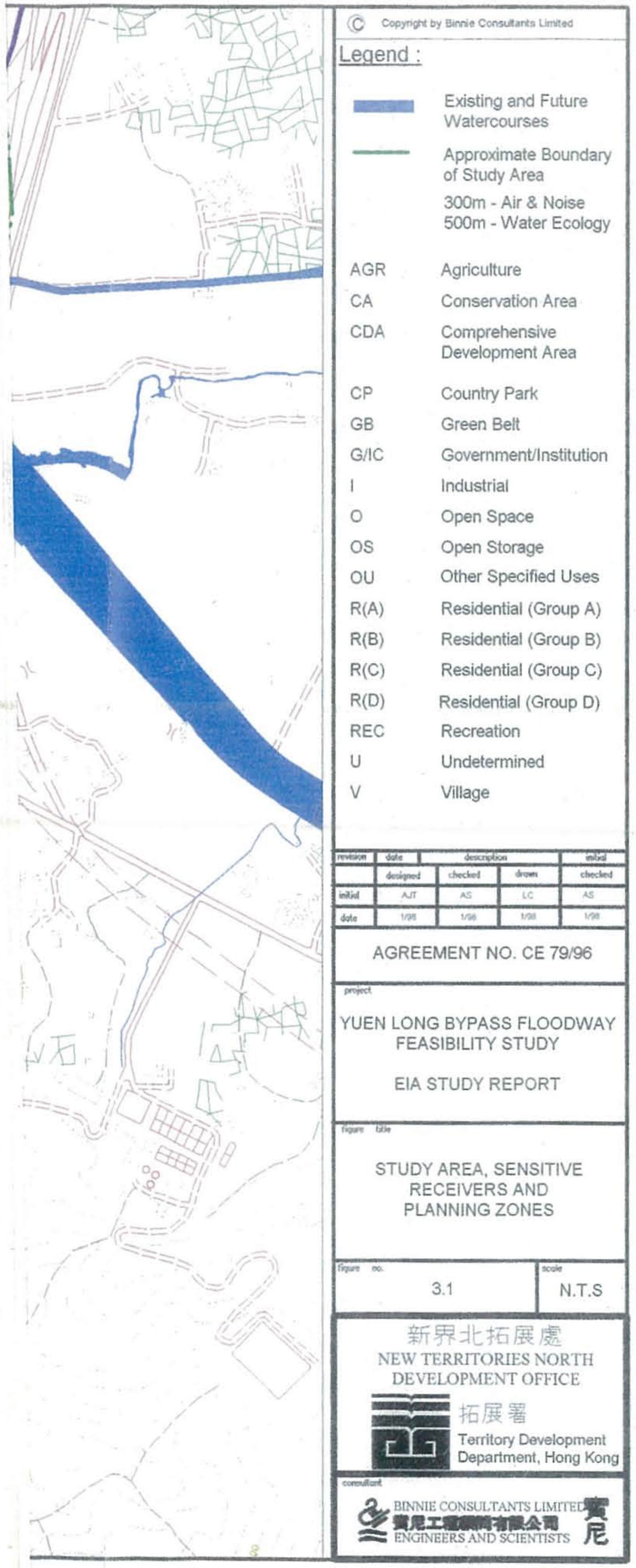
1 BCL (1997) *Public Works Programme, Environmental Impact Assessment Report for Highway Between Shap Pat Heung Interchange and Pok Oi Interchange - Pok Oi Flyover & Remaining Works* Highways Department

2 BCL (1997) 0080/EIA/FR/1 CE48/95, Yuen Long South Development Engineering Works in Areas 13 & 14, Yuen Long - EIA Final Assessment Report

3 CES Asia Ltd, (1995) *Route 3 Tai Lam Tunnel & Yuen Long Approach Northern Section. Vol , Detailed Environmental Impact Assessment* - Final Report. Route 3 Contractors Consortium






KEY PLAN 位置圖

A3 1:10000



NOTES:
1. ALL LEVELS ARE IN ETRES REFERRED TO HONG KONG PRINCIPAL DATUM.
2. CO-ORDINATES ARE OF HONG KONG 1980 GRID SYSTEM.

LEGEND:
- HAND RAILING, FENCE
- CHANNEL WITH FLOW DIRECTION
- PERMANENT BUILDING AND CANOPY
- ARTIFICIAL SLOPE
- TREE
- TOPOGRAPHIC SURVEY BOUNDARY
- CABLE

ABBREVIATION:

| | |
|---|---|
| BN | BENCH |
| CONC | CONCRETE |
| EP | ELECTRIC POLE |
| FB | FLOWER BED |
| FH | FIRE HYDRANT |
| FP | FOOTPATH |
| IL | INVERT LEVEL |
| LP | LAMP POST |
| MT | MANHOLE (TELEPHONE) |
| RS | ROAD SIGN |
| T1 | TREE NO. |
| TP | TELEPHONE POLE |
| UC | U-CHANNEL |
| VG | VALVE - GAS |
| SW | SEAWALL |
| KB | KERB BOTTOM |

| Rev | Date | Description of revision | Des'd | Chkd | Rd/Vd | Appd |
|---|---|---|---|---|---|---|

REVISIONS

| | initials | date | | initials | date |
|---|---|---|---|---|---|
| Designed | MC | 10/14 | Drawn | SZ | 10/14 |
| Checked | VT | 10/14 | Reviewed / Verified | AK | 10/14 |

Approved

Project title

大澳寶珠潭電纜管道工程
CABLE DUCT CROSSING
AT PO CHUE TAM, TAI O

Contract title

OUTLINE AGREEMENT NO. 4600003274
TRANMISSION CABLE ROUTE SELECTION
CONSULTANCY SERVICES

Drawing title

擬建大澳寶珠潭電纜管道
PROPOSED CABLE DUCT CROSSING
AT PO CHUE TAM, TAI O

Drawing Reference No. SKETCH 1

Revision –

Scale A1 1:250
A3 1:500

CLP 中電

BLACK & VEATCH HONG KONG LIMITED
博威工程顧問有限公司



Plot Date = $DATE$

CAD Filename = $FILE$

3.2.4 The study area between Tin Liu Tsuen and Chuk San Tsuen is generally village/suburban to rural in character. Land use is less industrialised than Yuen Long South (which is a mixture of small-to-medium industries, villages, active and fallow agricultural land, derelict livestock buildings, fishponds and heavily polluted concrete lined nullahs). A greater proportion of the agricultural land south of YLH has fallen into disuse than in the Yuen Long South area. Since the construction of the YLH the linking medium between the two areas are the flowing water bodies which also carry farm and light industry effluent arising from the Shap Pat Heung hinterland.

3.2.5 Between Chuk San Tsuen and Yeung Uk Tsuen the density of village development decreases abruptly with only occasional groups of houses. Most of the agricultural land in this area is abandoned. However, on the proposed floodway alignment immediately west of Yeung Uk Tsuen the land is almost entirely actively cultivated as lotus ponds.

3.2.6 North of Castle Peak Road, the study area includes Pok Oi Hospital, the villages of Sze Tsz Uk, Small Traders New Village, and Tung Shing Lei; fish ponds, duck ponds and a wooded fung shui knoll between Shan Pui Tsuen and Sha Po. North of Pok Oi Hospital the study area consists of squatters, small stone houses and fish ponds which recently have been considerably modified due to the construction of Route 3 with several fish and duck ponds having been temporarily dewatered under an "easement" for construction site storage.

3.2.7 Current sensitive receivers in respect of air and noise impacts include: Pok Oi Hospital; the villages of Sham Chung Tsuen, Shung Ching San Tsuen, Tai Kei Leng, Kong Tau San Tsuen, Chuk San Tsuen, and Yeung Uk Tsuen east of YLH and south of Castle Peak Road; a number of dwellings near Ha Yau Tin Tsuen, Sheung Yau Tin Tsuen, Tai Kei Leng and Fraser Village west of YLH.

3.2.8 Sensitive receivers in respect of water quality impacts include: fish ponds, lotus ponds; Yuen Long Creek, several small streams flowing north across the study area between Sham Chung Tsuen and Chuk San Tsuen, Kam Tin River and Inner Deep Bay.

3.2.9 Ecological sensitive receivers include: a wooded knoll, fish and duck ponds northeast of Pok Oi Hospital, active and fallow agricultural land, lotus ponds and several small watercourses and their riparian strips south of Castle Peak Road.

## 3.3 Current Planning Framework

3.3.1 According to Outline Zoning Plan (OZP) S/YL-TT/2 the area south of Castle Peak Road through which the proposed floodway alignment passes is largely zoned for Open Space or Agriculture except around the villages of Shung Ching San Tsuen, Kong Tau San Tsuen and Yeung Uk Tsuen where the alignment traverses small areas zoned for Village Type development (Figure 3.1). The alignment also bisects a small Comprehensive Development Area (CDA) between Yeung Uk Tsuen and Castle Peak Road. It is currently not intended that there should be significant urban development of this area.

3.3.2 The two strips of Open Space north of Tin Liu Tsuen/Sham Chung Tsuen and Tai Kei Leng are intended to provide local recreational facilities to the villages as well as to create a buffer to the YLH. The planning intention for the area zoned "Agriculture" between Kong Tau San Tsuen and Yeung Uk Tsuen is to retain and safeguard good agricultural land (whether fallow or active) for agricultural purposes. Under the areas zoned for Village Type development the overall intention is to concentrate development within the "V" zone to achieve a more orderly development pattern, economical and efficient use of land and provision of infrastructure and services.

3.3.3 The planning intention for the CDA between Yeung Uk Tsuen and Castle Peak Road is for low-density, low-rise residential use ensuring that any development is planned and designed in a comprehensive manner with due regard to environmental, traffic and engineering constraints. As noted in paragraph 1.2.2, Option 3 (i) this location is the only feasible point for the YLBF to cross Castle Peak Road. The alignment of the YLBF has been moved as far west as possible in this area to minimise the impact on the CDA site but to also be acceptable to the Transport Department with respect to the necessary regrading work required when raising the road level. The Planning Department has agreed to reserve the area required by the YLBF through the CDA site.

3.3.4 The area north of YLH and south of Castle Peak Road is scheduled for substantial redevelopment over the next 5 years in accordance with the *Tin Shui Wai/Yuen Long Development Programme 1996*[1]. These proposals are presented in OZP S/YL/2. Proposed development within the study area will include low to medium density private residential development, community facilities including schools and a community centre and a strip of open space along the north side of the YLH with provision for recreational and sports facilities. The open space strip also provides a buffer area between the YLH and the areas to the north. According to the TSW/YLDP, the population of this area (Planning Area 14) is planned to increase from an estimated 6,246 as at March 1996 to a maximum of 22,544 after March 2005. Development of the Yuen Long South Area 14 will commence with site formation roads and drainage works in July 2000.

3.3.5 North of Castle Peak Road the YLBF passes through land zoned for Undetermined (U) use in OZP S/YL-NSW/1 and clips a small Conservation Area (CA) where it connects to the Kam Tin River. The Engineering Report notes that the connection point of the YLBF to the Kam Tin River has been kept as close as possible to the Route 3 bridges. It is considered impracticable to move this connection to a sufficient extent to avoid the Conservation Area completely without severely affecting the hydraulic design of the YLBF. Therefore considering the YLBF only encroaches into the Conservation Area to a limited extent the Engineering Report proposes that the Planning Department should consider revising the OZP concerned to accommodate the proposed YLBF alignment.

3.3.6 According to the Notes accompanying OZP No. S/YL-NSW/1 The "U" designation of this area was given to allow for the detailed alignment of the Westrail (and presumably Route 3). The area occupies a transitional location between the urban area west of Pok Oi Hospital and the rural area comprising largely of fish ponds to the north. Government's intention is to provide a comprehensive layout plan for the area to avoid piecemeal developments/ redevelopments and specifically to protect the planning intention of sustaining Mai Po Nature Reserve. In future planning of the "U" zone, the chosen alignment option for the YLBF will be taken as a constraint.

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1 NTN Development Office, Territory Development Department (1996) - Tin Shui Wai/Yuen Long Development Programme (1996 edition)

3.3.7 A conceptual layout of development at Au Tau, which includes the study area north of Castle Peak Road, is presented in the *Territory Development Strategy Review '96*[2] and is reproduced as Figure 3.2. This plan is purely conceptual in nature and will be subject to the findings and recommendations arising from the Northwest New Territories Planning Study (currently being undertaken by BCL on behalf of TDD). Nevertheless, the conceptual layout suggests that "U" zoned area north of Castle Peak Road could be used for high to medium-rise housing, and low- rise high-tech industry interspersed and surrounded by open space buffer areas.

## 3.4 Project Description

3.4.1 The project involves the construction and operation of a drainage channel (YLBF) from the south side of Yuen Long to the Kam Tin River. A summary of the preliminary design channel details is given below. For additional technical information reference should be made to the Engineering Report (0136/REP/3/Issue 2)[3].

### *Channel Alignment*

3.4.2 The horizontal alignment is as shown in Figure 3.1 and the preliminary design layout is given in Appendix B. The 3.8km long channel commences at the Main Nullah servicing the large catchment to the south of Yuen Long and extends east. A maintenance access road is provided along the entire length of the channel. The first 1.9km of the channel is aligned as close as possible to the existing toe of the YLH to minimise land resumption and encroachment into existing village properties. The maintenance road between chainages 0 + 665 and 1 + 900 has been positioned between the toe of the YLH and the channel to provide sufficient working space for work associated with the YLH and YLBF and to provide a corridor for PWP Item No. 4274DS which requires vehicular access.

3.4.3 The alignment moves away from the YLH embankment toe at chainage 1 + 900 and meets Castle Peak Road at the only suitable crossing point which is between Pok Oi Hospital and the Sun Kong Hotel. The channel will be culverted for a distance of 130m at this crossing point to provide a crossing for Castle Peak Road and to accommodate the construction of the future Petrol Filling Station to the north of Castle Peak Road which has been given planning approval.

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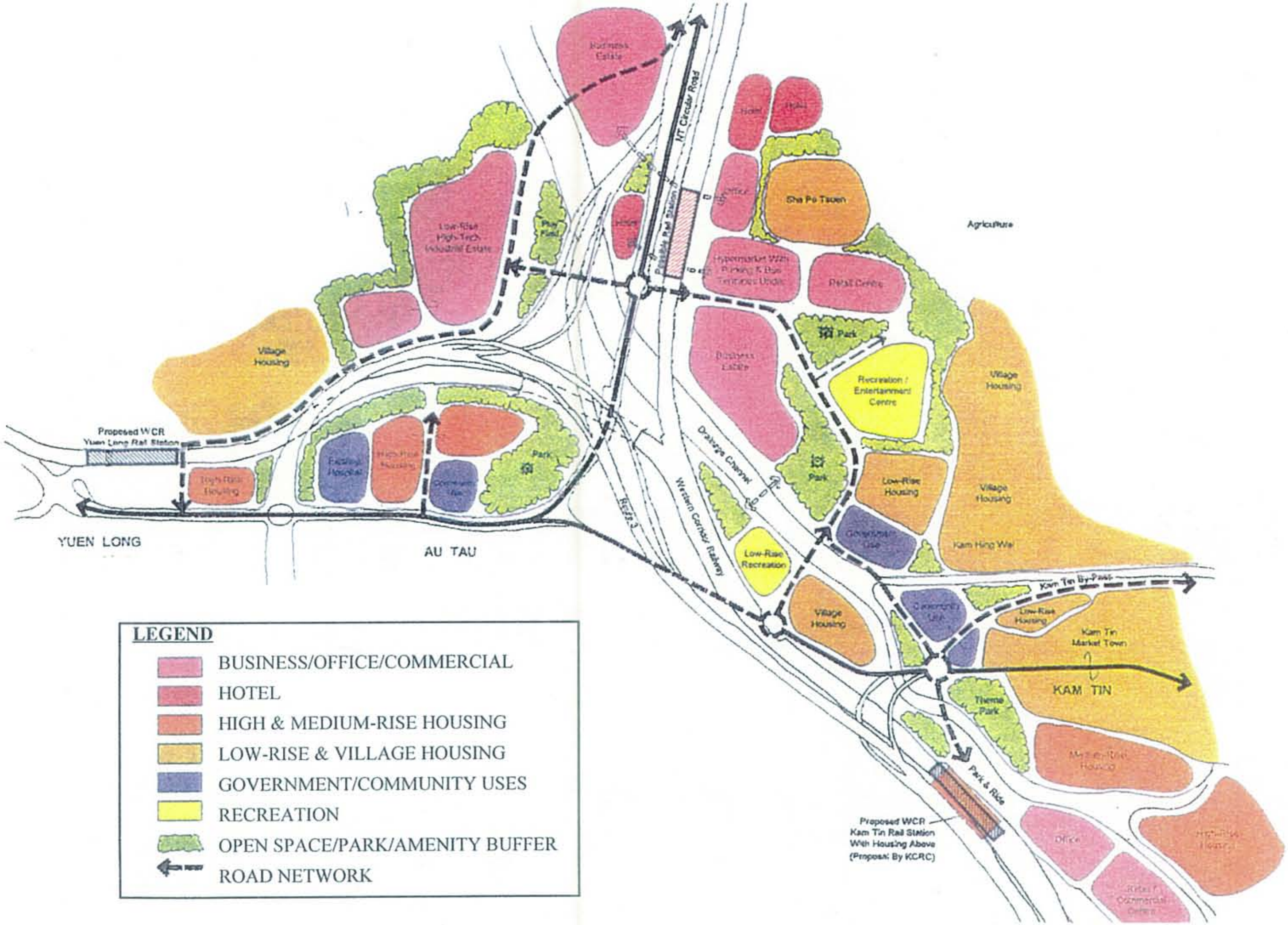
2 Planning Environment and Lands Branch Hong Kong Government 1996, A Consultative Digest Territory Development Strategy Review '96

3 BCL (1998) Agreement No. CE 79/96 - Yuen Long Bypass Floodway Feasibility Study (Series of Engineering Reports). TDD, Hong Kong Government




| | | | |
|---|---|---|---|
| **CONCEPTUAL LAYOUT OF DEVELOPMENT AT AU TAU** | TERRITORY DEVELOPMENT DEPARTMENT | Figure no. | 3.2 |
| | YUEN LONG BYPASS FLOODWAY FEASIBILITY STUDY EIA STUDY REPORT | Prepared: AJT | Checked: AS |
| | BINNIE CONSULTANTS LIMITED 賓尼工程顧問有限公司 CONSULTING ENGINEERS 賓尼 | Date: 1/98 | Scale: N.T.S |

3.4.4 After the Castle Peak Road box culvert the channel keeps as close as possible to Pok Oi Hospital to minimize isolation of property and the sterilising of useful land and to ensure a fixed crossing point with the Western Corridor Railway project.

3.4.5 From chainage 2 + 700 to 2 + 950 the channel swings towards the Route 3 Highway box culvert which has already been constructed as entrusted work under the Route 3 project. After the box culvert the channel executes a reverse curve towards the Route 3 embankment toe to avoid disruption of active fishponds and minimize the area of sterile land between the YLBF and Route 3. The connection point of the YLBF with that of the Kam Tin River is at a point close to the Route 3 embankment but downstream of the Route 3 flyovers to minimize hydraulic losses.

3.4.6 Grasscrete provides the most environmentally and ecologically friendly solution and aesthetically is far superior to the artificial hard surface lining provided by concrete. Grasscrete along with careful landscaping can be used to mitigate the effects on the surrounding areas of providing channels. In the case of the YLBF where existing and future development are expected to be in close proximity to the channel the use of grasscrete is essential for environmental and aesthetic reasons. However, to reduce the land resumption of existing properties concrete has been used in some locations.

3.4.7 The preliminary design has adopted a trapezoidal shape along the entire length of the channel. Only at the locations of box culvert crossing points will the channel be formed to a rectangular shape. Where land resumption is to be minimized through existing villages (ch 0 to 1 + 340) a 1 in 1 side slope fully concrete lined channel has been adopted. However, where land resumption is not considered as critical (ch 1 + 340 to 3 + 545) a 1 in 1.5 (ch 1 + 340 to 2 + 700) and 1 in 2 (ch 2 + 700 to 3 + 545) side slope, fully grasscrete lined channel (both base and sides) has been adopted. A 5 m wide concrete maintenance track will be provided at the invert along the grasscrete section of the channel to provide additional hydraulic conveyance and a clear maintenance route. The downstream section of the channel (ch 3 + 545 to 3 + 800) will be fully concrete lined as it will be downstream of the inflatable dam and within the tidal range.

3.4.8 For mitigation purposes, which are described throughout this report, off-line engineered wetland/marshcrete areas have been incorporated into the channel design. From ch 2 + 780 to 2 + 940 and 3 + 050 to 3 + 545, directly to the north and south of Route 3, off-line wetland areas have been provided at a higher level than the invert of the channel to prevent most brackish back water from the Kam Tin River from entering the wetland area. These off-line wetland areas will be fed from either a proportion of the pumped dry weather flow passing through the low flow pumping station or from local runoff, depending on the location of the wetland.

***Pumping Station and Inflatable Dam***

3.4.9 The downstream end of the channel connects to the Kam Tin River which is tidal. An inflatable dam and pumping station will be positioned at the downstream end of the YLBF just prior to connection with the Kam Tin River. This will be used to prevent brackish, heavily polluted and sediment rich waters from the Kam Tin River backing up into the YLBF and depositing residues in the channel which could cause undesirable pollution in existing or future urban areas with sensitive receivers. In addition, by preventing brackish waters from backing up into the YLBF, grasscrete can be used along the alignment for environmental purposes. Notwithstanding, salt tolerant species will be specified.

3.4.10 During low flow conditions the dam will be inflated and low flows in the YLBF will be pumped over the inflatable dam and into the lower section of the YLBF which will pass into the Kam Tin River. During flood conditions the inflatable dam will be deflated and storm flows from the YLBF will pass directly into the Kam Tin River. Once the storm has subsided the inflatable dam will be reinflated and low flows again pumped to the Kam Tin River. Delays in reinflation such as to allow several tides to sweep the YLBF are inevitable. However, the levels of salinity and pollution in these tidal waters immediately after the passage of a major storm can be expected to be much lower than normal for the Kam Tin River. The Operation Manual for the inflatable dam will put in place a reflation procedure that minimises the period of tidal exposure.

3.4.11 The operation will be similar to the existing inflatable dam and pumping station situated in the lower reaches of the Yuen Long Central Nullah which was also designed by BCL.

3.4.12 The pumping station will be used to pump flows over the inflatable dam. A small proportion of these pumped flows will be taken off and allowed to gravitate through a single U-channel system which will feed the off-line wetland area.

### *Dry Weather Flow Channel*

3.4.13 A dry weather flow channel will be provided from chainage 0 + 10 to 3 + 525 just short of the inflatable dam. The dry weather flow channel will maintain adequate flow velocity to minimise siltation during low flow and will confine the low flow for visual purposes. At chainage 3 + 525 the dry weather flow channel will drop into a storage pond/sump at the base of the pumping station. Low flows will be pumped around the dam and then dropped into the remaining tidal section of the YLBF channel concluding at chainage 3 + 800 where it will flow into the Kam Tin River.

### *Access Roads*

3.4.14 A 3.5 m wide access road with a 1.6m wide footpath will be provided along one side of the channel. It is anticipated that all drainage channel access roads will be open to the public in future and that the HyD will take up the maintenance responsibilities. Therefore all access roads will be designed to HyD standards. Consequently, street lighting and other street furniture will be required, passing bays will be provided along the length of the access road and turning areas provided for manoeuvring of public and maintenance vehicles.

3.4.15 In addition to the main access road provided at the top of the channel for both public and maintenance vehicles, a 5 m wide concrete maintenance track will be provided from ch 1 + 340 to 3 + 540 within the grasscrete section of the channel. This will provide a DSD only maintenance route and a clear path for maintaining the grasscrete adopted within the channel.

### *Access Ramps*

3.4.16 Concrete paved access ramps of width of 5 m and a slope of 1 in 12 will be provided at intervals of approximately 400 m for channel maintenance purposes. In addition access ramps will be provided between box culverts and in the case of the inflatable dam, an access ramp will be provided at both sides of the dam so as to avoid maintenance plant travelling over the dam. Lockable crash barriers will be positioned at the top of the access ramps to prevent public access into the channel.

*Maintenance Operations*

3.4.17 During operation of the YLBF it is intended that routine maintenance of the YLBF will be undertaken by DSD according to current practice. Maintenance work for the grasscrete will involve grass cutting, rubbish removal and sediment removal. It is envisaged that grasscutting would be required at least once a year and desilting and rubbish removal at least twice a year or as required following heavy rainfall events. Desilting of all sections of the YLBF will be undertaken in the dry using land-based plant. Sediment will be set aside to dry before being loaded onto trucks and disposed of at a landfill. Maintenance issues with regard to the ecological mitigation measures are discussed in Sections 5.5.24 to 5.5.27.

## 3.5 Construction Method

3.5.1 Construction of the YLBF along the majority of the length of the channel will generally involve excavation and filling followed by under drainage concreting/grasscreting of linings and construction of access roads.

3.5.2 In the area of the fish ponds where temporary easement or permanent resumption will be necessary to carry out the construction of the permanent works, filling will be necessary in the existing ponds. It is anticipated that for the existing ponds, which will be under temporary easement for the construction works, the ponds will be drained for the carrying out of the works. These ponds will be restored upon completion of the construction of the project and returned to the original owner/operator. In the case of the ponds which will be entirely within the permanent site boundary, an engineered wetland as described earlier will be constructed in association with the floodway channel thereby partly compensating for the unavoidable loss of existing wetland habitat.

3.5.3 At the Castle Peak Road crossing point special considerations will be necessary to simplify the construction methods used. The proposed Castle Peak Road crossing point will be a multi-celled box culvert. The opening of the Route 3 Highway in this area which is programmed for 1998, is expected to reduce the traffic along Castle Peak Road and enable one lane to be closed during the construction period. This will allow a simple open cut method of construction to be used which is the most economical method for culvert construction.

## 3.6 Project Implementation

3.6.1 The project is programmed to commence in March 2001 and will be completed in December 2003. A preliminary works programme is given in Figure 3.3.

# FIGURE 3.3
# YUEN LONG BYPASS FLOODWAY FEASIBILITY STUDY
# PRELIMINARY IMPLEMENTATION PROGRAMME

| Row # | Task Name | Duration | Start | End |
|---|---|---|---|---|
| 1 | FEASIBILITY/PRELIMINARY DESIGN STAGE | 392.06 d | Mar/12/97 | Sep/12/98 |
| 2 | Start Date | 0.00 d | Mar/12/97 | Mar/12/97 |
| 3 | Submit Review Report | 0.00 d | Nov/07/97 | Nov/07/97 |
| 4 | Submit Draft Land Resumption Plans | 0.00 d | Jan/12/98 | Jan/12/98 |
| 5 | Submit Draft EIA Report | 0.00 d | Feb/12/98 | Feb/12/98 |
| 6 | Submit Draft Engineering Report | 0.00 d | Feb/16/98 | Feb/16/98 |
| 7 | Submit Draft EM&A Manual | 0.00 d | Feb/17/98 | Feb/17/98 |
| 8 | Preliminary Site Investigation Work by GEO | 45.00 d | Mar/02/98 | May/01/98 |
| 9 | Comments | 44.00 d | Feb/17/98 | Apr/17/98 |
| 10 | Submit Remaining Reports and Finalize Reports | 105.00 d | Apr/20/98 | Sep/11/98 |
| 11 | Complete Feasibility/Preliminary Design Stage | 0.00 d | Sep/12/98 | Sep/12/98 |
| 12 | PREPARE CONSULTANTS BRIEF & AWARD DETAILED DESIGN | 130.00 d | Sep/14/98 | Mar/12/99 |
| 13 | DETAILED DESIGN STAGE | 385.00 d | Mar/12/99 | Aug/31/00 |
| 14 | Commence Assignment | 0.00 d | Mar/12/99 | Mar/12/99 |
| 15 | Adoptive Review | 44.00 d | Mar/12/99 | May/12/99 |
| 16 | Agree Exact Scope of Work | 23.00 d | May/12/99 | Jun/11/99 |
| 17 | Prepare Detailed Design Memorandum | 21.00 d | Jun/14/99 | Jul/12/99 |
| 18 | Identify Additional Site Investigation Work Required | 132.82 d | Jul/12/99 | Jan/12/00 |
| 19 | Conduct Topographical Survey | 23.50 d | Jul/12/99 | Aug/12/99 |
| 20 | Conduct Additional Borehole Investigations | 132.00 d | Jul/12/99 | Jan/12/00 |
| 21 | Conduct Utility Investigations | 66.00 d | Jul/12/99 | Oct/11/99 |
| 22 | Discussions with Utility Organisations | 43.00 d | Nov/12/99 | Jan/11/00 |
| 23 | Detailed Design | 241.00 d | Jul/12/99 | Jun/12/00 |
| 24 | Utility Diversions | 109.00 d | Jan/12/00 | Jun/12/00 |
| 25 | Geotechnical | 87.50 d | Jan/12/00 | May/12/00 |
| 26 | Box Culverts | 87.50 d | Jan/12/00 | May/12/00 |
| 27 | Maintenance Roads | 89.50 d | Jul/12/99 | Nov/12/99 |
| 28 | Channel | 175.00 d | Jul/12/99 | Mar/10/00 |
| 29 | Contributing Watercourse Modifications | 66.00 d | Jan/12/00 | Apr/12/00 |
| 30 | Traffic Diversions | 43.00 d | Jan/12/00 | Mar/10/00 |
| 31 | Landscape Design | 44.00 d | Feb/15/00 | Apr/14/00 |
| 32 | Low Flow Pumping Station/Inflatable Dam | 200.00 d | Jul/12/99 | Apr/14/00 |
| 33 | Reprovisioning Works | 176.00 d | Sep/13/99 | May/15/00 |
| 34 | EM&A | 105.00 d | Jan/17/00 | Jun/09/00 |
| 35 | Comments | 21.00 d | Jun/12/00 | Jul/10/00 |
| 36 | Finalize Design | 39.00 d | Jul/10/00 | Aug/31/00 |
| 37 | Cost Estimate | 44.00 d | Jun/12/00 | Aug/10/00 |
| 38 | Upgrade to Category A | 88.00 d | May/01/00 | Aug/30/00 |
| 39 | CONTRACT STAGE | 181.00 d | Jul/03/00 | Mar/12/01 |
| 40 | Prepare Draft Tender Documents | 65.00 d | Jul/03/00 | Sep/29/00 |
| 41 | Circulate Tender Documents | 22.50 d | Sep/29/00 | Oct/31/00 |
| 42 | Finalize Tender Documents | 11.00 d | Nov/01/00 | Nov/15/00 |
| 43 | Tender Gazetting | 0.00 d | Nov/15/00 | Nov/15/00 |
| 44 | Tender Period | 41.00 d | Nov/15/00 | Jan/10/01 |
| 45 | Tender Assessment | 44.00 d | Jan/10/01 | Mar/12/01 |
| 46 | Award Contract | 0.00 d | Mar/12/01 | Mar/12/01 |
| 47 | CONSTRUCTION STAGE | 720.00 d | Mar/12/01 | Dec/12/03 |
| 48 | Contract Award | 0.00 d | Mar/12/01 | Mar/12/01 |
| 49 | Site Preparation/Start-up | 23.50 d | Mar/12/01 | Apr/12/01 |
| 50 | Commence Construction | 0.00 d | Apr/12/01 | Apr/12/01 |
| 51 | Construction | 697.00 d | Apr/12/01 | Dec/12/03 |
| 52 | Completion of Contract | 0.00 d | Dec/12/03 | Dec/12/03 |


YLBF-IP.TLP
ISSUE 2

3.6.2 Construction of the YLBF will generally be carried out from the downstream end to the upstream to facilitate simple draining of the works site. However, the contractor may start at isolated sections to suit his allocation of resources and to maintain access across the channel banks. It is likely that the box culverts for the project may be built early.

3.6.3 The contractor will not be able to connect the YLBF channel to the Kam Tin River until the end of the project to ensure the tidal waters of the Kam Tin do not enter the new channel. Alternatively the contractor will be able to proceed with the construction of this connection point but will have to provide a temporary bund to bar the tidal water. In either situation a temporary pumping system will be required to drain the new channel. It is not expected that the inflatable dam or pumping station could be completed early for temporary diversion purposes due to the need to finish all the works including E&M works associated with the pumping station and inflatable dam.

3.6.4 It will also be necessary to carry out careful phasing of the connecting incoming watercourses to ensure satisfactory diversion of flows without the risk of flooding adjacent areas. It is proposed that connection of watercourses should be carried out during the dry season to minimize such risks.

3.6.5 The section crossing Castle Peak Road will take the most time as a three stage traffic diversion is expected. The need to divert large diameter watermains, high pressure gas mains and other utilities during the stage construction will make this section critical to completion. In addition a proposed Petrol Filling Station to be located to the north of Castle Peak Road may need to be closed, if constructed before the YLBF, to allow construction of the extended section of the Castle Peak Road box culvert. To minimize the length of time this Petrol Filling Station will need to be closed if it is constructed first and to provide adequate time for all the diversion works in this area it is anticipated that construction will start here at the contract commencement.

## 3.7 Site Access

3.7.1 All site access points are illustrated in the figures in Appendix B. In total four access points are proposed at Castle Peak Road, two onto the eastbound road and two onto the westbound. This will avoid the incoming site vehicles from blocking the kerbside lane to facilitate the outgoing vehicles and provide the contractor with greater flexibility while working on the narrow banks of the channel. Temporary run-in lanes should be provide for the construction vehicles to enable them to merge and diverge from the normal traffic as smoothly as possible.

3.7.2 A separate access point will also be required at the northern end of the site which is isolated due to the Route 3 box culvert. Works being carried out between chainages 3.0km and 3.8km will need to gain access to the site via the recently constructed 6.0m wide maintenance/village access road running along the Kam Tin River as this is the only suitable road in this isolated area.

3.7.3 No other access points are considered feasible as the construction traffic will need to pass through village areas along relatively minor roads. This situation is considered undesirable as it is expected to attract objection from local residents. It is therefore considered necessary to keep the haulage routes of the construction vehicles within the proposed site boundary and provide site access and egress at the points identified so as to minimize traffic impact during the construction period.

### 3.8 Concurrent Projects

3.8.1 The Yuen Long, Kam Tin and Ngau Tam Mei area is currently subject to extensive infrastructure development not least the related drainage infrastructure of which this project is a part. These developments will have varying degrees of impact on the project in terms of cumulative environmental impacts and/or engineering constraints. Table 3.2 lists the existing and future projects which have a direct relationship with this project. A detailed description of the various engineering constraints imposed by these projects on the YLBF is provided in the Engineering Report.

**Table 3.2**
**Current and Proposed Developments**
**Having a Direct Relationship With The Project**

| PWP No. | Title | Tentative Start/Completion Degree of Impact |
|---|---|---|
| 27CG | Yuen Long South Eastern Extension - Site Formation, Roads and Drainage Works | 12/00 - 12/02 |
| 28CG | Yuen Long South Western Extension - Site Formation, Roads and Drainage Works | 12/98 - 12/02 |
| - | Route 3 (Country Park Section) | 5/95 - 5/98 |
| 22CD | NWNT Development, Main Drainage Channels for Yuen Long and Kam Tin Remainder - Phase 4 | 4/00 - 11/02 |
| 29CD | NWNT Development - Main Drainage Channels for Ngau Tam Mei<br>Phase 1<br>Phase 2 | <br><br>4/99 - mid 02<br>4/99 - mid 02 |
| 30CD | Village Flood Protection for Yuen Long, Kam Tin and Ngau Tam Mei, NWNT<br>Stage I Sha Po Tsuen, Pok Wai, Chub Yuen Tsuen/Ha San Wan, Mai Po Lo Wai/Mai Po San Tsuen<br><br>Stage II Yuen Long and Kam Tin Villages (Ma Tin Tsuen, Shui Pin Tsuen, Shui Pin Wai, Tai Kiu, Wang Chau) | <br>mid 00 - mid 02<br><br>4/99 - 5/04 |
| 43CD | NWNT Development - Drainage Channels for Yuen Long & Kam Tin - Stage 1, Phase 2 | 10/95 - 10/98 |
| 60CD | NWNT Development - Main Drainage Channels for Yuen Long & Kam Tin<br>Stage 1, Phase 1 - Contract A<br>Stage 1, Phase 1 - Contract B | <br><br>10/93 - 4/99<br>4/94 - 7/98 |
| 61DS* | NWNT Development - Trunk Sewers, Sewage Pumping Stations and Rising Mains Stage III | 3/99 - 1/01 |
| 64CD/B | Small Traders New Village Stream Rehabilitation | After YLBF |
| 4157 DS | Yuen Long and Kam Tin Sewerage<br>Stage II - Phases 2A & 2B - Yuen Long South Pumping Station, Rising Mains to Castle Peak Road and Sewers | 4 /00 - 4/02 |
| 4274 DS | Stage III - Phase 1 Au Tau Sewerage Pumping Station, Rising Mains and Gravity Sewers | 10/01 - 10/03 |

| | | |
|---|---|---|
| 455CL | Site Formation for Yuen Long Combined Wholesale Food Market | 3/98 - 12/99 |
| 227WF | Extension of Au Tau Treatment Works Supply system - Main Laying between Au Tau Treatment Works & Yuen Long Town | 12/00 - 3/03 |
| | West Rail Project - Yuen Long | early 99 - end 03 |
| | Widening of Yuen Long Highway between Lam Tei and Shap Pat Heung Interchange | mid 02 - mid 04 |
| Item No. B644 TH | The Highway between Shap Pat Heung Interchange and Pok Oi Interchange - Pok Oi Flyover (Stage 1) | 9/97 - 2/99 |
| | The Highway between Shap Pat Heung Interchange and Pok Oi Interchange - Remaining Works (Stage 2) | 9/99 - 2/02 |
| YLRP 5/97-98 | RPIS Minor Works, Construction of Drainage Channel at Chuk San Tsuen, Shap Pat Heung | In progress |
| YLRP 23/97-98 | RPIS Minor Works, Construction of Drainage Channel at Sheung Yau Tin Tsuen, Shap Pat Heung | Commencement 2/98 |
| 278 CL Phase 2 | Yuen Long Kau Hui Development Phase 2 | 5/01 - 5/03 |

# 4. WATER QUALITY IMPACT ASSESSMENT

## 4.1 Introduction

4.1.1 This section describes the potential impacts on water quality from the proposed construction and subsequent operation of the Yuen Long Bypass Floodway. Where unacceptable impacts are identified, appropriate mitigation measures are recommended to reduce impacts to an acceptable level.

4.1.2 The creation of the bypass floodway will alter the course of the water flow in this area. Runoff from the region south of the floodway will be re-directed into the Kam Tin River instead of continuing into Yuen Long Creek. From a hydraulic point of view the Engineering Report explains the need for the floodway for flood control and has identified this routing as optimal for minimising engineering constraints. The environmental consequences of the construction and operation of this channel will be addressed in the following sections. The potential impacts are assessed based on a worst case scenario of a fully concrete lined channel. However, the current design has taken into account a number of the design mitigation measures recommended in this chapter.

## 4.2 Assessment Methodology and Criteria

4.2.1 The water quality assessment has been carried out with reference to the criteria listed in the EIA Ordinance and following the guidelines for assessment of water quality impacts. The criteria for assessment and the aspects relevant to the Yuen Long Bypass Floodway are shown in Table 4.1.

**Table 4.1**
**Criteria Used for Evaluating Potential Impacts on Water Quality**

| Criteria | Specific Areas to be Evaluated | Relevant Aspects for the Yuen Long Bypass Floodway |
|---|---|---|
| **General Criteria** | | |
| Aquatic Environment | Water quality<br>Hydrology<br>Bottom sediments<br>Ecology | Changes in flow rates and volume of runoff water from surrounding land, sediment deposition rates and ecological effects |
| Water Quality Objectives (WQO's) | Aesthetic environment<br>Human health<br>Aquatic life<br>Industrial use | WQOs for Deep Bay Water Control Zone (WCZ). |
| Mixing Zone Criteria | Assimilative capacity of the mixing zone | Circulation rates within Kam Tin River and Inner Deep Bay as receiving bodies. Poor water quality at mixing zone between floodway and feeder channels |

| | | |
|---|---|---|
| Stressed water bodies | Compliance with WQOs<br>Additions to the stressed condition of receiving water bodies | Poor water quality of Kam Tin River and Inner Deep Bay.<br>High levels of organic pollution in Yuen Long Creek and other feeder streams which feed into these water bodies |
| Cumulative impacts | Other impacts around the study area | Additional construction and operational impacts for the floodway from other projects |
| **Project Specific Criteria** | | |
| Waste discharges | Technical Memorandum on discharge standards | Potential discharges associated with construction and operation. |
| Dumping of wastes | Wastes dumped at sea and/or landfills | Removal of existing river sediments and use of construction materials |
| Stormwater runoff | Quality of runoff water entering the floodway from undeveloped, developed and a highway environment | Practical measures for reducing impacts from polluted stormwater runoff |
| Toxic and prohibited substances | Substances which are toxic, persistent and accumulative in water and can not be rendered harmless | No toxic substances generated by floodway but transport of such substances may be accelerated due to increased floodway flow rate |

4.2.2 The assessment of potential water quality impacts will focus on the assimilative capacity of the receiving water bodies and will be quantitative as far as possible. Following identification of the sensitive receivers and uses and the existing conditions, the impacts will be determined, predicted and evaluated.

4.2.3 Water quality impacts will be assessed initially through the current data available and observation of the current situation in the Yuen Long Bypass Floodway area. Evaluation of existing pollution impacts to water will include point and non-point sources, in particular wastewater effluent including livestock discharge to feeder streams and channels. A review of the construction type, methods and duration will be undertaken to identify the main activities which will impact the sensitive receivers.

4.2.4 Where the impacts exceed the appropriate criteria and are therefore determined to be unacceptable, mitigation measures will be recommended for incorporation into the design of the floodway which minimize impacts to an acceptable level. Monitoring and audit requirements to ensure the implementation of, and effectiveness of, mitigation measures will be defined. These steps are summarised in Table 4.2.

**Table 4.2**
**Guidelines for Water Quality Impact Assessment**

| Guidelines | Specific Areas to be Evaluated | Relevant Aspects for the Yuen Long Bypass Floodway |
|---|---|---|
| Identify characteristics of sensitive receivers | Water quality<br>Hydrology<br>Bottom sediments<br>Ecology<br>Beneficial uses<br>Assimilative capacities | Potential changes in water quality of Kam Tin River water |
| Identification of impact causing factors | Changes in landuse<br>River modifications<br>Waste discharges<br>Non point pollution sources<br>Construction activities | Creation of new channel where none existed before.<br><br>Increased speed of water flow in bypass floodway, transporting water from feeder streams and runoff to receiving water bodies. |
| Determination of impact boundary | Degree of mixing between water flow entering receiving water body | Dilution rates of Yuen Long Bypass Floodway and receiving water body, Kam Tin River |
| Baseline study | Water and sediment quality in existing studies | Existing water quality for Yuen Long Creek, Kam Tin River and Deep Bay water and sediment quality |
| Impact prediction and assessment | Quantitative and qualitative assessments of impacts | Construction impacts, including construction site runoff.<br><br>Operational impacts including increased transportation of surface runoff and reduced infiltration |
| Mitigation measures | Avoidance of water pollution through use of natural means such as an engineered wetland | No increase in pollution levels in Deep Bay, achieved through zero effluent policy |
| Monitoring | Parameter identification at different stages of the project | WQOs for Deep Bay<br><br>Waste water discharge standards |

## 4.3 Sensitive Receivers and Uses

4.3.1 The sensitive receivers for the water quality impact assessment include,

- Fish ponds;
- Lotus ponds;
- Yuen Long Creek;
- Other streams, culverts and channels;
- Kam Tin River, and
- Inner Deep Bay

4.3.2 These water bodies with expected chainage locations are shown on Figure 4.1

### *Fish Ponds*

4.3.3 The northern section of the proposed bypass floodway route, immediately north of Sze Tsz Uk (between ch 2 + 800 and 3 + 800) passes through an area of fish ponds currently drained and used as a stockpiling area for the Route 3 construction works or otherwise severely blighted by the works. Following completion of the Route 3 construction the affected fishponds will be reinstated. Several ponds/parts of ponds will be lost through construction of the bypass floodway.

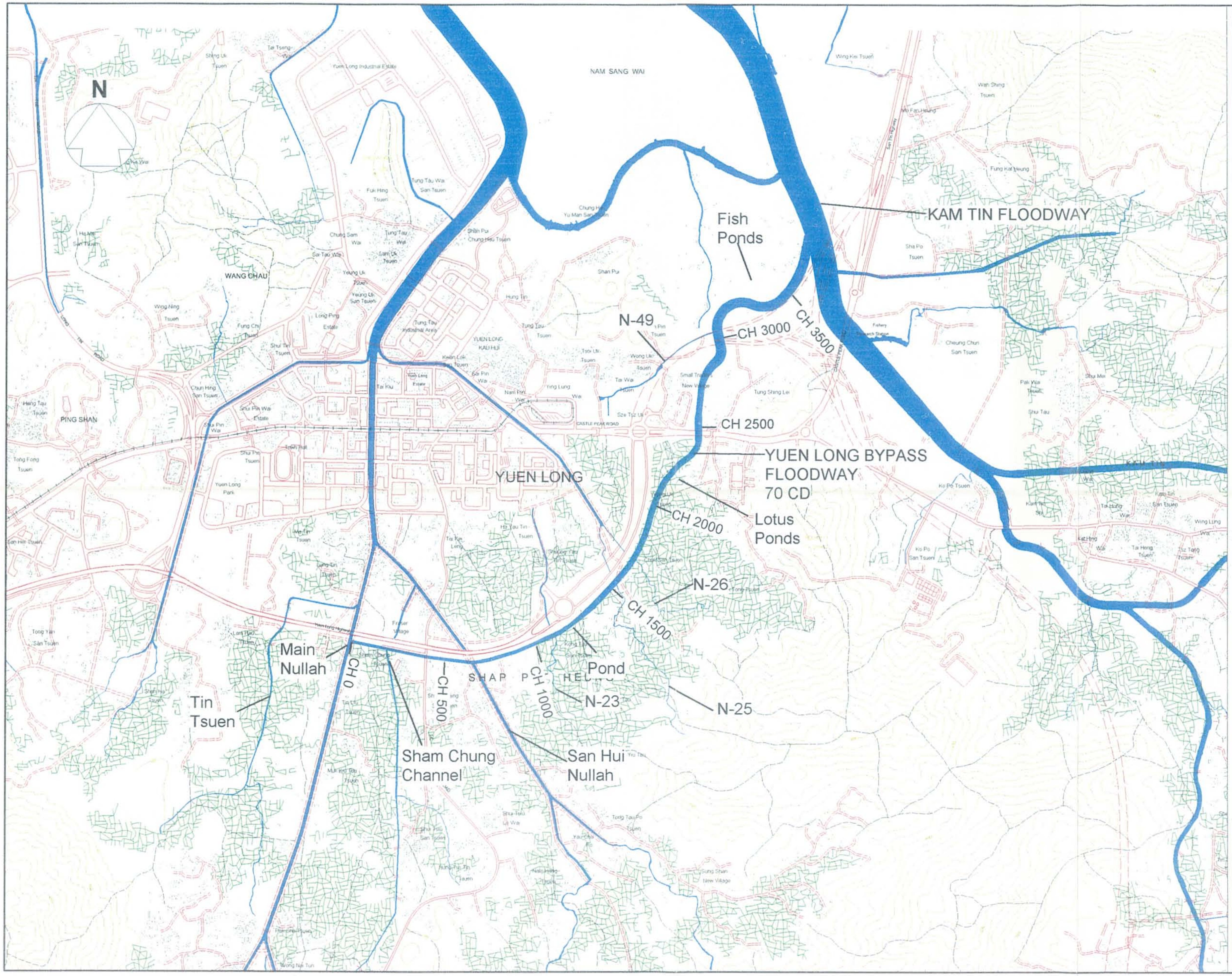
### *Lotus Ponds*

4.3.4 West of Yuen Long Highway and south of Castle Peak Road (between ch 2 + 000 and 2 + 240) are a group of approximately thirty five lotus ponds, at least twenty of which will be totally or partially destroyed as a result of the construction of the Yuen Long Bypass Floodway under the current alignment.

### *Yuen Long Creek*

4.3.5 The Yuen Long Bypass Floodway will be fed by several streams, two of which are the San Hui Nullah section of Yuen Long Creek, (ch 0 + 685) and the section known as the Main Nullah (ch 0 + 000). This partly channelised stream has a length of 60 km and a catchment of 26.7 km$^2$. It starts in the Tai Lam Country Park and continues down to Yuen Long New Town through a 12 km long open concrete nullah before it discharges into Deep Bay[1]. Close to the discharge point a large amount of sediment is retained as a result of the relatively limited dispersive capacity of Deep Bay, leading to the associated retention of pollutants. This creek is a temporary sensitive receiver during the construction of the bypass floodway in the two channels which feed it north (downstream) of the site of the floodway.

1 River Water Quality in Hong Kong for 1995, EPD, 1996

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YUEN LONG BYPASS FLOODWAY FEASIBILITY STUDY

EIA STUDY REPORT

figure title

WATER SENSITIVE RECEIVERS FOR THE YUEN LONG BYPASS FLOODWAY

figure no. 4.1

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### *Other Streams, Culverts and Channels*

4.3.6 There are several small streams across the Yuen Long floodplain which, at present, cross the site of the bypass floodway. This also makes them temporary sensitive receivers during the construction of the bypass floodway. Eventually the flow from these streams will be diverted into the floodway.

4.3.7 A large feeder stream is the Sham Chung channel (ch 0 +165) which will be concrete lined under a separate project (PWP Item No. 22CD in NWNT Development Main Drainage Channels for Yuen Long and Kam Tin - Remainder Phase 4). The water quality here is visibly poor due to the release of livestock and domestic waste effluents.

4.3.8 Between the villages of Shung Chung San Tsuen and Tai Kei Leng (ch 0 + 685) is the San Hui Nullah. A recently cleared or re-cut natural channel and seasonal stream (N23) crosses the site between Tai Kei Leng and Kong Tau San Tsuen (ch 1 + 095). A small shallow pond is located north east of this stream (ch 1 + 150) which will be affected under the current floodway alignment.

4.3.9 Further north east between the villages of Kong Tau San Tsuen and Chuk San Tsuen are two small streams N25 and N26 (ch 1 + 510 and 1 + 665) which will feed into the floodway. The eastern stream was undergoing engineering works (YLRP 5/97-98) to construct a concrete channel at the time of the stream survey (4/12/97).

4.3.10 A small stream at chainage ch 2 + 055 flows west between the fish ponds and was observed to have quite good water quality.

4.3.11 Towards the north east end of the floodway route, close to the Small Traders New Village is a stream which will enter the floodway from the west, N49 (ch 3 + 030). The upstream part of this stream is concrete lined while the lower stretch remains as a naturally vegetated channel and which discharges into the original Kam Tin River.

### *Kam Tin River*

4.3.12 The floodway will discharge to the Kam Tin River. Engineering works are currently in progress to widen, deepen and line the river. The Kam Tin River has a catchment of 44.3 km$^2$ mostly meandering across the Yuen Long flood plain.

*Inner Deep Bay and Deep Bay*

4.3.13 Inner Deep Bay is the estuarine section of Deep Bay and, as such has high salinity, especially away from the direct influence of the freshwater stream from the Shenzhen River. At the mouth of Deep Bay, salinity decreases again, particularly in the wet season under the influence of the large volumes of freshwater flowing out of the Pearl River. Inner Deep Bay is of concern environmentally as it is the site of five SSSI's and two nature reserves and an important area as a source of fish and seafood.

4.3.14 Kam Tin River which will receive water from Yuen Long Bypass Floodway enters Inner Deep Bay which could potentially be impacted as a result of construction and operation of the floodway.

4.3.15 A summary of the sensitive receivers for water quality impacts is shown in Table 4.3.

**Table 4.3**
**Summary of Sensitive Receivers for Water Quality Impact Assessment**

| Sensitive Receiver | General Description | Activities Affecting Sensitive Receiver |
|---|---|---|
| **Fish ponds** | Several inactive fishponds currently blighted by Route 3 construction works present along the floodway alignment.<br>Some will be destroyed by the floodway | Construction of floodway, use of concrete and site runoff |
| **Lotus ponds** | Five will be at least partially destroyed by the floodway | Construction of floodway, use of concrete and site runoff |
| **Yuen Long Creek** | Fed by several polluted streams and then discharges to Inner Deep Bay | Diversion of water flow during construction of floodway and construction runoff and activities |
| **Other streams, culverts and channels** | Several small watercourses, mostly poor water quality | Diversion of water flow during construction of floodway and construction runoff and activities |
| **Kam Tin River** | Polluted river, works in progress to line with concrete | General construction activities, site runoff effects |
| **Inner Deep Bay** | A shallow bay with a significant freshwater input from Shenzhen River | Discharges from floodway which feeds into Kam Tin River |

## 4.4 Existing Conditions

*Fish Ponds*

4.4.1 A number of the fish ponds have been temporarily drained and filled in association with the construction of Route 3. The remaining inactive fishponds along the floodway alignment are expected to have relatively good water quality. Ponds which are currently being used for stockpiling fill material from the Route 3 project will be reinstated upon completion of the works.

***Lotus Ponds***

4.4.2 The lotus ponds are commercially farmed and therefore water quality is expected to be reasonably good.

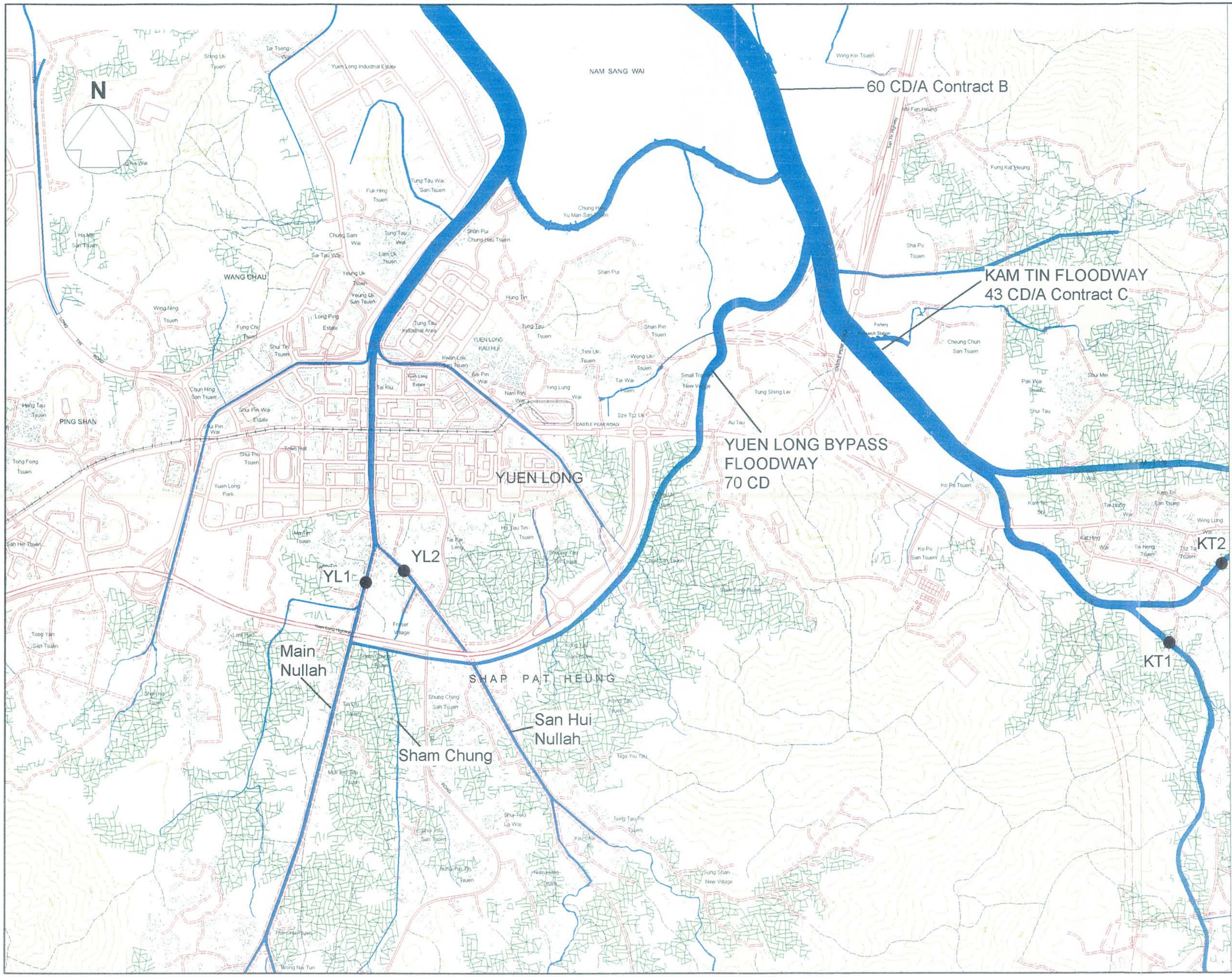
***Yuen Long Creek***

4.4.3 Discharges to the Yuen Long Creek at present include 504 livestock farms, and 37 industrial premises. The creek is badly polluted by organic waste from livestock farming and is described as being 'bad' to 'very bad' (1995)[2]. Throughout 1995 the Creek failed to comply with WQOs for $BOD_5$ and suspended solids. COD and DO had compliance percentages of 8 and 48 percent respectively. The monitoring stations at YL1 and YL2 (See Figure 4.2) are in close proximity to the site of the bypass floodway. YL1 is situated on the main nullah north of the proposed floodway route and YL2 is also north of the route on the San Hui Nullah. Both of these sites are close to the confluence of the two water courses and therefore represent existing water quality conditions for the Yuen Long Creek as a whole.

4.4.4 The most recent data available for Yuen Long Creek is from 1996 when the creek failed to meet the Deep Bay WQOs for several parameters. Dissolved oxygen at YL1 is lower than the WQO not less than 4 mg/l, while suspended solids, $BOD_5$, COD and E.Coli all exceed the limits recommended at both monitoring locations. For all parameters at YL1, apart from cadmium and lead, the 1996 conditions are worse than those observed in 1995. The stream water at YL2 also has poor quality but is significantly better than that found at YL1. Most parameters changed little between 1995 and 1996 for YL2. According to the TM for EIA Ordinance Annex 6 the waterbody is classified as highly stressed.

4.4.5 Water quality data for 1996 is shown in Table 4.4.

[2] River Water Quality in Hong Kong for 1995, EPD, 1996



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Existing and Future Watercourses

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EPD RIVER QUALITY MONITORING STATIONS ON YUEN LONG CREEK AND KAM TIN RIVER

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**Table 4.4**
**Water Quality for the Stations at YL1 and YL2 on Yuen Long Creek in 1996**

| Parameter | YL1 | YL2 |
|---|---|---|
| Dissolved Oxygen | 2.63 | 5.38 |
| pH | 7.41 | 7.16 |
| Suspended solids | 242 | 51.46 |
| $BOD_5$ | 286 | 31.86 |
| COD | 333.75 | 36.3 |
| Oil & Grease | 26.11 | 2.26 |
| *E.coli* (cfu/100ml) | 16,571,667 | NM |
| Ammoniacal nitrogen | 36.7 | 13.08 |
| Nitrate nitrogen | 0.018 | 0.49 |
| Total Kjeldahl nitrogen | 59.91 | 17.93 |
| Ortho-phosphate | 11.37 | 2.6 |
| Total phosphorous | 15.85 | 3.13 |
| Sulphide | 0.51 | 0.18 |
| Aluminum | 495 | 335.8 |
| Cadmium | 0.94 | 0.188 |
| Chromium | 5.1 | 2.1 |
| Copper | 513 | 14.16 |
| Lead | 13.92 | 8.6 |
| Zinc | 363 | 72.5 |
| Flow ($m^3/s$) | 0.161 | 0.198 |

Notes:
1. Data presented are the annual medians of monthly samples
2. DO, SS, $BOD_5$, COD, Oil & Grease, Ammoniacal nitrogen, Nitrate nitrogen, TKN, Ortho-phosphate, Total phosphorous and Sulphide in mg/L
3. Al, Cd, Cr, Cu, Pb, Zn, in $\mu$g/L.
4. Flow is in $m^3/s$

From: Hong Kong EPD, 1996.

4.4.6 Chemical waste discharges have been almost eliminated as a result of the chemical waste scheme implemented under the Waste Disposal Ordinance which provides services for collection and disposal of chemical waste. Livestock waste pollution is gradually being reduced through the Livestock Waste Control Scheme.

### *Other Streams, Culverts and Channels*

4.4.7 The widest stream is the Sham Chung (ch 0 + 165) and receives runoff from a few houses and small industrial sites, as well as livestock farms. No water quality data is available for this channel but visible evidence suggests poor water quality of turbid, dark water and odorous sediments. This channel will be concreted in the future and water will be diverted into the Yuen Long Bypass Floodway.

4.4.8 Similarly, the water quality in the San Hui nullah (ch 0+685) is turbid and dark, indicating the presence of organic pollution.

4.4.9 The cleared channel at ch 1 + 095 between Tai Kei Leng and Kong Tau San Tsuen and the pond at ch 1 + 150 are relatively unpolluted, receiving discharges from only a few dwellings along the bank.

4.4.10 Between Kong Tau San Tsuen and Chuk San Tsuen are two small streams (ch 1 + 510 and 1 + 665). The water quality in the more westerly stream is poor with a large amount of domestic refuse lining the channel in addition to industrial waste containers. A layer of oil and grease is apparent on the sediments on the stream bed. The eastern stream is, at present, in the process of being lined with a concrete channel. The water quality in the diverted flow around the works at this site also appears to be poor with a substantial quantity of domestic refuse and organic pollution.

4.4.11 The stream north east of the Small Traders New Village (ch 3 + 030), receives runoff and discharge from dwellings along its banks. The channelised section has a large amount of floating vegetation present indicating the presence of organics and nutrients in the water. Further downstream, the water quality appeared turbid, and dark mud was exposed on the banks.

### *Kam Tin River*

4.4.12 This water course receives industrial effluents, in particular with high levels of heavy metals. At the end of 1995 industrial pollution was thought to contribute around 8% of the $BOD_5$ loading to this river.

4.4.13 Water quality at the monitoring stations KT1 and KT2, (Figure 4.2) was described as 'very bad' during 1995/96. A substantial quantity of livestock waste is discharged into the river which contributes to the high $BOD_5$ and COD levels. Livestock waste discharges are decreasing under the current Livestock Waste Control Scheme. According to the TM for EIA Ordinance Annex 6 the waterbody is classified as highly stressed.

4.4.14 Water quality data for Kam Tin River for 1995 is shown in Table 4.5.

**Table 4.5**
**Water Quality Data for the Stations at KT1 and KT2 on the Kam Tin River in 1995**

| Parameter | KT1 | KT2 |
|---|---|---|
| Dissolved Oxygen | 1.7 | 1.4 |
| pH | 7.0 | 7.1 |
| Suspended solids | 37 | 72 |
| $BOD_5$ | 48 | 80 |
| COD | 66 | 110 |
| Oil & Grease | 2.3 | 3.8 |
| Ammoniacal nitrogen | 17.00 | 28.5 |
| Nitrate nitrogen | 0.01 | 0.01 |
| Total Kjeldahl nitrogen | 24.0 | 37.0 |
| Ortho-phosphate | 3.7 | 5.7 |
| Total phosphorous | 5.25 | 7.85 |
| Sulphide | .057 | 1.80 |
| Aluminum | 170 | 180 |
| Cadmium | 0.2 | 0.30 |
| Chromium | 2.0 | 2.0 |
| Copper | 12.5 | 13.5 |
| Lead | 5.5 | 4.5 |
| Zinc | 75 | 90 |
| Flow (L/s) | 130 | 127 |

Notes:
1. Data presented are the annual medians of monthly samples
2. DO, SS, $BOD_5$, COD, Oil & Grease, Ammoniacal nitrogen, Nitrate nitrogen, TKN, Ortho-phosphate, Total phosphorous and Sulphide in mg/L
3. Al, Cd, Cr, Cu, Pb, Zn, in $\mu$g/L.
From: EPD Marine Water Quality in Hong Kong for 1995.

4.4.15 As in Yuen Long Creek the dissolved oxygen levels in the Kam Tin River in 1995 were far lower than WQO's for Deep Bay. Suspended solids, $BOD_5$, and COD are all greater than the WQOs.

*Deep Bay and Inner Deep Bay*

4.4.16 The Kam Tin River drains into Inner Deep Bay, which receives livestock waste discharges and industrial effluents from the Rivers Indus, Beas and Ganges on the Hong Kong side and the Shenzhen River on the China side.

4.4.17 A considerable amount of data is available on the hydrology and the quality of water and sediment in Deep Bay. Data which is currently available will be discussed in relation to the environmental impact assessment of the Yuen Long Bypass Floodway.

*Hydrology*

4.4.18 A selection of the tidal vector charts based on dry season data show the spring tide flows in and out of the Bay along a northeast/southwest axis (Figure 4.3)[3].

4.4.19 In 1986, a two dimensional flow model suggested that there were a number of small residual current circulation cells, with a relatively strong clockwise cell in the region of WENT Landfill (Figure 4.4)[4]. This suggests there is no net drift towards Inner Deep Bay. The 1986 study also indicated that the main flood and ebb flows in Deep Bay occur in the main channel, not in different areas of the Bay as previously suggested, and that the ebb tide is stronger than the flood.

4.4.20 Inner Deep Bay therefore has poor circulation close to the Kam Tin River discharge point and water movement is significantly affected by outflow from Shenzhen River and the main drainage channels, especially during the wet season.

*Water Quality*

4.4.21 The slow water movement has several consequences for water quality in Inner Deep Bay. The flushing time is increased, hindering the removal of pollutants which enter the Bay and sediment deposition is also increased resulting in extensive mudflats at low tide in the Inner Deep bay area.

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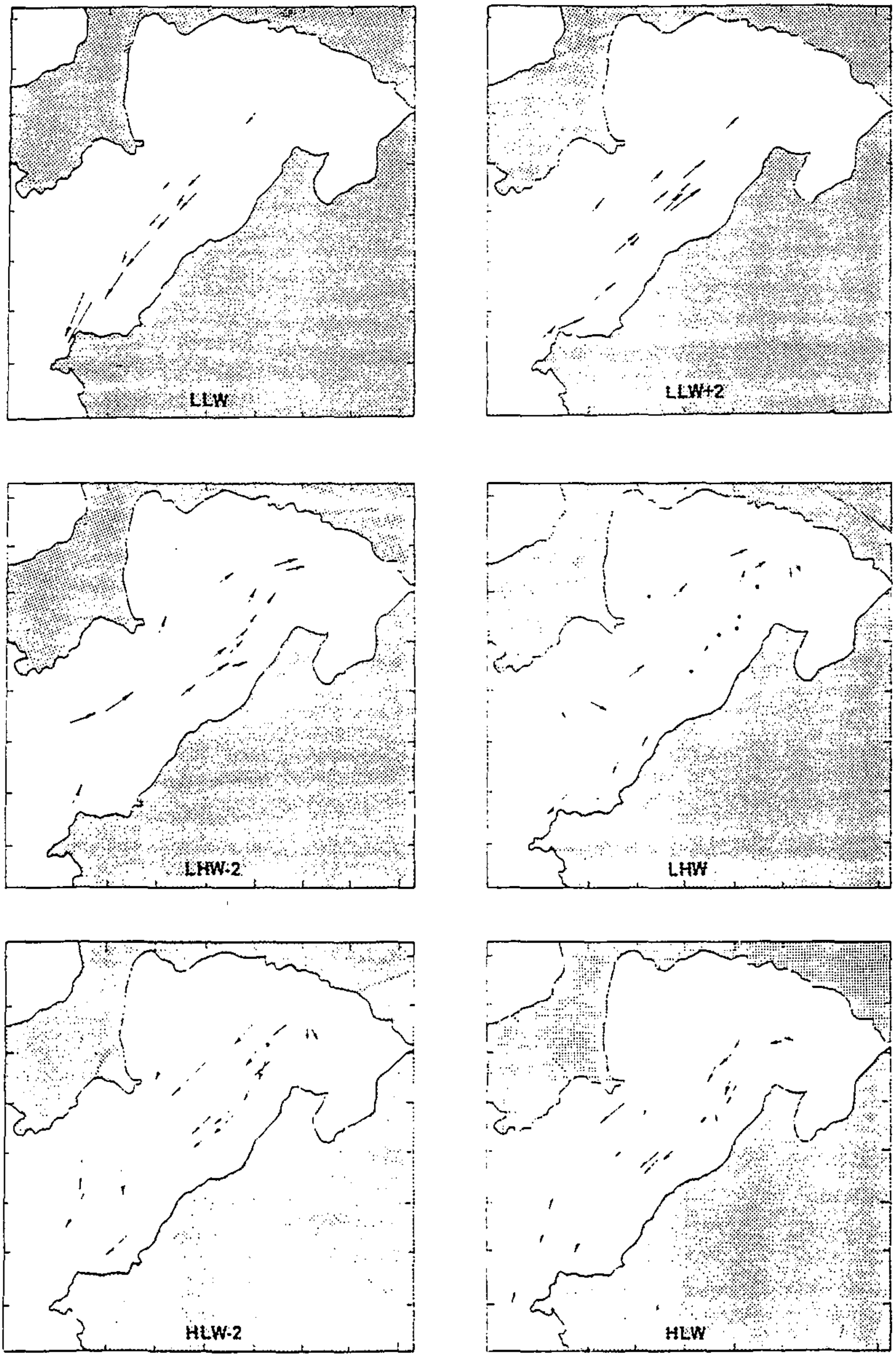
3 Binnie & Partners (HK) & Shankland Cox (1984). *Tin Shui Wai Development: Environmental Impact Assessment of Land Preparation Aspects Evaluation Report.*

4 Binnie & Partners (HK) & Shankland Cox (1985). *Working Paper No. 14 Evaluation of the Possible Release of Soluble Pollutants From Sediment During Dredging Operations.*




( SOURCE : TIN SHUI WAI DEVELOPMENT - EIA OF LAND PREPARATION ASPECTS : BINNIE AND SHANKLAND COX, 2/1985 )

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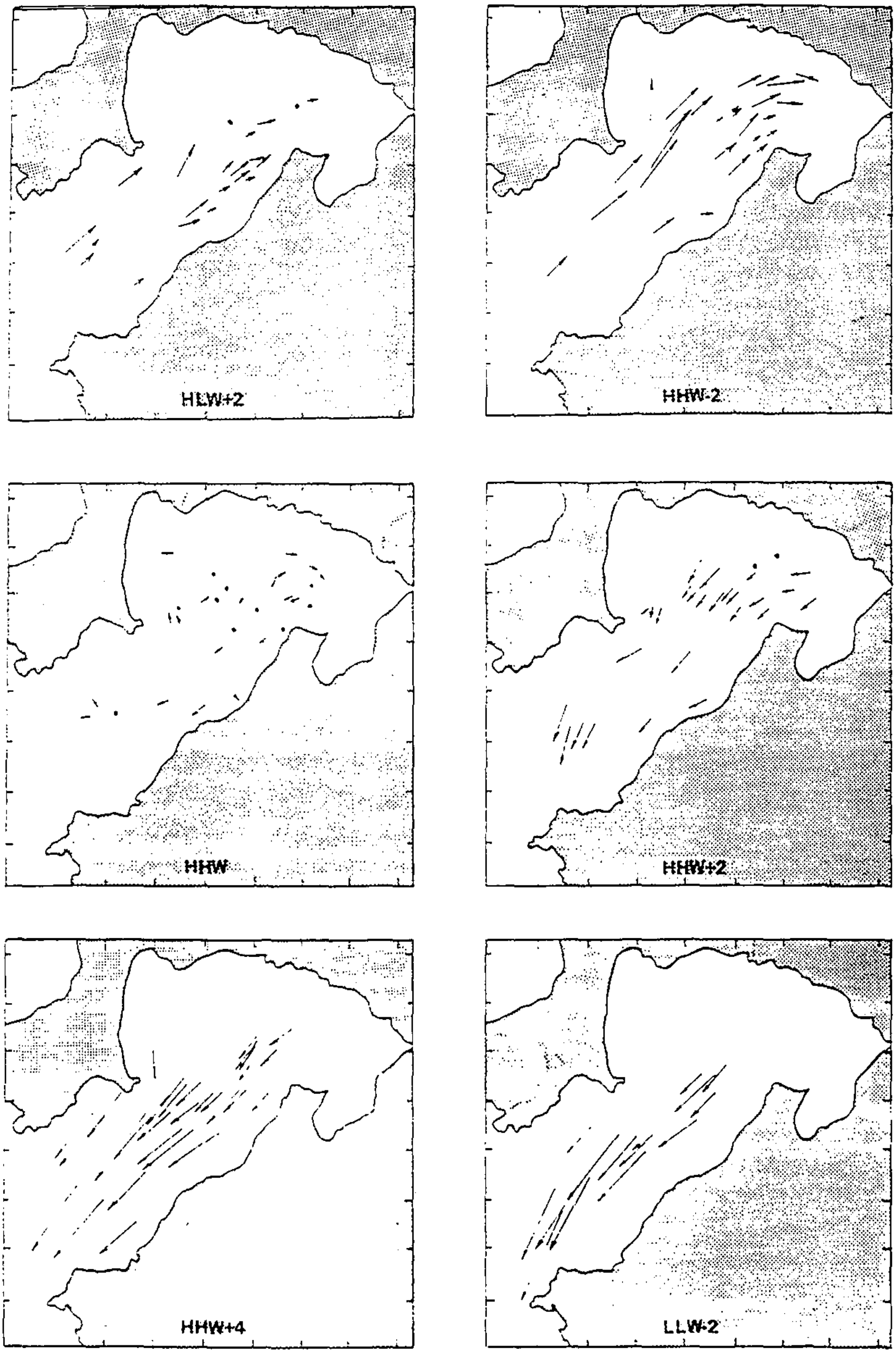


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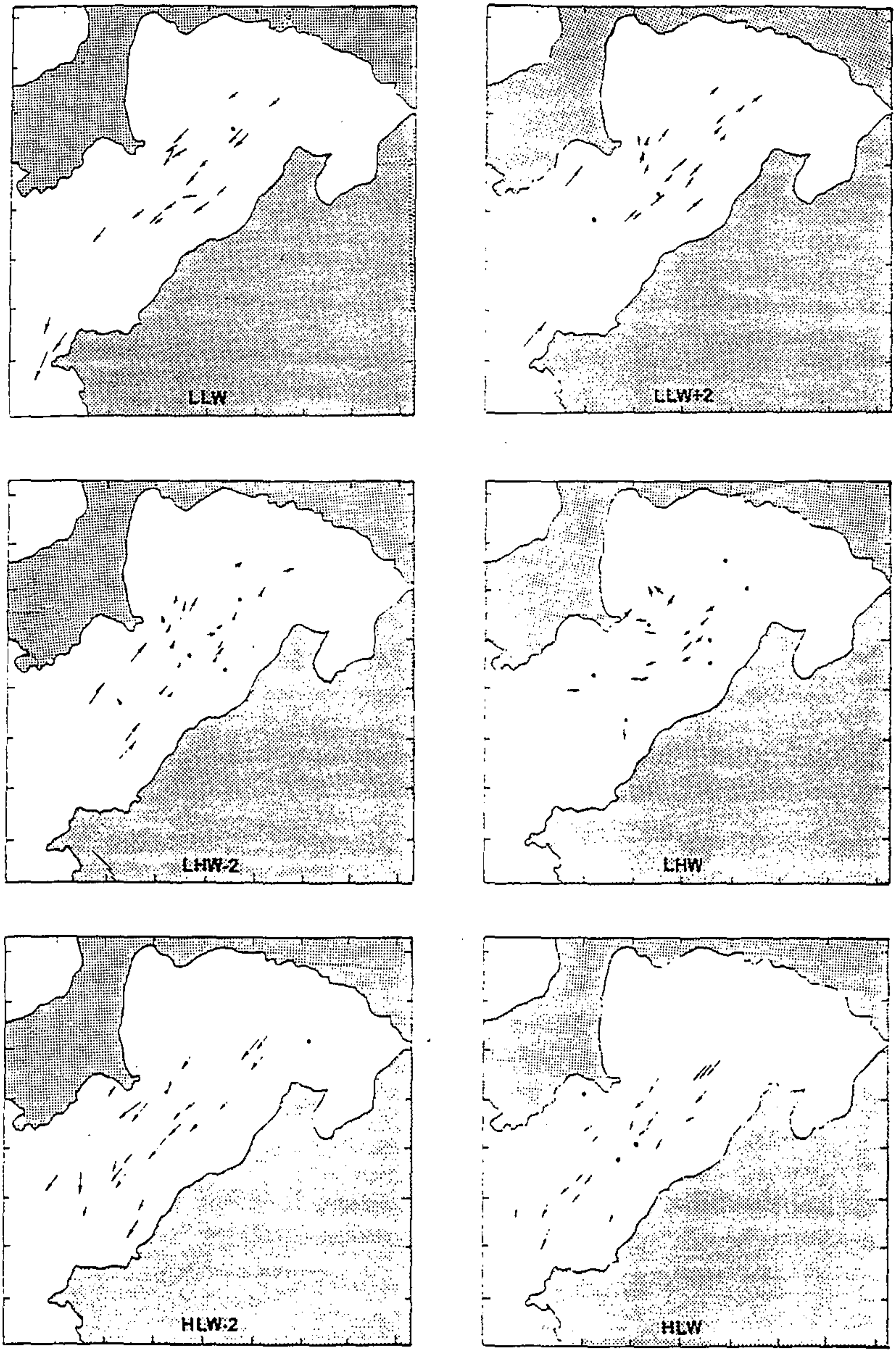


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| | | Reference No. BINNIE & SHANKLAND COX 2/1985 | File Name |
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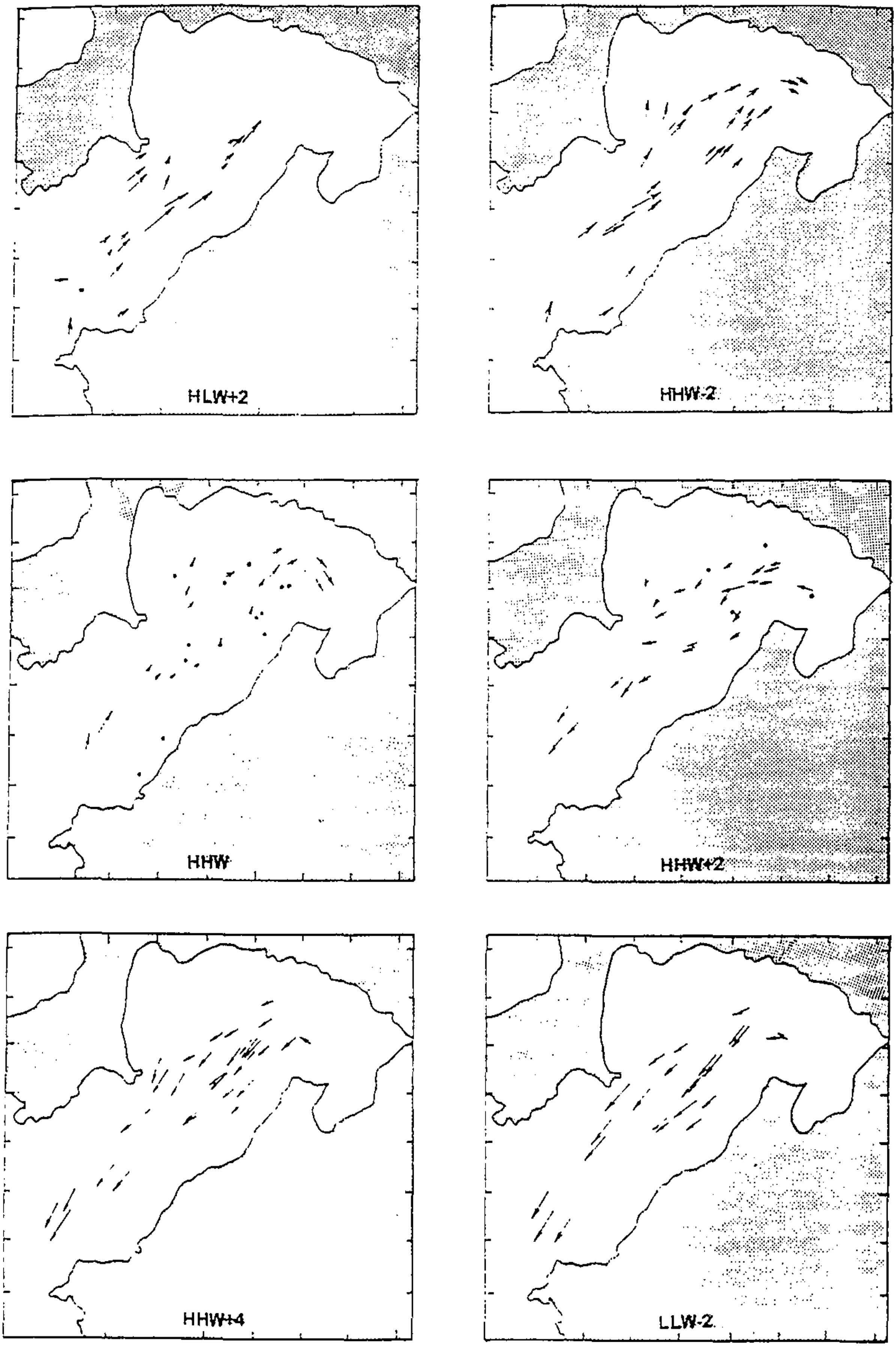


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( SOURCE : TIN SHUI WAI DEVELOPMENT - EIA OF LAND PREPARATION ASPECTS : BINNIE AND SHANKLAND COX, 2/1985 )

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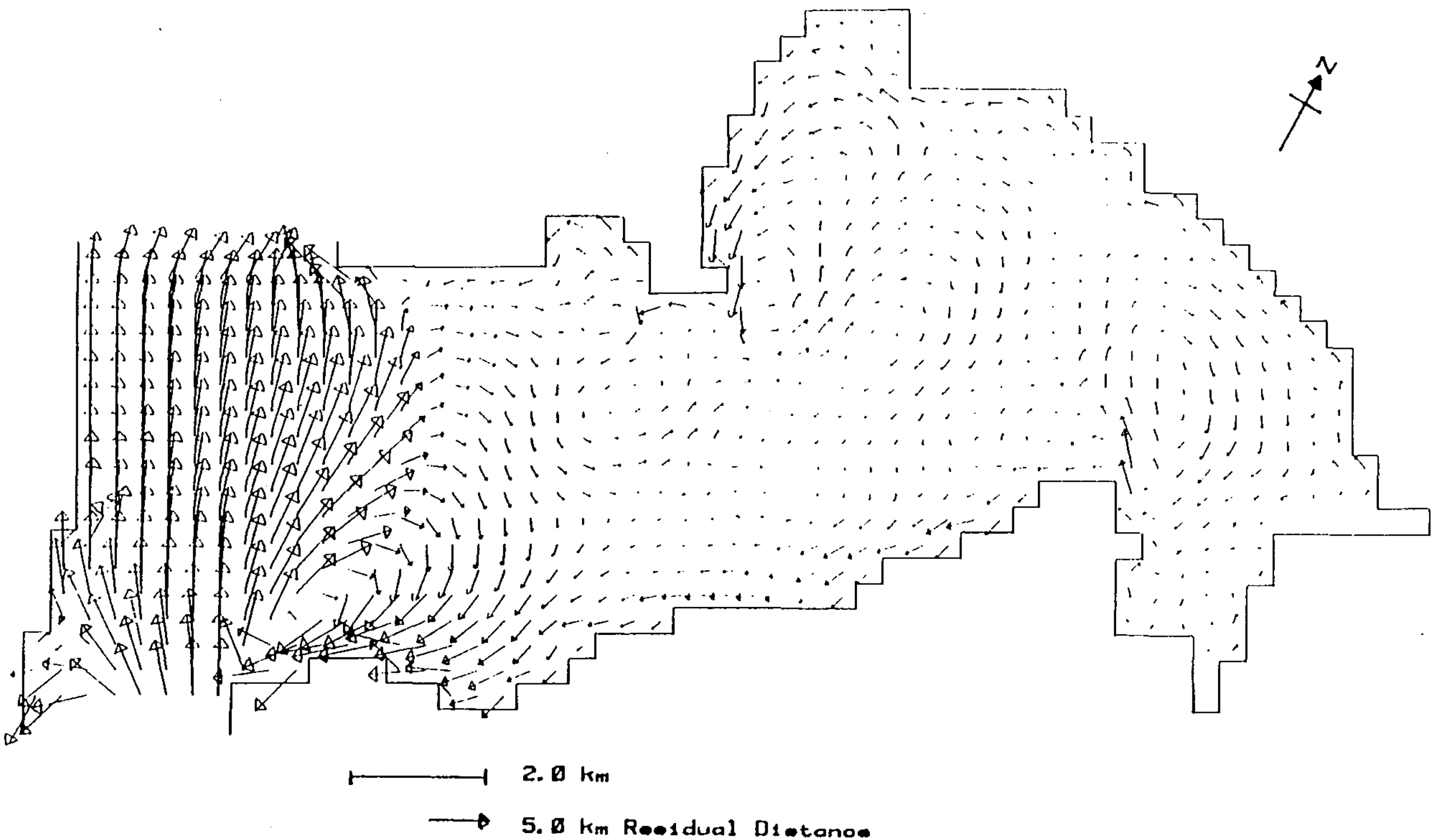


(SOURCE : TIN SHUI WAI DEVELOPMENT : LAND FORMATION WORKING PAPER NO 12 : BINNIE & PARTNERS, 9/1986 )

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| Figure No **4.4** | Revision 0 |
| Reference No. BINNIE 9/1986 | File Name - |
| Prepared MC | Checked JC |
| Date APR 96 | Scale AS SHOWN |

4.4.22 Water and sediment quality in Deep Bay is monitored regularly as part of the EPD marine water quality monitoring programme. Monitoring locations for water and sediment quality are shown in Figure 4.5. Data collected in 1996 showed a similar pattern for many parameters, with some notable exceptions. $BOD_5$, *E.coli*, TN and ammoniacal nitrogen increased at all monitoring stations in Inner Deep Bay, including DM3, particularly during the wet season. pH fluctuations during this period resulted in significant increases in the unionized form of ammonia, which is highly toxic to aquatic life. By the end of 1996, levels had returned to the lower levels measured in the dry season of 1995. Levels found at sites DM1 and DM2 for October 1996 to October 1997 are shown in Table 4.6.

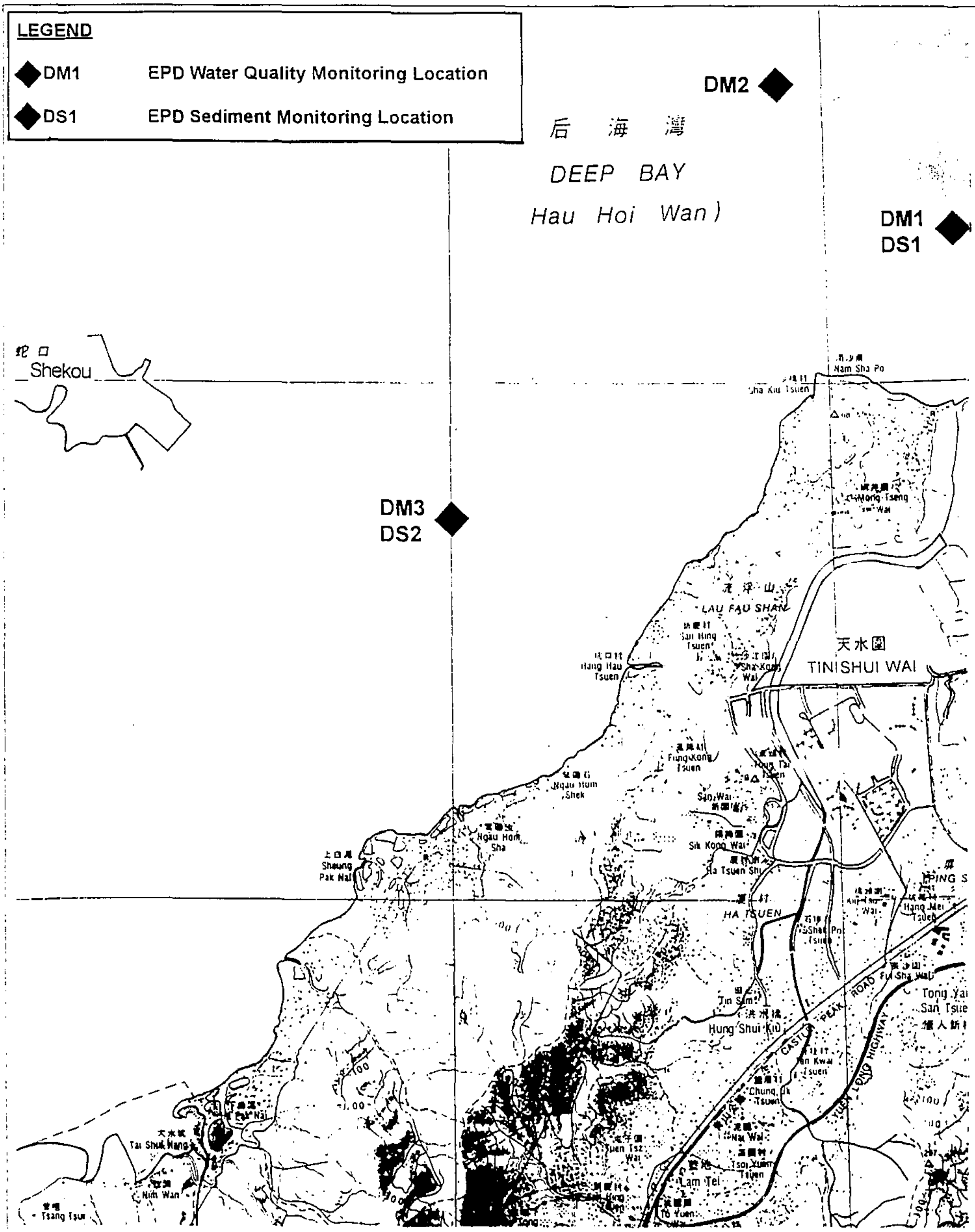
**Table 4.6**
**Average Water Quality Data for Sites DM1 and DM2 in Inner Deep Bay for October 1996 to October 1997**

| Parameter | DM1 | DM2 |
|---|---|---|
| Dissolved Oxygen | 4.51 | 5.11 |
| pH | 7.5 | 7.6 |
| Suspended solids | 76.38 | 40.62 |
| $BOD_5$ | 5.00 | 2.4 |
| *E.coli* (cfu/100ml) | 114,020 | 38,570 |
| Ammoniacal nitrogen | 4.47 | 2.88 |
| Nitrate nitrogen | 0.51 | 0.59 |
| Total Kjeldahl nitrogen | 5.47 | 3.64 |
| Ortho-phosphate | 0.57 | 0.39 |
| Total phosphorous | 0.93 | 0.61 |

Notes: 1. Data presented are the annual medians of monthly samples.
2. All units are mg/L unless otherwise stated.
From: HK EPD (Marine water quality data for 1996 and 1997).
pH averages from EPD Marine Water Quality in Hong Kong 1995.

*Sediment quality*

4.4.23 Nutrient levels, particularly phosphorous, in sediments of Deep Bay and Inner Deep Bay were high in 1997, relative to sediments in other parts of Hong Kong waters, reflecting the discharge of municipal wastewater, livestock waste and organic wastes from agriculture and mariculture into these waters. However, nutrient levels have generally been decreasing at location DS1 in recent years, in part due to improved control of livestock waste discharges into these waters.




( SOURCE : EPD WATER QUALITY MONITORING REPORTS ; HYDER'S "SEDIMENTATION STUDY" - INTERIM REPORT ; HYDER/CES'S "DEEP BAY WATER QUALITY REGIONAL CONTROL STRATEGY STUDY" - INTERIM REPORT. )

AGREEMENT NO. CE 79/96
YUEN LONG BYPASS FLOODWAY
FEASIBILITY STUDY
DRAFT EIA STUDY REPORT

BINNIE CONSULTANTS LIMITED
賓尼工程顧問有限公司
ENGINEERS AND SCIENTISTS

Title :

EPD MARINE WATER AND SEDIMENT
QUALITY MONITORING
STATIONS IN DEEP BAY

| | |
|---|---|
| Figure No. 4.5 | Revision 0 |
| Reference No. - | File Name - |
| Prepared KB | Checked PS |
| Date FEB 98 | Scale 1 : 50000 |

4.4.24 Heavy metal concentrations in sediment were similar throughout Deep Bay and lower than those in highly populated, industrialized centres. Metal concentrations have also been decreasing for the last 3 years up to 1997.

