Highways Department
Western Harbour Link Office

Agreement No. CE 27/92

ROUTE 3
COUNTRY PARK SECTION
AND TING KAU BRIDGE

PRELIMINARY DESIGN STAGE 2

Country Park Section -
Tai Lam Tunnel and Yuen Long Approach Road

Volume 3A
Environmental Assessment - Technical Report

FREEMAN FOX MAUNSELL

EIA-033.2/BC

ROUTE 3

COUNTRY PARK SECTION

AND TING KAU BRIDGE

PRELIMINARY DESIGN STAGE 2

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