4.4.25 Sediment quality data for DS1 is shown in Table 4.7.

**Table 4.7**
**Sediment Quality Data for Site DS1 in Inner Deep Bay**

| PARAMETER | DS1 |
|---|---|
| **TOC** | 0.45 |
| **Total P** | 215 |
| **Chromium** | 28.5 |
| **Copper** | 33 |
| **Zinc** | 135 |
| **Nickel** | 18 |
| **Lead** | 44.5 |
| **Mercury** | 0.215 |
| **PCB's μg/kg** | < 5 |
| **PAH's μg/kg** | 156 |

Notes:
1. Data presented are the averages of twice yearly sampling in 1996
2. All units are mg/kg unless otherwise stated.
From:HK EPD Sediment Quality Data for 1996

4.4.26 A summary of the baseline water quality in sensitive receivers is shown in Table 4.8.

**Table 4.8**
**Summary of Water and Sediment Quality at Each Sensitive Receiver**

| Sensitive Receiver | Water and sediment quality |
|---|---|
| **Fish Ponds** | In the inactive ponds, water quality is considered to be good. At present most of the ponds along the floodway alignment are drained and filled, providing stockpiling areas for construction of Route 3. These ponds will be reinstated upon the completion of Route 3 works. |
| **Lotus ponds** | Water quality appears to be good for the growth of lotus |
| **Yuen Long Creek** | Water quality considered to be 'bad' to 'very bad'. Highly contaminated by organic waste from livestock and also industrial waste. In 1997 high levels of oil and grease were found particularly at YL1 as a direct consequence of industrial effluents.<br><br>Heavy metal levels are high, especially at YL1 |
| **Other streams, culverts and channels** | Varying water quality from good to very bad. Many are highly contaminated by organic, industrial and domestic waste. |
| **Kam Tin River** | Poor water quality as a result of sewage and livestock discharges. Some industrial waste and high levels of heavy metals. Cadmium and zinc are especially high at KT2.<br>Dissolved oxygen levels are low, particularly at KT2. |
| **Inner Deep Bay** | Mixing of the marine waters is poor, increasing the flushing time for pollutant removal. The waters are shallow, minimizing stratification.<br><br>High pH values during the wet season of 1996 resulted in free ammonia values above toxic levels. Levels of both parameters decreased in the dry season of 1996.<br><br>Sediment in Deep Bay is high in nutrients, although levels have decreased in recent years. Metal levels are lower than other, more industrialized, parts of Hong Kong. |

## 4.5 Construction Impact Assessment

*Identification, Prediction and Evaluation of Impacts*

4.5.1 Construction activities during the development of the Yuen Long Bypass Floodway which have the potential to impact water quality in the identified sensitive receivers include:

- re-routing the existing heavily polluted water courses;
- construction site runoff and discharge;

- sewage discharge from the construction workforce;
- use of oils, fuels, lubricants, chemicals and other contaminants from construction works; and
- generation of small quantities of unsuitable or contaminated materials from a construction site.

*Re-routing of the Existing Polluted Water Courses*

4.5.2 Re-routing of the present channels and construction of the new floodway will have a temporary impact on the feeder streams of the Yuen Long area. The route of several of the channels will be changed to enter the floodway and ultimately the Kam Tin River and Inner Deep Bay. This change of route will result in additional pollution loading in Kam Tin River, although the loading into Yuen Long Creek from these water courses will be reduced. Diversion of stream water into the floodway has impacts on the pollutant loading and hydrology of the catchment which will be discussed in the operational impacts section.

4.5.3 Runoff from the Small Traders New Village presently enter the concrete lined channel which feeds into a vegetated channel close to the proposed floodway route. This channel will be diverted into the floodway, eliminating the water from the vegetated channel which will be fed only by runoff from the adjacent land. This vegetated channel may dry up unless development of this area occurs from which runoff will increase, especially in the dry season.

4.5.4 During construction of the floodway, flow from the feeder streams will have to be diverted through the construction of temporary coffer dams. Before completion of the floodway the stream flow may need to be pumped over the floodway in order to avoid flooding of the works area. Water from the channels will eventually flow into the floodway. There is a potential for construction site runoff to enter the downstream sections of the feeder channels, an impact which is unacceptable and must be mitigated.

*Construction Site Runoff and Discharge*

4.5.5 Construction site runoff may contain suspended material, oil and grease and concrete washings during the different activities of the works. Potential pollutants and their sources are shown in Table 4.9.

**Table 4.9**
**Pollutants in Construction Site Run-off,**
**Potential Sources and Impacts on Water Quality**

| Pollutant | Potential source(s) | Potential impact on water quality |
|---|---|---|
| Suspended solids | Wheel washing wastes. Excavation or earth moving works. | Increased turbidity in receiving water body |
| Oil and grease | Site compounds, vehicles on site, run-off from roads. | Visually displeasing and harmful to aquatic life |
| Concrete washings | Works areas where concrete is produced, used or discarded. | Raises pH, which increases toxicity of other pollutants, notably ammonia. |

4.5.6 Suspended solids in runoff may originate from erosion and runoff from surfaces in the construction area, eg: stockpiles, channels and recently exposed soil surfaces. Concrete slurries are another source of particulate contamination. The increase in suspended solids loading to the water increases the potential for sediment deposition. Dissolved oxygen levels are lowered in the presence of higher suspended solids levels, and increased nutrient levels from soil erosion can lead to eutrophication of the receiving waters. These impacts have a significant effect on fish and lotus ponds where siltation and a deterioration in water quality may affect flora and fauna in these ponds. Increased suspended solid levels in runoff is an unacceptable impact which must be mitigated.

4.5.7 During concreting of the stream base, concrete washings may enter the water column of downstream sections of streams, fishponds and lotus ponds. Where ammonia levels from the presence of organic pollution are high, an increase in pH from these washings is unacceptable, due to the potential development of ecotoxic conditions.

4.5.8 Potential impacts on feeder streams may also affect Kam Tin River which receives water from the floodway. The already stressed condition of Kam Tin River requires that any adverse impacts be mitigated.

*Oils, Fuels, Lubricants, Chemicals and Other Contaminates from Construction Work*

4.5.9 Discharge of oil from vehicles on site is a potential impact which may result in increased oil and grease concentrations in streams and ponds along the route of the bypass floodway. This can cause adverse biological and physical effects in water bodies.

4.5.10 Storage of fuel, maintenance of vehicles and runoff from contaminated areas also have potential impacts on the water quality discharged to the receiving water bodies and should be mitigated through good site management practices.

*Small Quantities of Unsuitable or Contaminated Materials From a Construction Site*

4.5.11 The poor quality of water in several of the feeder streams along the route of the bypass floodway indicates that the sediment in these streams may also be of poor quality.

4.5.12 During floodway construction, some sediments will be removed, leading to potential increases in pollutant loads from sediment disturbance. Suspended material, ammoniacal nitrogen, metals and organics may increase and dissolved oxygen decrease, in downstream sections of the feeder channels, particularly in the more polluted channels identified eg Sham Chung. These impacts will be passed on to the receiving waters of Inner Deep Bay and Deep Bay.

*Site Discharge From the Construction Workforce*

4.5.13 In addition to potential impacts on water quality which have been identified from the physical construction of the floodway, additional impacts may arise from the presence of workers on site for which sanitary facilities and possibly a temporary canteen need to be provided. Potential impacts include:

- Increased rubbish discarded into streams and water bodies, including food packaging and containers, leading to pollution, visual displeasure and nuisance.

- Increased sewage generation resulting in a potential impact of much higher biochemical oxygen demand (BOD), suspended solids, nutrients and bacterial count in receiving water bodies. Adverse surface water quality impacts may result from uncontrolled discharges on site. The provision of chemical toilets requires regular maintenance to ensure the wastewater does not pollute adjacent streams.

- Spilt liquids eg. oil, diesel and solvents can cause water quality impacts.

4.5.14 These potential impacts can be readily mitigated through good management arrangements on the construction site.

*Mitigation Measures*

4.5.15 The water quality in the culverts and channels should be prevented from deteriorating further as a result of site run-off. Mitigation measures for each of the potential impacts on water and sediment quality in the streams and ponds across the site of the Yuen Long Bypass Floodway are described in Table 4.10. These measures should be incorporated into the works programme.

4.5.16 ProPECC Paper (PN 1/94) on construction site drainage gives advice on how to handle and reduce construction site discharges.

**Table 4.10**
**Mitigation Measures to Minimize Potential Impacts on Water and Sediment Quality in the Streams and Ponds Along the Site of the Yuen Long Bypass Floodway**

| Potential impact | Mitigation Measure |
|---|---|
| Increased run-off and erosion leading to increased suspended solids | Carry out works in dry season as far as possible.<br><br>Cover areas of exposed earth, especially in wet season and where close to impermeable covered areas.<br><br>Install sand traps or catchpits at all drainage discharge points.<br><br>Discharge run-off into settlement pits instead of impermeable drainage systems where possible to allow infiltration. |
| Oil & grease run-off and potential fuel spillages. | Oil interceptors should be provided in site compounds and regularly emptied.<br><br>The oil interceptor should have a bypass to avoid flushing in heavy storms.<br><br>Oil and fuel bunkers should be bunded to avoid accidental spillages.<br><br>Ensure immediate disposal and correct handling of fuel/chemical spills.<br><br>Vehicles should be well maintained to avoid run-off onto roads. |
| Concrete washings run-off, especially during concrete lining of the channel. | Ensure drainage system from concrete producing area is diverted into settlement area for infiltration or storage.<br><br>Cover working area to minimize potentially contaminated run-off during wet conditions.<br><br>Avoid all contact with water in nearby water bodies (streams, channels, culverts, storm drains, rivers, sea)<br><br>During all concrete works within the channel, a coffer dam should be constructed around the works area to avoid concrete washings entering water bodies.<br><br>All concrete washings should be pumped out of the working area into an area away from receiving water bodies, preferably into a settlement pit where the concrete can set and surface water be recycled. |

| Potential impact | Mitigation Measure |
|---|---|
| Site runoff into fish ponds | Construction of a bund between works area and remaining pond water to avoid water quality impacts.<br><br>Bund should be of sufficient size to permit a buffer area between works and water body. The section of the pond along the channel alignment within the bund can be drained which will simplify the works procedure and allow construction to be carried out in dry conditions.<br><br>No run-off, wastewater or chemicals should be allowed to enter the pond. |
| Release of pollutants from removal of sediment | Carry out works in dry season or during periods of low flow in the stream.<br><br>Remove sediment with minimal disturbance. Remove sediment from dried areas first, and carry out concrete lining work in these sections. Divert water flow onto prepared channel lining, dry sediment in other sections and remove from behind bund or dam.<br><br>Care should be taken to avoid disturbance of wet sediment. Sediment should be disposed of according to the level of contamination as defined in WBTC 2/94 for contaminated mud. |
| Increase in organic pollution from increased sewage load from workers, discarded rubbish on site and canteen wastewater. | Proper sewage facilities should be installed for the additional worker population present during construction works.<br><br>Site cleanliness should be maintained. Rubbish bins should be provided and cleaned at regular intervals.<br><br>Discharges from the canteen should be treated by passing through a grease trap before discharge. |

4.5.17 All treatment facilities require regular maintenance to ensure the effective functioning of the systems in achieving pollution control.

*Potential Cumulative Impacts*

4.5.18 Inner Deep Bay is the ultimate receiving water body for all discharges from the Yuen Long Bypass Floodway. It also receives wastewaters from a number of other sources in the northwest New Territories of Hong Kong Shenzhen and the Shekou region of China. Due to the poor mixing capacity of the water body, cumulative impacts are of considerable concern.

4.5.19 Several other projects will be running concurrently with the Yuen Long Bypass Floodway project, which have the potential to impact water quality in the receiving water bodies of Kam Tin River and Inner Deep Bay.

4.5.20 These projects have been listed in Table 3.2 and include housing developments, highways projects and flood schemes. The works with the greatest potential to impact water quality are those which are directly related to water bodies, such as the Main Drainage Channels Projects, and large construction works such as West Rail and widening of Yuen Long Highway.

4.5.21 Concrete lining of the Sham Chung Stream will be carried out under Project 22 CD - Remainder, Phase 4. Water quality impacts which occur in the Sham Chung channel will be passed onto the floodway channel and ultimately to Inner Deep Bay.

4.5.22 Flows from the Small Traders New Village area will be collected in the Yuen Long Bypass Floodway, resulting in the postponement of channelising works in the area. Runoff from any future development in the Small Traders New Village area will be directed into the floodway.

4.5.23 Construction site runoff from West Rail and Yuen Long Highway widening project have the potential to impact water quality in the floodway or adjacent water bodies which lead to Kam Tin River and ultimately Inner Deep Bay.

4.5.24 In order to minimise the impacts, mitigation measures which have been specified for each project should be implemented. Potential cumulative impacts can be reduced by implementing the recommended measures for the present project as completely as possible during the works.

## 4.6 Operational Impact Assessment

### *Identification, Prediction and Evaluation of Impacts*

4.6.1 Once operational the floodway will act as the route for runoff from the surrounding land and streams. This will include:

- Polluted stream water,
- Runoff from vegetated land alongside floodway

4.6.2 The streams themselves receive domestic waste discharges which will enter the floodway. This will have a negative impact on the water quality downstream in the Kam Tin River resulting from an increase in pollutant transport and discharge, due to the flushing effect of a concrete channel.

4.6.3 A beneficial impact will be felt on Yuen Long Creek because of the removal of polluted flows which will be re-directed to the floodway. Both water courses discharge to Inner Deep Bay and therefore the impact on this major receiving water body would appear to be unchanged. However, the increased flushing of pollutants will have an overall negative impact on the water quality in Inner Deep Bay which is unacceptable.

4.6.4 One cause of this increased pollution discharge is the removal of vegetation in the region of the floodway which previously acted as an infiltration area, allowing stream water and road runoff some preliminary treatment before discharge into one of the concrete lined channels in the area.

4.6.5 Vegetation removes dissolved and particulate pollution through absorptive, filtration and biological mechanisms, which will be eliminated in an all concrete environment. This impact can be mitigated through appropriate design of the floodway. For example grasscrete (precast concrete mesh elements) can be used for the flooring and sides to the channel instead of concrete. The grasscrete can be planted with appropriate species such as *Phragmites* reed beds and wetland grass, which do not inhibit the occasional passage of flood flows.

4.6.6 Another potential impact is the release of odour from polluted water and sediments in the channel during low flow conditions. In hot conditions during the dry season this impact may become unacceptable.

*Hydrological Impacts*

4.6.7 Impacts from creating an artificial channel will cause a change in the hydrological processes occurring in the area. There will be an increase in the transport of surface runoff and wastewater discharges downstream because of the reduced hydraulic resistance in a concrete channel. A reduction in the potential treatment capacity will occur because of the absence of vegetation which is present in the existing receiving waters. At present, runoff water from developed areas along the feeder streams and the proposed route of the floodway feeds into small well vegetated streams. These provide a preliminary treatment for polluted waters through absorptive and biological mechanisms.

4.6.8 Concreting of the water course and diverting existing vegetated stream water into a concrete channel will lead to hydraulic changes. The peak run-off rate and the total run-off volume will increase. The downstream effects of water flow and pollutant passage will be felt in the Kam Tin River and Inner Deep Bay earlier as a result of the creation of an artificial channel due to the fact that concrete provides a low resistance surface for water flow. The amount and rate of sediment discharge from these streams will also increase as a result of concreting the channel.

*Mitigation Measures*

4.6.9 Hydrological impacts lead to water quality impacts of increased pollutant flushing into receiving water bodies, an unacceptable impact which must be mitigated.

4.6.10 Impacts on water quality resulting from runoff alongside the floodway can be reduced by including vegetative strips along the floodway to allow runoff water to infiltrate before entering the channel.

4.6.11 The main mitigation measure is the use of grasscrete instead of concrete for the lining of the base and sides of the channel, thus enabling a base for vegetative growth. Growth of vegetation in the channel will provide a mechanism for treatment of polluted water which flows down the channel. A proportion of the solids and associated pollutants such as metals will be filtered out by vegetation, which will provide a degree of aeration to the water, oxidising organic pollutants. This mitigation measure has additional benefits of aesthetic and ecological value.

4.6.12 It is also important to ensure that dry weather flows have the opportunity to react with grasscrete rather than being always confined to a narrow concrete lined dry weather flow channel located along the centre line of the floodway. This could be achieved by:

- ensuring that tributary inflows are allowed to spread across the grasscrete floor of the floodway rather than be directed straight into the dry weather flow channel; and

- locating the dry weather flow channel along the toe of the channel sides opposite to the tributary inflows thus allowing more time and surface area for infiltration.

4.6.13 Increased sediment loads to the Kam Tin River into which the floodway discharges can be minimised by a regular maintenance programme removing sediment from the base of the channel during low flow conditions.

4.6.14 Odour reduction can be achieved naturally through the use of grasscrete and vegetation along the base of the channel providing a treatment function coupled with the construction of a low flow concrete lined channel in the floodway to maintain a flow of water which may otherwise stagnate and create odours. Where a grasscrete base is not possible, regular sediment removal during low flow conditions will reduce odours arising from the accumulation of polluted sediments.

4.6.15 A summary of the mitigation measures is shown in Table 4.11.

## Table 4.11
## Mitigation Measures for Minimising Operational Impacts of Yuen Long Bypass Floodway

| Potential Impact | Mitigation Measure |
|---|---|
| Increased flow of water | Reduction of the flowrate of water entering the channel can be achieved by incorporating permeable areas along the banks of the channel. After entering the channel, the water flow can be reduced by using grasscrete in the construction to encourage infiltration of water into the ground. |
| Reduction in water quality of downstream water courses from introduction of pollutants upstream | Pollutants present in run-off during operation can be reduced through ensuring that as much as possible grasscrete is used for lining the sides and base of the channel and maximising exposure to pollutant absorbing species before overflow into the low flow channel. |
| Removal of permeable area presently covered in vegetation | Use of grasscrete for lining the sides and base of the floodway mitigates this impact through allowing vegetative growth. Infiltration of water into the ground and passage through vegetation will provide partial treatment of the water in terms of removal of suspended solids and removal of BOD through aeration.<br><br>Maximising opportunities for infiltration through:<br><br>• ensuring that tributary inflows are allowed to spread across the grasscrete floor of the floodway rather than be directed straight into the dry weather flow channel; and<br><br>• locating the dry weather flow channel along the toe of the channel sides opposite to the tributary inflows thus allowing more time and surface area for infiltration.<br><br>Use of the sterile land between Route 3 and the YLBF as an engineered wetland and incorporate it into the overall channel design (see Section 5). This would significantly increase the channel surface area available for natural infiltration and treatment.<br><br>Use of the remaining pond areas immediately south of Route 3 by incorporating them into the channel design would also increase the surface area available for infiltration. (See Section 5) |

## 4.7 Residual Impacts

4.7.1 With the implementation of mitigation measures as described, residual water quality impacts of the project during both construction and operation phases are expected to be negligible.

## 4.8 Environmental Monitoring and Audit Requirements

4.8.1 The assessment of water quality impacts associated with the proposed works for the Yuen Long Bypass Floodway has shown that with the implementation of the appropriate mitigation measures the residual water quality impacts of the project should be acceptable. However, monitoring of construction site discharges which enter streams, channels, or have the potential to enter fish ponds or lotus ponds, is essential to ensure mitigation measures are being implemented and impacts minimised.

4.8.2 All site discharge points should be inspected daily and if found to be turbid or with visible evidence of oil and grease present, samples should be taken for analysis. Weekly checks of dissolved oxygen, turbidity, temperature and pH should be made of all site discharges and at least monthly analysis of suspended solids and oil and grease should be made. The results should be compared with the appropriate discharge standards in the Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters (TM).

4.8.3 Due to the relatively high levels of ammonia in the Kam Tin River, discharges to this river should be monitored particularly closely during construction because of the effect of pH on the partitioning of ammonia into its ionized and more toxic unionized states. At a higher pH and temperature the toxic unionized fraction increases. Where ammonia levels in the Kam Tin River are high, the pH value of the discharge from the floodway becomes increasingly important. In the present condition the pH of the YLBF discharge should be maintained below 8.0 to minimise potential impacts on un-ionised ammonia levels. If the level of ammonia in the Kam Tin River increases to a concentration where a pH of 8 leads to unionized ammonia concentrations above the toxic level of 0.035mg/l, the YLBF discharge standard for pH may need to be reduced to a level which minimises the impact on toxic unionized ammonia levels. Limit levels for other parameters should be in accordance with the TM.

4.8.4 Routine audit of the implementation status of specified mitigation measures during the construction and operation phases should be undertaken by an Environmental Team which will undertake the EM&A function during the construction works. Such audits should be well documented and include action procedures in the case of noncompliance.

4.8.5 A summary of the proposed EM and A programme is shown in Table 4.12.

**Table 4.12**
**Summary of the Proposed EM & A Programme**

| Location | Parameters | Frequency |
|---|---|---|
| **All site discharges including ultimate discharge into Kam Tin River** | Turbidity, DO, pH, temperature, | Once per week (during mid ebb at ultimate discharge) |
| | Oil and grease, SS. | Once per month (during mid ebb at ultimate discharge) |
| **Mixing Zone of YLBF and Kam Tin River** | pH, Temperature, NH4-N, DO, Turbidity | Once per week during mid ebb |

## References

ACER (1996). Deep Bay Water Quality Regional Control Strategy Study. Agreement No. CE 17-95 for Environmental Protection Department, Hong Kong.

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# 5. ECOLOGY

This section examines the existing ecological conditions within the Study Area of Yuen Long Bypass (YLB) Floodway, and considers the ecological impacts of the project. Legislation related to this ecological impact assessment is presented in Appendix C of this report.

## 5.1 Assessment Methodology & Criteria

Field surveys were conducted on 12-13/5/97, 4/12/97 and 11/3/98, in order to establish broad-brush habitat maps across two seasons. Methods comprised: a preliminary field survey; literature review (including EIAs by others); mapping of ecological features (using site walkovers in order to ground-truth maps and aerial photographs) and using these to determine impacts. A tree survey was carried out and is presented in Appendix D. Criteria from the *TM for EIA Process* were used to evaluate ecological importance, and as guidelines for assessment. The Study Area was divided by habitat-type to facilitate the survey. Figure 5.1 illustrates the broad vegetation ecotopes found in the Study Area. Other, relevant ecological studies were reviewed.

## 5.2 Existing Conditions/Habitat Characterisation

***Tin Liu Tsuen to Chuk San Tsuen***

*Village Habitat*

5.2.1 The Study Area from Tin Liu Tsuen to Chuk San Tsuen is generally village/suburban to rural in character (see Plate 5.1). The landuse is noticeably less industrialised than Yuen Long South (which is a mixture of small-to-medium industries, villages, active and fallow agricultural land, derelict livestock buildings, fishponds and heavily polluted concrete-lined nullahs[1]). The majority of the identified tree species are fruit and shade trees with occasional decorative exotic species such as Norfolk Island Pine. The few on-site patches of productive, well-tended agricultural land are "kitchen gardens" enclosed within walls or fences abutting village houses.

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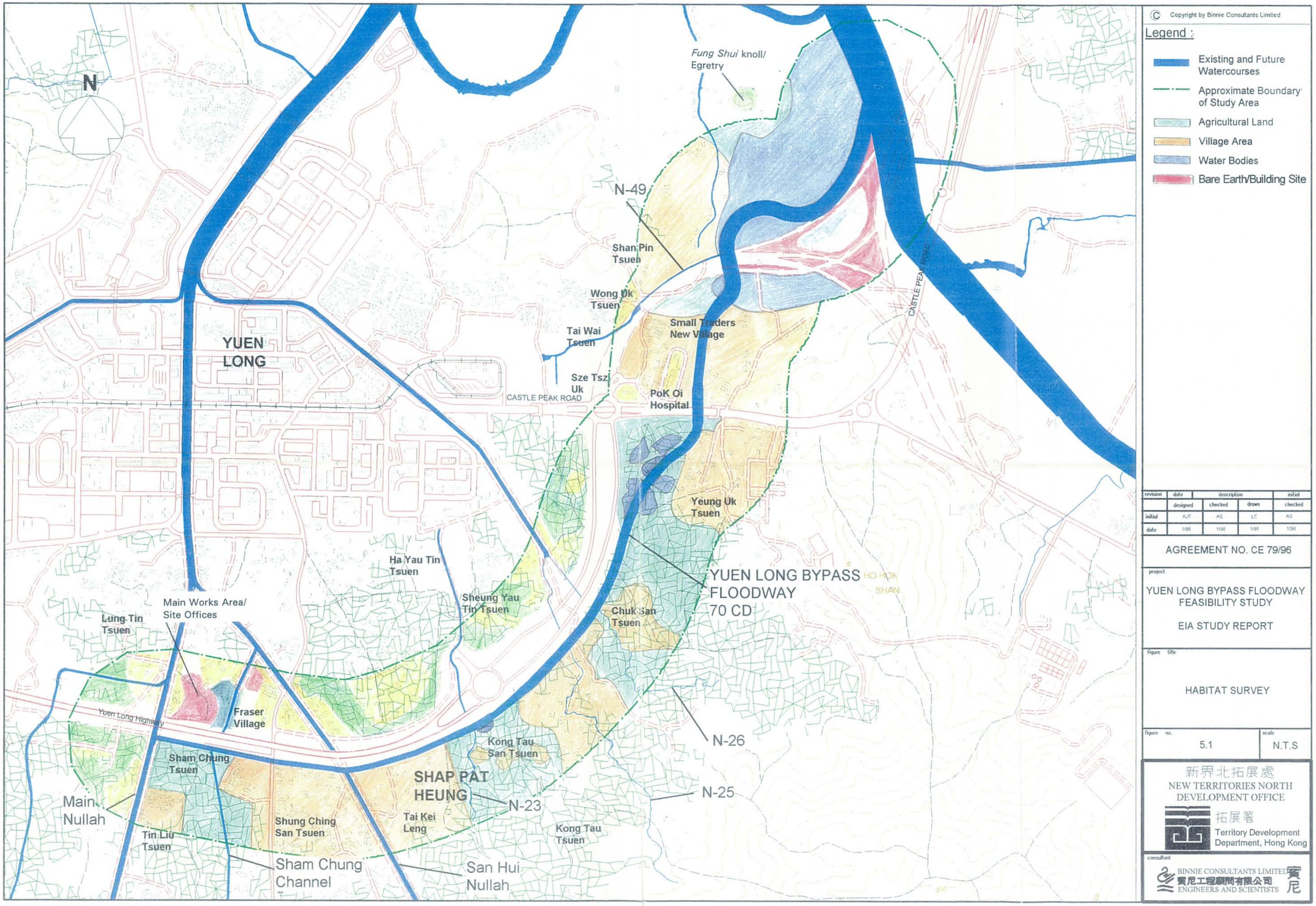
1 BCL, (1997) 0080/EIA/FR/1, CE 48/95, Yuen Long South Development Engineering Works in Areas 13 & 14, Yuen Long - EIA Final Assessment Report



N
YUEN LONG
Fung Shui knoll/ Egretry
N-49
Shan Pin Tsuen
Wong Uk Tsuen
Tai Wai Tsuen
Small Traders New Village
Sze Tsz Uk
CASTLE PEAK ROAD
Pok Oi Hospital
Yeung Uk Tsuen
Ha Yau Tin Tsuen
Sheung Yau Tin Tsuen
YUEN LONG BYPASS FLOODWAY 70 CD
Chuk San Tsuen
Main Works Area/ Site Offices
Lung Tin Tsuen
Fraser Village
Yuen Long Highway
Kong Tau San Tsuen
N-26
Sham Chung Tsuen
SHAP PAT HEUNG
N-23
N-25
Main Nullah
Tin Liu Tsuen
Shung Ching San Tsuen
Tai Kei Leng
Kong Tau Tsuen
Sham Chung Channel
San Hui Nullah
CASTLE PEAK ROAD
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Legend :
Existing and Future Watercourses
Approximate Boundary of Study Area
Agricultural Land
Village Area
Water Bodies
Bare Earth/Building Site
AGREEMENT NO. CE 79/96
YUEN LONG BYPASS FLOODWAY FEASIBILITY STUDY
EIA STUDY REPORT
HABITAT SURVEY
5.1
N.T.S
新界北拓展處
NEW TERRITORIES NORTH DEVELOPMENT OFFICE
拓展署
Territory Development Department, Hong Kong
BINNIE CONSULTANTS LIMITED
賓尼工程顧問有限公司
ENGINEERS AND SCIENTISTS


**Plate 5.1 Approximate route of Yuen Long Bypass Floodway**

*Agricultural habitat*

5.2.2 A greater proportion of the agricultural area has fallen into disuse than in the Yuen Long South area. The two areas were convergent before being physically separated by the Yuen Long Highway (YLH). Since the construction of the YLH, the linking media between the two areas are the flowing water bodies which also carry farm and light industry effluent arising from the Shap Pat Heung hinterland.

*Water bodies*

5.2.3 The Sham Chung stream crosses abandoned agricultural land within the Site (at chainage 0 + 170) less than 30m west of Sham Chung Tsuen. Despite having been recently dredged and being subject to gross organic pollution, a White-breasted Waterhen was observed foraging in the vicinity of the stream. The downstream end of this waterbody north of Fraser Village is channelized.

5.2.4 The San Hui Nullah crosses the Site (at chainage 0 + 650) between Shung Ching San Tsuen and Tai Kei Leng. The water in this trapezoidal nullah is polluted, and due to the concrete lining, plant life is limited to sporadic weeds. Consequently, avifauna is limited to Wagtails (*Motacilla cinerea, M.alba*,and *M.flava*).

5.2.5 A small stream (N-23) crosses abandoned agricultural land within the Site between Tai Kei Leng and Kong Tau San Tsuen (at chainage 1 + 90). The streamwater is clear and unpolluted. However, at the time of the survey, the channel had recently been dredged, and thus was devoid of both flora and fauna. See Plate 5.2.

5.2.6 At chainage 1 + 150, in an area of abandoned agricultural land, a shallow pond has formed immediately south of the Shap Pat Heung Interchange (see Plate 5.2, between the Interchange and the old village houses of Kong Tau San Tsuen). The pond is colonised by Water spinach (*Ipomoea reptans*) and Ginger (*Zingiber officinale*) and Taro (*Colocassia esculenta*). Two Little Egrets (*Egretta garzetta*) were seen flying from this pond and a closer inspection revealed Ardeid footprints in large numbers across most of the pond bed indicating that this pond is a feeding ground.

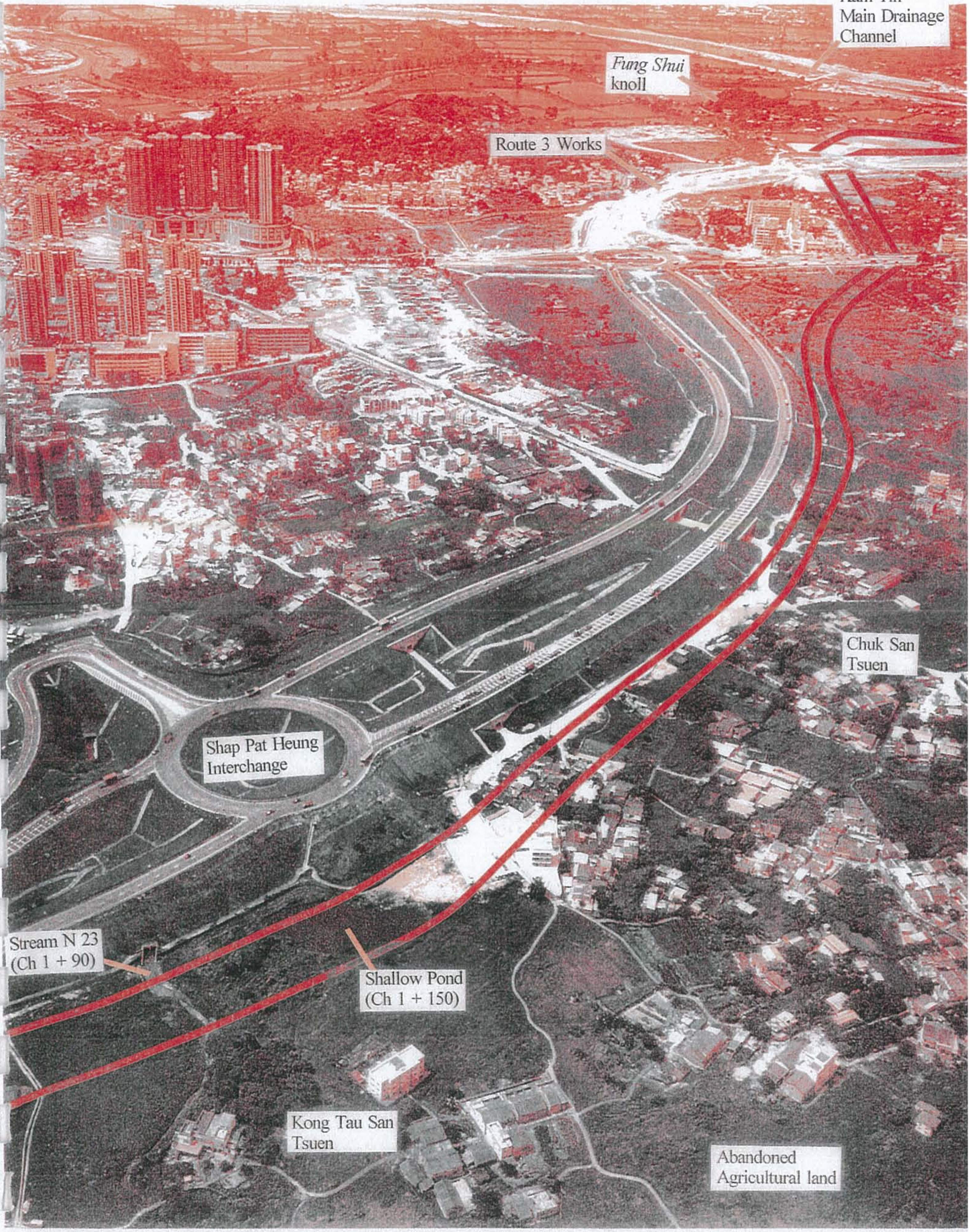


**Plate 5.2 Approximate route of Yuen Long Bypass Floodway**

5.2.7 Two small streams cross the Site between Kong Tau San Tsuen and Chuk San Tsuen. The western stream (N-25, at chainage 1 + 500) has a diverse riparian strip, however, it is grossly polluted with both effluent and garbage. The eastern stream (N-26 just south of Chuk San Tsuen, at chainage 1 + 650) was undergoing engineering works (YLRP 5/97-98) at the time of the stream survey (4/12/97). This channel will be contained within a concrete U-channel in future. The flow diverted around the works was grossly polluted with pig effluent. Faunal species identified along the alignment of the floodway between Tin Liu Tsuen and Chuk San Tsuen, are listed in Table 5.1.

**Table 5.1**
**Fauna identified within the Village, Riparian and Agricultural Land Habitats**

| Location | Common name | Scientific name | Activity |
|---|---|---|---|
| Sham Chung Tsuen | Avifauna | | |
| | Chinese Pond Heron+ | *Ardeola bacchus* | Foraging |
| | Swallow*+# | *Hirundo sp.* | Feeding on wing |
| to | Sparrow* | *Passer montanus* | |
| | White-breasted Waterhen+# | *Amaurornis phoenicurus* | Foraging |
| Shung Ching San Tsuen | Reptiles | | |
| | Chinese skink* | *Eumeces chinensis (chinensis)* | Basking |
| to | | | |
| | Avifauna | | |
| Tai Kei Leng | Long-tailed Shrike+ | *Lanius schach (schach)* | Perching |
| | Insects | | |
| | (dragonfly)+ | *Rhodothemis rufa* | |
| | | *Pseudagrion rubriceps rubriceps* | |
| to | | *Crocothenis servilia servilia* | |
| Kong Tau San Tsuen to Chuk San Tsuen | Avifauna | | |
| | Chinese Pond Heron+ | *A. bacchus* | Foraging |
| | Dusky Shrike+ | *Lanius schach (schach)* | Perching |
| | Little Egret+ | *Egretta garzetta* | Foraging |
| | Amphibian | | |
| | Common Asiatic toad+ | *Bufo melanostictus* | |

* Village habitat +Agricultural Habitat # Riparian

5.2.8 Floral species identified along the alignment of the YLB Floodway between Tin Liu Tsuen and Chuk San Tsuen, are listed in Table 5.2. A tree survey for the Site was undertaken and is included at Appendix D. An evaluation of each tree in respect of its preservation worth will be undertaken before the end of the Feasibility Study. No rare or endangered species were noted within the site. However, three species and a total of 17 trees are identified as protected under the Forestry Regulation.

**Table 5.2**
**Flora identified within the Village, Riparian and Agricultural Habitats**

| Location | Common Name | *Scientific Name* |
|---|---|---|
| Sham Chung Tsuen | Big-leaved Acacia+ | *Acacia mangium* |
| | Banana*+# | *Musa paradisiaca* |
| | Candlenut Tree* | *Aleurites moluccana* |
| | Lychee* | *Litchi chinensis* |
| | Ivy Tree* | *Scheflera octophylla* |
| | Elephant's Ear*+# | *Macaranga tanarius* |
| | Chinese Banyan+ | *Ficus microcarpa* |
| | Ginger+ | *Zingiber officinale* |
| | Taro+ | *Colocassia esculenta* |
| | Alocasia+# | *Alocasia odora* |
| | Common Reedgrass+# | *Phragmites sp.* |
| | Perrenial Morning Glory+ | *Ipomoea acuminata* |
| Shung Ching San Tsuen | Norfolk Island Pine* | *Araucaria heterophyla* |
| | White (Jade) Orchid Tree* | *Michelia alba* |
| | Bauhinia (Camel-foot tree)* | *Bauhinia sp.* |
| | Guava* | *Psidium guajava* |
| | Longan* | *Euphoria longan* |
| | India Rubber Tree* | *Ficus elastica* |
| | Leyland cypress* | *Cupressocyparis leylandii* |
| | Bamboo Palm* | *Chryslalidocarpus lutescens* |
| | Acacia+ | *Acacia confusa* |
| | Ginger lily+ | *Hedychium coronarium* |
| | Water spinach+ | *Ipomoea aquatica* |
| | (Hung lei yip choi)* | |
| | Common Reedgrass+# | *Phragmites sp.* |
| Tai Kei Leng | Flame of the Forest*+ | *Delonix regia* |
| | Elephant's Ear*+# | *Macaranga tanarius* |
| | Iron Tree+ | |
| | Lotus-flowered Magnolia+ | *Magnolia grandiflora* |
| | Acacia+ | *Acacia confusa* |
| | Longan+ | *Euphoria longan* |
| | Sugar/Custard Apple+ | *Annona squamosa* |
| | Banana+# | *Musa paradisiaca* |
| | Aubergine/Egg plant* | *Solanum melongena* |
| | Sugar Cane+ | *Saccharum officinarum* |
| | Alocasia+# | *Alocasia odora* |
| Kong Tau San Tsuen | Acacia* | *Acacia confusa* |
| | Cotton tree*+ | *Bombax malabaricum* |
| | Fishtail Palm* | *Caryota ochlandra* |
| | Horsetail tree* | *Casuarina equisetifolia* |

| Location | Common Name | *Scientific Name* |
|---|---|---|
| Chuk San Tsuen | Flame of the Forest+<br>Coral tree+<br>Red-stem Fig+#<br>Banana+*#<br>Tallow tree+<br>Wild Taro+#<br>Sugarcane+<br>Morning Glory+<br>Alocasia+# | *Delonix regia*<br>*Erythrina speciosa*<br>*Ficus variegata*<br>*Musa paradisiaca*<br>*Sapium sebiferum*<br>*Colocassia esculenta*<br>*Saccharum officinarum*<br>*Ipomoea sp.*<br>*Alocasia odora* |

* Village Habitat + Agricultural Habitat # Riparian Habitat

### *Chuk San Tsuen to Yeung Uk Tsuen*

*Village Habitat*

5.2.9 The density of village development (along the alignment of the proposed floodway) abruptly decreases between Chuk San Tsuen and Castle Peak Road at Yeung Uk Tsuen, with only occasional groups of houses (see Plate 5.3).

*Agricultural Habitat*

5.2.10 More than half of the agricultural land is abandoned or fallow. However, the land to the west of Yeung Uk Tsuen is almost entirely, actively cultivated as lotus ponds. Some of the fringing land to the east is used for vegetable plots and one small scale plant nursery. A pollarded Willow plantation spreads throughout this area, growing around and between the lotus ponds.

*Water bodies*

5.2.11 The lotus ponds are the significant water bodies within this section of the floodway. During the daylight, summer walkover, many different frog/toad calls were heard in this vicinity. Due to the density of the lotus foliage, species identification was not possible. As these animals are typically most active at night, this area is obviously an unusually rich habitat for amphibians. BCL's (1997) Yuen Long South amphibian and reptile survey reported a Narrow-mouthed Frog next to a lily pond south of Ma Tin Tsuen. This lowland, marsh species is restricted by the extent and availability of suitable habitat[2], and is described as

2 Karsen, S.J., Lau W.N. & Bogadek, A. (1986) *Hong Kong Amphibians & Reptiles*. Urban Council. pp33


**Plate 5.3** Approximate route of Yuen Long Bypass Floodway

rare[3]. Community consultation was carried out at Yeung Uk Tsuen (11/3/98) and the following information was collected.

Pond History

5.2.12 The whole area used to be paddy field in the past. When paddy farming was stopped, the agricultural land was abandoned for some time. It was not until 10 years ago or so that the ponds were set up for growing lotus. There are no noticeable changes to the ponds brought about by the nearby construction works. Over the last 30 years or so, there was only one incident of flooding in the area which happened several years ago (most likely in 1994). No changes to ponds were observed at that time.

Management practices

5.2.13 These are largely similar to vegetable farming practices. Pesticides are used on a regular basis to prevent bugs or insects damaging the lotus leaves. Normally no weeding is needed. Fertilizer is also used to increase productivity.

5.2.14 The cultivated species is *Nelumbo nucifera.* The plants are harvested for their leaves which are sold to restaurants for making something like 'lotus leaf rice'. Lotus is normally harvested between April and October. In winter, plants become dormant and produce no leaves. During the non-harvest period, ponds which exhibit low productivity will be replanted with new roots (brought from mainland China).

5.2.15 There is no relationship between the willow trees and the lotus ponds. The willow trees are pollarded for their branches (stalk with leaves attached) which are in particular demand during Ching Ming Festival. It is said the willow tree branches have the power to repel ghosts and unwanted spirits and are used to prevent or scare away bad luck.

Fauna

5.2.16 The most common snakes in the area are the Common rat snake (*Ptyas mucosus*) and the Indo-Chinese rat snake (*Ptyas korros*). As the name implies, both species feed on rats and frogs. Occasionally, the Chinese cobra (*Naja naja atra*) have been observed. Paddy frogs (*Rana* species) and the Asian common toads (*Bufo melanosticus*) are also common but not in large numbers.

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3 ERM (1997), *West Rail IAR*. pp209

5.2.17 Common avifauna seen by villagers are the Sparrow (*Passer montanus*), the Black-necked starling (*Sturnus nigricolis*) and the little egret (*Egretta garzetta*).

5.2.18 Floral species identified along the alignment of the YLB Floodway between Chuk San Tsuen and Yeung Uk Tsuen, are listed in Table 5.3.

**Table 5.3**
**Flora identified within the Agricultural Habitat between Chuk San Tsuen and Yeung Uk Tsuen including the Lotus Ponds and Nursery**

| Location | Common name | Scientific name |
|---|---|---|
| Agricultural habitat | Papaya | *Carica papaya* |
| | Horsetail tree | *Casuarina equisetifolia* |
| | Rough-leaved stem-fig | *Ficus hispida* |
| | Flame of the Forest | *Delonix regia* |
| | Indian Lotus | *Nelumbo nucifera* |
| | Guava | *Psidium guajava* |
| | Pomelo | *Citrus grandis Osbeck* |
| | Taro | *Colocassia esculenta* |
| | Weeping Willow | *Salix babylonica* |
| | Banana | *Musa paradisiaca* |
| | Ginger | *Zingiber officinale* |
| | Water lettuce | *Pistia stratiotes* |

5.2.19 A small pond next to a house to the west of Yeung Uk Tsuen was partially covered by Water Lettuce. Two terrapins were also observed swimming in this pond. During a Site visit in December 1997, several birds were observed feeding in the lotus ponds which were seasonally denuded of foliage.

5.2.20 The ardeids listed in Table 5.4 were observed wading and standing in the lotus ponds, and perching in the adjacent banana groves. This did not appear to be a nesting site, but the birds were obviously foraging in this area. The White-breasted Kingfisher was perching in a guava tree on the southern edge of the lotus pond area. It was observed flying from the tree, over the ponds and returning to the same perch. Although continuous viewing of a strike was not possible due to the interpositioned vegetation, this sort of behaviour is consistent with Kingfishers feeding. When disturbed, the large Kingfisher flew to the east-west orientated banana grove in the middle of the lotus ponds. The Common Kingfisher was perched in the Willow trees running north-south through the middle of lotus ponds, and a strike into the water was observed. Closer inspection of the lotus ponds revealed fish fry (probably Gambusia), tadpoles and water snails inhabiting the clean waters. This ready supply of food was also being utilised by a flock of about 15 Teal in the ponds closest to the YLH.

5.2.21 The other faunal species identified along the alignment of the floodway between Chuk San Tsuen and Yeung Uk Tsuen, are listed in Table 5.4.

**Table 5.4**
**Fauna identified within the Agricultural Habitat including the Lotus Ponds and Nursery between Chuk San Tsuen and Yeung Uk Tsuen**

| Common name | Scientific name | Activity |
|---|---|---|
| Avifauna | | |
| Sparrow | *Passer montanus (rutilans)* | |
| Chinese Pond Heron | *Ardeola bacchus* | Foraging in ponds |
| Great Egret | *Casmerodius albus* | Foraging in ponds |
| Little Egret | *Egretta garzetta* | Foraging in ponds |
| White-breasted Kingfisher | *Halcyon smyrnensis* | Perching in Guava |
| Common Kingfisher | *Alcedo atthis* | Feeding in ponds and Perching in Willow |
| Dusky Shrike | *Lanius schach (schach)* | Perching on lotus stem |
| Bull-headed Shrike | *L. bucephalus* | Perching on shrubs |
| Long-tailed Shrike | *L.schach (schach)* | Perching on wires |
| Fantail Warbler | *Cisticola juncidis (tinnabulans)* | Foraging in vegetable garden |
| Crested Mynah | *Acridotheres cristatellus* | Perching on wires |
| Spotted Dove | *Streptopelia chinensis (chinensis)* | Perching on wires |
| Chinese Bulbul | *Pycnonotus sinensis (sinensis)* | Perching on wires |
| Black-necked Starling | *Sturnus nigricollis* | Perching on wires |
| Blackbird | *Turdus merula (mandarinus)* | Perching on wires |
| Magpie Robin | *Copsychus saularis* | Foraging in vegetable garden |
| Warbler | *[Sylviidae]* | Flying |
| Teal+ | *Anas crecce* | Foraging in ponds |
| Amphibians* | | |
| Reptiles | | |
| Terrapin | *[Testudines]* | In pond |
| Insects | | |
| Lychee Stink Bug | *Tessaratoma papillosa* | |

* Various frogs and/or toads were heard (but not seen or identified) among the Lotus ponds during the Summer survey.

*Sze Tsz Uk (East of Pok Oi Hospital)*

5.2.22 Sze Tsz Uk is an area of old, village type housing. The vegetation is made up of mostly shade and fruit trees and vegetable gardens.

*Agricultural land*

5.2.23 Some of the land immediately to the north of the houses is cultivated for small-scale fruit and vegetable production. The Route 3 works formed a wide sterile swathe across the north of the village area's previous interface with the fishponds.

*Water bodies*

5.2.24 At the time of the surveys, the water bodies (fish and duck ponds) immediately north of Sze Tsz Uk were temporarily resumed for the major road engineering works being carried out (Route 3 - Country Park Section). The ponds had been drained and used to stockpile fill for the road works. Some shallow, residual pools remained in the unfilled areas - these were colonised by *Phragmites* sp. and the water covered with Lesser Duckweed. The ponds will be reinstated, in part, under the Route 3 works[4].

5.2.25 Floral species identified in the Sze Tsz Uk area are listed in Table 5.5.

**Table 5.5**
**Flora identified within the Northeastern Village Habitat**

| Location | Common name | Scientific name |
|---|---|---|
| Sze Tsz Uk | Jackfruit | *Artocarpus heterophyllus* |
| | Longan | *Euphoria longan* |
| | Banyan | *Ficus microcarpa* |
| | Mango | *Mangifera indica* |
| | Banana | *Musa paradisiaca* |
| | Elephant's Ear | *Macaranga tanarius* |
| | Common Reedgrass | *Phragmites sp.* |
| | Lesser Duckweed | *Lemna minor* |

5.2.26 Faunal species identified in the Sze Tsz Uk area are listed in Table 5.6.

[4] CES Asia Ltd, (1995) *Route 3 Tai Lam Tunnel & Yuen Long Approach Northern Section. Vol.1, Detailed Envrionmental Impact Assessment* - Final Report. Route 3 Contractors Consortium.

**Table 5.6**
**Fauna identified within the Sze Tsz Uk Village Habitat**

| Location | Common name | Scientific name | Activity |
|---|---|---|---|
| Drained pond | Avifauna<br>Chinese Pond Heron<br>Sparrow<br><br>Amphibians*<br>Common Asiatic Toad | <br>*Ardeola bachus*<br>*Passer montanus (rutilans)*<br><br><br>*Bufo melanostictus* | <br>Foraging |

* Various frogs and/or toads were heard (but not seen or identified) among the small fishponds between Sze Tsz Uk and Tung Shing Lei.

### *Fishpond Habitat and* Fung shui *Knoll North of the Route 3 Works*

*On-site*

5.2.27 No active fishponds were located along the proposed preferred alignment of the YLB Floodway during site surveys. Fishponds along (and either side of) the Route 3 works have been drained and temporarily resumed for stockpiling fill material. The fishponds are due to be reinstated after the completion of the Route 3 works.

*Off-site*

5.2.28 The area north of the Route 3 works and west of the Kam Tin (KT) River works consists of actively maintained fishponds. A wooded *fung shui* knoll midway between Shan Pui Tsuen and Sha Po is the principal ecological locus in this vicinity. The knoll is outside the alignment of the YLB Floodway, but falls within the habitat survey area (500m from the Site boundary) prescribed in the *TM for EIA Process, Annex 16, 5.1.2.2.* During the summer survey, the Bamboo and Lemon-scented Gum on this knoll were observed to be the nesting and breeding site for many Chinese Pond Herons. The Pond Herons were seen feeding in the surrounding fishponds (including those towards the Project alignment) and returning to the nests. Many other birds were either observed or identified by call in this wooded knoll. The area immediately to the south of the knoll is occupied by small scale fruit and vegetable farming.

5.2.29 Floral species identified in the vicinity of the *fung shui* knoll and the surrounding fishpond bunds are listed in Table 5.7.

**Table 5.7**
**Flora identified within the adjacent Northeastern Fishpond Habitat**

| Location | Common name | Scientific name |
|---|---|---|
| *Fung shui* hill vicinity | Acacia | *Acacia confusa* |
| | Chinese Aralia | *Aralia chinensis* |
| | Papaya | *Carica papaya* |
| | Lemon-scented Gum | *Eucalyptus citriodora* |
| | Banyan | *Ficus microcarpa* |
| | Lychee | *Litchi chinensis* |
| | Elephant's Ear | *Macaranga tanarius* |
| | Banana | *Musa paradisiaca* |
| | Guava | *Psidium guajava* |
| | Bamboo | *Bambusa sp.* |
| | Mango | *Mangifera indica* |
| | Pineapple | *Anana comosus* |
| | Taro | *Colocassia esculenta* |
| | Passion Flower | *Passiflora foetida* |
| | Reedgrass | *Phragmites sp.* |
| | Water Hyacinth | *Eichhornia crassipes* |

5.2.30 Faunal species observed in the area of the *fung shui* knoll and the fishponds to the southeast are listed in Table 5.8.

**Table 5.8**
**Fauna identified within the Off-site Fishponds Area North of the Route 3 Works Centering on the Fung Shui Knoll**

| Common name | Scientific name | Activity |
|---|---|---|
| Avifauna | | |
| Chinese Pond Heron | *Ardeola bacchus* | Nesting on Knoll |
| Little Egret | *Egretta garzetta* | Foraging in ponds |
| Swallow | *Hirundo sp.* | Feeding over ponds |
| Plain Prinia | *Prinia inornata (extensicauda)* | Flying in grassy bunds |
| Warbler | *[Sylviidae]* | Flying in grassy bunds |
| Sparrow | *Passer montanus (rutilans)* | |
| Black-eared Kite | *Milvus lineatus* | Flying over ponds |
| Crested Bulbul | *Pycnonotus sinensis* | Perching in trees |
| Spotted Dove | *Streptopelia chinensis (chinensis)* | Perching on wires |
| Lesser Coucal | *Centropus bengalensis* | Calling from Knoll |
| Koel | *Eudynamis scolopacea* | Calling from Knoll |
| Chinese Starling | *Sturnus sinensis* | Perching on wires |
| Magpie Robin | *Copsychus saularis* | Perching |
| Crested Myna | *Acridotheres cristatellus* | Flying over ponds |
| Insects | | |
| Damselfly | *Pseudagrion rubriceps rubriceps* | |
| Dragonfly | *Ryothemis variagata arria*<br>*Acisoma panorpoides panorpoides*<br>*Orthetrum sabina sabina* | |
| Butterfly | | |
| Waterbeetle | | |
| Water/Pond skaters | | |

5.2.31 Habitats along the Bypass Floodway alignment are illustrated in Plate 5.4.

## 5.3 Habitat Evaluation

5.3.1 In the first instance, it should be recognised that each of the habitats located within the study area is blighted by the close proximity of: the recently constructed, busy YLH; the works in progress for Route 3 (and associated approach roads); and, the Kam Tin River.

*Evaluation Approach*

5.3.2 The habitats found within the study area have been divided into the following types: village; cultivated land; flowing water bodies; and still water bodies. There is some inevitable overlap between these habitats, this is discussed below. All of the habitat types encountered are man-made, predominantly monocultured (i.e. lotus ponds, fishponds and agricultural land) and floraly artificial. However, each of these areas supports a variety of faunal species, some richer than others, therefore the two wet cultured habitats have been given separate and distinct assessment from agricultural land.

5.3.3 The different habitats described above have been evaluated for their ecological significance using the criteria laid out in the *Technical Memorandum for EIA Process*. The evaluation has concentrated on the waterbodies as ecological sampling nodes which will enable a comparison between the existing ecological environment and that ecological environment which will result from the Project (ie. a linear, flowing waterbody). The difference lies in the *naturalness* of these habitats.

5.3.4 The various different waterbodies including their riparian strip and their immediate landscape context are considered the most valuable habitats identified along the alignment of the Project. The presence of habitats such as lotus ponds are determined by market forces within the SAR. Healthy streams and marshes may be important centres of biodiversity in the SAR which provide habitat for a host of creatures including many reptiles, amphibians, fish, snails, crustaceans and especially insects[5].

5.3.5 The allocated rating is notwithstanding the poor water quality found in the majority of the streams, as, over a period of time coinciding with the implementation of the *Livestock Waste Control Scheme* (LWCS), the *Water Pollution Control Ordinance* (WPCO) and the *Waste Disposal Ordinance* (WDO) water quality should improve.

[5] Dudgeon, D. & Corlett, R. (1994) *Hills and Streams - An Ecology of Hong Kong.* Hong Kong University Press pp. 79-104.

*Evaluation Results*

*Overall habitat between Ch 000 and Ch 1+400*

5.3.6 The flora between Tin Liu Tsuen and Chuk San Tsuen is not of great ecological significance since the habitats are fragmented, mostly artificially propagated, and include many exotic species. The avifauna observed in this area are common and widespread species frequently found on the fringes of suburban to rural interfaces. The identified bird list for this habitat is not diverse which indicates that the fragmenting effect of human inhabitation is not conducive to wildlife. The streams and nullah within this section are mostly polluted (four out of the five), recently dredged or subject to river engineering works (also four of the five), a summary is given in Table 5.9.

**Table 5.9**
**Degree of anthropogenic influence on existing, flowing waterbodies**

| | *Sham Chung Stream Ch 0 + 170* | *San Hui Nullah Ch 0 + 650* | *Stream N-23 Ch 1 + 90* | *Stream N-25 Ch 1 + 500* | *Stream N-26 Ch 1 + 650* |
|---|---|---|---|---|---|
| **Pollution** | Farm effluent and domestic sewage | Farm effluent, domestic sewage and small quantities of refuse | Not evident | Farm effluent, domestic sewage and high levels of refuse | Farm effluent and small quantities of refuse including building materials |
| **Engineering** | Rip-rapped banks at downstream end | Concrete trapezoidal channel | Rip-rapped banks at downstream end | Not evident | Rip-rapped banks at downstream end - concrete U-channel being constructed |
| **Dredging and/or other disturbance** | Recent dredging and vegetation stripped back | Not evident | Recent dredging and vegetation stripped back | Not evident | Currently diverted around construction area |

*Village*

*Characteristics*

5.3.7 In total, three hectares of the land along the alignment falls within this category. This type of artificial environment is subject to constant human disturbance. Plants are: wholly artificially propagated, mostly domestic species, frequently exotics, common species, and of low diversity. This type of habitat provides little sustenance for native faunal species. Domestic animals such as cats and dogs, and species commonly associated with urban populations such as rats, out-compete (or predate on) native species such as birds, amphibians and insects.

5.3.8 The environment immediately adjacent to Pok Oi Hospital is similar to the Tin Liu Tsuen - Chuk San Tsuen area but in this instance the interface is with an area of former fishponds being converted to highway. This ecological environment is likely to be degraded as a consequence of the Route 3 - Castle Peak Road operation severing the ecological linkage with the surrounding landscape.

*Evaluation* - Low

***Cultivated Land***

5.3.9 The majority of the agricultural land along the alignment is abandoned. Another interpretation of this is that it is undergoing succession to its natural state. However, no specific research has been completed in the SAR that provides a comprehensive ecological evaluation of agricultural land - either active or inactive. This category of land is not specifically highlighted under Note 2, Annex 16 of the *TM on EIA Process*. This can be further sub-divided.

*Abandoned argricultural land characteristics*

5.3.10 Four hectares of the land within the Project alignment is abandoned or fallow agricultural land. This habitat is characterised as: low-lying flat land; frequently marshy or waterlogged (and crossed by streams, which are discussed later under water bodies); dominated by remnants of monocultured crops, or subject to successive colonisation by hardy invasive weeds; relatively low human disturbance compared to the village habitat. Invertebrate generation is likely to be higher than the village areas, as a consequence of this the fauna higher up the food chain (amphibians, reptiles and birds) will also be more diverse. Predation by domestic animals will be lower. The limiting factor for diversity of the faunal species will be the variety of floral species, which, in the short to medium term will be low.

*Evaluation* - Low to moderate

*Active agricultural land characteristics*

5.3.11 The only significant active agricultural land along the alignment is the lotus ponds (which will be discussed separately under water bodies) and a plant nursery to the west of Yeung Uk Tsuen. Plants generally found in active agricultural land (including the nursery) are: wholly artificially propagated, mostly domestic species, frequently exotics, common species, and of low diversity, and subject to moderate levels of human disturbance (the nursery abuts the village) including weeding and probable use of pesticides. However, limited invertebrate generation will still take place, and this will provide a foraging ground for common amphibian, reptile and bird species.

*Evaluation* - Low

5.3.12 The evaluations given above are substantiated against the criteria laid out in the TM for EIA Process in Table 5.10. The "scores" given in the table are on a scale of 0 to 5 - where 0 is an ecologically sterile environment; and 5 represents the highest ecological value. The scoring system reflects the value range found within the HKSAR.

**Table 5.10 Evaluation of the Site's Terrestrial Habitats**

| Criteria | Village | Abandoned agricultural land* |
|---|---|---|
| **Site of recognised conversation interest** | No<br>score: 0 | No<br>score: 0 |
| **Naturalness** | Urban<br>score: 0 | Largely monocultured, successive colonisation<br>score: 1 |
| **Size** | Narrow strip - total 3 ha<br>score: 0 | Narrow strip - total 4 ha<br>score: 1 |
| **Diversity** | Little<br>score: 1 | Little - moderate<br>score: 2 |
| **Rarity of habitat or species** | Common and increasing habitat and species<br>score: 0 | Common habitat but decreasing<br>score: 1 |
| **Recreatibility** | On-going<br>score: 0 | Ongoing but lost to development<br>score: 1 |
| **Fragmentation** | Greater<br>score: 1 | Moderate<br>score: 2 |

**Table 5.10 Evaluation of the Site's Terrestrial Habitats (Cont'd)**

| Criteria | Village | Abandoned agricultural land* |
|---|---|---|
| **Ecological linkage** | Little, acts as a barrier<br>score: 0 | Medium to high - allows species migration between habitats<br>score: 3 |
| **Potential value** | Low<br>score: 1 | Medium, if succession allowed<br>score: 3 |
| **Nursery/breeding ground** | Pests and vermin<br>score: 1 | Invertebrates, amphibians, reptiles and avifauna<br>score: 3 |
| **Age** | Ranges from old to recent<br>score: 1 | Recent succession<br>score: 2 |
| **Total** | 5 | 19 |

* Active agricultural land is assessed separately under water bodies (Table 5.11)

*Water bodies*

*Flowing water body characteristics*

5.3.13 Between twenty five to thirty five metres in length of each of the five flowing water bodies cross the on-site agricultural land. The riparian vegetation (5 m either side of each stream) is probably the only near-natural habitat within the study area (amounting to 0.1 ha). However, as can be seen from Table 5.9, four of the five streams are grossly polluted, and four of the five are subject to either recent temporary, or permanent engineering works. As a consequence the faunal diversity is limited to common, pollution-tolerant species. The degree of human disturbance on each of these is summarised in Table 5.9.

*Evaluation* - Low

*Still water body characteristics*

Lotus Ponds (active agricultural land)

5.3.14 The entire lotus pond habitat covers an area of around 6 ha. The flora in the lotus pond area is over 90% lotus, the remaining 10% is grasses and the trees identified in Table 5.3. The shallow water in the lotus ponds is clear and pollution free. This artificial, floraly monocultured habitat sustains invertebrates (insects and snails), fish fry, amphibians and avifauna. The bunds between the ponds and the surrounding land are planted with willow trees which serve as roosts and observation stations for the avifauna, and also shield the ponds from the YLH and Yeung Uk Tsuen. No specific research has been completed in the SAR (by Government or by Universities), that would provide a comprehensive ecological evaluation of lotus ponds. Species of this area are the richest and most diverse of the on-site habitats.

*Evaluation* - Medium

<u>Fishponds</u>

5.3.15 The fishpond area to be occupied under this Project is currently a works site for Route 3. The representative species identified were necessarily based on the nearest undisturbed fishponds. A study has already been carried out by Government which establishes the value of fishponds, but this has not yet been published.

5.3.16 The remainder of the YLB Floodway alignment will be contiguous with the northern edge of Route 3 to its confluence with the KT River. The contextual landscape to the north of the YLB Floodway is fishponds, with the *fung shui* knoll locus. This juxtaposition has provided a rich localised niche for avifauna. It is assumed that the avifauna (particularly the herons and egrets) colonising the knoll would utilise the currently filled fishponds as feeding grounds to a lesser degree when the ponds are reinstated, due to the close proximity of the new Route 3. Observations at the lotus ponds show that some egrets will overcome their nervousness of nearby traffic disturbance, given a plentiful food supply.

*Evaluation* - Low

5.3.17 Table 5.11 summarizes the evaluation of the various waterbody environments along the YLB Floodway according to the criteria laid out in the TM for EIA Process. The "scores" given in the table are on a scale of 0 to 5 - where 0 is an ecologically sterile environment; and 5 represents the highest ecological value.

**Table 5.11**
**Evaluation of the Site's waterbody habitats within their current landscape context**

| Criteria | *Sham Chung Stream Ch 0 +170* | *San Hui Nullah Ch 0 + 650* | *Stream N23 Ch 1 + 90* | *Shallow pond at Ch 1 +150* | *Stream N25 Ch 1 + 500* | *Stream N26 Ch1 + 650* | *Lotus ponds between Ch 2 + 000 and 2 + 240* | Fish ponds between Ch 2 + 800 and 3 + 700* |
|---|---|---|---|---|---|---|---|---|
| **Site of recognised conservation interest** | No<br>score: 0 | No<br>0 | No<br>0 | No<br>0 | No<br>0 | No<br>0 | No<br>0 | Ponds at floodway's confluence with Main Drainage Channel are designated CA on OZP<br>5 |
| **Naturalness** | Rip-rapped banks and dredged<br>score: 1 | Concrete<br>0 | Rip-rapped banks and dredged<br>1 | 2 | Natural riparian<br>3 | Currently being concrete lined<br>0 | Manmade using natural pervious materials and vegetation<br>3 | Manmade using natural materials and vegetation. Ponds disturbed at time of survey<br>0 |
| **Size** | Narrow and short length affected<br>score: 1 | Narrow and short length affected<br>0 | Narrow and short length affected<br>1 | Small area (approx. 200m²) and shallow<br>2 | Narrow and short length affected<br>1 | Narrow and short length affected<br>0 | 1 ha. of moderate habitat<br>3 | 9.0 ha. on-site of disturbed habitat<br>3 |
| **Diversity** | Low<br>score: 1 | Low<br>1 | Low<br>1 | Low-medium<br>2 | Low<br>1 | Low<br>1 | Medium to high<br>4 | Low<br>0 |
| **Rarity of habitat or species** | Common<br>score: 1 | Common<br>1 | Common<br>1 | Habitat Common<br>1 | Common<br>1 | Common<br>1 | Habitat uncommon & subject to market forces.<br>4 | Common but subject to market forces<br>0 |

| **Criteria** | *Sham Chung Stream Ch 0 +170* | *San Hui Nullah Ch 0 + 650* | *Stream N23 Ch 1 + 90* | *Shallow pond at Ch 1 +150* | *Stream N25 Ch 1 + 500* | *Stream N26 Ch1 + 650* | *Lotus ponds between Ch 2 + 000 and 2 + 240* | Fish ponds between Ch 2 + 800 and 3 + 700* |
|---|---|---|---|---|---|---|---|---|
| **Recreatability** | Easily<br>score: 1 | Easily<br>1 | Easily<br>1 | Easily<br>1 | Easily<br>1 | Easily<br>1 | Possible but requires labour intensive maintenance and space<br>3 | Fishponds can be re-instated<br>1 |
| **Fragmentation** | Medium<br>score: 2 | Medium<br>2 | Medium<br>2 | High<br>1 | Medium<br>2 | Medium<br>2 | Medium to Low<br>3 | High<br>1 |
| **Ecological linkage** | Low to medium<br>score: 1 | Low<br>1 | Low to medium<br>1 | Medium<br>3 | Low to medium<br>1 | Low to medium<br>1 | Medium to high<br>3 | Low<br>1 |
| **Potential value (eg. if water quality improved)** | Medium<br>score: 2 | Low<br>1 | Medium<br>2 | Medium<br>2 | Medium<br>2 | Medium<br>2 | Medium to high<br>3 | Medium<br>2 |
| **Nursery/breeding ground** | Ampullaria and Tubifex<br>score: 1 | Ampullaria and Tubifex<br>1 | Ampullaria and Tubifex<br>1 | Ampullaria amphibian<br>2 | Ampullaria and Tubifex<br>1 | Ampullaria and Tubifex<br>1 | Amphibians, birds, fish fry, reptiles, small mammals<br>4 | Currently, none<br>0 |
| **Age** | Very recently engineered<br>score: 1 | Very recently engineered<br>1 | Very recently engineered<br>1 | Recently formed<br>1 | Very recently engineered<br>1 | Very recently engineered<br>1 | Moderate age<br>3 | New<br>1 |
| **Total score** | 12 | 9 | 12 | 17 | 14 | 10 | 33 | 14 |

* This area is currently a works site for Route 3 and is highly disturbed. However, re-watering of the ponds will take place at the end of 1998. Over the period of time between the end of the Route 3 works and the start of the YLBF works, the habitat value will increase.

## 5.4 Identification, Prediction and Evaluation of Impacts

5.4.1 The Project's impact to the South of Castle Peak road is minimised because the site is narrow and for the most part abuts the YLH. However, in place of the described habitats, construction of the YLB Floodway will, if unmitigated, produce a 3.8km, concrete-lined, ecologically sterile nullah as a worst case scenario. The following evaluation assumes a worst case scenario.

*Village habitat*

5.4.2 The ecological impact of the Floodway on the village is minimal due to the low original value of these areas, and the increasing occurrence of this "habitat".

*Abandoned agricultural land*

5.4.3 Loss of use of the abandoned agricultural land as a feeding ground by Pond herons, and as habitat for invertebrates, amphibians, reptiles and other avifauna is moderated by the abundance of this type of habitat (locally and elsewhere within the SAR), and by the reduced quality of this habitat abutting the YLH.

*Stream/riparian habitat*

5.4.4 Due to the short length affected for each stream (equal the width of the Floodway) the impacts to the polluted and mostly engineered streams are moderate.

*Lotus ponds*

5.4.5 The ecological impacts of greatest significance arising from the implementation of this project are the loss of the lotus ponds (and surrounding pollarded Willow and fruit trees).

*Fishponds*

5.4.6 The ecological habitat of the fishpond area is already low due to the Route 3 works. Reinstatement of the fishponds would still provide a devalued habitat because of disturbance arising from the operation of Route 3. However, fishponds whether active or abandoned would be a better habitat than a concrete lined nullah.

5.4.7 Using this outline, the YLB Floodway has been evaluated in Table 5.12.

**Table 5.12**
**Evaluating the Significance of the Project's Unmitigated Ecological Impact**

| Criteria | *Village* | *Abandoned agriculture* | *Stream/ riparian* | *Lotus ponds* | *Fishponds* |
|---|---|---|---|---|---|
| **Impact on habitat quality** | Little ecological impact | Habitat value reduced to sterile concrete | Riparian value reduced to sterile concrete | Habitat value reduced to sterile concrete | Habitat quality has already been blighted by Route 3 works |
| **Impact on species** | No naturally occurring rare species of restricted distribution | On-site feeding ground loss for Pond heron and Little Egret | On-site feeding ground loss for Pond heron | On-site feeding ground loss for Great egret Pond heron, and Little Egret | On-site feeding ground loss for Pond heron |
| **Size/ abundance** | Narrow swathe through already blighted area | Narrow swathe through already blighted and fragmented area | Narrow swathe through already blighted area | Narrow swathe will cause fragmentation of remaining lotus pond area | Narrow swathe through already blighted and fragmented area |
| **Duration of impact** | Long term | Long term | Long term | Long term | Long term |
| **Reversibility of impact** | Irreversible | Irreversible | Irreversible | Irreversible | Irreversible |
| **Magnitude of overall negative impact** | Low | Medium | Medium | Medium to high | Low |

*Cumulative Impacts*

*Yuen Long & Kam Tin Sewerage, Stage III - Phase 1, Au Tau Sewage Pumping Station, Rising Main and Gravity Sewers*

5.4.8 Part of the area between the YLB Floodway and Pok Oi Interchange is due to be developed as a sewage pumping station. This will result in the further loss of lotus ponds and fringing habitat. As a result of the YLB Floodway Project and the separate pumping station, between 66-75% of the entire lotus ponds habitat within the study area will be lost.

*Yuen Long South Development, Engineering Works in Areas 13 & 14, Yuen Long*

5.4.9 Around 257 trees, 28ha of active agricultural land, 23ha of abandoned agricultural land, and 0.4ha of fishpond/lily pond will be affected due to the infrastructural development of Yuen Long South (Areas 13 & 14). The ecological impact arising from the Yuen Long South Development has been assessed in the EIA completed in late 1997.

*Livestock Waste Control Scheme, Water Pollution Control Ordinance & Waste Disposal Ordinance*

5.4.10 Positive impacts should result from the rigorous enforcement of the LWCS, WPCO & WDO which should result in improved water quality throughout the Yuen Long watershed and stop refuse and industrial waste being dumped into the streams. These inputs combined, have a considerable silting and blockage causing effect in the downstream reaches of the drainage channels necessitating regular dredging. Control of these inputs would reduce much of the predicted maintenance costs of the YLB Floodway, and as a result creates the possibility of leaving the base of the channel natural and allowing progressive vegetation.

## 5.5 Mitigation of Adverse or Unacceptable Impacts

### *Introduction*

5.5.1 In recent years there has been growing public concern that man-made changes to river channels have reduced the extent and diversity of plant and wildlife habitats and the quality of the landscape. In the case of flood alleviation/protection schemes this is of particular concern because of a potential conflict of interest. In most cases the most efficient hydraulic solution may not yield the optimum environmental solution. As a result, the use of relatively straight channels is being discarded in favour of either singly or doubly meandering channels. The term 'doubly meandering' is used to describe a compound channel in which both the upper and lower channels meander, but frequently with different sinuosities.

5.5.2 The advantages of this type of compound channel are that most flows are contained within the lower channel, while the design flood is contained within the total cross-section. During most of the year, therefore, the upper channel berm provides a low-lying river margin habitat[6].

5.5.3 Trapezoidal, concrete lined box sections might well be the straightforward way of channelling water, but they hold little appeal for wildlife. River channels do not need to be dead straight and concrete lined to work[7].

### *Aims*

5.5.4 According to the TM for EIA Process (Annex 16), the general policy for mitigating impacts on important habitats and wildlife, in order of priority, are: avoidance; minimisation; and compensation. Wherever possible we have used each of these basic precepts as guidance both at the overall Project scale and at the habitat-by-habitat scale.

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6 Lambert, M.F. & Sellin, R.H.J. (1996) Velocity distribution in a large scale model of a doubly meandering compound river channel. *Proc. Instn. Civ. Engrs Wat., Marit. & Energy*. 118 Mar, 10-20.

7 Russell, L. (1996) Channelling Effort. *New Civil Engineer* (25/1/96) pp 34.

*Avoidance*

5.5.5 In the first instance, as explained in Section 1, the preferred alignment abuts the YLH to the south of Castle Peak Road, and Route 3 to the north of Castle Peak Road. The alignment is situated in an area that will be subject to human disturbance in the form of traffic noise and reduced air quality - thus the alternative alignment option through more isolated agricultural land further south of the YLH (in closer proximity to Tai Lam Country Park) is avoided.

5.5.6 Close liaison between the engineers and the environmental team at an early stage, resulted in the YLB Floodway alignment north of Route 3 (to its confluence with the KT River) being pulled in closer to the new highway (shown in Figure 5.2). This has two benefits:

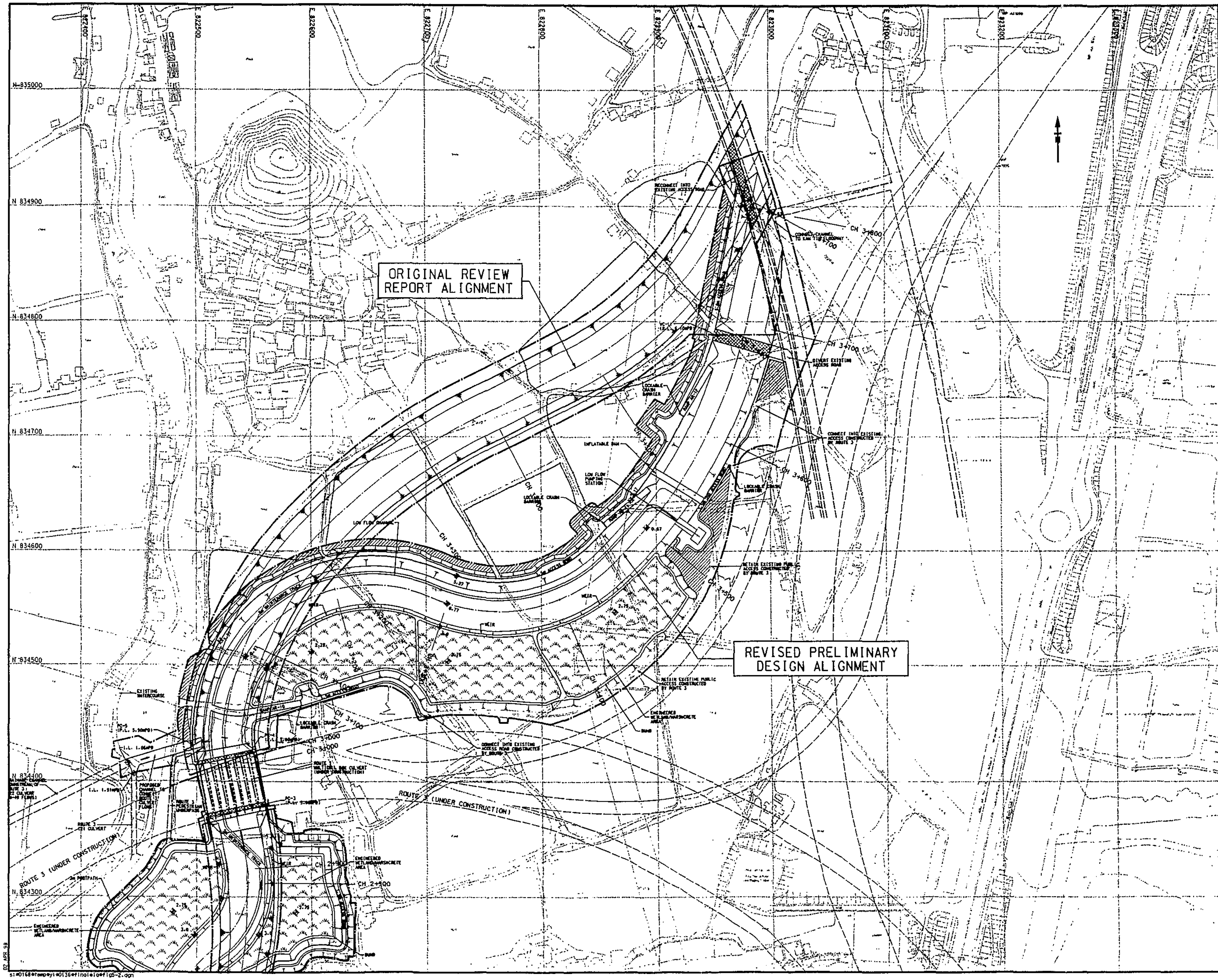
i. fragmentation of the active fishponds north of the floodway is avoided; and
ii. the works are moved further away from the *fung shui* knoll biodiversity locus and back into the disturbed zone near Route 3.

5.5.7 On a habitat-by-habitat level we propose that the construction methods should as closely as possible reproduce the materials and environment that currently exist. As far as is practicable, it has been a high priority to avoid creating a sterile concrete trapezoidal channel which would serve only to reinforce the fragmentary barrier unavoidably formed by the YLH and Route 3.

*Minimisation*

5.5.8 The alignment utilises the ponds currently used as fill storage areas (and other disturbed ponds) for the Route 3 project. The works therefore, have been confined to an area already subjected to severe disturbance over a period of several seasonal cycles. Similarly, by aligning the Floodway contiguously with Route 3 (which will cause disturbance to the adjacent reinstated fishponds in the future), the YLBF Project utilities an ecologically blighted area.

5.5.9 Straightforward reinstatement of the fishponds within this blighted area would result in a loss of habitat value. The preliminary tree survey included in Appendix D, shows that up to 400 trees may be lost as a result of this Project. This number will be confirmed when the tree survey is finalized. The landscaping proposals shown in Appendix G include restoration of the tree numbers by replanting atop both revetments of the whole Project alignment and within the strip of land between the road/footpath edges and the site limit. By using selected tree species we intend to enhance the ecological value of the Project environs.

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NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS STATED OTHERWISE.
2. ALL LEVELS ARE IN METERS ABOVE PRINCIPAL DATUM (mPD).
3. GRID LINES ARE HONG KONG METRIC GRID 1980.

LEGEND:

- PROPOSED SITE LIMIT
- DIRECTION OF FLOW
- BOX CULVERT
- PROPOSED SLOPE
- EXISTING SLOPE
- AREA TO BE FILLED TO ADJACENT GROUND LEVEL
- ENGINEERED WETLAND/MARSHCRETE AREA
- LIMIT OF RIGHT OF TEMPORARY OCCUPATION
- PROPOSED LEVEL
- EXISTING LEVEL (OBTAINED FROM SITE VISIT)
- VC VEHICULAR CROSSING
- PC PEDESTRIAN CROSSING
- R.L. TOP OF ROAD LEVEL
- P.L. TOP OF FOOTPATH LEVEL
- OTHER PROJECTS UNDER PRESENT/FUTURE CONSTRUCTION

KEY PLAN

SHEET 1 SHEET 2 SHEET 3 SHEET 4 SHEET 5 SHEET 6 SHEET 7

CAUTION
THIS MAY BE A REDUCED SIZE DRAWING. VERIFY SCALES SHOWN BEFORE SCALING THE DRAWING.

| revision | date | description | | initial |
|---|---|---|---|---|
| | designed | checked | drawn | checked |
| initial | AJT | CWC | YLL | CWC |
| date | 01/98 | 01/98 | 01/98 | 01/98 |

AGREEMENT NO. CE 79/96

project

YUEN LONG BYPASS FLOODWAY
FEASIBILITY STUDY

EIA STUDY REPORT

Figure title

ENVIRONMENTAL
MITIGATION MEASURES

REVISED CHANNEL ALIGNMENT

Figure no. 5.2

Scale 1:1500

新界北拓展處
NEW TERRITORIES NORTH DEVELOPMENT OFFICE

拓展署
Territory Development Department, Hong Kong

BINNIE CONSULTANTS LIMITED
賓尼工程顧問有限公司
ENGINEERS AND SCIENTISTS

賓尼

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*Compensation*

5.5.10 Mitigating the losses incurred as a result of the YLB Floodway offers the opportunity to ecologically enhance the Yuen Long flood basin, by extending ecological linkage where currently, little exists. Habitat creation in the form of planting with grasscrete is considered to provide a post-project net engineering/ecological benefit. Monocultured planting along the whole alignment will be avoided.

5.5.11 The aim of the following mitigation is to:

i. provide a "softer" engineering solution;
ii. which leads to a more natural landscape;
iii. which, in turn, provides a riparian habitat that becomes more naturalistic as it matures.

***Mitigation Measures***

Grasscrete

5.5.12 The preferred channel lining medium is grasscrete, which can be used on both the sides and the channel base for most of the alignment. Grasscrete has several benefits: it allows percolation of rainfall through to the groundwater; it enables growth of grasses, sedges and reeds through the open spaces; which, in turn provides a habitat for invertebrates (insects) and higher fauna such as birds.

5.5.13 Streambanks and levees are subjected to erosion and scour by flowing water. The erosive power of flowing water increases with velocity. Slope vegetation can help to reduce this type of erosion. Some controversy exists about the wisdom of allowing woody vegetation to grow on levees, particularly revetted sections. Objections that have been raised include loss of conveyance from increased roughness, difficulty of inspection and cleaning, hindrance of flood alleviation and alleged threats to structural integrity as a result of root penetration and subsequent piping. In response to these objections Gray (1995) notes that in large rivers, additional roughness will have a negligible effect on the stage of the design flood. The affects of vegetation on the structural integrity of sandy levees has been investigated[8]. A North American study concluded that woody vegetation did not adversely affect the structural integrity. On the contrary, the presence of plant roots reinforced the soil and increased the shear strength of the surface layers in

8 Shields, F.D. & Gray, D.H. (1993) Effects of Woody Vegetation on the Structural Integrity of Sandy Levees. *Water Resources Bulletin*,Vol.28, No.5, pp 917-31.

a measurable manner. In European practice, vegetation is often used as a means of stabilizing both streambanks and levee slopes[9] (see Figure 5.3). A mixture of plants (including reeds, grasses, shrubs and herbs) can be used in association with grasscrete and other standard engineering control measures to retard erosion[10]. Investigations into the influence of woody vegetation growing in a structural, rip-rap revetment showed that the frequency of revetment failure was actually lower in vegetated revetments compared with unvegetated sections[11].

5.5.14 Table 5.13 summarizes a list of grasses and sedges which have a variety of benefits including rhizomous root systems (which helps to prevent erosion), shade tolerance, affinity for damp conditions and saline tolerance (which may be useful at the downstream end of the YLBF). The use of grasscrete in the YLBF has been adopted from drainage 1.34 km to 3.545 km. At this Preliminary Design Stage the incorporation of trees along the revetments have been restricted to the top due to common concerns. However, during the detailed Design Stage the benefits of incorporating more trees into the channel embankment should be considered in more detail.

9 Gray, D.H. (1995) Influence of Vegetation on the Stability of Slopes. In: Barker, D.H. (ed) *Vegetation and Slopes - Stabilisation, Protection and Ecology* Institute of Civil Engineers, London, 5.

10 Keller, E.A. & Brookes, A. (1984) Considerations of Meandering in Channelization Projects: Selected Observations and Judgements. *Proceedings*, Conference on Rivers, 1983, pp 384-97.

11 Shields, F.D. (1991) Woody Vegetation and Riprap Stability along the Sacramento River Mile 84.5 to 119. *Water Resouces Bulletin*, Vol.27, No.3, pp 527-36

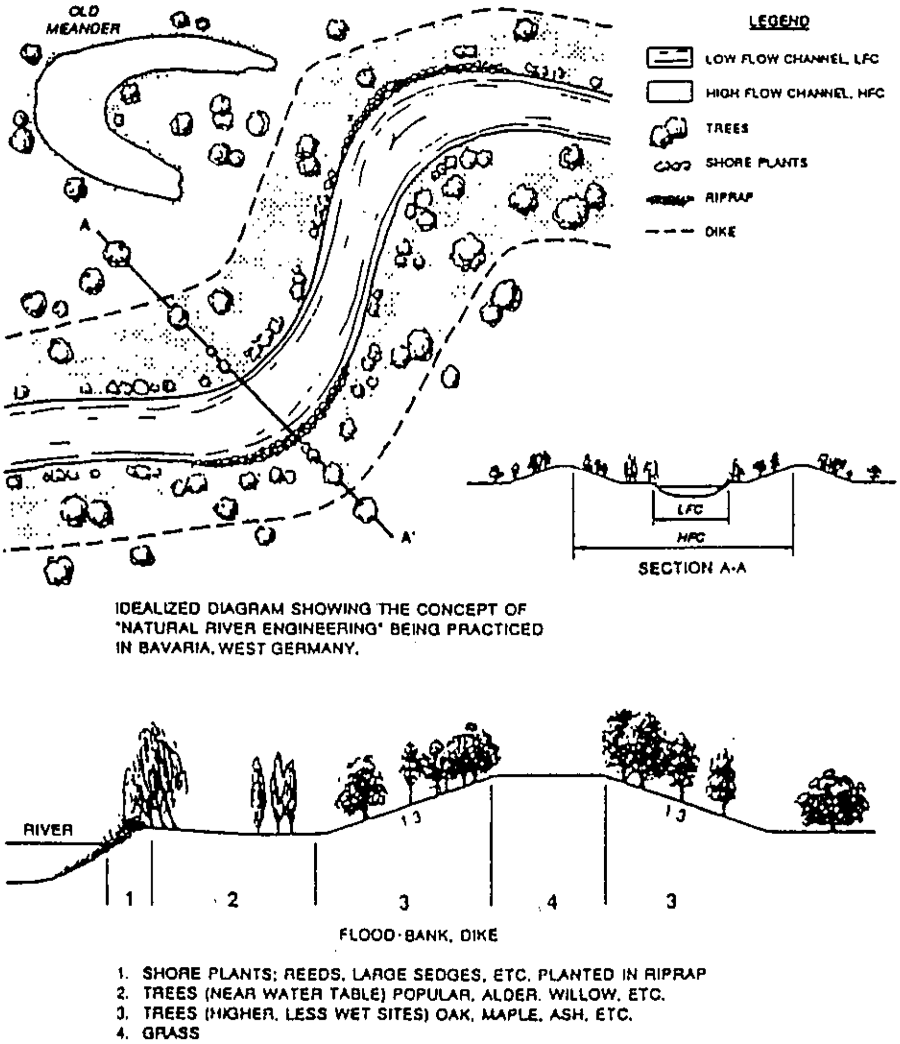



**Figure 5.3** Use of vegetation on flood dikes in Bavaria, West Germany. (from Keller and Brookes, 1984)

**Table 5.13**
**Preferred habitat and possible benefits of selected grasses and sedges**

| Plant species | Habitat and benefits |
|---|---|
| *Gramineae* | Grasses |
| *Alpuda mutica* | Woodland edge perennial; good fodder |
| *Eremochloa ciliaris* | Sandy rocky areas; good fodder |
| *Ischaemum rugosum (Salisb.) var. segetum* | Damp places including stream banks; good fodder |
| *Saccharum spontaneum* | Vigorous coloniser of bare ground; extensive root system |
| *Arundinella setosa* | Woodland edge perennial |
| *Cyrtococcum patens* | Woodland edge; good fodder |
| *Digitaria longiflora* | Open land; good fodder |
| *Digitaria radicosa* | Open fields and shady places; good fodder |
| *Echinochloa crus-galli* | Swampy ground; good fodder |
| *Hymenachne amplexicaulis* | Marshy ground and ponds; useful fodder |
| *Isachne globosa* | Woodland and damp ground |
| *Oplismenus compositus* | Shady areas under trees; excellent fodder |
| *Ottochloa malabarica* | Woodland edge perennial; good fodder |
| *Panicum repens* | Rhizomous perennial; good fodder |
| *Paspalum conjugatum* | Creeping grass with long stolons |
| *Paspalum distichum* | Wet places, long creeping stolons, extensive rhizomes; good fodder |
| *Paspalum longifolium* | Marshy and dry ground |
| *Sacciolepis indica* | Drained land; good fodder |
| *Setaria italica* | Used as food for caged birds |
| *Leersia hexandra* | Perennial of damp ground/standing water |
| *Eragrostis atrovirens* | Open pastures; **much sort after by birds** |
| *Leptochloa chinensis* | Paddy fields; good fodder |
| *Zoyzia matrella* | Sand near the sea, well developed rhizomes |
| *Cynodon dactylon* | Perennial forming dense sward, **used to bind soil** |
| *Phragmites communis* | Marshy ground; habitat for marsh birds |
| *Phragmites karka* | Marshy ground; habitat for marsh birds |
| *Phyllostachys nidularia* | Aggressive rhizome system; planted to stabilise slopes |
| *Cyperaceae* | Sedges |
| *Carex cruciata* | Woodland edge perennial, stout rhizome |
| *Cyperus difformis* | Annual found in paddy fields or watersides |
| *Cyperus malaccensis Lam. var.brevifolium* | Perennial at riversides and damp swampy soils, long woody rhizome |
| *Cyperus polystachyos* | Perennial of seashores or sandy soils |
| *Cyperus radiatus (C. imbricatus Retz)* | Perennial of paddy fields or damp areas |
| *Cyperus rotundus* | Perennial of hillsides and near water, creeping rhizomes |
| *Eleocharis acicularis* | Paddy fields, ponds and wet soil |
| *Fuirena umbellata* | Woods, and damp and swampy ground |
| *Kyllinga monocephala* | Perennial of grassland, well developed rhizome |
| *Scirpus erectus* | Swampy land or near paddy fields |

Source: Griffiths, D.A. (1983) *Grasses & Sedges of Hong Kong*. Urban Council - Hong Kong

*Marshcrete*

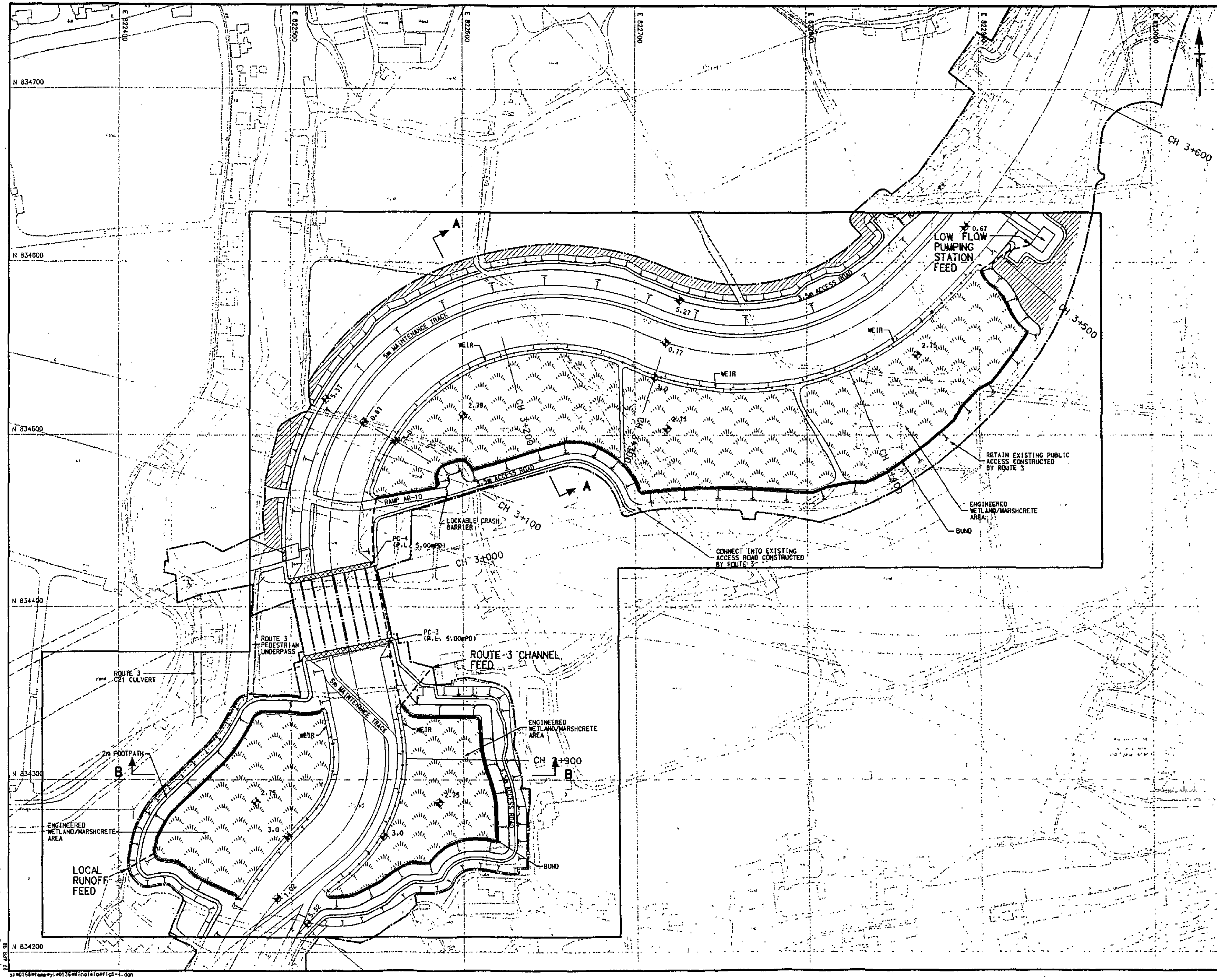
5.5.15 In two areas (the fishpond south of the Route 3 box culvert, and the fishponds north of Route 3 - see Figures 5.4 and 5.5) we propose that "marshcrete" (inundated grasscrete) is used to provide a off-line wetland area.

5.5.16 The marshcrete will be watered mainly by recirculation of a proportion of the pumped flows from the low flow pumping station, and also from local run-off. These nutrient-rich low flows will be used to fertilize the aquatic marsh plants in the wetland areas.

5.5.17 A range of freshwater plants (including grasses, reeds, sedges and some small herbs) are widespread in the SAR which are: native species; pollution and saline tolerant; spread via rhizomes (and hence can be trimmed without any detriment to the plant); non-invasive; usually fairly short; and can assist in the clean up of enriched waters. The off-line marshcrete areas will rarely be required for hydraulic conveyance of flood flows and thus the growth will not obstruct the flow. It is therefore envisaged that the marshcrete areas will require minimum maintenance and should be allowed to mature.

5.5.18 Species chosen to protect the marshcrete areas will have to be able to withstand submergence to different degrees depending on their position with respect to the water level (Figure 5.6)[12]. The seasonally flooded off-line areas can be protected with fast growing reeds sedges and grass which will add to the strength of the bank through reinforcement of the soil by the roots. The plants must be planted close enough to this part of the bank for the roots to extend into this zone and the reinforcement to be effective. A range of suitable plants is given in table 5.14 and sample species shown on Plate 5.5.

12 Morgan, R.P.C. & Rickson, R.J. (1995) Water Erosion Control. In: Morgan, R.P.C. & Rickson, R.J. (eds.) *Slope Stabilization and Erosion Control: A Bioengineering Approach* E&FN Spon, London

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NOTES:

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2. ALL LEVELS ARE IN METERS ABOVE PRINCIPAL DATUM (mPD).
3. GRID LINES ARE HONG KONG METRIC GRID 1980.
4. DRAWING MODIFIED FROM ORIGINAL PRELIMINARY LAYOUT FIGURE 4.7.

LEGEND:

- PROPOSED SITE LIMIT
- DIRECTION OF FLOW
- WETLAND AREA
- BOX CULVERT
- PROPOSED SLOPE
- EXISTING SLOPE
- AREA TO BE FILLED TO ADJACENT GROUND LEVEL
- LIMIT OF RIGHT OF TEMPORARY OCCUPATION
- PROPOSED LEVEL
- EXISTING LEVEL (OBTAINED FROM SITE VISIT)
- VC VEHICULAR CROSSING
- PC PEDESTRIAN CROSSING
- R.L. TOP OF ROAD LEVEL
- P.L. TOP OF FOOTPATH LEVEL
- OTHER PROJECTS UNDER PRESENT/FUTURE CONSTRUCTION
- PIPE
- U-CHANNEL
- 0.5m HIGH WALL

CAUTION
THIS MAY BE A REDUCED SIZE DRAWING. VERIFY SCALES SHOWN BEFORE SCALING THE DRAWING.

| revision | date | description | | | initial |
|---|---|---|---|---|---|
| | designed | checked | drawn | checked | |
| initial | AJT | CWC | YLL | CWC | |
| date | 01/98 | 01/98 | 01/98 | 01/98 | |

AGREEMENT NO. CE 79/96

project

YUEN LONG BYPASS FLOODWAY FEASIBILITY STUDY

EIA STUDY REPORT

Figure title

ENVIRONMENTAL MITIGATION MEASURES

OFF-LINE WETLAND AREA PLAN

Figure no. 5.4

Scale 1:1000

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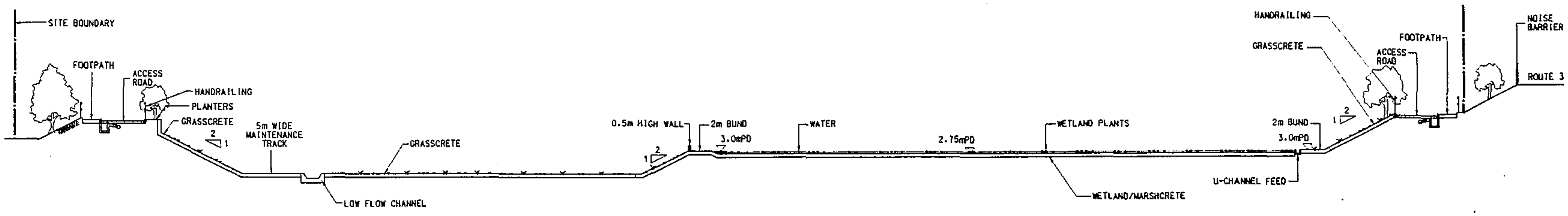
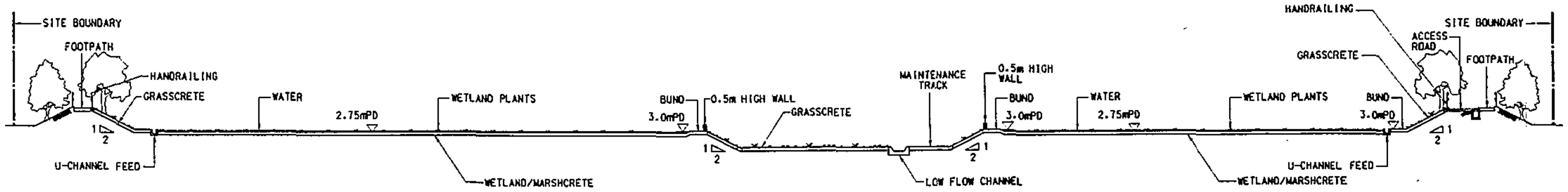
拓展署
Territory Development Department, Hong Kong

BINNIE CONSULTANTS LIMITED
賓尼工程顧問有限公司
ENGINEERS AND SCIENTISTS
賓尼




SECTION A-A




SECTION B-B

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS STATED OTHERWISE.
2. ALL LEVELS ARE IN METERS ABOVE PRINCIPAL DATUM (mPD).
3. GRID LINES ARE HONG KONG METRIC GRID 1980.

| revision | date | description | | initial |
|---|---|---|---|---|
| | designed | checked | drawn | checked |
| initial | AJT | CWC | YLL | CWC |
| date | 01/98 | 01/98 | 01/98 | 01/98 |

AGREEMENT NO. CE 79/96

project

YUEN LONG BYPASS FLOODWAY FEASIBILITY STUDY

EIA STUDY REPORT

Figure title

ENVIRONMENTAL MITIGATION MEASURES

OFF-LINE WETLAND AREA DETAILS

| Figure no. | Scale |
|---|---|
| 5.5 | N.T.S. |

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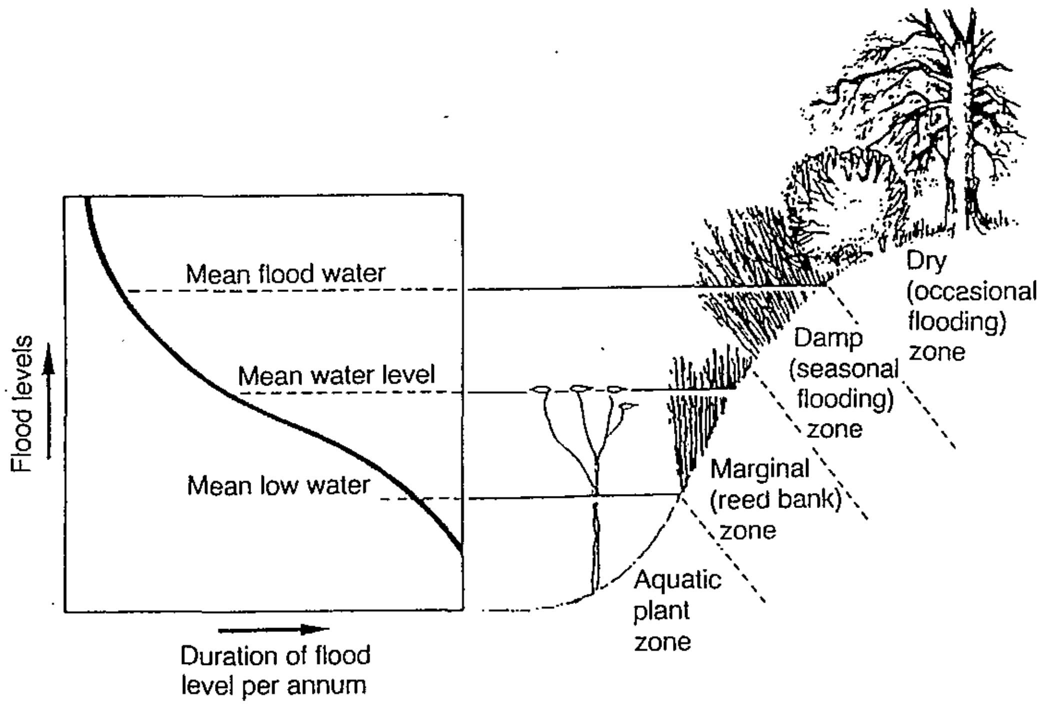



**Figure 5.6 Vegetation Zones on a Natural River Bank**
( Source: Morgan & Rickson, 1995 )

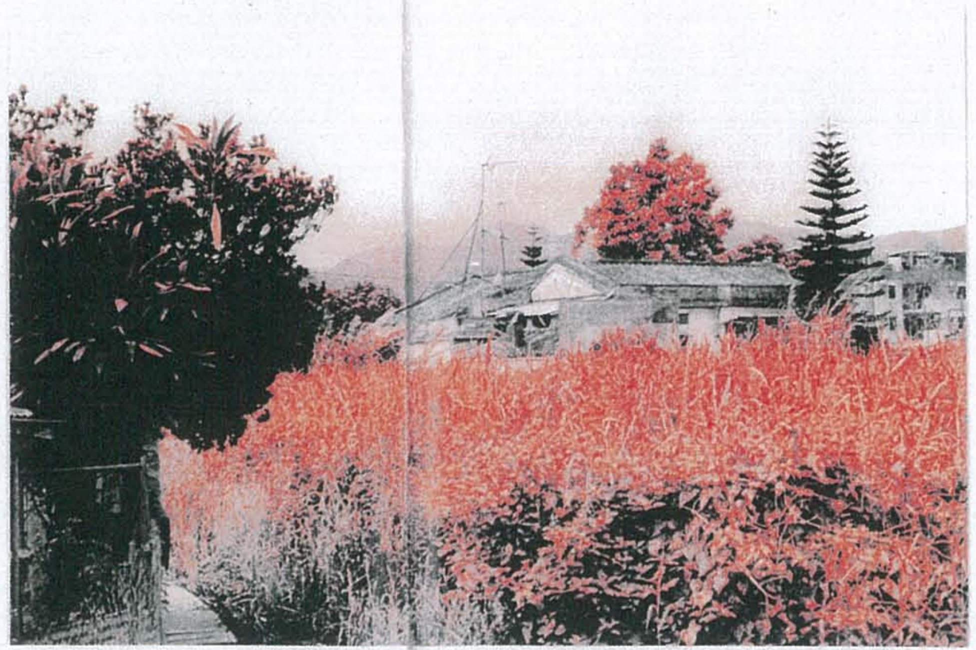
## Table 5.14
## Aquatic Flora Beneficial to Fauna

| Plant Species | Ecological and other Benefits |
|---|---|
| *Acorus gramineus* *# | Rhizomous, so binds substrate; eaten by herbivores |
| *Alocasia odora* ***# | Tuberous root stock - thrives next to eutrophic streams |
| *Alopecurus aequalis* **# | Soil binder, confers stability on wet muddy ground |
| *Bacopa monniera* *# | Survives prolonged inundation; eaten by ducks |
| *Callitriche stagnalis* **# | Water birds feed on stems; enriches oxygen to water |
| *Carex spp.* *# | |
| *Chara spp.* + | Rhizomous; marsh birds eat nutlets |
| *Colocasia esculenta* *# | Fish spawning ground; eaten by water birds |
| *Cyperus spp.* *# | Rhizomous |
| *Eleocharis spp.* *# | Rhizomous; food for aquatic birds |
| *Equisetum debile* *# | Rhizomous; food for aquatic birds |
| *Eriocaulon spp.* *# | Food for birds and herbivorous animals |
| *Fimbristylis spp.* # | Leaves eaten by ducks |
| *Fuirena umbellata* # | Nutlets eaten by water birds |
| *Juncus spp.* # | Nutlets eaten by birds |
| *Leersia hexandra* # | Rhizomous; seeds eaten by birds, shoots by herbivores, submerged parts shelter fish spawning |
| *Nasturtium officinale* # | Ducks eat young succulent parts |
| *Nelumbo nucifera* *# | Food for ducks and small aquatic animals |
| *Nymphaea spp.* *# | Rhizomous; shelters amphibians and fish |
| *Panicum repens* # | Rhizomous |
| *Papsalum distichum* # | |
| *Phragmites communis* # | |
| *Polygonum hydropiper* # | Feeding ground for marsh birds |
| *Ranunculus scleratus* # *,** | Food for aquatic birds and herbivores |
| *Rhynchospora spp.* # | Food for aquatic birds and herbivores; also feeding ground for fish |
| *Rumex maritimus* # | Nutlets eaten by birds |
| *Sagittaria sagittifolia* # | Nutlets eaten by wild fowl |
| *Salvinia natans* * | Rhizomous; eaten by herbivores |
| *Scirpus erectus* #* | Eaten by ducks |
| *Vallisneria spiralis* # | Rhizomous; nesting for birds; food for herbivores |
| | Food and shelter for fish and aquatic animals |

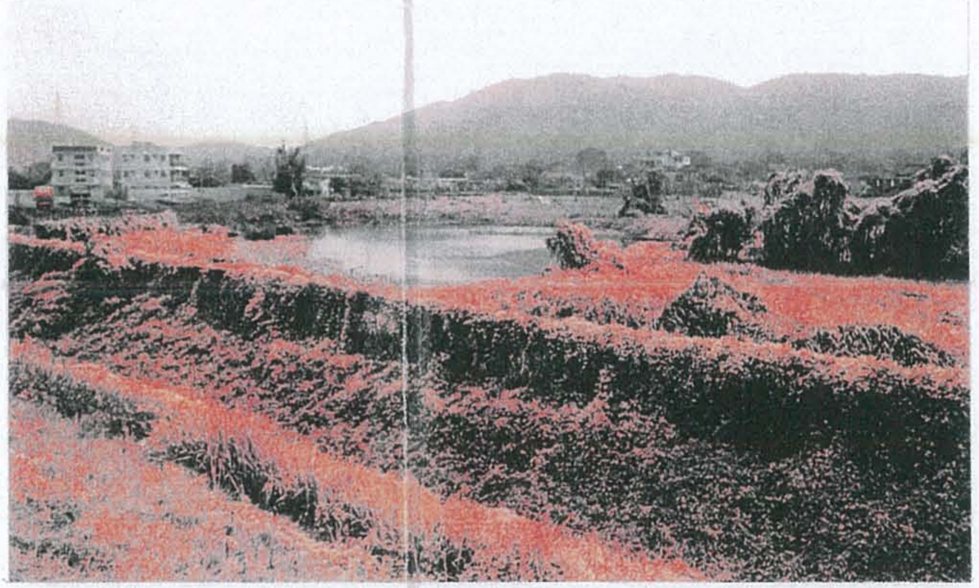
*** Fast flowing water
** Slow flowing water
* Stagnant water
+ Deep water
# Shallow water/water margins

^ The polluted Sham Chung stream.

V Stream N-23, recently dredged in Dec '97.



^ Shung Ching San Tsuen village habitat, featuring exotic trees.
V Shallow pond at Ch.1 + 150 (note Little Egret flying from pond).



V Lotus ponds at Yeung Uk Tsuen.

^ Abandoned agricultural land between Shung Ching San Tsuen and Tai Kei Leng.

**Plate 5.4 Habitats along the Floodway Bypass alignment**

V Chinese Pond Herons roosting at the *fung shui* knoll.

**Cyperus** spp. (Cyperaceae)

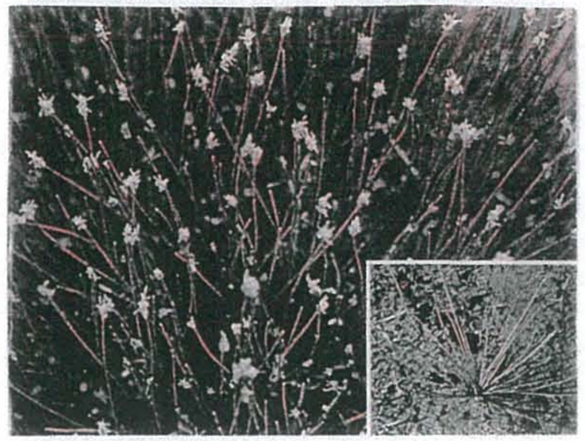
Common name: Cyperus

Perennial grass-like herbs common in moist places. Stem long, stiff, triangular in section, solid, often arising from a short creeping rhizome. Leaves, mostly alternate but the involucral leaves sometimes whorled. Sheaths green at first, later brown. Spikelets several-flowered, flattened as a result of the scales being arranged in 2 rows. Glumes all nearly equal with 1 hermaphrodite flower in each. The individual spikelets may be clustered in heads or forming spikes, which are usually several together in a simple or compound irregular umbel.

Flowering in summer and autumn.

They serve as soil binders and as food for aquatic birds. Some species are useful as aquarium plants. In various parts of the world certain species, for example *C. malaccensis* Lam., are used for making matting and string; another for papyrus (*C. papyrus*); and yet another *C. esculentus*, is cultivated for its edible tubers (often wrongly called "water chestnut").

30



**Eleocharis** spp. (Cyperaceae)

Common name: Spike rush

A perennial plant with creeping rhizomes, common at the margins of shallow ditches and ponds and in marshes. Stem grass green, slender, mostly 4-angled, flattened, up to 20 cm long. Leaves often occur only as a collar-like sheath at the base of the stem. Inflorescence a brown, terminal, egg-shaped spike. The pistil has a permanent style which enlarges to form a tubercle at the summit of the nutlet.

Flowering in summer and autumn.

They are useful soil binders and serve as food for aquatic birds (including ducks). Some species are useful aquarium plants, especially those which are underwater forms. One species, *E. dulcis* (Burm. f.) Trin. (again often incorrectly termed the "water chestnut"), has corms which are edible and also from which starch can be obtained.

33

**Fimbristylis** spp. (Cyperaceae)

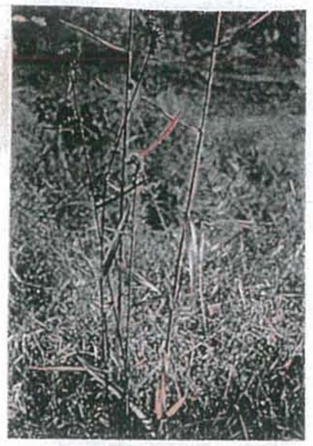
Common name: Fimbristylis

A common sedge at the margins of water bodies. Stem erect, up to 1 m high. Leaves typically sheathing the stem at its base, sometimes all reduced to sheaths. Spikelets solitary or forming an umbel, several-flowered. Flowers hermaphrodite. Stamens 3 or fewer. Style 2 or 3 cleft, usually thickened at the base (this feature differentiates it from *Scirpus*) falls at maturity and so does not form a tubercle on the nutlet (this differentiates it from *Rhynchospora*).

Flowering in summer and autumn.

The nutlets are eaten by water birds.

38



**Fuirena umbellata** Rottb. (Cyperaceae)

Common name: Umbrella grass

Tufted sedges with a creeping rhizome found on the wet shores of water bodies. Stem up to 150 cm high, noded. Leaves flat, often with spreading hairs. Spikelets in close clusters, mostly 1 cm long, each with a leaf-like bract at its base. Nutlet small, triangular, stalked and beaked, with 3 bristles and 3 perianth scales at its base.

Flowering in summer and autumn.

Nutlets eaten by birds.

40

**Panicum repens** L. (Gramineae)

Common name: Panic grass

A characteristic grass of wet places. Stem creeping, rooting at the base. Leaf narrow, hairy at the base. Flowering stalk 30-60 cm high. Inflorescence a slender, sparsely branched, erect or spreading panicle. Spikelet oval, distant, containing 2 flowers, a male or sterile one below and an upper perfect one. Outer glume very short and rounded, second one longer and pointed. Fruit enclosed between hardened lemma and palea, globose.

Flowering in summer and autumn.

62

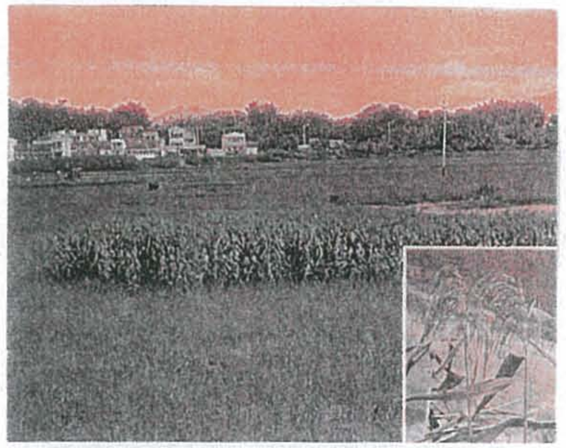
**Paspalum distichum** L. (Gramineae)

Common name: Knotgrass

A perennial tufted grass of wet places with somewhat rhizomatous roots. May be found in shallow water or as a weed of paddy fields. Leaf blades soft, linear, 5-10 cm long, 3-7 mm wide, pale green, glabrous. Inflorescence composed of 2 spreading racemes, 3-6 cm long. Spikelets nearly sessile, about 3 mm long, obovate-oblong. First glume absent, the second as long as the spikelet. Lemma leathery with inrolled margins embracing the palea. Palea flat membranous. Stamens 3. Fruit tightly enclosed between hardened lemma and palea, compressed dorsally.

Flowering July to September.

63



**Phragmites communis** Trin. (Gramineae)

**Phragmites karka** (Retz.) Trin. (Gramineae)

Common name: Common reedgrass and reed respectively

Perennial grasses 1–4 m high, found at the margins of lakes and streams and in marshes and ditches. Rhizome subterranean, creeping, up to 2.5 cm in diameter, richly branching. Leaves broad, widely spreading from the stem, only occurring above maximum water level. Inflorescence a plumelike panicle. In *P. karka* it is bigger, 40-60 cm, widespreading, with 8-12 mm long spikelets and 4 to 6 flowers per spikelet. In *P. communis* it is smaller, 10-40 cm, only slightly spreading, with 12-16 mm long spikelets and 4 to 7 flowers per spikelet. Spikelet purple in both. Flowers opening to expose long white hairs which give the spike a glistening white appearance which persists throughout winter.

*P. communis* flowers from July to November, *P. karka* in autumn and winter.

Young plants are used for animal fodder and young children often suck the stem sap. They are used for thatching and making reed mats. *P. communis* roots are used medicinally for the relief of stomach upsets, arthritis, jaundice, food poisoning and pulmonary abscesses.

65

**Rumex maritimus** L. (Polygonaceae)

Common name: Dock

An annual herb which is a weed of paddy fields and abandoned land, 30 cm to 1 m high. Leaf membranous, lance-shaped, 7-25 cm long, glabrous. Flowers greenish-yellow, axillary in loose whorls. Flower stalk slender and weak, 2-4 mm. Perianth segments 6, the outer 3 green, linear, the inner 3 yellowish brown with maturity, broadly oval, with a coloured tubercle at the midrib base. Stamens 6. Styles 3 with fringed stigmas. Fruit a small seed-like nut.

Flowering in winter and spring.

Nutlets eaten by wild fowl.

71

**Plate 5.5 Ecologically Beneficial Aquatic Plants**

(Source: Hodgkiss, I.J. (1978) Hong Kong Freshwater Plants. Urban Council - Hong Kong Government

5.5.19 In the wetland area between the outer revetment of the YLB Floodway meander and Route 3 embankment (Figures 5.4 and 5.5), the swathe closest to Route 3 should be planted with riparian trees tolerant of seasonal flooding. This will provide a noise buffer between the wetland and the highway.

*Tree Planting*

5.5.20 A list of Hong Kong plants has been identified which are attractive to birds[13] and other fauna, these are listed in Table 5.15. It is a recommendation of this report that floral species are selected from this list for planting atop the grasscrete banks of the YLB Floodway and along the Route 3 bund. Kadoorie Farm and Botanic Gardens will have a commercial production facility for native and endangered plant species propagation for habitat replacement. The landscape contractors should utilize this or similar facilities to source seedlings.

5.5.21 According to the CES report (1995), all the heron nests in the northern area of Route 3 (in the area around north Au Tau) were constructed in stands of bamboo. Several bamboo species are recommended for revegetation of drainage channels and pond edges, including: *Bambusa chungii, Bambusa sinospinosa, Bambusa texilis* and *Dendrocalamus latiflorus*. Other riparian tree species recommended are *Cleistocalyx operculata, Syzigium jambos, Sterculia lanceolata* and *Sapium sebiferum*.

13 Corlett, R.T. (1993) Plants attractive to frugivorous birds in Hong Kong. *HK Nat. Hist. Soc.*, 19:115-116

**Table 5.15**
**Flora beneficial to fauna**

| Plant Species | |
|---|---|
| Trees | Small trees |
| *Bischofia trifoliata** | *Bridelia tomentosa*** |
| *Camellia hongkongensis+* | *Homalium cochinchinensis+* |
| *Celtis sinensis*** | *Lithocarpus corneus+* |
| *Cinnamomum camphora*** | *Mallotus paniculata*** |
| *Cleistocalyx operculata+* | *Rhus chinensis*** |
| *Diospyros morrisiana*** | Shrubs |
| *Evodia meliaefolia** | *Litsea rotundifolia*** |
| *Ficus microcarpa+* | *Rhaphiolepis indica*** |
| *Ficus superba*** | *Rhodomyrtus tomentosa*** |
| *Glyptostrobus pensilis+* | Bamboo |
| *Ilex rotunda** | *Bambusa chungii++* |
| *Litchi chinensis+** | *Bambusa sinospinosa ++* |
| *Macaranga tanarius*** | *Bambusa texilis++* |
| *Machilus breviflora*** | *Dendrocalamus latiflorus++* |
| *Salix babylonica+* | |
| *Sapium discolor*** | |
| *Sapium sebiferum*** | |
| *Schefflera octophylla*** | |
| *Sterculia lanceolata+* | |
| *Syzigium jambos+** | |

* Attractive to frugivorous birds, (Thrower, S.L. 1988. *Hong Kong Trees - Omnibus Volume*. Urban Council.)

\+ Riparian plant, (Thrower, S.L. 1988. *Hong Kong Trees - Omnibus Volume*. Urban Council.)

** Attractive to frugivorous birds, (Corlett, R.T. 1993)

\++ Ardeid nesting bamboos, (CES. 1995)

### *Distribution of Mitigation Measures*

5.5.22 The distribution of the mitigation measures within the Site habitats is summarised in Table 5.16.

**Table 5.16**
**Features of mitigation measures replacing Original Habitats**

| Original Habitat | Tree planting along revetment | Grasscrete | Marshcrete |
|---|---|---|---|
| Village | ✓ | X | X |
| Abandoned agriculture | ✓ | ✓ base & sides | X |
| Lotus ponds | ✓ | ✓ base & sides | ✓[1] base |
| Stream/riparian | ✓ | X | X |
| Fishponds | ✓ | ✓ sides | ✓ base |
| Value | Medium | Medium | Medium to High |
| Value overall* | Medium to High | | |

* due to linkage within the project and to adjacent habitat

✓ mitigation to be implemented

X no mitigation to be implemented

[1] The mitigation for loss of original pond habitat is included in the proposed offline engineered wetland areas. In other words, the offline engineered wetland areas provide effective mitigation for the adjacent fish ponds lost to the project as well as mitigation for the loss of lotus ponds south of Castle Peak Road.

5.5.23 The impacts of the mitigated Project are summarized in Table 5.17.

**Table 5.17**
**Evaluating the Significance of the Mitigated Ecological Impact**

| Criteria | *Village* | *Abandoned agriculture* | *Stream/ riparian* | *Lotus ponds[1]* | *Fishponds* |
|---|---|---|---|---|---|
| **Impact on habitat quality** | Some linkage possible via planted tree-top canopy | Tree corridor (of varied native species) atop revetment and grasscrete base and sides of channel will improve habitat and linkage | Larger and longer riparian habitat created, which will provide linkage between the existing streams | Grasscrete base and sides adjacent to lotus ponds in conbination with off-line marshcrete wetland (north of CPR) will have a similar function to lotus pond habitat | Reinstated area will be marshcrete rather than monocultured fishponds, this will result in greater species diversity |
| **Impact on species** | Improved corridor for migration of fauna via tree-top canopy | Greater diversity due to increase in food supply. Nesting possible in trees | Greater diversity due to increase in food supply. Nesting possible in trees | Equal or better than current species diversity due to greater linkage and lack of pesticides and other human disturbance | Equal or better than current species diversity due to greater linkage and lack of pesticides and other human disturbance |
| **Size/ abundance** | Part of the 3.8km long tree-top canopy and grasscrete/ marshcrete habitat | Total grasscrete area to be created 6.5ha in addition to tree planting | Part of the 3.8km long tree-top canopy and grasscrete/ marshcrete habitat | Grasscrete and marshcrete to be created in addition to tree planting | 3.0ha of marshcrete to be created in addition to tree planting |
| **Duration of impact** | Permanent | Permanent | Permanent | Permanent | Permanent |
| **Reversibility of impact** | Subject to healthy growth of vegetation and fauna colonisation | Subject to healthy growth of vegetation and fauna colonisation | Subject to healthy growth of vegetation and fauna colonisation | Subject to healthy growth of vegetation and fauna colonisation | Subject to healthy growth of vegetation and fauna colonisation |
| **Magnitude of overall positive impact compared to existing situation** | Low to medium | Low to medium | Low to medium | Low to medium | Medium to high |

1 The mitigation for loss of original pond habitat is included in the proposed offline engineered wetland areas. In other words, the offline engineered wetland areas provide effective mitigation for the adjacent fish ponds lost to the project as well as mitigation for the loss of lotus ponds south of Castle Peak Road.

***Funding, Implementation Management and Maintenance of Ecological Mitigation Measures***

5.5.24 The ecological mitigation measures proposed for this project include the following:

(i) use of grasscrete for lining the sides and base of the floodway (dry grasscrete) excluding the dry weather flow channel and a 5 m wide maintenance track along the channel base;
(ii) creation of marshland type habitat off-line through the use of submerged grasscrete (marshcrete) with planting of marsh tolerant grasses and other low to medium height vegetation; and
(iii) soft landscaping along the banks of the channel to encourage diversity of fauna and flora.

5.5.25 TDD will be responsible for the funding and implementation of the detailed design and construction of the YLBF, including all ecological measures and landscaping works. Following completion of the YLBF the main channel section, including the grasscrete proposed on the side slope and base of the channel, will be handed over to DSD for management and maintenance. The off-line wetland areas will be managed and maintained by a separate body. Landscaping elements within the roadside verge and amenity area will be managed and maintained by RSD/HyD as detailed in Works Branch Technical Circular No. 18/94. It is anticipated the standard one year maintenance period after construction completion will be the responsibility of the contractor.

5.5.26 At this time the appropriate organisation taking up the long term maintenance responsibility of the off-line wetland areas can not be confirmed. Under the Wetland Compensation Study (WCS) which will be commissioned by AFD, the existing mechanism and authorities responsible for the management and maintenance of such wetlands will be reviewed. The study is expected to recommend an appropriate arrangement to maintain established wetlands in its final report currently schedule to be completed by the year 2000, 5 years ahead of the current anticipated expiration of the maintenance period of the YLBF when the established wetland will have to be handed over for maintenance. Although it is expected that the management and maintenance responsibilities will be identified by the WCS and will be in place well before the YLBF project will be completed, TDD will, if necessary, provide a short-term arrangement through the project vote to extend the establishment period until the maintenance authority is confirmed. It is unlikely that such an arrangement will be necessary, but the situation will be reviewed in the year 2000 when the application of funding for the construction of the YLBF is prepared.

5.5.27 Maintenance work for the grasscrete within the main channel section by DSD will involve grass cutting and sediment removal. Very little if any maintenance will be required for the off-line wetland areas, which at most would involve periodic sediment removal and occasional grass cutting. It is envisaged that this area should be left to mature and should be inspected annually by an ecologist to monitor the ecological progress of the areas and identify any maintenance required. RSD will be responsible for the maintenance of all soft landscaping works at the top of the channels.

## 5.6 Residual Impacts

5.6.1 During the construction stage there will be a temporary loss of habitat and feeding ground for birds, however, the mitigation proposals outlined in Table 5.18 will reprovide these types of habitats and feeding grounds.

5.6.2 Providing the prescribed mitigation is implemented and monitored, habitat creation in the form of combined tree planting with grasscrete and marshcrete is considered to provide a post-project net engineering/ecological benefit along the banks of the YLB Floodway alignment. Following the reinstatement of this Project's affected ponds to the north of the alignment, the fishpond habitat is likely to continue to be an increasingly richer niche away from the new Route 3 and towards the knoll (if that contextual landscape remains the same). Water quality should progressively improve as a result of the enforcement of existing legislation, and due to the filtering effects of aquatic planting along the channel edges. The residual impacts are quantified and valued in Table 5.18.

**Table 5.18**
**The Predicted Residual Value of the Project's Mitigation Measures**

| Habitat | Area (ha) unless stated | Value |
|---|---|---|
| Existing (affected) | | |
| Village | 3.0 | Low |
| Abandoned agriculture | 4.0 | Low-medium |
| Stream/riparian | 0.1 | Low |
| Lotus ponds | 1.0 | Medium |
| Route 3 disturbed fishponds | 9.0 [1] | Low-Medium |
| (Trees across all habitats) | (400 trees) | |
| Replacement | | |
| Grasscrete | 6.8 | Medium |
| "Re-circulated" Marshcrete | 3.0 | Medium-high |
| Trees | 2500 trees | Medium |

[1] Includes area to be used for offline marshcrete

5.6.3 Of the existing habitats, village and stream/riparian are of a low ecological value and thus do not require any mitigation. The fishponds will be re-watered at the end of 1998 which (regardless of whether they are actively farmed) will increase the ecological value of this habitat over a period of time. Consequently, the ecological value has been raised from "low" to "low-medium", giving it a value equal to that of abandoned agricultural land. The lotus ponds although small in area, are of medium ecological value. The total habitat area requiring mitigation is 14 ha.

5.6.4 The proposed mitigation measures include grasscrete (which if mixed grasses and sedges are used, will be of medium value, ie greater than that of abandoned agricultural land because of the improved linkage), and marshcrete (which will exceed the value of the fish pond habitat because of greater diversity, and the increase in habitat size). The planting of 2,500 trees will be in part mitigation for the loss of 400 trees as a result of the Project, and part landscaping enhancement. The tree planting will also provide linkage between the various habitats both created as part of the Project and existing outside the Project. The grasscrete and marshcrete total habitat area resulting from this Project will be 9.8ha of medium and medium-high value ecological habitat. This constrasts with the loss (resulting from the Project) of 14 ha of largely low-medium value habitat. Whilst it would appear that there is an overall loss of 4.2 ha of low-medium value habitat, we consider that the increased value of the created habitat (in conjunction with the landscaping trees and improved ecological linkage), at least balances/compensates for the value of the Site's original habitats. Thus with the implementation of the proposed mitigation measures we consider that the residual impact of the project is negligible.

5.6.5 In conclusion, we believe that the mitigated project presented in this report, as far as is practicable, satisfies the ecological requirements of the Brief. The mitigation measures including re-alignment, grasscreting, marshcreting and tree planting will not only result in negligible ecological impacts but will also lead to a general habitat enhancement along the whole 3.8 km corridor.

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# 6. WASTE IMPACT

## 6.1 Introduction

6.1.1 This section examines the timing, quality and quantity of potential sources of wastes arising from the construction and operational phases of the project. In order to minimise waste production, the potential for reuse and recycling has been considered.

The methodology follows the criteria set out in Annex 7 and 15, of the *Technical Memorandum on the Environmental Impact Assessment Process.*

6.1.2 This section of the EIA Study has:

(i) identified the sources, volumes, quality and timing of wastes arising from the construction activities;

(ii) recommended a construction waste management strategy and control measures/routings (including final disposal sites) in accordance with the current legislative and administrative requirements for the disposal of construction waste, including consideration of waste reduction, reuse and recycling, for inclusion into contract documents; and

(iii) assessed the disposal of inert materials and wastes.

## 6.2 Construction Waste

6.2.1 Careful calculation of waste quantities, and the speed of their generation has allowed the formulation of plans for their efficient removal and disposal, with the aims of minimal disruption to traffic flow and maximum environmental protection.

6.2.2 Waste generation arising from construction activities will include:

(i) *Site clearance materials*: This will mainly involve concrete rubble and other materials from demolished buildings and other structures, concrete and asphalt from surfaces, grass and arboraceous material and refuse;

(ii) *Excavated material*: This includes inert material removed from the ground and sub-surface. Variable quantities of excavated material will be produced along the Bypass floodway during the excavation of the channel;

(iii) *Concrete waste*: There will inevitably be a small excess of concrete and other damaged, used and surplus construction materials arising from the various construction activities undertaken throughout the project;

(iv) *Slurries*: These include bentonite slurries or similar grouts and surplus excavated materials with a high clay/water content; and

(v) *General works waste*: This includes wooden material waste, construction material packaging, chemical waste, aqueous waste, domestic/municipal waste and sewage from the establishment of site offices, works compounds and canteens, and day to day activities.

6.2.3 The government's construction and demolition waste management hierarchy is the same as for other wastes, i.e. in order of desirability: avoidance; minimisation; recycling; treatment; and safe disposal of construction materials. During the detailed design stage, the engineers and environmental assessors should work closely together with a view to reducing the volumes of materials requiring removal and final disposal. The various types of waste arising from the project are described below and the favoured disposal option (according to the government's strategy) outlined for each waste material. Responsibilities for disposal and, where possible, recycling, are discussed.

6.2.4 The legislation and guidelines relating to these issues are presented in Appendix C.

6.2.5 The construction waste impact assessment has been undertaken with reference to the *Waste Disposal Ordinance Cap 354* and the subsequent Waste Disposal Plan.

***Site Clearance***

6.2.6 Vegetation, demolition waste, building materials (including concrete, corrugated iron and wood) and a small proportion of the available topsoil will arise during the site clearance works: approximately 270,000m$^2$ of land will need to be cleared. All construction waste should be sorted on site into inert and non-inert materials. Non-inert materials such as wood, and materials such as glass and plastics should be disposed of at landfill. Inert materials such as soil, sand, concrete, rubble, etc. should be kept separate and disposed of at public filling areas which are operated by CED.

6.2.7 Construction waste with only a small amount of inert material (not more than 20% by volume) will be allowed for disposal at landfill. In the case of reinforced concrete, steel rods should be separated from concrete rubble by mechanical means, and disposed of separately. Steel or other metals should be retrieved from the existing structures either before or after demolition. They should be recycled.

6.2.8 Attention shall be paid to *WBTC 6/92, Fill Management* which states that it is the responsibility of controllers of Government and quasi-Government projects, and of Government Departments processing plans for major private developments which generate fill material, to keep the Secretary of the FMC fully informed of anticipated volumes of excess fill. The identification of final disposal sites for spoil created by the construction work should be considered during the detailed design stage of the project. The disposal requirements of construction and demolition waste at various landfills are listed below in Tables 6.2 and 6.3.

**Table 6.1**
**Construction and Demolition (C&D) Waste with small amount of inert material not exceeding 20% by volume**

| Deposit Site | Opening Hours |
|---|---|
| SENT Landfill<br>Wan Po Road, Tseung Kwan O<br>Enquiry - 2706 8888 | 0800-2300<br>(including Sunday and public holidays) |
| NENT Landfill<br>Wo Keng Shan Road, Ta Kwu Ling<br>Enquiry - 2674 6505 | 0800-1800<br>(including Sunday and public holidays) |
| WENT Landfill<br>Lung Kwu Tan Road, Tuen Mun<br>Enquiry - 2477 4382 | 0800-1800<br>(including Sunday and public holidays) |

**Table 6.2**
**Mixed C&D Waste with inert material not exceeding 20% by volume**

| Deposit Site | Opening Hours |
|---|---|
| SENT Landfill<br>Wan Po Road, Tseung Kwan O<br>Enquiry - 2706 8888 | 0800-2300<br>(including Sunday and public holidays) |

6.2.9 'Inert materials' (public fill) refers to material such as soil, sand, rock, rubble, concrete, brick, cement mortar etc.

6.2.10 Any vehicle leaving the site carrying C&D waste or public fill, should have their load covered. They should be routed, so far as is practically possible, to avoid sensitive receivers in the area.

6.2.11 The potential for contaminated land along the alignment is considered slight. This judgement is based on field assessments and desk surveys of the proposed channel alignment. During the detailed design stage, a core sampling programme will be undertaken to ascertain the nature of the substratum. In the unlikely event of contaminated land being encountered, it will be subject to the criteria specified in ProPECC Paper (PN3/94) Contaminated Land Assessment and Remediation.

*Topsoil*

6.2.12 During site clearance works, large amounts of potentially desirable topsoil will be exposed. Much of the Shap Pat Heung area (through which the Bypass Floodway passes) is fertile agricultural land. The topsoil is thus expected to be of good agricultural and landscaping value.

6.2.13 It is recommended that the topsoil underlying the proposed channel alignment be stripped off and put to use in agriculture, horticulture, nurseries and landscaping works. Such provisions should be written into contract documents, subject to AFD approval.

6.2.14 The topsoil should be stockpiled in a designated area within the works site, to be used as required. The stockpile should be less than 2 m in height, formed to a safe angle of repose, and hydroseeded or covered with tarpaulin to prevent erosion during the rainy season, and to minimise dust generation.

*Excavated Material*

6.2.15 The majority of material excavated during open cut works, and channel formation works is expected to consist of soil material, and also road and footpath making materials (such as concrete, cement, tar and other macadam based materials) which are inert.

6.2.16 Preliminary investigations suggest that the total volume of excavated material will be approximately 420,000 $m^3$. This material should be stockpiled (less than 2 m in height and formed to a safe angle of repose) for use elsewhere in the Project area. Spoil initially designated as unsuitable for re-use in the Works by virtue of excess moisture should be stockpiled, drained and dried out, or mixed with overly dry materials and re-used in the Works as suitable fill.

6.2.17 Initial indications are that 102,000 $m^3$ of the spoil excavated from the channel alignment south of the Route 3 project, will be required for landscaping and filling works on the Bypass Floodway. Therefore, a surplus of excavated material in the region of 318,000 $m^3$ will need to be removed from the site. The detailed engineering study should seek to identify a suitable receiver site. The quantity of fill that will be generated is marginally less than that normally considered by the Fill Management Committee (FMC). However, the FMC will be consulted to identify potential receiver sites.

6.2.18 The preferred disposal option for such a sizeable quantity of fill material would be to concurrent projects in the area, such as Yuen Long South Development or the Lau Fau Shan Development. However, any surplus excavated material can be disposed of at a public filling area, so long as it complies with the public filling licence requirements.

***Concrete Waste***

6.2.19 Concrete is the main construction material likely to be used in the installation of the 3.8 km long flood channel and all other associated works. Of the volume of concrete supplied, it is assumed that approximately 3-5% of the concrete used will be lost to waste. The estimated total volume of concrete to be used on the Bypass Floodway construction is 47,000$m^3$. Dry concrete waste will be sorted out from the other wastes and recycled for reuse or sorted for disposal at a public filling area e.g. Pak Shek Kok.

***General Works Waste***

*Wooden Materials*

6.2.20 Different kinds of wooden materials are essential to the construction project, such as wooden boards for formwork, erection of site boundaries, as well as bamboo for any scaffolding. Wooden materials are important and valuable resources. Options for the reuse and recycling of discarded wooden waste are discussed below.

*Formwork*

6.2.21 Wood is generally used as formwork for concrete structures, although reusable steel shutters are an alternative. In order to estimate the waste volume of wooden boards and shutter ply, which may be required if steel shutters are not used, the following assumptions have been made:

(i) wooden boards are assumed to be 0.02 m thick;

(ii) it is assumed that the wooden boards can be reused five times, therefore the wastage rate of the wooden boards is assumed to be 20%.

6.2.22 All wooden materials used on site should be kept separate from other wastes. Wooden boards can be reused on site although the reusability and quantity of final waste depends on the shape and quality of the boards. Timber which cannot be reused should be sorted and stored separately from all inert waste before being disposed of to landfill. A number of private contractors will collect used formwork materials for local reuse or export to China.

6.2.23 Reusable steel shutters can be used as a preferred alternative.

*Site fencing*

6.2.24 Site fencing will be necessary to separate the construction works from the public and to reduce construction nuisance, such as noise, to nearby sensitive receivers. Two types of site fencing will be employed on the works area. These are:

i) Full hoarding, and

ii) Open Safety fencing

Full hoarding will be used for works at the Castle Peak Road crossing, the pumping station and around culvert sites. Elsewhere, open safety fencing will be used extensively in delineating the works and keeping the general public at bay, away from danger.

6.2.25 In the few areas where hoarding is relevant, the possibility of using metal fencing or building panels to provide site fencing should be considered. Concrete building panels with a lightweight core could be used. The material provides good sound and thermal insulation, as well as being both waterproof and fire resistant. These panels are easily recycled and reduce wastage of timber. However, wooden panels are more likely be used and the following data can be utilised in calculating waste.

6.2.26 It is assumed that the wooden hoarding used will be 0.02 m thick with a height of 2 m. The volume of waste generated from this source is often assumed to be 20% of the total volume.

6.2.27 This type of wooden board is valuable for reuse on other construction sites and should not therefore be disposed of to landfill. On completion of the construction phase, the boards should be sorted and grouped then distributed to other construction sites. The open safety fencing will have to be collected by the contractor, prior to disposal at a landfill site.

6.2.28 Under *Section 43* of the *Air Pollution Control Ordinance (Cap. 311), Open Burning Regulation (1995)*, it is an offence under law to openly burn any waste emanating from, or located at, a construction site.

*Chemical Waste*

6.2.29 Where the construction processes produce chemical waste, the Contractor must register with EPD as a Chemical Waste Producer. Wastes classified as chemical wastes are listed in the *Waste Disposal (Chemical Waste) (General) Regulation.* These wastes are subject to stringent disposal routes. EPD requires information on the particulars of the waste generation processes including the types of waste produced, their location, quantities and generation rates. A nominated contact person must be provided.

6.2.30 The major chemical waste types arising from the construction sites are likely to be oils, lubricants, paints and solvents. Oil waste may be in the form of raw waste, or as sundries such as spent oil filters, or materials used to absorb oil leaks. Storage and disposal of these wastes are discussed below.

6.2.31 Hard standing surfaces draining via oil interceptors shall be provided in plant yards and works area compounds. Interceptors will be regularly emptied to prevent release of oils and grease into the surface water drainage system after accidental spillages. The interceptor should have a bypass to prevent flushing during periods of heavy rain. Oil and fuel bunkers should be bunded to prevent discharge due to accidental spillages or breaches of tanks. Waste collected from any grease traps should be collected and disposed of by a licensed contractor.

6.2.32 Any construction plant which is likely to leak oil, should have absorbent inert material eg. sand, placed beneath it. This material should be replaced on a regular basis and the contaminated material should be stored in a designated, secure place. Such relatively inert material is suitable for landfill disposal and can be disposed of via the normal waste stream.

6.2.33 Lubricants and waste oils are likely to be generated during the maintenance of vehicles and mechanical equipment. Used lubricants will be collected and stored in individual containers which are fully labelled. The containers should be stored in a designated secure place. If possible such waste should be sent to oil recycling companies; there are also companies which collect empty oil drums for reuse or refill.

6.2.34 Oil and lubricant wastes are classified as chemical wastes, and if not recycled, should be treated at the Chemical Waste Treatment Centre, Tsing Yi, or other sites licensed for the disposal of waste oil. A trip ticket system operates to control the movement of such chemical waste and tickets have to be produced upon the request of EPD.

6.2.35 Some paints and solvents are classified as chemical waste and, if used on site, will be subject to the stringent requirements of the *Waste Disposal (Chemical Waste) (General) Regulation*. Empty paint cans should be recycled or collected as waste. Any dry paint waste should be swept up and collected in containers for disposal.

6.2.36 No lubricants, oils, solvents or paint products should be allowed to discharge into water courses, either by direct discharge, or as contaminants carried in surface water runoff from the construction site. Measures should be taken to prevent such occurrences.

*Aqueous Wastes*

6.2.37 Requirements designed to protect against surface runoff include the use of sediment traps, settlement ponds, special drainage channels and bunding. Discharges from concrete batching must be settled and possibly treated to restore a balanced pH. Oil interceptors must have a bypass. Landtake under stockpiles or open working areas must be minimised wherever practicable such as the road upgrading works. Stockpiles are to be fenced and bunded and treated to reduce erosion and sediment release. The water must be collected and settled. Solids accumulated in the sand traps, settlement tanks, manholes, and streambeds must be cleared out regularly and disposed of correctly.

6.2.38 All discharged waters, including sewage and site runoff, should comply with the appropriate standards in the *TM on Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters*, prior to discharge. Advice on the handling and disposal of construction site discharges, including site runoff and contaminated wastewaters, is provided in the *ProPECC Paper (PN1/94), Construction Site Drainage.*

6.2.39 Any floating refuse, emanating from the works, should be collected using refuse booms and disposed of appropriately.

6.2.40 All vehicles leaving the Site will pass through a wheelwash at the access/exit. If, at any time, further entry/exit points are created, they will be provided with similar facilities. The wheelwash requires regular cleaning to remove sediment, and may also produce a large volume of wastewater. To prevent excess sedimentation, and possible contamination of local streams and water courses, these wastewaters should be directed into settlement ponds as far as practicable. The wastewater can then be reused on Site. The maintenance of the wheelwash will be the responsibility of the Contractor undertaking the site formation works.

*Sewage*

6.2.41 Sewage is characterised by high BOD and suspended solids, and is enriched with nutrients and high bacteriological counts. Domestic sewage generated from the site toilets, washing facilities and any temporary canteen provided for construction workers will need to be collected separately and disposed of or appropriately treated to comply with Government requirements. Chemical toilets should be used if direct connection to public sewer is not possible.

*Municipal Waste*

6.2.42 Solid and liquid wastes will be generated by the construction workers during the clearance/construction period. The total number of site staff is estimated to be between 60 to 110 persons. If the quantity of municipal waste generated is assumed to be 1.29 kg/employee/day[1], then the total generated waste requiring disposal is approximately 77 to 142 kg per day.

6.2.43 The Contractor will be required to set up a temporary refuse collection station. Municipal waste will be collected regularly in black refuse bags and delivered to, and disposed of at, an approved landfill as required by the Regional Services Department (RSD).

1 *Monitoring of Municipal Solid Waste 1991, 1992* (1993) Environmental Protection Department.

6.2.44 Wastes arising during the construction phase of the Bypass Floodway are summarised in Table 6.3.

**Table 6.3**
**Summary of Potential Waste Types and Disposal Options**

| Major Activities | Waste Type | Disposal |
|---|---|---|
| Site Clearance | vegetation<br>wooden waste<br>concrete<br>steel/corrugated iron | - Landfill<br>- Landfill<br>- Public Filling Area (e.g. Pak Shek Kok)<br>- Recycle |
| Site Formation | excess spoil | - Reuse within site; excess to Public Filling Area or to identified compatible receiver site |
| Channel Construction | concrete waste<br>wooden waste<br>steel rebar | - Public filling area<br>- Landfill<br>- Recycle |
| General Site Activities | sewage wastes<br>domestic wastes<br>packaging materials<br>chemical waste<br>waste oil | - Sewage treatment<br>- Landfill<br>- Landfill<br>- CWTC*<br>- Licensed contractor |

* Chemical Waste Treatment Centre, Tsing Yi Island

*Recycling or Re-use Facilities*

6.2.45 As a result of the large variety of wastes which will be generated during the formation, construction and operation of the site, the establishment of an efficient collection system is required to achieve environmental objectives. The system should allow for the recycling of certain materials while ensuring the proper disposal of other materials, as detailed in Table 6.4.

6.2.46 The feasibility of establishing a C&D material sorting facility, similar to that being operated at SENT landfill, should be examined. Such plants help reduce the amount of inert waste disposed of to landfill, thereby conserving much needed void space.

## Table 6.4
## Waste types and their potential for recycling or re-use

| Waste type | Works generating waste | Volumes lost as waste | Potential re-use or recycling | Disposal Options |
|---|---|---|---|---|
| Fill material | Site Formation | None | Large amounts of good quality fill material will be generated by the excavation works | Approx. 318,000 $m^3$ of excess fill material will be generated during excavation works. The preferred disposal option is to concurrent projects in the area. Any surplus should be disposed of to a public filling area |
| | Topsoil | None | Stockpiled & reused | |
| | Construction of channel | None | | |
| Concrete/ Asphalt | Construction of channel | 3-5% | Needs to be separated; re-useable material needs to be crushed | To public filling area |
| Wood formwork, fencing | Construction of channel | 20% | Used as lower grade shuttering or fencing on-site or other sites | To landfill |
| Reinforcing steel, steel cable and shutters | Construction of channel | 1% | Most material can be re-used after cleaning; Reinforcement off-cuts to be scrapped/recycled | |
| Chemical waste | General site activities | Small amounts | Recycling/disposal firms will collect chemicals or waste oil, or refill oil containers | Chemical waste, including paints disposed of to treatment facility - REQUIRES LICENSE |
| Oil waste | | | | Oily contaminated materials such as sand or clothes which are soaked with oil should be disposed of at Chemical Waste Treatment Centre (CWTC). Waste oil should be disposed of at CWTC or other licensed waste oil facilities |
| Grease trap waste | | | | Grease trap waste collected by EPD registered collectors for disposal at the grease trap waste facility at WENT landfill |
| Wheel wash waste | Vehicle use during general works | Total volume when replaced | Recycling through filter until replacement of water is required | Onto sand area where natural filtration occurs, and oils can be retained before landfill disposal. |
| Domestic waste | General site activities | Putrescible waste, wet paper, fabrics | Cans, bottles, dry paper | To landfill |

***Responsibility for Waste Management***

6.2.47 The Fill Management Committee, reviews and coordinates the provision and operation of public filling facilities. Responsibilities for recycling, re-use or disposal of waste materials are divided between the contractors generating the waste, RSD and the management of the receiving public filling areas. These responsibilities are described below and summarised in Table 6.5.

6.2.48 Under present practices, contractors handle their own wastes, often without separating different types of waste resulting in incorrect disposal. Under the proposed scheme, contractors would be required to separate wastes to ensure maximum reuse of materials (as specified in WBTC 2/93) and minimise adverse impact on the environment. This may include reuse as hardcore in temporary site haul roads.

*Concrete*

6.2.49 The waste concrete generated during construction can be transported directly to the public filling area by the contractor. Segregation of waste is essential to facilitate recycling. For example, concrete waste could be crushed at the disposal site, and used as fill at other sites.

*Wood formwork and steel*

6.2.50 Only waste construction material need be taken to the public dump. They should be separated from recyclable concrete. Contractors are responsible for storage of re-useable materials on site.

6.2.51 The ease of disposal of concrete and wood waste to public filling areas and their operation as processing centres for concrete depends on the location of the filling area. Currently, Pak Shek Kok filling area is the closest available dump site to this project. However, this is the subject of a Territory-wide study.

*Chemical wastes and oil wastes*

6.2.52 Contractors are responsible for obtaining licenses for the disposal of chemical and oil wastes. A storage area should be designated as a pre-disposal containment area to prevent environmental impacts from spilt chemicals.

*Wheelwash waste*

6.2.53 Areas of sand for absorbing oily wash water should be set up by the contractor. Liaison with RSD is essential for ensuring its correct disposal.

*Domestic waste*

6.2.54 Provision and collection of skips for different types of recyclable waste is the responsibility of the contractor. Arrangements should be made directly with the recycling companies, for example, the paper merchants, to collect the waste as required.

6.2.55 While fulfilling the responsibilities described above, each contractor is required to maintain their work area in compliance with environmental requirements. The generation of dust and noise from concrete and other waste collection must be minimised in compliance with Quality Objectives. Maintenance of a clean and tidy environment is essential to minimise adverse environmental and visual impact.

**Table 6.5**
**Responsibilities for waste collection, recycling and disposal**

| *Waste type* | *Responsibility for collection of waste* | *Responsibility for transport of waste off-site* | *Responsibility for recycling* | *Responsibility for disposal* |
|---|---|---|---|---|
| *Fill material* | Construction contractors required to stockpile excess fill for use elsewhere | Contractor | Recycled on site | Contractor |
| *Concrete* | Contractor - directly at source of waste generation<br><br>Separation of re-useable and waste concrete should be carried out at source by contractor | Contractor - in contractor's vehicles to public filling area<br><br>Disposal of re-useable and waste concrete in different areas of filling area as required | FMC defines suitable dumpsites. Project proponent of public filling area<br><br>Project proponent to provide different areas for re-useable and waste concrete as required | FMC defines suitable filling area. Project proponent of public filling area responsible |
| *Wood formwork, fencing* | Contractor - directly at source of waste generation where volumes are large | Contractor - transported in contractor's vehicles to public filling area | Contractor - at source | Contractor to Landfill |

**Table 6.5**
**Responsibilities for waste collection, recycling and disposal** (cont'd)

| *Waste type* | *Responsibility for collection of waste* | *Responsibility for transport of waste off-site* | *Responsibility for recycling* | *Responsibility for disposal* |
|---|---|---|---|---|
| <br><br><br><br><br>*Reinforcing steel, steel cable and shutters* | Separation of waste wood and concrete should be carried out at source by contractor<br><br>Contractor - directly at source of waste generation where volumes are large<br><br>Separation of waste steel and concrete should be carried out at source by contractor | <br><br><br><br><br>Contractor - transported in contractor's vehicles scrap/recycling | <br><br><br><br><br>Contractor - at source | <br><br><br><br><br>Contractor to scrap/recycling |
| *Chemical waste*<br><br>*Oil waste*<br><br>*Grease trap waste* | Contractor - separate bunded area required for storage prior to collection | Contractor - liaison with chemical waste and waste oil collection firms | Chemical waste collection firms or oil recycling firms | Contractor through chemical waste collection firms or oil recycling firms.<br><br>Contractor REQUIRES LICENCE |
| *Wheel wash waste* | Contractor - on solid sand trap or as liquid for disposal | Contractor - contaminated sand to landfill, or liquid waste to foul water system | Contractor - during wheel washing activity<br><br>No recycling applicable after collection on sand trap | Contractor - if liquid waste to foul water system<br><br>RSD if sand trap waste disposed of to landfill |
| *Domestic waste* | Contractor - provision of skips and sorting of recyclable wastes into separate skips | Contractor - liaison with recycling companies | Recycling firms | RSD - to landfill |

## 6.3 Operational Waste

6.3.1 This section of the report assesses the operational waste impact of the Bypass Floodway. This includes, wherever possible:

(i) a characterisation and quantification of the waste generated by the proposed Works;

(ii) the identification of feasible means for the collection, storage and handling of waste generated from the proposed Works for the purpose of disposal of the waste to the existing and committed waste management facilities outside the Works, or to other such facilities that may be proposed by EPD;

(iii) the identification and proposal of mitigation measures to ameliorate environmental impacts associated with the construction and/or operation of any means identified above.

### *Accumulated Channel Deposits*

6.3.2 During the operation of the Bypass Floodway, sediment will settle and accumulate in the channel. This will need to be removed and disposed of on a regular basis, to reduce the amount of sediment washed down the YLB Floodway into receiving water bodies i.e. Deep Bay.

6.3.3 Desilting of the YLBF will be undertaken in the dry using land based plant. Excavated sediment should be air dried (liquid content not exceeding 70% by weight) to reduce its volume, and to prevent spillage during haulage by truck to landfill for disposal. It is recommended that this work be carried out during the dry season. The excavated sediment should be set aside to dry on the flat base of the channel either side of the low flow channel prior to being loaded into a truck and disposed of at a Government landfill. Routine desilting operations undertaken in this manner should not give rise to any unacceptable environmental impact.

### *Flotsam and Jetsam*

6.3.4 Litter and general refuse such as polystyrene, polythene bags, plastic bottles and cans will inevitably enter the Bypass Floodway. To prevent this nuisance from entering the Kam Tin River, and ultimately Deep Bay, a refuse boom should be laid across the channel. The accumulated waste should be collected frequently and disposed of to landfill.

## 6.4 Summary

*Construction Phase*

6.4.1 Waste will inevitably be produced during the construction period. The government's construction and demolition waste management hierarchy is the same as for other wastes, i.e. in order of desirability: avoidance; minimisation; recycling; treatment; and safe disposal of construction materials. The quantity of waste should be minimised and materials should be reused and recycled as far as practicable. Thus minimizing the disposal requirement and conserving void space at landfill sites.

6.4.2 The delivery of 318,000 m³ (about 8% of the current annual demand public filling capacity) of surplus excavated material to public filling areas could have a significant impact on the public filling programme. All effort should be made to find alternative disposal sites for such material.

6.4.3 Any stockpiles should be suitably protected from erosion.

6.4.4 Any vehicles leaving the site carrying unsuitable excavated material should have their loads covered and be routed, so far as is practically possible, to avoid sensitive receivers in the area.

6.4.5 Water and liquid waste products arising on site should be collected and removed from the site and disposed of at a location and in a manner that should not cause pollution or a public health hazard. The Contractor shall be responsible for the adequate maintenance and clearance of drainage channels and gullies.

6.4.6 Contract requirements should include the responsibilities of the contractor for waste collection, on-site sorting (including separation at source) and disposal. Suitable facilities should be provided, for example, an accessible filling area with processing capabilities to ensure maximum utilisation of waste materials.

6.4.7 Correct storage of and, where possible, recycling of chemical and oil wastes is required to minimise environmental impacts.

6.4.8 In order to maximise re-use of materials and minimise the cumulative impact of waste products on the environment, on-site facilities should be set up for the separation of recyclable material from construction and demolition waste and domestic waste to facilitate easy collection by recycling companies.

6.4.9 Provided that there is strict control of wastes from construction works and all arisings are stored, transported and disposed of using approved methods as described previously, no significant impacts are predicted.

### *Operational Phase*

6.4.10 As an integral component of the regular maintenance work of the Bypass Floodway sediment build up along the channel will be removed using land based plant. Excavated sediment will be set aside to dry prior to being loaded into trucks and disposed of at a Government landfill.

6.4.11 The channel should also be regularly cleared of litter and other general refuse. A refuse boom should be erected to prevent waste from entering the receiving water course.

# 7. AIR IMPACT ASSESSMENT

## 7.1 Introduction

7.1.1 This section presents a quantitative assessment of air quality impacts associated with the construction and operation of the Yuen Long Bypass Floodway (YLBF). Worst case impacts on the air sensitive receivers have been modelled and presented below. Construction works include site formation, infrastructure provision and maintenance/village access roads. The major temporary air pollutant is dust generated as a result of these construction works. The nuisance from construction vehicle and plant emissions is likely to be negligible because it is anticipated that the number of these vehicles and plant will be small for the areas involved.

7.1.2 During the operational phase, the minor odour nuisance associated with the nearby nullahs and streams that will enter the YLBF has been addressed.

## 7.2 Air Quality Assessment Criteria

7.2.1 The principal legislation regulating air emissions in Hong Kong is the Air Pollution Control Ordinance (APCO) [Cap 311] and its subsidiary regulations including the Air Pollution Control (Construction Dust) Regulation. The whole of the Territory has been covered by Air Control Zones. The Hong Kong Air Quality Objectives (AQOs) stipulate maximum acceptable concentration of air pollutants. The AQOs for one, 24 hour and annual concentrations of four major pollutants are shown in Table 7.1.

**Table 7.1**
**Hong Kong Air Quality Objectives (AQOs)**

| Pollutants | Concentration in Micrograms per Cubic Metre ($\mu g/m^3$) | | |
|---|---|---|---|
| | Averaging Time | | |
| | 1 hour[1] | 24 hour[2] | 1 year[3] |
| Nitrogen Dioxide ($NO_2$) | 300 | 150 | 80 |
| Sulphur Dioxide ($SO_2$) | 800 | 350 | 80 |
| Total Suspended Particulates (TSP) | 500[5] | 260 | 80 |
| Respirable Suspended Particulates (RSP)[4] | - | 180 | 55 |

Notes: Concentrations measured at 298K(25°C) and 101.325 kPa (one atmosphere).

1 One hour criteria not to be exceeded more than 3 times per year.
2 24 hour criteria not to be exceeded more than once per year.
3 Arithmetic means.
4 Respirable suspended particles means suspended particulates in air with a nominal aerodynamic diameter of 10 micrometer (μm) or smaller.
5 This control limit has no statutory basis but is used as a target level for limiting fugitive dust emissions generated by construction activities.

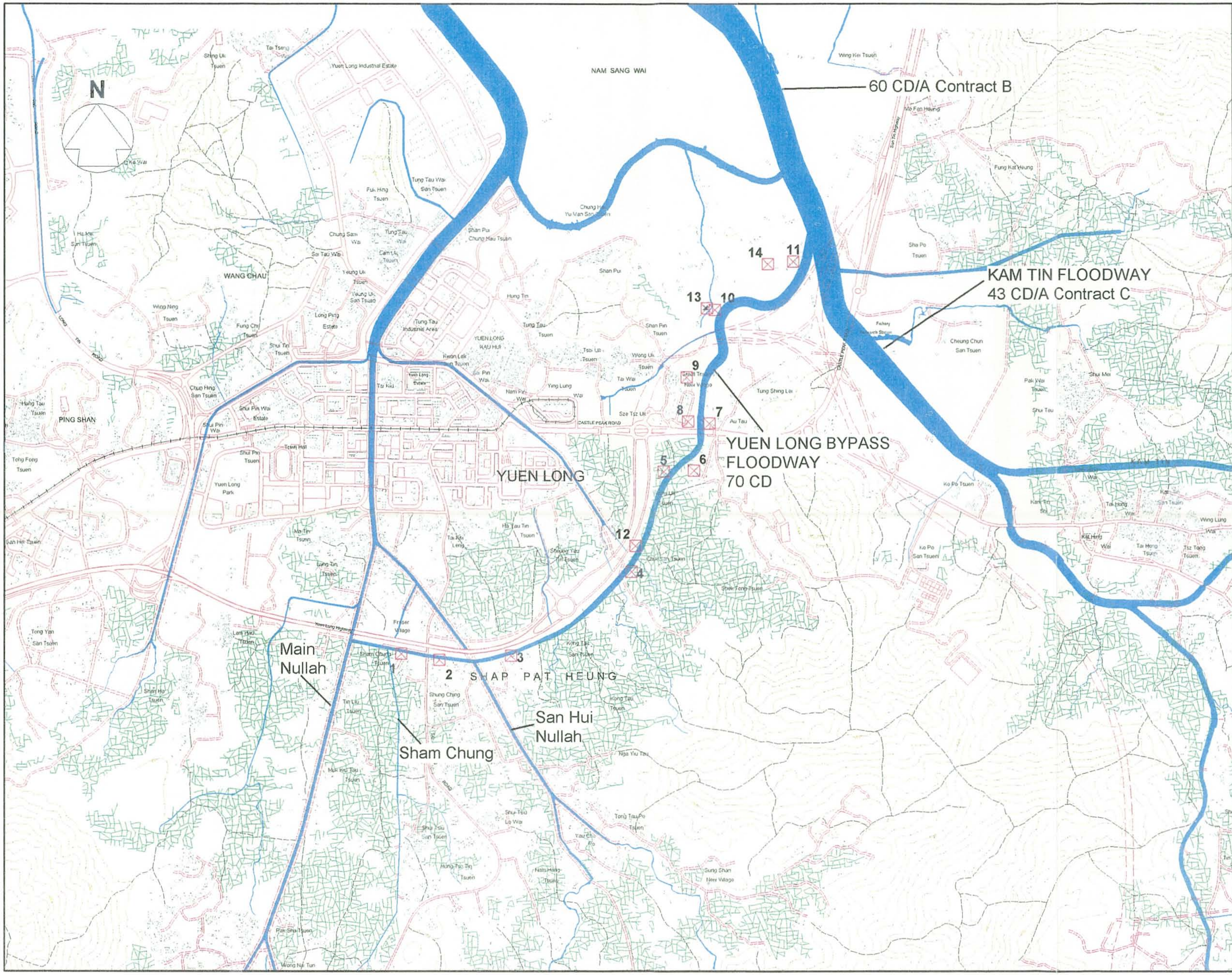
7.2.2 There are no statutory criteria for maximum levels of odours in Hong Kong. EPD's recommended odour nuisance criteria is 5 odour units (OUs) based on time of average time of 5 seconds at the sensitive receiver.

## 7.3 Air Sensitive Receivers

7.3.1 The representative air sensitive receivers (ASRs) that will be exposed to the construction air impacts from the Project are listed in Table 7.2. The location of the ASRs is shown in Figure 7.1. Some of the residents of the existing sensitive receivers (such as ASR11) will be located temporarily during the construction phase.

**Table 7.2**
**Representative Air Sensitive Receivers**

| ASRs | Description | mPD | No. of Floor |
|---|---|---|---|
| 1 | Village | 6 | 2 |
| 2 | Village | 7 | 1 |
| 3 | Village | 8 | 1 |
| 4 | Village | 7 | 1 |
| 5 | Village | 5 | 1 |
| 6 | Tse Tong (ceremonial places) | 5 | 1 |
| 7 | Hotel | 6 | 4 |
| 8 | Hospital (Pok Oi Hospital) | 3 | 4 |
| 9 | School | 4 | 1 |
| 10 | Village | 3 | 1 |
| 11 | Village | 4 | 1 |
| 12 | Village | 4 | 1 |
| 13 | Village | 4 | 1 |
| 14 | Village | 4 | 1 |

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Legend :

Existing and Future Watercourses

Air Sensitive Receiver

| revision | date | description | | | initial |
|---|---|---|---|---|---|
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| initial | GY | AJT | LC | | CWC |
| date | 1/98 | 1/98 | 1/98 | | 1/98 |

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figure title

LOCATIONS OF
AIR SENSITIVE RECEIVERS

| figure no. | scale |
|---|---|
| 7.1 | N.T.S |

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## 7.4 Baseline Air Quality

*Meteorology and Topography*

7.4.1 The Yuen Long Bypass Floodway is located in the Deep Bay Airshed. In the north of Study Area are the Yuen Long South Development area, Yuen Long Town Centre, Yuen Long Industrial Estate and Tung Tau Industrial Area. Kiu Tau Wai Industrial Estate is to the west of the Study Area.

7.4.2 Figure 7.2 illustrates wind conditions at Lau Fau Shan station which is close to the Study Area. During the winter season, the dominant wind direction is northeasterly. For the rest of the season, 45-50% of the winds are from the east while about 15-20% comes from the southwest direction[1]. The wind pattern discrepancy between the Study Area and the rest of Hong Kong is the result of the blocking effect of hills over the western part of New Territories.

7.4.3 In addition to these wind patterns, the Study Area exhibits a limited dispersive capacity because of the occurrence of inversion layer in the morning and evening over this area[2]. In short, the stable layer associated with the inversion layer acts as a lid to the pollutants, thereby being trapped[3].

*Existing Air Quality*

7.4.4 According to the data from the Yuen Long Station for the period between late 1995 to early 1996, the averages for $NO_2$, $SO_2$, TSP and RSP are tabulated below[4] (Appendix F1):

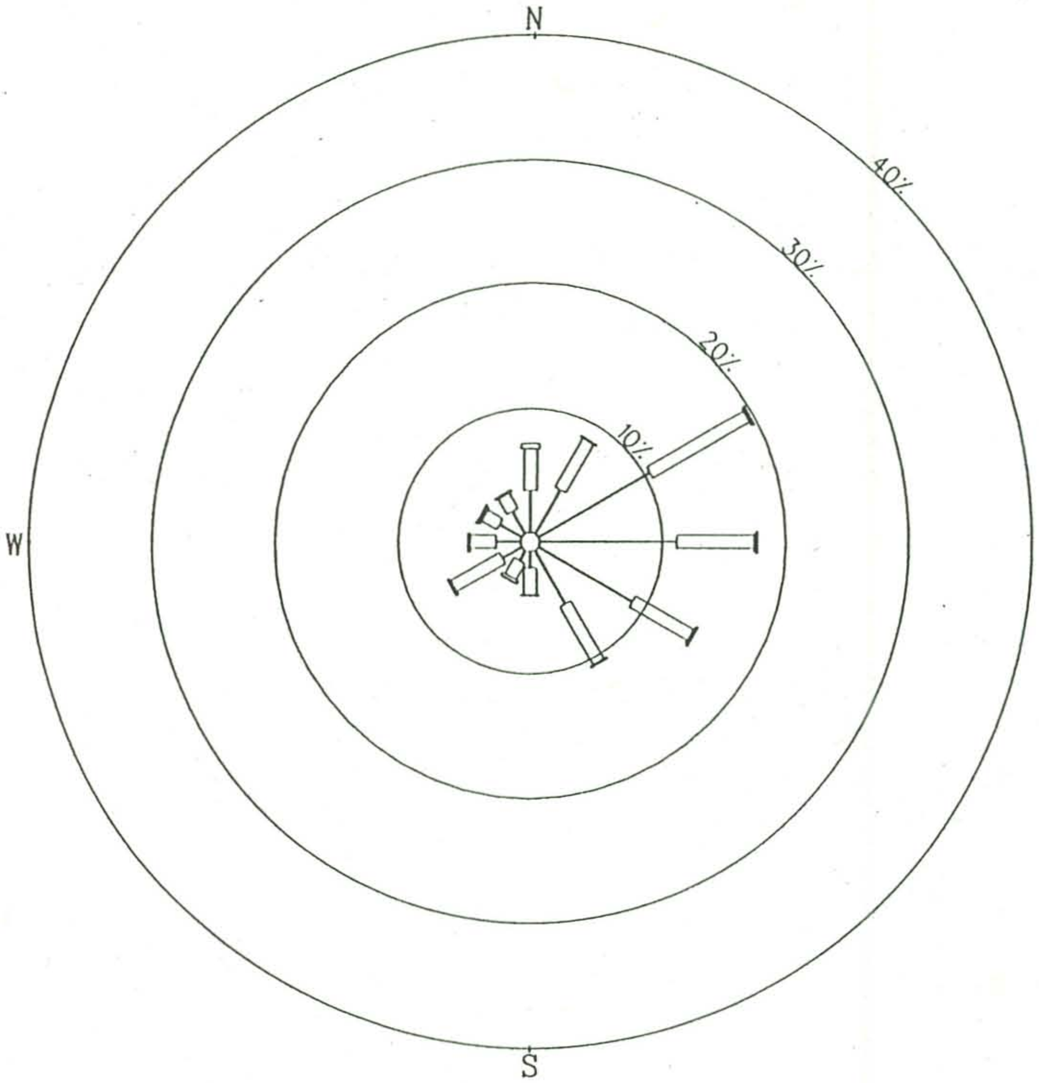
---

1 Royal Observatory Hong Kong, 1981: A Preliminary Report on the Meteorological Conditions in the Deep Bay Area.

2 Royal Observatory Hong Kong, 1984: Meteorological Assessment of Atmospheric Transport Condition in the Deep Bay Airshed.

3 Roland, B.S. (1988): An Introduction to Boundary Layer Meteorology, Kluwer Academic Publishers, p666.

4 EPD 1996: Environment Hong Kong 1996, Hong Kong Government




JAN 1989 - DEC 1993

No. of observations = 41340

No. of variable winds = 1 ( .0%)

No. of calm winds = 162 ( .4%)

0 10 20 30

Percentage frequency

| 2-12 | 13-30 | 31-51 | >51 | km/h |
|---|---|---|---|---|
| 0.1-3.2 | 3.3-8.2 | 8.3-14.2 | >14.2 | m/s |
| 1-2 | 3-4 | 5-6 | >6 | Beaufort force |

Wind speed

| EIA – WIND ROSE FOR LAU FAU SHAN AWS | TERRITORY DEVELOPMENT DEPARTMENT | Figure no. 7.2 | |
|---|---|---|---|
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**Table 7.3**
**Monthly Average Concentrations at Yuen Long EPD Station (1995 and 1996)**

| | 1hr | | 24hr | | Annual | |
|---|---|---|---|---|---|---|
| | Maximum | AQOs | Maximum | AQOs | Average | AQOs |
| TSP | N/A | 500 | 150 | 260 | 109 | 80 |
| RSP | N/A | N/A | 90 | 180 | 62 | 55 |
| $NO_2$ | 140 | 300 | 88 | 150 | 25 | 80 |
| $SO_2$ | 120 | 800 | 40 | 350 | 15 | 80 |

Notes: N/A means Not Applicable; Concentration in Micrograms per Cubic Metre ($\mu g/m^3$)

7.4.5 The table indicates that the concentrations of $NO_2$ and $SO_2$ are fairly low and well below the AQOs. The short term maximum concentration of TSP and RSP are well below the AQOs, but the annual average of the particulates exceeds the AQOs. In fact, 6 out of 9 monitoring stations in the network had annual averages exceeding the annual AQOs of 80 $\mu g/m^3$. The other non-exceeding stations also registered the reading close to the limit (Appendix F1).

7.4.6 The high TSP and RSP levels at the Yuen Long station was probably due to the heavy construction activities in the vicinity area such as the Route 3 (Country Park Section), Village Flood Protection for Yuen Long, Kam Tin & Ngau Tam Mei (30CD), Drainage Channels for Yuen Long & Kam Tin (43CD and 60CD), infrastructure provision for Yuen Long South development and the heavy industrial activities near Shenzhen. The long term trend of high TSP and RSP in Yuen Long area is likely to continue as the construction and industrial activities remain very active.

7.4.7 Principle sources of odour have been identified. The impacts of the sources are very localized and in some cases outside the scope of this Project. The sources are the pig farms and waters polluted by pig farm waste.

## 7.5 Construction Impact Assessment

### *Introduction*

7.5.1 Dust, measurable as TSP (Total Suspended Particulates) and RSP (Respiratory Suspended Particulates), is generated as the result of construction activities.

7.5.2 The dust associated with construction activities is generated from loading and unloading, top soil removal, travel over dirt roads, stockpiling and wind erosion. No concrete batching plants and rock crushing are foreseen as necessary for the Project and blasting will not be required.

***Construction Programme***

7.5.3 The tentative construction programme is to commence in January 2001 and will be completed in December 2003. Thus the construction period is about three years. Construction of the YLBF will be fairly straight forward along the majority of the length of the channel, generally comprising site formation, excavation and filling followed by concreting of linings and construction of maintenance/access roads.

7.5.4 Construction of YLBF will generally be carried out from the downstream end to the upstream to facilitate simple draining of the works site. Preliminary investigation indicates that the total volume of excavated material will be approximately 420,381 $m^3$ and fill material about 127,761 $m^3$ for the main YLBF, associated roads and filling of pond areas at northern end of site.

7.5.5 Based on the assumption that 80% of the required fill material can be obtained from the excavated material on site, there will be an excess of excavated material which will need to be transported and exported to a designated site. FMC have been contacted during the Preliminary Design and a number of dumping sites in the Yuen Long area have been identified. However, the suitability of the YLBF excavated material for other projects should be assessed based on SI information. It is anticipated that the excavated material to be dumped will not be contaminated because most of the material will be excavated from agricultural fields and pond areas. There is very little evidence of any vehicle storage and breaking activity or other industrial or chemical storage activity along the Floodway route.

7.5.6 At the Castle Peak Road crossing point, special considerations will be necessary to simplify the construction methods used. The proposed Castle Peak Road crossing point will be a multi-celled box culvert. The opening of the Route 3 Highway in this area which is programmed for 1998, is expected to reduce the traffic along Castle Peak Road. Therefore, it is anticipated that the existing dual-3 lane Castle Peak Road can be restricted to a dual-2 lane during the construction period, allowing an open cut method of construction to be used which is the most economical method for culvert construction. In addition, it is proposed that the main access points for the construction traffic should be at Castle Peak Road in order to avoid annoyance to the local village residents.

7.5.7 In total four access points are proposed at Castle Peak Road, two onto the eastbound road and two onto the westbound. This will avoid the incoming site vehicles from blocking the kerbside lane to facilitate the outgoing vehicles. No other access points are considered feasible as the construction traffic will need to pass through village areas along relatively minor roads. It is therefore considered necessary to keep the haulage routes of the construction vehicles within the proposed site boundary and provide site access and egress at Castle Peak Road so as to minimize traffic impact during the construction period.

***Scenarios***

7.5.8 Given the tentative construction programmes, the peak construction period is assumed to be about two and half years. The Project will be implemented in a single phase. Dust will be generated throughout most of the construction phase. The potential dust generation will be the greatest during site formation works for the proposed bypass floodway.

7.5.9 The final level for the floodway has been determined from the latest engineering study. Using this information, the estimated fill materials for ponds and the excavated material is about 500,000 $m^3$. The site area of the floodway is about 26.8 ha while the total length of the proposed dirt road network is about 3.8 km.

***Assessment Methodology***

*FDM*

7.5.10 The Fugitive Dust Model (FDM) which is approved by USEPA and Hong Kong EPD is used to assess the impact of the site formation dust emissions on the surrounding area. A detailed description of the model is given by the User's Guide[5]. Briefly, FDM which is an atmospheric dispersion model is specifically designed for the analysis of fugitive dust sources. The model is based on the widely used Gaussian Plume formulation for estimating pollutant concentrations, but has been adapted to incorporate a gradient-transfer deposition algorithm which accounts for the settling out of dust particles, and to include the wind dependence factor on the dust emission rates.

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5 TRC Environmental Consultants, 1990: User's Guide for the Fugitive Dust Model (FDM), Revised. Report for Region 10, U.S. EPA, EPA-910/9-88-202R.

7.5.11 TSP and RSP impacts have been evaluated. The assessment has been based on the 1994 sequential meteorological data collected at the Lau Fau Shan Station containing the hourly wind direction, wind speed, stability and temperature. The surface roughness is 10.0 cm. The Study Area has been one domain and fully covers the impacts on the nearby sensitive receivers in relation to the scenario for dust assessment. The domain of 27 x 27 grid has a grid spacing of 100 m. The default particle distribution in FDM has been used. The fraction in each of 0-2.5, 2.5-5, 5-10,10-15 and greater than 15 μm is 0.0262, 0.0678, 0.1704, 0.1536 and 0.5820 respectively. For RSP, the relevant percentage of particles below 10 μm is so calculated that they total 100% while keeping the same relative proportions. Average dust density of 2.5 $g/cm^3$ has been assumed in this assessment.

*Dust Sources*

7.5.12 The dust sources have been identified as following:

(i) Unpaved roads and haul routes;
(ii) Loading and unloading;
(iii) Stockpiling/Aggregate storage;
(iv) Top soil removal; and
(v) Wind erosion of the whole exposed area.

7.5.13 It has been assumed in this assessment that all these activities/processes have been occurring concurrently. For worse case scenarios, the areas of loading and unloading, top soil removal as well as the wind erosion have been assumed to take place over the whole exposed site area for the proposed bypass floodway. Based on engineering practices, the likely stockpiling areas have been assumed to be located at the existing ponds in the north of the Study Area, temporary storage area near Shap Pat Heung, chainage CH3+500 to CH3+400 as well as CH2+100 to CH2+000. The most likely haul routes for the movement of material have been assumed along the alignment of the proposed floodway.

7.5.14 Vehicle roundtrip calculations have been based on a 8 hour per day, 24 day per month over 2.5 years. The capacity of the trucks has been taken to be 8 $m^3$. Particulate emission rates for the identified potential dust sources have been determined according to the US EPA publication *Compilation of Air Pollution Emission Factors (AP42)*. Dust emission factors have been calculated using the latest equations in the draft 5th Edition of USEPA AP42 (1995).

7.5.15 The equations used for the calculation of emission rates for each dust source are shown in Appendix F2. The parameters used for the calculation of emission rates and the emission rates for the worse-case scenarios are summarised in Appendix F3.

***Model Results***

7.5.16 Since the construction dust impacts are only short term, the long term impact (i.e. annual) is not required to be assessed. The predicted maximum (unmitigated and mitigated), 24 hr and 1 hr average dust levels at individual sensitive receivers obtained for TSP and RSP are discussed below. It should be noted that all the tabulated results and contour figures have included the baseline dust levels.

7.5.17 Table 7.4 shows the maximum 1 hour and 24 hour average TSP and RSP concentrations at the sensitive receivers with and without adoption of dust suppression measures. With no mitigation, all sensitive receivers are subject to excessive dust concentration levels.

**Table 7.4**
**Predicted Maximum Hourly and Daily Particulate Concentrations ($\mu g/m^3$)**

| ASR | Without Mitigation | | | With 97% Reduction of Dust Emission | | |
|---|---|---|---|---|---|---|
| | TSP | | RSP | TSP | | RSP |
| | Hourly | Daily | Daily | Hourly | Daily | Daily |
| 1 | 2536 | 1139 | 531 | 261 | 193 | 110 |
| 2 | 3014 | 1212 | 587 | 285 | 200 | 114 |
| 3 | 2890 | 1300 | 648 | 280 | 203 | 117 |
| 4 | 2378 | 727 | 374 | 292 | 186 | 109 |
| 5 | 2151 | 930 | 454 | 252 | 190 | 111 |
| 6 | 2328 | 684 | 342 | 273 | 181 | 106 |
| 7 | 2948 | 641 | 335 | 291 | 178 | 105 |
| 8 | 2113 | 805 | 414 | 290 | 193 | 113 |
| 9 | 1339 | 652 | 334 | 276 | 191 | 113 |
| 10 | 3975 | 1232 | 610 | 404 | 250 | 144 |
| 11 | 7130 | 2830 | 1343 | 456 | 259 | 145 |
| 12 | 4656 | 1783 | 847 | 398 | 246 | 137 |
| 13 | 1653 | 699 | 372 | 322 | 219 | 128 |
| 14 | 1524 | 564 | 308 | 305 | 217 | 127 |

Note: Background concentrations have been included.
ASR 11 will be relocated during the construction phase.

7.5.18 Dust due to truck movement on dirt roads on the site constitutes the highest concentrations because emission rates associated with the dirt roads account for 95% of the total dust emission rates. Other dust sources including loading and unloading, stockpiling, wind erosion and top soil removal are relatively minor. The unmitigated cumulative hourly impacts including all the dust sources plus the background dust level shows that the predicted concentration levels at all of the representative sensitive receivers, closest to the boundary of site formation area, will exceed the AQOs. Due to their proximity to the works, they register the highest dust levels.

7.5.19 Figures 7.3, 7.4 and 7.5 illustrate the unmitigated dust isopleths on the Site Area at pedestrian level. ASRs 2 and 12 register the most dust levels due to the dominant westerly wind direction in this area (see Table 7.4). The school, hospital and hotel are also subject to excessive dust levels. The residents of ASR11 will be relocated temporarily because their ponds adjacent to the northern part of the YLBF will be used as a working area during the construction phase.

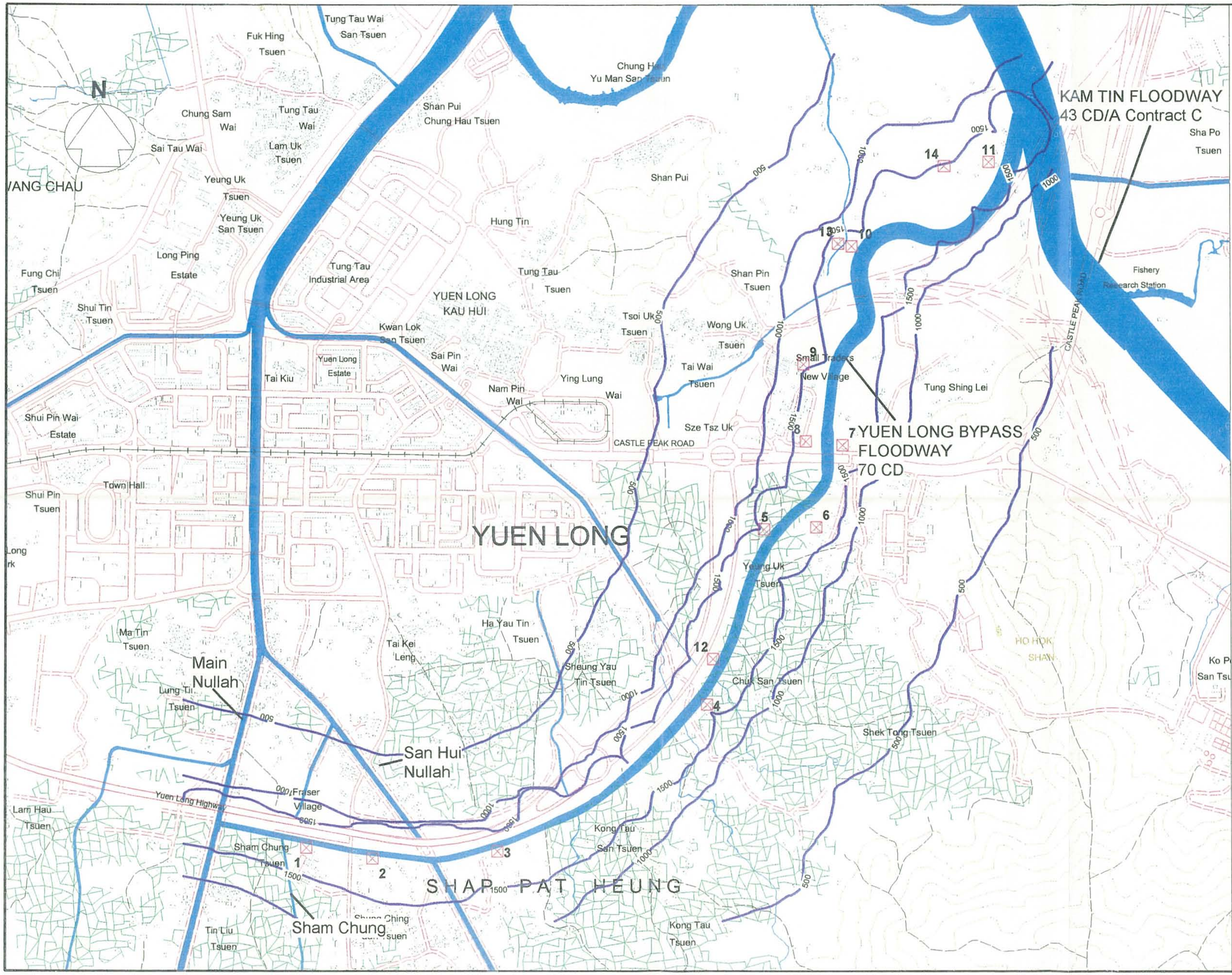
7.5.20 Haul road traffic generates the most dust. Watering twice a day can reduce other dust emission rates by half, thereby lowering the dust level concentration by as much as 50%[6]. It is our experience from other similar sites in Hong Kong when undertaking the Environmental Monitoring and Auditing Phase[7] that higher mitigation levels can be achieved if watering is undertaken regularly and frequently. To ensure full compliance and to make allowance for concurrent works particularly during very dry days or worst dust situations, it is recommended that watering should be conducted once every hour. Reducing dust emissions from the haul roads by 97% is achievable and is shown in Table 7.4 as well as Figures 7.6, 7.7 and 7.8 such that the AQOs can be met at all sensitive receivers. The dust levels at the school, hospital and hotel are all within the AQOs.

***Construction of associated drains, sewers and water mains***

7.5.21 Construction of drains and culverts will require excavation of trenches. These will be constructed section by section and a typical open cut dimension could be 20 m by 5 m; thus the quantity of excavated material is unlikely to be large enough to cause a dust nuisance. It is anticipated that excavated material will only be stockpiled at each local works area. The duration of stockpiling will be as short as possible since most of the material will be used as backfill material for the open

6 Jutze, G.A., K. Aetell Jr. and W. Parker, 1974: Investigation of Fugitive Dust - Sources, Emissions and Control, Pub. No. EPA-450/3-74-046a, United States Environmental Protection Agency.

7 Binnie Consultants Limited, 1995-1997: Environmental Project Office (ENPO), West Kowloon Project Office, Hong Kong Environment Protection Department, Hong Kong Government.

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Legend :

- Existing and Future Watercourses
- Maximum Total Suspended Particulate (TSP) Concentrations at Pedestrian Level (1.5m above ground) Hourly Average Unmitigated
- Air Sensitive Receiver

| revision | date | description | initial |
|---|---|---|---|
| A | 7/98 | Air Sensitive Receiver Added | LY |

| | designed | checked | drawn | checked |
|---|---|---|---|---|
| initial | GY | AJT | LC | CWC |
| date | 1/98 | 1/98 | 1/98 | 1/98 |

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MAXIMUM TSP CONCENTRATIONS

HOURLY AVERAGE UNMITIGATED

| figure no. | scale |
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**Legend :**

- Existing and Future Watercourses
- Maximum Total Suspended Particulate (TSP) Concentrations at Pedestrian Level (1.5m above ground) Daily Average Unmitigated
- ☒ Air Sensitive Receiver

| revision | date | description | initial |
|---|---|---|---|
| A | 7/98 | Air Sensitive Receiver Added | LY |

| | designed | checked | drawn | checked |
|---|---|---|---|---|
| initial | GY | AJT | LC | CWC |
| date | 1/98 | 1/98 | 1/98 | 1/98 |

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figure title
MAXIMUM TSP CONCENTRATIONS

DAILY AVERAGE UNMIGITATED

figure no. 7.4 | scale N.T.S

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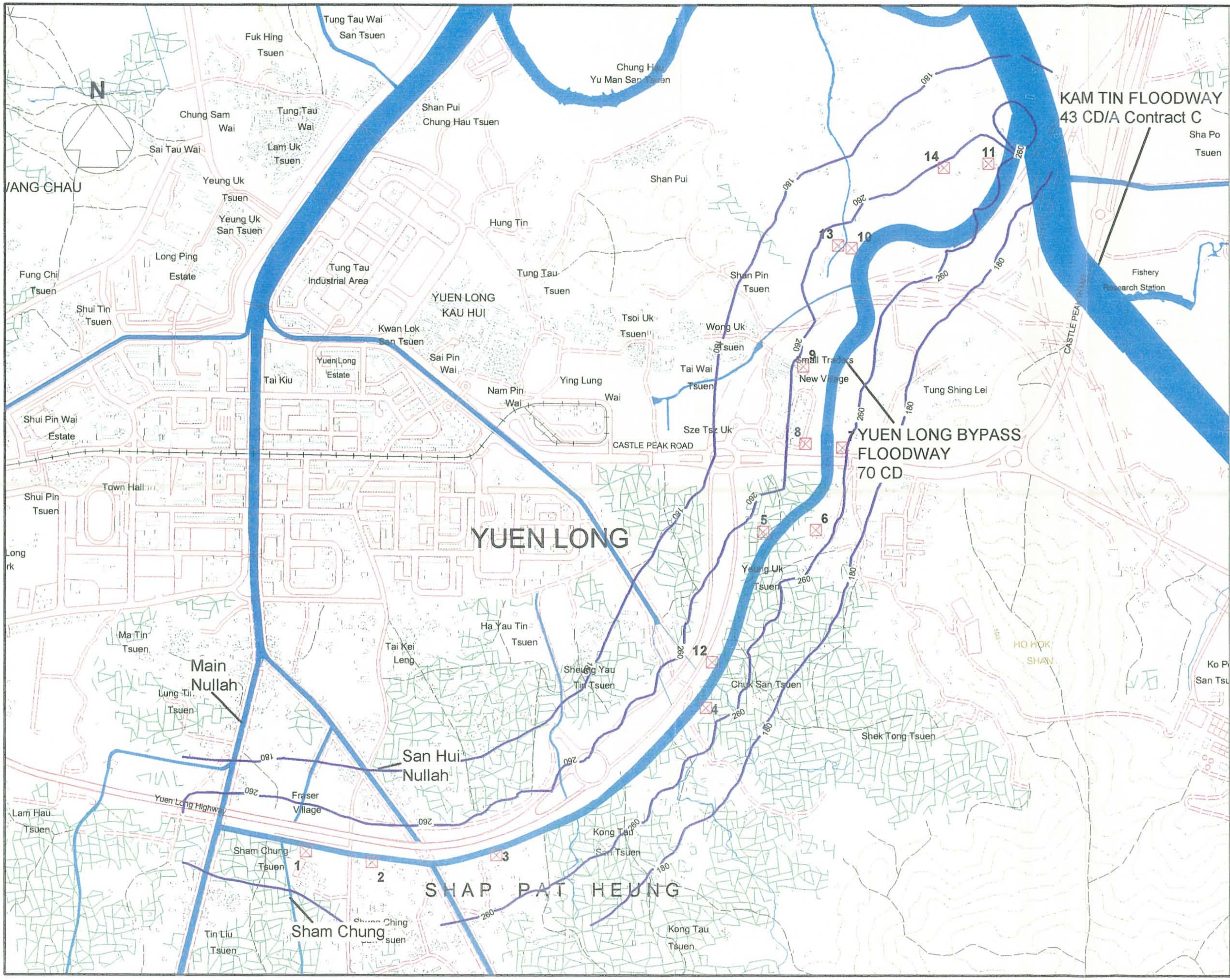


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**Legend :**

- Existing and Future Watercourses
- Maximum Total Respirable Particulate (RSP) Concentrations at Pedestrian Level (1.5m above ground) Daily Average Unmitigated
- ☒ Air Sensitive Receiver

| revision | date | description | initial |
|---|---|---|---|
| A | 7/98 | Air Sensitive Receiver Added | LY |

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| initial | GY | AJT | LC | CWC |
| date | 1/98 | 1/98 | 1/98 | 1/98 |

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figure title

MAXIMUM RSP CONCENTRATIONS

DAILY AVERAGE UNMITIGATED

figure no. 7.5

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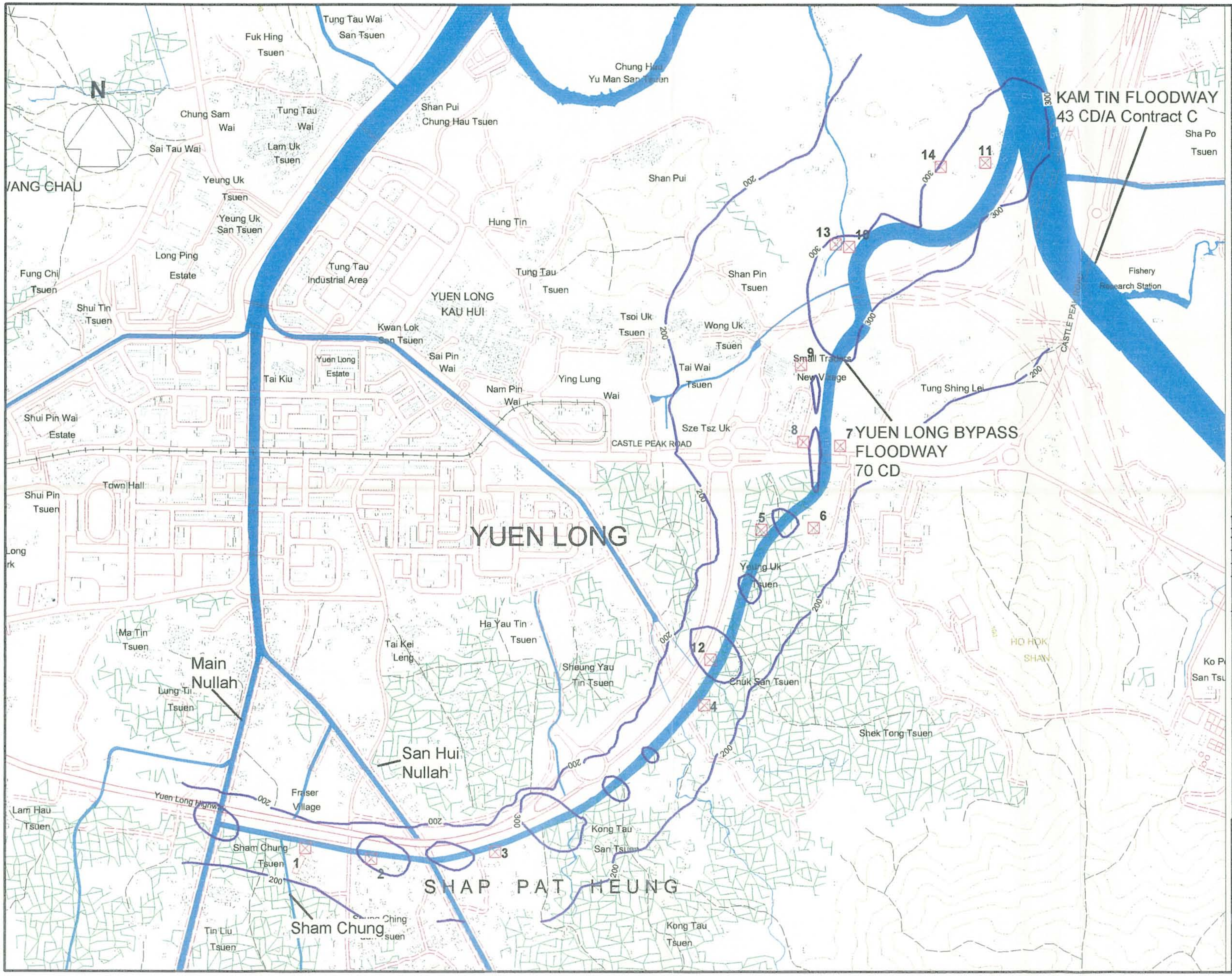


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Legend :

- Existing and Future Watercourses
- Maximum Total Suspended Particulate (TSP) Concentrations at Pedestrian Level (1.5m above ground) Hourly Average Migitated
- Air Sensitive Receiver

| revision | date | description | initial |
|---|---|---|---|
| A | 7/98 | Air Sensitive Receiver Added | LY |

| | designed | checked | drawn | checked |
|---|---|---|---|---|
| initial | GY | AJT | LC | CWC |
| date | 1/98 | 1/98 | 1/98 | 1/98 |

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figure title

MAXIMUM TSP CONCENTRATIONS

HOURLY AVERAGE MIGITATED

figure no. 7.6

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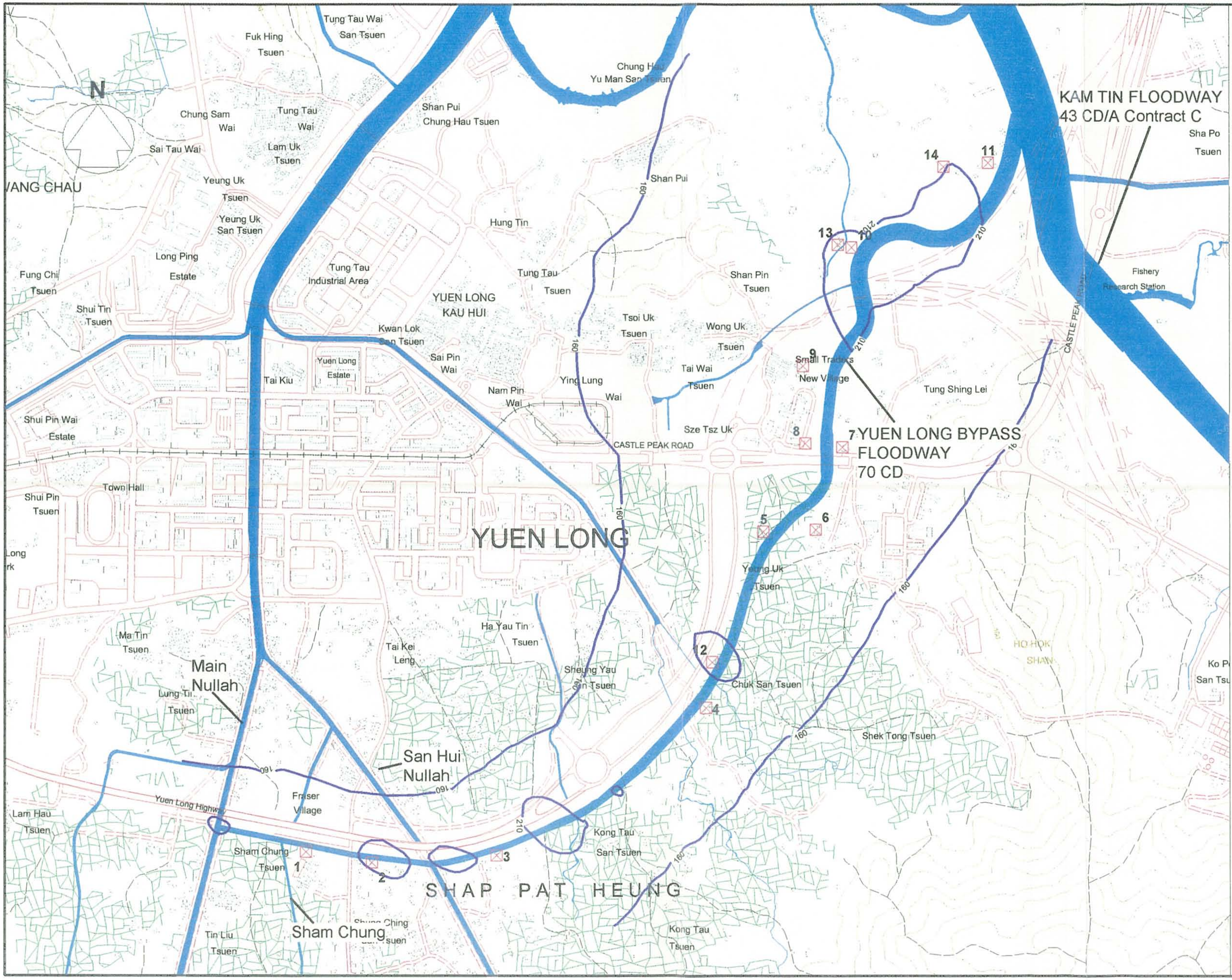


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**Legend :**

- Existing and Future Watercourses
- Maximum Total Suspended Particulate (TSP) Concentrations at Pedestrian Level (1.5m above ground) Daily Average Migitated
- Air Sensitive Receiver

| revision | date | description | | | initial |
|---|---|---|---|---|---|
| A | 7/98 | Air Sensitive Receiver Added | | | LY |
| | designed | checked | drawn | checked | |
| initial | GY | AJT | LC | CWC | |
| date | 1/98 | 1/98 | 1/98 | 1/98 | |

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YUEN LONG BYPASS FLOODWAY FEASIBILITY STUDY

EIA STUDY REPORT

figure title

MAXIMUM TSP CONCENTRATIONS

DAILY AVERAGE MIGITATED

figure no. 7.7

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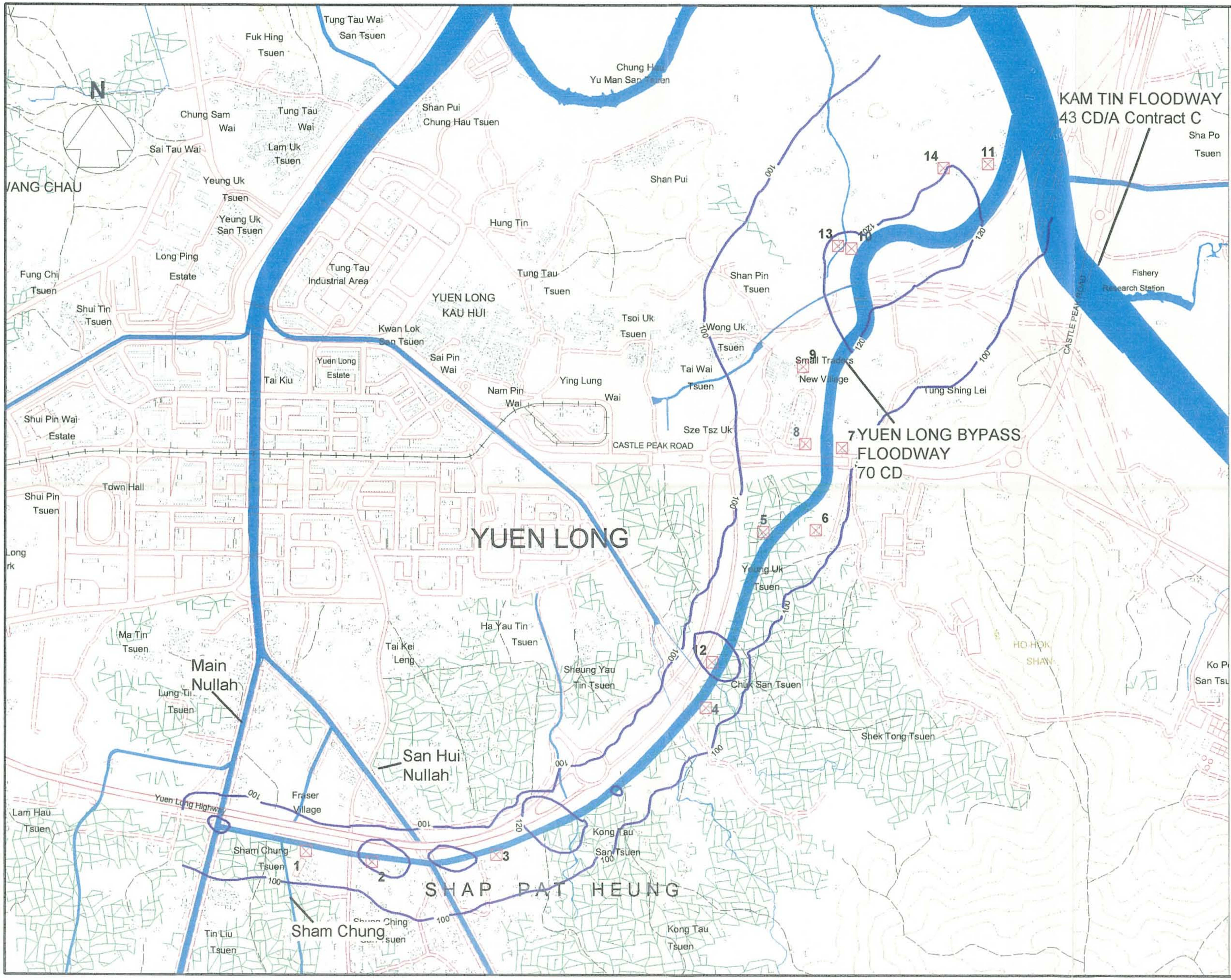


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**Legend :**

- Existing and Future Watercourses
- Maximum Total Respirable Particulate (RSP) Concentrations at Pedestrian Level (1.5m above ground) Daily Average Migitated
- Air Sensitive Receiver

| revision | date | description | | initial |
|---|---|---|---|---|
| A | 7/98 | Air Sensitive Receiver Added | | LY |

| | designed | checked | drawn | checked |
|---|---|---|---|---|
| initial | GY | AJT | LC | CWC |
| date | 1/98 | 1/98 | 1/98 | 1/98 |

AGREEMENT NO. CE 79/96

project

YUEN LONG BYPASS FLOODWAY FEASIBILITY STUDY

EIA STUDY REPORT

figure title

MAXIMUM RSP CONCENTRATIONS

DAILY AVERAGE MIGITATED

| figure no. | scale |
|---|---|
| 7.8 | N.T.S |

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consultant

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cut trenches. Leveling, compacting and resurfacing of the trenches will not involve significant movement of materials, hence dust impacts will not be significant. However proper watering of exposed dirt surface should be undertaken throughout the construction phase to ensure that the cumulative impacts of these and other concurrent works comply with the AQOs at all times.

***Dust Suppression Measures***

7.5.22 As presented above, the site formation works are likely to cause short-term unacceptable dust impact on all of the representative sensitive receivers. The following dust control measures as part of good construction practice should be incorporated in the Contract Specification and implemented to minimise dust nuisance to within acceptable levels arising from the works:

(i) The Contractor shall undertake at all times to prevent dust nuisance as a result of his activities. Effective dust suppression measures as are necessary should be installed to ensure that the air quality, at the boundary of the site and at any sensitive receivers, complies with the Hong Kong Air Quality Objectives.

(ii) The Contractor shall frequently clean and water the Site to minimise fugitive dust emissions.

(iii) Effective water sprays shall be used during the delivery and handling of all raw sand and aggregate, and other similar materials, when dust is likely to be created and to dampen all stored materials during dry and windy weather.

(iv) Areas within the Site where there is a regular movement of vehicles must be regularly watered as often as is necessary for effective suppression of dust or as often as directed by the Engineer. In most instances it will necessary to water haul roads on an hourly basis.

(v) Should a conveyor system be used, the contractor shall implement the following precaution measures. Conveyor belts shall be fitted with windboards, ad conveyor transfer points and hopper discharge areas shall be enclosed to minimize dust emission. all conveyors under the contractor's control and carrying materials which have the potential to create dust shall be totally enclosed and fitted with belt cleaners.

(vi) Where dusty materials are being discharged to vehicle from a conveying system at a fixed transfer point, a three-sided roofed enclosure with a flexible curtain across the entry shall be provided. Exhaust fans shall be provided for this enclosure and vented to a suitable fabric filter system.

(vii) The Contractor shall confine haulage and delivery vehicles to designated roadways inside the Site. If in the opinion of the Engineer, any motorized vehicle is causing dust nuisance, the Engineer may require that the vehicle be restricted to a maximum speed of 15 km per hour while within the Site.

(viii) Wheel washing facilities shall be installed and used by all vehicles leaving the Site. No earth, mud, debris, dust and the like shall be deposited on public roads. Water in the wheel cleaning facility shall be changed at frequent intervals and sediments shall be removed regularly. The Contractor shall submit details of proposals for the wheel cleaning facilities to the Engineer prior to construction of the facility. Such wheel washing facilities shall be usable prior to any earthworks excavation activity on the Site. The Contractor shall also provide a hard-surfaced road between any washing facility and the public road.

(ix) All site vehicle exhausts should be directed vertically upwards or directed away from ground.

***EM&A Requirement***

7.5.23 The mitigation measures recommended above should ensure that dust levels are kept at acceptable levels throughout the Project construction phase. Environmental monitoring and audit (EM&A) of dust should be undertaken at the most critical ASRs during construction to ensure that compliance with statutory limits is maintained. Details of the proposed EM&A requirements will be provided in the EM&A Manual.

***Conclusions***

7.5.24 The air quality assessment has assessed the dust impacts associated with the construction phase of the Project. The assessment has concluded that:

(i) The worst case scenario will occur during the site formation of the proposed Yuen Long Bypass Floodway because there would be a large quantity of earth works and frequent truck movements over dirt roads.

(ii) Without adequate mitigation, dust levels generated by the site formation works are likely to exceed the Air Quality Objectives at the nearby air sensitive receivers.

(iii) The transport of material by trucks travelling over dirt haul roads is the principal source of excessive dust generation.

(iv) Mitigation measures sufficient to ensure compliance with the Air Quality Objectives have been included in the assessment. As a result, school, hospital and hotel nearby the subject site will be within AQOs.

(v) An environmental monitoring and audit programme has been formulated to ensure compliance is maintained.

## 7.6 Operational Impact Assessment

***Introduction***

7.6.1 During the operational phase of the YLBF, the pollutant source is odour from the nearby nullahs and streams that will enter into the low flow channel of the proposed bypass floodway.

***Odour Impact Assessment***

*Odour arising from nullahs*

7.6.2 There are two nullahs and several streams located within the Study Area, namely Main Nullah, San Hui Nullah, Sham Chung Stream and several un-named stream courses. Odour from the nullahs and streams are the major odour nuisance. The odour arises from pollutants in the water. The major source of pollutants is animal wastes washed down from upstream pig farms. In addition, the current sewerage system in the Yuen Long South Development Area (such as Area 13 & 14) is 'less formalised' and uncontrolled discharge of sewage into the drainage nullahs is a common practice.

***Mitigation Measures***

7.6.3 The Livestock Waste Control Scheme was implemented in July 1, 1997. Since the Livestock Waste Control Scheme has been implemented and enforced, substantial reduction in pollutant levels have resulted. As the construction of the YLBF will not begin until early 2001, theoretically the control scheme should be fully in operation in time for the new influx of residents in Yuen Long South Development. The discharges from the pig farms scattered in the Study Area should therefore have been treated before being discharged into the nullahs. Thus odour nuisance should not be an issue.

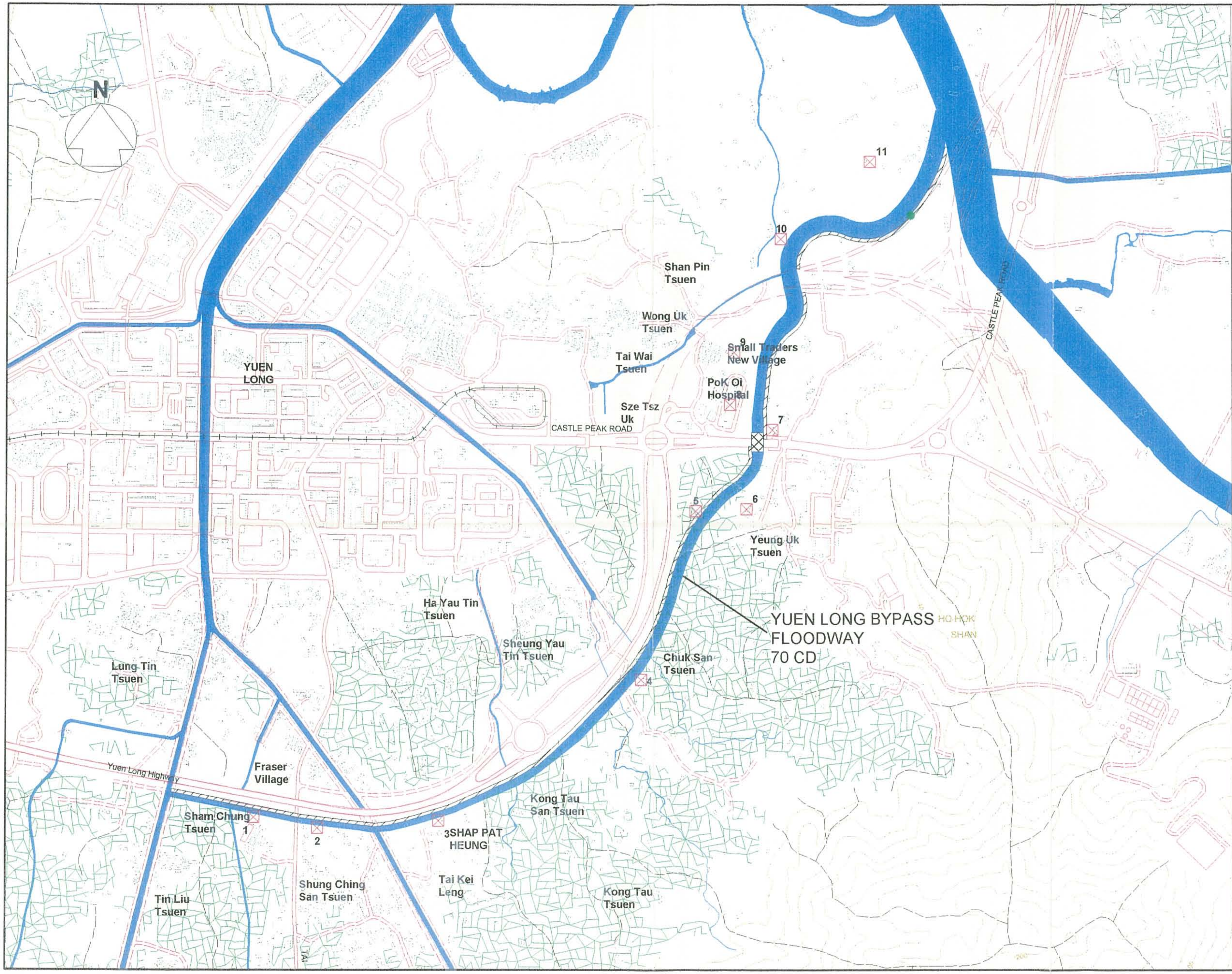
7.6.4 In the interim period, the odour problems can be minimised by dredging the river bed more often so as to remove the odorous sediments.

**7.7 Overall Conclusions**

7.7.1 It is not likely that the air quality in the Study Area will be subjected to any significant construction and operational impacts.

7.7.2 The construction impact assessment showed that with the implementation of the mitigation measures, the air quality during the construction phase can be kept at the acceptable levels.

7.7.3 During the operational phase, the odour nuisance associated with the pollutants in the Yuen Long Bypass Floodway can be reduced to an acceptable levels provided that mitigation measures are implemented.






Legend :

- Existing and Future Watercourses
- Noise Sensitive Receiver
- Likely Location of Haul Road
- Proposed Multi-celled Box Culvert at Castle Peak Road Crossing Point
- Location of the Low Flow Pumping Station

| revision | date | description | | initial |
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| | designed | checked | drawn | checked |
| initial | GY | AJT | LC | CWC |
| date | 1/98 | 1/98 | 1/98 | 1/98 |

AGREEMENT NO. CE 79/96

project

YUEN LONG BYPASS FLOODWAY FEASIBILITY STUDY

EIA STUDY REPORT

figure title

LOCATION OF REPRESENTATIVE NOISE SENSITIVE RECEIVERS

| figure no. | scale |
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新界北拓展處
NEW TERRITORIES NORTH DEVELOPMENT OFFICE

拓展署
Territory Development Department, Hong Kong

consultant

BINNIE CONSULTANTS LIMITED
賓尼工程顧問有限公司
ENGINEERS AND SCIENTISTS
賓尼

# 8. NOISE IMPACT ASSESSMENT

## 8.1 Construction Noise

*Introduction*

8.1.1 This section assesses the potential noise impacts during construction of the Yuen Long Bypass Floodway (YLBF). It is anticipated that noise from the use of powered mechanical equipment on site and the haulage of fill material on- and off-site will cause a nuisance to the nearby existing noise sensitive receivers.

8.1.2 In general terms, the methodology used involves the following steps:

(i) identification of the most likely worst case scenario from the construction programme;

(ii) identification of the nearest representative Noise Sensitive Receivers (NSRs) to the work site;

(iii) calculation of the total Sound Power Level (SWL) of equipment to be used;

(iv) calculation of Predicted Noise Level (PNL) based on distance attenuation from the notional noise source point to the NSRs; and

(v) comparison of the construction noise levels with relevant standards.

8.1.3 Mitigation measures are then considered if construction noise levels are expected to exceed standards.

*Noise Assessment Criteria*

8.1.4 Environmental legislation and standards for construction noise are listed in Appendix C & E.

*Construction Programme and Sequence*

8.1.5 The Project is programmed to commence in January 2001 and is expected to be completed in December 2003.

8.1.6 Construction of the YLBF is expected to be carried out from the downstream end to the upstream to facilitate draining of the works site. However, the contractor may start at isolated sections to suit his allocation of resources and to maintain access across the channel banks. It is likely that box culverts for the project may be built early for the contractor to maintain access.

8.1.7 Construction will start with site clearance and excavation to the required formation level. The channel sides will then be battered back to the required angle. Granular material and blinding layer will be placed along the sides and base. Finally, the base will be formed with concrete while the sides will be either concreted or grasscreted. A maintenance /access road will then be built along the edge of the channel.

8.1.8 The main construction activities during construction of the YLBF which have been identified to generate potential impacts at nearby NSRs include the following:

(i) site clearance and excavation;
(ii) forming of channel sides;
(iii) placing of granular material and blinding layer; and
(iv) concreting of channel base and sides.

8.1.9 In addition, there will be construction traffic noise from the haul road. It is anticipated that no percussive piling will be required.

8.1.10 During site clearance any existing buildings or structures will need to be demolished before excavation can begin. The area which requires breaking of structures is relatively small and the duration is expected to be short and therefore will have minimal impact.

8.1.11 A multi-celled box culvert is proposed at the Castle Peak Road crossing point to avoid disruption of traffic. It is anticipated that the existing dual 3 lane Castle Peak Road can be restricted to a dual 2 lane during the construction period, allowing for an open cut method of construction. The work generally involves breaking up of the existing surface, excavation of a trench, followed by construction of the concrete box culvert. The trench will then be backfilled and compacted before the surface is reinstated.

8.1.12 All other activities will be of small scale such that the noise contribution will be insignificant when compared to the aforementioned construction activities.

***Emission Inventory***

8.1.13 The likely type, quantity and the SWL for each type of Powered Mechanical Equipment (PME) used during construction of the YLBF and the multi-celled box culvert are tabulated in Table 8.1a-8.1b below. It should be noted that this is an assumption of the likely equipment to be used. The actual construction equipment will be determined by the contractors performing the works. A 50% time usage on certain equipment has been assumed in the calculations. This is to avoid an overestimation of the PNL since in actual construction it is rare that all construction equipment will be operating at the same time.

## Table 8.1a
## Construction Equipment during Construction of the YLBF

| Equipment | TM Reference Code | Number of Equipment | SWL per piece (dB(A)) | Total SWL (dB(A)) |
|---|---|---|---|---|
| ***Site Clearance/Excavation Works*** | | | | |
| Excavator | 081 | 1 | 112 | 116.3 |
| Dump truck* | 067 | 1 | 117 | |
| Water pump (electric) | 281 | 6 | 88 | |
| Generator, silenced | 102 | 1 | 100 | |
| ***Forming Channel Sides*** | | | | |
| Crane, mobile* | 048 | 1 | 112 | 111.9 |
| Compactor, vibratory | 050 | 2 | 105 | |
| Water pump (electric) | 281 | 6 | 88 | |
| Generator, silenced | 102 | 1 | 100 | |
| ***Channel Side Foundation*** | | | | |
| Crane, mobile* | 048 | 1 | 112 | 112.4 |
| Lorry* | 141 | 1 | 112 | |
| Water pump (electric) | 281 | 6 | 88 | |
| Generator, silenced | 102 | 1 | 100 | |
| ***Concreting of Channel*** | | | | |
| Concrete lorry mixer* | 044 | 1 | 109 | 114.5 |
| Poker, vibratory* | 170 | 2 | 113 | |
| Concrete Pump* | 047 | 1 | 109 | |

Notes:
TM Technical Memorandum on Noise from Construction Works other than Percussive Piling
SWL Sound Power Level
* assuming 50% on time usage

**Table 8.1b**
**Construction Equipment during Construction of the Multi-celled Box Culvert**

| Equipment | TM Reference Code | Number of Equipment | SWL per piece (dB(A)) | Total SWL (dB(A)) |
|---|---|---|---|---|
| ***Concrete Breaking*** | | | | |
| Pneumatic breaker | 027 | 1 | 122 | 122.0 |
| ***Excavation Works*** | | | | |
| Excavator | 081 | 1 | 112 | 116.3 |
| Dump truck* | 067 | 1 | 117 | |
| Water pump (electric) | 281 | 6 | 88 | |
| Generator, silenced | 102 | 1 | 100 | |
| ***Construction of Box Culvert*** | | | | |
| Crane, mobile* | 048 | 1 | 112 | 115.2 |
| Concrete lorry mixer* | 044 | 1 | 109 | |
| Poker, vibratory* | 170 | 2 | 113 | |
| Water pump (electric) | 281 | 6 | 88 | |
| Generator, silenced | 102 | 1 | 100 | |
| ***Backfilling Works*** | | | | |
| Excavator* | 081 | 1 | 112 | 112.8 |
| Crane, mobile* | 048 | 1 | 112 | |
| Compactor, vibratory | 050 | 1 | 105 | |
| ***Resurfacing Works*** | | | | |
| Asphalt paver | 004 | 1 | 109 | 113.5 |
| Road roller | 185 | 1 | 108 | |
| Lorry* | 141 | 1 | 112 | |

TM Technical Memorandum on Noise from Construction Works other than Percussive Piling
SWL Sound Power Level
* assuming 50% on time usage

8.1.14 The sound power level for each type of PME is quoted from the following sources:

(i) *Technical Memorandum on Noise from Construction Work Other Than Percussive Piling, EPD (TM).*

(ii) *BS5228: Part 1: 1984 British Standard Noise Control on Construction and Open Sites, Code of Practice for Basic Information and Procedure for Noise Control.*

***Representative Noise Sensitive Receivers***

8.1.15 A considerable number of NSRs exist along the proposed floodway. Representative NSRs (RNSRs) have been chosen from the NSRs for noise prediction (Figure 8.1). A description of the sensitive receivers is tabulated below in Table 8.2.

**Table 8.2**
**Representative NSRs during Construction Phase**

| NSR | Description | mPD | no. of storeys |
|---|---|---|---|
| 1 | village house at Sham Chung Tsuen | 6.7 | 2 |
| 2 | village house at Shung Chung San Tsuen | 7.5 | 1 |
| 3 | village house at Tai Kei Leng | 8.1 | 1 |
| 4 | village house | 7.2 | 1 |
| 5 | village house at Yeung Uk Tsuen | 5.6 | 1 |
| 6 | village house at Yeung Uk Tsuen | 5.5 | 1 |
| 7 | San Kong Hotel | 6.1 | 4 |
| 8 | Pok Oi Hospital | 5.0 | 5 |
| 9 | Small Traders New Village Public School | 4.4 | 1 |
| 10 | village house | 3.5 | 1 |
| 11 | village house | 6.7 | 1 |

*Assessment Approach*

8.1.16 The construction noise impact is divided into two parts, the first is the noise due to the various construction activities employing PME, the second is the noise from haulage traffic. The noise levels at the RNSRs due to these two components are added together logarithmically. It is expected during concreting works on the channel that all of the transporting of fill will be finished in the immediate vicinity, therefore no loading and haulage traffic is assumed during that stage.

8.1.17 The assessment was undertaken on the assumption that all construction equipment is located at a notional noise source and is operating simultaneously at the same time. In order to avoid an overestimated PNL, a 50% time usage of certain mobile equipment has been assumed in the calculations. Details of the assessment methodology and calculation are shown in Appendix E.

8.1.18 To simulate a worst case scenario during the construction of the multi-celled box culvert, it is assumed that it will be conducted concurrently with the construction of the YLBF. The noisiest activity during construction of the YLBF (excavation works) was assumed to be concurrent with the noisiest activity during construction of the multi-celled box culvert (surface breaking). Construction works on the multi-celled box culvert will be restricted around the Castle Peak Road crossing point therefore RNSRs 7 and 8 (San Kong Hotel and Pok Oi Hospital) will be the main affected NSRs.

*Predicted Noise Levels (PNL)*

8.1.19 The PNLs for the different construction activities are tabulated below in Tables 8.3a - 8.3e. The worst case scenario during construction of multi-celled box culvert is tabulated in Table 8.3f. Details of the calculations are included in Appendix E.

**Table 8.3a**
**The PNLs during Site Clearance / Excavation Works**

| NSR | Construction Activities | T. SWL (dB(A)) | Distance (m) | PNL (dB(A)) |
|---|---|---|---|---|
| 1 | Site clearance / excavation works<br>Haul road traffic* | 116.3<br>69.9 | 18<br>- | 86.3 |
| 2 | Site clearance / excavation works<br>Haul road traffic* | 116.3<br>69.9 | 16<br>- | 87.3 |
| 3 | Site clearance / excavation works<br>Haul road traffic* | 116.3<br>69.1 | 26<br>- | 83.2 |
| 4 | Site clearance / excavation works<br>Haul road traffic* | 116.3<br>68.1 | 30<br>- | 81.9 |
| 5 | Site clearance / excavation works<br>Haul road traffic* | 116.3<br>77.7 | 25<br>- | 84.4 |
| 6 | Site clearance / excavation works<br>Haul road traffic* | 116.3<br>64.7 | 80<br>- | 73.8 |
| 7 | Site clearance / excavation works<br>Haul road traffic* | 116.3<br>68.6 | 47<br>- | 78.3 |
| 8 | Site clearance / excavation works<br>Haul road traffic* | 116.3<br>64.2 | 90<br>- | 72.9 |
| 9 | Site clearance / excavation works<br>Haul road traffic* | 116.3<br>64.4 | 87<br>- | 73.1 |
| 10 | Site clearance / excavation works<br>Haul road traffic* | 116.3<br>66.5 | 40<br>- | 79.5 |
| 11 | Site clearance / excavation works<br>Haul road traffic* | 116.3<br>61.8 | 170<br>- | 69.5 |

* details of haul road traffic calculations are shown in Appendix E.

**Table 8.3b**
**The PNLs during Forming of Channel Sides**

| NSR | Construction Activities | T. SWL (dB(A)) | Distance (m) | PNL (dB(A)) |
|---|---|---|---|---|
| 1 | Forming of channel sides<br>Haul road traffic* | 111.9<br>69.9 | 18<br>- | 82.0 |
| 2 | Forming of channel sides<br>Haul road traffic* | 111.9<br>69.9 | 16<br>- | 83.0 |
| 3 | Forming of channel sides<br>Haul road traffic* | 111.9<br>69.1 | 26<br>- | 79.0 |
| 4 | Forming of channel sides<br>Haul road traffic* | 111.9<br>68.1 | 30<br>- | 77.8 |
| 5 | Forming of channel sides<br>Haul road traffic* | 111.9<br>77.7 | 25<br>- | 81.4 |
| 6 | Forming of channel sides<br>Haul road traffic* | 111.9<br>64.7 | 80<br>- | 70.3 |
| 7 | Forming of channel sides<br>Haul road traffic* | 111.9<br>68.6 | 47<br>- | 74.7 |
| 8 | Forming of channel sides<br>Haul road traffic* | 111.9<br>64.2 | 90<br>- | 69.4 |
| 9 | Forming of channel sides<br>Haul road traffic* | 111.9<br>64.4 | 87<br>- | 69.6 |
| 10 | Forming of channel sides<br>Haul road traffic* | 111.9<br>66.5 | 40<br>- | 75.4 |
| 11 | Forming of channel sides<br>Haul road traffic* | 111.9<br>61.8 | 170<br>- | 65.1 |

* details of haul road traffic calculations are shown in Appendix E.

**Table 8.3c**
**The PNLs during Channel Sides Foundation**

| NSR | Construction Activities | T. SWL (dB(A)) | Distance (m) | PNL (dB(A)) |
|---|---|---|---|---|
| 1 | Channel sides foundation<br>Haul road traffic* | 112.4<br>69.9 | 18<br>- | 82.5 |
| 2 | Channel sides foundation<br>Haul road traffic* | 112.4<br>69.9 | 16<br>- | 83.5 |
| 3 | Channel sides foundation<br>Haul road traffic* | 112.4<br>69.1 | 26<br>- | 79.5 |
| 4 | Channel sides foundation<br>Haul road traffic* | 112.4<br>68.1 | 30<br>- | 78.3 |
| 5 | Channel sides foundation<br>Haul road traffic* | 112.4<br>77.7 | 25<br>- | 81.7 |
| 6 | Channel sides foundation<br>Haul road traffic* | 112.4<br>64.7 | 80<br>- | 70.6 |
| 7 | Channel sides foundation<br>Haul road traffic* | 112.4<br>68.6 | 47<br>- | 75.1 |
| 8 | Channel sides foundation<br>Haul road traffic* | 112.4<br>64.2 | 90<br>- | 69.7 |
| 9 | Channel sides foundation<br>Haul road traffic* | 112.4<br>64.4 | 87<br>- | 70.0 |
| 10 | Channel sides foundation<br>Haul road traffic* | 112.4<br>66.5 | 40<br>- | 75.9 |
| 11 | Channel sides foundation<br>Haul road traffic* | 112.4<br>61.8 | 170<br>- | 65.3 |

* details of haul road traffic calculations are shown in Appendix E.

**Table 8.3d**
**The PNLs during Concreting Works**

| NSR | Construction Activities | T. SWL (dB(A)) | Distance (m) | PNL (dB(A)) |
|---|---|---|---|---|
| 1 | Concreting works | 114.5 | 18 | 84.4 |
| 2 | Concreting works | 114.5 | 16 | 85.4 |
| 3 | Concreting works | 114.5 | 26 | 81.2 |
| 4 | Concreting works | 114.5 | 30 | 79.9 |
| 5 | Concreting works | 114.5 | 25 | 81.5 |
| 6 | Concreting works | 114.5 | 80 | 71.4 |
| 7 | Concreting works | 114.5 | 47 | 76.1 |
| 8 | Concreting works | 114.5 | 90 | 70.4 |
| 9 | Concreting works | 114.5 | 87 | 70.7 |
| 10 | Concreting works | 114.5 | 40 | 77.5 |
| 11 | Concreting works | 114.5 | 170 | 64.9 |

* details of haul road traffic calculations are shown in Appendix E.

**Table 8.3e**
**The PNLs during Construction of the Multi-celled Box Culvert**

| NSR | Construction Activities | T. SWL (dB(A)) | Distance (m) | PNL (dB(A)) |
|---|---|---|---|---|
| 7 | Surface breaking | 122.0 | 50 | 83.0 |
| | Excavation works | 116.3 | 50 | 77.3 |
| | Construction of box culvert | 115.2 | 50 | 76.2 |
| | Backfilling works | 112.8 | 50 | 73.8 |
| | Resurfacing works | 113.5 | 50 | 74.5 |
| 8 | Surface breaking | 122.0 | 113 | 75.9 |
| | Excavation works | 116.3 | 113 | 70.2 |
| | Construction of box culvert | 115.2 | 113 | 69.1 |
| | Backfilling works | 112.8 | 113 | 66.7 |
| | Resurfacing works | 113.5 | 113 | 67.4 |

**Table 8.3f**
**The PNLs during Construction of the Multi-celled Box Culvert**
**(Worst Case Scenario)**

| NSR | Construction Activities | T. SWL (dB(A)) | Distance (m) | PNL (dB(A)) | PNL (dB(A)) |
|---|---|---|---|---|---|
| 7 | Surface breaking | 122.0 | 50 | 83.0 | 84.3 |
| | Excavation works<br>Haul road traffic* | 116.3<br>68.6 | 47<br>- | 78.3 | |
| 8 | Surface breaking | 122.0 | 113 | 75.9 | 77.7 |
| | Excavation works<br>Haul road traffic* | 116.3<br>64.2 | 90<br>- | 72.9 | |

* details of haul road traffic calculations are shown in Appendix E.

***Impact Evaluation and Recommended Mitigation Measures***

8.1.20 The PNLs shows that construction noise will exceed the daytime noise criteria of 75 dB(A) at most of the NSRs. It should be noted that these noise levels represent the maximum anticipated noise levels that may be experienced at some time during the construction works. However, these levels would not persist for the duration of the whole Project.

8.1.21 Mitigation measures are required and the following forms of mitigation are recommended.

*Reducing the Number of Equipment/Construction Works in Areas Close to NSRs*

8.1.22 Noise can be reduced by increasing the distance between the operating equipment and the NSRs or by reducing the number of items of equipment, construction activity in the area and/or duration of construction at any one time. By controlling the number of items of particularly noisy equipment operating near NSRs (particularly sensitive NSRs like schools), noise levels can be reduced by about 3 dB(A).

*Noise Control on Equipment*

8.1.23 Equipment noise can be effectively reduced by means of silencers, mufflers, acoustic linings or shields. The engines of equipment such as bulldozers, excavators and other earthmoving plant generate most of the noise. Sound absorbing linings to the engine compartments; effective engine exhaust silencers; and sound baffles mounted at all openings to the engine compartments can reduce noise levels by around 3 dB(A). Crawler cranes also create noise nuisance if they are not kept well greased and properly serviced.

*Use of Quiet Plant and Working Methods*

8.1.24 The use of quiet plant and working methods can further reduce noise levels. Quiet plant is defined as Powered Mechanical Equipment (PME) whose actual sound power level is less than the value specified in the TMs for the same piece of equipment. To allow the Contractor some flexibility to select equipment to suit his needs, it is considered too restrictive to specify which specific items of silenced equipment to be used for the construction operations. It should be noted that various types of silenced equipment can be found in Hong Kong and are readily available on the market.

Examples of SWLs for specific silenced PME that may be used during construction are shown below:

- Dump truck max SWL : 110 dB(A);
- Excavator max SWL : 105 dB(A);
- Vibratory poker max SWL : 110 dB(A);
- Lorry max SWL : 105 dB(A); and
- Concrete pump max SWL : 105 dB(A)

Note: Mouchel Asia Ltd., "*Feasibility Study for Route 16 from West Kowloon to Sha Tin - Environmental Impact Assessment Report*" (1996) Highways Department

Some common quiet working methods applicable to site clearance and excavation works includes:

- avoid any sudden banging and clanging of materials or equipment;
- avoid sudden revving of engine on any mobile plant; and
- avoid dumping of materials onto dump truck at a great height and to dump as slowly and as quietly as possible.

*Use of Temporary Noise Barrier*

8.1.25 Noise can also be reduced by construction of barriers which screen the lower floors from viewing the sites. These barriers should be gap free and have a surface mass density of at least 20 kg/m$^2$. Materials of this density include brick, concrete and composite material comprising of minimum 50 mm thick sound absorbing lining with 10 mm thick plywood (or 1 mm thick steel) backing These barriers reduce noise by about 5 dB(A). If barriers fully screen equipment from the view of any NSR, noise reduction will be about 10 dB(A).

8.1.26 It should be possible for the Contractor to construct temporary noise barriers in the form of site hoardings. A 2.5 m high temporary noise barrier should be sufficient to reduce noise levels provided the barriers have no openings or gaps and have a superficial surface density of at least 20 kg/m$^2$. Since most of the worst affected NSRs are village houses of 1 to 2 storeys, the height of the barrier is considered to be adequate in providing the necessary protection to most of the affected NSRs.

8.1.27 The Contractor should ensure that the noise barrier is properly maintained at all times, any gaps or openings should be repaired promptly to ensure its effectiveness.

8.1.28 Provided the Contractor implements the recommended mitigation measures, construction noise levels can be kept to reasonable levels at all times. The noise levels before and after mitigation are shown in Table 8.4a - 8.4e and discussed below.

Site Clearance/Excavation Works

8.1.29 Assessment has indicated that unmitigated construction activities would cause exceedances at most of the NSRs. Table 8.4a shows the noise levels with and without mitigation during site clearance/excavation works.

**Table 8.4a**
**Comparison of Noise Levels With and Without Specific Mitigation during Site Clearance/Excavation Works**

| RNSRs | unmitigated PNL dB(A) | ANL* dB(A) | exceedance of noise criteria before mitigation dB(A) | mitigated PNL** dB(A) | further mitigated PNL*** dB(A) | exceedance of noise criteria after mitigation dB(A) |
|---|---|---|---|---|---|---|
| 1 | 86.3 | 75 | yes ≈ 11.3 | 80.3 | 75.3 | no |
| 2 | 87.3 | 75 | yes ≈ 12.3 | 81.3 | 76.3 | yes ≈ 1.3[a] |
| 3 | 83.2 | 75 | yes ≈ 8.2 | 77.2 | 72.2 | no |
| 4 | 81.9 | 75 | yes ≈ 6.9 | 75.9 | 70.9 | no |
| 5 | 84.4 | 75 | yes ≈ 9.4 | 78.4 | 73.4 | no |
| 6 | 73.8 | 75 | no | 67.8 | 62.8 | no |
| 7 | 78.3 | 75 | yes ≈ 3.3 | 72.3 | 67.3 | no |
| 8 | 72.9 | - | N/A | 66.9 | 61.9 | N/A |
| 9+ | 73.1 | 70 | yes ≈ 3.1 | 67.1 | 62.1 | no |
| 10 | 79.5 | 75 | yes ≈ 4.5 | 73.5 | 68.5 | no |
| 11 | 69.5 | 75 | no | 63.5 | 58.5 | no |

+ school
* ANL 75 dB(A) for residences and 70 dB(A) for school based on EPD's ProPECC PN/2/93.
** Assuming 3 dB(A) reduction from using acoustic lining/shield, silencer or muffler on earthmoving plant's engine.
Assuming 3 dB(A) reduction from limiting of equipment and/or construction activity and reduction of construction duration.
*** Assuming 5 dB(A) reduction from noise barrier in the form of site hoarding.
a Marginal exceedances; the use of quiet equipment and working methods should alleviate the problem. Alternatively a more effective noise barrier should be constructed to provide additional noise reduction.

Forming of Channel Sides and Base

8.1.30 Assessment has indicated that unmitigated construction activities would cause exceedances at some of the NSRs. Table 8.4b shows the noise levels with and without mitigation during forming of channel sides and base.

**Table 8.4b**
**Comparison of Noise Levels With and Without Specific Mitigation during Forming of Channel Sides and Base**

| RNSRs | unmitigated PNL dB(A) | ANL* dB(A) | exceedance of noise criteria before mitigation dB(A) | mitigated PNL** dB(A) | further mitigated PNL*** dB(A) | exceedance of noise criteria after mitigation dB(A) |
|---|---|---|---|---|---|---|
| 1 | 82.0 | 75 | yes ≈ 7.0 | 76.0 | 71.0 | no |
| 2 | 83.0 | 75 | yes ≈ 8.0 | 77.0 | 72.0 | no |
| 3 | 79.0 | 75 | yes ≈ 4.0 | 73.0 | 68.0 | no |
| 4 | 77.8 | 75 | yes ≈ 2.8 | 71.8 | 66.8 | no |
| 5 | 81.4 | 75 | yes ≈ 6.4 | 75.4 | 70.4 | no |
| 6 | 70.3 | 75 | no | 64.3 | 59.3 | no |
| 7 | 74.7 | 75 | no | 68.7 | 63.7 | no |
| 8 | 69.4 | - | N/A | 63.4 | 58.4 | N/A |
| 9+ | 69.6 | 70 | no | 63.6 | 58.6 | no |
| 10 | 75.4 | 75 | yes ≈ 0.4 | 69.4 | 64.4 | no |
| 11 | 65.1 | 75 | no | 59.1 | 54.1 | no |

+ school
* ANL 75 dB(A) for residences and 70 dB(A) for school based on EPD's ProPECC PN/2/93.
** Assuming 3 dB(A) reduction from using acoustic lining/shield, silencer or muffler on earthmoving plant's engine.
Assuming 3 dB(A) reduction from limiting of equipment and/or construction activity and reduction of construction duration.
*** Assuming 5 dB(A) reduction from noise barrier in the form of site hoarding.

Channel Sides Foundation

8.1.31 Assessment has indicated that unmitigated construction activities would cause exceedances at some of the NSRs. Table 8.4c shows the noise levels with and without mitigation during foundation of channel sides.

**Table 8.4c**
**Comparison of Noise Levels With and Without Specific Mitigation during Foundation of Channel Sides**

| RNSRs | unmitigated PNL dB(A) | ANL* dB(A) | exceedance of noise criteria before mitigation dB(A) | mitigated PNL** dB(A) | further mitigated PNL*** dB(A) | exceedance of noise criteria after mitigation dB(A) |
|---|---|---|---|---|---|---|
| 1 | 82.5 | 75 | yes ≈ 7.5 | 76.5 | 71.5 | no |
| 2 | 83.5 | 75 | yes ≈ 8.5 | 77.5 | 72.5 | no |
| 3 | 79.5 | 75 | yes ≈ 4.5 | 73.5 | 68.5 | no |
| 4 | 78.3 | 75 | yes ≈ 3.3 | 72.3 | 67.3 | no |
| 5 | 81.7 | 75 | yes ≈ 6.7 | 75.7 | 70.7 | no |
| 6 | 70.6 | 75 | no | 64.6 | 59.6 | no |
| 7 | 75.1 | 75 | no | 69.1 | 64.1 | no |
| 8 | 69.7 | - | N/A | 63.7 | 58.7 | N/A |
| 9+ | 70.0 | 70 | no | 64.0 | 59.0 | no |
| 10 | 75.9 | 75 | yes ≈ 0.9 | 69.9 | 64.9 | no |
| 11 | 65.3 | 75 | no | 59.3 | 54.3 | no |

\+ school
* ANL 75 dB(A) for residences and 70 dB(A) for school based on EPD's ProPECC PN/2/93.
** Assuming 3 dB(A) reduction from using acoustic lining/shield, silencer or muffler on earthmoving plant's engine.
Assuming 3 dB(A) reduction from limiting of equipment and/or construction activity and reduction of construction duration.
*** Assuming 5 dB(A) reduction from noise barrier in the form of site hoarding.

Concreting of Channel

8.1.32 Assessment has indicated that unmitigated construction activities would cause exceedances at some of the NSRs. Table 8.4d shows the noise levels with and without mitigation during concreting of the channel.

**Table 8.4d**
**Comparison of Noise Levels With and Without Specific Mitigation during Concreting of Channel**

| RNSRs | unmitigated PNL dB(A) | ANL* dB(A) | exceedance of noise criteria before mitigation dB(A) | mitigated PNL** dB(A) | further mitigated PNL*** dB(A) | exceedance of noise criteria after mitigation dB(A) |
|---|---|---|---|---|---|---|
| 1 | 84.4 | 75 | yes ≈ 9.4 | 78.4 | 73.4 | no |
| 2 | 85.4 | 75 | yes ≈ 10.4 | 79.4 | 74.4 | no |
| 3 | 81.2 | 75 | yes ≈ 6.2 | 75.2 | 70.2 | no |
| 4 | 79.9 | 75 | yes ≈ 4.9 | 73.9 | 68.9 | no |
| 5 | 81.5 | 75 | yes ≈ 6.5 | 75.5 | 70.5 | no |
| 6 | 71.4 | 75 | no | 65.4 | 60.4 | no |
| 7 | 76.1 | 75 | yes ≈ 1.1 | 70.1 | 65.1 | no |
| 8 | 70.4 | - | N/A | 64.4 | 59.4 | N/A |
| 9+ | 70.7 | 70 | yes ≈ 0.7 | 64.7 | 59.7 | no |
| 10 | 77.5 | 75 | yes ≈ 2.5 | 71.5 | 66.5 | no |
| 11 | 64.9 | 75 | no | 58.9 | 53.9 | no |

+ school
* ANL 75 dB(A) for residences and 70 dB(A) for school based on EPD's ProPECC PN/2/93.
** Assuming 3 dB(A) reduction from using acoustic lining/shield, silencer or muffler on earthmoving plant's engine.
Assuming 3 dB(A) reduction from limiting of equipment and/or construction activity and reduction of construction duration.
*** Assuming 5 dB(A) reduction from noise barrier in the form of site hoarding.

Construction of the Multi-celled Box Culvert

8.1.33 Assessment has indicated that unmitigated construction activities would cause exceedances at the NSRs. Table 8.4e shows the noise levels with and without mitigation during construction of the multi-celled box culvert.

**Table 8.4e**
**Comparison of Noise Levels With and Without Specific Mitigation during Construction of the Multi-celled Box Culvert (Worst Case Scenario)**

| RNSRs | unmitigated PNL - worst case scenario dB(A) | ANL* dB(A) | exceedance of noise criteria before mitigation dB(A) | mitigated PNL** dB(A) | further mitigated PNL*** dB(A) | exceedance of noise criteria after mitigation dB(A) |
|---|---|---|---|---|---|---|
| 7 | 84.3 | 75 | yes ≈ 9.3 | 78.3 | 73.3 | no |
| 8 | 77.7 | - | N/A | 71.7 | 66.7 | N/A |

+ school
* ANL 75 dB(A) for residences and 70 dB(A) for school based on EPD's ProPECC PN/2/93.
** Assuming 3 dB(A) reduction from using acoustic lining/shield, silencer or muffler on earthmoving plant's engine.
Assuming 3 dB(A) reduction from limiting of equipment and/or construction activity and reduction of construction duration.
*** Assuming 5 dB(A) reduction from noise barrier in the form of site hoarding.

### *Environmental Monitoring and Audit (EM&A) Requirement*

8.1.34 In view of the potentially high construction noise levels, monitoring of noise levels at appropriate NSRs throughout the construction phase is recommended. The purpose of the monitoring is to ensure that construction takes place with a minimum adverse impact to the nearby NSRs. The noise monitoring programme to be implemented during the construction period is outlined in the Environmental Monitoring and Audit (EM&A) Manual.

### *Mitigation Clauses*

8.1.35 The following sections outline the mitigation clauses recommended for inclusion in the EM&A Manual and the Contract documents.

8.1.36 The Contractor should consider noise as an environmental constraint in the planning and execution of the Works.

8.1.37 The Contractor should comply with the *Noise Control Ordinance (Cap 400)* and with any regulations made under the Ordinance, including restrictions placed on noise from construction work and the requirements to seek CNPs. Before commencing work which requires CNPs, the Contractor should obtain these permits and display them appropriately.

8.1.38 In addition to the requirements imposed by the *Noise Control Ordinance*, to control noise generated from equipment and activities for the purpose of carrying out any construction work other than percussive piling, during the time period from 0700 to 1900 hours, on any day not being a general holiday (including Sundays), the following requirements shall also be complied with:

(a) The noise level measured at 1 m from the most affected external facade of the nearby noise sensitive receivers from the construction work alone during any 30 minute period shall not exceed an equivalent noise level (Leq) of 75 dB(A).

(b) The noise level measured at 1 m from the most affected external facade of the nearby schools from the construction work alone during any 30 minute period shall not exceed an equivalent noise level (Leq) of 70 dB(A) [65 dB(A) during school examination periods].

The Contractor shall liaise with the schools and the Examination Authority to ascertain the exact dates and times of all examination periods during the course of the contract.

(c) The Contractor shall, before the start of the Project, inform and liaise with the authority of the Pok Oi Hospital on the timing, duration of the Project, the noise to which the Hospital may be exposed to and the measures being taken to limit the nuisance.

The Contractor shall take all practical measures so as to minimize the noise impact on the Hospital and ensure that noise form the Project be kept to a minimum as far as practicable.

(d) Should the limits stated in the above sub-clauses (a) and (b), be exceeded, the construction shall stop and shall not recommence until appropriate measures acceptable to the Engineer, that are necessary for compliance, have been implemented.

Any stoppage or reduction in output resulting from compliance with this clause shall not entitle the Contractor to any extension of time for completion or to any additional costs whatsoever.

8.1.39 The Contractor shall devise, arrange methods of working and carry out the Works in such a manner so as to minimise noise impacts on the surrounding environment, and shall provide experienced personnel with suitable training to ensure that these methods are implemented.

8.1.40 Before the commencement of any work, the Engineer may require the methods of working, equipment and sound-reducing measures intended to be used on the Site to be made available for inspection and approval to ensure that they are suitable for the project.

8.1.41 The Contractor shall ensure that all plant and equipment to be used on the Site likely to cause excessive noise be effectively sound-reduced by means of silencers, mufflers, acoustic linings or shields, acoustic sheds or screens or other means to avoid disturbance to any nearby NSRs. All hand-held percussive breakers and air compressors will comply with the *Noise Control (Hand-held Percussive Breakers) Regulations and Noise Control (Air Compressors) Regulations* respectively under the *Noise Control Ordinance (Ordinance No. 75/88, NCO Amendment 1992 No. 6).*

8.1.42 The Contractor shall ensure that all plant and equipment to be used on site are properly maintained in good operating condition.

8.1.43 It is recommended that construction noise should be mitigated using a suitable combination of the following measures:

(a) Noisy equipment and activities should be sited by the Contractor as far from close-proximity sensitive receivers as is practical. Prolonged operation of noisy equipment close to dwellings and school should be avoided.

(b) Noisy plant or processes should be replaced by quieter alternatives where possible. Silenced diesel and gasoline generators and power units, as well as silenced and super-silenced air compressors, can be readily obtained.

(c) Noisy activities should be scheduled to minimise exposure of nearby sensitive receivers to high levels of construction noise. For example, noisy activities can be scheduled for midday, or at times coinciding with periods of high background noise (such as during peak traffic hours).

(d) Idle equipment should be turned off or throttled down. Noisy equipment should be properly maintained and used no more often than is necessary.

(e) The power units of non-electric stationary plant and earth-moving plant should be quietened by vibration isolation and partial or full acoustic enclosures for individual noise-generating components.

(f) Construction activities should be planned so that parallel operation of several sets of equipment close to a given receiver is avoided thus reducing the cumulative impacts between operations. The numbers of operating items of powered mechanical equipment should be minimised.

(g) Construction plant should be properly maintained and operated. Construction equipment often has silencing measures built in or added on, e.g. bulldozer silencers, compressor panels, and mufflers. Silencing measures should be properly maintained and utilised.

(h) Equipment known to emit sound strongly in one direction, should, where possible, be oriented so that the noise is directed away from nearby NSRs.

(i) Material stockpiles and other structures should be effectively utilised, where practicable, to screen noise from on-site construction activities.

(j) A noise barrier in the form of a 2.5 m high site hoarding should be built along the site boundary in the vicinity of nearby noise sensitive receivers as required. These temporary noise barriers should be gap free and have a surface mass density of 20 kg/m². The Contractor should ensure that the noise barrier is properly maintained at all times and that any gaps or opening should be repaired promptly to ensure its effectiveness.

8.1.44 For the purposes of the above clauses, any domestic premises, hotels, hostel, temporary housing accommodation, hospital, medical clinic, educational institution, place of public worship, library, court of law, performing arts centre or office building shall be considered a noise sensitive receiver.

8.1.45 Notwithstanding the requirements and limitations set out and subject to the clauses above, the Engineer may upon application in writing by the Contractor, allow the use of any equipment and the carrying out of any construction activities for any duration provided that he is satisfied with the application which, in his opinion, to be of absolute necessity and adequate noise insulation has been provided to the educational institutions to be affected, or of emergency nature, and not in contravention with the *Noise Control Ordinance* in any respect.

***Residual Impacts***

8.1.46 Provided the Contractor implements the recommended mitigation measures, construction noise levels can be kept to reasonable levels at all times. No residual impact is expected. A noise monitoring programme will be implemented to ensure the noise impacts would be kept within the recommended noise criteria throughout the construction works.

The area adjacent to the proposed low flow pumping station is currently zoned as 'Undetermined'. The proposed pumping station will be located adjacent to several extensive infrastructure projects, namely Route 3 Highway and Kam Tin River. Any potential future noise sensitive development will be at a distance unlikely to be affected by the operation of the pumping station.

## 8.2 Operational Noise

8.2.1 During operational phase, it is not expected that the proposed YLBF will have any significant noise impact. Traffic travelling along the access road and the pumping facilities installed at the pumping station are likely to be the only noise sources during the operational phase of the Project.

8.2.2 An access road will be built along the entire length of the YLBF. In accordance with recent government policy the access road will be built to HyD standards, maintained by HyD and open to the public. Traffic using this road is unlikely to be significant since most of the traffic will be from local villages. It is probable that DSD would utilize the access road for maintenance purposes at approximately 6 month intervals.

8.2.3 A low flow pumping station is proposed near the northern part of the YLBF. Location of the proposed low flow pumping station is shown in Figure 8.1 and its general layout is shown in Figure 8.2. The nearest NSR (RNSR 11) is some 210 m away from the pumping station. Since the pumping facilities will be situated inside an enclosed structure, the noise level associated with the pumping station is not expected to be significant.

## 8.3 Impact Summary and Conclusion

*Construction Noise*

8.3.1 Noise from the use of powered mechanical equipment on site and the haulage of fill material on- and off-site will cause a nuisance to the nearby existing noise sensitive receivers.

8.3.2 The construction noise assessment shows that unmitigated noise levels could exceed EPD's recommended maximum noise levels for day-time construction work when construction activities occur in close proximity to noise sensitive receivers or when several construction works occur simultaneously.

8.3.3 Exceedances of noise level is unavoidable because of the close proximity between the construction works and the NSRs. Effective noise mitigation measures will be necessary for the construction works to meet the criteria.

8.3.4 The use of quiet plant and working methods, reducing the number of equipment, restricting the number of works and the use of substantial noise barriers to protect the closest residences and schools has been recommended and should be sufficient to reduce noise levels to compliant levels at the NSRs.

cut trenches. Leveling, compacting and resurfacing of the trenches will not involve significant movement of materials, hence dust impacts will not be significant. However proper watering of exposed dirt surface should be undertaken throughout the construction phase to ensure that the cumulative impacts of these and other concurrent works comply with the AQOs at all times.

***Dust Suppression Measures***

7.5.22 As presented above, the site formation works are likely to cause short-term unacceptable dust impact on all of the representative sensitive receivers. The following dust control measures as part of good construction practice should be incorporated in the Contract Specification and implemented to minimise dust nuisance to within acceptable levels arising from the works:

(i) The Contractor shall undertake at all times to prevent dust nuisance as a result of his activities. Effective dust suppression measures as are necessary should be installed to ensure that the air quality, at the boundary of the site and at any sensitive receivers, complies with the Hong Kong Air Quality Objectives.

(ii) The Contractor shall frequently clean and water the Site to minimise fugitive dust emissions.

(iii) Effective water sprays shall be used during the delivery and handling of all raw sand and aggregate, and other similar materials, when dust is likely to be created and to dampen all stored materials during dry and windy weather.

(iv) Areas within the Site where there is a regular movement of vehicles must be regularly watered as often as is necessary for effective suppression of dust or as often as directed by the Engineer. In most instances it will necessary to water haul roads on an hourly basis.

(v) Should a conveyor system be used, the contractor shall implement the following precaution measures. Conveyor belts shall be fitted with windboards, ad conveyor transfer points and hopper discharge areas shall be enclosed to minimize dust emission. all conveyors under the contractor's control and carrying materials which have the potential to create dust shall be totally enclosed and fitted with belt cleaners.

(vi) Where dusty materials are being discharged to vehicle from a conveying system at a fixed transfer point, a three-sided roofed enclosure with a flexible curtain across the entry shall be provided. Exhaust fans shall be provided for this enclosure and vented to a suitable fabric filter system.

(vii) The Contractor shall confine haulage and delivery vehicles to designated roadways inside the Site. If in the opinion of the Engineer, any motorized vehicle is causing dust nuisance, the Engineer may require that the vehicle be restricted to a maximum speed of 15 km per hour while within the Site.

(viii) Wheel washing facilities shall be installed and used by all vehicles leaving the Site. No earth, mud, debris, dust and the like shall be deposited on public roads. Water in the wheel cleaning facility shall be changed at frequent intervals and sediments shall be removed regularly. The Contractor shall submit details of proposals for the wheel cleaning facilities to the Engineer prior to construction of the facility. Such wheel washing facilities shall be usable prior to any earthworks excavation activity on the Site. The Contractor shall also provide a hard-surfaced road between any washing facility and the public road.

(ix) All site vehicle exhausts should be directed vertically upwards or directed away from ground.

***EM&A Requirement***

7.5.23 The mitigation measures recommended above should ensure that dust levels are kept at acceptable levels throughout the Project construction phase. Environmental monitoring and audit (EM&A) of dust should be undertaken at the most critical ASRs during construction to ensure that compliance with statutory limits is maintained. Details of the proposed EM&A requirements will be provided in the EM&A Manual.

***Conclusions***

7.5.24 The air quality assessment has assessed the dust impacts associated with the construction phase of the Project. The assessment has concluded that:

(i) The worst case scenario will occur during the site formation of the proposed Yuen Long Bypass Floodway because there would be a large quantity of earth works and frequent truck movements over dirt roads.

(ii) Without adequate mitigation, dust levels generated by the site formation works are likely to exceed the Air Quality Objectives at the nearby air sensitive receivers.

(iii) The transport of material by trucks travelling over dirt haul roads is the principal source of excessive dust generation.

(iv) Mitigation measures sufficient to ensure compliance with the Air Quality Objectives have been included in the assessment. As a result, school, hospital and hotel nearby the subject site will be within AQOs.

(v) An environmental monitoring and audit programme has been formulated to ensure compliance is maintained.

## 7.6 Operational Impact Assessment

***Introduction***

7.6.1 During the operational phase of the YLBF, the pollutant source is odour from the nearby nullahs and streams that will enter into the low flow channel of the proposed bypass floodway.

***Odour Impact Assessment***

*Odour arising from nullahs*

7.6.2 There are two nullahs and several streams located within the Study Area, namely Main Nullah, San Hui Nullah, Sham Chung Stream and several un-named stream courses. Odour from the nullahs and streams are the major odour nuisance. The odour arises from pollutants in the water. The major source of pollutants is animal wastes washed down from upstream pig farms. In addition, the current sewerage system in the Yuen Long South Development Area (such as Area 13 & 14) is 'less formalised' and uncontrolled discharge of sewage into the drainage nullahs is a common practice.

***Mitigation Measures***

7.6.3 The Livestock Waste Control Scheme was implemented in July 1, 1997. Since the Livestock Waste Control Scheme has been implemented and enforced, substantial reduction in pollutant levels have resulted. As the construction of the YLBF will not begin until early 2001, theoretically the control scheme should be fully in operation in time for the new influx of residents in Yuen Long South Development. The discharges from the pig farms scattered in the Study Area should therefore have been treated before being discharged into the nullahs. Thus odour nuisance should not be an issue.

7.6.4 In the interim period, the odour problems can be minimised by dredging the river bed more often so as to remove the odorous sediments.

## 7.7 Overall Conclusions

7.7.1 It is not likely that the air quality in the Study Area will be subjected to any significant construction and operational impacts.

7.7.2 The construction impact assessment showed that with the implementation of the mitigation measures, the air quality during the construction phase can be kept at the acceptable levels.

7.7.3 During the operational phase, the odour nuisance associated with the pollutants in the Yuen Long Bypass Floodway can be reduced to an acceptable levels provided that mitigation measures are implemented.

# 8. NOISE IMPACT ASSESSMENT

## 8.1 Construction Noise

### *Introduction*

8.1.1 This section assesses the potential noise impacts during construction of the Yuen Long Bypass Floodway (YLBF). It is anticipated that noise from the use of powered mechanical equipment on site and the haulage of fill material on- and off-site will cause a nuisance to the nearby existing noise sensitive receivers.

8.1.2 In general terms, the methodology used involves the following steps:

(i) identification of the most likely worst case scenario from the construction programme;

(ii) identification of the nearest representative Noise Sensitive Receivers (NSRs) to the work site;

(iii) calculation of the total Sound Power Level (SWL) of equipment to be used;

(iv) calculation of Predicted Noise Level (PNL) based on distance attenuation from the notional noise source point to the NSRs; and

(v) comparison of the construction noise levels with relevant standards.

8.1.3 Mitigation measures are then considered if construction noise levels are expected to exceed standards.

### *Noise Assessment Criteria*

8.1.4 Environmental legislation and standards for construction noise are listed in Appendix C & E.

### *Construction Programme and Sequence*

8.1.5 The Project is programmed to commence in January 2001 and is expected to be completed in December 2003.

8.1.6 Construction of the YLBF is expected to be carried out from the downstream end to the upstream to facilitate draining of the works site. However, the contractor may start at isolated sections to suit his allocation of resources and to maintain access across the channel banks. It is likely that box culverts for the project may be built early for the contractor to maintain access.

8.1.7 Construction will start with site clearance and excavation to the required formation level. The channel sides will then be battered back to the required angle. Granular material and blinding layer will be placed along the sides and base. Finally, the base will be formed with concrete while the sides will be either concreted or grasscreted. A maintenance /access road will then be built along the edge of the channel.

8.1.8 The main construction activities during construction of the YLBF which have been identified to generate potential impacts at nearby NSRs include the following:

(i) site clearance and excavation;
(ii) forming of channel sides;
(iii) placing of granular material and blinding layer; and
(iv) concreting of channel base and sides.

8.1.9 In addition, there will be construction traffic noise from the haul road. It is anticipated that no percussive piling will be required.

8.1.10 During site clearance any existing buildings or structures will need to be demolished before excavation can begin. The area which requires breaking of structures is relatively small and the duration is expected to be short and therefore will have minimal impact.

8.1.11 A multi-celled box culvert is proposed at the Castle Peak Road crossing point to avoid disruption of traffic. It is anticipated that the existing dual 3 lane Castle Peak Road can be restricted to a dual 2 lane during the construction period, allowing for an open cut method of construction. The work generally involves breaking up of the existing surface, excavation of a trench, followed by construction of the concrete box culvert. The trench will then be backfilled and compacted before the surface is reinstated.

8.1.12 All other activities will be of small scale such that the noise contribution will be insignificant when compared to the aforementioned construction activities.

***Emission Inventory***

8.1.13 The likely type, quantity and the SWL for each type of Powered Mechanical Equipment (PME) used during construction of the YLBF and the multi-celled box culvert are tabulated in Table 8.1a-8.1b below. It should be noted that this is an assumption of the likely equipment to be used. The actual construction equipment will be determined by the contractors performing the works. A 50% time usage on certain equipment has been assumed in the calculations. This is to avoid an overestimation of the PNL since in actual construction it is rare that all construction equipment will be operating at the same time.

**Table 8.1a**
**Construction Equipment during Construction of the YLBF**

| Equipment | TM Reference Code | Number of Equipment | SWL per piece (dB(A)) | Total SWL (dB(A)) |
|---|---|---|---|---|
| ***Site Clearance/Excavation Works*** | | | | |
| Excavator | 081 | 1 | 112 | 116.3 |
| Dump truck* | 067 | 1 | 117 | |
| Water pump (electric) | 281 | 6 | 88 | |
| Generator, silenced | 102 | 1 | 100 | |
| ***Forming Channel Sides*** | | | | |
| Crane, mobile* | 048 | 1 | 112 | 111.9 |
| Compactor, vibratory | 050 | 2 | 105 | |
| Water pump (electric) | 281 | 6 | 88 | |
| Generator, silenced | 102 | 1 | 100 | |
| ***Channel Side Foundation*** | | | | |
| Crane, mobile* | 048 | 1 | 112 | 112.4 |
| Lorry* | 141 | 1 | 112 | |
| Water pump (electric) | 281 | 6 | 88 | |
| Generator, silenced | 102 | 1 | 100 | |
| ***Concreting of Channel*** | | | | |
| Concrete lorry mixer* | 044 | 1 | 109 | 114.5 |
| Poker, vibratory* | 170 | 2 | 113 | |
| Concrete Pump* | 047 | 1 | 109 | |

Notes:
TM Technical Memorandum on Noise from Construction Works other than Percussive Piling
SWL Sound Power Level
* assuming 50% on time usage

**Table 8.1b**
**Construction Equipment during Construction of the Multi-celled Box Culvert**

| Equipment | TM Reference Code | Number of Equipment | SWL per piece (dB(A)) | Total SWL (dB(A)) |
|---|---|---|---|---|
| ***Concrete Breaking*** | | | | |
| Pneumatic breaker | 027 | 1 | 122 | 122.0 |
| ***Excavation Works*** | | | | |
| Excavator | 081 | 1 | 112 | 116.3 |
| Dump truck* | 067 | 1 | 117 | |
| Water pump (electric) | 281 | 6 | 88 | |
| Generator, silenced | 102 | 1 | 100 | |
| ***Construction of Box Culvert*** | | | | |
| Crane, mobile* | 048 | 1 | 112 | 115.2 |
| Concrete lorry mixer* | 044 | 1 | 109 | |
| Poker, vibratory* | 170 | 2 | 113 | |
| Water pump (electric) | 281 | 6 | 88 | |
| Generator, silenced | 102 | 1 | 100 | |
| ***Backfilling Works*** | | | | |
| Excavator* | 081 | 1 | 112 | 112.8 |
| Crane, mobile* | 048 | 1 | 112 | |
| Compactor, vibratory | 050 | 1 | 105 | |
| ***Resurfacing Works*** | | | | |
| Asphalt paver | 004 | 1 | 109 | 113.5 |
| Road roller | 185 | 1 | 108 | |
| Lorry* | 141 | 1 | 112 | |

TM Technical Memorandum on Noise from Construction Works other than Percussive Piling
SWL Sound Power Level
* assuming 50% on time usage

8.1.14 The sound power level for each type of PME is quoted from the following sources:

(i) *Technical Memorandum on Noise from Construction Work Other Than Percussive Piling, EPD (TM).*

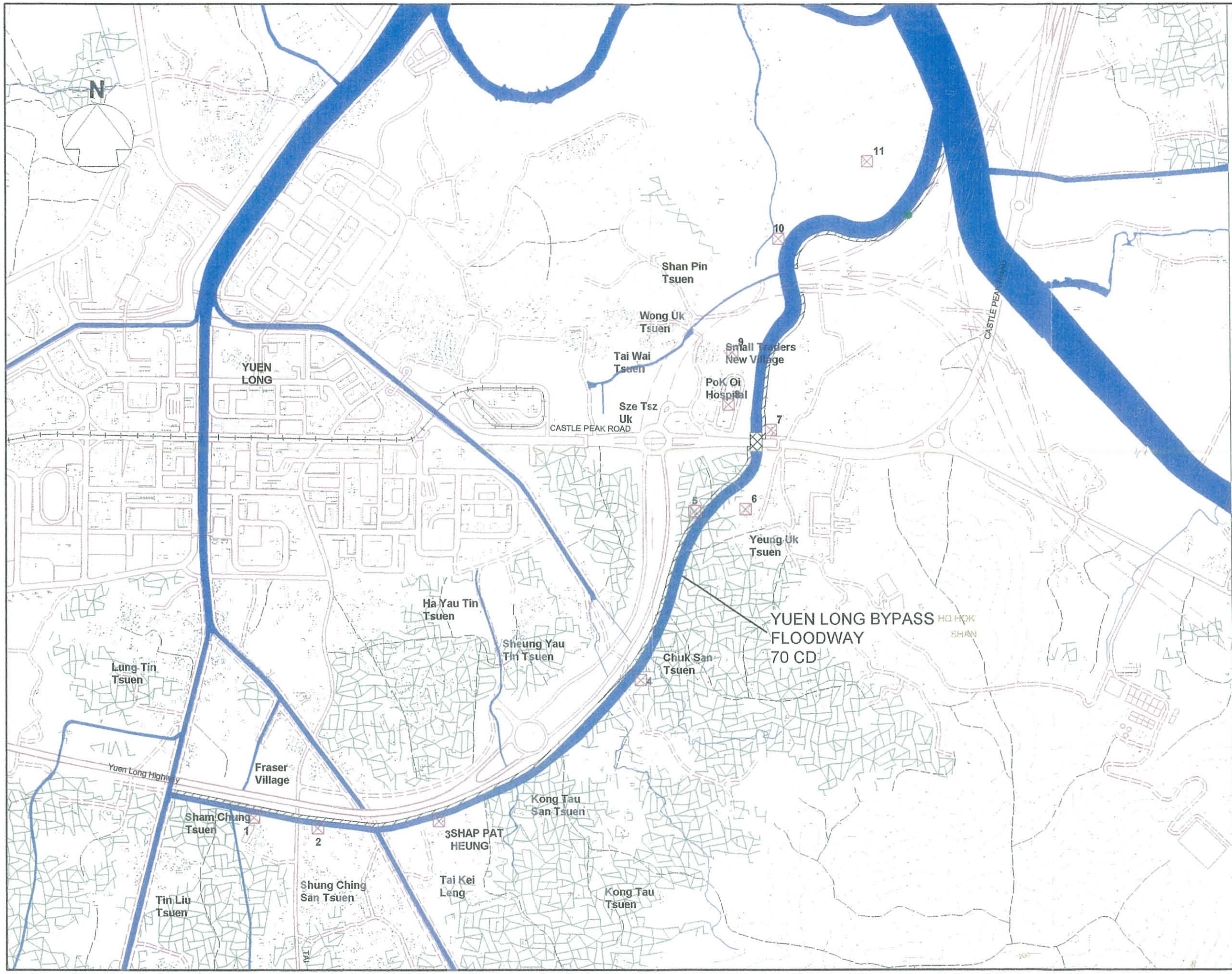
(ii) *BS5228: Part 1: 1984 British Standard Noise Control on Construction and Open Sites, Code of Practice for Basic Information and Procedure for Noise Control.*

***Representative Noise Sensitive Receivers***

8.1.15 A considerable number of NSRs exist along the proposed floodway. Representative NSRs (RNSRs) have been chosen from the NSRs for noise prediction (Figure 8.1). A description of the sensitive receivers is tabulated below in Table 8.2.

**Table 8.2**
**Representative NSRs during Construction Phase**

| NSR | Description | mPD | no. of storeys |
|---|---|---|---|
| 1 | village house at Sham Chung Tsuen | 6.7 | 2 |
| 2 | village house at Shung Chung San Tsuen | 7.5 | 1 |
| 3 | village house at Tai Kei Leng | 8.1 | 1 |
| 4 | village house | 7.2 | 1 |
| 5 | village house at Yeung Uk Tsuen | 5.6 | 1 |
| 6 | village house at Yeung Uk Tsuen | 5.5 | 1 |
| 7 | San Kong Hotel | 6.1 | 4 |
| 8 | Pok Oi Hospital | 5.0 | 5 |
| 9 | Small Traders New Village Public School | 4.4 | 1 |
| 10 | village house | 3.5 | 1 |
| 11 | village house | 6.7 | 1 |

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Legend :

- Existing and Future Watercourses
- Noise Sensitive Receiver
- Likely Location of Haul Road
- Proposed Multi-celled Box Culvert at Castle Peak Road Crossing Point
- Location of the Low Flow Pumping Station

| revision | date | description | | | initial |
|---|---|---|---|---|---|
| | designed | checked | drawn | | checked |
| initial | GY | AJT | LC | | CWC |
| date | 1/98 | 1/98 | 1/98 | | 1/98 |

AGREEMENT NO. CE 79/96

project

YUEN LONG BYPASS FLOODWAY FEASIBILITY STUDY

EIA STUDY REPORT

figure title

LOCATION OF REPRESENTATIVE NOISE SENSITIVE RECEIVERS

figure no. 8.1

scale N.T.S

新界北拓展處
NEW TERRITORIES NORTH DEVELOPMENT OFFICE
拓展署
Territory Development Department, Hong Kong

consultant

BINNIE CONSULTANTS LIMITED
賓尼工程顧問有限公司
ENGINEERS AND SCIENTISTS
賓尼

*Assessment Approach*

8.1.16 The construction noise impact is divided into two parts, the first is the noise due to the various construction activities employing PME, the second is the noise from haulage traffic. The noise levels at the RNSRs due to these two components are added together logarithmically. It is expected during concreting works on the channel that all of the transporting of fill will be finished in the immediate vicinity, therefore no loading and haulage traffic is assumed during that stage.

8.1.17 The assessment was undertaken on the assumption that all construction equipment is located at a notional noise source and is operating simultaneously at the same time. In order to avoid an overestimated PNL, a 50% time usage of certain mobile equipment has been assumed in the calculations. Details of the assessment methodology and calculation are shown in Appendix E.

8.1.18 To simulate a worst case scenario during the construction of the multi-celled box culvert, it is assumed that it will be conducted concurrently with the construction of the YLBF. The noisiest activity during construction of the YLBF (excavation works) was assumed to be concurrent with the noisiest activity during construction of the multi-celled box culvert (surface breaking). Construction works on the multi-celled box culvert will be restricted around the Castle Peak Road crossing point therefore RNSRs 7 and 8 (San Kong Hotel and Pok Oi Hospital) will be the main affected NSRs.

*Predicted Noise Levels (PNL)*

8.1.19 The PNLs for the different construction activities are tabulated below in Tables 8.3a - 8.3e. The worst case scenario during construction of multi-celled box culvert is tabulated in Table 8.3f. Details of the calculations are included in Appendix E.

**Table 8.3a**
**The PNLs during Site Clearance / Excavation Works**

| NSR | Construction Activities | T. SWL (dB(A)) | Distance (m) | PNL (dB(A)) |
|---|---|---|---|---|
| 1 | Site clearance / excavation works<br>Haul road traffic* | 116.3<br>69.9 | 18<br>- | 86.3 |
| 2 | Site clearance / excavation works<br>Haul road traffic* | 116.3<br>69.9 | 16<br>- | 87.3 |
| 3 | Site clearance / excavation works<br>Haul road traffic* | 116.3<br>69.1 | 26<br>- | 83.2 |
| 4 | Site clearance / excavation works<br>Haul road traffic* | 116.3<br>68.1 | 30<br>- | 81.9 |
| 5 | Site clearance / excavation works<br>Haul road traffic* | 116.3<br>77.7 | 25<br>- | 84.4 |
| 6 | Site clearance / excavation works<br>Haul road traffic* | 116.3<br>64.7 | 80<br>- | 73.8 |
| 7 | Site clearance / excavation works<br>Haul road traffic* | 116.3<br>68.6 | 47<br>- | 78.3 |
| 8 | Site clearance / excavation works<br>Haul road traffic* | 116.3<br>64.2 | 90<br>- | 72.9 |
| 9 | Site clearance / excavation works<br>Haul road traffic* | 116.3<br>64.4 | 87<br>- | 73.1 |
| 10 | Site clearance / excavation works<br>Haul road traffic* | 116.3<br>66.5 | 40<br>- | 79.5 |
| 11 | Site clearance / excavation works<br>Haul road traffic* | 116.3<br>61.8 | 170<br>- | 69.5 |

* details of haul road traffic calculations are shown in Appendix E.

**Table 8.3b**
**The PNLs during Forming of Channel Sides**

| NSR | Construction Activities | T. SWL (dB(A)) | Distance (m) | PNL (dB(A)) |
|---|---|---|---|---|
| 1 | Forming of channel sides<br>Haul road traffic* | 111.9<br>69.9 | 18<br>- | 82.0 |
| 2 | Forming of channel sides<br>Haul road traffic* | 111.9<br>69.9 | 16<br>- | 83.0 |
| 3 | Forming of channel sides<br>Haul road traffic* | 111.9<br>69.1 | 26<br>- | 79.0 |
| 4 | Forming of channel sides<br>Haul road traffic* | 111.9<br>68.1 | 30<br>- | 77.8 |
| 5 | Forming of channel sides<br>Haul road traffic* | 111.9<br>77.7 | 25<br>- | 81.4 |
| 6 | Forming of channel sides<br>Haul road traffic* | 111.9<br>64.7 | 80<br>- | 70.3 |
| 7 | Forming of channel sides<br>Haul road traffic* | 111.9<br>68.6 | 47<br>- | 74.7 |
| 8 | Forming of channel sides<br>Haul road traffic* | 111.9<br>64.2 | 90<br>- | 69.4 |
| 9 | Forming of channel sides<br>Haul road traffic* | 111.9<br>64.4 | 87<br>- | 69.6 |
| 10 | Forming of channel sides<br>Haul road traffic* | 111.9<br>66.5 | 40<br>- | 75.4 |
| 11 | Forming of channel sides<br>Haul road traffic* | 111.9<br>61.8 | 170<br>- | 65.1 |

* details of haul road traffic calculations are shown in Appendix E.

**Table 8.3c**
**The PNLs during Channel Sides Foundation**

| NSR | Construction Activities | T. SWL (dB(A)) | Distance (m) | PNL (dB(A)) |
|---|---|---|---|---|
| 1 | Channel sides foundation<br>Haul road traffic* | 112.4<br>69.9 | 18<br>- | 82.5 |
| 2 | Channel sides foundation<br>Haul road traffic* | 112.4<br>69.9 | 16<br>- | 83.5 |
| 3 | Channel sides foundation<br>Haul road traffic* | 112.4<br>69.1 | 26<br>- | 79.5 |
| 4 | Channel sides foundation<br>Haul road traffic* | 112.4<br>68.1 | 30<br>- | 78.3 |
| 5 | Channel sides foundation<br>Haul road traffic* | 112.4<br>77.7 | 25<br>- | 81.7 |
| 6 | Channel sides foundation<br>Haul road traffic* | 112.4<br>64.7 | 80<br>- | 70.6 |
| 7 | Channel sides foundation<br>Haul road traffic* | 112.4<br>68.6 | 47<br>- | 75.1 |
| 8 | Channel sides foundation<br>Haul road traffic* | 112.4<br>64.2 | 90<br>- | 69.7 |
| 9 | Channel sides foundation<br>Haul road traffic* | 112.4<br>64.4 | 87<br>- | 70.0 |
| 10 | Channel sides foundation<br>Haul road traffic* | 112.4<br>66.5 | 40<br>- | 75.9 |
| 11 | Channel sides foundation<br>Haul road traffic* | 112.4<br>61.8 | 170<br>- | 65.3 |

* details of haul road traffic calculations are shown in Appendix E.

**Table 8.3d**
**The PNLs during Concreting Works**

| NSR | Construction Activities | T. SWL (dB(A)) | Distance (m) | PNL (dB(A)) |
|---|---|---|---|---|
| 1 | Concreting works | 114.5 | 18 | 84.4 |
| 2 | Concreting works | 114.5 | 16 | 85.4 |
| 3 | Concreting works | 114.5 | 26 | 81.2 |
| 4 | Concreting works | 114.5 | 30 | 79.9 |
| 5 | Concreting works | 114.5 | 25 | 81.5 |
| 6 | Concreting works | 114.5 | 80 | 71.4 |
| 7 | Concreting works | 114.5 | 47 | 76.1 |
| 8 | Concreting works | 114.5 | 90 | 70.4 |
| 9 | Concreting works | 114.5 | 87 | 70.7 |
| 10 | Concreting works | 114.5 | 40 | 77.5 |
| 11 | Concreting works | 114.5 | 170 | 64.9 |

* details of haul road traffic calculations are shown in Appendix E.

**Table 8.3e**
**The PNLs during Construction of the Multi-celled Box Culvert**

| NSR | Construction Activities | T. SWL (dB(A)) | Distance (m) | PNL (dB(A)) |
|---|---|---|---|---|
| 7 | Surface breaking | 122.0 | 50 | 83.0 |
| | Excavation works | 116.3 | 50 | 77.3 |
| | Construction of box culvert | 115.2 | 50 | 76.2 |
| | Backfilling works | 112.8 | 50 | 73.8 |
| | Resurfacing works | 113.5 | 50 | 74.5 |
| 8 | Surface breaking | 122.0 | 113 | 75.9 |
| | Excavation works | 116.3 | 113 | 70.2 |
| | Construction of box culvert | 115.2 | 113 | 69.1 |
| | Backfilling works | 112.8 | 113 | 66.7 |
| | Resurfacing works | 113.5 | 113 | 67.4 |

**Table 8.3f**
**The PNLs during Construction of the Multi-celled Box Culvert**
**(Worst Case Scenario)**

| NSR | Construction Activities | T. SWL (dB(A)) | Distance (m) | PNL (dB(A)) | PNL (dB(A)) |
|---|---|---|---|---|---|
| 7 | Surface breaking | 122.0 | 50 | 83.0 | 84.3 |
| | Excavation works<br>Haul road traffic* | 116.3<br>68.6 | 47<br>- | 78.3 | |
| 8 | Surface breaking | 122.0 | 113 | 75.9 | 77.7 |
| | Excavation works<br>Haul road traffic* | 116.3<br>64.2 | 90<br>- | 72.9 | |

* details of haul road traffic calculations are shown in Appendix E.

*Impact Evaluation and Recommended Mitigation Measures*

8.1.20 The PNLs shows that construction noise will exceed the daytime noise criteria of 75 dB(A) at most of the NSRs. It should be noted that these noise levels represent the maximum anticipated noise levels that may be experienced at some time during the construction works. However, these levels would not persist for the duration of the whole Project.

8.1.21 Mitigation measures are required and the following forms of mitigation are recommended.

*Reducing the Number of Equipment/Construction Works in Areas Close to NSRs*

8.1.22 Noise can be reduced by increasing the distance between the operating equipment and the NSRs or by reducing the number of items of equipment, construction activity in the area and/or duration of construction at any one time. By controlling the number of items of particularly noisy equipment operating near NSRs (particularly sensitive NSRs like schools), noise levels can be reduced by about 3 dB(A).

*Noise Control on Equipment*

8.1.23 Equipment noise can be effectively reduced by means of silencers, mufflers, acoustic linings or shields. The engines of equipment such as bulldozers, excavators and other earthmoving plant generate most of the noise. Sound absorbing linings to the engine compartments; effective engine exhaust silencers; and sound baffles mounted at all openings to the engine compartments can reduce noise levels by around 3 dB(A). Crawler cranes also create noise nuisance if they are not kept well greased and properly serviced.

*Use of Quiet Plant and Working Methods*

8.1.24 The use of quiet plant and working methods can further reduce noise levels. Quiet plant is defined as Powered Mechanical Equipment (PME) whose actual sound power level is less than the value specified in the TMs for the same piece of equipment. To allow the Contractor some flexibility to select equipment to suit his needs, it is considered too restrictive to specify which specific items of silenced equipment to be used for the construction operations. It should be noted that various types of silenced equipment can be found in Hong Kong and are readily available on the market.

Examples of SWLs for specific silenced PME that may be used during construction are shown below:

- Dump truck max SWL : 110 dB(A);
- Excavator max SWL : 105 dB(A);
- Vibratory poker max SWL : 110 dB(A);
- Lorry max SWL : 105 dB(A); and
- Concrete pump max SWL : 105 dB(A)

Note: Mouchel Asia Ltd., "*Feasibility Study for Route 16 from West Kowloon to Sha Tin - Environmental Impact Assessment Report*" (1996) Highways Department

Some common quiet working methods applicable to site clearance and excavation works includes:

- avoid any sudden banging and clanging of materials or equipment;
- avoid sudden revving of engine on any mobile plant; and
- avoid dumping of materials onto dump truck at a great height and to dump as slowly and as quietly as possible.

*Use of Temporary Noise Barrier*

8.1.25 Noise can also be reduced by construction of barriers which screen the lower floors from viewing the sites. These barriers should be gap free and have a surface mass density of at least 20 kg/m$^2$. Materials of this density include brick, concrete and composite material comprising of minimum 50 mm thick sound absorbing lining with 10 mm thick plywood (or 1 mm thick steel) backing These barriers reduce noise by about 5 dB(A). If barriers fully screen equipment from the view of any NSR, noise reduction will be about 10 dB(A).

8.1.26 It should be possible for the Contractor to construct temporary noise barriers in the form of site hoardings. A 2.5 m high temporary noise barrier should be sufficient to reduce noise levels provided the barriers have no openings or gaps and have a superficial surface density of at least 20 kg/m$^2$. Since most of the worst affected NSRs are village houses of 1 to 2 storeys, the height of the barrier is considered to be adequate in providing the necessary protection to most of the affected NSRs.

8.1.27 The Contractor should ensure that the noise barrier is properly maintained at all times, any gaps or openings should be repaired promptly to ensure its effectiveness.

8.1.28 Provided the Contractor implements the recommended mitigation measures, construction noise levels can be kept to reasonable levels at all times. The noise levels before and after mitigation are shown in Table 8.4a - 8.4e and discussed below.

Site Clearance/Excavation Works

8.1.29 Assessment has indicated that unmitigated construction activities would cause exceedances at most of the NSRs. Table 8.4a shows the noise levels with and without mitigation during site clearance/excavation works.

**Table 8.4a**
**Comparison of Noise Levels With and Without Specific Mitigation during Site Clearance/Excavation Works**

| RNSRs | unmitigated PNL dB(A) | ANL* dB(A) | exceedance of noise criteria before mitigation dB(A) | mitigated PNL** dB(A) | further mitigated PNL*** dB(A) | exceedance of noise criteria after mitigation dB(A) |
|---|---|---|---|---|---|---|
| 1 | 86.3 | 75 | yes ≈ 11.3 | 80.3 | 75.3 | no |
| 2 | 87.3 | 75 | yes ≈ 12.3 | 81.3 | 76.3 | yes ≈ 1.3[a] |
| 3 | 83.2 | 75 | yes ≈ 8.2 | 77.2 | 72.2 | no |
| 4 | 81.9 | 75 | yes ≈ 6.9 | 75.9 | 70.9 | no |
| 5 | 84.4 | 75 | yes ≈ 9.4 | 78.4 | 73.4 | no |
| 6 | 73.8 | 75 | no | 67.8 | 62.8 | no |
| 7 | 78.3 | 75 | yes ≈ 3.3 | 72.3 | 67.3 | no |
| 8 | 72.9 | - | N/A | 66.9 | 61.9 | N/A |
| 9[+] | 73.1 | 70 | yes ≈ 3.1 | 67.1 | 62.1 | no |
| 10 | 79.5 | 75 | yes ≈ 4.5 | 73.5 | 68.5 | no |
| 11 | 69.5 | 75 | no | 63.5 | 58.5 | no |

\+ school
* ANL 75 dB(A) for residences and 70 dB(A) for school based on EPD's ProPECC PN/2/93.
** Assuming 3 dB(A) reduction from using acoustic lining/shield, silencer or muffler on earthmoving plant's engine.
Assuming 3 dB(A) reduction from limiting of equipment and/or construction activity and reduction of construction duration.
*** Assuming 5 dB(A) reduction from noise barrier in the form of site hoarding.
a Marginal exceedances; the use of quiet equipment and working methods should alleviate the problem. Alternatively a more effective noise barrier should be constructed to provide additional noise reduction.

Forming of Channel Sides and Base

8.1.30 Assessment has indicated that unmitigated construction activities would cause exceedances at some of the NSRs. Table 8.4b shows the noise levels with and without mitigation during forming of channel sides and base.

**Table 8.4b**
**Comparison of Noise Levels With and Without Specific Mitigation during Forming of Channel Sides and Base**

| RNSRs | unmitigated PNL dB(A) | ANL* dB(A) | exceedance of noise criteria before mitigation dB(A) | mitigated PNL** dB(A) | further mitigated PNL*** dB(A) | exceedance of noise criteria after mitigation dB(A) |
|---|---|---|---|---|---|---|
| 1 | 82.0 | 75 | yes ≈ 7.0 | 76.0 | 71.0 | no |
| 2 | 83.0 | 75 | yes ≈ 8.0 | 77.0 | 72.0 | no |
| 3 | 79.0 | 75 | yes ≈ 4.0 | 73.0 | 68.0 | no |
| 4 | 77.8 | 75 | yes ≈ 2.8 | 71.8 | 66.8 | no |
| 5 | 81.4 | 75 | yes ≈ 6.4 | 75.4 | 70.4 | no |
| 6 | 70.3 | 75 | no | 64.3 | 59.3 | no |
| 7 | 74.7 | 75 | no | 68.7 | 63.7 | no |
| 8 | 69.4 | - | N/A | 63.4 | 58.4 | N/A |
| 9+ | 69.6 | 70 | no | 63.6 | 58.6 | no |
| 10 | 75.4 | 75 | yes ≈ 0.4 | 69.4 | 64.4 | no |
| 11 | 65.1 | 75 | no | 59.1 | 54.1 | no |

+ school
* ANL 75 dB(A) for residences and 70 dB(A) for school based on EPD's ProPECC PN/2/93.
** Assuming 3 dB(A) reduction from using acoustic lining/shield, silencer or muffler on earthmoving plant's engine.
Assuming 3 dB(A) reduction from limiting of equipment and/or construction activity and reduction of construction duration.
*** Assuming 5 dB(A) reduction from noise barrier in the form of site hoarding.

Channel Sides Foundation

8.1.31 Assessment has indicated that unmitigated construction activities would cause exceedances at some of the NSRs. Table 8.4c shows the noise levels with and without mitigation during foundation of channel sides.

**Table 8.4c**
**Comparison of Noise Levels With and Without Specific Mitigation during Foundation of Channel Sides**

| RNSRs | unmitigated PNL dB(A) | ANL* dB(A) | exceedance of noise criteria before mitigation dB(A) | mitigated PNL** dB(A) | further mitigated PNL*** dB(A) | exceedance of noise criteria after mitigation dB(A) |
|---|---|---|---|---|---|---|
| 1 | 82.5 | 75 | yes ≈ 7.5 | 76.5 | 71.5 | no |
| 2 | 83.5 | 75 | yes ≈ 8.5 | 77.5 | 72.5 | no |
| 3 | 79.5 | 75 | yes ≈ 4.5 | 73.5 | 68.5 | no |
| 4 | 78.3 | 75 | yes ≈ 3.3 | 72.3 | 67.3 | no |
| 5 | 81.7 | 75 | yes ≈ 6.7 | 75.7 | 70.7 | no |
| 6 | 70.6 | 75 | no | 64.6 | 59.6 | no |
| 7 | 75.1 | 75 | no | 69.1 | 64.1 | no |
| 8 | 69.7 | - | N/A | 63.7 | 58.7 | N/A |
| $9^+$ | 70.0 | 70 | no | 64.0 | 59.0 | no |
| 10 | 75.9 | 75 | yes ≈ 0.9 | 69.9 | 64.9 | no |
| 11 | 65.3 | 75 | no | 59.3 | 54.3 | no |

+ school
* ANL 75 dB(A) for residences and 70 dB(A) for school based on EPD's ProPECC PN/2/93.
** Assuming 3 dB(A) reduction from using acoustic lining/shield, silencer or muffler on earthmoving plant's engine.
Assuming 3 dB(A) reduction from limiting of equipment and/or construction activity and reduction of construction duration.
*** Assuming 5 dB(A) reduction from noise barrier in the form of site hoarding.

Concreting of Channel

8.1.32 Assessment has indicated that unmitigated construction activities would cause exceedances at some of the NSRs. Table 8.4d shows the noise levels with and without mitigation during concreting of the channel.

**Table 8.4d**
**Comparison of Noise Levels With and Without Specific Mitigation during Concreting of Channel**

| RNSRs | unmitigated PNL dB(A) | ANL* dB(A) | exceedance of noise criteria before mitigation dB(A) | mitigated PNL** dB(A) | further mitigated PNL*** dB(A) | exceedance of noise criteria after mitigation dB(A) |
|---|---|---|---|---|---|---|
| 1 | 84.4 | 75 | yes ≈ 9.4 | 78.4 | 73.4 | no |
| 2 | 85.4 | 75 | yes ≈ 10.4 | 79.4 | 74.4 | no |
| 3 | 81.2 | 75 | yes ≈ 6.2 | 75.2 | 70.2 | no |
| 4 | 79.9 | 75 | yes ≈ 4.9 | 73.9 | 68.9 | no |
| 5 | 81.5 | 75 | yes ≈ 6.5 | 75.5 | 70.5 | no |
| 6 | 71.4 | 75 | no | 65.4 | 60.4 | no |
| 7 | 76.1 | 75 | yes ≈ 1.1 | 70.1 | 65.1 | no |
| 8 | 70.4 | - | N/A | 64.4 | 59.4 | N/A |
| 9+ | 70.7 | 70 | yes ≈ 0.7 | 64.7 | 59.7 | no |
| 10 | 77.5 | 75 | yes ≈ 2.5 | 71.5 | 66.5 | no |
| 11 | 64.9 | 75 | no | 58.9 | 53.9 | no |

\+ school
* ANL 75 dB(A) for residences and 70 dB(A) for school based on EPD's ProPECC PN/2/93.
** Assuming 3 dB(A) reduction from using acoustic lining/shield, silencer or muffler on earthmoving plant's engine.
Assuming 3 dB(A) reduction from limiting of equipment and/or construction activity and reduction of construction duration.
*** Assuming 5 dB(A) reduction from noise barrier in the form of site hoarding.

Construction of the Multi-celled Box Culvert

8.1.33 Assessment has indicated that unmitigated construction activities would cause exceedances at the NSRs. Table 8.4e shows the noise levels with and without mitigation during construction of the multi-celled box culvert.

**Table 8.4e**
**Comparison of Noise Levels With and Without Specific Mitigation during Construction of the Multi-celled Box Culvert (Worst Case Scenario)**

| RNSRs | unmitigated PNL - worst case scenario dB(A) | ANL* dB(A) | exceedance of noise criteria before mitigation dB(A) | mitigated PNL** dB(A) | further mitigated PNL*** dB(A) | exceedance of noise criteria after mitigation dB(A) |
|---|---|---|---|---|---|---|
| 7 | 84.3 | 75 | yes ≈ 9.3 | 78.3 | 73.3 | no |
| 8 | 77.7 | - | N/A | 71.7 | 66.7 | N/A |

\+ school
* ANL 75 dB(A) for residences and 70 dB(A) for school based on EPD's ProPECC PN/2/93.
** Assuming 3 dB(A) reduction from using acoustic lining/shield, silencer or muffler on earthmoving plant's engine.
Assuming 3 dB(A) reduction from limiting of equipment and/or construction activity and reduction of construction duration.
*** Assuming 5 dB(A) reduction from noise barrier in the form of site hoarding.

### *Environmental Monitoring and Audit (EM&A) Requirement*

8.1.34 In view of the potentially high construction noise levels, monitoring of noise levels at appropriate NSRs throughout the construction phase is recommended. The purpose of the monitoring is to ensure that construction takes place with a minimum adverse impact to the nearby NSRs. The noise monitoring programme to be implemented during the construction period is outlined in the Environmental Monitoring and Audit (EM&A) Manual.

### *Mitigation Clauses*

8.1.35 The following sections outline the mitigation clauses recommended for inclusion in the EM&A Manual and the Contract documents.

8.1.36 The Contractor should consider noise as an environmental constraint in the planning and execution of the Works.

8.1.37 The Contractor should comply with the *Noise Control Ordinance (Cap 400)* and with any regulations made under the Ordinance, including restrictions placed on noise from construction work and the requirements to seek CNPs. Before commencing work which requires CNPs, the Contractor should obtain these permits and display them appropriately.

8.1.38 In addition to the requirements imposed by the *Noise Control Ordinance*, to control noise generated from equipment and activities for the purpose of carrying out any construction work other than percussive piling, during the time period from 0700 to 1900 hours, on any day not being a general holiday (including Sundays), the following requirements shall also be complied with:

(a) The noise level measured at 1 m from the most affected external facade of the nearby noise sensitive receivers from the construction work alone during any 30 minute period shall not exceed an equivalent noise level (Leq) of 75 dB(A).

(b) The noise level measured at 1 m from the most affected external facade of the nearby schools from the construction work alone during any 30 minute period shall not exceed an equivalent noise level (Leq) of 70 dB(A) [65 dB(A) during school examination periods].

The Contractor shall liaise with the schools and the Examination Authority to ascertain the exact dates and times of all examination periods during the course of the contract.

(c) The Contractor shall, before the start of the Project, inform and liaise with the authority of the Pok Oi Hospital on the timing, duration of the Project, the noise to which the Hospital may be exposed to and the measures being taken to limit the nuisance.

The Contractor shall take all practical measures so as to minimize the noise impact on the Hospital and ensure that noise form the Project be kept to a minimum as far as practicable.

(d) Should the limits stated in the above sub-clauses (a) and (b), be exceeded, the construction shall stop and shall not recommence until appropriate measures acceptable to the Engineer, that are necessary for compliance, have been implemented.

Any stoppage or reduction in output resulting from compliance with this clause shall not entitle the Contractor to any extension of time for completion or to any additional costs whatsoever.

8.1.39 The Contractor shall devise, arrange methods of working and carry out the Works in such a manner so as to minimise noise impacts on the surrounding environment, and shall provide experienced personnel with suitable training to ensure that these methods are implemented.

8.1.40 Before the commencement of any work, the Engineer may require the methods of working, equipment and sound-reducing measures intended to be used on the Site to be made available for inspection and approval to ensure that they are suitable for the project.

8.1.41 The Contractor shall ensure that all plant and equipment to be used on the Site likely to cause excessive noise be effectively sound-reduced by means of silencers, mufflers, acoustic linings or shields, acoustic sheds or screens or other means to avoid disturbance to any nearby NSRs. All hand-held percussive breakers and air compressors will comply with the *Noise Control (Hand-held Percussive Breakers) Regulations and Noise Control (Air Compressors) Regulations* respectively under the *Noise Control Ordinance (Ordinance No. 75/88, NCO Amendment 1992 No. 6).*

8.1.42 The Contractor shall ensure that all plant and equipment to be used on site are properly maintained in good operating condition.

8.1.43 It is recommended that construction noise should be mitigated using a suitable combination of the following measures:

(a) Noisy equipment and activities should be sited by the Contractor as far from close-proximity sensitive receivers as is practical. Prolonged operation of noisy equipment close to dwellings and school should be avoided.

(b) Noisy plant or processes should be replaced by quieter alternatives where possible. Silenced diesel and gasoline generators and power units, as well as silenced and super-silenced air compressors, can be readily obtained.

(c) Noisy activities should be scheduled to minimise exposure of nearby sensitive receivers to high levels of construction noise. For example, noisy activities can be scheduled for midday, or at times coinciding with periods of high background noise (such as during peak traffic hours).

(d) Idle equipment should be turned off or throttled down. Noisy equipment should be properly maintained and used no more often than is necessary.

(e) The power units of non-electric stationary plant and earth-moving plant should be quietened by vibration isolation and partial or full acoustic enclosures for individual noise-generating components.

(f) Construction activities should be planned so that parallel operation of several sets of equipment close to a given receiver is avoided thus reducing the cumulative impacts between operations. The numbers of operating items of powered mechanical equipment should be minimised.

(g) Construction plant should be properly maintained and operated. Construction equipment often has silencing measures built in or added on, e.g. bulldozer silencers, compressor panels, and mufflers. Silencing measures should be properly maintained and utilised.

(h) Equipment known to emit sound strongly in one direction, should, where possible, be oriented so that the noise is directed away from nearby NSRs.

(i) Material stockpiles and other structures should be effectively utilised, where practicable, to screen noise from on-site construction activities.

(j) A noise barrier in the form of a 2.5 m high site hoarding should be built along the site boundary in the vicinity of nearby noise sensitive receivers as required. These temporary noise barriers should be gap free and have a surface mass density of 20 kg/m². The Contractor should ensure that the noise barrier is properly maintained at all times and that any gaps or opening should be repaired promptly to ensure its effectiveness.

8.1.44 For the purposes of the above clauses, any domestic premises, hotels, hostel, temporary housing accommodation, hospital, medical clinic, educational institution, place of public worship, library, court of law, performing arts centre or office building shall be considered a noise sensitive receiver.

8.1.45 Notwithstanding the requirements and limitations set out and subject to the clauses above, the Engineer may upon application in writing by the Contractor, allow the use of any equipment and the carrying out of any construction activities for any duration provided that he is satisfied with the application which, in his opinion, to be of absolute necessity and adequate noise insulation has been provided to the educational institutions to be affected, or of emergency nature, and not in contravention with the *Noise Control Ordinance* in any respect.

***Residual Impacts***

8.1.46 Provided the Contractor implements the recommended mitigation measures, construction noise levels can be kept to reasonable levels at all times. No residual impact is expected. A noise monitoring programme will be implemented to ensure the noise impacts would be kept within the recommended noise criteria throughout the construction works.

The area adjacent to the proposed low flow pumping station is currently zoned as 'Undetermined'. The proposed pumping station will be located adjacent to several extensive infrastructure projects, namely Route 3 Highway and Kam Tin River. Any potential future noise sensitive development will be at a distance unlikely to be affected by the operation of the pumping station.

## 8.2 Operational Noise

8.2.1 During operational phase, it is not expected that the proposed YLBF will have any significant noise impact. Traffic travelling along the access road and the pumping facilities installed at the pumping station are likely to be the only noise sources during the operational phase of the Project.

8.2.2 An access road will be built along the entire length of the YLBF. In accordance with recent government policy the access road will be built to HyD standards, maintained by HyD and open to the public. Traffic using this road is unlikely to be significant since most of the traffic will be from local villages. It is probable that DSD would utilize the access road for maintenance purposes at approximately 6 month intervals.

8.2.3 A low flow pumping station is proposed near the northern part of the YLBF. Location of the proposed low flow pumping station is shown in Figure 8.1 and its general layout is shown in Figure 8.2. The nearest NSR (RNSR 11) is some 210 m away from the pumping station. Since the pumping facilities will be situated inside an enclosed structure, the noise level associated with the pumping station is not expected to be significant.

## 8.3 Impact Summary and Conclusion

*Construction Noise*

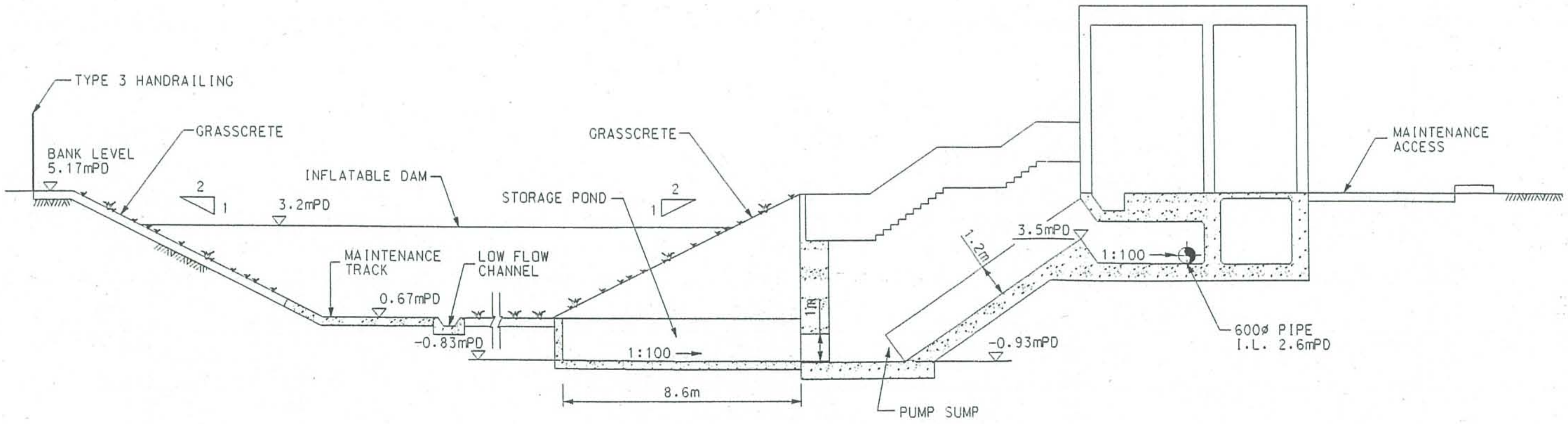
8.3.1 Noise from the use of powered mechanical equipment on site and the haulage of fill material on- and off-site will cause a nuisance to the nearby existing noise sensitive receivers.

8.3.2 The construction noise assessment shows that unmitigated noise levels could exceed EPD's recommended maximum noise levels for day-time construction work when construction activities occur in close proximity to noise sensitive receivers or when several construction works occur simultaneously.

8.3.3 Exceedances of noise level is unavoidable because of the close proximity between the construction works and the NSRs. Effective noise mitigation measures will be necessary for the construction works to meet the criteria.

8.3.4 The use of quiet plant and working methods, reducing the number of equipment, restricting the number of works and the use of substantial noise barriers to protect the closest residences and schools has been recommended and should be sufficient to reduce noise levels to compliant levels at the NSRs.


PLAN




SECTION A-A



NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS STATED OTHERWISE.
2. ALL LEVELS ARE IN METERS ABOVE PRINCIPAL DATUM (mPD).
3. GRID LINES ARE HONG KONG METRIC GRID 1980.

CAUTION
THIS MAY BE A REDUCED SIZE DRAWING. VERIFY SCALES SHOWN BEFORE SCALING THE DRAWING.

| revision | date | description | | initial |
|---|---|---|---|---|
| | designed | checked | drawn | checked |
| initial | GY | AJT | YLL | CWC |
| date | 12/97 | 12/97 | 12/97 | 12/97 |

AGREEMENT NO. CE 79/96

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YUEN LONG BYPASS FLOODWAY FEASIBILITY STUDY

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figure title

PUMPING STATION GENERAL ARRANGEMENT AND TYPICAL CROSS SECTION

| Figure no. | Scale |
|---|---|
| 8.2 | N.T.S. |

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8.3.5 A noise monitoring programme is proposed to ensure construction noise is within the recommended criteria throughout the construction works.

### *Operational Noise*

8.3.6 Noise associated with the access road and the low flow pumping station is not expected to create nuisance to the nearby noise sensitive receivers during operational phase.

# 9. LANDSCAPE AND VISUAL IMPACT ASSESSMENT (L&VIA)

## 9.1 Introduction

9.1.1 This chapter provides an assessment on the potential landscape and visual impacts resulting from the proposed Yuen Long Bypass Floodway (YLBF) and recommends suitable mitigation measures to minimize the potential impact. In addition to the site of the proposed YLBF, some fishponds adjacent to the site will also be affected by temporary occupation during the construction of the proposed YLBF. The potential landscape and visual impacts on these affected adjacent fishponds have also been taken into consideration during this assessment.

9.1.2 The Landscape and Visual Impact Assessment (L&VIA) has been prepared with reference to the guidelines in the Technical Memorandum for Environment Impact Assessment Process (Annexes 10 and 18). The landscape impact study includes: a description of the existing landscape condition of the site and the affected adjacent areas; review of the current and future land uses identified in the Tai Tong, Nam Sang Wai, and Yuen Long Outline Zoning Plans (OZPs) and proposed or committed Government projects; and identification of the potential landscape impact. The visual impact study includes: study of the site context; identification of existing and planned visual receptors with respect to the current site context and land use zoning in the OZPs and proposed/committed Government projects; and identification of potential visual impacts. In the final section of the assessment, mitigation measures for potential landscape and visual impacts are recommended.

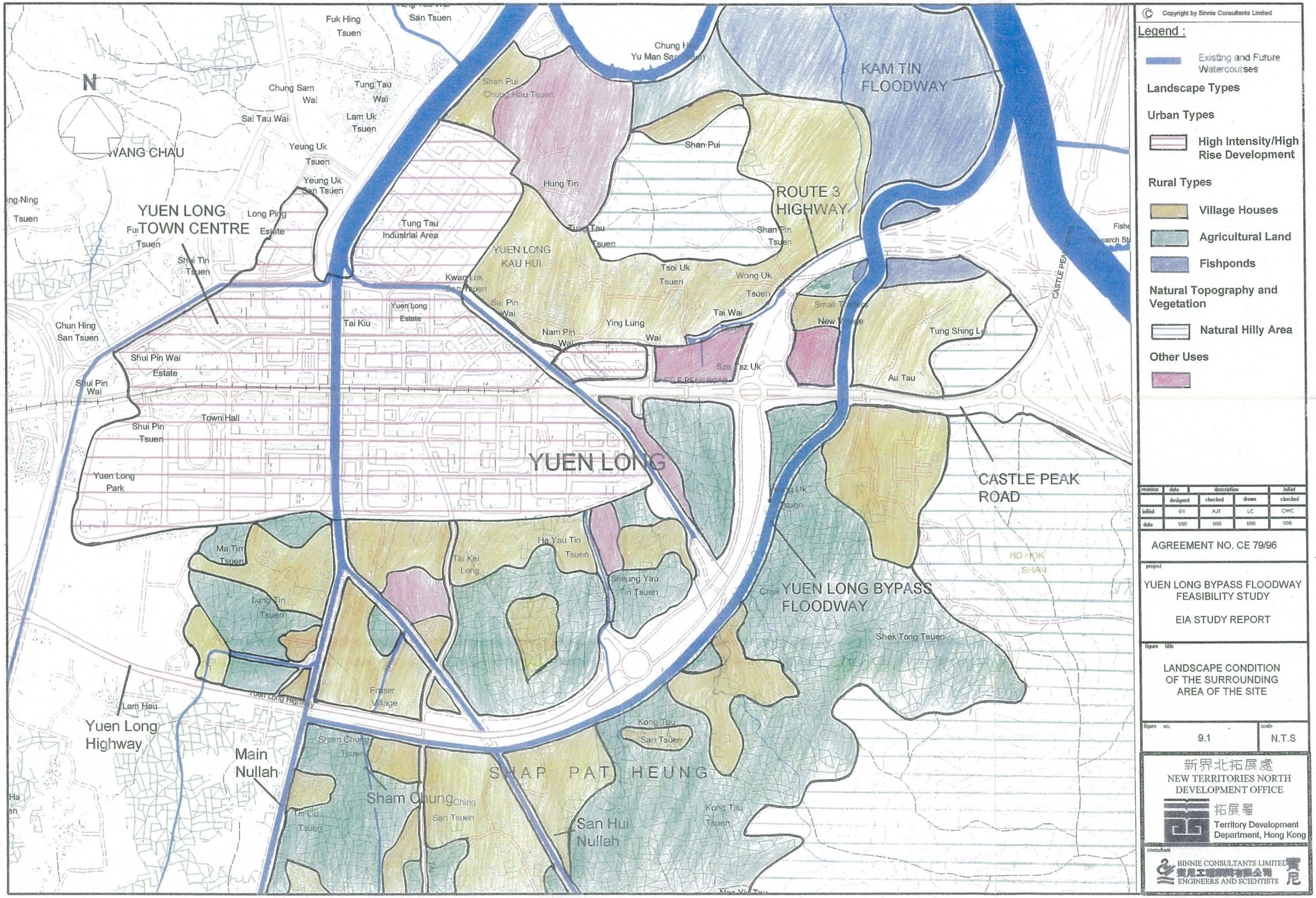
9.1.3 A number of aerial photographs, photomontage and plans are also provided to aid the graphical presentation of the assessment. The Conceptual Landscape Plans which provide chainage details are included in Appendix G.

## 9.2 Landscape Condition and Character of the Site and its Surrounding Areas

9.2.1 This section assesses the landscape character of the site in the light of the current landscape situation and future land uses taking into account the Yuen Long and Tai Tong OZPs and proposed and committed Government projects.

***Existing Landscape Conditions (Figure 9.1 and Plates 9.1-9.3)***

9.2.2 Yuen Long Town Centre comprises high density, high rise urban development. To the southeast of Yuen Long Town Centre is a mix of scattered village houses interspersed with areas of active and inactive agricultural land. Village settlements and agricultural land extend across the border between Yuen Long and Tai Tong and cover the southern and western part of Tai Tong district. The Yuen Long Highway (YLH) truncates this low-lying area which is bordered to the south and east by undeveloped hilly terrain. In the east and northeast of the Yuen Long Town Centre lie mainly fishponds and scattered village houses.



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Legend :
Existing and Future Watercourses
Landscape Types
Urban Types
High Intensity/High Rise Development
Rural Types
Village Houses
Agricultural Land
Fishponds
Natural Topography and Vegetation
Natural Hilly Area
Other Uses
N
WANG CHAU
YUEN LONG TOWN CENTRE
KAM TIN FLOODWAY
ROUTE 3 HIGHWAY
YUEN LONG KAU HUI
YUEN LONG
CASTLE PEAK ROAD
YUEN LONG BYPASS FLOODWAY
SHAP PAT HEUNG
Yuen Long Highway
Main Nullah
San Hui Nullah
Sham Chung
Fuk Hing Tsuen
San Tsuen
Chung Sam Wai
Tung Tau Wai
Sai Tau Wai
Lam Uk Tsuen
Yeung Uk Tsuen
Yeung Uk San Tsuen
Long Ping Estate
Shui Tin Tsuen
Chun Hing San Tsuen
Shui Pin Wai Estate
Shui Pin Wai
Shui Pin Tsuen
Town Hall
Yuen Long Park
Tai Kiu
Yuen Long Estate
Tung Tau Industrial Area
Shan Pui
Chung Hau Tsuen
Hung Tin
Shan Pin Tsuen
Tsoi Uk Tsuen
Wong Uk Tsuen
Tai Wai
Sai Pin Wai
Nam Pin Wai
Ying Lung Wai
Sze Tsz Uk
Small Traders New Village
Tung Shing Lei
Au Tau
Ma Tin Tsuen
Lung Tin Tsuen
Tai Kei Leng
Ha Yau Tin Tsuen
Sheung Yau Tin Tsuen
Fraser Village
Lam Hau
Sham Chung Tsuen
Tin Liu Tsuen
Ching San Tsuen
Kong Tau San Tsuen
Kong Tau Tsuen
Shek Tong Tsuen
HO HOK SHAN
AGREEMENT NO. CE 79/96
YUEN LONG BYPASS FLOODWAY FEASIBILITY STUDY
EIA STUDY REPORT
LANDSCAPE CONDITION OF THE SURROUNDING LAND AREA OF THE SITE
9.1
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**Plate 9.1: Overview of Landscape and Visual Condition of the Site and its Surrounding Areas**

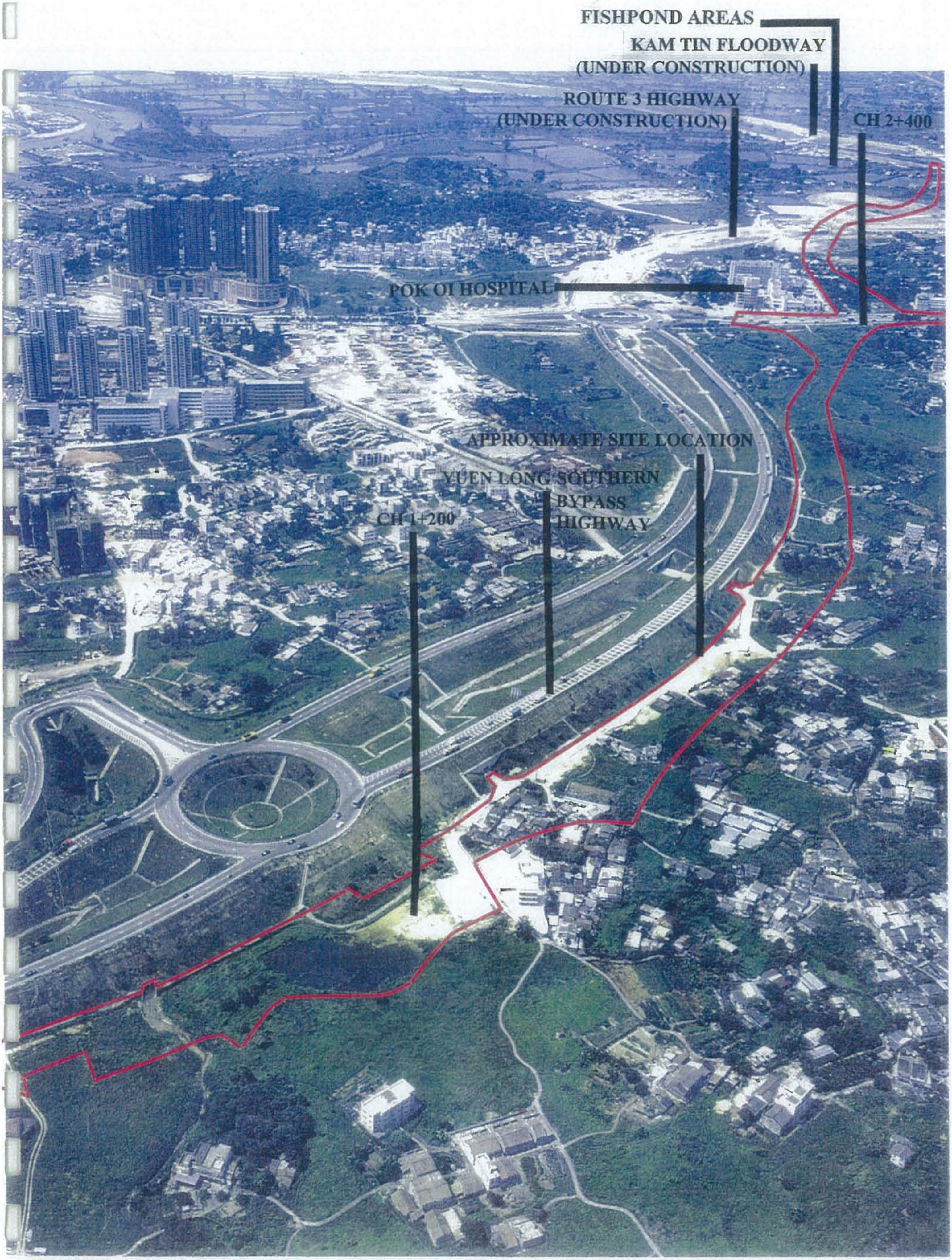



**Plate 9.2: Closer View toward Portion of the Site and its Adjacent Areas near CH 1+200**

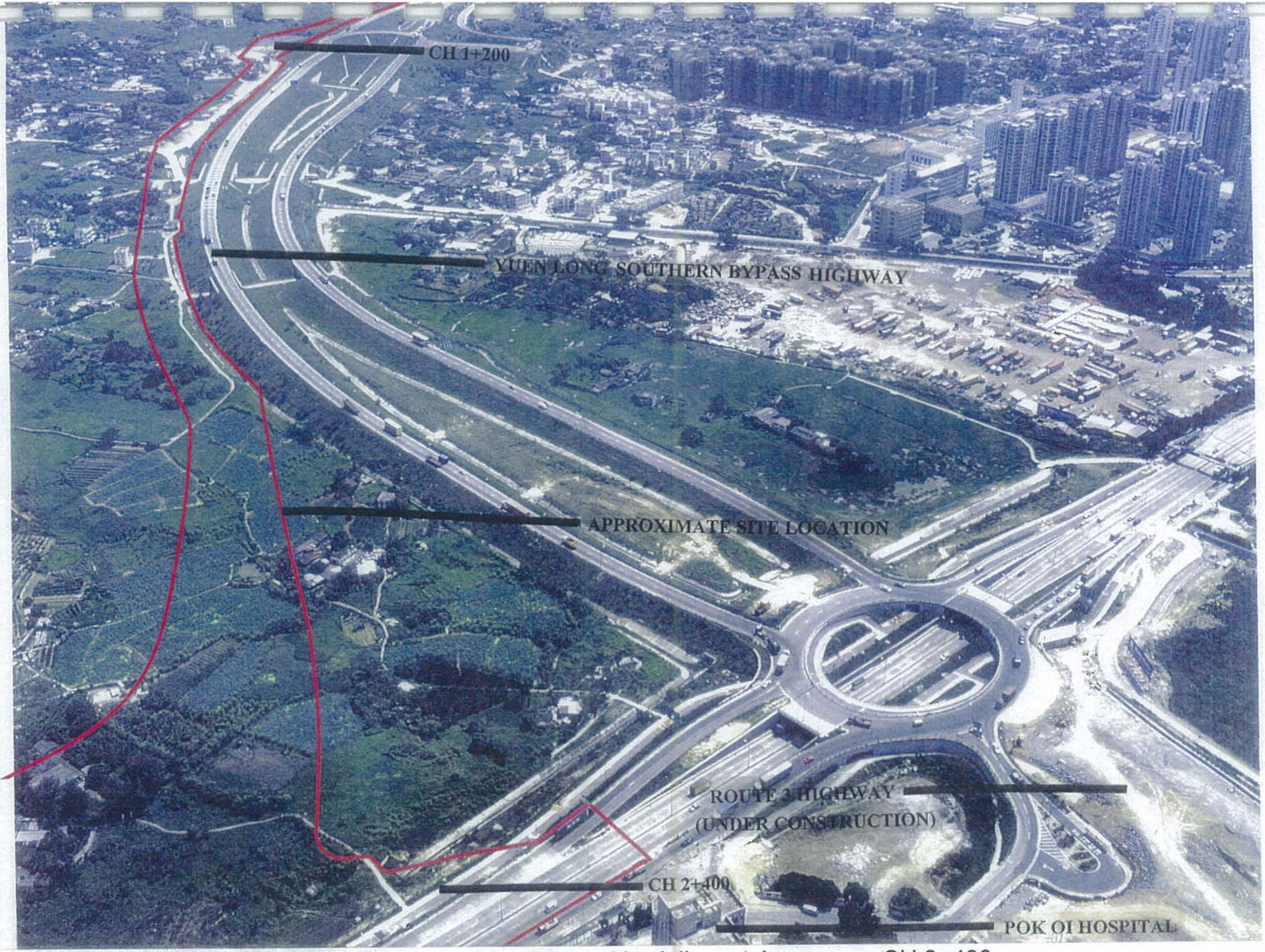



Plate 9.3: Closer View toward Portion of the Site and its Adjacent Areas near CH 2+400

***Land Use Pattern in Yuen Long and Tai Tong (Figure 9.2)***

9.2.3 According to the Yuen Long OZP, Yuen Long Town Centre comprises mostly 'Residential (Group A)' zones in which relatively high-intensity and high-rise developments (in comparison to the surrounding rural area) are permitted. The Yuen Long Town Centre will therefore remain an area of relatively high-intensity and high-rise urban-type development.

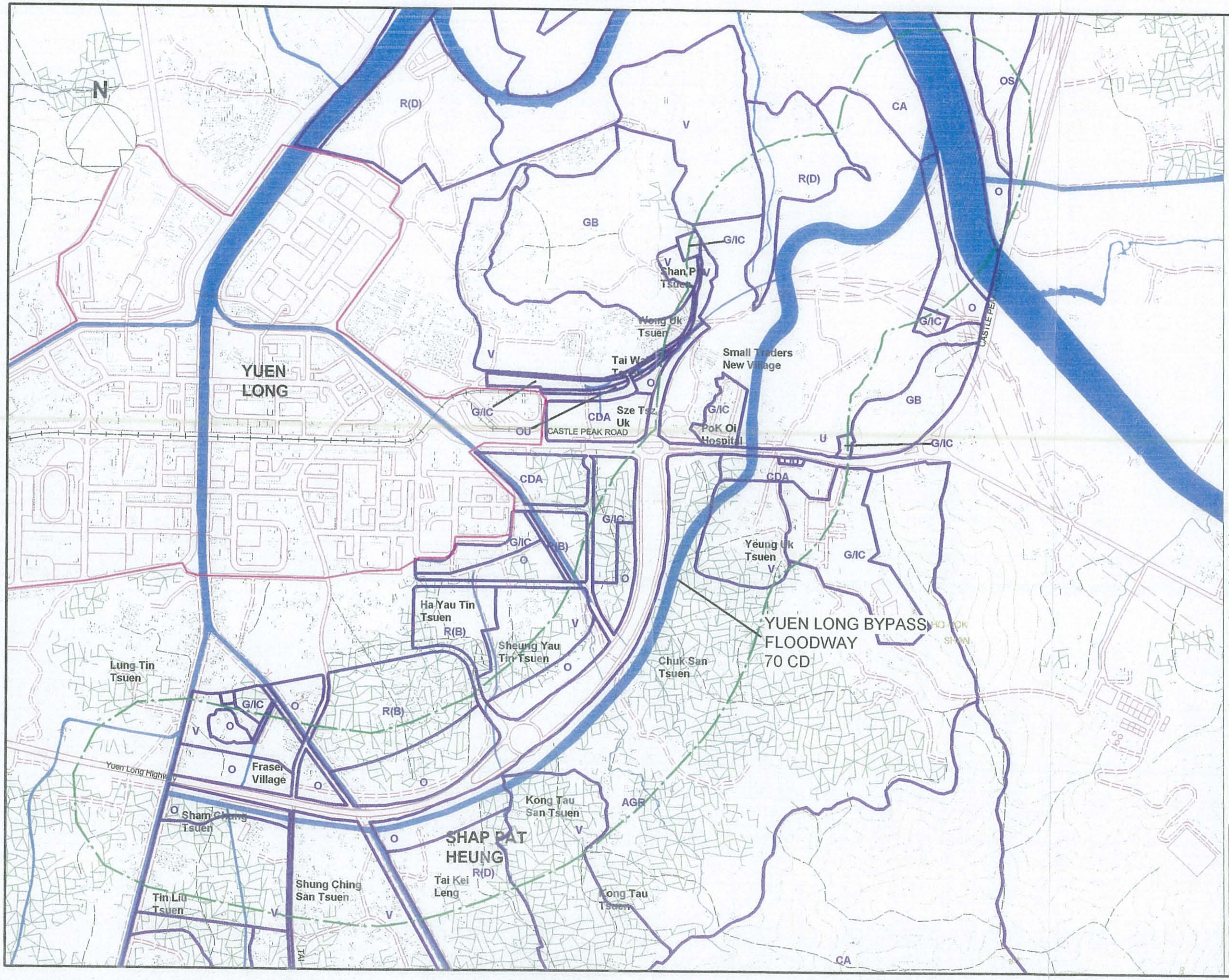
9.2.4 According to the Yuen Long and Tai Tong OZPs, the area between the existing border of Yuen Long Town Centre and YLH comprises various land use zones including 'Village Type Development', 'Residential (Group A)', 'Residential (Group B)', 'Comprehensive Development Area' (CDA), 'Open Space' and 'Government/Institution/Community' zones. A mix of low-intensity and low-rise village-type development, and relatively high intensity residential developments is planned for this area. However, this is likely to be further intensified in future as a result of the transportation improvements provided by the future West Rail Stations in Yuen Long and the Route 3 highway.

9.2.5 To the south and southeast of the YLH planning zones include: 'Village-Type Development', 'Residential (Group D)', 'CDA', 'Open Space' and 'Agriculture' zones. This area is therefore likely to remain as a largely low lying rural area. The slopes adjoining Tai Lam Country Park in the southern part of the Tai Tong area and the hilly areas in the eastern part of Tai Tong are designated as 'Conservation Area'. These areas will therefore be retained as a natural open passive recreation area.

9.2.6 In the Au Tau district, the proposed YLBF is situated in an area mainly designated as an 'Undetermined' ('U') zone on the Nam Sang Wai OZP. The future development pattern of the 'U' area is not known at this stage. The adjacent areas of the 'Undetermined' zone are designated as 'Green Belt', 'Open Space', 'Village Type Development', 'Government/Institution/Community' and 'Residential (Group D)' zones. Thus there will be a mix of low-intensity, low-rise village residential development, and green open space in the area adjacent to the 'U' zone.

***Landscape Character of the Site and its Surrounding Areas (Plate 9.1)***

9.2.7 In view of the current landscape situation and the future land use pattern according to the OZPs, the Yuen Long Town Centre will expand up to the YLH. To the south and southeast of the YLH, a rural area will remain. The YLH provides the physical separation between the two areas of the Yuen Long Town Centre and the southeastern rural area. The rural area is geographically connected to the natural hilly area to the southeast which forms part of the Tai Lam Country Park. The proposed YLBF abuts the toe of the southeastern embankments of the YLH and is






Legend :

| | |
|---|---|
| | Existing and Future Watercourses |
| | Approximate Boundary of Study Area<br>300m - Air & Noise<br>500m - Water Ecology |
| | Boundary of Yuen Long Town Centre |
| AGR | Agriculture |
| CA | Conservation Area |
| CDA | Comprehensive Development Area |
| CP | Country Park |
| GB | Green Belt |
| G/IC | Government/Institution |
| I | Industrial |
| O | Open Space |
| OS | Open Storage |
| OU | Other Specified Uses |
| R(A) | Residential (Group A) |
| R(B) | Residential (Group B) |
| R(C) | Residential (Group C) |
| R(D) | Residential (Group D) |
| REC | Recreation |
| U | Undetermined |
| V | Village |

| revision | date | description | | | initial |
|---|---|---|---|---|---|
| | designed | checked | drawn | | checked |
| initial | AJT | AS | LC | | AS |
| date | 1/98 | 1/98 | 1/98 | | 1/98 |

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figure title

LAND USE ZONING OF OZP OF THE SITE AND THE SURROUNDING AREAS

figure no. 9.2

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therefore situated adjacent to the rural area to the south and southeast of the highway.

9.2.8 The overall landscape of the rural area is low-lying and generally flat. The current landscape elements in the rural area include agricultural land, village houses with fishponds in the north. Most of the existing landscape elements such as village houses and agricultural land are likely to remain in future. However, according to the OZPs some current landscape elements such as fishponds and surrounding rural areas, will be replaced by low-intensity residential elements in the 'Residential (Group D)' zone and new village houses in the 'Village Type Development' zones. The major landscape elements are defined as follows.

- village houses
- green landcover and rural vegetation including cultivated land
- low-intensity and low-rise residential developments
- fishponds in the 'Undetermined' zone

9.2.9 In spite of the likely changes as a result of the land use zoning of the OZPs the overall rural landscape character will be retained. The above landscape elements contribute to the rural landscape character of the site and its surrounding environment.

9.2.10 There are in the order of 467 trees in the subject site (a detailed list is provided in Appendix D as part of the preliminary Tree Survey). Clusters of trees are scattered throughout the site area but no distinct woodland landscape feature exists within the site. Seventeen of the trees found within the proposed site limit are listed in the Forestry Regulations (Cap. 96 Section 3)[1], including *Michelia alba* and *Magnolia grandiflora* (Magnoliaceae species), and *Lagerstroemia speciosa* (Lagerstroemia species). Most of the other trees within the site are plantation or fruit trees. Over 80% of the trees in the site are introduced species and over 60% are fruit trees. Generally, the trees have a diameter at breast height (DBH) of between 10 cm and 65 cm and a tree height of between 1.7 m and 12 m. There is an exceptionally large Ficus microcarpa (tree no. 28) which has DBH of 2.5 m, crown diameter of 12 m and tree height of 10m.

1 The Forestry Regulations apply to plants within un-leased Government land only. At the time of assessment, only one *Michelia alba* is found in unleased government land.

## 9.3 Visual Analysis

### *Site Context*

9.3.1 The proposed YLBF is located to the south and east of Yuen Long Town within the rural area of the Northwest New Territories. The 3.8km YLBF alignment commences at the Main Nullah, runs along the southern side of the YLH, crosses Castle Peak Road adjacent to Yeung Uk Tsuen, and continues Northeast to the Kam Tin River. The site's content (and thus the area to be affected) is mostly agricultural land, village settlement area and fishponds (Plate 9.1). The YLH and Pok Oi Hospital are immediately adjacent to the proposed floodway from chainage 0 to 2+400 and at chainage 2+500 respectively. The Yuen Long Town Centre is approximately 600 metres away from the proposed floodway. The proposed Route 3 Highway will be located adjacent to the northern section of the floodway (chainage 2+900 - 3+800) and the future West Rail will pass over the proposed floodway at chainage 2+650.

### *Visual Receptors*

9.3.2 Looking at the adjacent site context there are several sensitive visual receptors: at chainage 2+650 residential properties (the adjacent village houses and some of the existing and future residential buildings in Yuen Long Town Centre); main roads/rail routes (YLH, the future West Rail); a development approved by the Town Planning Board at the Pun Uk site and Pok Oi Hospital. The sensitivity of these visual receptors are identified in Table 9.1 and the following paragraphs.

**Table 9.1: Types of Visual Receptor and Sensitivity**

| Types of Visual Receptors | Sensitivity |
|---|---|
| Residential Properties | High |
| Main Road / Railway | Moderate |
| Hospital | Moderate |
| Commercial / Industrial Properties | Low |

### *Channel Section from Chainage 0+000 to 2+400*

9.3.3 The floodway will be visible, viewed from the adjacent villages to the south and east and overlooked from the YLH along its length.

9.3.4 However, the floodway will not be visible from the villages to the north of the YLH due to the intervening highway embankment.

***Channel Section from Chainage 2+400 to 2+800***

9.3.5 Visual receptors in the this area include a development approved by the Town Planning Board at the Pun Uk site, Pok Oi Hospital and the Small Traders New Village west of the floodway and some village houses to the east. The proposed West Rail will pass over the floodway in this section. The floodway will be visible from the proposed West Rail.

***Channel Section from Chainage 2+800 to 3+800***

9.3.6 Fishponds and village houses are adjacent to the floodway. The floodway will be visible, viewed from the village houses. Route 3 will pass over the floodway along this channel section. However, on both sides of the Route 3, over 3.5 metre high concrete noise barriers have been constructed except in the Route 3 fly-over section which is adjacent to chainages 3+100 to 3+800 of the YLBF (plates 9.4 and 9.5). Therefore, the YLBF will only be visible from the Route 3 fly-over section.

***Yuen Long Town Centre***

9.3.7 In the existing Yuen Long Town Centre, there are high-rise buildings which are mainly residential properties (Plate 9.1 ). To the south of the existing Yuen Long Town Centre, a large area of land is currently occupied by village settlement and agricultural activities. In this area, some portions of land are zoned as 'Residential (Group A)' (Area 13 - west of the study area) and 'Residential (Group B)' (Area 14), refer to figure 9.2. To the east of the existing Yuen Long Town Centre, there are two 'CDA' zones near the future West Rail Yuen Long Station. Along with the residential developments planned for Areas 13 and 14 it is likely that high-rise residential developments will occur in the 'CDA' zones as a result of the transport improvements resulting from the future West Rail and Route 3 highway. Thus, the Yuen Long Town Centre will expand significantly into the Yuen Long South area.

9.3.8 The southern part of the YLH, immediately adjacent to the proposed YLBF, is situated at a higher level than the proposed channel. Between chainage 0+0 and 2+100 the floodway will be visually screened from the distant view from the existing Yuen Long Town Centre. However, the northern part of the proposed floodway will be visible from the high-rise buildings at the eastern edge of the existing Yuen Long Town Centre. In view of the land use zoning on the OZPs and the future transport improvement by the West Rail and the Route 3 highway, high-rise residential developments will occur near the proposed YLBF to the south and east of Yuen Long Town Centre. The proposed floodway will be visible from the

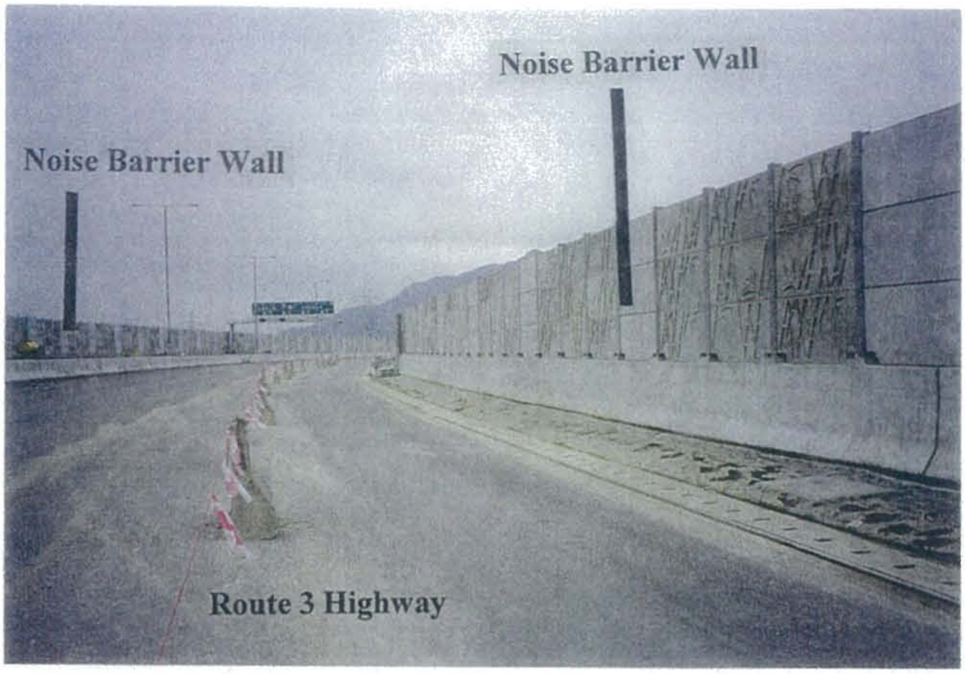



**Plate 9.4: Inside View of Route 3 Highway**

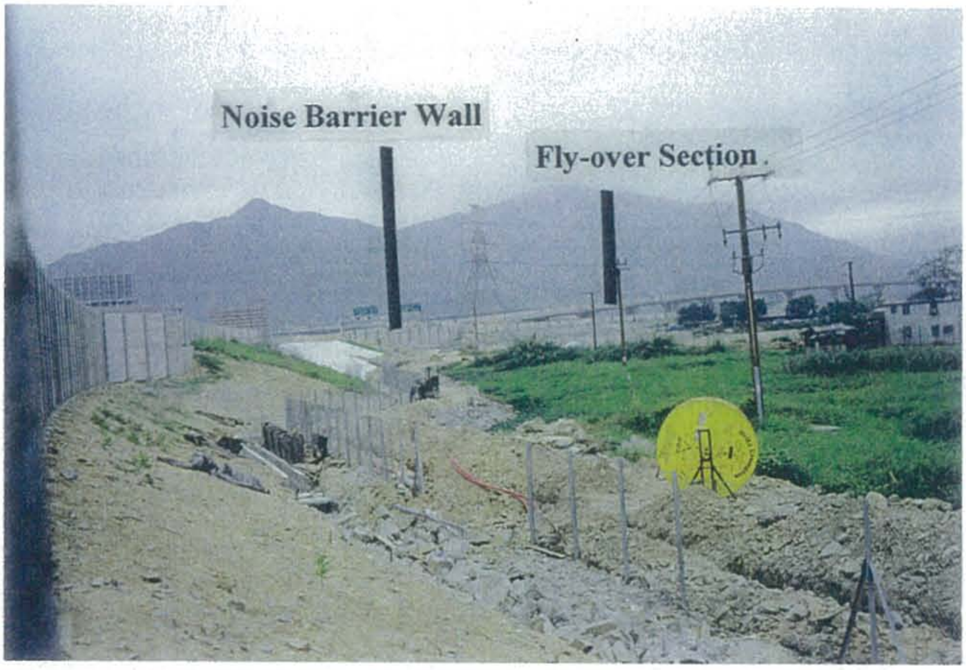



**Plate 9.5: Outside View of Route 3 Highway**

future high-rise residential developments.

9.3.9 Based on the above investigation, the visual receptors of the floodway (Figure 9.2) and their levels of view are summarised as follows.

| Visual Receptors | Level of View |
|---|---|
| The adjacent villages | Low |
| Pok Oi Hospital | High |
| Yuen Long Highway | High |
| Route 3 Highway | High |
| Proposed West Rail | High |

## 9.4 Potential Landscape and Visual Impacts

### *Potential Landscape Impacts*

9.4.1 In view of the land use zoning of Yuen Long, Tai Tong and Nam Sang Wai OZPs, the proposed YLBF alignment will not encroach on conservation areas except a small corner at its northern end when it meets the Kam Tin and Yuen Long Drainage channels. The existing landform will not be seriously affected by the construction of the YLBF as it will remain as a low lying landform with the proposed YLBF. Furthermore the water body introduced by the proposed YLBF will enhance the rural landscape environment if the embankment is treated with landscape elements compatible with the surrounding rural environment. In addition the proposed engineered wetland areas with specific wetland planting occupying the northern end of the YLBF (from chainage 2+680 to 2+960 and chainage 3+010 to 3+545) will enhance the local landscape character.

9.4.2 Seventeen trees of protected species and a very large Ficus microcarpa are within the subject site. Eleven trees of protected species will be affected by the construction of the proposed YLBF. In addition a swathe of largely agricultural land will be replaced by the stormwater channel and its associated facilities such as a pumping station and box culvert. The replacement of agricultural land with a partially concrete lined channel will lead to significant disturbance of the landscape character of the locality.

9.4.3 Moreover, a number of fishponds adjacent to the proposed YLBF will also be disturbed by the construction works of the proposed YLBF. Some fishponds will be lost as a result of the project and replaced by the wetland areas and therefore the rural landscape character of the area will be affected.

***Potential Visual Impacts***

9.4.4 The invert levels of the YLBF range between 3.16 mPD at chainage 0+010 and 0.52 mPD at 3+800. The depth of the channel ranges between 4 metres and 4.5 metres and the pumping station at the downstream end is a low-rise structure. The YLBF will therefore cause no significant visual obstruction.

9.4.5 The proposed floodway will transform the existing village settlement areas, green vegetated areas and some fishponds into a stormwater channel finished with concrete and grasscrete materials (Table 9.3) and associated structures including maintenance access, footpaths and a pumping station. The southern section of the floodway (from chainage 0+000 to 2+800) is situated in a rural and vegetated green environment. According to the OZPs the area to the south and east of the proposed floodway (Figure 9.1) (from chainage 0+000 to 2+800) is mostly used for village development and agriculture. The northern section of the floodway (from chainage 2+800 to 3+700) is located in the fishpond area.

9.4.6 Over half of the channel (from chainage 1+340 to 3+545) will be constructed with grasscrete (sides and base) refer to Table 9.3. This section of the channel has the greatest top width (from 29.5 m to 50 m) refer to Table 9.3. The grasscrete design of the channel will greatly reduce the potential visual impact arising from the YLBF.

9.4.7 Nevertheless, the concrete channel sections (from chainage 0+000 to 1+340 and from chainage 3+545 to 3+800) and its associated facilities will have potential visual impact as they are visually incompatible with the surrounding visual context. Chainage 0+000 to 1+340 will be concrete lined to minimize the extent of land resumption necessary for the YLBF and encroachment into existing village properties. Chainage 3+545 to 3+000 will be concrete lined as this portion of the channel is downstream of the inflatable dam and therefore within the tidal range of the channel.

**Table 9.3: Yuen Long Bypass Floodway Cross Sections**

| Chainage | Base Width (metres) | Top Width (metres) | Side Slope | Material | Remarks |
|---|---|---|---|---|---|
| 0-10 | 16 | 16 | vertical | concrete | VC-1 |
| 10-400 | 8 | 14 | 1 on 1 | concrete | trapezoidal |
| 400-410 | 17 | 17 | vertical | concrete | VC-3 |
| 410-600 | 8 | 14 | 1 on 1 | concrete | trapezoidal |
| 600-625 | 8-10 | 14-16 | 1 on 1 | concrete | transition |
| 625-635 | 19 | 19 | vertical | concrete | VC-4 |
| 635-780 | 10 | 16 | 1 on 1 | concrete | trapezoidal |
| 780-790 | 19 | 19 | vertical | concrete | VC-6 |
| 790-1000 | 10 | 16 | 1 on 1 | concrete | trapezoidal |
| 1000-1040 | 10-15 | 16-21 | 1 on 1 | concrete | transition |
| 1040-1170 | 15 | 21 | 1 on 1 | concrete | trapezoidal |
| 1170-1290 | 24 | 24 | vertical | concrete | VC-7 |
| 1290-1300 | 15 | 21 | 1 on 1 | concrete | trapezoidal |
| 1300-1340 | 15-19 | 21-29.5 | 1 on 1 / 1 on 1.5 | concrete | transition |
| 1340-1675 | 19 | 29.5 | 1 on 1.5 | grasscrete | trapezoidal |
| 1675-1685 | 32.4 | 32.4 | vertical | concrete | VC-9 |
| 1685-2410 | 19 | 29.5 | 1 on 1.5 | grasscrete | trapezoidal |
| 2410-2540 | 37.2 | 37.2 | vertical | concrete | VC-10 |
| 2540-2680 | 19 | 29.5 | 1 on 1.5 | grasscrete | trapezoidal |
| 2680-2700 | 19 | 29.5-34 | 1 on 1.5 / 1 on 2 | grasscrete | trapezoidal |
| 2700-2800 | 19-35 | 34-50 | 1 on 2 | grasscrete | trapezoidal |
| 2800-2940 | * | * | * | grasscrete | wetland |
| 2940-2960 | 35 | 50 | 1 on 2 | grasscrete | trapezoidal |
| 2960-3010 | 52 | 52 | vertical | concrete | Route 3 VC |
| 3010-3040 | 35 | 50 | 1 on 2 | grasscrete | trapezoidal |
| 3040-3490 | * | * | * | grasscrete | wetland |
| 3490-3545 | 35 | 50 | 1 on 2 | grasscrete | trapezoidal |
| 3545-3680 | 35 | 50 | 1 on 2 | concrete | trapezoidal |
| 3680-3690 | 52 | 52 | vertical | concrete | VC-11 |
| 3690-3800 | 35 | 50 | 1 on 2 | concrete | trapezoidal |

Notes: VC - vehicular crossing
* - wetland area - main channel section plus wetland to side

9.4.8 The fishponds between the YLBF and Route 3 in what will be effectively become 'sterile' land in terms of development and the fish ponds directly to the south of the Route 3 box culvert will be reinstated as off-line engineered wetland areas. These wetlands will be planted with saline tolerant marsh species. The engineered wetland areas will be visually compatible with the surrounding visual context such as fishponds and agricultural land.

## 9.5 Conclusion

### *Potential Landscape Impact*

9.5.1 The YLBF will be compatible with the low lying landform of the rural area. As a water body, it will also provide an opportunity for landscape improvement of the rural area when landscape treatment is implemented on the embankments.

9.5.2 Some potential undesirable landscape impacts will result due to loss of agricultural land and some fishponds. In addition a certain amount of Open Space will be affected by the YLBF, however, reprovisioning of open space will be considered taking into account the findings of the Planning and Development Study on the NWNT.

### *Potential Visual Impact*

9.5.3 The proposed floodway will give rise to significant visual changes over an extensive area. A large portion of the stormwater channel will be grasscrete lined and therefore visually compatible with the surrounding environment. The remaining concrete portion of the stormwater channel and its associated structures are visually incompatible with the surrounding visual context. The visual receptors in the villages to the south and east of the proposed floodway will have a low level view towards the floodway and the visual impact to them will be mitigated by landscape screening along the embankment slopes of the floodway. The floodway (from chainage section 0+000 to 0+1340) will be completely concrete. The concrete stormwater channel and its associated structures will result in adverse visual impact to the visual receptors along the YLH and to a lesser extent the Pok Oi Hospital and proposed West Rail. Much of the view of the channel from the YLH will be screened by roadside planting when the trees and shrubs are mature. The stormwater channel between chainages 3+545 to 3+800 will also be completely concrete but due to the concrete noise barriers along the Route 3 Highway should not be visible from Route 3 except at the fly-over section.

9.5.4 Adverse visual impacts may also result during the construction of the YLBF which will take approximately 3 years to construct. The surrounding visual receptors will be subject to this potential visual impact.

9.5.5 In view of the potential landscape and visual impacts identified, some mitigation measures with respect to the visual receptors and the disturbed landscape elements and land use should be implemented to minimize such impacts due to the proposed floodway.

## 9.6 Opportunities for Landscape and Visual Impact Mitigation

9.6.1 In order to minimize the potential landscape and visual impact resulting from the YLBF, some mitigation measures are proposed to be implemented. The mitigation measures have been considered for not only after completion of the construction works (long-term mitigation) but also during the construction period in order to maximize the opportunities for mitigating potential landscape and visual impacts.

9.6.2 Native plant species should be utilized in the subject area to restore the green landcover and rural vegetation environment. For long-term mitigation, the areas which provide opportunities for introducing soft landscape elements include the peripheral site areas, the proposed embankment slopes, the footpath sides, and the access road sides. Tree and shrub planting can be considered in these areas. Hydroseeding can also be applied to the proposed embankment slopes and the peripheral site areas. Vegetation can also be introduced into the floodway channel wherever it is technically feasible to maintain vegetation. These potential areas provide ample opportunities for the accommodation of native plant species. The landscape treatment on the embankment also aids the proposed floodway as a water body to enhance the rural landscape character.

9.6.3 In a few localised areas landscaping will need to be restricted in the peripheral site areas. The locations are identified on the Conceptual Landscape Plans provided in Appendix G. The specific areas are between chainages 0+650 to 1+200 and 2+340 to 2+530. Chainage 0+650 to 1+200 will not be landscaped in the area shown as this land area will effectively be taken over by the HyD and landscaping mitigation work will be carried out under the YLH widening project. However, hydroseeding should be undertaken in the interim period between completion of the YLBF and commencement of the YLH project. Chainage 2+340 to 2+530 will be restricted to minimize the land required by the YLBF which will pass through and identified CDA site to the south of Castle Peak Road and a proposed Petrol Filling Station to the north of Castle Peak Road.

9.6.4 Views towards the proposed floodway from the adjacent village settlements are at low level. Landscaping with shrub and tree planting along the floodway embankment slopes and the peripheral site areas, along the footpath sides and the stormwater channel edges can also be used as a mitigation measure for potential visual impact. The trees and shrubs can serve as a visual screen for the adjacent villages. The views towards the stormwater channel from the adjacent village settlements will be replaced with a view of green vegetation that is visually compatible with the surrounding rural and green vegetation environment. Moreover, landscaping in the peripheral site area and the affected adjacent areas can avoid the potential adverse visual impacts and even provide opportunities for visual improvement. Plates 9.6 and 9.7 show photomontage of the view towards the proposed floodway from an adjacent village, Yeung Uk Tsuen, before the implementation of landscaping mitigation measures and the tenth year of the implementation of landscaping mitigation measures.

9.6.5 Views towards the proposed floodway from Yuen Long Town Centre, YLH, the future West Rail and Pok Oi Hospital are at high levels. Tree planting on the embankment slopes, along the footpath sides and the stormwater channel edges will only provide partial visual screening from these view points but considering most of the channel will be lined with grasscrete the impact will be minimal. Tree planting will serve as a landscape feature to soften the visual impact of the floodway.

9.6.6 Plates 9.8 and 9.9 provide photomontage of the view towards the proposed floodway from the YLH before the implementation of landscaping mitigation measures and the tenth year of the implementation of landscaping mitigation measures. Plates 9.10 and 9.11 are photomontage of the view towards the proposed floodway from a location in Pok Oi Hospital and the proposed West Rail alignment before the implementation of landscaping mitigation measures and the tenth year of the implementation of landscaping mitigation measures. The future buildings in the area between the existing Yuen Long Town Centre and YLH do not currently exist. It is therefore impossible to take photographs for a view or an approximate view from the future buildings. In addition photographs for the view from the fly-over section of the Route 3 highway cannot be taken due to the safety problems associated with entry onto the Route 3 construction site. Therefore, photomontage for the views of the proposed floodway from the future buildings and fly-over section of Route 3 cannot be provided.

9.6.7 The disturbed fishponds adjacent to the YLBF will receive mitigation measures. To minimize the long-term landscape and visual impact of the proposed YLBF on the fishponds, an area of fishponds to the north which are outside the subject site but disturbed by the construction works of the proposed YLBF will be restored to fishponds after the completion of the construction works. The fishponds within the site boundary will become engineered wetland areas and planted with specific wetland species.

Plate 9.6 Photomontage for a View toward the Proposed YLBF from an Adjacent Village, Yeung Uk Tsuen on the First Day of Completion of YLBF Construction without Visual Impact Mitigation.

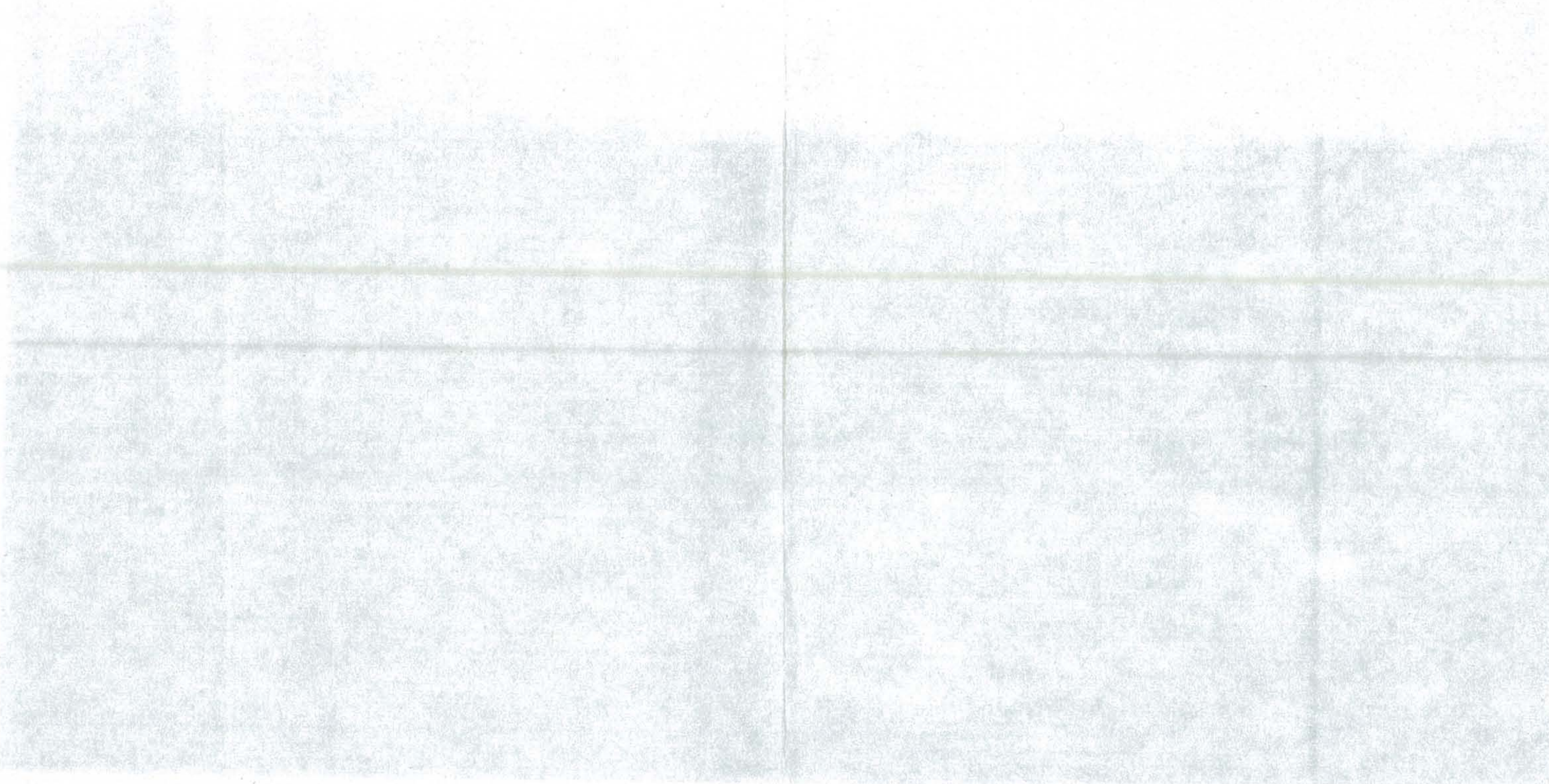


Plate 9.7 Photomontage for a View toward the Proposed YLBF from an Adjacent Village, Yeung Uk Tsuen in Tenth Year of Implementation of Visual Impact Mitigation.

Plate 9.8 Photomontage for a View toward the Proposed YLBF from Yuen Long Southern Bypass Highway on the First Day of Completion of Yuen Long Bypass Floodway Construction without Visual Impact Mitigation.

Plate 9.9 Photomontage for a View toward the Proposed YLBF from Yuen Long Southern Bypass Highway in Tenth Year of Implementation of Visual Impact Mitigation.

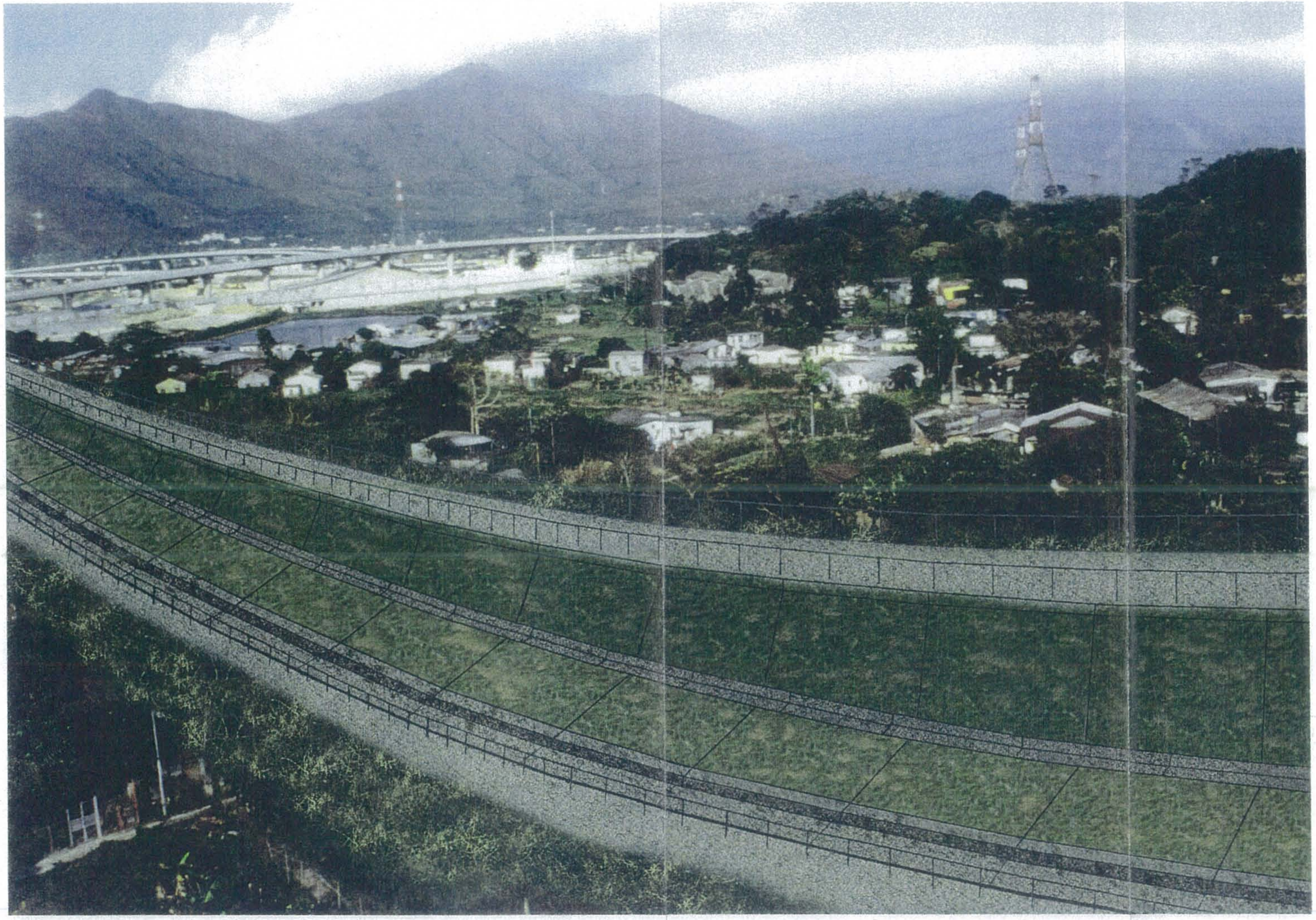


Plate 9.10 Photomontage for a View toward the Proposed YLBF from a Location in Pok Oi Hospital near the Proposed West Rail on the First Day of Completion of Yuen Long Bypass Floodway Construction without Visual Impact Mitigation.

Plate 9.11 Photomontage for a View toward the Proposed YLBF from a Location in Pok Oi Hospital near the Proposed West Rail in Tenth Year of Implementation of Visual Impact Mitigation.

9.6.8 The proposed YLBF will affect certain 'Open Space' designated on the OZPs. Since the landscape works for the YLBF will be serving as a buffer between the YLH and the existing villages and 'Village Type Development' zone, the reprovisioned public open space may focus on recreational opportunities which are easily accessible to nearby villagers. Nevertheless, such reprovisioning will be considered taking into account the findings of the Planning and Development Study on NWNT.

9.6.9 The exterior colour of the pumping station, handrailing for footpaths and parapets for access roads can be chosen for the purpose of visual compatibility with the surrounding areas. Trees and shrubs may also be planted around the pumping station to soften the visual impact of the structure.

9.6.10 To minimize the visual and landscaping impact of the concrete sections of the channel stone finish was considered. However, as detailed in the Engineering Report the use of stone finish can create additional friction losses thus requiring the channel to be wider. Considering the land resumption problems of the upstream portion of the channel and the fact that concrete is cheaper and more easily available, stone finish has been ruled out technically. However, the inclusion of stone finish in small areas of the channel to aid visual impact mitigation could be investigated during the Detailed Design Stage of the Project.

9.6.11 In order to bring the project in line with forestry conservation interests, preservation of the protected plant species and the very large Ficus microcarpa should be considered. An assessment of the Preliminary Design has shown that the very large Ficus microcarpa and six of the protected tree species can be retained. The remaining eleven protected tree species can be transplanted. This should be reviewed at the Detailed Design Stage of the Project. The final Tree Survey will identify in greater detail the trees to be preserved under this project.

9.6.12 Apart from the above long-term mitigation measures, advanced planting works along the periphery of the works area have also been considered which could eventually be integrated into the final landscape plans of the whole project. This however is not considered feasible considering the works areas alongside the channel are minimal and thus trees planted in advance could be damaged. In addition no real screening benefit could be achieved until the first 3 to 5 years, which would be after the construction period. Therefore advanced planting has been ruled out especially considering the construction stage impact will only be temporary and not of major significance. Nevertheless, hydroseeding is recommended to provide a greening effect and to reduce dust as far as practicable.

9.6.13 The existing top soil will be an important landscaping resource and should be retained for use in the landscaping mitigation measures to enhance the proposed planting. During construction, the top soil should be removed separately and stored and used for the soft landscaping works later in the construction works. The stockpiles of topsoil should not exceed 2 metres in height.

## 9.7 Funding Management and Maintenance of Landscape Works

9.7.1 The funding, management and maintenance of the landscape works within the roadside verge and amenity areas are discussed in details in paragraph 5.5.24 to 5.5.27 in Section 5 of this Report.

## 9.8 Summary of Landscape and Visual Mitigation Measures

9.8.1 The landscape and visual impact mitigation measures can be summarized as follows:-

- Soft landscaping such as tree and shrub planting and hydroseeding should be implemented in the areas including the peripheral site area, the proposed embankment slopes, footpath sides and access road sides.
- The affected fishponds adjacent to the subject site to the north should be restored to fishponds after the completion of the construction works.
- Reprovisioned public 'Open Space' to compensate for 'Open Space' affected by the YLBF may focus on recreational opportunities.
- The exterior of the pumping station, handrailings and parapets should be chosen so as to minimize visual impact.
- Tree and shrub planting around the pumping station should be used to soften the visual impacts of the pumping station.
- Landscaping should be located in the peripheral site areas and the adjacent affected areas including the wetland areas directly to the north and south of Route 3.
- The protected plant species and very large Ficus microcarpa should be preserved.
- Existing top soil should be retained for use in landscaping mitigation measures.

# 10. SUMMARY AND CONCLUSIONS

## 10.1 Introduction

10.1.1 This section presents a summary of the key findings of the EIA which includes:

- identification and description of the potential environmental impacts;
- recommendations for necessary mitigation measures to ensure that residual impacts are within established environmental guidelines and therefore acceptable;
- an implementation schedule of recommended mitigation measures which identifies the timing and responsibilities in respect of their implementation; and
- a summary of the key Environmental Monitoring and Audit (EM&A) requirements as specified in the accompanying EM&A Manual.

The EIA report initially reviews the environmental significance of the four optional routes for the floodway in conjunction with engineering and planning constraints and demonstrates that Option 3 is the most favourable. A detailed EIA is then presented based on the preliminary engineering design for the preferred Option 3.

10.1.2 The preliminary design of this project, has adopted a number of environmental mitigation measures. These include: the realignment of the northern section of the channel closer to the Route 3 Highway to minimize resumption of fish ponds and sterilized land between the two projects; the use of grasscrete on the base and side slopes along approximately two thirds of the channel; the use of adjacent fish ponds to provide two off-line engineered wetland areas to compensate for habitat losses; and landscaping wherever possible.

10.1.3 The scope of the EIA includes assessment of potential construction and operational impacts of the project in respect of water quality, ecology, waste management, air quality, noise and landscape and visual issues.

## 10.2 Water Quality

*Potential Construction Impacts*

10.2.1 Potential impacts on surface water quality during construction of the Yuen Long Bypass Floodway may include:

- construction site runoff and discharge;
- release of pollutants through removal of sediment;
- sewage discharge and other waste from construction workforce.

10.2.2 Construction site runoff has the potential to contain increased loads of sediments and other suspended solids and contaminants such as nutrients, bacteria, oil and grease, etc. Potential sources of pollution from site drainage may include:

- runoff and erosion from site surface, earthworks stockpiles and drainage channels;
- fuel, oil and grease from construction vehicles;
- concrete slurries runoff (washdown of waste concrete and concrete curing sprays);
- runoff into fish and lotus ponds; and
- release of pollutants from removal of sediment.

10.2.3 An increase in organic pollution of nearby water courses could result from increased sewage load from construction workers, discarded rubbish and canteen wastewater.

*Mitigation Measures*

10.2.4 The following mitigation measures are proposed to reduce the potential impacts to acceptable levels:

- carry out works in the dry season;
- cover areas of exposed earth;
- install sand traps or catchpits at all drainage discharge points;

- discharge runoff into settlement pits to allow infiltration;
- provide and maintain oil interceptors in site compounds
- provide bunds around oil and fuel bunkers;
- ensure immediate disposal and correct handling of chemical spills;
- ensure drainage system from concrete producing area is diverted into a settlement area for infiltration or storage;
- avoid all contact between concrete washings and nearby water bodies using bunding if necessary;
- all concrete washings/surplus concrete should be discharged into designated settlement pits for setting and water recycling;
- bunds should be constructed between the works area and remaining fish ponds;
- no runoff, wastewater or chemicals should be allowed to enter fish ponds;
- remove sediments with minimal disturbance during dry season and dispose of according to WBTC 2/94;
- ensure proper sewage facilities are provided for construction workers;
- ensure site cleanliness is maintained with rubbish bins provided and serviced properly; and
- canteen discharges should pass through a grease trap before discharge.

***Potential Operational Impacts***

10.2.5 During operation of the floodway the main potential impacts include:

- hydraulic changes from creating an artificial (concrete) channel resulting in increase in transport of surface runoff and pollution downstream; and
- reduction in treatment capacity because of the absence of vegetation which is present in the existing water courses.

*Mitigation Measures*

10.2.6 The main mitigation measure recommended in the EIA for these potential impacts involves sensitive environmental design of the floodway channel through the use of grasscrete for the flooring and sides of the channel as much as possible instead of concrete, thus enabling a base for vegetative growth. Growth of vegetation in the channel provides a mechanisum for natural treatment of polluted water flowing down the channel through infiltration and absorption.

- ensuring that tributary inflows are allowed to spread across the grasscrete floor of the floodway rather than be directed straight into the dry weather flow channel; and

- locating the dry weather flow channel along the toe of the channel sides opposite to the tributary inflows thus allowing more time and surface area for infiltration.

10.2.7 Other mitigation measures recommended include:

- use of the sterile land between Route 3 and the YLBF as an engineered wetland incorporating it into the overall channel design; and

- use of the remaining pond areas immediately south of Route 3 by incorporating them into the channel design.

10.2.8 The Yuen Long Bypass Floodway project has the potential to create unacceptable water quality impacts during the construction and operation phases. However, with the implementation of specific mitigation measures these impacts can be reduced to acceptable levels such that there should be no unacceptable residual water quality impacts as a result of the project.

## 10.3 Ecology

10.3.1 Construction of the Yuen Long Bypass Floodway will result in the loss of, and disturbance to, a number of different habits along the 3.8km alignment of the floodway. The unmitigated Project which assumes a worst case scenario involving a concrete lined, ecologically sterile nullah along the entire length of the floodway would result in the following impacts:

- loss of 3 ha of village-type habitat through an already blighted area
  *low habitat value*
  *low impact significance*

- loss of 4ha of abandoned agricultural land habitat, already blighted and fragmented but providing a feeding ground for herons and egrets
  *low to medium habitat value*
  *medium impact significance*

- loss of 0.1ha of stream/riparian habitat through an already blighted area
  *low habitat value*
  *medium impact significance*

- loss of 1ha of lotus pond habitat causing fragmentation of remaining lotus ponds
  *medium habitat value*
  *medium to high impact significance*

- loss of 9ha of fish pond habitat already blighted and fragmented by Route 3 construction works
  *low to medium habitat value*
  *low impact significance*

10.3.2 Mitigation measures proposed to reduce impacts to acceptable levels comprise the following:

(i) Amendment to the alignment of the YLBF north of Route 3 so that it runs closer to the highway. This avoids fragmentation of the active fishponds north of the floodway and moves the works further away from a *fung shui* knoll biodiversity locus located northwest of the Project area.

(ii) Use of grasscrete for lining the sides and base of the channel (from ch 1+340 to ch 3+545 creating 6.8ha of dry grasscrete). This allows percolation to the groundwater, enables growth of grasses sedges and reeds which in turn provides a habitat for invertebrates (insects) and higher fauna (birds)
*medium habitat value*

(iii) Creation of offline marshland type habitat through the use of submerged grasscrete (marshcrete) making use of the swathe of land between Route 3 and the YLBF and a fish/duck pond immediately south of the Route 3 box culvert. The marshcrete (watered in part by recirculation of a proportion of the pumped flows from the low flow pumping station and also from local runoff) would be planted with selected saline tolerant and pollution tolerant wetland grasses, reeds and sedges creating 3ha of marshland habitat.
*medium to high habitat value*

(iv) Tree planting of over 2500 trees along the channel banks and adjacent to the access roads and footpaths with species selected for their attractiveness to the local flora and fauna
*medium habitat value*

10.3.3 The grasscrete and marshcrete total habitat area resulting from the Project will be 9.8ha of medium and medium to high ecological habitat. This contrasts with the loss of 14ha of largely low to medium value habitat and 3.1ha of low value habitat which does not require mitigation. It is considered that the increased value of the created habitat (in conjunction with the landscaping trees and improved ecological linkage) at least balances/compensates for the value of the site's original habitats. Thus, with the implementation of the proposed mitigation measures it is considered that the residual ecological impact of the Project is negligible. The mitigation measures including; re-alignment, grasscreting, marshcreting and tree planting, not only result in negligible ecological impacts but will also lead to a general habitat enhancement along the entire 3.8km Project corridor.

## 10.4 Waste Impact

### *Construction Phase*

10.4.1 Waste will inevitably be produced during the construction period. The Government's construction and demolition waste management hierarchy is the same as for other wastes, ie. in order of desirability: avoidance; minimisation; recycling; treatment and safe disposal of construction materials. The quantity of waste should be minimised and materials should be re-used and recycled as far as practicable, thus minimising the disposal requirement and conserving void space at landfill sites.

10.4.2 The delivery of 318,000 $m^3$ (about 8% of the current annual demand public filling capacity) of surplus excavated material to public filling areas could have a significant impact on the public filling programme and on the road transportation system. The planning and the programming of the works should take into account these factors to find alternative disposal sites for such material and to prevent unacceptable traffic impacts. Notwithstanding that every effort should be made to reuse as much of the excavated material as possible on site.

10.4.3 Whilst the potential for contaminated land along the alignment of the YLBF is slight, during the detailed design stage a core sampling programme will be undertaken to ascertain the nature of the substratum. Should contaminated land be encountered the sediments will be tested, handled and disposed of in accordance with government requirements.

10.4.4 Contract arrangements should include the responsibilities of the Contractor for waste collection, on-site sorting (including separation at source) and disposal. Suitable facilities should be provided, for example, an accessible filling area with processing capabilities to ensure maximum utilisation of waste materials.

10.4.5 Correct storage of and, where possible, recycling of chemical and oil wastes is required to minimise environmental impacts.

10.4.6 In order to maximise re-use of materials and minimise the cumulative impact of waste products on the environment, on-site facilities should be set up for the separation of recyclable materials from construction and demolition waste and domestic waste to facilitate easy collection by recycling companies.

10.4.7 Provided that there is strict control of wastes from construction works and all arisings are stored, transported and disposed of using approved methods as described in Section 6, no significant impacts are predicted.

*Operational Phase*

10.4.8 As an integral component of the regular maintenance work of the Bypass Floodway, sediment build up along the channel will be removed using land-based plant. Excavated sediment will be set aside to dry prior to being also loaded into trucks and disposed of at a Government landfill.

10.4.9 The channel should also be regularly cleared of litter and other general refuse. A refuse boom should be erected to prevent waste from entering receiving water courses.

## 10.5 Air Quality

*Construction Impact Assessment*

10.5.1 The Construction Impact assessment has concluded that:

- The worst case scenario will occur during the site formation of the proposed Yuen Long Bypass Floodway because there would be a large quantity of earth works and frequent truck movements over dirt roads;
- Without adequate mitigation, dust levels generated by the site formation works are likely to exceed the Air Quality Objectives at the nearby air sensitive receivers;

- The transport of material by trucks travelling over dirt haul roads is the principal source of potentially excessive dust generation;

- Mitigation measures sufficient to ensure compliance with the Air Quality Objectives have been included in the assessment. As a result, a school, hospital and hotel nearby the site will be within AQOs; and

- An environmental monitoring and audit programme has been formulated to ensure compliance is maintained.

*Operational Impact Assessment*

10.5.2 The key potential air impact during the operational phase is odour nuisance from polluted water entering the channel. Odour nuisance can be mitigated through routine maintenance of the channel through the removal of odorous sediments. Furthermore, it is expected that there will be a progressive reduction in pollutant levels as the Livestock Waste Control Scheme is progressively implemented.

## 10.6 Noise

*Construction Noise*

10.6.1 Noise from the use of powered mechanical equipment on site and the haulage of fill material on- and off-site will cause a nuisance to the nearby existing noise sensitive receivers.

10.6.2 The construction noise assessment shows that unmitigated noise levels could exceed EPD's recommended maximum noise levels for day-time construction work when construction activities occur in close proximity to noise sensitive receivers or when several construction works occur simultaneously.

10.6.3 Exceedances of noise level is unavoidable because of the close proximity between the construction works and the NSRs. Adequate mitigation measures will be necessary for the construction works to meet the criteria.

10.6.4 The use of quiet plant and working methods, reducing the number of equipment, restricting the number of works and the use of substantial noise barriers to protect the closest residences and schools has been recommended and should be sufficient to reduce noise levels to compliant levels at the NSRs.

10.6.5 A noise monitoring programme is proposed to ensure construction noise is within the recommended criteria throughout the construction works.

*Operation Noise*

10.6.6 Noise associated with the DSD maintenance road and the low flow pumping station is not expected to create nuisance to the nearby noise sensitive receivers during the operational phase.

## 10.7 Landscape and Visual Impacts

10.7.1 The landscape Impact Assessment concluded that the YLBF will be compatible with the lowlying landform of the rural area and as a water body, it will provide an opportunity for landscape improvement of the rural area when landscape treatment is implemented on the embankments. Some potential undesirable impacts will result due to loss of agricultural and some fishponds.

10.7.2 The Visual Impact Assessment identified that the YLBF will result in visual impacts on nearby visual receptors including; adjacent village settlements, Yuen Long Highway, Pok Oi Hospital, Route 3 and the proposed West Rail. The main visual impacts arise from the concrete portion of the channel which is incompatible with the surrounding visual context. Mitigation measures recommended to reduce the landscape and visual impacts and to enhance the existing landscape and visual environment include:

- Soft landscaping such as tree and shrub planting and hydroseeding should be implemented in the areas including the peripheral site area, the proposed embankment slopes, footpath sides and access road sides.

- The affected fishponds adjacent to the subject site to the north should be restored to fishponds after the completion of the construction works.

- Reprovisioned public 'Open Space' to compensate for 'Open Space' affected by the YLBF may focus on recreational opportunities.

- The exterior of the pumping station, handrailings and parapets should be chosen so as to minimize visual impact.

- Tree and shrub planting around the pumping station should be used to soften the visual impacts of the pumping station.

- Landscaping should be located in the peripheral site areas and the adjacent affected areas including the wetland areas directly to the north and south of Route 3.

- The protected plant species and very large Ficus microcarpa should be preserved.

- Existing top soil should be retained for use in landscaping mitigation measures.

## 10.8 Implementation Schedule for Environmental Mitigation Measures

10.8.1 Table 10.1 presents an Implementation Schedule for all the mitigation measures recommended during the EIA process to date. As this EIA covers the preliminary design it will be subject to review and refinement during the detailed design stage. The schedule provides the currently available information on:

- the specific mitigation measures recommended;
- the location and timing of implementation of the mitigation measures;
- the party responsible for implementing each mitigation measure; and
- the relevant ordinance (if any) that the mitigation measures are subject to.

## Table 10.1
## IMPLEMENTATION SCHEDULE

| Environment Protection Measures | Location/ Timing | Implementation Agent | Enforcing Ordinance |
|---|---|---|---|
| Air Quality | | | |
| Regular watering of haul roads - hourly when necessary | whole site/all times | CC | Nil |
| Water sprays during delivery and handling of sand and aggregate when dust is likely to be created and to dampen all stored materials during dry and windy weather | | | |
| Any conveyor system to be fitted with windboards, enclosures at conveyor transfer points and hopper discharge areas, three sided roofed enclosure with flexible curtain across the entry, conveyor belt cleaners and exhaust fans with suitable fabric cleaner | | | |
| Confinement of haulage and delivery vehicles to designated roadways on site | | | |
| Vehicle speed on site restricted to 15km/hr | | | |
| Wheel washing facilities to be installed at site exits, changing washing water, removal of sediments from washing facilities and provision of hard-surfaced road between washing facilities and public roads | | | |
| All site vehicle exhausts should be directed upwards or away from the ground | whole site/all times | CC | Nil |
| Regular removal of odorous sediments from channel | whole channel/ according to maintenance schedule | DSD | Nil |
| Noise | | | |
| Noise to be considered as an environmental constraint in the planning and execution of the works | whole site/all times | CC | Nil |

| Environment Protection Measures | Location/<br>Timing | Implementation<br>Agent | Enforcing Ordinance |
|---|---|---|---|
| Specific noise levels set<br><br>Liaise with schools and Examination Authority for examination times during contract period<br><br>Liaise with Pok Oi Hospital on timing, duration of project | whole site/all times | CC | Nil |
| Arrange working methods to minimise noise impacts on NSRs | whole site/all times | CC | Nil |
| Inspection of working methods and silenced equipment by Engineer prior to works commencement | whole site/all times | CC,E | Nil |
| Silenced equipment to be used on site | whole site/all times | CC | Nil |
| Maintenance of all plant and equipment | whole site/all times | CC | Nil |
| Noisy equipment and activities to be sited as far away from NSRs as possible<br><br>Scheduling of noisy activities to minimise exposure at NSRs<br><br>Idle equipment to be turned off or throttled down<br><br>Acoustic enclosures (where necessary) for power units of nonelectric stationary plant<br><br>Arrangement of minimum parallel operation of noisy equipment<br><br>Orientation of noisy equipment directed away from NSRs<br><br>Utilise stockpiles and other structures to screen noise<br><br>Erect temporary noise barriers 2.5m high at site boundary in vicinity of nearby NSRs | whole site/all times | CC | Nil |

| Environment Protection Measures | Location/ Timing | Implementation Agent | Enforcing Ordinance |
|---|---|---|---|
| Water | | | |
| Carry out works in dry season as much as possible | whole site/all times | CC | Nil |
| Cover areas of exposed earth | | | |
| Install sand traps or catchpits at all drainage discharge points | | | |
| Discharge runoff into settlement pits for infiltration instead of into drainage system (minimise all site runoff) | | | |
| Install and maintain oil interceptors in site compounds | | | |
| Oil and fuel bunkers to be bunded | | | |
| Immediate disposal and correct handling of any chemical spills | | | |
| Prevent concrete washings entering drainage channels (cover working area, provide settlement and treatment pits) | | | |
| Prevent runoff into adjacent ponds through construction of bunds between works area and ponds | | | |
| Remove sediments with minimal disturbance(use of "dry" working methods) | | | |
| Provide proper sewage facilities for site workers | | | |

| Environment Protection Measures | Location/ Timing | Implementation Agent | Enforcing Ordinance |
|---|---|---|---|
| Incorporate permeable areas along channel banks<br><br>As much as possible channel to be grasscrete lined (sides and base)<br><br>Plant pollutant absorbing species along grasscrete channel<br><br>Ensure tributary flows can react with grasscrete<br><br>Incorporate remaining Government land between Route 3 and YLBF and remaining pond areas south of Route 3 into channel design providing greater surface area for infiltration | whole site/DD stage | DDE/CC | Nil |
| <u>Waste</u><br><br>*Construction*<br><br>To be handled in accordance with the Construction Waste Management strategy outlined in Chapter 6 of the EIA which takes account of Government's construction and demolition waste management hierarchy ie) in order of desirability:- avoidance, minimisation, recycling/reuse, treatment, disposal | whole site/all times | CC | Nil |
| *Operation*<br><br>channel desilting to be carried out during the dry season<br><br>dredged sediments to be set aside and air dried prior to being loaded onto trucks for disposal at landfill<br><br>refuse boom to be laid across YLBF confluence with Kam Tin Floodway and regularly collected and disposed of at a landfill | whole site/routinely according to DSD maintenance schedule | DSD | Nil |

| Environment Protection Measures | Location/ Timing | Implementation Agent | Enforcing Ordinance |
|---|---|---|---|
| Ecology | | | |
| Ecologist to be included in detailed design team | DD | DDE | Nil |
| Alignment of northern channel section closer to Route 3 to minimise impact on fish ponds (Figure 6.1); | DD/C | DDE/CC | |
| Use of grasscrete on sides and base of channel between ch 1+340 and 3 +545. (See Appendix 1); | DD/C | DDE/CC | |
| Use of Government and private land south of Route 3 to provide an off-line marshcrete area between ch 2+780 and 2+940. "Recirculated" water back-pumped from pumping station to supply wetland area in association with local runoff. Planting of pollution and saline tolerant species; | DD/C | DDE/CC | |
| Use of land between YLBF and Route 3 to create off-line wetland area on marshcrete. "Recirculated" water supply back pumped from pumping station. Planting of pollution and saline tolerant wetland species; | DD/C | DDE/CC | Nil |
| Tree planting along channel banks should be attractive to fauna. Species should be selected from species list given in Table 5.15 of EIA; | DD/C | DDE/CC | |
| Maintenance of wetland areas as required during operational phase in the form of grass cutting and sediment removal | Whole site/Op | temporarily by a permanent maintenance department identified[1] | |
| Landscape & Visual Impacts | | | |
| Soft landscaping measures using native plant species to restore green landcover and enhance the vegetated, rural environment. This includes tree/shrub planting and hydroseeding in the peripheral site area, the proposed embankment slopes, footpath sides and access roads. | Whole site/C | CC | Nil |
| Planting of wetland species in engineered wetland areas. | Fishpond area/C | CC | |

| Environment Protection Measures | Location/ Timing | Implementation Agent | Enforcing Ordinance |
|---|---|---|---|
| Restoration of drained fishponds, to the north of the site, after completion of construction works | Fishpond area/C | CC | |
| The recreational opportunities presented by the reprovisioning of public open space affected by the YLBF, should be considered. | DD/C | DDE/CC | Nil |
| The exterior of the pumping station, handrailings and parapets shall be painted in a colour so as to minimise visual impact. Trees and shrubs may be planted around the pumping station to soften the visual impact of the structure. | Pumping Station, handrailings & parapets/C | CC | |
| The inclusion of small areas of stone finishing, to soften the visual impact of the channel, should be examined. | DD | DDE | |
| In the interests of conservation and preservation, the large *Ficus Microcarpa* and six protected species can be retained. Eleven protected tree species can be transplanted. | DD | DDE | |
| Top soil to be retained and used in any landscape mitigation measures. | Whole site/C | CC | |

Note This Implementation Schedule is based on information provided in the EIA and EM&A for the preliminary design and will be subject to review during subsequent stages of the project.

DD: Detailed Design Design Stage
DSD: Drainage Services Department,
DDE: Detailed Design Engineer
Op: Operation Stage

CC: Construction Contractor,
ER: Engineer's Representative
C: Construction Stage
E: Engineer

## 10.9 Environmental Monitoring and Audit

10.9.1 The construction and operation of the Yuen Long Bypass Floodway will give rise to adverse impacts on the environment. The EIA has shown that such impacts can be mitigated to acceptable levels through the implementation of a suite of environmental mitigation measures as summarised in Table 10.1. Many of these mitigation measures constitute good construction practice.

10.9.2 To ensure that the specified mitigation measures are implemented and that the resultant environmental impacts of the works are acceptable an environmental monitoring and audit (EM&A) programme will be undertaken during the project implementation. All details regarding the scope, management structure and implementation of the proposed EM&A programme are presented in the EM&A Manual accompanying this report. The EM&A Manual should be reviewed during the detailed design and periodically throughout the project implementation to ensure that it remains relevant and effective in respect of changing site conditions.

10.9.3 The key EM&A requirements are summarised below.

*Monitoring*

10.9.4 Monitoring of various environmental parameters will be undertaken according to the monitoring plan presented in Table 10.2.

**Table 10.2**
**Environmental Monitoring Plan**

| Monitoring Requirement | Period | Location | Parameters | Monitoring Frequency Duration |
|---|---|---|---|---|
| Air | Baseline | Pok Oi Hospital | TSP 1-hr, 24-hr | 24-hr TSP for 14 consecutive days prior to construction<br>1-hr TSP, 3 times per day during each 24-hr TSP event |
| | Impact | Up to 3 locations (Figure 10.1) | TSP 1-hr, 24-hr | 24-hr TSP every 6 days and 1-hr TSP 3 times in every 6 days. |
| Noise | Baseline | 3 locations (Figure 10.2) | Leq 30 | Continuous 30 minute measurements on 3 working days between 0700 and 1900 hrs immediately prior to construction |
| | Impact | Up to 3 locations (Figure 10.2) depending on works programme | Leq 30 | One Leq 30 measurement per week at each monitoring station during 0700-1900 hrs |
| Water | Baseline | Immediate mixing zone W1 (Figure 10.3) | DO, Turbidity pH, $NH_4$-N Temperature | One measurement every day for two consecutive weeks during mid ebb |
| | Impact | All site dischanges | DO, Turbidity pH Temperature | Once per week |
| | | Mixing zone | Oil and grease | Once per month |
| Ecology | Baseline | Floodway alignment | Ecological survey | Within 3 months prior to construction |
| | Operational Phase | Engineered wetland areas | Ecological survey | Once per year for five years for flora Twice per year for five years for avifauna. |

*Audit*

10.9.5 Environmental Audit will comprise two key activities including audit of monitoring results against prescribed action and limit levels and site inspections.

10.9.6 Action and Limit levels for various environmental parameters will be established on the basis of baseline monitoring results and /or statutory and contractual criteria. The Action and Limit levels for the various parameters (or methodology for setting such levels) are described in the EM&A Manual. A well defined Action Plan has been established to ensure appropriate actions are taken in the case of monitoring data exceedances.

10.9.7 Routine formal site inspections involving the Contractor and Engineer throughout the construction phase will ensure that the recommended environmental mitigation measures are implemented according to the Implementation Schedule.

10.9.8 Routine EM&A reports will be produced throughout the construction phase. These reports will record all monitoring results and audit findings including actions taken to rectify any noncompliance. Recommendations will be made for remedial measures and any amendments required to the EM&A programme. Details are provided in the EM&A Manual.

## 10.10 Conclusion

10.10.1 With the implementation of the recommended mitigation measures and monitoring of the environmental conditions at sensitive receivers in accordance with the Environmental Monitoring and Audit Manual, the impact on water quality, ecology, waste, air quality, noise and landscaping and visual impacts will be reduced to within established environmental guidelines and standards. This will result in the construction and operation of the Yuen Long Bypass Floodway being implemented in an environmentally acceptable manner.

## 10.11 Summary of Mitigation Measures and Implementation Schedule

10.11.1 Table 10.3 presents an Implementation Schedule for all the mitigation measures recommended during the EIA process to date. As this EIA covers the preliminary design it will be subject to review and refinement during the detailed design stage. The schedule provides the currently available information on:

- the specific mitigation measures recommended including references to the EIA;
- the location and timing of implementation of the mitigation measures;
- the party responsible for implementing each mitigation measure; and
- the project stage at which the mitigation measure is to be implemented.

**Table 10.3**
**IMPLEMENTATION SCHEDULE (See Notes at End of Table for Codes)**

| EIA Ref | EM&A Log Ref | Environment Protection Measures | Location/ Timing | Implementation Agent | Implementation Stages* Des | C | O | Relevant Legislation and Guidelines |
|---|---|---|---|---|---|---|---|---|
| | | <u>Air Quality</u> | | | | | | |
| | | *Construction mitigation measures* | | | | | | |
| 7.5.22 | 2.8.1 | Regular watering of haul roads to maintain surface wet. In order to meet this requirement, watering should be carried out at least twice a day and a water refilling system should be installed so that the water refilling time should be less than ten minutes. | whole site/all times | CC | | ✓ | | APCO, APCR, LS2 to Gazette 14 Part III.14 |
| | 2.8.1 | Effective water sprays shall be used during delivery and handling of sand and aggregate and similar materials when dust is likely to be created and to dampen all stored materials during dry and windy weather. | whole site/all times | CC | | ✓ | | APCR, LS2 Part IV.19 |
| | | Any conveyor system used for transfer of dusty materials should be fitted with windboards on all sides, enclosures at conveyor transfer points and hopper discharge areas, three sided roofed enclosure with flexible curtain across the entry, conveyor belt cleaners and exhaust fans with suitable fabric cleaner. | whole site/all times | CC | | ✓ | | APCR, LS2 Part IV.20 |

| EIA Ref | EM&A Log Ref | Environment Protection Measures | Location/ Timing | Implementation Agent | Implementation Stages* | | | Relevant Legislation and Guidelines |
|---|---|---|---|---|---|---|---|---|
| | | | | | Des | C | O | |
| 7.5.22 | 2.8.1 | The Contractor shall confine haulage and delivery vehicles to designated roadways inside the Site. Any motorized vehicle causing dust nuisance shall be restricted to a maximum speed of 15 km per hour while within the Site. | whole site/all times | CC | | ✓ | | -- |
| | | Wheel washing facilities shall be installed and used by all vehicles leaving the Site. No earth, mud, debris, dust and the like shall be deposited on public roads. Water in the wheel cleaning facility shall be changed at frequent intervals and sediments shall be removed regularly. The Contractor shall submit details of proposals for the wheel washing facilities to the Engineer prior to construction of the facility. Such wheel washing facilities shall be usable prior to any earthworks excavation activity on the Site. The Contractor shall also provide a hard-surfaced road between any washing facility and the public road. | whole site/all times | CC | | ✓ | | APCR, LS2 Part III.B and Part IV.A |
| | | All site vehicle exhausts should be directed upwards or away from the ground. | whole site/all times | CC | | ✓ | | |

| EIA Ref | EM&A Log Ref | Environment Protection Measures | Location/ Timing | Implementation Agent | Implementation Stages* Des | C | O | Relevant Legislation and Guidelines |
|---|---|---|---|---|---|---|---|---|
| | | *Operational mitigation measures* | | | | | | |
| 7.6.4 | - | Odorous sediments should be removed from the channel on a regular basis. The frequency of removal will vary with the time of year and should be carried out to minimize dispersion of odour to surrounding areas. | whole channel/according to maintenance schedule | DSD | | | ✓ | -- |
| | | *Monitoring* | | | | | | |
| 7.5.23 | 2.5 | The ET Leader shall carry out baseline monitoring at monitoring location C (Pok Oi Hospital) for at least 14 consecutive days prior to the commissioning of the construction works to obtain daily 24 hour TSP samples. 1-hour sampling shall also be done at least 3 times per day while the highest dust impact is expected. | monitoring locations/specified times | ET | | | | -- |
| 7.5.23 | 2.6 | Routine sampling frequency should be carried out once in every six-days for 24-hr TSP monitoring and at least 3 times in every six days for 1-hr TSP monitoring (undertaken when the highest dust impact occurs) at each monitoring station that is currently affected by the works. | monitoring locations/specified times | ET | | ✓ | | -- |
| | | The impact monitoring results shall be compared with the air quality criteria set up for 24-hour TSP and 1-hour TSP. | monitoring locations/specified times | ET | | ✓ | | -- |

| EIA Ref | EM&A Log Ref | Environment Protection Measures | Location/ Timing | Implementation Agent | Implementation Stages* Des | C | O | Relevant Legislation and Guidelines |
|---|---|---|---|---|---|---|---|---|
| 7.5.23 | 2.6 | In the case of non-compliance more frequent monitoring shall be conducted within 24 hrs after the result is obtained. This additional monitoring shall be continued until the excessive dust emission or deterioration in air quality is rectified. | monitoring locations/specified times | ET | | ✓ | | -- |
| | | <u>Noise</u><br><br>*Construction mitigation measures* | | | | | | |
| 8.1.36 | 3.7 | The contractor shall consider noise as an environmental constraint in the planning and execution of the works. With reference to Sections 8.1.36 to 8.1.43 of the EIA study report and Section 3.7 of the EM&A Manual, the Contractor shall prepare and submit to the Environmental Manager four (4) copies of a method statement fully indicating the noise mitigation to be adopted and its adequacy for each major item of works at least six (6) weeks before construction starts. This method statement must be certified by the Environmental Manager and submitted to EPD one month before construction starts. | whole site/all times | CC | ✓ | ✓ | | -- |

| EIA Ref | EM&A Log Ref | Environment Protection Measures | Location/ Timing | Implementation Agent | Implementation Stages* | | | Relevant Legislation and Guidelines |
|---|---|---|---|---|---|---|---|---|
| | | | | | Des | C | O | |
| 8.1.37 | 3.7.2 | The Contractor shall comply with the *Noise Control Ordinance (Cap 400)* and with any regulations made under the Ordinance, including restrictions placed on noise from construction work and the requirements to seek Construction Noise Permits. Before commencing work which requires Construction Noise Permits, the Contractor should obtain such permits and display these appropriately. | whole site/all times | CC | | ✓ | | NCO (Cap 400) |
| 8.1.38 | 3.7.4 | In addition to the requirements imposed by the *Noise Control Ordinance*, to control noise generated from equipment and activities for the purpose of carrying out any construction work other than percussive piling during the time period from 0700 to 1900 hours on any day not being a general holiday (including Sundays), the following requirements shall also be complied with: | whole site/all times | CC | | ✓ | | -- |

| EIA Ref | EM&A Log Ref | Environment Protection Measures | Location/ Timing | Implementation Agent | Implementation Stages* | | | Relevant Legislation and Guidelines |
|---|---|---|---|---|---|---|---|---|
| | | | | | Des | C | O | |
| 8.1.38 | 3.7.4 | (a) The noise level measured at 1 m from the most affected external facade of the nearby noise sensitive receivers from the construction work alone during any 30 minute period shall not exceed an equivalent sound level (Leq) of 75 dB(A). | whole site/all times | CC | | ✓ | | -- |
| | | (b) The noise level measured at 1 m from the most affected external facade of any nearby schools from the construction work alone during any 30 minute period shall not exceed an equivalent sound level (Leq) of 70 dB(A) [65 dB(A) during school examination periods]. | whole site/all times | CC | | ✓ | | -- |
| | | The Contractor shall liaise with the schools and the Examination Authority to ascertain the exact dates and times of all examination periods during the course of the contract. The Contractor should also liaise with Pok Oi Hospital regarding the timing and location of works. | whole site/all times | CC | | ✓ | | -- |

| EIA Ref | EM&A Log Ref | Environment Protection Measures | Location/ Timing | Implementation Agent | Implementation Stages* | | | Relevant Legislation and Guidelines |
|---|---|---|---|---|---|---|---|---|
| | | | | | Des | C | O | |
| 8.1.38 | 3.7.4 | Should the limits stated in the above sub-clauses (a) and (b) or, where applicable, (c) be exceeded, the construction shall stop and shall not recommence until appropriate measures acceptable to the Engineer that are necessary for compliance have been implemented. If two contractors working under this Project are both working close to the same NSR, both contractors may be required to reduce the noise level from their individual contract to 3 dB(A) less than the levels stipulated above so that the combined noise level does not exceed these limits. | whole site/all times | CC | | ✓ | | -- |
| 8.1.39 | 3.7.5 | The Contractor shall devise, arrange methods of working and carry out the works in such a manner as to minimise noise impacts on the surrounding environment, and shall provide experienced personnel with suitable training to ensure that these methods are implemented. | whole site/all times | CC | | ✓ | | -- |
| 8.1.40 | 3.7.6 | Six weeks before the commencement of any work, the methods of working, equipment and sound-reducing measures intended to be used on the Site should be made available to the Environmental Manager and the Engineer for inspection and approval to ensure that they are suitable for the project. | whole site/all times | CC,ER | | ✓ | | -- |

| EIA Ref | EM&A Log Ref | Environment Protection Measures | Location/ Timing | Implementation Agent | Implementation Stages* | | | Relevant Legislation and Guidelines |
|---|---|---|---|---|---|---|---|---|
| | | | | | Des | C | O | |
| 8.1.41 | 3.7.7 | The Contractor shall ensure that all plant and equipment to be used on the Site likely to cause excessive noise effectively sound-reduced by means of silencers, mufflers, acoustic linings or shields, acoustic sheds or screens or other means to avoid disturbance to any nearby noise sensitive receivers (NSRs). All hand-held percussive breakers and air compressors will comply with the *Noise Control (Hand-held Percussive Breakers) Regulations and Noise Control (Air Compressors) Regulations* respectively under the *Noise Control Ordinance (Ordinance No. 75/88, NCO Amendment 1992 No. 6).* | whole site/all times | CC | | ✓ | | NCR (HPB)<br>NCR (AC)<br>NCO |
| 8.1.42 | 3.7.8 | The Contractor shall ensure that all plant and equipment to be used on site are properly maintained and in good operating condition. | whole site/all times | CC | | ✓ | | -- |
| 8.1.43 | 3.7.9 | It is recommended that construction noise should be mitigated using a suitable combination of the following measures: | whole site/all times | CC | | ✓ | | -- |

| EIA Ref | EM&A Log Ref | Environment Protection Measures | Location/ Timing | Implementation Agent | Implementation Stages* | | | Relevant Legislation and Guidelines |
|---|---|---|---|---|---|---|---|---|
| | | | | | Des | C | O | |
| 8.1.43 | 3.7.9 | Noisy equipment and activities should be sited by the Contractor as far from close-proximity sensitive receivers as is practical and orientated away from NSRs. Prolonged operation of noisy equipment close to dwellings should be avoided. | whole site/all times | CC | | ✓ | | -- |
| | | Noisy plant or processes should be replaced by quieter alternatives. Silenced diesel and gasoline generators and power units, as well as silenced and super-silenced air compressors, can be readily obtained. | whole site/all times | CC | | ✓ | | -- |
| | | Noisy activities should be scheduled to minimise exposure of nearby sensitive receivers to high levels of construction noise. For example, noisy activities can be scheduled for midday, or at times coinciding with periods of high background noise (such as during peak traffic hours). | whole site/all times | CC | | ✓ | | -- |
| | | Idle equipment should be turned off or throttled down. Noisy equipment should be properly maintained and used no more often than is necessary. | whole site/all times | CC | | ✓ | | -- |
| | | The power units of non-electric stationary plant and earth-moving plant should be quietened by vibration isolation and partial or full acoustic enclosures for individual noise-generating components. | whole site/all times | CC | | ✓ | | -- |

| EIA Ref | EM&A Log Ref | Environment Protection Measures | Location/ Timing | Implementation Agent | Implementation Stages* | | | Relevant Legislation and Guidelines |
|---|---|---|---|---|---|---|---|---|
| | | | | | Des | C | O | |
| 8.1.43 | 3.7.9 | Construction activities should be planned so that parallel operation of several sets of equipment close to a given sensitive receiver is avoided. The numbers of operating items of powered mechanical equipment should be minimised. | whole site/all times | CC | | ✓ | | -- |
| | | Construction plant should be properly maintained and operated. Construction equipment often has silencing measures built in or added on, e.g. bulldozer silencers, compressor panels, and mufflers. Silencing measures should be properly maintained and utilised. | whole site/all times | CC | | ✓ | | -- |
| | | Acoustic barriers should be used to protect nearby noise sensitive receivers if necessary. Barriers can be made of mounds of fill or any material having a surface density of 20 $kg/m^3$. | whole site/all times | CC | | ✓ | | -- |
| | | *Monitoring* | | | | | | |
| 8.1.46 | 3.4 | The baseline noise monitoring shall be carried out at the noise monitoring locations for a period of two weeks prior to the commencement of the construction works. | monitoring locations/ specified times | ET | | | | -- |
| 8.1.46 | 3.5 | Construction noise monitoring shall be carried out once per week between 0700-1900 on normal weekdays at all designated monitoring locations. | monitoring locations/specified times | ET | | ✓ | | -- |

| EIA Ref | EM&A Log Ref | Environment Protection Measures | Location/ Timing | Implementation Agent | Implementation Stages* | | | Relevant Legislation and Guidelines |
|---|---|---|---|---|---|---|---|---|
| | | | | | Des | C | O | |
| 8.1.46 | 3.5 | In case of noncompliance with the construction noise criteria, more frequent monitoring as specified in the Action Plan shall be carried out. The additional monitoring shall be continued until the recorded noise levels are rectified or proved to be irrelevant to the construction activities. | monitoring locations/specified times | ET | | ✓ | | -- |
| | | <u>Water</u><br><br>*Construction mitigation measures*<br><br>With reference to Table 4.10 of the EIA study report and section 4.7 of the EM&A manual the Contractor shall submit to the Engineer and the Environmental Manager at least six (6) weeks prior to construction a total of five (5) copies of a method statement with accompanying drawings to illustrate the adequacy of the provision of water quality mitigation measures to be implemented as designated in items (a) to (l) below. These drawings and method statement must be agreed and certified by the Environmental Manager. A certified copy must be deposited with the Director of Environmental Protection one month before construction starts. | | | | | | |

| EIA Ref | EM&A Log Ref | Environment Protection Measures | Location/ Timing | Implementation Agent | Implementation Stages* Des | C | O | Relevant Legislation and Guidelines |
|---|---|---|---|---|---|---|---|---|
| Table 4.10 | 4.7 | (a) The Contractor shall ensure that works within the Yuen Long Bypass Floodway take place in the dry season as far as practicable or else additional temporary works such as cofferdam or temporary earth bund will be required to minimise runoff and pollution from the works entering the water column. Water collecting behind the cofferdam shall be either pumped onto the land-bank or collected, settled and pH adjusted to 8.5 or less before being allowed to enter the channels. | whole site/all times | CC | | ✓ | | ProPECC PN 1/94 |
| | | (b) Open stockpiles of construction materials (e.g. aggregates, sand and fill material) on site shall be protected from erosion during rainstorms. Measures shall be taken to prevent the washing away of construction materials, soil, silt or debris into any drainage system. Hydroseeding should be used where practical. | whole site/all times | CC | | ✓ | | ProPECC PN 1/94 |

| EIA Ref | EM&A Log Ref | Environment Protection Measures | | Location/ Timing | Implementation Agent | Implementation Stages* | | | Relevant Legislation and Guidelines |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Des | C | O | |
| Table 4.10 | 4.7 | (c) | The transport of sediment to the environment shall be minimised by the installation of appropriate sediment traps within the drainage system. Sediment traps shall be designed with adequate capacity. | whole site/all times | CC | | ✓ | | ProPECC PN 1/94 |
| | | (d) | Wastewater generated from the washing down of mixer trucks and drum mixers and similar equipment should be recycled. The discharge of wastewater should be kept to a minimum. | whole site/all times | CC | | ✓ | | -- |
| | | (e) | Wastewater generated from construction activities should be discharged into an excavated sedimentation pit prior to discharge. The pit should be unlined to allow for infiltration of water into the ground and setting of concrete before disposal. | whole site/all times | CC | | ✓ | | -- |
| | | (f) | In the case of an unlined pit for all types of wastewater being settled out, water infiltration into the ground requries a license from EPD under the WPCO regulations. Where a license cannot be obtained, or if water re-use is practiced, the pit may need to be lined, which requires more frequent removal of the contents. | whole site/all times | CC | | ✓ | | WPCO |

| EIA Ref | EM&A Log Ref | Environment Protection Measures | | Location/ Timing | Implementation Agent | Implementation Stages* | | | Relevant Legislation and Guidelines |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Des | C | O | |
| Table 4.10 | 4.7 | (g) | Oil interceptors shall be provided in Site compounds and regularly emptied to prevent release of oils and grease into the urface water drainage system after accidental spillages. The interceptor shall have a bypass to prevent flushing during periods of heavy rain. Oil and fuel bunkers shall be bunded to prevent discharge due to accidental spillages or breaching of tanks. | whole site/all times | CC | | ✓ | | ProPECC PN 1/94 |
| | | (h) | Any waters entering the storm drains must have a pH less than 8.5. Under normal circumstances, surplus wastewater may be discharged into foul sewers after treatment in silt removal and pH adjustment facilities (to within the pH range of 6 to 9). Disposal of wastewater into storm drains will require more elaborate treatment. Surface run-off should be segregated from the concrete batching plant and casting yard area, if used, and diverted to the stormwater drainage system. Surface run-off contaminated by materials in a concrete batching plant or casting yard, if used, should be adequately treated before disposal into stormwater drains. | whole site/all times | CC | | ✓ | | ProPECC PN 1/94 |
| | | (i) | Runoff should be prevented from entering adjacent ponds through construction of bunds between works areas and ponds. | whole site/all times | CC | | ✓ | | -- |

| EIA Ref | EM&A Log Ref | | Environment Protection Measures | Location/ Timing | Implementation Agent | Implementation Stages* | | | Relevant Legislation and Guidelines |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Des | C | O | |
| Table 4.10 | Section 4.7 | (j) | The Contractor shall take all reasonable measures to minimise adverse impacts resulting from construction activities associated with the removal of sediments. These measures shall include ensuring that all plant and equipment and working methods meet the following criteria. | whole site/all times | CC | | ✓ | | - |
| | | • | utilising appropriate suspended solids containment screen while removing sediment. | | | | | | |
| | | • | minimise disturbance of the channel bed while dredging; | | | | | | |
| | | • | minimise leakage of dredged sediment during lifting through the use of closed grabs where practical; | | | | | | |
| | | • | prevent the overflowing of any hopper used to contain removed sediments. | | | | | | |
| | | (k) | The Contractor shall be responsible for disposing of all dredged sediments at an appropriate location depending on the volume and composition of the material. | whole site/all times | CC | | ✓ | | -- |

| EIA Ref | EM&A Log Ref | Environment Protection Measures | Location/ Timing | Implementation Agent | Implementation Stages* | | | Relevant Legislation and Guidelines |
|---|---|---|---|---|---|---|---|---|
| | | | | | Des | C | O | |
| Table 4.10 | 4.7 | (l) If any office, works area canteen or toilet facilities are erected, foul water effluent should be directed to a foul sewer or to a sewage treatment facility either directly or indirectly by means of pumping or other means approved by the Engineer. | whole site/all times | CC | | ✓ | | ProPECC PN 1/94 |
| | | *Operational mitigation measures*<br><br>With reference to Table 4.11 and Figures 5.4 and 5.5 in the EIA Study Report, the Detailed Design Engineer (DDE) shall deposit scaled location and detail drawings with the Director of Environmental Protection at least one month before the commencement of construction showing the design of the channel banks, the areas of grasscrete and other ecological mitigation as specified in items (a), (b) and (c) below and in the section on ecological mitigation in this schedule. The drawings shall be submitted to the Environmental Manager for prior approval and certification. | | | | | | |

| EIA Ref | EM&A Log Ref | Environment Protection Measures | Location/ Timing | Implementation Agent | Implementation Stages* | | | Relevant Legislation and Guidelines |
|---|---|---|---|---|---|---|---|---|
| | | | | | Des | C | O | |
| Table 4.11 | - | The Contractor should incorporate permeable areas along the channel banks such as grasscrete, and establish plant pollutant absorbing species in the channel as described in the Ecology section of this Implementation Schedule. | whole site Des&C stages | DDE/CC | ✓ | ✓ | | -- |
| | | The water flow should be directed so that water comes into contact with grasscrete. | whole site Des&C stages | DDE/CC | ✓ | ✓ | | -- |
| | | The remaining Government land between Route 3 and YLBF and remaining pond areas south of Route 3 should be incorporated into channel design to provide a greater surface area for infiltration (Figures 5.4 and 5.5 in EIA). | whole site Des&C stages | DDE/CC | ✓ | ✓ | | -- |
| Table 4.11 | | *Monitoring* | | | | | | |
| | | Baseline monitoring of DO Turbidity, pH, $NH_4$-N and Temperature at the immediate mixing zone ($W_1$) shall be undertaken by the ET, during mid ebb tide for a period of two consecutive weeks at a frequency of once per day. The samples shall be taken at mid depth. | monitoring locations/specified times | ET | | | | -- |

<table>
<tr><th rowspan="2">EIA<br>Ref</th><th rowspan="2">EM&A<br>Log Ref</th><th rowspan="2">Environment Protection Measures</th><th rowspan="2">Location/<br>Timing</th><th rowspan="2">Implementation<br>Agent</th><th colspan="3">Implementation Stages*</th><th rowspan="2">Relevant Legislation and Guidelines</th></tr>
<tr><th>Des</th><th>C</th><th>O</th></tr>
<tr><td>Table 4.11</td><td>4.5</td><td>Impact monitoring should be carried out as follows:
<table>
<tr><th>Location</th><th>Parameters</th><th>Frequency</th></tr>
<tr><td rowspan="2">All Site Discharges including ultimate discharge into Kam Tin River</td><td>Turbidity, PO, pH, Temperature</td><td>Once per week (during mid ebb at ultimate discharge)</td></tr>
<tr><td>oil and grease, SS</td><td>Once per month (during mid ebb at ultimate discharge)</td></tr>
<tr><td>Mixing Zone of YLBF and Kam Tin River[1]</td><td>pH, Temperature, NH4-N, DO Turbidity</td><td>Once per week during mid ebb</td></tr>
</table>
[1] Mixing zone is taken to be 10 m downstream from the floodway discharge part</td><td>monitoring locations/specified times</td><td>ET</td><td></td><td>✓</td><td></td><td>--</td></tr>
<tr><td>Table 4.11</td><td>4.6</td><td>Data obtained from impact monitoring should meet the compliance criteria for each parameter. Should the monitoring results of the water quality parameters at any designated monitoring stations indicate that the water quality criteria are exceeded, the actions in accordance with the Action Plan should be carried out.</td><td>monitoring locations/specified times</td><td>ET</td><td></td><td>✓</td><td></td><td>--</td></tr>
</table>

| EIA Ref | EM&A Log Ref | Environment Protection Measures | Location/ Timing | Implementation Agent | Implementation Stages* | | | Relevant Legislation and Guidelines |
|---|---|---|---|---|---|---|---|---|
| | | | | | Des | C | O | |
| | | Waste<br>*Construction mitigation measures*<br>With reference to Sections 6.1 and 6.2 of the EIA Study Report, the Contractor shall deposit to the Director of Environmental Protection, a detailed methodology statement demonstrating the adequacy of the provisions made, at least one month prior to the commencement of construction. This statement must have prior approval and certification by the Environmental Manager. The statement should be accompanied with location and detail drawings of provisions for hard-standing areas, settlement ponds, fuel storage facilities, chemical waste storage facilities, and all other temporary waste storage facilities including stock-piled materials. The Method Statement must include the Spill Action Plan. | | | | | | |

| EIA Ref | EM&A Log Ref | Environment Protection Measures | Location/ Timing | Implementation Agent | Implementation Stages* | | | Relevant Legislation and Guidelines |
|---|---|---|---|---|---|---|---|---|
| | | | | | Des | C | O | |
| 6.1,6.2 | Chapter 5 | The Contractor is responsible for waste control within the construction site, removal of the waste material produced from the site and implementation of any mitigation measure to minimise waste or redress problems arising from the waste from the site. The waste material may include any sewage, waste water or effluent containing sand, cement, silt or any other suspended or dissolved material to flow from the site onto any adjoining land, storm sewer, sanitary sewer, or any waste matter or refuse to be deposited anywhere within the site or onto any adjoining land. | whole site/all times | CC | | ✓ | | WDO Cap 354 |
| | | Waste should be handled in accordance with the Construction Waste Management Strategy recommendations for handling of waste. The hierarchy of management method is: avoidance, minimisation, recycling/re-use, treatment, disposal. | whole site/all times | CC | | ✓ | | -- |

| EIA Ref | EM&A Log Ref | Environment Protection Measures | Location/ Timing | Implementation Agent | Implementation Stages* Des | C | O | Relevant Legislation and Guidelines |
|---|---|---|---|---|---|---|---|---|
| 6.1,6.2 | Chapter 5 | When handling the waste material, the following measures shall be undertaken by the Contractor: | whole site/all times | CC | | ✓ | | |
| | | (i) The Contractor shall be aware of, and comply with, the *Waste Disposal Ordinance*, the *Public Health and Municipal Services Ordinances*, the *Water Pollution Control Ordinance* and the *Waste Disposal (Chemical Waste) (General Regulation)*. | whole site/all times | CC | | ✓ | | WDO, PHMSO, WPCO, WD(CW) (GR |
| | | (ii) The excavation of soft, contaminated mud and its removal must, as far as is practicable, be carried out during the dry season. | whole site/all times | CC | | ✓ | | ProPECC PN3/94 |
| | | (iii) The Contractor's attention is drawn to *A Guide to the Chemical Waste Control Scheme*; *A Guide to the Registration of Chemical Waste Producers*; and the *Code of Practice on the Packing, Labelling and Storage of Chemical Wastes*. | whole site/all times | CC | | ✓ | | CWCS RCWP CPPLSCW |
| | | (iv) The Contractor shall segregate all inert construction waste material suitable for reclamation or land formation and shall dispose of such material at public dumping areas or at a location agreed in advance by the FMC and EPD. | whole site/all times | CC | | ✓ | | WBTC 5/98 |

| EIA Ref | EM&A Log Ref | Environment Protection Measures | | Location/ Timing | Implementation Agent | Implementation Stages* | | | Relevant Legislation and Guidelines |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Des | C | O | |
| 6.1,6.2 | Chapter 5 | (v) | All non-inert construction waste material deemed unsuitable for reclamation or land formation and all other waste material shall be dumped at public landfill. | whole site/all times | CC | | ✓ | | WBTC 5/98 |
| | | (vi) | The Contractor shall comply with and complete the procedures in WBTC No. 2/93 and/or EPD's ProPECC PN 3/94 regarding marine or land-based disposal of dredged mud, prior to the commencement of Works. | whole site/all times | CC | | ✓ | | WBTC 2/93 ProPECC PN3/94 |
| | | (vii) | The new *Air Pollution Control (Open Burning) Regulation* came into effect on 26th February 1995. This regulation prohibits open burning for the disposal of construction waste or the clearance of a site in preparation for construction work. Certain other types of open burning are allowed under permits issued by the EPD. | whole site/all times | CC | | ✓ | | APC(OB)R |
| | | (viii) | Fossil fuel and used lubricants for trucks and machinery are classified as chemical wastes. The Contractor shall register with EPD as a chemical waste producer and observe all the requirements under the storage, labelling, transportation and disposal of chemical waste. | whole site/all times | CC | | ✓ | | WDO(CW)(GR) |

| EIA Ref | EM&A Log Ref | Environment Protection Measures | Location/ Timing | Implementation Agent | Implementation Stages* | | | Relevant Legislation and Guidelines |
|---|---|---|---|---|---|---|---|---|
| | | | | | Des | C | O | |
| 6.1,6.2 | Chapter 5 | (ix) The Contractor shall prevent fuel and lubricating oil leakage from plant and storage sites from contaminating the construction site. All compounds in works areas shall be located on areas of hardstanding with provision of drainage channels and settlement lagoons where necessary to allow interception and controlled release of settled water; and provision of bunding for all potentially hazardous materials on Site including fuels. The Contractor shall prepare a spill action plan and keep suitable clean-up materials on site. | whole site/all times | CC | | ✓ | | WDO(CW) (GR) |

| EIA Ref | EM&A Log Ref | Environment Protection Measures | Location/ Timing | Implementation Agent | Implementation Stages* Des | C | O | Relevant Legislation and Guidelines |
|---|---|---|---|---|---|---|---|---|
| 6.1,6.2 | Chapter 5 | (x) Care must be taken to prevent spillages:<br>(a) the storage area for fuels and lubricants shall be isolated from working areas and kept secure;<br>(b) use of fuels and lubricants shall be carried out with care;<br>(c) any spillage problem due to any truck and machinery shall not be ignored;<br>(d) emulsifier and absorbent shall be available on Site, so that immediate action can be taken when there is minor spillage;<br>(e) all containers shall be stored so as to prevent any spillage of the contents and disposed of carefully; and<br>(f) concepts of 'Site cleanliness' shall be introduced to workers, to gather and store construction waste in an appropriate manner. | whole site/all times | CC | | ✓ | | WDO(CW) (GR) |
| | | (xi) Temporary waste facilities shall be set up by the Contractor. Municipal waste shall be collected in black refuse bags and delivered to, and disposed of at, an approved landfill. | whole site/all times | CC | | ✓ | | -- |

| EIA Ref | EM&A Log Ref | Environment Protection Measures | Location/ Timing | Implementation Agent | Implementation Stages* | | | Relevant Legislation and Guidelines |
|---|---|---|---|---|---|---|---|---|
| | | | | | Des | C | O | |
| 6.1,6.2 | Chapter 5 | A core sampling programme should be undertaken to ascertain the nature of the substratum. In the unlikely event of contaminated land being encountered, it will be subject to the criteria specified in ProPECC Pager (PN3/94) Contaminated Land Assessment and Remediation. | whole site/Des | DDE | ✓ | | | ProPECC PN 3/94 |
| | | *Operation mitigation measures* | | | | | | |
| 6.3 | 5.10 | Channel desilting should be carried out during the dry season whenever possible | whole site/routinely according to DSD maintenance schedule | DSD | | | ✓ | ProPECC PN 3/94 |
| | | Dredged sediments should be set aside and air dried prior to being loaded onto trucks for disposal at landfill | | | | | ✓ | -- |
| | | A refuse boom should be laid across YLBF confluence with Kam Tin Floodway and the sediment should be regularly collected and disposed of at a landfill | | | | | ✓ | -- |
| | | *Monitoring*<br>No monitoring is proposed to identify the nature of waste arising. It is the responsibility of the Contractor to measure the contaminant level of dredged mud and classify it before disposal. The success of measures to minimise impact on the aquatic environment may be reflected by water quality monitored as described in Section 4. | | | | | | -- |

| EIA Ref | EM&A Log Ref | Environment Protection Measures | Location/ Timing | Implementation Agent | Implementation Stages* | | | Relevant Legislation and Guidelines |
|---|---|---|---|---|---|---|---|---|
| | | | | | Des | C | O | |
| | 6.1.3 | Ecology<br><br>*Construction mitigation measures* | | | | | | |
| | | An Ecologist should be included in detailed design team. | Des | DDE | ✓ | | | -- |
| | | With reference to Section 5.5 of the EIA Study Report and Section 6.2 of the EM&A Manual, the Detailed Design Engineer will deposit with the Director of Environmental Protection scaled location and detail drawings at least one month before construction commences. These drawings shall show all ecological mitigation measures for the Project. The drawings shall demonstrate conformance with the measures in the EIA study report and shall be certified by the Environmental Manager. | | | | | | |
| 5.5.6 | 6.2 | The alignment of northern channel section should be routed as close as possible to Route 3 to minimise impact on fish ponds (Figure 5.2 in EIA). | specified locations/Des&C stages | DDE/CC | ✓ | ✓ | | -- |
| 5.5.12 - 5.5.14 | 6.2 | Grasscrete should be incorporated in the channel design on sides and base of channel between ch 1+340 and 3+545. | specified locations/Des&C stages | DDE/CC | ✓ | ✓ | | -- |

| EIA Ref | EM&A Log Ref | Environment Protection Measures | Location/ Timing | Implementation Agent | Implementation Stages* | | | Relevant Legislation and Guidelines |
|---|---|---|---|---|---|---|---|---|
| | | | | | Des | C | O | |
| 5.5.15 - 5.5.19 | 6.2 | Government and private land south of Route 3 should provide an off-line marshcrete area between ch 2+780 and 2+940 (Figures 5.4 and 5.5 in EIA). "Recirculated" water should be back-pumped from pumping station to supply wetland area in association with local runoff. Pollution and saline tolerant species should be planted and established along the channel. | specified locations/Des&C stages | DDE/CC | ✓ | ✓ | | -- |
| 5.5.14 - 5.5.19 | 6.2 | The land between the YLBF and Route 3 (between ch 3+050 and 3+545) should be utilised to create an offline wetland area on a submerged grasscrete substrate. Recirculated water back-pumped from the pumping station will supply wetland area. Saline tolerant and pollution tolerant wetland species should be planted and established along the channel. | specified locations/Des&C stages | DDE/CC | ✓ | ✓ | | -- |
| 5.5.20 | 6.2 | Suitable tree species should be planted along the channel banks which are attractive to fauna. Species should be selected from species list given in Table 5.15 of EIA; | specified locations/Des&C stages | DDE/CC | ✓ | ✓ | | -- |
| | | *Operation mitigation measures* | | | | | | |
| 5.5.25 - 5.5.26 | 6.2 | Maintenance of wetland areas should be carried out during the operational phase in the form of grass cutting and sediment removal. | Whole site/O | temporarily by TDD until a permanent maintenance department identified[1] | | | ✓ | -- |

| EIA Ref | EM&A Log Ref | Environment Protection Measures | Location/ Timing | Implementation Agent | Implementation Stages* | | | Relevant Legislation and Guidelines |
|---|---|---|---|---|---|---|---|---|
| | | | | | Des | C | O | |
| | | *Monitoring* | | | | | | -- |
| | 6.1 | An ecological baseline survey of the proposed YLBF alignment shall be undertaken within three months prior to the commencement of construction activities. The results compared with the results of the ecological survey undertaken under this study to provide information on recent changes in habitat conditions. Both floral and faund surveys should be carried out. Ecological surveys shall be undertaken under the supervision of an ecologist with at least 3 years of local experience. | monitoring locations/specified times | ET | | | | -- |
| | | No ecological monitoring will be required during the construction phase. | monitoring locations/specified times | ET | | | | -- |
| | | During the first 2 years (commencing immediately after project completion), quarterly floral and faunal surveys shall be carried out by (or under the supervision of) an ecologist of at least three years local experience (vetted by AFD if necessary). | | | | | ✓ | -- |

| EIA Ref | EM&A Log Ref | Environment Protection Measures | Location/ Timing | Implementation Agent | Implementation Stages* | | | Relevant Legislation and Guidelines |
|---|---|---|---|---|---|---|---|---|
| | | | | | Des | C | O | |
| | 6.1 | The floral survey shall monitor the dominance, height and density of naturally colonising wetland plant species, using 1 m quadrats at three points within the marshcrete areas (to be decided in agreement with AFD during detailed design) along the alignment. One point should be at the downstream end to monitor the influence (if any) of saline intrusion on both floral and faunal presence. | monitoring locations/specified times | ET | | | ✓ | -- |
| | | Faunal surveys shall included bird and insect counts noting the activities of these fauna (breeding/feeding/courting etc.) with regard to the whole landscaping and channel area. This will determine the use of landscaped trees, the grasscrete sides, and the "marshcrete" areas by fauna. In order to assess the value of the "marshcrete" areas, floral and faunal presence should be specifically related to each of these habitats. Amphibian surveys should be carried out within the period of peak activity of this class (i.e. twice, during the wet season - May/June and July/August). | monitoring locations/specified times | ET | | | ✓ | -- |

| EIA Ref | EM&A Log Ref | Environment Protection Measures | Location/ Timing | Implementation Agent | Implementation Stages* Des | C | O | Relevant Legislation and Guidelines |
|---|---|---|---|---|---|---|---|---|
| | | Attention shall be drawn to dominant species (and their density), and the occurrence (if any) of rarities and protected species, and the activities of fauna (breeding/feeding/courting etc.). Any other outside influencing factors (pollution, development etc.) should be highlighted. | monitoring locations/specified times | ET | | | ✓ | -- |
| | | For the next three years, the surveys shall be conducted on an annual, early wet season (May-June) cycle. Any other outside influencing factors (pollution, nearby development etc.) should be highlighted. | monitoring locations/specified times | ET | | | ✓ | -- |
| | 6.1 | The criteria for the success of the mitigation proposals will be based on an ecological comparison with an existing concrete nullah in the Yuen Long Area (e.g. the Shan Pui Nullah). The baseline data prior to the Project commencement will be available for reference. | monitoring locations/specified times | ET | | | ✓ | -- |
| | | <u>Landscape & Visual Impacts</u><br>With reference to Section 9.6 of the EIA Study Report and Chapter 7 of the EM&A Manual, the Detailed Design Engineer shall deposit with the Director of Environmental Protection, scaled location and landscape report drawings and a landscape report demonstrating conformance with the requirements of the EIA study. The drawings and landscape report shall have prior approval and certification by the Environmental Manager. | | | | | | |

| EIA Ref | EM&A Log Ref | Environment Protection Measures | Location/ Timing | Implementation Agent | Implementation Stages* | | | Relevant Legislation and Guidelines |
|---|---|---|---|---|---|---|---|---|
| | | | | | Des | C | O | |
| 9.6.2 | Chapter 7 | Soft landscaping measures should be used, employing native plant species to restore green landcover and enhance the vegetated, rural environment. This includes tree/shrub planting and hydroseeding in the peripheral site area, the proposed embankment slopes, footpath sides and access roads. | Whole site/C | CC | | ✓ | | -- |
| 9.6.7 | Chapter 7 | Saline tolerant and pollution tolerant wetland species should be planted in engineered wetland areas. | Fishpond area/C | CC | | ✓ | | -- |
| 9.6.7 | Chapter 7 | After completion of construction works, the drained fishponds to the north of the site, should be restored. | Fishpond area/C | CC | | ✓ | | -- |
| 9.6.8 | Chapter 7 | The recreational opportunities presented by the reprovisioning of public open space affected by the YLBF, should be considered. | specified locations/Des&C stages | DDE/CC | ✓ | ✓ | | -- |
| 9.6.9 | Chapter 7 | The exterior of the pumping station, handrailings and parapets shall be painted in a colour so as to minimise visual impact. Trees and shrubs may be planted around the pumping station to soften the visual impact of the structure. | Pumping Station, handrailings & parapets/C | CC | | ✓ | | -- |
| 9.6.10 | Chapter 7 | The inclusion of small areas of stone finishing, to soften the visual impact of the channel, should be examined. | specified locations/Des | DDE | ✓ | | | -- |

| EIA Ref | EM&A Log Ref | Environment Protection Measures | Location/ Timing | Implementation Agent | Implementation Stages* | | | Relevant Legislation and Guidelines |
|---|---|---|---|---|---|---|---|---|
| | | | | | Des | C | O | |
| 9.6.11 | Chapter 7 | In the interests of conservation and preservation, the large *Ficus Microcarpa* and six protected species should be retained as described in the Tree Survey Report (Report No. 0136/TSR/Issue 1). Eleven protected tree species should be transplanted. | specified locations/Des | DDE | ✓ | | | -- |
| 9.6.13 | Chapter 7 | Top soil should be retained and used in any landscape mitigation measures.<br><br>Detailed landscape design should be carried out by a landscape architect. | Whole site/C | CC | | ✓ | | --<br><br>-- |
| | 7.1 | *Monitoring*<br><br>During the soft landscape establishment and maintenance, each of the following stages shall be subject to the inspection and approval of the landscape architect before commencement of the next stage of works. | specified locations/C | ET | | ✓ | | -- |

| EIA Ref | EM&A Log Ref | Environment Protection Measures | Location/ Timing | Implementation Agent | Implementation Stages* | | | Relevant Legislation and Guidelines |
|---|---|---|---|---|---|---|---|---|
| | | | | | Des | C | O | |
| 9.6.13 | 7.1 | 1. After checking of setting out of planting areas and subgrade levels, and setting out of any additional planting and drainage prior to placing topsoils. | specified locations/C | ET | | ✓ | | -- |
| | | 2. At completion of soil preparation prior to planting. | specified locations/C | ET | | ✓ | | -- |
| | | 3. After planting, staking and tying prior to placing mulch. | specified locations/C | ET | | ✓ | | -- |
| | | 4. At completion of works | specified locations/C | ET | | ✓ | | -- |
| | | 5. At completion of each three month period of the maintenance works. | specified locations/O | ET | | | ✓ | -- |
| | | Maintenance works landscaping monitoring should be carried out in accordance with the General Schedule of Maintenance Works. | specified locations/O | ET | | | ✓ | -- |

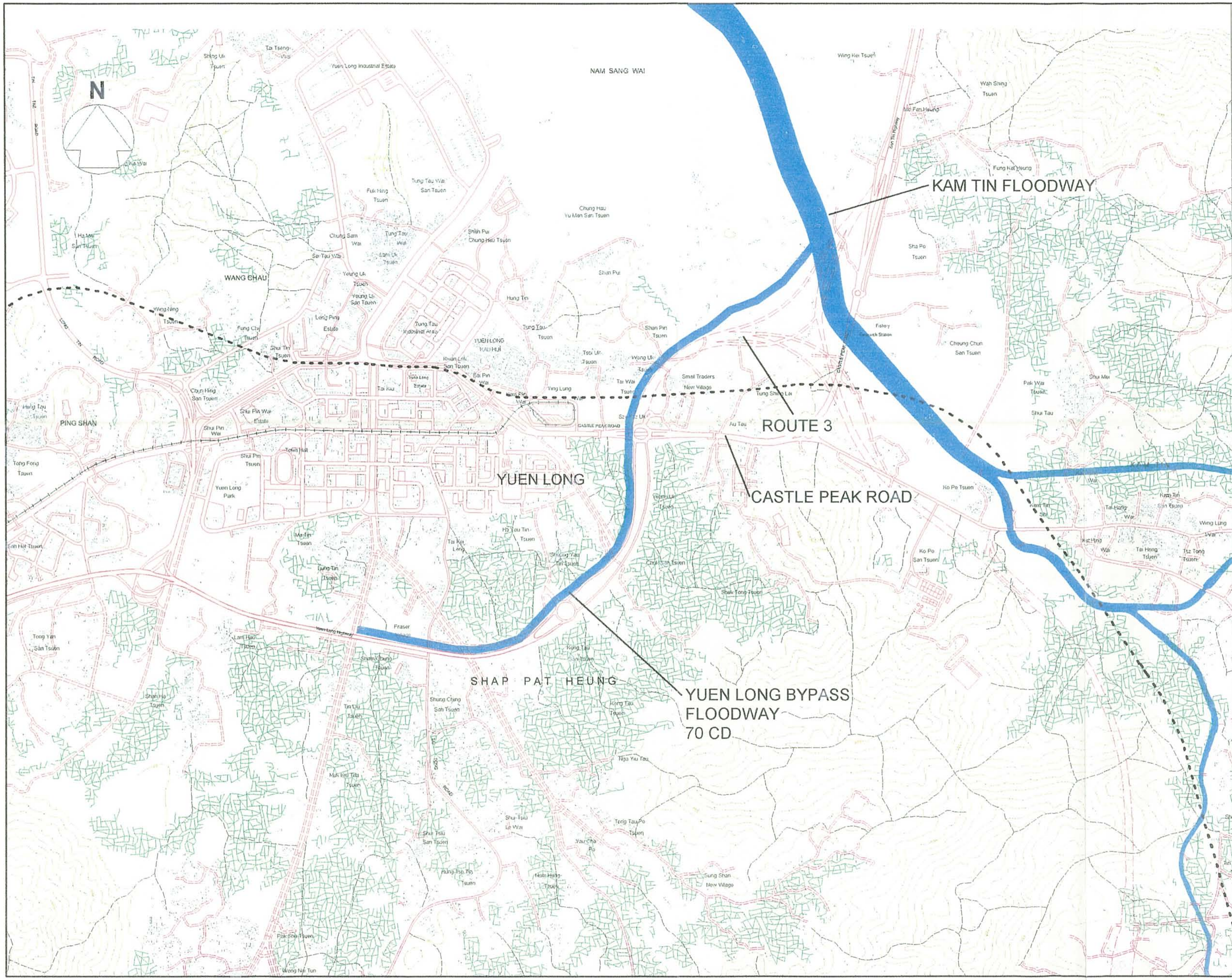
| | |
|---|---|
| Note | This Implementation Schedule is based on information provided in the EIA and EM&A for the preliminary design and will be subject to review during subsequent stages of the project. |
| * | Des=Design; C=Construction; O=Operation;<br>Territory Developments Department (TDD) is the ultimate agent responsible for the implementation of the mitigation measures during design and construction stages.<br>The Detailed Design Engineer (DEE), Construction Contractor (CC), Engineer's Representative (ER) and Environmental Team (ET) will be employed by TDD in due course.<br>DSD is responsible for maintenance of the concrete channel during operation stage. |
| 1 | TDD has agreed to provide interim maintenance responsibility until a permanent maintenance authority has been designated for such sites under the Wetlands Compensation Study |

| | |
|---|---|
| APCO | Air Pollution Control Ordinance |
| APCR,LS2 | Air Pollution Control Regulation, Legal Supplement 2 |
| NCO | Noise Control Ordinance |
| NCR(HPB) | Noise Control Regulation (Hand-held Percussive Breakers) |
| NCR(AC) | Noise Control Regulation (Air Compressors) |
| ProPECC PN1/94 | Professional Persons Practice Note 1 (1994) |
| WDO | Waste Disposal Ordinance |
| PHMSO | Public Health and Municipal Services Ordinances |

| | |
|---|---|
| WPCO | Water Pollution Control Ordinance |
| WD(CW)(GR) | Waste Disposal (Chemical Works)(General Regulations) |
| ProPECC PN3/94 | Professional Persons Practice Note 3(1994) |
| CWCS | A guide to the Chemical Waste Control Scheme |
| RCWP | A guide to the Registration of Chemical Waste Producers |
| CPPLSCW | Code of Practice on the Packing, Labelling and Storage of Chemical Wastes |
| WBTC 5/98 | Works Branch Technical Circular No. 5 (1998) |
| APC(OB)R | Air Pollution Control (Open Burning) Regulation |

# APPENDIX A

# ALIGNMENT OPTIONS






Legend :

| revision | date | description | | initial |
|---|---|---|---|---|
| | designed | checked | drawn | checked |
| initial | GY | AJT | LC | CWC |
| date | 1/98 | 1/98 | 1/98 | 1/98 |

AGREEMENT NO. CE 79/96

project

YUEN LONG BYPASSS FLOODWAY
FEASIBILITY STUDY

figure title

YUEN LONG BYPASS
FLOODWAY
OPTION 1

| figure no. | scale |
|---|---|
| 3.1 | N.T.S |

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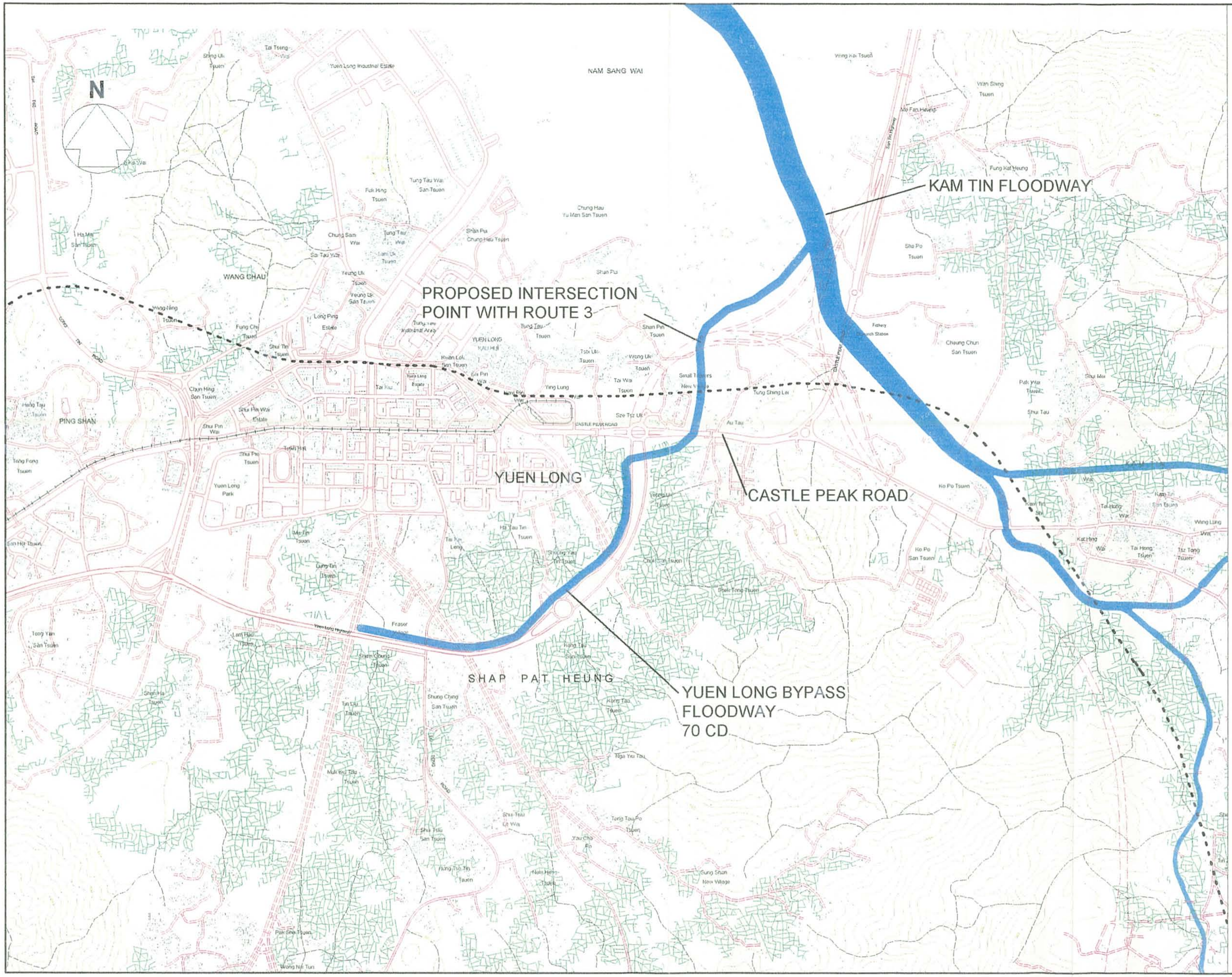




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| | designed | checked | drawn | checked |
| initial | GY | AJT | LC | CWC |
| date | 1/98 | 1/98 | 1/98 | 1/98 |

AGREEMENT NO. CE 79/96

project

YUEN LONG BYPASSS FLOODWAY
FEASIBILITY STUDY

figure title

YUEN LONG BYPASS
FLOODWAY
OPTION 2

figure no. 3.2

scale N.T.S

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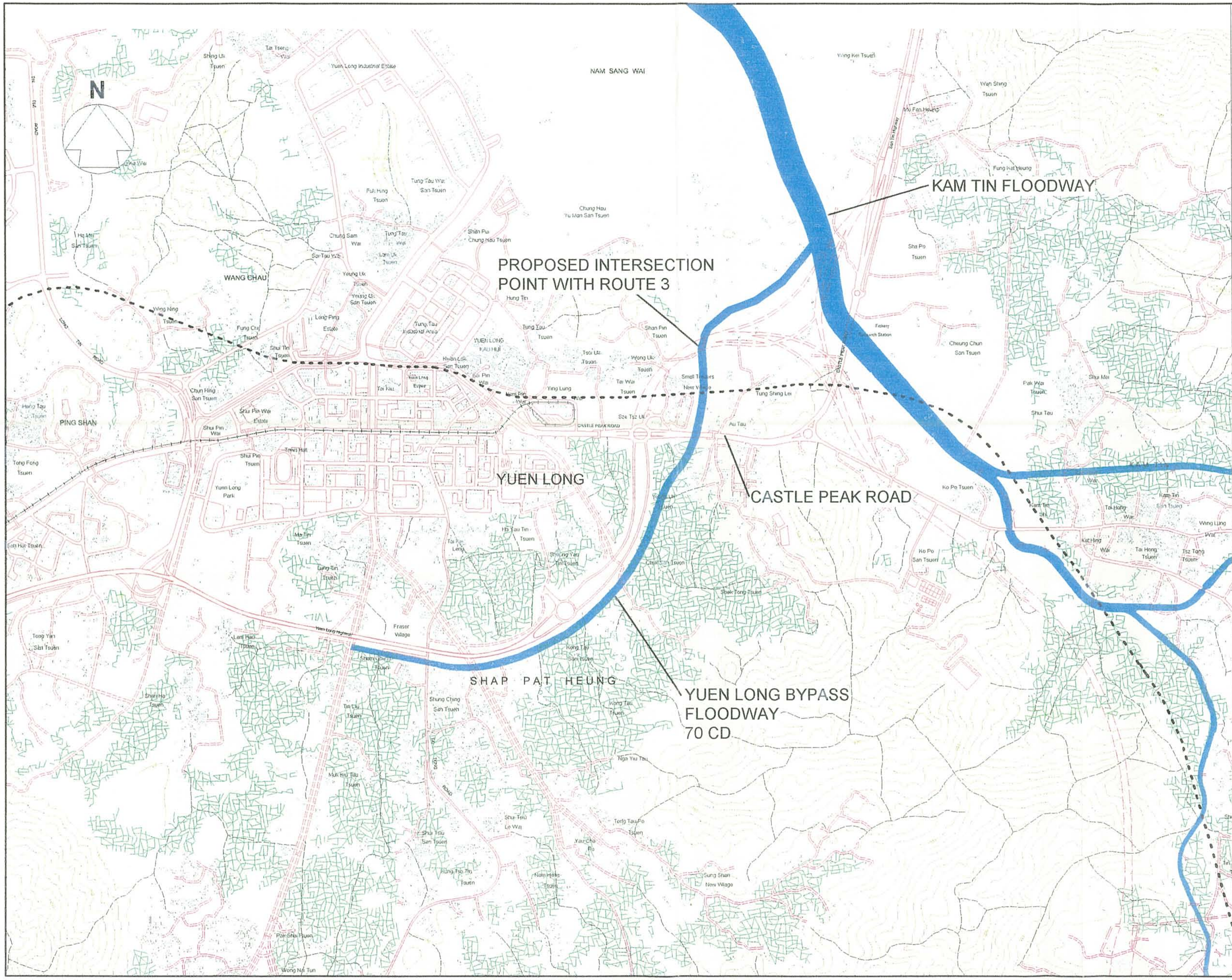




Legend :

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| initial | GY | AJT | LC | | CWC |
| date | 1/98 | 1/98 | 1/98 | | 1/98 |

AGREEMENT NO. CE 79/96

project

YUEN LONG BYPASSS FLOODWAY FEASIBILITY STUDY

figure title

YUEN LONG BYPASS FLOODWAY OPTION 3

| figure no. | scale |
|---|---|
| 3.3 | N.T.S |

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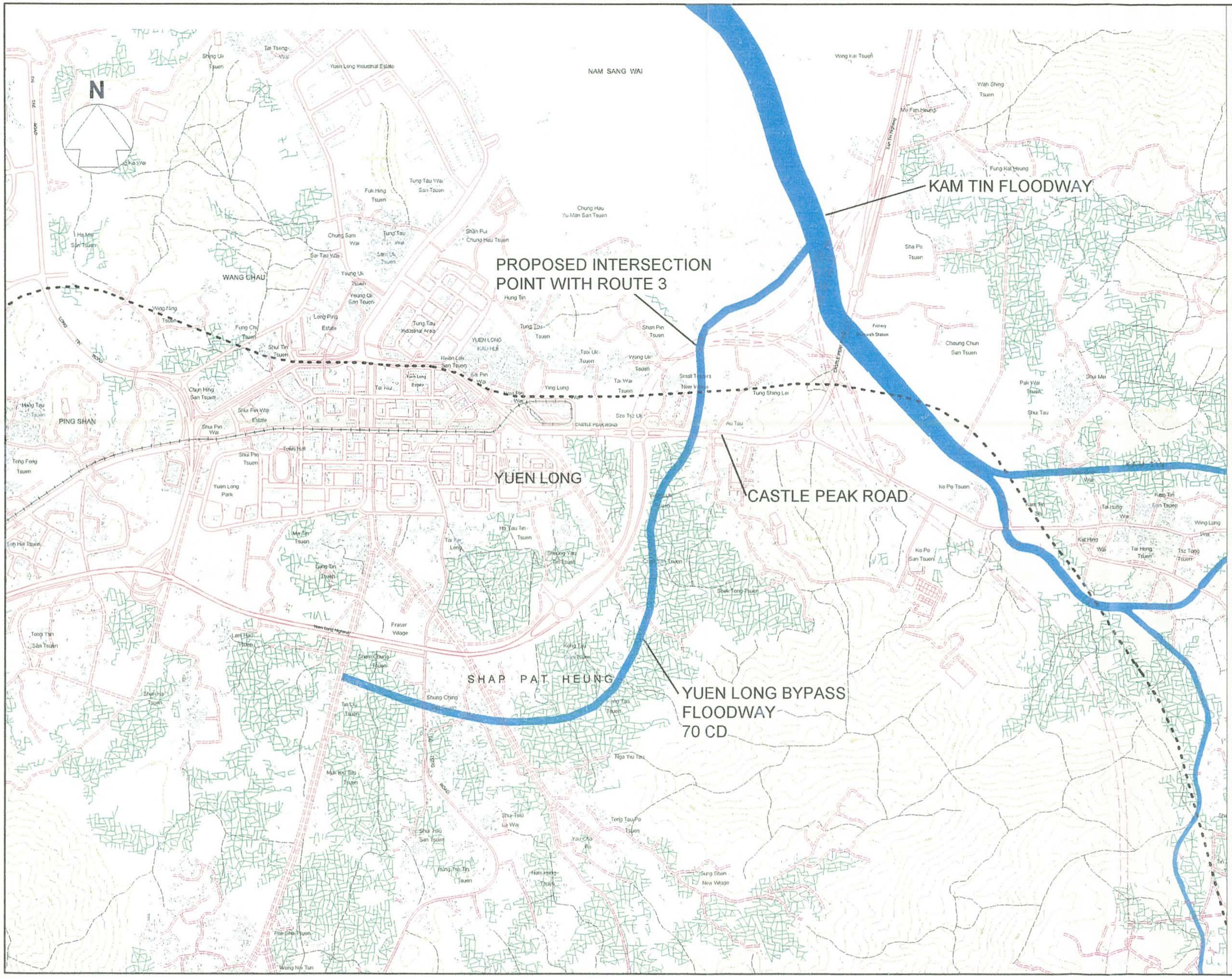




Legend :

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| | designed | checked | drawn | checked |
| initial | GY | AJT | LC | CWC |
| date | 1/98 | 1/98 | 1/98 | 1/98 |

AGREEMENT NO. CE 79/96

project

YUEN LONG BYPASSS FLOODWAY
FEASIBILITY STUDY

figure title

YUEN LONG BYPASS
FLOODWAY
OPTION 4

figure no. 3.4

scale N.T.S

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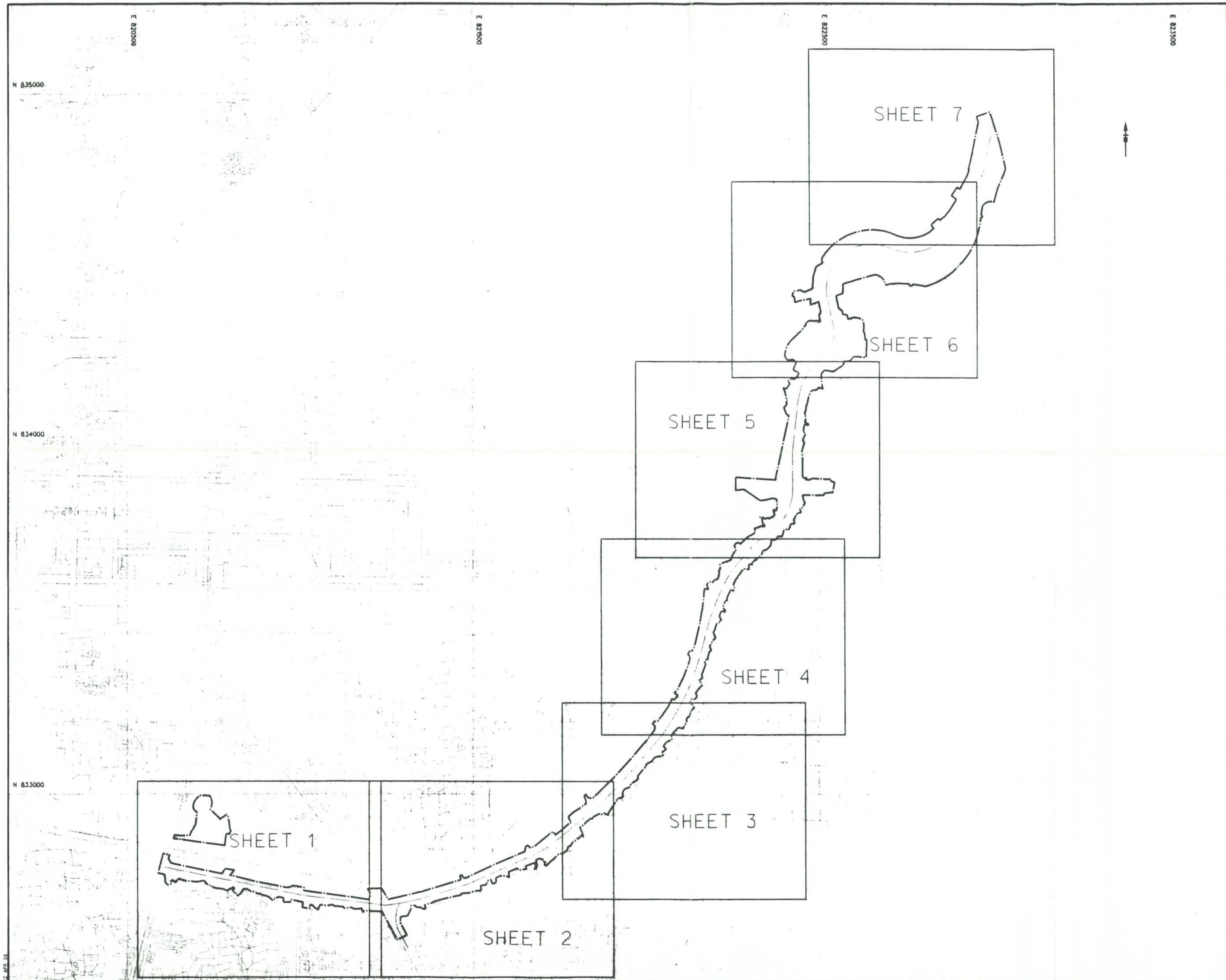




NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS STATED OTHERWISE.
2. ALL LEVELS ARE IN METERS ABOVE PRINCIPAL DATUM (mPD).
3. GRID LINES ARE HONG KONG METRIC GRID 1980.

LEGEND:

PRELIMINARY SITE LIMIT
PROPOSED CHANNEL ALIGNMENT

| revision | date | description | initial |
|---|---|---|---|

| | designed | checked | drawn | checked |
|---|---|---|---|---|
| initial | GY | AJT | YLL | CWC |
| date | 01/98 | 01/98 | 01/98 | 01/98 |

AGREEMENT NO. CE 79/96

project

YUEN LONG BYPASS FLOODWAY FEASIBILITY STUDY

ENGINEERING REPORT

figure title

PROPOSED CHANNEL KEY LAYOUT PLAN

figure no: 4.1

scale: 1:5000

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# APPENDIX B

# PRELIMINARY DESIGN LAYOUT




NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS STATED OTHERWISE.
2. ALL LEVELS ARE IN METERS ABOVE PRINCIPAL DATUM (mPD).
3. GRID LINES ARE HONG KONG METRIC GRID 1980.

LEGEND:

- PROPOSED SITE LIMIT
- DIRECTION OF FLOW
- BOX CULVERT
- PROPOSED SLOPE
- EXISTING SLOPE
- AREA TO BE FILLED TO ADJACENT GROUND LEVEL
- ENGINEERED WETLAND/MARSHCRETE AREA
- LIMIT OF RIGHT OF TEMPORARY OCCUPATION
- PROPOSED LEVEL
- VC VEHICULAR CROSSING
- PC PEDESTRIAN CROSSING
- R.L. TOP OF ROAD LEVEL
- P.L. TOP OF FOOTPATH LEVEL
- OTHER PROJECTS UNDER PRESENT/FUTURE CONSTRUCTION

KEY PLAN

SHEET 7, SHEET 6, SHEET 5, SHEET 4, SHEET 3, SHEET 2, SHEET 1

CAUTION
THIS MAY BE A REDUCED SIZE DRAWING. VERIFY SCALES SHOWN BEFORE SCALING THE DRAWING.

| revision | date | description | | initial |
|---|---|---|---|---|
| | designed | checked | drawn | checked |
| initial | AJT | CWC | YLL | CWC |
| date | 01/98 | 01/98 | 01/98 | 01/98 |

AGREEMENT NO. CE 79/96

project

YUEN LONG BYPASS FLOODWAY FEASIBILITY STUDY

ENGINEERING REPORT

figure title

PRELIMINARY LAYOUT
(SHEET 1 OF 7)

| Figure no | Scale |
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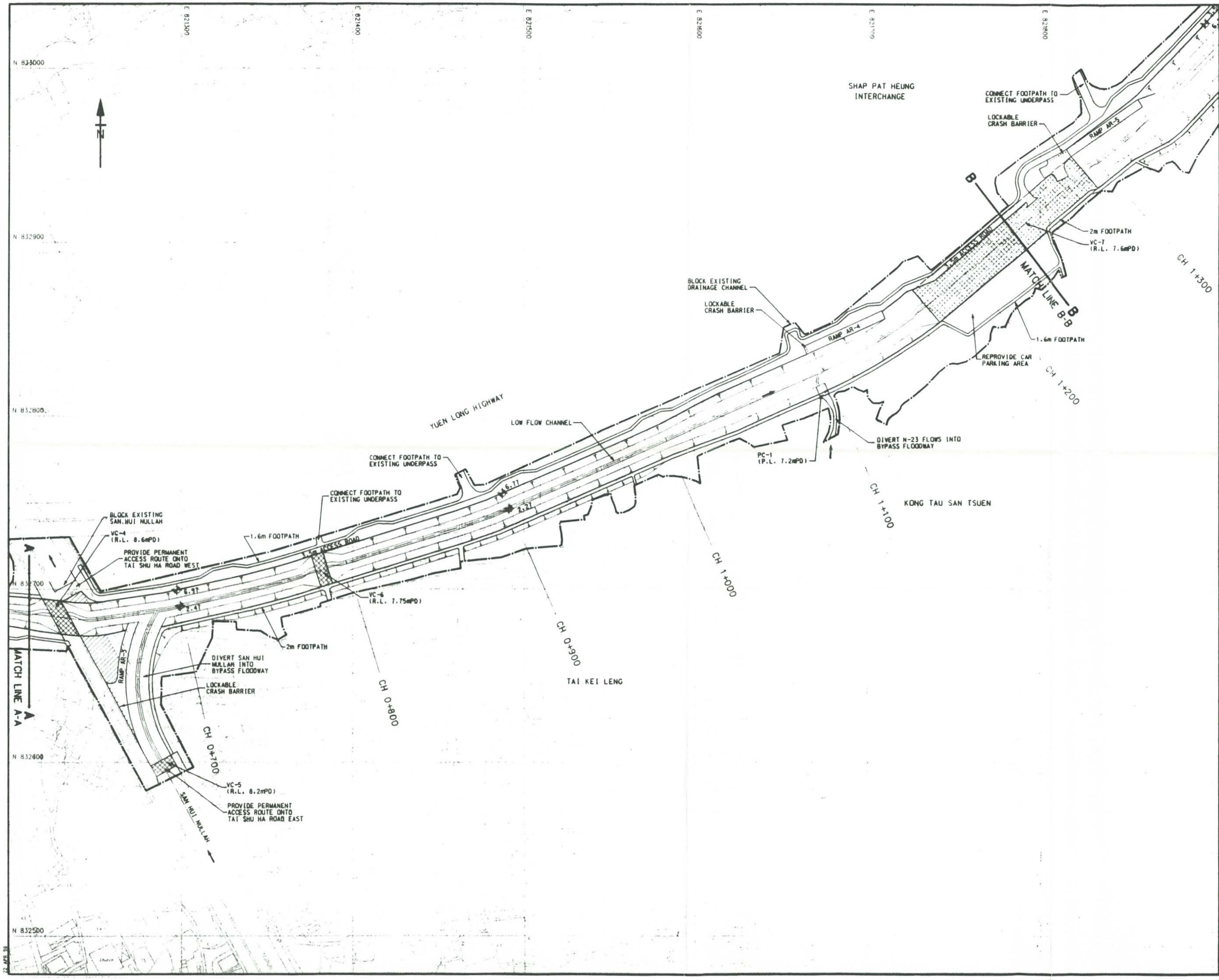




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LEGEND:

- PROPOSED SITE LIMIT
- DIRECTION OF FLOW
- BOX CULVERT
- PROPOSED SLOPE
- EXISTING SLOPE
- AREA TO BE FILLED TO ADJACENT GROUND LEVEL
- ENGINEERED WETLAND/MARSHCRETE AREA
- LIMIT OF RIGHT OF TEMPORARY OCCUPATION
- PROPOSED LEVEL
- VC VEHICULAR CROSSING
- PC PEDESTRIAN CROSSING
- R.L. TOP OF ROAD LEVEL
- P.L. TOP OF FOOTPATH LEVEL
- OTHER PROJECTS UNDER PRESENT/FUTURE CONSTRUCTION

KEY PLAN

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(SHEET 2 OF 7)

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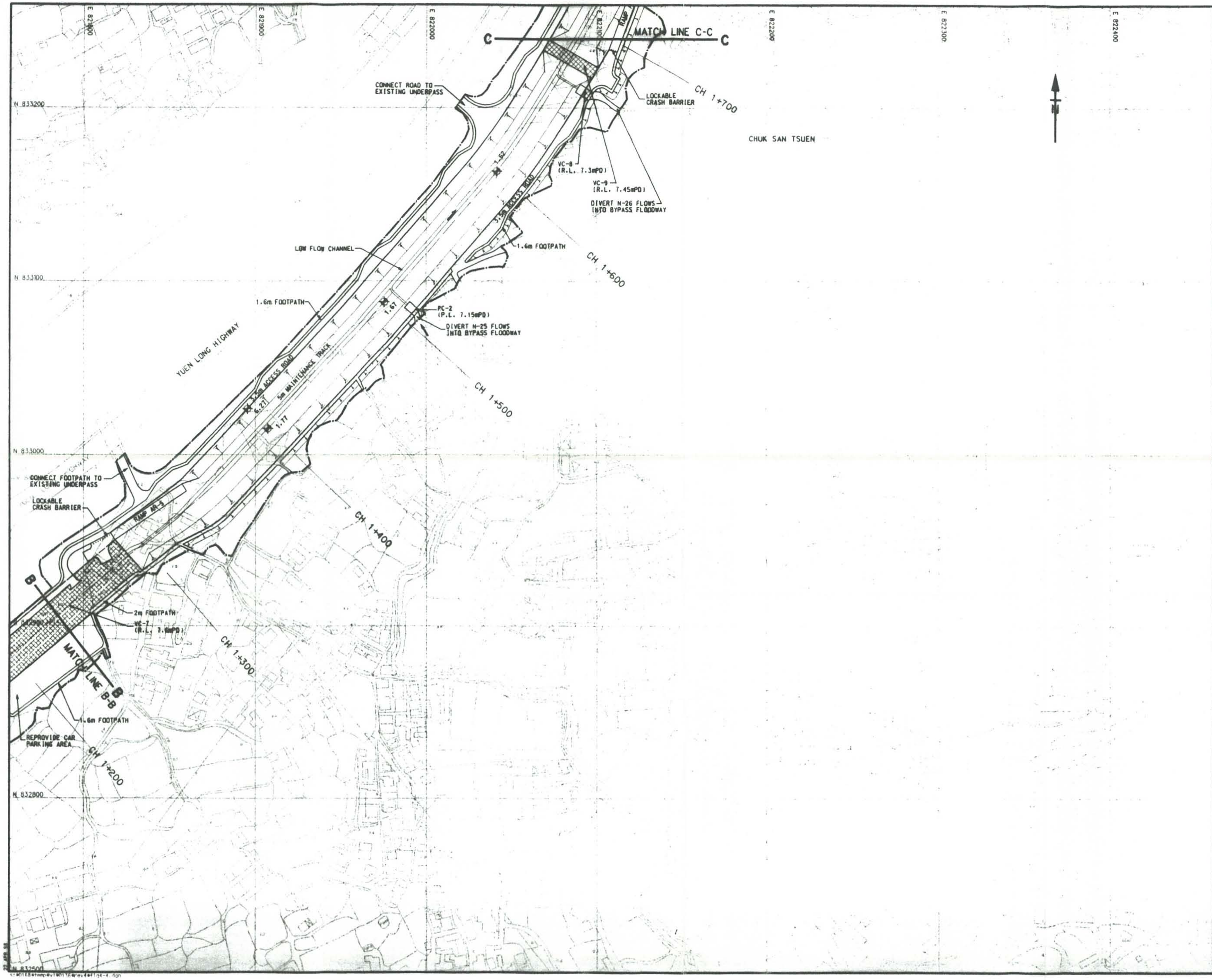


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- DIRECTION OF FLOW
- BOX CULVERT
- PROPOSED SLOPE
- EXISTING SLOPE
- AREA TO BE FILLED TO ADJACENT GROUND LEVEL
- ENGINEERED WETLAND/MARSHCRETE AREA
- LIMIT OF RIGHT OF TEMPORARY OCCUPATION
- PROPOSED LEVEL
- VC VEHICULAR CROSSING
- PC PEDESTRIAN CROSSING
- R.L. TOP OF ROAD LEVEL
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- OTHER PROJECTS UNDER PRESENT/FUTURE CONSTRUCTION

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(SHEET 3 OF 7)

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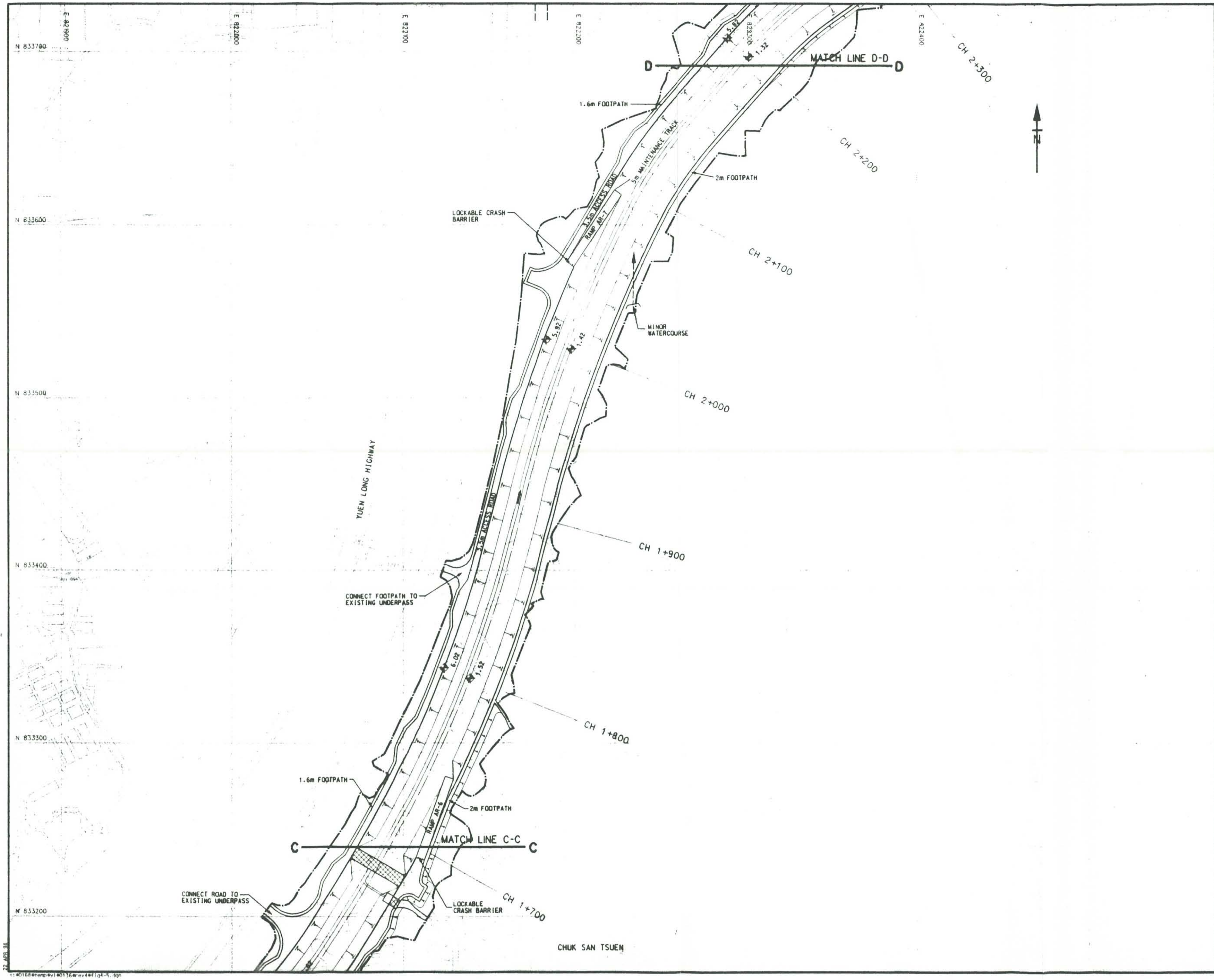




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LEGEND:

- PROPOSED SITE LIMIT
- DIRECTION OF FLOW
- BOX CULVERT
- PROPOSED SLOPE
- EXISTING SLOPE
- AREA TO BE FILLED TO ADJACENT GROUND LEVEL
- LIMIT OF RIGHT OF TEMPORARY OCCUPATION
- PROPOSED LEVEL
- VC VEHICULAR CROSSING
- PC PEDESTRIAN CROSSING
- R.L. TOP OF ROAD LEVEL
- P.L. TOP OF FOOTPATH LEVEL
- OTHER PROJECTS UNDER PRESENT/FUTURE CONSTRUCTION

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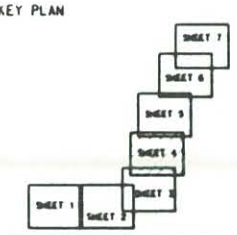


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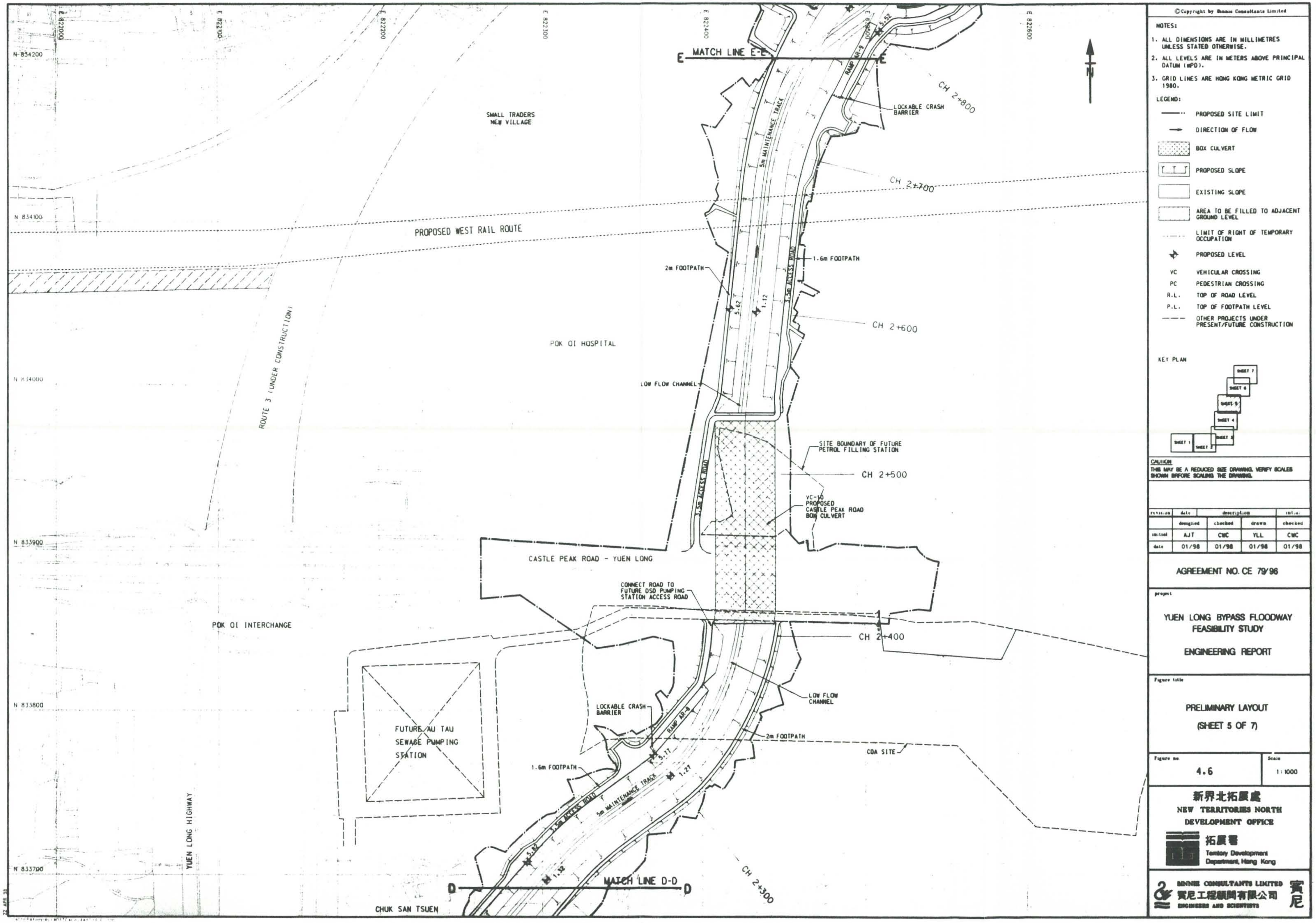

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LEGEND:
PROPOSED SITE LIMIT
DIRECTION OF FLOW
BOX CULVERT
PROPOSED SLOPE
EXISTING SLOPE
AREA TO BE FILLED TO ADJACENT GROUND LEVEL
LIMIT OF RIGHT OF TEMPORARY OCCUPATION
PROPOSED LEVEL
VC VEHICULAR CROSSING
PC PEDESTRIAN CROSSING
R.L. TOP OF ROAD LEVEL
P.L. TOP OF FOOTPATH LEVEL
OTHER PROJECTS UNDER PRESENT/FUTURE CONSTRUCTION
KEY PLAN
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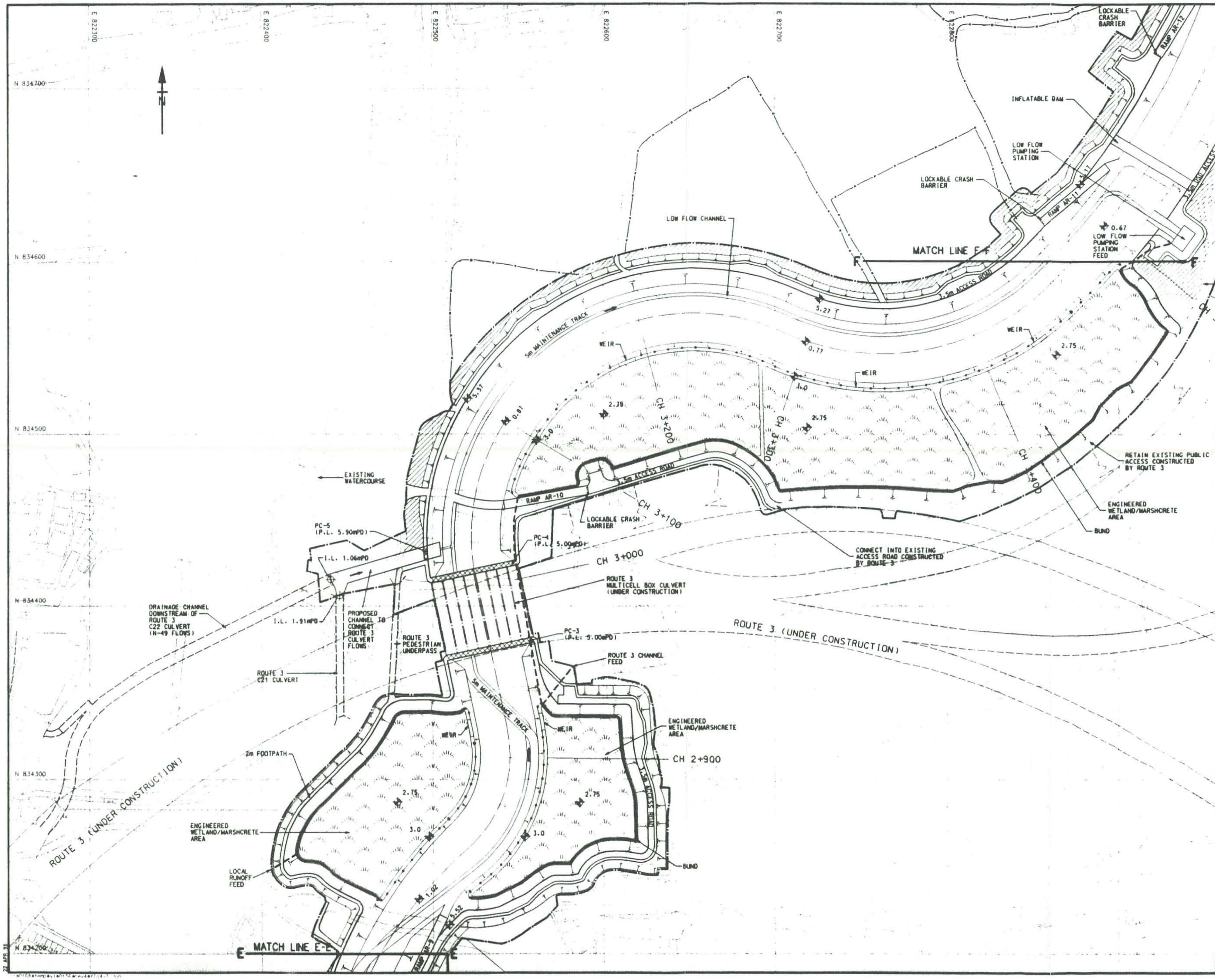
N 833800
N 833700
MATCH LINE E-E
MATCH LINE D-D
SMALL TRADERS NEW VILLAGE
LOCKABLE CRASH BARRIER
CH 2+800
CH 2+700
CH 2+600
CH 2+500
CH 2+400
CH 2+300
5m MAINTENANCE TRACK
RAMP AR-9
RAMP AR-4
PROPOSED WEST RAIL ROUTE
2m FOOTPATH
1.6m FOOTPATH
3.5m ACCESS ROAD
ROUTE 3 (UNDER CONSTRUCTION)
POK OI HOSPITAL
LOW FLOW CHANNEL
SITE BOUNDARY OF FUTURE PETROL FILLING STATION
VC-10 PROPOSED CASTLE PEAK ROAD BOX CULVERT
CASTLE PEAK ROAD - YUEN LONG
CONNECT ROAD TO FUTURE DSD PUMPING STATION ACCESS ROAD
POK OI INTERCHANGE
FUTURE AU TAU SEWAGE PUMPING STATION
CDA SITE
YUEN LONG HIGHWAY
CHUK SAN TSUEN

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LEGEND:

- PROPOSED SITE LIMIT
- DIRECTION OF FLOW
- BOX CULVERT
- PROPOSED SLOPE
- EXISTING SLOPE
- AREA TO BE FILLED TO ADJACENT GROUND LEVEL
- ENGINEERED WETLAND/MARSHCRETE AREA
- LIMIT OF RIGHT OF TEMPORARY OCCUPATION
- PROPOSED LEVEL
- EXISTING LEVEL (OBTAINED FROM SITE VISIT)
- VC VEHICULAR CROSSING
- PC PEDESTRIAN CROSSING
- R.L. TOP OF ROAD LEVEL
- P.L. TOP OF FOOTPATH LEVEL
- OTHER PROJECTS UNDER PRESENT/FUTURE CONSTRUCTION
- PIPE
- U-CHANNEL
- 0.5m HIGH WALL

KEY PLAN

SHEET 7, SHEET 6, SHEET 5, SHEET 4, SHEET 3, SHEET 2, SHEET 1

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Figure title

PRELIMINARY LAYOUT (SHEET 6 OF 7)

Figure no 4.7

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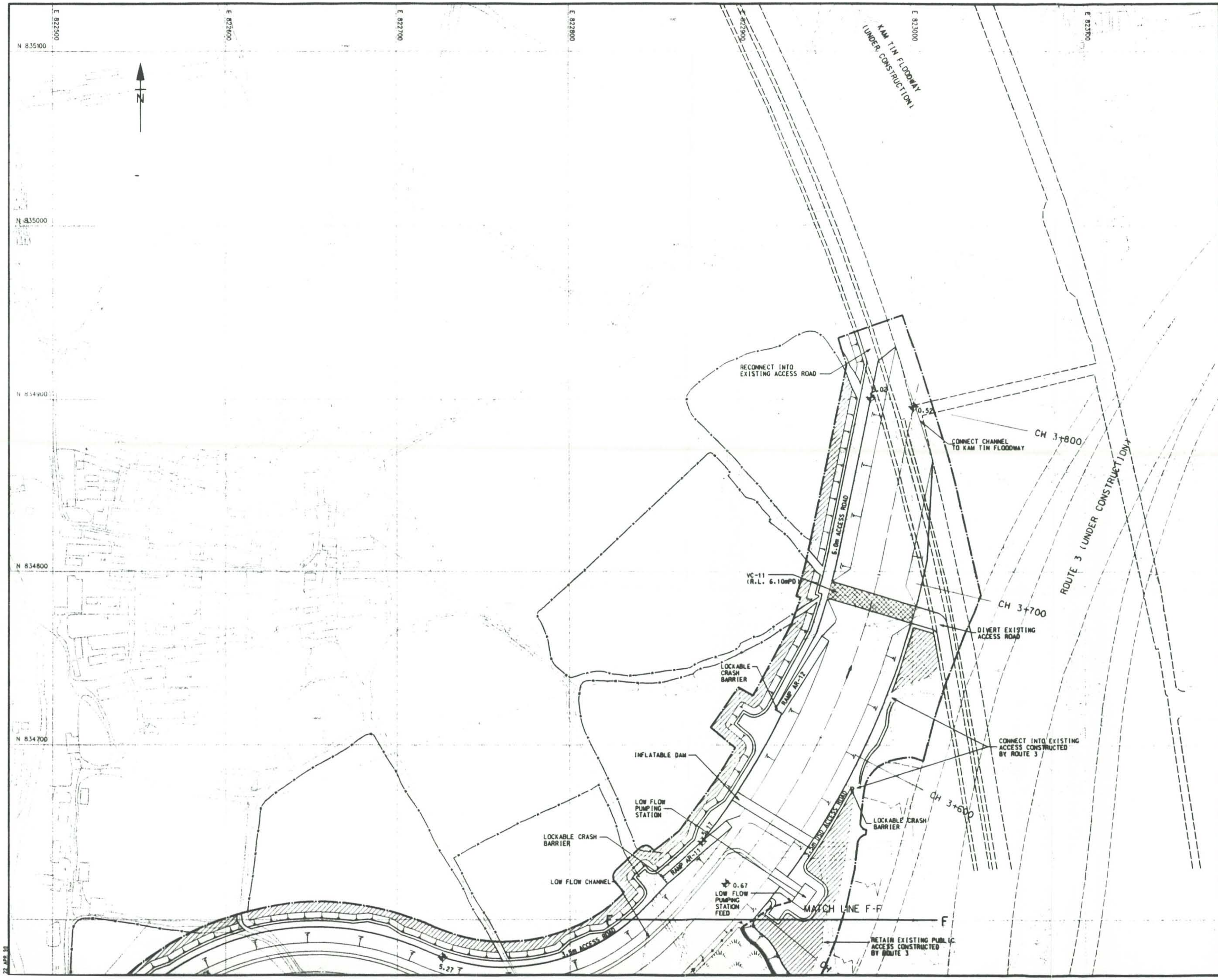


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- PROPOSED LEVEL
- VC VEHICULAR CROSSING
- PC PEDESTRIAN CROSSING
- R.L. TOP OF ROAD LEVEL
- P.L. TOP OF FOOTPATH LEVEL
- OTHER PROJECTS UNDER PRESENT/FUTURE CONSTRUCTION
- 0.5m HIGH WALL

KEY PLAN

SHEET 1 SHEET 2 SHEET 3 SHEET 4 SHEET 5 SHEET 6 SHEET 7

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Figure title

PRELIMINARY LAYOUT
(SHEET 7 OF 7)

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# APPENDIX C

# ENVIRONMENTAL LEGISLATION AND PLANNING GUIDELINES

# APPENDIX C - ENVIRONMENTAL LEGISLATION AND PLANNING GUIDELINES

## C1 Introduction

C1.1 One of the Hong Kong Government's overall policy objectives on environmental planning, as outlined in the 1989 *White Paper on Pollution in Hong Kong*, is "to avoid creating new environmental problems by ensuring the consequences for the environment are properly taken into account in site selection, planning and design of all new developments".

C1.2 This section highlights the relevant environmental legislation and guidelines which are currently applicable to the proposed project.

## C2 Hong Kong Planning Standards and Guidelines

C2.1 The *Hong Kong Planning Standards and Guidelines* (*HKPSG*) *Chapter 9: Environment* provides guidance for including environmental considerations in the planning of both public and private developments. The environmental suitability of a site for a certain land use is governed by such factors as:

(i) natural environmental characteristics including topography, climate, hydrological and hydrographical characteristics, vegetation, wildlife and habitat, and soil conditions;

(ii) the nature, distribution and consequences of the residuals including aerial emissions, wastes, sewage or noise generated by land uses in the development area;

(iii) the capacity of the environment to receive additional developments; and

(iv) existing land uses.

C2.2 The *HKPSG* specifies the Government's overall policy objective for environmental planning to be:

"to seize opportunities for environmental improvement as they arise in the course of urban redevelopment"; and to ensure that,

"adequate and suitably sited environmental facilities are provided to ensure proper handling and disposal of all wastes and waste water arising from proposed developments."

## C3 Conservation

C3.1 *HKPSG Chapter 10: Conservation* states that the following four principles should be adopted for the practical pursuit of conservation in land use planning:

(i) retain significant landscapes and ecological attributes and heritage features as conservation zones;

(ii) restrict uses within conservation zones to those which sustain particular landscapes and ecological attributes and heritage features;

(iii) control adjoining use to minimise adverse impacts on conservation zones and optimise their conservation value; and

(iv) create, where possible, new conservation zones in compensation for areas of conservation value which are lost to development.

C3.2 Items of value which merit conservation are identified in territorial, sub-regional and district planning exercises, special surveys undertaken by other departments or as the result of public views. However, plans which include conservation use have to be seen in a wider context and take into account the need to provide adequate space for development needs. The challenge is to combine these different uses into acceptable and realistic plans which take account of territorial growth and principles of sustainable development.

*Protecting Natural Landscapes and Habitats*

C3.3 Natural landscapes and habitats may be gazetted as Country Parks or Special Areas (*Country Parks Ordinance* Cap 208), Restricted Areas (*Wild Animals Protection Ordinance* Cap 170), Water Gathering Grounds (*Waterworks Ordinance* Cap 102), conservation zones (*Town Planning Ordinance* Cap 131) or listed as Sites of Special Scientific Interest (SSSIs).

C3.4 Country Parks and Special Areas are designated under the *Country Parks Ordinance* and managed by the Agriculture and Fisheries Department (AFD) on the advice of the Country Parks Board. At present there are 21 Country Parks (area 40, 833 ha) and 14 Special Areas (area 1,639 ha), 11 of which are within Country Parks. Country Parks are designated for the purposes of nature conservation, countryside recreation and education; Special Areas are areas of government land with special interest and importance by reason of their flora, fauna, geological, cultural or archaeological features. The Country Parks Authority has established criteria for determining whether or not a particular location is suitable for designation as a Country Park or Special Area. The criteria include landscape quality, recreation potential, conservation value, size, land status and the practicality of management.

C3.5 The *Wild Animals Protection Ordinance* restricts access to designated areas of wildlife habitat. Restricted Areas under the Ordinance are implemented by the AFD although certain site management activities may be shared by others. Two Restricted Areas have been designated, the Mai Po Marshes and the Yim Tso Ha Egretry. In addition, the Ordinance protects local wildlife through both the prohibition of hunting territory-wide and the possession of scheduled protected wild animals or hunting appliances.

C3.6 Areas of conservation use may be declared as conservation zones under clause 4(1)(g) of the *Town Planning Ordinance*. These zones are shown on statutory plans which are approved by the Town Planning Board and this process is further discussed in the subsequent section on preparing plans to conserve natural landscapes and habitats.

C3.7 SSSIs may be land based or marine sites which are of special interest because of their flora, fauna, geographical, geological or physiographic features. SSSIs are identified by the AFD and the Planning Department maintains a register of sites. Once identified. SSSIs are shown on statutory and departmental plans prepared by the Planning Department. Inter-relationships between land uses can be quite subtle. A SSSI declared as a wildlife habitat may only be sustainable if the wider surroundings remain rural so as to provide feeding grounds. Similarly, a wetland site may only be sustained if a particular water source is protected.

C3.8 The Government recognises the need to protect marine and wetland habitats. The AFD is responsible for the implementation of marine parks/reserves. Important wetlands may be declared as being of international importance under the *Convention on Wetlands of International Importance* Especially as Waterfowl Habitat (known as the *'Ramsar' Convention*). Parties to the Convention may designate sites for inclusion in the *List of Wetlands of International Importance* which is administered by the Bureau of the Convention. The *Ramsar Convention* states that "wetlands should be selected for the List on account of their international significance in terms of ecology, botany, zoology, limnology or hydrology. In the first instance, wetlands of international importance to waterfowl at any season should be included". The Mai Po Marshes (a restricted area and a SSSI) the intertidal mudflat at Inner Deep Bay and the fishponds in Buffer Zone 1 have been designated as a Ramsar Site in September 1995.

*Statutory Plans*

C3.9 The *Town Planning Ordinance* permits statutory land use zones under clause 4(1)(g) for 'country parks, coastal protection areas, sites of special scientific interest, green belts or other specified uses that promote conservation or protection of the environment'. Conservation zones for statutory plans are:

| | | |
|---|---|---|
| (i) | SSSI | to conserve and to protect fauna and flora and other natural features with special scientific value. |
| (ii) | Country Park | to encourage recreation and tourism, protect vegetation and wildlife, preserve and maintain buildings and sites of historical or cultural significance within country parks and to provide facilities and services for the public enjoyment of the country.<br><br>(Note: The term 'Country Parks' includes 'Special Areas' designated under the Country Parks Ordinance.) |
| (iii) | Coastal Protection Area | to retain natural coastline. |
| (iv) | Conservation Area | to retain existing natural features and rural use. |
| (v) | Green Belt | to define the limits of urban development areas by conserving landscape features. |

## C4 Visual Assessment and Landscaping

C4.1 There current legislation which specifically relates to landscape and visual impacts of developments in Hong Kong is contained within the *TM for EIA Process* Annex 10 and 18. The older *HKPSG Chapter 10: Landscape and Conservation* contain recommendations about developments in agricultural areas, woodlands, water gathering grounds, areas of freshwater fish culture, scenic and potential recreation areas. HKPSG also provided guidelines for reducing adverse environmental effects of development in rural areas. Recommendations covered:

(i) *Topography and site information:*

Developments on hill tops, scenic ridges and prominent positions should be avoided wherever possible. Site layout, road alignments, etc. should follow and relate to the natural contours. Overall, formation work and site disturbance should be minimised.

In scenic areas, opportunities should be taken to use local landform and any excavated material available to 'fit' the development into the ground form, soften the geometric outline of buildings, and screen ancillary features from view;

Developments should be sited and planned to minimise long term visual impact.

(ii) *Retention of existing vegetation:*

Developments should be sited so as to retain existing woodlands, groups of trees and feature trees wherever possible.

Retention of trees on development sites is made easier if non-building areas are specified to include all significant tree features and suitable conditions to ensure these areas are protected and included in development proposals.

Advice should be sought from Agriculture and Fisheries Department, Buildings Department, Architectural Services Department, Urban Services Department or Regional Services Department on regulations governing the felling of trees, the suitability of trees for retention and the possible occurrence of important flora and fauna.

(iii) *Site layout, overhead services alignments, etc.:*

The appropriate siting and design of development is often crucial for the maintenance of the landscape in rural areas. Building layouts that avoid regular repetitive or geometric forms and that relate well to natural landforms are preferred.

Views from surrounding areas should be taken into account.

Overhead services should be aligned to minimise visual impact and below ground routes should be preferred in sensitive areas.

(iv) *Building design and landscape treatment:*

In areas of scenic importance, building design should be sympathetic with the surrounding landscape and the general rural environment.

The preparation and implementation of landscape plans should be a requirement on all major developments and, as a general rule, for developments in scenic areas. Landscape Plans should include all or most of the following:

(a) A framework of tree planting to separate, screen and complement buildings;

(b) Shrub and ground cover on the periphery of the site where this is open to public view;

(c) Re-vegetation of excavated areas and formed slopes not built upon, consistent with geotechnical requirements; and

(d) Proposals to ensure that the vegetation to be established is maintained or self-sustaining.

C4.2 *HKPSG* also provides the following guidelines for roadside planting which are applicable in both the urban and rural context:

(i) Wherever possible, existing trees and woodlands are to be retained. Where this proves impractical, all possible efforts should be made to transplant suitable healthy trees either elsewhere on site or in the near vicinity.

(ii) Wherever possible, footways, median strips and road side areas should be designed to accommodate planting. Transport Department, Highways Department and Fire Services Department should be consulted. In areas where planting is intended, special consideration to the location of utility services may be required.

(iii) Roadside and median plantings can also temper the environment, reduce vehicle pollution to a degree and screen traffic and other uses.

(iv) Major planting belts (structure plantings) should be wide enough to be usable for recreation and be heavily planted. Where a buffer for polluting uses is intended a wide planting is needed (say 45 m).

(v) Intersections (especially grade separated) occupy large areas and present scope for heavy planting and contouring. Care must be taken with sight lines, and the Territory Development Department should be consulted.

(vi) Always consult with future maintenance authorities (Urban Services Department, Regional Services Department).

## C5 Noise

C5.1 *HKPSG* states that "The basic role of planning against noise is to provide an environment whereby noise impacts on sensitive uses are maintained at acceptable levels."

C5.2 Noise control legislation in Hong Kong comes under the *Noise Control Ordinance [Cap 400]* (1988), the *Noise Control (General) Amendment Regulation* and the *Noise Control (Construction) Regulation* (1996), and associated Technical Memoranda (TM). The following TM have been issued on:

(i) *The Assessment of Noise from Places other than Construction Sites, Domestic Premises or Public Places* (1997)

(ii) *Noise from Percussive Piling* (1997)

(iii) *Noise from Construction Works other than Percussive Piling* (1996)

(iv) *Noise from Construction Work in Designated Areas* (1996)

C5.3 The recently amended *TM on Noise from Percussive Piling* is intended to gradually phase out the use of diesel hammers.

C5.4 Noise Sensitive Receivers (NSRs) are defined by the *HKPSG* and *Noise Control Ordinance* as follows:

(i) all domestic premises, including temporary housing accommodation;

(ii) hotels and hostels

(iii) offices

(iv) educational institutions, including kindergartens, nurseries and all others where unaided voice communication is required

(v) places of public worship and courts of law

(vi) hospitals, clinics, convalescences and homes for the aged, diagnostic rooms and wards

(vii) amphitheatres and auditoria, libraries, performing arts centres and Country Parks

C5.5 The appropriate Acceptable Noise Level (ANL) for a particular NSR is dependent on the character of the area in which the NSR is located, and the time of day under consideration. The Area Sensitivity Rating (ASR) is a function of the type of area within which the NSR is located and the degree of the effect on the NSR of particular Influencing Factors (IFs). IFs include any industrial area, major roads (ie. those with a heavy and generally continuous flow of vehicular traffic) and the area within the boundary of Hong Kong International Airport. Table 5.1 shows the Area Sensitivity Ratings given by the *Noise Control Ordinance.*

**Table 5.1**
**Area Sensitivity Ratings**

| Type of Area containing NSR / Degree to which NSR is affected by IF | | Not Affected | Indirectly Affected | Directly Affected |
|---|---|---|---|---|
| (i) | Rural area, including Country Parks or village type developments | A | B | B |
| (ii) | Low density residential area consisting of low-rise or isolated high-rise developments | A | B | C |
| (iii) | Urban area | B | C | C |
| (iv) | Area other than above | B | B | C |

**Notes:**

'Country Park' means an area that is designated as a country park pursuant to section 14 of the *Country Parks Ordinance.*

'Directly Affected' means that the NSR is at such a location that noise generated by the IF is readily noticeable by the NSR and is a dominant feature of the noise climate of the NSR.

'Indirectly Affected' means that the NSR is at such a location that noise generated by the IF, whilst noticeable at the NSR, is not a dominant feature of the noise climate of the NSR.

'Not Affected' means that the NSR is at such a location that noise generated by the IF is not noticeable at the NSR.

'Urban Area' means and area of high density, diverse development including a mixture of such elements as industrial activities, major trade or commercial activities and residential premises.

*Construction Noise*

C5.6 There are no statutory criteria for noise from construction work other than percussive piling generated during the daytime hours of 07:00-19:00, Monday to Saturday, excluding public holidays. However, the Environmental Protection Department (EPD) normally recommends 75 dB(A) $L_{eq}$(30 min) as the acceptable noise level during daytime hours at the facade of residential sensitive receivers and 70 dB(A) at schools (65 dB(A) during examinations) as outlined in the ProPECC paper (PN 2/93) on *Noise from Construction Activities - Non-Statutory Controls.*

C5.7 Noise restrictions are imposed during the evenings (19:00-23:00), night-time (23:00-07:00) and all day on Sunday and public holidays. For construction activities during these hours, a Construction Noise Permit (CNP) is required from the Environmental Protection Department (EPD). The CNP application will be assessed in accordance with the Basic Noise Levels (BNLs) given in the *TM on Noise from Construction Works other than Percussive Piling*, as shown in Table 5.2.

**Table 5.2**
**Basic Noise Levels for General Construction Noise**

| ASR / Time Period | A | B | C |
|---|---|---|---|
| All days during the evening (19:00-23:00), and general holidays (including Sundays) during the daytime and evening (07:00-23:00) | 60 | 65 | 70 |
| All days during the night-time (23:00-07:00) | 45 | 50 | 55 |

C5.8 The TM on *Noise from Construction Work in Designated Areas* details the CNP procedures to be adopted for construction work using Specified Powered Mechanical Equipment (SPME) other than percussive piling during restricted hours. SPME refers to dumptrucks, bulldozers, concrete lorry mixers, hand-held breakers and hand-held vibratory pokers. Parts of Yuen Long falls within the 'Noise Control Designated Areas - Hong Kong Whole Territory' (Plan No. EPD/NP/WT-01) appended to the TM.

C5.9 Noise criteria applied to control the noise from percussive piling is detailed in the *TM on Noise from Percussive Piling*. Any percussive piling requires a CNP from EPD. When considering the issue of a CNP, EPD compares the corrected noise level (CNL) with the Acceptable Noise Level (ANL) for the area. Table 5.3 shows the ANLs for percussive piling.

**Table 5.3**
**Acceptable Noise Levels for Percussive Piling**

| NSR Window Type or Means of Ventilation | | ANL (dB(A)) |
|---|---|---|
| (i) | NSR (or part of NSR) with no windows or other openings | 100 |
| (ii) | NSR with central air conditioning system | 90 |
| (iii) | NSR with windows or other openings but without central air conditioning system | 85 |

Note: 10 dB(A) is deducted from the ANLs shown above for NSRs such as hospitals, medical clinics, education and other NSRs considered to be particularly sensitive to noise.

C5.10 The CNL relates to the tonality, impulsiveness and intermittency of the noise. In the event that the CNL exceeds the ANL, EPD will impose restrictions on the permitted hours of piling operation Table 5.4a lists the permitted hours of operation for the carrying out of piling work not involving the use of diesel, pneumatic and/or steam hammer. Table 5.4b listed the permitted hours for the use of diesel, pneumatic and/or steam hammers.

**Table 5.4a**
**Permitted Hours of Operation for the Carrying Out of Piling Work Not Involving the Use of Diesel, Pneumatic and/or Steam Hammers**

| Amount by which Corrected Noise Level (CNL) exceeds Acceptable Noise Level (ANL), CNL-ANL | Permitted hours of operation on any day not being a general holiday |
|---|---|
| 10 dB(A)<CNL-ANL | 0800 to 0900 AND 1230 to 1330 AND 1700 to 1800 |
| 0 dB(A)<CNL-ANL≤10 dB(A) | 0800 to 0930 AND 1200 to 1400 AND 1630 to 1800 |
| CNL-ANL≤0 dB(A) | 0700 to 1900 |

**Table 5.4b**
**Permitted Hours of Operation for the Carrying Out of Piling Work Involving the Use of Diesel, Pneumatic and/or Steam Hammers**

(i) Effective for percussive piling work to be conducted until 31.3.98

| Amount by which Corrected Noise Level (CNL) exceeds Acceptable Noise Level (ANL), CNL-ANL | Permitted hours of operation on any day not being a general holiday |
|---|---|
| 10 dB(A)<CNL-ANL | 0800 to 0900 AND 1230 to 1330 AND 1700 to 1800 |
| 0 dB(A)<CNL-ANL≤10 dB(A) | 0800 to 0930 AND 1200 to 1400 AND 1630 to 1800 |
| CNL-ANL≤0 dB(A) | 0700 to 1900 |

(ii) Effective for percussive piling work to be conducted between 1.4.98 and 30.9.98 (Stage 1)

| Amount by which Corrected Noise Level (CNL) exceeds Acceptable Noise Level (ANL), CNL-ANL | Permitted hours of operation on any day not being a general holiday |
|---|---|
| 20 dB(A)<CNL-ANL | Nil |
| 10 dB(A)<CNL-ANL≤20 dB(A) | 0800 to 0900 AND 1230 to 1330 AND 1700 to 1800 |
| 0 dB(A)<CNL-ANL≤10 dB(A) | 0800 to 0930 AND 1200 to 1400 AND 1630 to 1800 |
| CNL-ANL≤0 dB(A) | 0700 to 1900 |

(iii) Effective for percussive piling work to be conducted between 1.10.98 and 31.3.99 (Stage 2)

| Amount by which Corrected Noise Level (CNL) exceeds Acceptable Noise Level (ANL), CNL-ANL | Permitted hours of operation on any day not being a general holiday |
|---|---|
| 10 dB(A)<CNL-ANL | Nil |
| 0 dB(A)<CNL-ANL≤10 dB(A) | 0800 to 0930 AND 1200 to 1400 AND 1630 to 1800 |
| CNL-ANL≤0 dB(A) | 0700 to 1900 |

(iv) Effective for percussive piling work to be conducted between 1.4.99 and 30.9.99 (Stage 3)

| Amount by which Corrected Noise Level (CNL) exceeds Acceptable Noise Level (ANL), CNL-ANL | Permitted hours of operation on any day not being a general holiday |
|---|---|
| 0 dB(A)<CNL-ANL | Nil |
| CNL-ANL≤0 dB(A) | 0700 to 1900 |

(v) Effective for percussive piling work to be conducted on or after 1.10.99 (Stage 4)

| Amount by which Corrected Noise Level (CNL) exceeds Acceptable Noise Level (ANL), CNL-ANL | Permitted hours of operation on any day not being a general holiday |
|---|---|
| -10 dB(A)<CNL-ANL | Nil |
| CNL-ANL≤-10 dB(A) | 0700 to 1900 |

C5.11 The information required in an application for a CNP includes:

(i) a map (preferably 1:1000 scale) showing precise details of the site location, site limits and nearby noise sensitive receivers, e.g. residential buildings, schools, hospitals;

(ii) location of any stationary powered mechanical equipment on site or, in the case of an application for a percussive piling permit, the piling zone or actual pile locations;

(iii) details of time period (time of day, duration in days/weeks/months) for which the CNP is required;

(iv) a description, including two photographs and identification codes, and number of units of each item of powered mechanical equipment to be used or, in the case of piling, details of the piling method and pile type including number of units;

(v) details of any particularly quiet items of equipment or piling methods, special noise control measures to be employed on site, or any other information thought to be relevant.

C5.12 During daytime works, EPD recommends that the advice in EPD's *Practice Note ProPECC PN2/93* on construction noise abatement practice is followed.

*Operational Noise*

C5.13 *HKPSG* states that noise levels from a new fixed source should be 5 dB(A) below the relevant ANL presented in the *TM on The Assessment of Noise from Places other than Construction Sites, Domestic Premises or Public Places* or the prevailing background noise level, whichever is lower. The ANL from the TM for a given NSR is presented in dB(A) in Table 5.5 below.

**Table 5.5**
**Acceptable Noise Levels during Operations**

| ASR / Time Period | A | B | C |
|---|---|---|---|
| Day (07:00-19:00) and Evening (19:00-23:00) | 60 | 65 | 70 |
| Night (23:00-07:00) | 50 | 55 | 60 |

*Road Traffic Noise*

C5.14 As outlined in the *HKPSG*, the severity of road traffic noise impact on sensitive uses depends on many variables, some of which can be controlled or influenced by land use planning. These variables include:

(i) road alignment, ie. providing distance separation between the noise receiver and the vehicles;

(ii) traffic composition and volume, ie. using traffic planning and management to control vehicle movements and type of vehicles at different times of the day;

(iii) line-of-sight, ie. using noise-tolerant buildings to reduce the angle of view of receiver on road traffic;

(iv) shieldings, eg. using barriers, road enclosures or road decking.

C5.15 For road traffic noise, the *HKPSG* specifies the acceptable noise limit at the external facade of all domestic premises which rely on open windows for ventilation, including temporary housing areas, as $L_{10}$ (1 hour) of 70 dB(A). See Table 5.6.

*Rail Noise*

C5.16 For rail noise, the *HKPSG* specifies the acceptable noise limit at the facades of all noise sensitive buildings, as $L_{eq}$ (24 hours) of 65 dB(A). See Table 5.6.

**Table 5.6**
**Traffic Noise Standards**

| Noise Source<br>Use | Road Traffic Noise $L_{10}$(1 hr) dB(A) | Rail Noise $L_{eq}$ (24 hours) dB(A) |
|---|---|---|
| All domestic premises including temporary housing accommodation | 70 | 65 (or Lmax (2300-0700) = 85 dB(A)) |
| Hotels and houses | 70 | |
| Offices | 70 | |
| Educational institutions including kindergartens, nurseries and all others where unaided voice communication is required | 65 | |
| Places of public worship and courts of law | 65 | |
| Hospitals, clinics, convalescences and homes for the aged: diagnostic rooms and wards | 55 | |
| Amphitheatres and auditoria, libraries, performing arts centres and Country Parks | depends on locations and construction | |

**Notes:**

1 The above standards apply to uses which rely on open windows for ventilation
2 The above standards should be viewed as the maximum permissable noise levels at the external facade

## C6 Air Quality

C6.1 *HKPSG* states that "Air quality is affected by such factors as the emission rate of air pollutants, the separation distance between emission sources and receptors, topography, height and width of buildings as well as meteorology."

C6.2 The principal legislation regulating air emissions in Hong Kong is the *Air Pollution Control Ordinance (APCO) [Cap 311]* of 1983 and its subsidiary regulations.

C6.3 The whole of the Territory has been divided into Air Control Zones. Yuen Long falls within the topographically confined Deep Bay Airshed.

C6.4 Technical Memoranda have been issued on:

(i) Specifying Air Quality Objectives for Hong Kong (Table 6.1);
(ii) Issuing Air Pollution Abatement Notices to Control Air Pollution from Stationary Pollution Processes.

Other subsidiary regulations issued are as follows:

A1 - Furnaces, Ovens and Chimneys (Installation and Alteration) Regulations.
B1 - Dust and Grit Emission Regulations.
C1 - Smoke Regulations.
D1 - Appeal Board.
E1 - Air Control Zones (Declaration and Consideration) Order.
F1 - Specified Processes.
G1 - Specification of Required Particulars and Information.
H1 - Consolidation Statement of Air Quality Objectives.
I1 - Fuel Restriction
J1 - Vehicle Design Standards (Emission) Regulations.

*Construction Dust*

C6.5 New environmental legislation entitled *Air Pollution Control (Construction Dust) Regulations* is currently under consultation. These regulations are to control the dust emission from construction sites by a notification and permit procedure.

C6.6 During the construction phase of the project, an hourly average TSP limit of 500 $\mu g/m^3$ is recommended by EPD for assessing construction dust impacts. This limit is not statutory, but nonetheless has been used in many construction works in Hong Kong as a contractual requirement.

C6.7 The *HKPSG* recommends that any open storage areas should be located at least 100 m from any air sensitive receiver.

*Cement and Concrete*

C6.8 Cement works in which the total silo capacity exceeds 50 tonnes and in which cement is handled fall under the Specified Processes under the *Air Pollution Control Ordinance.*

C6.9 In order to obtain a licence to conduct a Specified Process, EPD may require the applicant to submit an air pollution control plan for the process. This will include:

(i) a description and technical particulars of the plant or equipment that may evolve an air pollutant;

(ii) details of pollution control equipment or measures proposed to minimise emissions and comply with the requirement to use the best practicable means of controlling air pollution;

(iii) a description (with maps) to identify sensitive receivers, eg. residential buildings, schools, hospitals;

(iv) an assessment of the resulting air quality and risk to human health, including supporting calculations and information;

(v) a statement that the best practicable means of controlling air pollution has been adopted or is proposed, including supporting calculations and information;

(vi) a plan for, or scheme of, monitoring the emission at source or the ambient concentration of any air pollutant.

C6.10 The *HKPSG* recommends that any concrete batching plants and open storage areas should be located at least 100 m from any air sensitive receiver.

*Operational Emissions*

C6.11 The Hong Kong Air Quality Objectives (AQOs) state the maximum acceptable concentration of air pollutants. The AQOs for one and 24 hour concentrations of five major pollutants are shown in Table A.7. The Government aims to achieve the AQOs throughout the Territory as soon as 'reasonably practicable'. Efforts are being made to control and reduce air pollution emitters in areas where the AQOs are already exceeded, eg. by controlling new developments. The AQOs will apply to the operational phases of the project.

**Table 6.1**
**Air Quality Objectives**

| Pollutant | Concentration (µg)m$^3$ | | | | | Health effects of pollutant at elevated ambient levels |
|---|---|---|---|---|---|---|
| | Average Time | | | | | |
| | 1hr | 8hrs | 24hrs | 3mths | 1yr | |
| Sulphur Dioxide | 800[2] | | 350[3] | | 80 | Respiratory illness; reduced lung function; morbidity and mortality rates increase at higher levels. |
| Total Suspended Particulate | | | 260[3] | | 80 | Respirable fraction has effects on health. |
| Respirable Suspended Particulates | | | 180[3] | | 55 | Respiratory illness; reduced lung function; cancer risk for certain particles; morbidity and mortality rates increase at higher levels. |
| Nitrogen Dioxide | 300[2] | | 150[3] | | 80 | Respiratory irritation; increased susceptibility to respiratory infection; lung development impairment. |
| Carbon Monoxide | 30000[2] | 10000[3] | | | | Impairment of co-ordination; deleterious to pregnant women and those with heart and circulatory conditions. |
| Photochemical Oxidants as ozone | 240[2] | | | | | Eye irritation; cough; reduced athletic performance; possible chromosome damage. |
| Lead | | | | 1.5 | | Affects cell and body processes; likely neuro-psychological effects, particularly in children; likely effects on rates of incidence of heart attacks, strokes and hypertension. |

**Notes:** Concentrations measured at 298°K (25°C) and 101.325 kPA

1 Suspended particles in air with a nominal aerodynamic diameter of 10 µm or smaller
2 Criteria not to be exceeded more than 3 times per year
3 Criteria not to be exceeded more than once per year

## C7 Water Quality

C7.1 The principal legislation for controlling water pollution in Hong Kong is the *Water Pollution Control Ordinance (WPCO) [Cap 358]* of 1981 which allows for gazette of Water Control Zones (WCZ) within which the discharge of liquid effluents and the deposit of matter into any water bodies, public sewers and drains are controlled. The WPCO is applicable for construction site discharges as well as for discharges during the operational phase.

C7.2 The Study Area falls within the Deep Bay Water Control Zone, which was declared on 1 December 1990. Deep Bay (Hau Hoi Wan) is affected by pollution from various sources both within and outside Hong Kong. The water quality objectives for Deep Bay are presented in Table 7.1.

**Table 7.1**
**Statement of Water Quality Objectives**
**(Deep Bay Water Control Zone)**

| Water Quality Objective | | | Part or Parts of Zone |
|---|---|---|---|
| A. | AESTHETIC APPEARANCE | | |
| | (a) | Waste discharges shall cause no objectionable odours or discolouration of the water. | Whole Zone |
| | (b) | Tarry residues, floating wood, articles made of glass, plastic, rubber or of any other substances should be absent. | Whole Zone |
| | (c) | Mineral oil should not be visible on the surface. Surfactants should not give rise to a lasting foam. | Whole Zone |
| | (d) | There should be no recognisable sewage-derived debris. | Whole Zone |
| | (e) | Floating, submerged and semi-submerged objects of a size likely to interfere with the free movement of vessels, or cause damage to vessels, should be absent. | Whole Zone |
| | (f) | Waste discharges shall not cause the water to contain substances which settle to form objectionable deposits. | Whole Zone |
| B. | BACTERIA | | |
| | (a) | The level of *Escherichia coli* should not exceed 610 per 100 mL, calculated as the geometric mean of all samples collected in one calender year. | Secondary Contact Recreation Subzone and Mariculture Subzone *(L.N. 455 of 1991)* |
| | (b) | The level of *Escherichia coli* should be zero per 100 mL, calculated as the running median of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days. | Yuen Long & Kam Tin (Upper) Subzone, Beas Subzone, Indus Subzone, Ganges Subzone and Water Gathering Ground Sub-zones |
| | (c) | The level of *Escherichia coli* should not exceed 1000 per 100 mL, calculated as the running median of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days. | Yuen Long & Kam Tin (Lower) Subzone and other inland waters |
| | (d) | The level of *Escherichia coli* should not exceed 180 per 100 mL, calculated as the geometric mean of all samples collected from March to October inclusive in one calendar year. Samples should be taken at least 3 times in a calender month at intervals of between 3 and 14 days. | Yuen Long Bathing Beach Subzone *(L.N. 455 of 1991)* |

| Water Quality Objective | | | Part or Parts of Zone |
|---|---|---|---|
| C. | COLOUR | | |
| | (a) | Waste discharges shall not cause the colour of water to exceed 30 Hazen units. | Yuen Long & Kam Tin (Upper) Subzone, Beas Subzone, Indus Subzone, Ganges Subzone and Water Gathering Ground Subzones |
| | (b) | Waste discharges shall not cause the colour of water to exceed 50 Hazen units. | Yuen Long & Kam Tin (Lower) Subzone and other inland waters |
| D. | DISSOLVED OXYGEN | | |
| | (a) | Waste discharges shall not cause the level of dissolved oxygen to fall below 4 milligrams per litre for 90% of the sampling occasions during the year; values should be taken at 1 metre below surface. | Inner Marine Subzone excepting Mariculture Subzone |
| | (b) | Waste discharges shall not cause the level of dissolved oxygen to fall below 4 milligrams per litre for 90% of the sampling occasions during the year; values should be calculated as water column average (arithmetic mean of at least 2 measurements at 1 metre below surface and 1 metre above seabed). In addition, the concentration of dissolved oxygen should not be less than 2 milligrams per litre within 2 metres of the seabed for 90% of the sampling occasions during the year. | Outer Marine Subzone excepting Mariculture Subzone |
| | (c) | The dissolved oxygen level should not be less than 5 milligrams per litre for 90% of the sampling occasions during the year; values should be taken at 1 metre below surface. | Mariculture Subzone |
| | (d) | Waste discharges shall not cause the level of dissolved oxygen to be less than 4 milligrams per litre. | Yuen Long & Kam Tin (Upper and Lower) Subzones, Beas Subzone, Indus Subzone, Ganges Subzone, Water Gathering Ground Subzones and other inland waters of the Zone |
| E. | pH | | |
| | (a) | The pH of the water should be within the range of 6.5-8.5 units. In addition, waste discharges shall not cause the natural pH range to be extended by more than 0.2 units. | Marine waters excepting Yuen Long Bathing Beach Subzone |
| | (b) | Waste discharges shall not cause the pH of the water to exceed the range of 6.5-8.5 units. | Yuen Long & Kam Tin (Upper and Lower) Subzones, Beas Subzone, Indus Subzone, Ganges Subzone and Water Gathering Ground Subzones |
| | (c) | The pH of the water should be within the range of 6.0-9.0 units. | Other inland waters |

| Water Quality Objective | | | Part or Parts of Zone |
|---|---|---|---|
| | (d) | The pH of the water should be within the range of 6.0-9.0 units for 95% of samples. In addition, waste discharges shall not cause the natural pH range to be extended by more than 0.5 units. | Yuen Long Bathing Beach Subzone |
| F. | TEMPERATURE | | |
| | Waste discharges shall not cause the natural daily temperature range to change by more than 2.0°C. | | Whole Zone |
| G. | SALINITY | | |
| | Waste discharges shall not cause the natural ambient salinity level to change by more than 10%. | | Whole Zone |
| H. | SUSPENDED SOLIDS | | |
| | (a) | Waste discharges shall neither cause the natural ambient level to be raised by 30% nor give rise to accumulation of suspended solids which may adversely affect aquatic communities. | Marine waters |
| | (b) | Waste discharges shall not cause the annual median of suspended solids to exceed 20 milligrams per litre. | Yuen Long & Kam Tin (Upper and Lower) Subzones, Beas Subzone, Ganges Subzone, Indus Subzone, Water Gathering Ground Subzones and other inland waters |
| I. | AMMONIA | | |
| | The un-ionized ammonical nitrogen level should not be more than 0.021 milligram per litre, calculated as the annual average (arithmetic mean). | | Whole Zone. |
| J. | NUTRIENTS | | |
| | (a) | Nutrients shall not be present in quantities sufficient to cause excessive or nuisance growth of algae or other aquatic plants. | Inner and Outer Marine Subzones |
| | (b) | Without limiting the generality of objective (a) above, the level of inorganic nitrogen shp1210Xobjective | |
| | | (a) above, the level of inorganic nitrogen should not exceed 0.5 milligram per litre, expressed as annual water column average (arithmetic mean of at least 2 measurements at 1 metre below surface and 1 metre above seabed). | Outer Marine Subzone |

| Water Quality Objective | | | Part or Parts of Zone |
|---|---|---|---|
| K. | 5-DAY BIOCHEMICAL OXYGEN DEMAND | | |
| | (a) | Waste discharges shall not cause the 5-day biochemical oxygen demand to exceed 3 milligrams per litre. | Yuen Long & Kam Tin (Upper) Subzone, Beas Subzone, Indus Subzone, Ganges Subzone and Water Gathering Ground Subzones |
| | (b) | Waste discharges shall not cause the 5-day biochemical oxygen demand to exceed 5 milligrams per litre. | Yuen Long & Kam Tin (Lower) Subzone and other inland waters |
| L. | CHEMICAL OXYGEN DEMAND | | |
| | (a) | Waste discharges shall not cause the chemical oxygen demand to exceed 15 milligrams per litre. | Yuen Long & Kam Tin (Upper) Subzone, Beas Subzone, Indus Subzone, Ganges Subzone and Water Gathering Ground Subzones. |
| | (b) | Waste discharges shall not cause the chemical oxygen demand to exceed 30 milligrams per litre. | Yuen Long & Kam Tin (Lower) Subzone and other inland waters |
| M. | TOXINS | | |
| | (a) | Waste discharges shall not cause the toxins in water to attain such level as to produce significant toxic carcinogenic, mutagenic or teratogenic effects in humans, fish or any other aquatic organisms, with due regard to biologically cumulative effects in food chains and to toxicant interactions with each other. | Whole Zone |
| | (b) | Waste discharges shall not cause a risk to any beneficial uses of the aquatic environment. | Whole Zone |
| N. | PHENOL | | |
| | Phenols shall not be present in such quantities as to produce a specific odour, or in concentration greater than 0.05 milligrams per litre as $C_6H_5OH$. | | Yuen Long Bathing Beach Subzone |
| O. | TURBIDITY | | |
| | Waste discharges shall not reduce light transmission substantially from the normal level. | | Yuen Long Bathing Beach Subzone |

C7.3 The *TM on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters* was issued in 1991. Under the provisions of this TM, all discharges must be licensed. Tables included within the document identify standards related to effluent flow rates ranging from <10 $m^3$/day to 6,000 $m^3$/day, providing guidance on a case-by-case basis. To illustrate this, standards for selected discharges to Deep Bay are shown in Table 7.2.

**Table 7.2**
**Standards for Effluents discharged into the coastal waters of Deep Bay**

| Flow rate ($m^3$/day) Determinant | ≤10 | >10 to ≤200 | >1000 to ≤1500 | >3000 to ≤4000 | >5,000 to ≤6,000 |
|---|---|---|---|---|---|
| pH (pH units) | 6-9 | 6-9 | 6-9 | 6-9 | 6-9 |
| Temperature (°C) | 45 | 45 | 45 | 45 | 45 |
| Colour (lovibond units) (25 mm cell length) | 1 | 1 | 1 | 1 | 1 |
| Suspended solids | 50 | 50 | 25 | 25 | 25 |
| BOD | 20 | 20 | 10 | 10 | 10 |
| COD | 80 | 80 | 50 | 50 | 50 |
| Oil & Grease | 20 | 20 | 10 | 10 | 10 |
| Iron | 10 | 10 | 3 | 1 | 1 |
| Boron | 5 | 4 | 1.1 | 0.4 | 0.2 |
| Barium | 5 | 4 | 1.1 | 0.4 | 0.2 |
| Mercury | 0.1 | 0.001 | 0.001 | 0.001 | 0.001 |
| Cadmium | 0.1 | 0.001 | 0.001 | 0.001 | 0.001 |
| Other toxic metals individually | 1 | 0.5 | 0.25 | 0.1 | 0.1 |
| Total toxic metals | 2 | 1 | 0.5 | 0.2 | 0.1 |
| Cyanide | 0.1 | 0.1 | 0.06 | 0.02 | 0.01 |
| Phenols | 0.5 | 0.5 | 0.1 | 0.1 | 0.1 |
| Sulphide | 5 | 5 | 2.5 | 1 | 0.5 |
| Total residual chlorine | 1 | 1 | 1 | 1 | 1 |
| Total nitrogen | 100 | 100 | 80 | 50 | 50 |
| Total phosphorus | 10 | 10 | 8 | 5 | 5 |
| Surfactants (total) | 15 | 15 | 10 | 10 | 7 |
| E Coli (count/100 ml) | 1000 | 1000 | 1000 | 1000 | 1000 |

**Note:** All units in mg/L unless otherwise indicated; all figures are upper limits unless otherwise indicated

*Site Discharges*

C7.4 Advice on the handling and disposal of construction site discharges, including site runoff and contaminated wastewaters, is provided in the *ProPECC Paper (PN1/94)* on *Construction Site Drainage*.

C7.5 The *Water Pollution Control (Sewerage) Regulation* requires owners of any land or premises to connect their discharge of wastewater to the public sewerage system. It also provides control over operation and maintenance of private treatment facilities. This regulation specifies the gazetted procedures for infrastructure works and is designed to reduce direct discharges of wastewater to the environment and lead to water quality improvements in areas served by the public sewerage system.

C7.6 The *Livestock Waste Control Scheme* (LWCS) to the *Waste Disposal (Livestock Waste) Regulations* was implemented in June 1988 under the *Waste Disposal Ordinance (Cap. 354)*. The LWCS was reviewed and a new implementation programme was adopted in April 1994 under the *Amendment of the Waste Disposal (Livestock Waste) Regulations*.

*Discharge Standards*

| Restriction Area | Phased Implementation of Discharge Standards@ | | |
|---|---|---|---|
| | 250:250 | 100:100 | 50:50 |
| 10R, 13R & 14R | 1 Jul 1995 | 1 Jul 1996 | 1 Jul 1997 |
| 11R | 1 Jul 1994* | 1 Jul 1996 | 1 Jul 1997 |
| 16R, 18R, 19R, 21R, 23R-25R | 1 Jan 1996 | 1 Jan 1997 | 1 Jan 1998 |
| Control Area | | | |
| 10, 12-14 | 1 Jul 1995 | 1 Jul 1996 | 1 Jul 1997 |
| 11 | 1 Jul 1994 | 1 Jul 1996 | 1 Jul 1997 |
| 15-17 | 1 Jul 1996 | 1 Jul 1997 | 1 Jul 1998 |
| 18-25 | 1 Jul 1997 | 1 Jul 1998 | 1 Jul 1999 |

**Important Note:**

@ in addition to meeting the above phased implementation programme, any farm that is new or restarts business after acceptance of the ex-gratia allowance must immediately comply with the discharge standard of 250:250 as soon as it starts ore restarts its business. Any failure to comply fully with the control requirements would result in enforcement and prosecution action.

* 1 July 1995 for farms on Lantau Island other than in Mui Wo Environs.

## C8 Solid Waste

C8.1 Chapter 9 of HKPSG states, in Section 6 - Waste Management that "The Government's overall objectives for waste management planning are to ensure:

(i) the adequate provision of facilities for cost-effective and environmentally satisfactory disposal of all wastes; and

(ii) the availability of and proper enforcement of legislation on storage, collection, transport, treatment and disposal of wastes, to safeguard the health and welfare of the community from any adverse environmental effects."

C8.2 Disposal of chemical, household, street, trade and livestock waste is controlled by the *Waste Disposal Ordinance [Cap 354]* of 1980. This legislation covers all aspects of the production, storage, collection and disposal, including the treatment, reprocessing and recycling of waste. In 1989, the formulation of a strategic *Waste Disposal Plan for Hong Kong* was founded on this legislation.

C8.3 Construction waste generated during the construction phase should be sorted on site into inert and non-inert fraction for reuse and recycling as far as practical. The non-inert fraction containing no more than 20% by volume of inert content can be disposed of at landfills, whilst the inert fraction should be delivered to public dumps or other reclamation sites. Inert material means soil, rock, asphalt, concrete, brick, cement plaster/mortar, building debris, aggregates, etc.

C8.4 Handling and disposal of chemical wastes including oils and grease are covered by the *Waste Disposal (Chemical Waste) (General) Regulations*. Chemical wastes must be disposed of at a licensed chemical waste disposal facilities. The Chemical Waste Treatment Centre (CWTC) at Tsing Yi is one of the facilities licensed to allow disposal of waste oil. Waste oil may also be disposed of at other licensed disposal sites. Design of oil/fuel storage facilities is covered by the *Code of Practice for Oil Storage Installations, 1992* issued by the Building Authority and the handling of chemical spillages on land is regulated by the Fire Services Department.

C8.5 EPD's *Practice Note ProPECC PN 3/94* describes the requirements for assessment and management of potentially contaminated sites such as car repairing/dismantling workshops.

C8.6 Dredging and dumping for land formation is controlled under the *Foreshore and Sea Bed Reclamations Ordinance [Cap 127]* (1985) and the *Dumping at Sea Act (1974) Overseas Territories Order* (1975) respectively. The former provides for the control of reclamation and use of foreshore and seabed. The latter prohibits dumping at sea without a licence.

C8.7 The classification of contaminated sediments as detailed in EPD's *Technical Circular (TC) No. 1-1-92 Classification of Dredged Sediments for Marine Disposal* is presented in Table 8.1. A revised classification with 'Super Class C' is currently being developed (1996).

**Table 8.1**
**Classification of Sediments by Metal Content (mg/kg dry weight)**

| | Cd | Cr | Cu | Hg | Ni | Pb | Zn |
|---|---|---|---|---|---|---|---|
| Class A | 0.0-0.9 | 0-49 | 0-54 | 0.0-0.7 | 0-34 | 0-64 | 0-140 |
| Class B | 1.0-1.4 | 50-79 | 55-64 | 0.8-0.9 | 35-39 | 65-74 | 150-190 |
| Class C | 1.5 or more | 80 or more | 65 or more | 1.0 or more | 40 or more | 75 or more | 200 or more |

Note: Tests results should be rounded off to two significant figures before comparing with the table, e.g. Cd to the nearest 0.1 mg/kg, Cr to the nearest 1 mg/kg, and Zn to the nearest 10 mg/kg, etc.

C8.8 Waste reception and transfer facilities should be sited so that any adjacent development is very well buffered. For facilities handling the reception and disposal of dusty or odoriferous wastes, special precautions should be taken to avoid nuisance to surrounding areas. Note should be taken of prevailing wind direction and subsequent potential for nuisance.

## C9 Ecology

### *TM For EIA*

C9.1 The TM for EIA Process provides criteria for evaluating ecological importance as well as assessment and mitigation guidelines. Criteria for evaluating ecological impacts and general criteria for evaluating ecological importance of a site or species is given in Annex 8, and for assessment and mitigation in Annex 16.

### *Criteria for Evaluating Ecological Impact*

C9.2 Annex 8 provides examples of important habitats in the Territory, and criteria for evaluating a site or species. These criteria are listed in Table A.6 below.

### *Assessment and Mitigation Guidelines*

C9.3 Annex 16 gives the guidelines for ecological assessment and mitigation. The need for an ecological assessment for this project is stated in the brief.

C9.4 The five parts of an ecological assessment are given in the TM (Annex 16 (4)) as:

(1) Provision of comprehensive and accurate information of the baseline environment;

(2) Identification and prediction of potential ecological impacts;

(3) Evaluation of the significance of the impacts identified;

(4) Recommendations of effective and practicable alternatives and mitigation measures; and

(5) Recommendations of the need for and the scope of an appropriate monitoring and audit programme.

C9.5 Important habitats include Recognized Sites of Conservation Interest (Annex 16, Appendix A, Note 1), as well as other habitats. The criteria for important habitats requiring assessment are partly based on their size, and is given in the Table below:

**Table 3.6**
**Minimum Size of Habitats Requiring Assessment or Considered to be Important**

| Habitat Type | TM on EIA Process Annex 8.2 Table (1) Note: examples of important habitat types | TM on EIA Process Annex 16, Appendix A, Note 2: important habitats where an ecological assessment is necessary | PELB Technical Circular No. 1/97& WBTC 4/97: Guidelines for Implementing the Policy on Off-site Ecological Mitigation Measures: examples of important habitat types |
|---|---|---|---|
| Woodland | mature native > 1 ha | > 1 ha | mature native > 1 ha |
| Undisturbed Natural Coast | > 1 ha or 500 metres long | > 1 ha or 500 metres long | > 1 ha or 500 metres long |
| Intertidal Mudflats | > 1 ha | > 0.5 ha | > 1 ha |
| Established Mangrove stands | any size | any size | any size |
| Freshwater or Brackish Marshes | > 1 ha | > 0.5 ha | > 1 ha |
| Established Seagrass Bed | any size | any size | any size |
| Natural Stream Courses and Rivers of Significant Length | > 500 metres long | > 100 metres | Unpolluted natural stream courses > 500 metres long |
| Other Wetlands defined by Ramsar but not Mentioned Above | (not included) | > 1 ha | (not included) |
| Established Coral Communities | any size | any size | any size |
| Other Habitats Considered to Have Special Conservation Importance by Documented Scientific Studies | no size criteria | no size criteria | no size criteria |

C9.6 Annex 16 of the TM states that there is a general policy for mitigating impacts on important habitats and wildlife. The importance is established in the assessment process criteria given in the Table above. The policy for mitigation (Annex 16 (5.4.1 a-c)), in order of priority, is:

(1) Avoidance: adopting suitable alternatives, e.g. design;

(2) Minimize unavoidable impacts through relocation, programming, or restoration;

(3) impacts that cannot be avoided or minimized may be compensated.

C9.7 The TM states a preference for on-site mitigation rather than off site (Annex 16, 5.4.3). Off-site compensation will only be considered when all other mitigation measures have been investigated and exhausted in the EIA process, and significant residual impacts (according to the criteria in Annexes 8 and 16) persist.

*Guidelines for Implementing the Policy on Off-site Ecological Mitigation Measures - PELB Technical Circular No. 1/97*

C9.8 Ecological impact is a product of the magnitude and scale of an impact and the asserted importance of the species or habitat(s) likely to be affected (TM Annex 16,5.3.1). Criteria for implementing policy on off-site mitigation found in PELB Technical Circular 1/97 give examples of important sizes of habitats. These are compared to the TM criteria in the Table above.

C9.9 The PELB Technical Circular provides guidelines for funding arrangements and implementation of off-site ecological measures.

*Sites of Special Scientific Interest*

C9.10 There are various legislative and regulatory controls in place for the conservation of species and protection of the environment. Table 1.2 from *HKPSG's Chapter 9: Environment* highlights "ecologically sensitive areas such as Sites of Special Scientific Interest (SSSI) and areas with other particular vegetation and wildlife habitat characteristics" as Environmental Factors influencing Land Use Planning, and states that Nature Reserves and SSSI should be adequately protected from the effects of pollution and from the diversion of natural flows.

C9.11 The *HKPSG* also highlight the need for care to be taken in planning and implementation of civil engineering construction works to avoid, minimise or ameliorate the occurrence of pollution from silt, oil and other sources on water bodies in unspoilt areas designated for conservation and in SSSI.

*Wild Animals*

C9.12 Wild animals are protected by the *Wild Animals Protection Ordinance [Cap 170]* (1980), which fall under the authority of the Director of Agriculture and Fisheries. The latest version of Cap 170 is the Second Schedule of the *Wild Animals Protection Ordinance [Cap 170]* which was revised in 1992. Protected wild animals listed under the Schedule include mammals, all wild birds, reptiles, amphibians and an insect.

C9.13 The *Animals and Plants (Protection of Endangered Species) Ordinance* (Cap. 187) controls the possession of any endangered species and is designed to prohibit collection, import and export. The *Wild Animals Protection Ordinance* (Cap. 170) is aimed mainly at hunters and collectors, but does apply to this case under Section 5, "No person shall take, remove, injure, destroy or wilfully disturb a nest or egg of any protected wild animal."

*Rare and Endangered Plant Species*

C9.14 Various species of plants are protected under the Forestry Regulations of the *Forestry and Countryside Ordinance [Cap 96]* (1950) and *Animals and Plants (Protection of Endangered Species) Ordinance [Cap 187]* (1976). The *Forestry and Countryside Ordinance [Cap 96]* and *Forestry Regulations [Cap 96 Sub. leg. A]* were revised in 1993. The *Animals and Plants (Protection of Endangered Species) Ordinance [Cap 187]* was revised in 1995.

C9.15 Regarding the specific protection laws, all Government forests are protected under Hong Kong's *Forestry and Countryside Ordinance*. The law (Cap. 96, section 21), states that:

"Any person who, without lawful authority or excuse, in any forest or plantation:-

b) plucks or damages any bud, blossom or leaf of any tree, shrub or plant;
d) fells, cuts, burns or otherwise destroys any trees or growing plants,

shall be guilty of an offence."

The law defines "forest" to mean "any area of Government land covered with selfgrown trees."

Section 3 of the subsidiary *Forestry Regulation* is more specific and provides a list of plants which are protected.

*Tree Preservation*

C9.16 *Works Branch Technical Circular 24/94 (Planning, Environment and Lands Branch Circular 3/94) on Tree Preservation* states that:

"The need to preserve trees must be borne in mind particularly by those in charge of engineering, architectural and landscape projects ..... There are many projects such as ... service reservoirs, formation works and the like where virtually all trees and shrubs within the works area boundary may have to be destroyed. In these cases care should be taken to minimise the extent of the works area and thereby maximise the number of trees to be preserved."

C9.17 The most recent regulations and guidelines for tree preservation are contained in *WBTC No. 24/94.* Every effort should be made to preserve trees in the planning, design and construction of development projects (*WBTC No. 24/94* para (4)) and, in general, permission to lop or cut down any tree will not be granted unless good cause is shown (*WBTC No. 24/94* Appendix A, para (3)).

C9.18 Director of Urban Services is the authority for felling or maintenance of trees located within 5 m of the edge of a roadway. The Director of Lands is the Land Authority, therefore applications for felling are submitted through the DLO. For government projects, a tree felling application shall be submitted to DLO after D of A&F or DUS has expressed no objection to felling (*WBTC No. 24/94* Appendix B, para E(2)). Whenever possible, permission should be sought 12 months in advance so that root systems can be prepared for transplant if appropriate (*WBTC No. 24/94* Appendix A, para E(3)). Trees that are less than 95 mm DBH presumably are protected under *Forestry and Countryside Ordinance*, and felling requires permission from D of A&F.

C9.19 The relevant guidelines for felling permission for this project are as follows (paraphrased from *WBTC No. 24/94* Appendix B para (C)):

1. irreplaceable rare tree species are not involved;
2. felling would not cause serious environmental impact;
3. genuine development need to fell exists, which cannot be reasonably overcome;
4. compensatory landscaping/replanting to Government's satisfaction will be undertaken;
5. the tree is not an unusually large or fine example;
6. the tree is in poor condition.

*Felling Application Procedure*

C9.20 After D of A&F or DUS has expressed no objection to feeling, works department shall submit tree feeling application to DLO.

C9.21 Applications shall be accompanied by:

1. two copies of a tree survey plan, showing accurate location of the tree(s), height, circumference, tree spread to scale. Plans should include trees to be retained, transplanted, and felled, existing levels in the vicinity of each tree, and future proposals (outline of road, formation and finished levels);
2. a tree schedule, including botanical name, height, circumference of the trunk, tree spread, and condition;
3. photographs
4. compensatory landscaping/replanting plan to which an undertaking will be tied.

*Replanting Plans*

C9.22 Tree species selected for replanting in areas where felling cannot be avoided should retain the amenity value as well as improve the ecological value of the affected area if possible. Amenity value is increased with trees that provide shade, ability to screen out poor views, fragrance or colour of leaves or blossoms. Ecological value can be improved in several ways. One improvement is to plant native species of trees with fruit or seeds useful as food for birds. Another is to increase the diversity of an area by planting a variety of native species. Diversity can be similarly increased by planting trees that will attain various heights, giving a multi-layered canopy.

C9.23 Some factors to be considered in the selection of roadside trees in urban areas of Hong Kong (Webb 1991) are:

a) pollution tolerance;
b) drought tolerance;
c) tolerant of compacted or heavy soil
d) resistant to typhoon damage (no brittle branches);
e) straight trunk to 3-4 m;
f) non-toxic fruit or leaves.

*Tree Planting and Landscaping*

C9.24 General advice on tree planting and landscaping is presented in this section under the heading 'Visual Impact and Landscaping'.

# APPENDIX D

# TREE SURVEY

## APPENDIX D - TREE SURVEY

### D1 Introduction

D1.1 As part of Agreement No. CE 76/96 Yuen Long Bypass Floodway, a tree survey was conducted to identify trees along channel alignments, and assess their vulnerability to impacts from the construction phase.

D1.2 This report describes the trees present along the alignments, and the area resumed for temporary traffic diversion. The information required for obtaining felling permission are described in WBTC 24/94.

### D2 Methodology

D2.1 Field surveys were undertaken at the end of December 1997 along the channel alignments and trees potentially affected were identified in the field. Their location were marked on 1:1,000 survey maps with the help of a mobile dGPS (differential Global Positioning System).

D2.2 Morphometric parameters [diameter at breast height (dbh), diameter of tree crown spread and height] of each individual tree were recorded and a photographic record taken. For trees that branched at low level, branch diameter(s) at 1m level that were greater than 95mm were recorded. For tree colonies or tree clusters (mostly banana) the average height, crown spread and dbh were taken instead.

### D3 Assessment of Trees

D3.1 A total of 467 trees within the project area were surveyed, three were unidentified dead specimens. The 464 live trees consisted of 45 species, the majority of them were introduced species (80% in terms of total count, 71% in terms of species variety). Most of trees are fruit species (61% in term of total count), especially Longan, Banana and Guava. A list of species composition is shown in Table D1. The morphometric parameters of individual trees are listed in Table D2.

D3.2 There are no rare or endangered species in the Site. The species list (Table D1) included three exotic species, White orchid tree (*Michelia alba*), Lotus-flowered Magnolia (*Magnolia grandiflora*) of the family Magnoliaceae and Queen crape-myrtle (*Lagerstroemia speciosa*) which would be protected under Forestry Regulation if they are rooted in un-leased land. At the time of assessment, only one *Michelia alba* (tree ID 201) is un-leased land.

D3.3 The trees can be grouped into three categories based on their habitats:

(1) house side trees;
(2) garden / plantation trees; and
(3) roadside trees.

D3.4 Most of the trees fall within categories (1) and (2). Category (2) are small scale plantations characterised by Banana and Jackfruit and high tree density. They were irregularly distributed and found in Sham Chung Tsuen, Chuk San Tsuen, Yeung Uk Tsuen and Tong Shing Lai. A commercial nursery garden was at Tong Shing Lai (adjacent to Pok Oi Hospital).

D3.5 The only roadside trees (3) are Autumn maple and Paper-bark alongside the Castle Peak Road - Yuen Long section

D3.6 All of the trees will be within the authority of Agriculture and Fisheries Department (AFD) once the land is resumed, except the roadside trees which are within the authority of Regional Service Department (RSD).

## D4 Reference

Jim, C.Y. 1990. *Trees in Hong Kong: Species for Landscape Planting*. Hong Kong University Press.

Thrower, S.L. 1988. *Hong Kong Trees,* omnibus volume. Urban Council, Hong Kong.

Webb, R. 1991. *Tree Planting and Maintenance in Hong Kong*. Standing Interdepartmental Landscape Technical Group, Hong Kong Government.

WBTC No. 24/94, 1994. *Tree Preservation*. Hong Kong Government.

Table D1. Tree Composition in Yuen Long Bypass Floodway Project area

| Common Name | Scientific Name | Count | Origin | Remark |
|---|---|---|---|---|
| Longan | *Euphoria longan* | 134 | I | Fruit species |
| Banana | *Musa paradisiaca* | 53 | I | Fruit species |
| Elephant's ear | *Macaranga tanarius* | 33 | N | |
| Guava | *Psidium guajava* | 33 | I | Fruit species |
| Mango | *Mangifera indica* | 25 | I | Fruit species |
| Chinese hackberry | *Celtis sinensis* | 17 | N | |
| Rose-apple | *Syzygium jambos* | 16 | I | Fruit species |
| White orchid tree / White champak | *Michelia alba* | 14 | I | Protected species * |
| Chinese banyan | *Ficus microcarpa* | 11 | N | |
| Fishtail palm | *Caryota ochlandra* | 10 | I | |
| Tallow tree | *Sapium sebiferum* | 10 | N | |
| Jackfruit | *Artocarpus heterophyllus* | 9 | I | Fruit species |
| Acacia | *Acacia confusa* | 8 | I | |
| Horsetail tree | *Casuarina equisetifolia* | 8 | I | |
| Paper-bark tree | *Melaleuca leucadendron* | 8 | I | |
| China-berry | *Melia azedarach* | 7 | I | |
| Lychee | *Litchi chinensis* | 6 | I | Fruit species |
| Pomelo | *Citrus grandis* | 6 | I | Fruit species |
| Weeping fig | *Ficus benjamina* | 6 | I | |
| White Bauhina | *Bauhinia variegata* | 5 | I | |
| Autumn maple | *Bischofia trifoliata* | 4 | N | |
| Cotton tree | *Bombax malabaricum* | 4 | N | |
| Candlenut tree | *Aleurites moluccana* | 3 | I | |
| Flame of the forest | *Delonix regia* | 3 | I | |
| Norfolk Island pine | *Araucaria heterophylla* | 3 | I | |
| Superb fig | *Ficus superba* | 3 | N | |
| King palm | *Archontophoenix alexandrae* | 2 | I | |
| Pop-gun seed | *Bridelia monoica* | 2 | N | |
| Queen crape-myrtle | *Lagerstroemia speciosa* | 2 | I | Protected species * |
| Red-stem fig | *Ficus variegata* | 2 | N | |
| Sea mango | *Cerbera manghas* | 2 | N | |
| White popinac | *Leucaena leucocephala* | 2 | I | |
| Camphor tree | *Cinnamomum camphora* | 1 | N | |
| Carambola | *Averrhoa carambola* | 1 | I | |
| Chinese juniper | *Juniperus chinensis* | 1 | I | |
| Coconut palm | *Cocos nucifera* | 1 | I | |
| India-rubber tree | *Ficus elastica* | 1 | I | |
| Lotus-flowered Magnolia | *Magnolia grandiflora* | 1 | I | Protected species * |
| Mock Peepul tree | *Ficus rumphii* | 1 | I | |
| Noble bottle tree | *Sterculia nobilis* | 1 | N | |
| Orange-jessamine | *Murraya paniculata* | 1 | I | |
| Papaya | *Carica papaya* | 1 | I | Fruit species |
| Sugar apple | *Annona squamosa* | 1 | I | Fruit species |
| Swamp mahogany | *Eucalyptus robusta* | 1 | I | |
| Wampi | *Clausena lansium* | 1 | N | |
| subtotal | | 464 | | 45 species |
| Dead tree | | 3 | | Not used in calculation |
| Total Trees | | 467 | | |

I = introduced species
N = native species
* The species is protected under Forestry Regulation if it is rooted in un-leased Government Land

| Tree ID | Common Name | Scientific Name | Photo ID | Tree Height (m) | Crown Diameter (m) | DBH (cm) | Action (Retain / Fell / Transplant) | Remark |
|---|---|---|---|---|---|---|---|---|
| 1 | Cotton tree | *Bombax malabaricum* | 1 | 6 | 4 | 15 | | |
| 2a | Tallow tree | *Sapium sebiferum* | 2 | 6 | 6 | 20+25 | | trunk branched at low level |
| 2b | Longan | *Euphoria longan* | 2 | 4.5 | 4 | 15 | | |
| 3 | Longan | *Euphoria longan* | 3 | 10 | 12 | 60 | | trunk branched at low level |
| 4 | Longan | *Euphoria longan* | 3 | 10 | 6 | 26 | | trunk branched at low level |
| 5 | Tallow tree | *Sapium sebiferum* | 4 | 5 | 3 | 13 | | |
| 6 | Banana | *Musa paradisiaca* | 5 | 2 | 2 | 12 | | |
| 7 | Banana | *Musa paradisiaca* | 5 | 3 | 2 | 14 | | |
| 8 | Banana | *Musa paradisiaca* | 6 | 3 | 2 | 15 | | |
| 9 | Banana | *Musa paradisiaca* | 6 | 1.8 | 1.5 | 9.5 | | |
| 10 | Guava | *Psidium guajava* | 7 | 4 | 4 | 14 | | |
| 11 | Banana | *Musa paradisiaca* | 8 | 2 | 2 | 11 | | |
| 12 | Banana | *Musa paradisiaca* | 8 | 2 | 2 | 14 | | |
| 13 | Banana | *Musa paradisiaca* | 8 | 2 | 2 | 14 | | |
| 14 | Banana | *Musa paradisiaca* | 8 | 2 | 2 | 14 | | |
| 15 | Banana | *Musa paradisiaca* | 8 | 2 | 2 | 14 | | |
| 16 | Banana | *Musa paradisiaca* | 8 | 2 | 2 | 14 | | |
| 17 | Banana | *Musa paradisiaca* | 8 | 2 | 2 | 14 | | |
| 18 | Banana | *Musa paradisiaca* | 8 | 2 | 2 | 14 | | |
| 19 | Longan | *Euphoria longan* | 9 | 5 | 5 | 18 | | |
| 20 | Banana | *Musa paradisiaca* | 10 | 3 | 3 | 3 x 10 | | composite of 4 strands |
| 21 | Banana | *Musa paradisiaca* | 10 | 3 | 3 | 6 x 10 | | composite of 8 strands |
| 22 | Banana | *Musa paradisiaca* | 10 | 3 | 3 | 6 x 10 | | composite of 9 strands |
| 23 | Banana | *Musa paradisiaca* | 10 | 3 | 3 | 3 x 10 | | composite of 6 strands |
| 24 | Banana | *Musa paradisiaca* | 11 | 3 | 3 | 2 x 10 | | composite of 2 strands |
| 25 | Banana | *Musa paradisiaca* | 11 | 1.5 | 2 | 2 x 10 | | composite of 2 strands |
| 26 | Banana | *Musa paradisiaca* | 12 | 4 | 5 | 11 x 10 | | composite of 11 strands |
| 27 | Camphor tree | *Cinnamomum camphora* | 13 | 6 | 4 | 27 | | |
| 28 | Chinese banyan | *Ficus microcarpa* | 14 | 10 | 12 | 250 | | partially damaged |
| 29 | Banana | *Musa paradisiaca* | 15 | 4 | 2.5 | 13 | | composite of 6 strands |
| 30 | Banana | *Musa paradisiaca* | 15 | 2 | 2.5 | 12 | | composite of 5 strands |
| 31 | Longan | *Euphoria longan* | 15 | 6 | 12 | 20 | | |
| 32 | Longan | *Euphoria longan* | 16 | 5 | 6 | 13 | | |
| 33 | Longan | *Euphoria longan* | 17 | 9 | 12 | 30+15 | | trunk branched at low level |
| 34 | Longan | *Euphoria longan* | 18 | 8 | 7 | 40 | | trunk branched at low level |
| 35 | Longan | *Euphoria longan* | 19 | 8 | 8 | 28 | | |
| 36 | Longan | *Euphoria longan* | 19 | 7 | 6 | 20 | | |
| 37 | Longan | *Euphoria longan* | 19 | 10 | 7 | 40 | | |
| 38 | Longan | *Euphoria longan* | 20 | 5 | 4.5 | 25 | | |

| Tree ID | Common Name | *Scientific Name* | Photo ID | Tree Height (m) | Crown Diameter (m) | DBH (cm) | Action (Retain / Fell / Transplant) | Remark |
|---|---|---|---|---|---|---|---|---|
| 39 | Pomelo | *Citrus grandis* | 21 | 2.5 | 3 | 13 | | heavily pruned |
| 40 | Cotton tree | *Bombax malabaricum* | 22 | 6 | 8 | 25 | | |
| 41 | Norfolk Island pine | *Araucaria heterophylla* | 23 | 6 | 3 | 15 | | |
| 42 | Guava | *Psidium guajava* | 24 | 4 | 4 | 13+13 | | covered by climbers |
| 43 | Longan | *Euphoria longan* | 25 | 5 | 5 | 20 | | |
| 44 | Longan | *Euphoria longan* | 26 | 5 | 5 | 15 | | |
| 45 | Longan | *Euphoria longan* | 27 | 5 | 5 | 15+15 | | trunk branched at low level |
| 46 | Longan | *Euphoria longan* | 27 | 5 | 5 | 30 | | |
| 47 | Mango | *Mangifera indica* | 28 | 5 | 6 | 20+20 | | trunk lopped; leave regenerating |
| 48 | Longan | *Euphoria longan* | 29 | 4.5 | 3 | 13 | | |
| 49 | Longan | *Euphoria longan* | 29 | 6 | 5 | 15 | | |
| 50 | Mango | *Mangifera indica* | 30 | 6 | 3 | 13 | | |
| 51 | Longan | *Euphoria longan* | 31 | 5.5 | 5 | 25 | | |
| 52 | Mango | *Mangifera indica* | 32 | 1.5 | 0.15 | 15 | | very poor condition |
| 53 | India-rubber tree | *Ficus elastica* | 33 | 6 | 5 | 15 | | trunk branched at low level |
| 54 | Chinese hackberry | *Celtis sinensis* | 34 | 10 | 10 | 80 | | |
| 55 | Longan | *Euphoria longan* | 34 | 4 | 7 | 15 | | |
| 56 | Banana | *Musa paradisiaca* | 35 | 3.5 | 5 | 5 x 10 | | composite of 5 strands |
| 57 | Longan | *Euphoria longan* | 36 | 4.5 | 3 | 20 | | very poor living condition |
| 58 | Longan | *Euphoria longan* | 37 | 7 | 3 | 15 | | |
| 59 | Chinese hackberry | *Celtis sinensis* | 37 | 7 | 7 | 60 | | |
| 60 | Noble bottle tree | *Sterculia nobilis* | 37 | 8 | 6 | 48 | | |
| 61 | Flame of the forest | *Delonix regia* | 37 | 9 | 12 | 30 | | |
| 62 | Longan | *Euphoria longan* | 38 | 2 | 2 | 13 | | pruned; covered by climber |
| 63 | Elephant's ear | *Macaranga tanarius* | 39 | 5 | 6 | 15 | | |
| 64 | Elephant's ear | *Macaranga tanarius* | 40 | 4.5 | 8 | 20 | | |
| 65 | Elephant's ear | *Macaranga tanarius* | 41 | 2.5 | 3 | 11 | | pruned; covered by climber |
| 66 | Wampi | *Clausena lansium* | 41 | 3 | 5 | 13 | | |
| 67 | Sugar apple | *Annona squamosa* | 42 | 4.5 | 3 | 18 | | |
| 68 | Pomelo | *Citrus grandis* | 42 | 2.5 | 2 | 10 | | poor condition |
| 69 | Longan | *Euphoria longan* | 42 | 6 | 10 | 25 | | |
| 70 | Banana | *Musa paradisiaca* | 43 | 2 | 2 | 3 x 10 | | composite of 5 strands |
| 71 | Banana | *Musa paradisiaca* | 43 | 2 | 2 | 2 x 10 + 15 | | composite of 5 strands |
| 72 | Chinese hackberry | *Celtis sinensis* | 43 | 8 | 8 | 25 | | |
| 73 | Banana | *Musa paradisiaca* | 43 | 2 | 2.5 | 3 x 10 | | composite of 4 strands |
| 74 | Pomelo | *Citrus grandis* | 44 | 3 | 4 | 11 | | |
| 75 | Longan | *Euphoria longan* | 44 | 5 | 4 | 16 | | |
| 76 | Lychee | *Litchi chinensis* | 44 | 6 | 6 | 18 | | |
| 77 | Longan | *Euphoria longan* | 45 | 5.5 | 6 | 20 | | |

| Tree ID | Common Name | Scientific Name | Photo ID | Tree Height (m) | Crown Diameter (m) | DBH (cm) | Action (Retain / Fell / Transplant) | Remark |
|---|---|---|---|---|---|---|---|---|
| 78 | Longan | *Euphoria longan* | 45 | 6 | 7 | 25 | | |
| 79 | Elephant's ear | *Macaranga tanarius* | 46 | 4 | 6 | 16 | | |
| 80 | Guava | *Psidium guajava* | 46 | 4.5 | 4 | 12 | | |
| 81 | Longan | *Euphoria longan* | 46 | 4 | 5 | 11 + 11 | | trunk branched at low level |
| 82 | Banana | *Musa paradisiaca* | 46 | 2.5 | 3 | 4 x 13 | | composite of 9 strands |
| 83 | Elephant's ear | *Macaranga tanarius* | 47 | 4 | 3 | 15 | | |
| 84 | Longan | *Euphoria longan* | 47,48 | 5 | 1 | 18 | | heavily pruned |
| 85 | Pomelo | *Citrus grandis* | 48 | 5 | 3 | 12 | | pruned |
| 86 | Guava | *Psidium guajava* | 48 | 6 | 4 | 20 + 20 | | poor condition |
| 87 | White orchid tree * | *Michelia alba* | 49 | 2.5 | 0.5 | 18 | | poor condition |
| 88 | Pomelo | *Citrus grandis* | 50 | 4 | 4 | 15 | | |
| 89 | Elephant's ear | *Macaranga tanarius* | 51 | 3.5 | 3 | 17 | | |
| 90 | Elephant's ear | *Macaranga tanarius* | 51 | 3 | 3 | 15 | | pruned |
| 91 | Banana | *Musa paradisiaca* | 52 | 1.7 | 10 | 10 | | |
| 92 | Banana | *Musa paradisiaca* | 52 | 1.7 | 10 | 10 | | |
| 93 | Banana | *Musa paradisiaca* | 52 | 1.7 | 10 | 10 | | |
| 94 | Banana | *Musa paradisiaca* | 53 | 1.7 | 10 | 5 x 10 | | composite of 10 strands |
| 95 | White orchid tree * | *Michelia alba* | 53 | 5 | 3 | 12 | | |
| 96 | Longan | *Euphoria longan* | 54 | 4 | 3 | 12 | | |
| 97 | White orchid tree * | *Michelia alba* | 54 | 2.5 | 0.15 | 15 | | poor, pruned |
| 98 | White orchid tree * | *Michelia alba* | 54 | 2.5 | 0.15 | 15 | | poor, pruned |
| 99 | King palm | *Archontophoenix alexandrae* | 55 | 8 | 3 | 10 | | |
| 100 | White orchid tree * | *Michelia alba* | 56 | 3.5 | 3 | 15 | | |
| 101 | Longan | *Euphoria longan* | 56,57 | 3.5 | 3 | 12 | | |
| 102 | Elephant's ear | *Macaranga tanarius* | 57,59 | 3.5 | 3 | 15 | | |
| 103 | Elephant's ear | *Macaranga tanarius* | 57 | 2.5 | 3 | 15 | | |
| 104 | Elephant's ear | *Macaranga tanarius* | 57 | 3.5 | 3.5 | 15 | | |
| 105 | Lychee | *Litchi chinensis* | 58 | 4 | 3.5 | 18 | | |
| 106 | Elephant's ear | *Macaranga tanarius* | 58 | 3 | 4 | 20 | | |
| 107 | Elephant's ear | *Macaranga tanarius* | 59 | 3.5 | 4 | 15 | | |
| 108 | Longan | *Euphoria longan* | 60 | 3 | 3 | 11 | | |
| 109 | Longan | *Euphoria longan* | 61 | 4 | 3 | 10 | | |
| 110 | Chinese hackberry | *Celtis sinensis* | 62 | 4.5 | 4 | 20 | | |
| 111 | Longan | *Euphoria longan* | 63 | 4 | 4 | 20 | | |
| 112 | Guava | *Psidium guajava* | 64 | 5 | 5 | 15 | | |
| 113 | Guava | *Psidium guajava* | 64 | 4 | 1 | 10 | | inclined, covered by climbers |
| 114 | Guava | *Psidium guajava* | 64 | 4 | 1 | 8 | | very poor |
| 115 | Dead tree | -- | 64 | 4 | 0.15 | 15 | | |
| 116 | Longan | *Euphoria longan* | 65 | 3.5 | 3 | 15 | | |

| Tree ID | Common Name | Scientific Name | Photo ID | Tree Height (m) | Crown Diameter (m) | DBH (cm) | Action (Retain / Fell / Transplant) | Remark |
|---|---|---|---|---|---|---|---|---|
| 117 | Longan | *Euphoria longan* | 66 | 3 | 3.5 | 11+10 | | trunk branched at low level |
| 118 | Chinese banyan | *Ficus microcarpa* | 67 | 9 | 12 | 40+50 | | trunk branched at low level; pruned |
| 119 | Chinese banyan | *Ficus microcarpa* | 67 | 9 | 12 | 60 | | recently pruned |
| 120 | Banana | *Musa paradisiaca* | 68 | 2 | 2 | 16 x 12 | | line of 20 strands |
| 121 | Guava | *Psidium guajava* | 69 | 2.2 | 0.5 | 10 | | heavily pruned; leave regenerating |
| 122 | Acacia | *Acacia confusa* | 70 | 6.5 | 6 | 15 | | |
| 123 | Acacia | *Acacia confusa* | 70,71 | 6.5 | 6 | 20 | | |
| 124 | Horsetail tree | *Casuarina equisetifolia* | 70,71 | 8 | 4 | 20 | | |
| 125 | Longan | *Euphoria longan* | 70 | 3 | 3 | 15 | | |
| 126 | White Bauhina | *Bauhinia variegata* | 71 | 4 | 2 | 10+10 | | trunk branched at low level |
| 127 | Lotus-flowered Magnolia * | *Magnolia grandiflora* | 72 | 4 | 4 | 15 | | |
| 128 | Cotton tree | *Bombax malabaricum* | 73 | 7 | 4 | 25 | | |
| 129 | White Bauhina | *Bauhinia variegata* | 74 | 1.8 | 1.5 | 0 | | trunk lopped, regenerating |
| 130 | Longan | *Euphoria longan* | 75 | 3 | 3 | 9 | | |
| 131 | Superb fig | *Ficus superba* | 75 | 5 | 4.5 | 30 | | |
| 132 | Guava | *Psidium guajava* | 76 | 6 | 5 | 12 | | trunk branched at low level |
| 133 | Guava | *Psidium guajava* | 77 | 5 | 5 | 15 | | trunk branched at low level |
| 134 | Tallow tree | *Sapium sebiferum* | 77 | 6 | 5 | 23 | | |
| 135 | Elephant's ear | *Macaranga tanarius* | 77 | 2.5 | 3 | 11 | | |
| 136 | Norfolk Island pine | *Araucaria heterophylla* | 78 | 4 | 1.5 | 12 | | |
| 137 | Norfolk Island pine | *Araucaria heterophylla* | 78 | 7 | 3 | 10 | | |
| 138 | Longan | *Euphoria longan* | 79 | 3 | 3 | 12 | | |
| 139 | Longan | *Euphoria longan* | 79 | 4.5 | 6 | 2.5 | | trunk branched at low level |
| 140 | Longan | *Euphoria longan* | 80 | 4 | 4 | 11 | | |
| 141 | King palm | *Archontophoenix alexandrae* | 80 | 2 | 0 | 13 | | poor, bud damaged |
| 142 | Guava | *Psidium guajava* | 81 | 6 | 6 | 17+10 | | two trunks |
| 143 | Longan | *Euphoria longan* | 81 | 6 | 8 | 20 | | |
| 144 | Longan | *Euphoria longan* | 81 | 6 | 8 | 15+15 | | two trunks |
| 145 | Longan | *Euphoria longan* | 81 | 6 | 8 | 20 | | |
| 146 | Longan | *Euphoria longan* | 82 | 3 | 3 | 9.5 | | |
| 147 | Longan | *Euphoria longan* | 82 | 3 | 3 | 9.5 | | |
| 148 | Guava | *Psidium guajava* | 83 | 2.5 | 4 | 10+10 | | two trunks |
| 149 | Longan | *Euphoria longan* | 84 | 4 | 3 | 15 | | |
| 150 | Jackfruit | *Artocarpus heterophyllus* | 84 | 4 | 3 | 15 | | |
| 151 | Longan | *Euphoria longan* | 85 | 4 | 7 | 18+9 | | |
| 152 | Guava | *Psidium guajava* | 85 | 4 | 6 | 14 | | |
| 153 | Guava | *Psidium guajava* | 86 | - - | - - | - - | | dead, uprooted, no morhpometry |
| 154 | Guava | *Psidium guajava* | 86 | - - | - - | - - | | dead, uprooted, no morhpometry |

| Tree ID | Common Name | Scientific Name | Photo ID | Tree Height (m) | Crown Diameter (m) | DBH (cm) | Action (Retain / Fell / Transplant) | Remark |
|---|---|---|---|---|---|---|---|---|
| 155 | Longan | *Euphoria longan* | 87 | 4 | 7 | 15 | | |
| 156 | Lychee | *Litchi chinensis* | 87 | 4 | 4 | 18 | | |
| 157 | Elephant's ear | *Macaranga tanarius* | 88 | 4 | 4 | 9+9+9 | | |
| 158 | Chinese banyan | *Ficus microcarpa* | 88 | 4 | 10 | 50 | | |
| 159 | Mango | *Mangifera indica* | 89 | 3 | 1.5 | 10 | | |
| 160 | Mango | *Mangifera indica* | 89 | 4 | 1.5 | 10 | | |
| 161 | Elephant's ear | *Macaranga tanarius* | 88 | 2.5 | 0.15 | 15 | | dead tree |
| 162 | Candlenut tree | *Aleurites moluccana* | 91,92 | 8 | 4 | 20 | | |
| 163 | Superb fig | *Ficus superba* | 90 | 8 | 10 | 70 | | a bird's net on branch |
| 164 | Chinese hackberry | *Celtis sinensis* | 92 | 5 | 5 | 35 | | |
| 165 | Longan | *Euphoria longan* | 93 | 4.5 | 4 | 15 | | |
| 166 | Longan | *Euphoria longan* | 94 | 2.5 | 2.5 | 11 | | |
| 167 | Longan | *Euphoria longan* | 94 | 3.5 | 3 | 12 | | |
| 168 | Longan | *Euphoria longan* | 94 | 2.5 | 2 | 10 | | |
| 169 | Tallow tree | *Sapium sebiferum* | 95 | 6 | 3 | 10 | | |
| 170 | Tallow tree | *Sapium sebiferum* | 95 | 6 | 3 | 11 | | |
| 171 | Tallow tree | *Sapium sebiferum* | 96 | 4 | 4 | 10 | | two trunks |
| 172 | White orchid tree * | *Michelia alba* | 97 | 3 | 2 | 12+12 | | trunk branched at low level |
| 173 | Banana | *Musa paradisiaca* | 98 | 2.5 | 2 | 4 x 10 | | composite of 10 strands |
| 174 | Banana | *Musa paradisiaca* | 98 | 2.5 | 2 | 3 x 10 | | composite of 6 strands |
| 175 | Banana | *Musa paradisiaca* | 98 | 2.5 | 2 | 2 x 10 | | composite of 4 strands |
| 176 | Banana | *Musa paradisiaca* | 98 | 2.5 | 2 | 4 x 12 | | composite of 8 strands |
| 177 | Banana | *Musa paradisiaca* | 98 | 2.5 | 2 | 4 x 10 | | composite of 9 strands |
| 178 | Acacia | *Acacia confusa* | 99 | 8 | 8 | 20 | | |
| 179 | Acacia | *Acacia confusa* | 99 | 8 | 6 | 20 | | |
| 180 | Acacia | *Acacia confusa* | 99 | 8 | 6 | 18 | | |
| 181 | Tallow tree | *Sapium sebiferum* | 100 | 6 | 5 | 18 | | |
| 182 | Fishtail palm | *Caryota ochlandra* | 101 | 3.5 | 2.5 | 12 | | |
| 183 | Fishtail palm | *Caryota ochlandra* | 101 | 3.5 | 2.5 | 12 | | |
| 184 | Fishtail palm | *Caryota ochlandra* | 101 | 4 | 2.5 | 12 | | |
| 185 | Fishtail palm | *Caryota ochlandra* | 101 | 3.5 | 2.5 | 12 | | |
| 186 | Fishtail palm | *Caryota ochlandra* | 102 | 3.5 | 2.5 | 12 | | |
| 187 | Fishtail palm | *Caryota ochlandra* | 102 | 3.5 | 2.5 | 12 | | |
| 188 | Fishtail palm | *Caryota ochlandra* | 102 | 4 | 2.5 | 12 | | |
| 189 | Fishtail palm | *Caryota ochlandra* | 103 | 3.5 | 2.5 | 12 | | |
| 190 | Fishtail palm | *Caryota ochlandra* | 103 | 3.5 | 2.5 | 12 | | |
| 191 | White popinac | *Leucaena leucocephala* | 104 | 3.5 | 3 | 10 | | |
| 192 | White popinac | *Leucaena leucocephala* | 104 | 4 | 3 | 15 | | |
| 193 | Acacia | *Acacia confusa* | 105 | 4 | 1 | 15 | | wilted |

| Tree ID | Common Name | Scientific Name | Photo ID | Tree Height (m) | Crown Diameter (m) | DBH (cm) | Action (Retain / Fell / Transplant) | Remark |
|---|---|---|---|---|---|---|---|---|
| 194 | Acacia | *Acacia confusa* | 105 | 4 | 1 | 15 | | wilted |
| 195 | Tallow tree | *Sapium sebiferum* | n/a | 4.5 | 3 | 20 | | trunk branched at low level |
| 196 | China-berry | *Melia azedarach* | 106 | 5 | 4 | 15 | | |
| 197 | Longan | *Euphoria longan* | 106 | 3.5 | 3.5 | 8+8+8 | | trunk branched at low level |
| 198 | Lychee | *Litchi chinensis* | 106 | 3.5 | 3.5 | 8+12 | | trunk branched at low level |
| 199 | China-berry | *Melia azedarach* | 106 | 4.5 | 4 | 12 | | |
| 200 | China-berry | *Melia azedarach* | 106 | 4 | 3 | 10 | | |
| 201 | White orchid tree $ | *Michelia alba* | 107 | 4 | 3 | 13 | | |
| 202 | Banana | *Musa paradisiaca* | 108 | 2.5 | 2 | 10 | | |
| 203 | Banana | *Musa paradisiaca* | 109 | 2.5 | 2.5 | 12 | | strand size; ~30 clusters, each ~6 strands |
| 204 | Longan | *Euphoria longan* | 108 | 5 | 8 | 30 | | pruned |
| 205 | Longan | *Euphoria longan* | 108 | 4 | 4.5 | 30 | | |
| 206 | Elephant's ear | *Macaranga tanarius* | 108 | 4 | 6 | 40 | | pruned |
| 207 | Longan | *Euphoria longan* | 110 | 7 | 9 | 17+21 | | trunk branched at low level |
| 208 | Horsetail tree | *Casuarina equisetifolia* | 110 | 12 | 6 | 40 | | |
| 209 | Horsetail tree | *Casuarina equisetifolia* | 111 | 12 | 6 | 35 | | |
| 210 | No tree 210-299 | -- | -- | -- | -- | -- | | |
| 300 | Horsetail tree | *Casuarina equisetifolia* | 111 | 14 | 6 | 45 | | |
| 301 | Horsetail tree | *Casuarina equisetifolia* | 112 | 13 | 7 | 35 | | |
| 302 | Horsetail tree | *Casuarina equisetifolia* | 112 | 13 | 7 | 30 | | |
| 303 | Carambola | *Averrhoa carambola* | 112,113 | 3.5 | 5 | 25 | | |
| 304 | Longan | *Euphoria longan* | 113 | 4 | 5 | 18+16 | | trunk branched at low level |
| 305 | Horsetail tree | *Casuarina equisetifolia* | 114,115 | 1 | 7 | 30 | | heavily pruned |
| 306 | White orchid tree * | *Michelia alba* | 114,115 | 8 | 2 | 25+28 | | trunk branched at low level |
| 307 | Longan | *Euphoria longan* | 116 | 4 | 5 | 16+21 | | trunk branched at low level |
| 308 | Chinese banyan | *Ficus microcarpa* | 117 | 3.5 | 2 | 28 | | trunk branched at low level |
| 309 | Longan | *Euphoria longan* | 117 | 3.5 | 5 | 21+22 | | trunk branched at low level |
| 310 | Longan | *Euphoria longan* | 118 | 3.5 | 5 | 30 | | |
| 311 | Longan | *Euphoria longan* | 119 | 2.5 | 3.5 | 10+14 | | trunk branched at low level |
| 312 | Longan | *Euphoria longan* | 119 | 3.5 | 3.5 | 18+19 | | trunk branched at low level |
| 313 | Dead tree | - - | 120 | 3 | 2.5 | 15 | | Dead tree, supports Fungi |
| 314 | Guava | *Psidium guajava* | 121 | 3 | 2.5 | 10 | | |
| 315 | Superb fig | *Ficus superba* | 121 | 3.5 | 7 | 18+16 | | trunk branched at low level |
| 316 | Guava | *Psidium guajava* | 122 | 2 | 2 | 16 | | very poor, covered by climbers |
| 317 | Elephant's ear | *Macaranga tanarius* | 123 | 3 | 3.5 | 12 | | |
| 318 | Tallow tree | *Sapium sebiferum* | 124 | 8 | 8 | 20 | | |
| 319 | Chinese banyan | *Ficus microcarpa* | 124 | 4 | 4 | 30+13 | | covered by climbers |
| 320 | Dead tree | - - | 124 | 3 | 4 | 18 | | covered by climbers |
| 321 | Chinese banyan | *Ficus microcarpa* | 125 | 5 | 8 | 20 | | covered by climbers |

| Tree ID | Common Name | *Scientific Name* | Photo ID | Tree Height (m) | Crown Diameter (m) | DBH (cm) | Action (Retain / Fell / Transplant) | Remark |
|---|---|---|---|---|---|---|---|---|
| 322 | Longan | *Euphoria longan* | 126 | 3.5 | 3.5 | 19+10 | | |
| 323 | Elephant's ear | *Macaranga tanarius* | 126 | 2.5 | 2 | 9.5 | | |
| 324 | Banana | *Musa paradisiaca* | 127 | 2 | 1.5 | 4 x 12 | | composite of 10 strands |
| 325 | Banana | *Musa paradisiaca* | 127 | 2 | 1.5 | 12 | | composite of 4 strands |
| 326 | Banana | *Musa paradisiaca* | 128 | 2 | 1.5 | 2 x 10 | | composite of 4 strands |
| 327 | Banana | *Musa paradisiaca* | 128 | 2 | 1.5 | 3 x 12 | | composite of 4 strands |
| 328 | Banana | *Musa paradisiaca* | 129 | 2 | 1.5 | 3 x13 | | composite of 6 strands |
| 329 | Banana | *Musa paradisiaca* | 129 | 2 | 1.5 | 2 x 12 | | composite of 5 strands |
| 330 | Horsetail tree | *Casuarina equisetifolia* | 130 | 14 | 12 | 35 | | |
| 331 | Mango | *Mangifera indica* | 131 | 3 | 2 | 20 | | |
| 332 | Longan | *Euphoria longan* | 132 | 3 | 3.5 | 16+15 | | trunk branched at low level |
| 333 | Longan | *Euphoria longan* | 132 | 3.5 | 4 | 25 | | |
| 334 | Longan | *Euphoria longan* | 133 | 2.5 | 2 | 10 | | |
| 335 | White Bauhina | *Bauhinia variegata* | 134 | 3 | 3 | 20 | | |
| 336 | Jackfruit | *Artocarpus heterophyllus* | 135 | 3 | 1.5 | 11 | | |
| 337 | Mango | *Mangifera indica* | 135 | 3 | 1.5 | 11 | | |
| 338 | Longan | *Euphoria longan* | 136 | 3.5 | 4 | 20 | | |
| 339 | Banana | *Musa paradisiaca* | 137 | 1.8 | 2 | 2 x 10 | | poor condition; composite of 6 strands |
| 340 | Guava | *Psidium guajava* | 138 | 3.5 | 3.5 | 20+15 | | trunk branched at low level |
| 341 | White orchid tree * | *Michelia alba* | 139 | 3.5 | 2 | 10 | | |
| 342 | Red-stem fig | *Ficus variegata* | 140 | 3.5 | 3 | 15 | | |
| 343 | Mango | *Mangifera indica* | 141 | 3.5 | 3 | 8+8 | | trunk branched at low level |
| 344 | Mango | *Mangifera indica* | 141 | 3.5 | 3 | 10+11 | | |
| 345 | Mango | *Mangifera indica* | 141 | 3.5 | 3 | 9 | | |
| 346 | Mango | *Mangifera indica* | 141 | 3.5 | 3 | 13 | | |
| 347 | Longan | *Euphoria longan* | 142 | 3 | 3 | 10 | | |
| 348 | Longan | *Euphoria longan* | 142 | 3 | 3 | 7+7 | | |
| 349 | Longan | *Euphoria longan* | 143 | 3 | 3 | 11 | | |
| 350 | Guava | *Psidium guajava* | 144 | 3 | 3 | 11 | | |
| 351 | Banana | *Musa paradisiaca* | 145,146 | 2.5 | 14 x 2.5 | 40 x 10 | | 6 clusters;~50 strands |
| 352 | Banana | *Musa paradisiaca* | 147 | 2.5 | 4 | 7 x 12 | | composite of 14 strands |
| 353 | Mango | *Mangifera indica* | 148 | 3.5. | 2.5 | 15 | | |
| 354 | Mango | *Mangifera indica* | 148 | 3.5 | 2 | 15 | | |
| 355 | Jackfruit | *Artocarpus heterophyllus* | 148 | 3.5 | 2 | 15 | | |
| 356 | Paper-bark tree | *Melaleuca leucadendron* | 149 | 12 | 4 | 30 | | |
| 357 | Paper-bark tree | *Melaleuca leucadendron* | 149 | 12 | 4 | 34 | | |
| 358 | Paper-bark tree | *Melaleuca leucadendron* | 149 | 12 | 4 | 36 | | |
| 359 | Paper-bark tree | *Melaleuca leucadendron* | 149 | 12 | 4 | 30 | | |
| 360 | Paper-bark tree | *Melaleuca leucadendron* | 149 | 12 | 4 | 29 | | |

| Tree ID | Common Name | *Scientific Name* | Photo ID | Tree Height (m) | Crown Diameter (m) | DBH (cm) | Action (Retain / Fell / Transplant) | Remark |
|---|---|---|---|---|---|---|---|---|
| 361 | Paper-bark tree | *Melaleuca leucadendron* | 149 | 12 | 4 | 36 | | |
| 362 | Paper-bark tree | *Melaleuca leucadendron* | 149 | 12 | 4 | 32 | | |
| 363 | Guava | *Psidium guajava* | 150 | 3 | 3 | 15 | | |
| 364 | Guava | *Psidium guajava* | 151 | 6 | 4 | 18 | | |
| 365 | Guava | *Psidium guajava* | 152 | 6 | 4 | 15 | | |
| 366 | China-berry | *Melia azedarach* | 152 | 10 | 8 | 35 | | |
| 367 | Flame of the forest | *Delonix regia* | 153 | 10 | 10 | 50 | | |
| 368 | Flame of the forest | *Delonix regia* | 153 | 10 | 16 | 65 | | |
| 369 | Longan | *Euphoria longan* | 154 | 5 | 4 | 15 | | |
| 370 | Longan | *Euphoria longan* | 155,157 | 5.5 | 6 | 20 | | |
| 371 | Mock Peepul tree | *Ficus rumphii* | 156 | 10 | 10 | 60 | | trunk branched at low level |
| 372 | Elephant's ear | *Macaranga tanarius* | 152 | 4 | 5 | 15 | | |
| 373 | Guava | *Psidium guajava* | 157 | 3 | 2 | 12+10 | | trunk branched at low level |
| 374 | Elephant's ear | *Macaranga tanarius* | 158 | 3.5 | 4 | 15 | | |
| 375 | Longan | *Euphoria longan* | 159 | 3.5 | 3 | 10 | | |
| 376 | Longan | *Euphoria longan* | 159 | 3.5 | 3 | 10 | | |
| 377 | Longan | *Euphoria longan* | 159 | 3.5 | 3 | 10 | | |
| 378 | Longan | *Euphoria longan* | 159 | 3.5 | 3 | 10 | | |
| 379 | Chinese hackberry | *Celtis sinensis* | 160 | 10 | 10 | 20 | | |
| 380 | Autumn maple | *Bischofia trifoliata* | 161 | 10 | 10 | 60 | | |
| 381 | Autumn maple | *Bischofia trifoliata* | 161 | 10 | 10 | 56 | | |
| 382 | Guava | *Psidium guajava* | 162 | 4 | 2 | 12 | | |
| 383 | Autumn maple | *Bischofia trifoliata* | 162 | 10 | 2 | 48 | | |
| 384 | Autumn maple | *Bischofia trifoliata* | 162 | 10 | 8 | 60 | | |
| 385 | Fishtail palm | *Caryota ochlandra* | 163 | 4 | 3 | 4 x 12 | | composite of 7 strands |
| 386 | Chinese hackberry | *Celtis sinensis* | 164 | 4 | 3.5 | 15 | | |
| 387 | No tree 387 | - - | - - | - - | - - | - - | | |
| 388 | Orange-jessamine | *Murraya paniculata* | 165 | 3.5 | 2 | 10 | | |
| 389 | Chinese juniper | *Juniperus chinensis* | 166 | 3 | 3 | 10 | | |
| 390 | Guava | *Psidium guajava* | 166 | 4 | 3 | 15 | | |
| 391 | Longan | *Euphoria longan* | 167 | 5 | 5 | 30 | | |
| 392 | Longan | *Euphoria longan* | 167 | 5 | 5 | 20+18 | | |
| 393 | Longan | *Euphoria longan* | 168 | 4 | 4 | 12 | | |
| 394 | Longan | *Euphoria longan* | 168 | 4 | 4 | 14 | | |
| 395 | Longan | *Euphoria longan* | 169 | 4 | 2 | 10 | | |
| 396 | Longan | *Euphoria longan* | 169 | 4 | 2 | 10 | | |
| 397 | Longan | *Euphoria longan* | 170 | 4 | 2 | 10 | | |
| 398 | Longan | *Euphoria longan* | 170 | 4 | 2 | 10 | | |
| 399 | Mango | *Mangifera indica* | 171 | 5 | 3.5 | 16 | | |

| Tree ID | Common Name | Scientific Name | Photo ID | Tree Height (m) | Crown Diameter (m) | DBH (cm) | Action (Retain / Fell / Transplant) | Remark |
|---|---|---|---|---|---|---|---|---|
| 400 | Longan | *Euphoria longan* | 172 | 3.5 | 2 | 14 | | |
| 401 | Elephant's ear | *Macaranga tanarius* | 173 | 3.5 | 4 | 28 | | |
| 402 | Longan | *Euphoria longan* | 174 | 3.5 | 3 | 20 | | |
| 403 | Mango | *Mangifera indica* | 175 | 3 | 2 | 12 | | |
| 404 | Longan | *Euphoria longan* | 176 | 2.5 | 2.5 | 11 | | |
| 405 | Longan | *Euphoria longan* | 177 | 2.5 | 2.5 | 11 | | |
| 406 | Longan | *Euphoria longan* | 178 | 2.5 | 2.5 | 9.5 | | |
| 407 | Chinese hackberry | *Celtis sinensis* | 179 | 10 | 5 | 45 | | |
| 408 | Chinese hackberry | *Celtis sinensis* | 178 | 10 | 10 | 45 | | |
| 409 | Elephant's ear | *Macaranga tanarius* | 180 | 3 | 5 | 18 | | |
| 410 | Elephant's ear | *Macaranga tanarius* | 181 | 3.5 | 4 | 10 | | |
| 411 | Elephant's ear | *Macaranga tanarius* | 181 | 3.5 | 4 | 10 | | |
| 412 | Elephant's ear | *Macaranga tanarius* | 181 | 3.5 | 4 | 12 | | |
| 413 | Longan | *Euphoria longan* | 182 | 2.5 | 2.5 | 11 | | |
| 414 | Longan | *Euphoria longan* | 182 | 2.5 | 2.5 | 10 | | |
| 415 | Longan | *Euphoria longan* | 183 | 3 | 2 | 18 | | |
| 416 | Longan | *Euphoria longan* | 183 | 4 | 4 | 30 | | |
| 417 | Longan | *Euphoria longan* | 183 | 3.5 | 6 | 15 | | |
| 418 | Elephant's ear | *Macaranga tanarius* | 184 | 4 | 5 | 20 | | trunk branched at low level |
| 419 | Banana | *Musa paradisiaca* | 185 | 2.5 | 2.5 | 4 x 12 | | composite of 6 strands |
| 420 | Banana | *Musa paradisiaca* | 185 | 2.5 | 2.5 | 2 x 12 | | composite of 3 strands |
| 421 | Longan | *Euphoria longan* | 186 | 3 | 1.5 | 10 | | one branch lopped |
| 422 | Longan | *Euphoria longan* | 186 | 3.5 | 5 | 15 | | |
| 423 | Rose-apple | *Syzygium jambos* | 187 | 12 | 6 | 30 | | |
| 424 | Rose-apple | *Syzygium jambos* | 187 | 12 | 12 | 60 | | |
| 425 | Mango | *Mangifera indica* | 188 | 4 | 1 | 12 | | |
| 426 | Jackfruit | *Artocarpus heterophyllus* | 188 | 4 | 2 | 15 | | |
| 427 | Mango | *Mangifera indica* | 188 | 4 | 2 | 20 | | |
| 428 | Jackfruit | *Artocarpus heterophyllus* | 188 | 4 | 2 | 18 | | |
| 429 | Longan | *Euphoria longan* | 189 | 4 | 2.5 | 15 | | |
| 430 | Guava | *Psidium guajava* | 189 | 4 | 2 | 15 | | |
| 431 | Guava | *Psidium guajava* | 189 | 4 | 2 | 15 | | |
| 432 | Guava | *Psidium guajava* | 190 | 4 | 3 | 15 | | |
| 433 | Longan | *Euphoria longan* | 190 | 3 | 5 | 10+10+12 | | trunk branched at low level |
| 434 | Mango | *Mangifera indica* | 190 | 5 | 3 | 20 | | |
| 435 | Rose-apple | *Syzygium jambos* | 190 | 2.5 | 1.5 | 33 | | heavily pruned |
| 436 | Rose-apple | *Syzygium jambos* | 190 | 10 | 8 | 35+30 | | trunk branched at low level |
| 437 | Longan | *Euphoria longan* | 191 | 3.5 | 4 | 15 | | |
| 438 | Mango | *Mangifera indica* | 192 | 3 | 2 | 10+8 | | trunk branched at low level |

| Tree ID | Common Name | Scientific Name | Photo ID | Tree Height (m) | Crown Diameter (m) | DBH (cm) | Action (Retain / Fell / Transplant) | Remark |
|---|---|---|---|---|---|---|---|---|
| 439 | Longan | *Euphoria longan* | 193 | 3.5 | 3 | 15 | | |
| 440 | Longan | *Euphoria longan* | 194 | 4 | 3 | 18 | | |
| 441 | Mango | *Mangifera indica* | 194 | 4 | 3 | 18 | | |
| 442 | Guava | *Psidium guajava* | 194 | 4 | 3 | 12 | | |
| 443 | White orchid tree * | *Michelia alba* | 195 | 6 | 4 | 18 | | |
| 444 | Longan | *Euphoria longan* | 195 | 3.5 | 3 | 11 | | |
| 445 | Longan | *Euphoria longan* | 195 | 3.5 | 3 | 11 | | |
| 446 | Longan | *Euphoria longan* | 196 | 4 | 3 | 15 | | |
| 447 | Longan | *Euphoria longan* | 196 | 4 | 3 | 15 | | |
| 448 | Longan | *Euphoria longan* | 196 | 4 | 3 | 18 | | |
| 449 | Longan | *Euphoria longan* | 197 | 4 | 3 | 13 | | |
| 450 | Longan | *Euphoria longan* | 197 | 5 | 4 | 15 | | |
| 451 | Rose-apple | *Syzygium jambos* | 197 | 5 | 4 | 18+15 | | |
| 452 | Longan | *Euphoria longan* | 197 | 6 | 4 | 14 | | |
| 453 | Rose-apple | *Syzygium jambos* | 197 | 6 | 6 | 40 | | |
| 454 | Rose-apple | *Syzygium jambos* | 198 | 2.5 | 2.5 | 11 | | |
| 455 | Longan | *Euphoria longan* | 198 | 2 | 2.5 | 10 | | |
| 456 | Elephant's ear | *Macaranga tanarius* | 199 | 5 | 3 | 20 | | |
| 457 | Mango | *Mangifera indica* | 199 | 7 | 4 | 18 | | |
| 458 | Longan | *Euphoria longan* | 199 | 3 | 3 | 12+8 | | |
| 459 | Elephant's ear | *Macaranga tanarius* | 199 | 3 | 3 | 8+5 | | |
| 460 | Papaya | *Carica papaya* | 200 | 2.5 | 1 | 10 | | |
| 461 | Longan | *Euphoria longan* | 200 | 4 | 4 | 12 | | |
| 462 | Longan | *Euphoria longan* | 200 | 4.5 | 4 | 16 | | |
| 463 | Chinese banyan | *Ficus microcarpa* | 201 | 4.5 | 3 | 25 | | |
| 464 | Guava | *Psidium guajava* | 202 | 4 | 3 | 15 | | |
| 465 | Longan | *Euphoria longan* | 202 | 3 | 2 | 10 | | |
| 466 | Mango | *Mangifera indica* | 202 | 5 | 3 | 16 | | |
| 467 | Guava | *Psidium guajava* | 202 | 4 | 3 | 15 | | |
| 468 | Longan | *Euphoria longan* | 202 | 3 | 3 | 10 | | |
| 469 | Longan | *Euphoria longan* | 203 | 3 | 3 | 15 | | |
| 470 | Longan | *Euphoria longan* | 204 | 3 | 2 | 10 | | |
| 471 | Longan | *Euphoria longan* | 204 | 3 | 2 | 10 | | |
| 472 | Banana | *Musa paradisiaca* | 205 | 2.5 | 3 x 2.5 | 9 x 10 | | composite of 16 strands |
| 473 | Banana | *Musa paradisiaca* | 206 | 2.5 | 2.5 | 3 x 10 | | composite of 3 strands |
| 474 | Banana | *Musa paradisiaca* | 206 | 2.5 | 2.5 | 2 x 10 | | composite of 3 strands |
| 475 | Elephant's ear | *Macaranga tanarius* | 207 | 5 | 6 | 20 | | |
| 476 | Longan | *Euphoria longan* | 207 | 4 | 4 | 18 | | |
| 477 | Longan | *Euphoria longan* | 208 | 3 | 3 | 10 | | |

| Tree ID | Common Name | Scientific Name | Photo ID | Tree Height (m) | Crown Diameter (m) | DBH (cm) | Action (Retain / Fell / Transplant) | Remark |
|---|---|---|---|---|---|---|---|---|
| 478 | Guava | *Psidium guajava* | 209 | 5 | 5 | 25 | | |
| 479 | Cotton tree | *Bombax malabaricum* | n/a | 10 | 8 | 30 | | |
| 480 | Chinese hackberry | *Celtis sinensis* | 210 | 10 | 6 | 30 | | covered by climbers |
| 481 | Chinese hackberry | *Celtis sinensis* | 210 | 8 | 6 | 30 | | |
| 482 | Chinese hackberry | *Celtis sinensis* | 210 | 8 | 6 | 25 | | |
| 483 | Longan | *Euphoria longan* | 211 | 4 | 3 | 10+10 | | trunk branched at low level |
| 484 | Chinese hackberry | *Celtis sinensis* | 211 | 6 | 5 | 18 | | |
| 485 | Coconut palm | *Cocos nucifera* | 212 | 6.5 | 6 | 25 | | |
| 486 | Mango | *Mangifera indica* | 212 | 4 | 4 | 10 | | |
| 487 | Longan | *Euphoria longan* | 212 | 3.5 | 3 | 12 | | |
| 488 | Tallow tree | *Sapium sebiferum* | 213 | 8 | 6 | 20 | | |
| 489 | Pop-gun seed | *Bridelia monoica* | 214 | 3 | 4 | 10 | | |
| 490 | Banana | *Musa paradisiaca* | 215 | 2.5 | 2 x 30 | 15 x 10 | | composite of 26 strands |
| 491 | White Bauhina | *Bauhinia variegata* | 163 | 4 | 2 | 15 | | |
| 492 | Chinese banyan | *Ficus microcarpa* | 216 | 3 | 3.5 | 18 | | |
| 493 | Queen crape-myrtle | *Lagerstroemia speciosa* | 217 | 4 | 3 | 18 | | |
| 494 | White orchid tree * | *Michelia alba* | 218 | 6 | 2 | 12 | | |
| 495 | White orchid tree * | *Michelia alba* | 218 | 5 | 2 | 12 | | |
| 496 | White orchid tree * | *Michelia alba* | 218 | 6 | 2 | 12 | | |
| 497 | Weeping fig | *Ficus benjamina* | 218 | 6.5 | 2 | 30 | | |
| 498 | White orchid tree * | *Michelia alba* | 219 | 5 | 2 | 10+12 | | |
| 499 | Pop-gun seed | *Bridelia monoica* | 219 | 5 | 2 | 15+8 | | |
| 500 | Chinese hackberry | *Celtis sinensis* | 219 | 5.5 | 4 | 18 | | |
| 501 | Chinese hackberry | *Celtis sinensis* | 220 | 4.5 | 2.5 | 15 | | |
| 502 | Chinese banyan | *Ficus microcarpa* | 221 | 4 | 2 | 8+9+10 | | |
| 503 | Queen crape-myrtle | *Lagerstroemia speciosa* | 221 | 4 | 2 | 11 | | |
| 504 | Guava | *Psidium guajava* | 221 | 3 | 2 | 12 | | |
| 505 | Paper-bark tree | *Melaleuca leucadendron* | 222 | 6 | 2.5 | 2x10 +15+ 3x18 + 20 | | composite of 7 strands |
| 506 | Longan | *Euphoria longan* | 223 | 7 | 4 | 15 | | |
| 507 | Chinese hackberry | *Celtis sinensis* | 223 | 7 | 4 | 15 | | |
| 508 | Longan | *Euphoria longan* | 223 | 7 | 4 | 15 | | |
| 509 | Chinese hackberry | *Celtis sinensis* | 224 | 7 | 4 | 18 | | |
| 510 | Candlenut tree | *Aleurites moluccana* | 224 | 8 | 2 | 13 | | |
| 511 | Candlenut tree | *Aleurites moluccana* | 224 | 8 | 2 | 15 | | |
| 512 | Mango | *Mangifera indica* | 224 | 8 | 4 | 35 | | |
| 513 | Longan | *Euphoria longan* | 225 | 4 | 3 | 13 | | |
| 514 | Weeping fig | *Ficus benjamina* | 225 | 9 | 5 | 15+15 | | trunk branched at low level |
| 515 | Weeping fig | *Ficus benjamina* | 225 | 9 | 5 | 35 | | trunk branched at low level |
| 516 | Lychee | *Litchi chinensis* | 226 | 6 | 6 | 35 | | |

| Tree ID | Common Name | *Scientific Name* | Photo ID | Tree Height (m) | Crown Diameter (m) | DBH (cm) | Action (Retain / Fell / Transplant) | Remark |
|---|---|---|---|---|---|---|---|---|
| 517 | Red-stem fig | *Ficus variegata* | 227 | 6 | 2.5 | 20 | | |
| 518 | Rose-apple | *Syzygium jambos* | 227 | 4 | 2.5 | 15+8 | | |
| 519 | White Bauhina | *Bauhinia variegata* | 227 | 4 | 2.5 | 11 | | one branch lopped |
| 520 | Lychee | *Litchi chinensis* | 228 | 5 | 5 | 35 | | |
| 521 | Jackfruit | *Artocarpus heterophyllus* | 228 | 3 | 2 | 12 | | |
| 522 | Weeping fig | *Ficus benjamina* | 228 | 6 | 2 | 12 | | |
| 523 | Longan | *Euphoria longan* | 229,230 | 5 | 6 | 15+18+15 | | trunk branched at low level |
| 524 | Weeping fig | *Ficus benjamina* | 230 | 7 | 2 | 18 | | |
| 525 | Longan | *Euphoria longan* | 231 | 5 | 3 | 10 | | |
| 526 | Longan | *Euphoria longan* | 231 | 5 | 2.5 | 18 | | wilted |
| 527 | Elephant's ear | *Macaranga tanarius* | 232 | 4 | 3 | 15 | | |
| 528 | Elephant's ear | *Macaranga tanarius* | 232 | 4 | 3 | 10 | | |
| 529 | Weeping fig | *Ficus benjamina* | 233 | 6 | 3 | 12 | | |
| 530 | Longan | *Euphoria longan* | 234 | 7 | 6 | 20 | | |
| 531 | Longan | *Euphoria longan* | 235 | 7 | 5 | 15+20+15 | | trunk branched at low level |
| 532 | Longan | *Euphoria longan* | 235 | 7 | 5 | 45 | | trunk branched at low level |
| 533 | Swamp mahogany | *Eucalyptus robusta* | 236 | 7 | 4.5 | 20+16 | | trunk branched at low level |
| 534 | Longan | *Euphoria longan* | 237 | 7 | 8 | 20+18+16 | | |
| 535 | Longan | *Euphoria longan* | 238 | 7 | 8 | 20+18 | | |
| 536 | Elephant's ear | *Macaranga tanarius* | 237 | 6 | 5 | 16 | | |
| 537 | Chinese banyan | *Ficus microcarpa* | 237 | 7 | 10 | 25+25 | | trunk branched at low level |
| 538 | Mango | *Mangifera indica* | 239 | 4 | 2 | 10 | | |
| 539 | Jackfruit | *Artocarpus heterophyllus* | 239 | 6 | 2 | 10+11 | | trunk branched at low level |
| 540 | Jackfruit | *Artocarpus heterophyllus* | 239 | 6 | 4 | 13+12+10 | | |
| 541 | China-berry | *Melia azedarach* | 240 | 2.5 | 2.5 | 10 | | |
| 542 | Rose-apple | *Syzygium jambos* | 241 | 2.5 | 2.5 | 10+10 | | |
| 543 | Rose-apple | *Syzygium jambos* | 241 | 2.5 | 2.5 | 12+10 | | |
| 544 | Rose-apple | *Syzygium jambos* | 241 | 2.5 | 2.5 | 10+10 | | |
| 545 | China-berry | *Melia azedarach* | 242 | 5 | 3 | 12+10 | | |
| 546 | China-berry | *Melia azedarach* | 242 | 5 | 3 | 15+10 | | |
| 547 | Pomelo | *Citrus grandis* | 243 | 4 | 1.5 | 12 | | |
| 548 | Jackfruit | *Artocarpus heterophyllus* | 244 | 6 | 2.5 | 12 | | |
| 549 | Rose-apple | *Syzygium jambos* | 244 | 5 | 3 | 15 | | |
| 550 | Rose-apple | *Syzygium jambos* | 245 | 5 | 3.5 | 20 | | |
| 551 | Elephant's ear | *Macaranga tanarius* | 246 | 4.5 | 3.5 | 16+13+16 | | |
| 552 | Sea mango | *Cerbera manghas* | 247 | 4 | 5 | 20 | | |
| 553 | Acacia | *Acacia confusa* | 248 | 4.5 | 3.5 | 15+15 | | |
| 554 | Sea mango | *Cerbera manghas* | 249 | 4 | 3.5 | 12+12 | | |
| 555 | Rose-apple | *Syzygium jambos* | 249 | 4 | 3.5 | 15 | | |

| Tree ID | Common Name | *Scientific Name* | Photo ID | Tree Height (m) | Crown Diameter (m) | DBH (cm) | Action (Retain / Fell / Transplant) | Remark |
|---|---|---|---|---|---|---|---|---|
| 556 | Rose-apple | *Syzygium jambos* | 250 | 4 | 3.5 | 15 | | |
| 557 | Rose-apple | *Syzygium jambos* | 250 | 4 | 3.5 | 15 | | |

* Protected by Forestry Regulation if the land is un-leased Government Land

$ Rooted in un-leased Government Land and is Protected by Forestry Regulation

Photo for tree 195 and 479 were not available due to technical failure.

# APPENDIX E

# CONSTRUCTION NOISE ASSESSMENT

## APPENDIX E - CONSTRUCTION NOISE ASSESSMENT

### E1. Noise Assessment Criteria

E1.1 The noise assessment criteria used for assessing construction noise impact are given in Table E1.1.

**Table E1.1**
**Construction Noise Assessment Criteria**

| | | |
|---|---|---|
| 0700-1900 hrs on normal weekdays | 75* dB(A), EPD's ProPECC PN2/93 | |
| 0700-2300 hrs on holidays; and 1900-2300 hrs on all other days | 60/65/70**(1) dB(A) | 45/50/55**(2) dB(A) |
| 2300-0700 hrs of next day | 45/50/55**(1) dB(A) | 30/35/40**(2) dB(A) |

* applies to dwellings; reduce to 70 dB(A) for schools and 65 dB(A) during school examination periods.
** to be selected based on Area Sensitivity Rating.
(1) TM on Noise from Construction Work Other Than Percussive Piling.
(2) TM on Noise from Construction Work in Designated Area.

Although a daytime construction noise criteria for hospital is not stated in PN 2/93, it is suggested that the noise impact arising from the construction of the project on Pok Oi Hospital should be kept to a minimum as far as practical.

E1.2 At present evening and night time works (1900-0700) are not expected. However, should works within these hours be required, a Construction Noise Permit (CNP) must be obtained from the relevant Noise Control Authority before works are allowed to take place. Piling works are subject to licensing under the Noise Control Ordinance.

### E2. Construction Noise Assessment Methodology

E2.1 The calculation of the noise levels at the RNSR due to construction activities is based on the methodology stipulated in the TM.

E2.2 Based on the TM, the Notional Noise Source (NNS) positions have been located at the mid points between the geometric centre of the site and the site boundary along the line between the facade of the RNSR and the site's geometric centre.

E2.3 If the construction site is linear in shape (that is, long, thin and substantially uniform in width, but not necessary straight) with a length to width ratio exceeding 5:1, only the dominant portion of the site shall be considered for the purpose of determining the notional source position.

E2.4 However, if the NNSs are located at more than 50 metres away from the site boundary, the NNSs are positioned at a point 50 metres away from the site boundary rather than the midpoints.

E2.5 All the equipment in the equipment list apart from the dump truck traffic on the haul road have been assumed to be placed at the NNSs. The haul road traffic noise levels have been assessed separately, and added to the predicted noise levels to give the total predicted noise levels at each RNSR.

## E3. Haul Road Traffic Calculation

E3.1 The estimated amount of materials to be moved along haul roads within the site and the number of vehicle movements per hour during transporting of fill is tabulated below in Table E1.2

**Table E1.2**
**Haul Road Traffic Volume**

| Estimated Volume of Materials ($m^3$) | Construction Period (months) | No. of Vehicle Round Trips per Hour (veh/hr) |
|---|---|---|
| 500,000 | 30 | 22 |

E3.2 The likely location of the haul road is shown in Figure 8.1.

E3.3 The calculations assume that the works proceed for 8 hours per day and 24 days per month. Each dump truck was taken to have a capacity of 8 $m^3$ and travelling at a speed of 15 km/hr.

E3.4 It has been assumed that a dump truck travelling along a fixed route (and is not dumping) has a SWL of 113 dB. This figure was derived by logarithmically averaging the SWL of 35 ton dump trucks in Table 12 of BS5228.

E3.5 The calculation of haul road traffic was based on the method given in BS5228. The general expression for predicting the $L_{Aeq}$ alongside a haul road used by mobile sources is:

$$L_{Aeq}\ (dB(A)) = L_{WA} - 33 + 10\ log_{10}Q - 10\ log_{10}V - 10\ log_{10}d$$

where:

$L_{WA}$ is the sound power level of the plant;
Q is the number of vehicles per hour;
V is the average vehicle speed in kilometres per hour (assume 15 km/hr);
d is the distance of receiving position from the centre of haul road in metres.

E3.6 The noise levels generated by the haul road traffic at RNSRS are tabulated below in Table E1.3.

**Table E1.3**
**Haul Road Traffic Noise Calculation**

| RNSR | No. of Vehicle per Hour | Distance (m) | $L_{Aeq}$ (dB(A)) |
|---|---|---|---|
| 1 | 22 | 30 | 69.9 |
| 2 | 22 | 30 | 69.9 |
| 3 | 22 | 36 | 69.1 |
| 4 | 22 | 45 | 68.1 |
| 5 | 22 | 5 | 77.7 |
| 6 | 22 | 100 | 64.7 |
| 7 | 22 | 40 | 68.6 |
| 8 | 22 | 110 | 64.2 |
| 9 | 22 | 106 | 64.4 |
| 10 | 22 | 65 | 66.5 |
| 11 | 22 | 195 | 61.8 |

Notes:
(1) Assume travelling speed of 15 km/hr.
(2) Assume dump truck SWL of 113 dB.
(3) 3 dB(A) facade correction is included in the LAeq.

## E4. Construction Noise Calculation

E4.1 The construction noise level calculations follow the procedures described in the TMs.

*Summation of Noise Levels*

E4.2 Summation of noise levels has been calculated based on the following formula:

$$Total\ SWL\ (dB(A)) = 10\ log_{10}\ \Sigma\ Ni\ 10^{(SWLi/10)}$$

where:
SWL is the sound power level;
SWLi is the SWL of a particular type of powered mechanical equipment (PME);
Ni is the number of that type of PME.

*Distance Attenuation*

E4.3 The predicted noise level at the NSR due to distance attenuation has been calculated as follows:

*for general construction noise:*
$$PNL\ at\ the\ NSR\ (dB(A)) = Total\ SWL - 20\ log_{10}\ D - 8$$

where:
PNL is the predicted noise level;
D is the distance between the NSR and the noise source in metres.

*Correction for Acoustic Reflection*

E4.4 A positive correction of 3 dB(A) is added to the PNL for acoustic reflections from the facade of the NSRs if it is a building.

*Barrier Correction*

E4.5 During the construction phase, there are no natural or man-made barriers between the noise sources and receivers hence no barrier correction was considered.

E4.6 Details of the construction noise assessment are tabulated below in Tables E1.4 - E1.9.

# APPENDIX F

# DETAILS OF AIR QUALITY ASSESSMENT

## APPENDIX F1 - BACKGROUND AIR QUALITY MONITORING

### Introduction

F1.1 This Appendix presents the monthly averages of the various required pollutants obtained at EPD's Yuen Long monitoring station. The monthly averages are used as the annual averages.

F1.2 Concentrations of sulphur dioxide ($SO_2$), nitrogen oxides (including nitric oxide (NO), nitrogen dioxide ($NO_2$)), and total and respirable suspended particulate (TSP and RSP respectively) were monitored at rooftop level of the Yuen Long Police Station at Yuen Long Town Centre.

**Yuen Long Monitoring Station**
**Monthly Average (unit: $\mu g/m^3$)**

| | TSP | RSP | $SO_2$ | $NO_2$ |
|---|---|---|---|---|
| May-95 | 68 | 42 | ** | 15 |
| Jun-95 | 62 | 30 | ** | 13 |
| Jul-95 | 43 | 12 | ** | 19 |
| Aug-95 | 54 | 31 | 16 | 29 |
| Sep-95 | 95 | 55 | 11 | 38 |
| Oct-95 | 93 | 50 | 8 | 33 |
| Nov-95 | 214 | 125 | 10 | 39 |
| Dec-95 | 200 | 116 | 26 | 72 |
| Jan-96 | 192 | 101 | 28 | 72 |
| Feb-96 | 96 | 54 | 17 | 53 |
| Mar-96 | 110 | 79 | 16 | 53 |
| Apr-96 | 85 | 52 | 12 | 42 |
| Arithmetic Mean | 109 | 62 | 16 | 38 |

** Data not yet available.

## APPENDIX F2 - THE DETAILED CALCULATIONS OF EMISSION RATES FOR EACH DUST SOURCE

### Loading and Unloading

F2.1 The dust sources associated with the loading and unloading at the excavation sites have been considered as area sources. The quantity of particulate emissions generated by a batch drop or continuous drop operation, per ton of material transferred, may be estimated with an emission factor rating of C using the following empirical expression (USEPA 1995; p.13.2.4-4):

$$E = k(0.0016)\frac{(\frac{U}{2.2})^{1.3}}{(\frac{M}{2})^{1.4}}(kg/Mg) \ldots .(F2.1)$$

where:

| | | |
|---|---|---|
| E | = | emission factor |
| k | = | particle size multiplier (dimensionless) |
| U | = | mean wind speed, m/s, (mph) |
| M | = | material moisture content (%) |

F2.2 Equation (F2.1) can be rewritten as following:

$$E' = Q_o U'^{w} \ldots\ldots\ldots (F2.2)$$

where $Q_o$ is the "unadjusted" emission factor which does not consider the change of hourly wind speed and direction, $U'$ is hourly wind speed and w is the wind dependent factor. E is the mean value of E's. It is noted that equation (F2.2) is a general equation for all emission factors. In equation F2.1, the power of U is 1.3, i.e. w is 1.3.

F2.3 Using equation (F2.1) and (F2.2), the emission factors for TSP and RSP can be estimated by the required data listed in Table F2.1.

**Table 2.1**
**Physical Data for Evaluating the Impact of Loading and Unloading**

| Parameters of Equation (1) | TSP | RSP |
|---|---|---|
| Particle Size Multiplier (k) | 0.74 (USEPA 1995: page 13.2.4-4) | 0.35 (USEPA 1995: page 13.2.4-4) |
| Material Moisture Content (M) | 15% (USEPA 1995: page 13.2.4-4) | 15% (USEPA 1995: page 13.2.4-4) |

F2.4 By the use of equation (F2.1), the "unadjusted" emission factor for TSP becomes:

$$Q_o = 0.74(0.0016)\frac{(\frac{1}{2.2})^{1.3}}{(\frac{15}{2})^{1.4}}(kg/Mg)....(F2.3)$$

= 2.53E-05 kg/T

F2.5 The "unadjusted" emission factor for RSP becomes:

$$Q_o = 0.35(0.0016)\frac{(\frac{1}{2.2})^{1.3}}{(\frac{15}{2})^{1.4}}(kg/Mg)....(F2.4)$$

= 1.20E-05 kg/T

The wind dependent factor, w, in this case, is 1.3.

F2.6 Assuming a density of $1.987 \times 10^3$ kg/m$^3$ and 9 hour working day, 24 days a month and for 720 days total, the material to be shifted per hour is 172 T/hr, i.e.,

$$\frac{500000m^3 x 1.987 x 10^3 kg/m^3}{720x8hr} = 172482.6(kg/hr)....(F2.5)$$

F2.7 The unadjusted emission rate for TSP is 0.012 g/sec,

$$\frac{2.53x10^{-5}kg/Tx172T/hr}{3.6} = 0.012(g/\text{sec})....(F2.6)$$

where 3.6 is the conversion factor for the change of kg/hr to g/sec. The unadjusted emission rate for RSP is 0.00057 g/sec.

$$\frac{1.20x10^{-5}kg/Tx172T/hr}{3.6} = 0.00057(g/\text{sec})....(F2.7)$$

F2.8 An area of 268,600 $m^2$ has been used as the loading area for YLBF. Consequently, the unadjusted emission rate per unit area can be calculated from equation (F2.6) and (F2.7) and then substituted into equation (F2.2). The emission rates become:

TSP: = 4.51 x $10^{-9}$ g/s/$m^2$,
RSP: = 2.13 x $10^{-9}$ g/s/$m^2$.

**Unpaved roads and haul routes**

F2.9 The top soil and other fill materials at the excavation site will be transported by dump trucks that will cause dust emission when they travel over unpaved roads and haul routes. The emission factor to be used is from AP-42 (USEPA 1995; equation 1, p 13.2.2-1) with emission factor rating A:

$$E = k(1.7)(\frac{s}{12})(\frac{S}{48})(\frac{W}{2.7})^{0.7}(\frac{w}{4})^{0.5}(\frac{365-p}{365})(kg/VKT)..(F2.8)$$

where

| | | |
|---|---|---|
| E | = | emission factor |
| k | = | particle size multiplier (dimensionless) |
| s | = | silt content of road surface material (%) |
| S | = | mean vehicle speed, km/hr |
| W | = | mean vehicle weight, Mg(ton) |
| w | = | mean number of wheels |
| p | = | number of days with at least 0.254 mm of precipitation per year. |
| VKT | = | vehicle kilometre travelled |

F2.10 The data for estimating the emission rates of unpaved road and haul routes due to site formation are summarized in Table F2.2

**Table F2.2**
**Physical Data for Evaluating the Impact of Unpaved Roads and Haul Roads**

| Parameters | TSP | RSP |
|---|---|---|
| Particle size Multiplier (k) | 0.8 | 0.36 |
| Maximum Silt Content of Road Surface Material(s) | 6%* | 6%* |
| Mean Vehicle Speed (S) km/hr | 15 | 15 |
| Mean Vehicle Weight (W) tonnes | 35 | 35 |
| Mean Number of Wheels (w) (Nissan Motor Co. and Caterpiller Inc. USA) | 10 | 10 |
| Number of Rainy Days per Year (Royal Observatory) | 100 days | 100 days |

* Based on Tin Shui Wai Land Formation Material Testing Data

F2.11 The locations of the haul roads have been based on the engineering study. For example, in YLBF, there is a surplus volume of about 500,000 $m^3$.

F2.12 The calculation of the emission rates due to haul road are described below. The calculations assumed the works to proceed 9 hours per day and 24 days per month. The dump truck was taken to have a capacity of 8 $m^3$ with a travelling speed of 15 km/hr. The distance that the dump trucks travel on haul road in YLBF coincide with the length of the haul road: roughly 3.8 km for a single trip. The round trip distances have been simulated by modelling as the line sources twice in the FDM run. The dust source due to dump truck traffic on haul roads is identified as a line source.

F2.13 VKT can be expressed as total vehicle movement per hour. Construction vehicle movement per hour has been calculated by dividing the total material to be moved by 8.0 $m^3$ dump truck. This is the average load carried by the dump trucks planned for the site. The number of vehicle roundtrips per hr is roughly 10 veh/hr.

F2.14 The wind dependent factor, in this case, is zero. So the emission factor becomes:

$$E = 0.8(1.7)\left(\frac{6}{12}\right)\left(\frac{15}{48}\right)\left(\frac{35}{2.7}\right)^{0.7}\left(\frac{10}{4}\right)^{0.5}\left(\frac{365-100}{365}\right)(kg/VKT)..(F2.9)$$

i.e. E = 1.47 kg/VKT.

F2.15 With 10 Veh/hr and kg/VKT in terms of g/m/s, using a conversion factor of

$$\left(\frac{vehicle/hour}{3.6x1000}\right),$$

the emission rate for TSP on YLBF becomes:

$$\left(\frac{1.47}{3.6x1000}\right)x22 = 0.00896 g/m/s....(F2.10)$$

For RSP, the emission rate is $4.03 \times 10^{-3}$ g/m/s. The detailed emission rates for all haul roads are listed at Appendix B3 for easy reference.

**Stockpile/Aggregate Storage**

F2.16 For emissions from wind erosion of active storage piles, the emission rate for TSP is from AP-42 (USEPA 1985, equation 3, p 2.3-5) with rating C for sand and gravel material:

$$E = 1.9\left(\frac{s}{1.5}\right)\left(\frac{f}{15}\right)\left(\frac{365-p}{235}\right)(kg/day/hectare)...(F2.13)$$

where:

E = emission rate
s = silt content of aggregate (%)
f = percent of time that wind speed exceeds 5.4 m/s at mean pile height
p = number of days with at least 0.254 mm of precipitation per year.

F2.17 The parameter f requires some modification. Royal Observatory (RO) measures the wind speed at a height of 10 metres above ground level. In case of heights less than 10 metres, a log wind profile (Roland 1988) can be used to estimate the wind speed at the top of the pile: pile height (Appendix F2.1). The ratio between the wind speed at 10 metres and that at pile height is the conversion factor that converts the percentage provided by RO to the percentage at pile height. For example, with a pile height of 5 m, the conversion factor is 83%. Given that the RO percentage is 11.44% when wind speed exceeds 5.4 m/s at mean pile height, the percentage at pile height is thus 11.44% x 0.83 = 7.0%.

F2.18 With this 7.0% percentage and a 6.0% silt content for the stockpile material, and based on Table 11.2.3-1 in AP-42 (mean value for stone processing), the emission rate is 3.99 kg/day/hectare,

$$E-1.9(\frac{6}{1.5})(\frac{7}{15})(\frac{365-100}{235})-3.99(kg/day/hectare)...(F2.14)$$

Given 1 hectare = $10^4$ $m^2$, the emission rate is for TSP = 4.63 x $10^{-6}$ g/s/$m^2$

F2.19 Since there is no specified emission rate for RSP given in AP-42, 50% TSP is assumed as the emission for RSP. Thus, the emission rate is for RSP = 2.31 x $10^{-6}$ g/s/$m^2$.

**Top Soil removal**

F2.20 The emission factor for top soil removal is 0.02 kg/Mg (USEPA 1985, Table 11.24-4). For example, the surface area of YLFB is about 268,600 $m^2$. Assuming the depth of top soil to be 0.2 m, the volume of top soil is 53,720 $m^3$. Assuming the relative density of top soil is 1.987 x $10^3$ kg/$m^3$, then the mass of the soil removed is given by

$$Mass(T)-(\frac{53720x1987}{1000})-106741.6(T)...(F2.15)$$

F2.21 The total volume of materials handled in YLBF is roughly 500,000 $m^3$ while there is only 53,720 $m^3$ top soil material. As the time required for the initial site formation works will be expected to last for 30 months. Thus, the time required is 720 days. So the rate of removal is

$$(\frac{106741.1}{720X8})-18.5(T/hr)....(F2.16)$$

F2.22 The TSP emission rate is 0.02 kg/T X 18.5 T/hr = 0.37 kg/hr (8g/s).

F2.23 The emission rates per unit area at site are:

TSP : 3.83 x $10^{-7}$ g/s/$m^2$
RSP : 1.92 x $10^{-7}$ g/s/$m^2$

**Wind erosion of the whole exposed area**

F2.24 The TSP emission factor of wind erosion of exposed areas (USEPA 1985, Table 24-4) is 0.85 Mg/hectare/yr. Given 1 hectare = $10^4$ $m^2$, the emission rate for TSP becomes

$$\frac{0.85 \times 1000}{10^4 \times 365 \times 24 \times 3.6} = 2.69E - 6 \ g/s/m^2 \ .... \ (F2.17)$$

F2.25 Since the emission rate of RSP is not available in AP-42, 50% of TSP is assumed to be the emission rate of RSP. Thus the emission rate of wind erosion of the whole exposed area is

for TSP = 2.70 x $10^{-6}$ g/s/$m^2$
for RSP = 1.35 x $10^{-6}$ g/s/$m^2$

## Appendix F2.1: Log Wind Profile

F2.1.1 To estimate the mean wind speed as a function of height z, we use a logarithmic relationship (log wind profile) as following:

$$U = \frac{U^*}{k} \; In \; \frac{z}{z_o} \quad \text{.........} \; (F2.1.1)$$

where

$U^*$= friction velocity,
k = von Karman constant, 0.4 (dimensionless),
$z_o$= roughness length (10 cm).

F2.1.2 The friction velocity can be recalculated from equation (F2.1.1) by substituting U = 5.4 m/s, z = 10 m in equation (F2.1.1). The friction velocity is thus 0.46 m/s.

F2.1.3 For example, if the pile height is 5 metre, then the mean velocity is thus 4.49 m/s. Hence, the conversion factor is (4.49/5.4) x 100% = 83%. This conversion factor will be used to convert the percentage provided by Royal Observatory to the value (f) used in pile height.

## APPENDIX F3 - EMISSION RATES FOR DUST SOURCES

### Yuen Long Bypass Floodway (Site Formation)

#### Loading & Unloading

| | TSP | RSP |
|---|---|---|
| Particle size multiplier, k | 0.74 | 0.35 |
| Mean wind speed (m/s), U | 1 | 1 |
| Material moisture content (%), M | 15 | 15 |
| Unadjusted emission rate (kg/T), Qo | 2.53E-05 | 1.20E-05 |
| Volumen of material ($m^3$) | 500000 | 500000 |
| Density of material ($kg/m^3$) | 1987 | 1987 |
| Days of work | 720 | 720 |
| Working hours | 8 | 8 |
| Unadjusted emission rate (g/s) | 0.0012 | 0.00057 |
| Surface area ($m^2$) | 268600 | 268600 |
| Unadjusted emission rate ($g/s/m^2$) | 4.51E-09 | 2.13E-09 |

#### Unpaved Road and Haul Routes (2 way)

| | TSP | RSP |
|---|---|---|
| Particle size multiplier, k | 0.8 | 0.36 |
| Silt content of road surface material (%), s | 6 | 6 |
| Mean vehicle speed (km/hr), S | 15 | 15 |
| Mean vehicle weight (T), W | 35 | 35 |
| Mean number of wheels, w | 10 | 10 |
| Number of days with at least 0.254 mm rainfall per year, p | 100 | 100 |
| Number of vehicle roundtrips per hr | 22 | 22 |
| E (kg/VKT) | 1.46613832 | 0.65976224 |
| E (g/s/m) | 8.96E-03 | 4.03E-03 |

## Stock Piling

| | |
|---|---|
| Silt content of aggregate (%), s | 6 |
| % of time with wind speed > 5.4 m/s at mean pile height | 7 |
| Number of days with at least 0.254 mm rainfall per year, p | 100 |
| E (kg/day/hectare) | 3.99943262 |
| E ($g/s/m^2$) for TSP | 4.63E-06 |
| E ($g/s/m^2$) for RSP | 2.31E-06 |

## Top Soil Removal

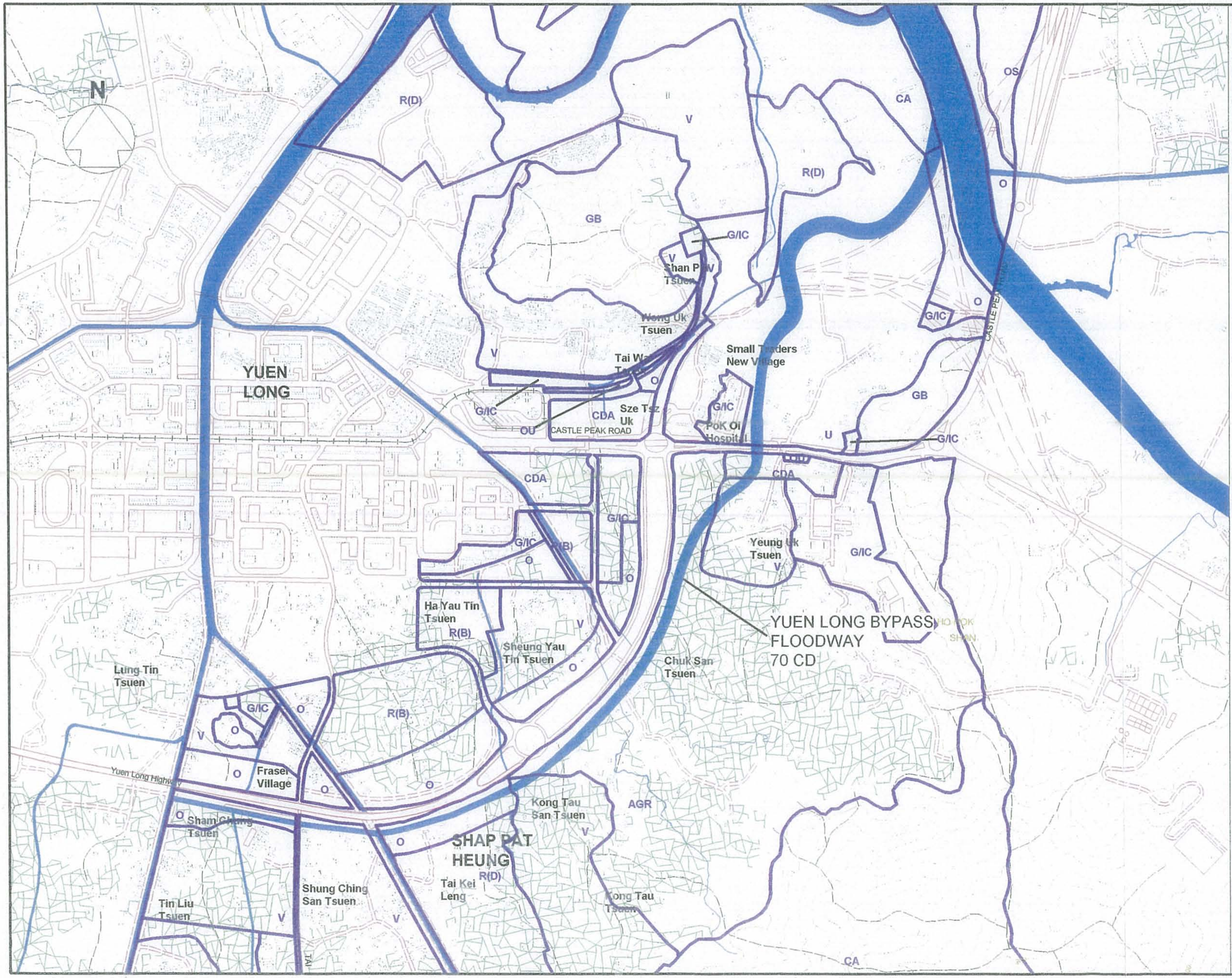
| | |
|---|---|
| Depth of top soil (m) | 0.2 |
| surface area ($m^2$) | 268600 |
| Density of material ($kg/m^3$) | 1987 |
| Mass of material (T) | 106741.64 |
| Days of work | 720 |
| Working hours | 8 |
| Rate of removal (T/hr) | 18.5 |
| E (g/s) for TSP | 0.10 |
| E (g/s) for RSP | 0.05147649 |
| E ($g/s/m^2$) for TSP | 3.83E-07 |
| E ($g/s/m^2$) for RSP | 1.92E-07 |

## Wind Erosion

| | |
|---|---|
| E ($g/s/m^2$) for TSP | 2.70E-06 |
| E ($g/s/m^2$) for RSP | 1.35E-06 |

# APPENDIX G

# LANDSCAPING PROPOSALS






**Legend :**

Existing and Future Watercourses

| | |
|---|---|
| AGR | Agriculture |
| CA | Conservation Area |
| CDA | Comprehensive Development Area |
| CP | Country Park |
| GB | Green Belt |
| G/IC | Government/Institution |
| I | Industrial |
| O | Open Space |
| OS | Open Storage |
| OU | Other Specified Uses |
| R(A) | Residential (Group A) |
| R(B) | Residential (Group B) |
| R(C) | Residential (Group C) |
| R(D) | Residential (Group D) |
| REC | Recreation |
| U | Undetermined |
| V | Village |

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SITE LOCATION AND OZP IN SURROUNDING AREA

| figure no. | scale |
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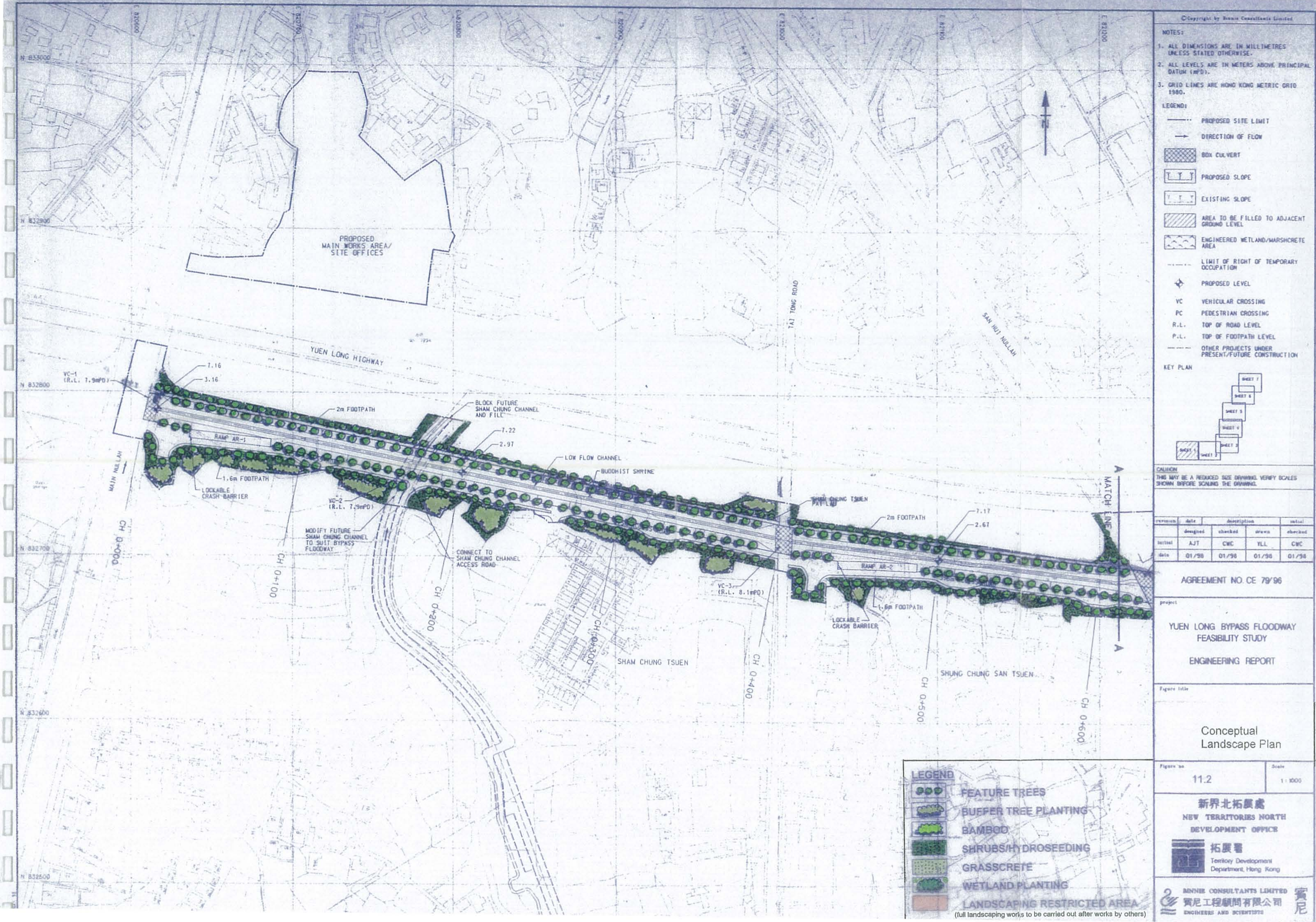

PROPOSED MAIN WORKS AREA/ SITE OFFICES
YUEN LONG HIGHWAY
TAI TONG ROAD
SAN HUI NULLAH
MAIN NULLAH
VC-1 (R.L. 7.9mPD)
7.16
3.16
2m FOOTPATH
RAMP AR-1
BLOCK FUTURE SHAM CHUNG CHANNEL AND FILL
7.22
2.97
LOW FLOW CHANNEL
BUDDHIST SHRINE
1.6m FOOTPATH
LOCKABLE CRASH BARRIER
VC-2 (R.L. 7.9mPD)
MODIFY FUTURE SHAM CHUNG CHANNEL TO SUIT BYPASS FLOODWAY
CONNECT TO SHAM CHUNG CHANNEL ACCESS ROAD
SHAM CHUNG TSUEN
PAI LAU
2m FOOTPATH
7.17
2.67
RAMP AR-2
VC-3 (R.L. 8.1mPD)
1.6m FOOTPATH
LOCKABLE CRASH BARRIER
SHAM CHUNG TSUEN
SHUNG CHUNG SAN TSUEN
MATCH LINE
CH 0+000
CH 0+100
CH 0+200
CH 0+300
CH 0+400
CH 0+500
CH 0+600
N 833000
N 832900
N 832800
N 832700
N 832600
N 832500
LEGEND
FEATURE TREES
BUFFER TREE PLANTING
BAMBOO
SHRUBS/HYDROSEEDING
GRASSCRETE
WETLAND PLANTING
LANDSCAPING RESTRICTED AREA
(full landscaping works to be carried out after works by others)
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LEGEND:
PROPOSED SITE LIMIT
DIRECTION OF FLOW
BOX CULVERT
PROPOSED SLOPE
EXISTING SLOPE
AREA TO BE FILLED TO ADJACENT GROUND LEVEL
ENGINEERED WETLAND/MARSHCRETE AREA
LIMIT OF RIGHT OF TEMPORARY OCCUPATION
PROPOSED LEVEL
VC VEHICULAR CROSSING
PC PEDESTRIAN CROSSING
R.L. TOP OF ROAD LEVEL
P.L. TOP OF FOOTPATH LEVEL
OTHER PROJECTS UNDER PRESENT/FUTURE CONSTRUCTION
KEY PLAN
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drawn YLL 01/98
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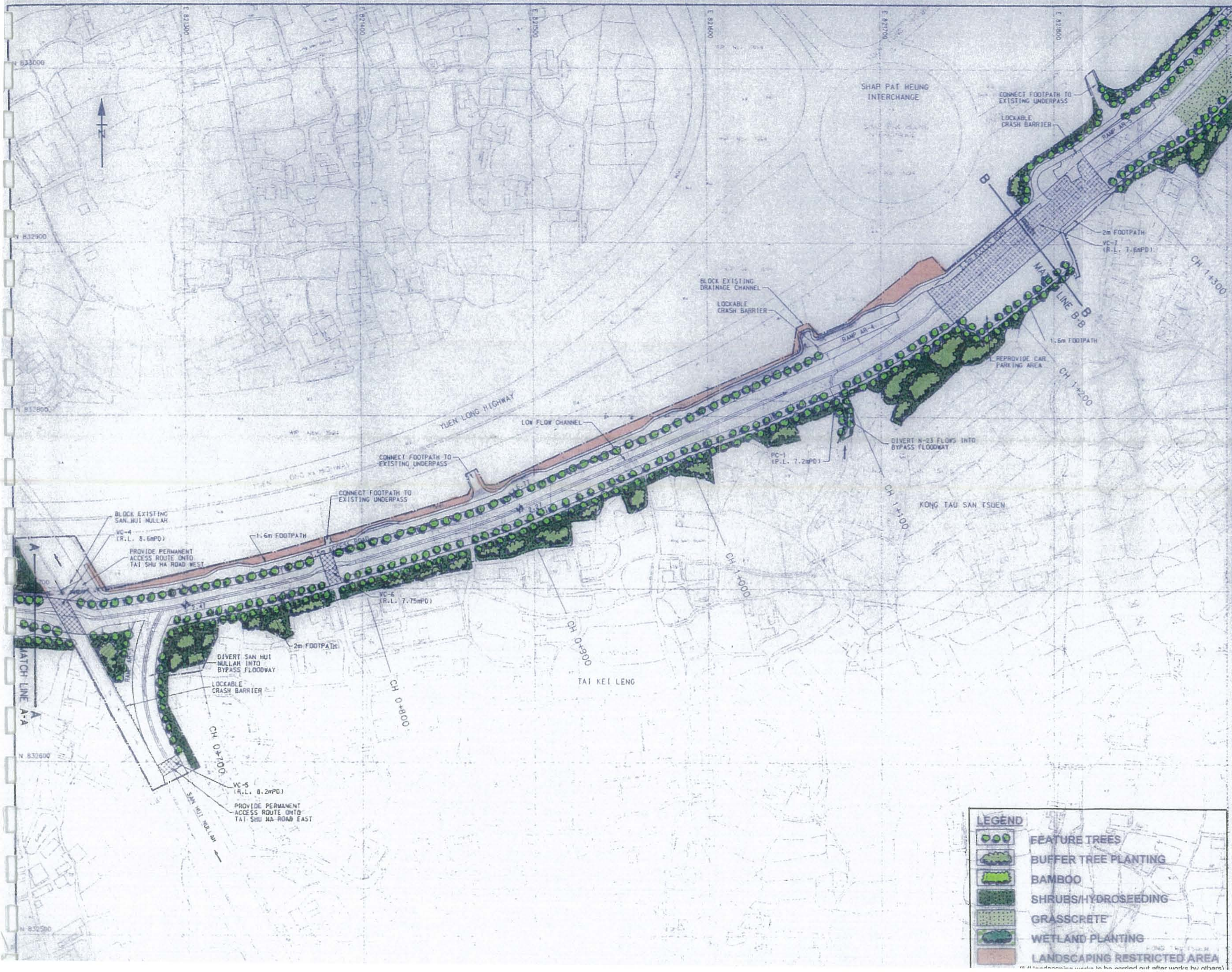




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DIRECTION OF FLOW
BOX CULVERT
PROPOSED SLOPE
EXISTING SLOPE
AREA TO BE FILLED TO ADJACENT GROUND LEVEL
ENGINEERED WETLAND/MARSHCRETE AREA
LIMIT OF RIGHT OF TEMPORARY OCCUPATION
PROPOSED LEVEL
VC VEHICULAR CROSSING
PC PEDESTRIAN CROSSING
R.L. TOP OF ROAD LEVEL
P.L. TOP OF FOOTPATH LEVEL
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- PROPOSED SITE LIMIT
- DIRECTION OF FLOW
- BOX CULVERT
- PROPOSED SLOPE
- EXISTING SLOPE
- AREA TO BE FILLED TO ADJACENT GROUND LEVEL
- ENGINEERED WETLAND/MARSHCRETE AREA
- LIMIT OF RIGHT OF TEMPORARY OCCUPATION
- PROPOSED LEVEL
- VC VEHICULAR CROSSING
- PC PEDESTRIAN CROSSING
- R.L. TOP OF ROAD LEVEL
- P.L. TOP OF FOOTPATH LEVEL
- OTHER PROJECTS UNDER PRESENT/FUTURE CONSTRUCTION

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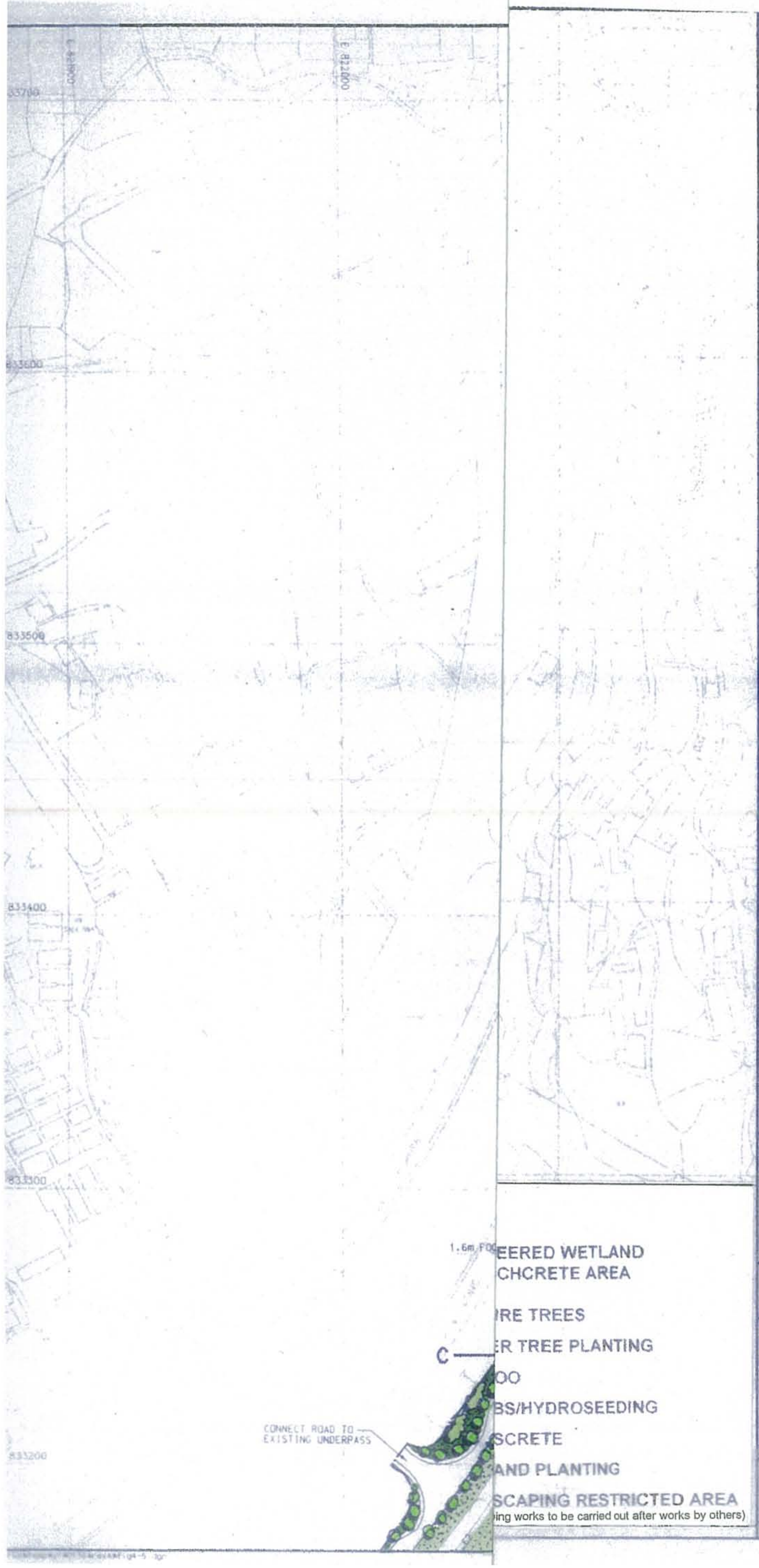




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- DIRECTION OF FLOW
- BOX CULVERT
- PROPOSED SLOPE
- EXISTING SLOPE
- AREA TO BE FILLED TO ADJACENT GROUND LEVEL
- ENGINEERED WETLAND/MARSHCRETE AREA
- LIMIT OF RIGHT OF TEMPORARY OCCUPATION
- PROPOSED LEVEL
- VC VEHICULAR CROSSING
- PC PEDESTRIAN CROSSING
- R.L. TOP OF ROAD LEVEL
- P.L. TOP OF FOOTPATH LEVEL
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KEY PLAN

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- DIRECTION OF FLOW
- BOX CULVERT
- PROPOSED SLOPE
- EXISTING SLOPE
- AREA TO BE FILLED TO ADJACENT GROUND LEVEL
- ENGINEERED WETLAND/MARSHCRETE AREA
- LIMIT OF RIGHT OF TEMPORARY OCCUPATION
- PROPOSED LEVEL
- EXISTING LEVEL (OBTAINED FROM SITE VISIT)
- VC VEHICULAR CROSSING
- PC PEDESTRIAN CROSSING
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- EXISTING SLOPE
- AREA TO BE FILLED TO ADJACENT GROUND LEVEL
- ENGINEERED WETLAND/MARSHCRETE AREA
- LIMIT OF RIGHT OF TEMPORARY OCCUPATION
- PROPOSED LEVEL
- VC VEHICULAR CROSSING
- PC PEDESTRIAN CROSSING
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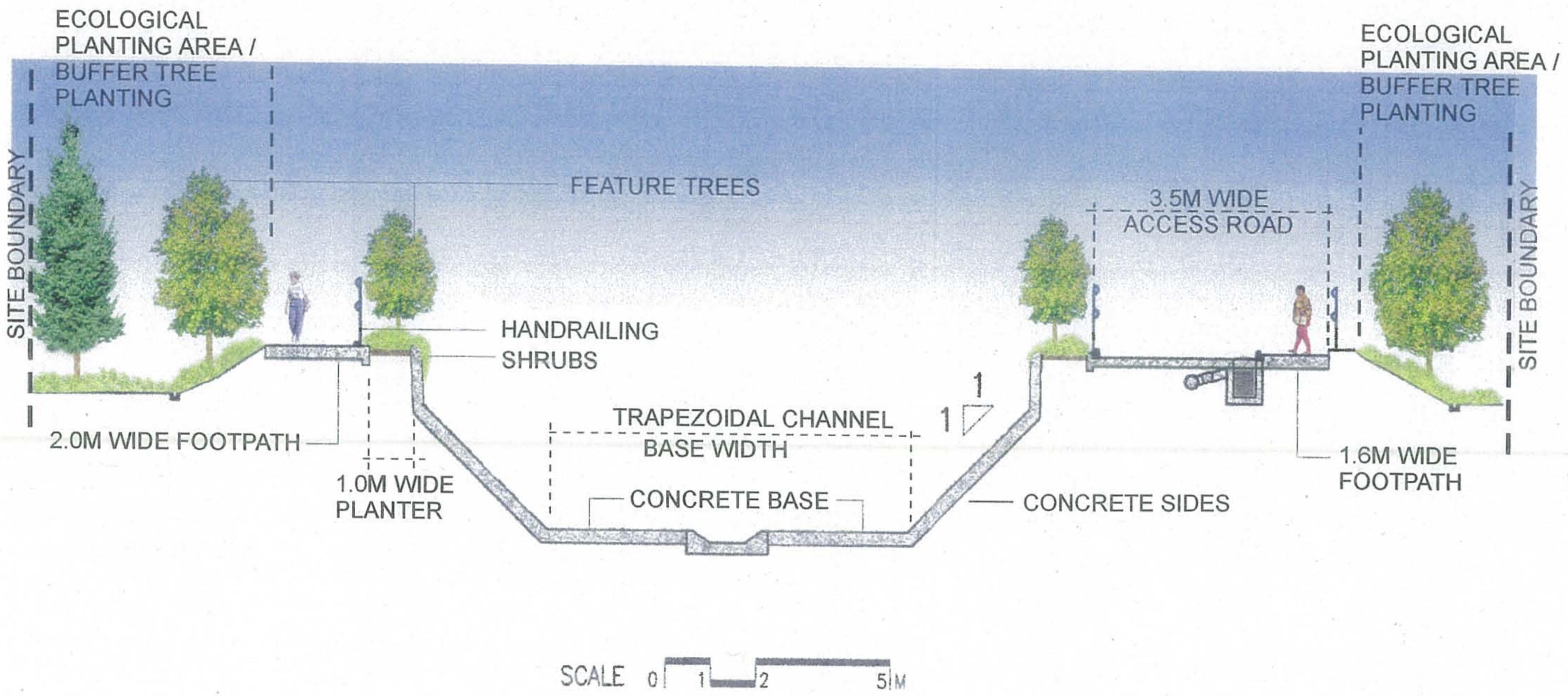


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TYPICAL SECTION OF 8m,10m AND 15m BASE WIDTH CONCRETE PORTION OF CHANNEL

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|---|---|
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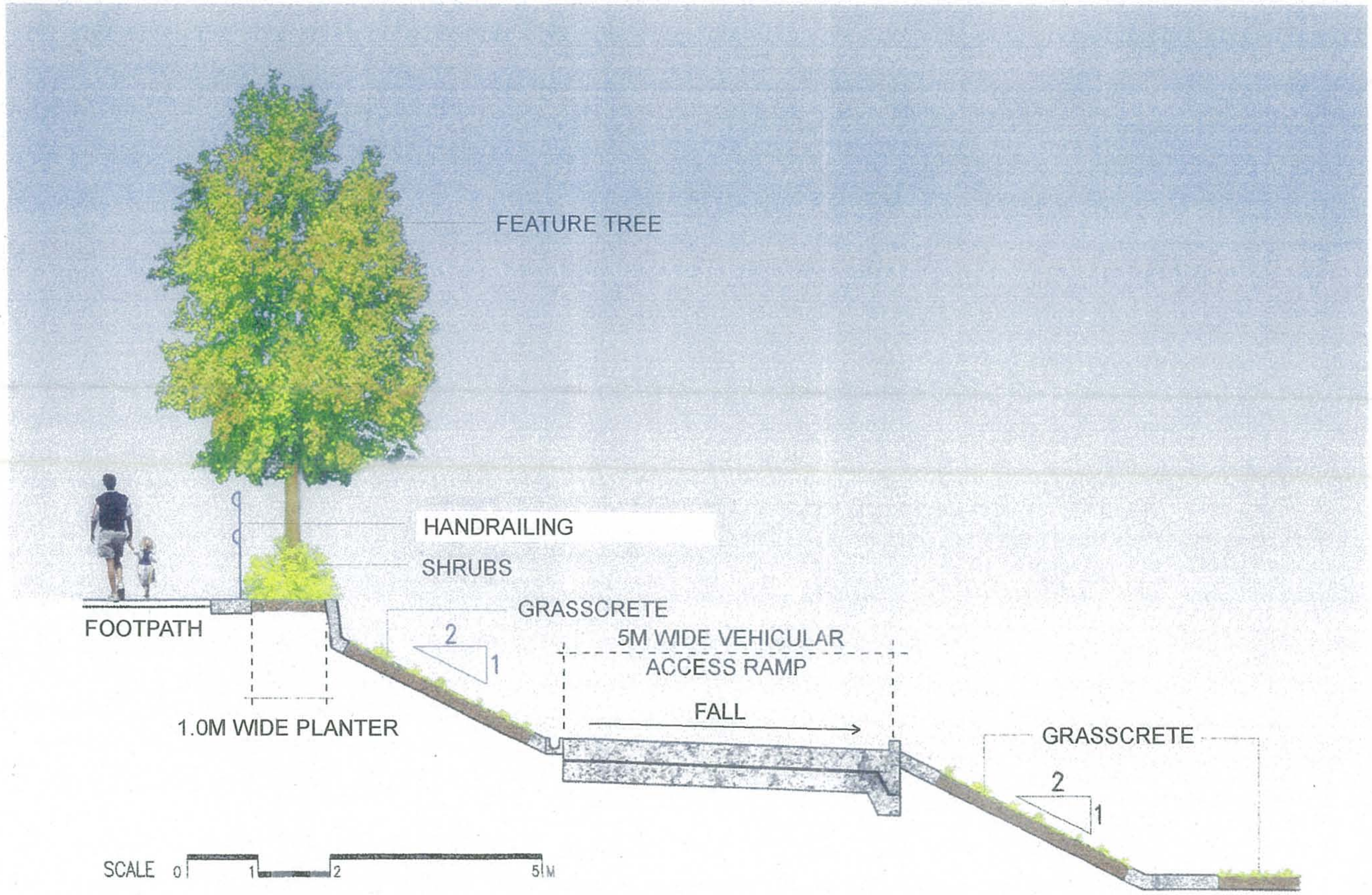




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| date | 01/98 | 01/98 | 01/98 | 01/98 |

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figure title

TYPICAL SECTION OF ACCESS RAMP

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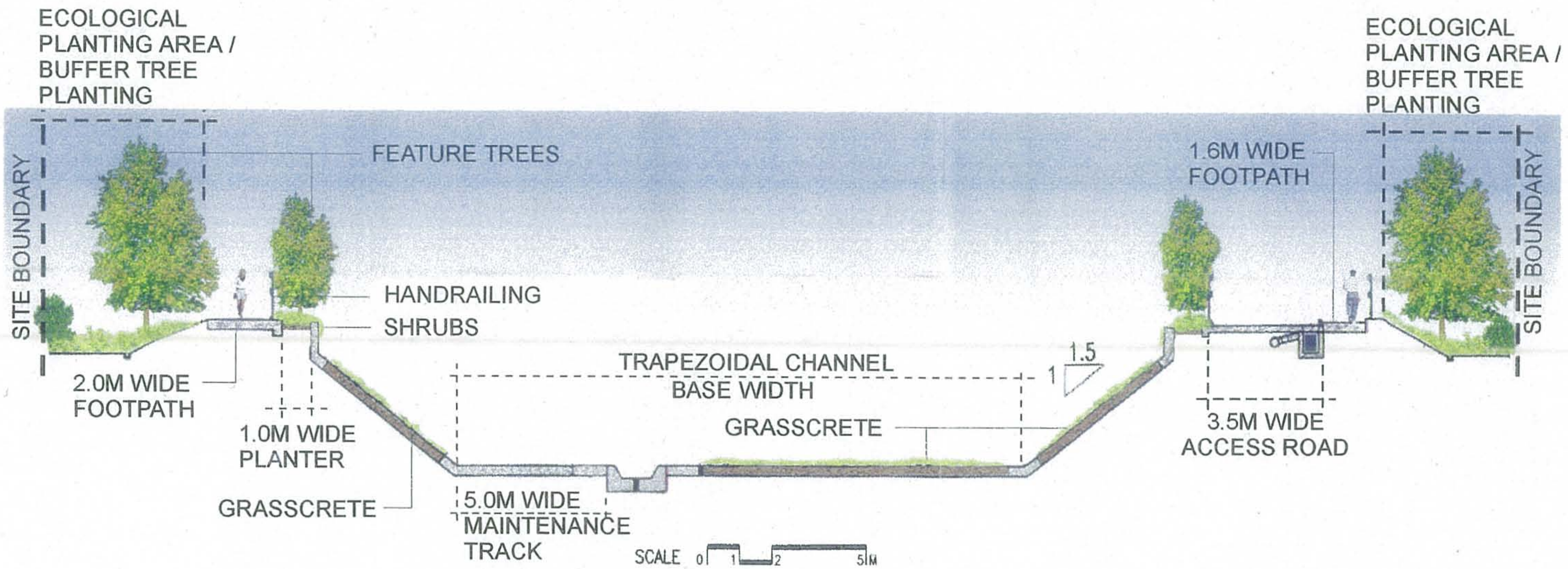


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| date | 01/98 | 01/98 | 01/98 | 01/98 |

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YUEN LONG BYPASS FLOODWAY FEASIBILITY STUDY

figure title

TYPICAL SECTION OF 19m BASE WIDTH GRASSCRETE PORTION OF CHANNEL

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|---|---|
| 11.11 | AS SHOWN |

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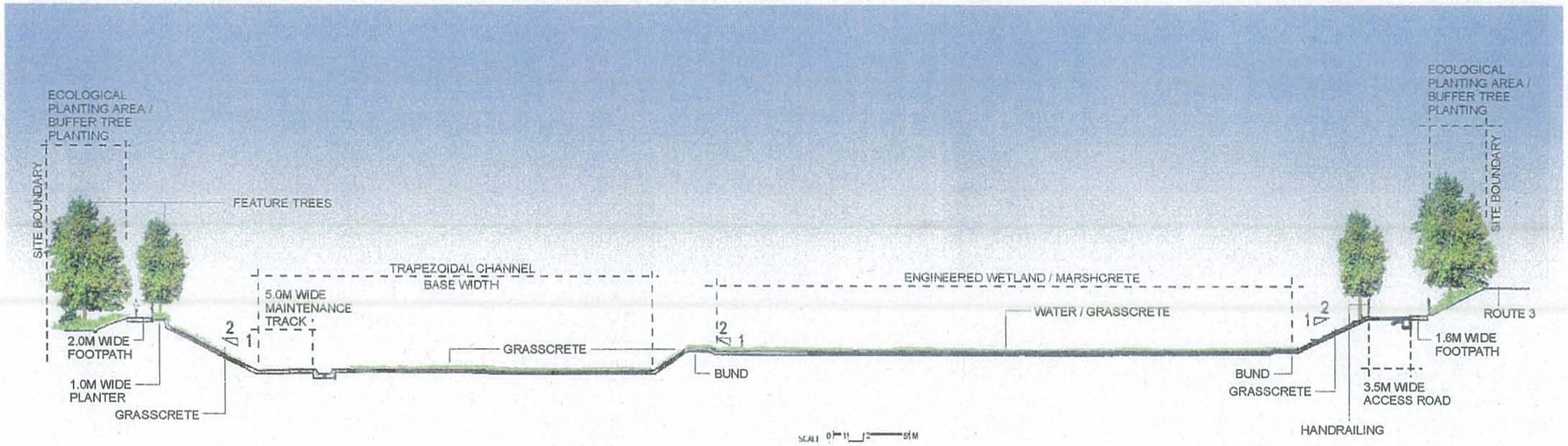




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| revision | date | description | | initial |
|---|---|---|---|---|
| | designed | checked | drawn | checked |
| initial | AJT | CWC | YLL | CWC |
| date | 01/98 | 01/98 | 01/98 | 01/98 |

AGREEMENT NO. CE 79/96

project

YUEN LONG BYPASS FLOODWAY FEASIBILITY STUDY

figure title

TYPICAL SECTION OF ENGINEERED WETLAND/ MARSCHCRETE PORTION OF CHANNEL

| figure no. | scale |
|---|---|
| 11.12 | AS SHOWN |

新界北拓展處
NEW TERRITORIES NORTH DEVELOPMENT OFFICE

拓展署
Territory Development Department, Hong Kong

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賓尼工程顧問有限公司
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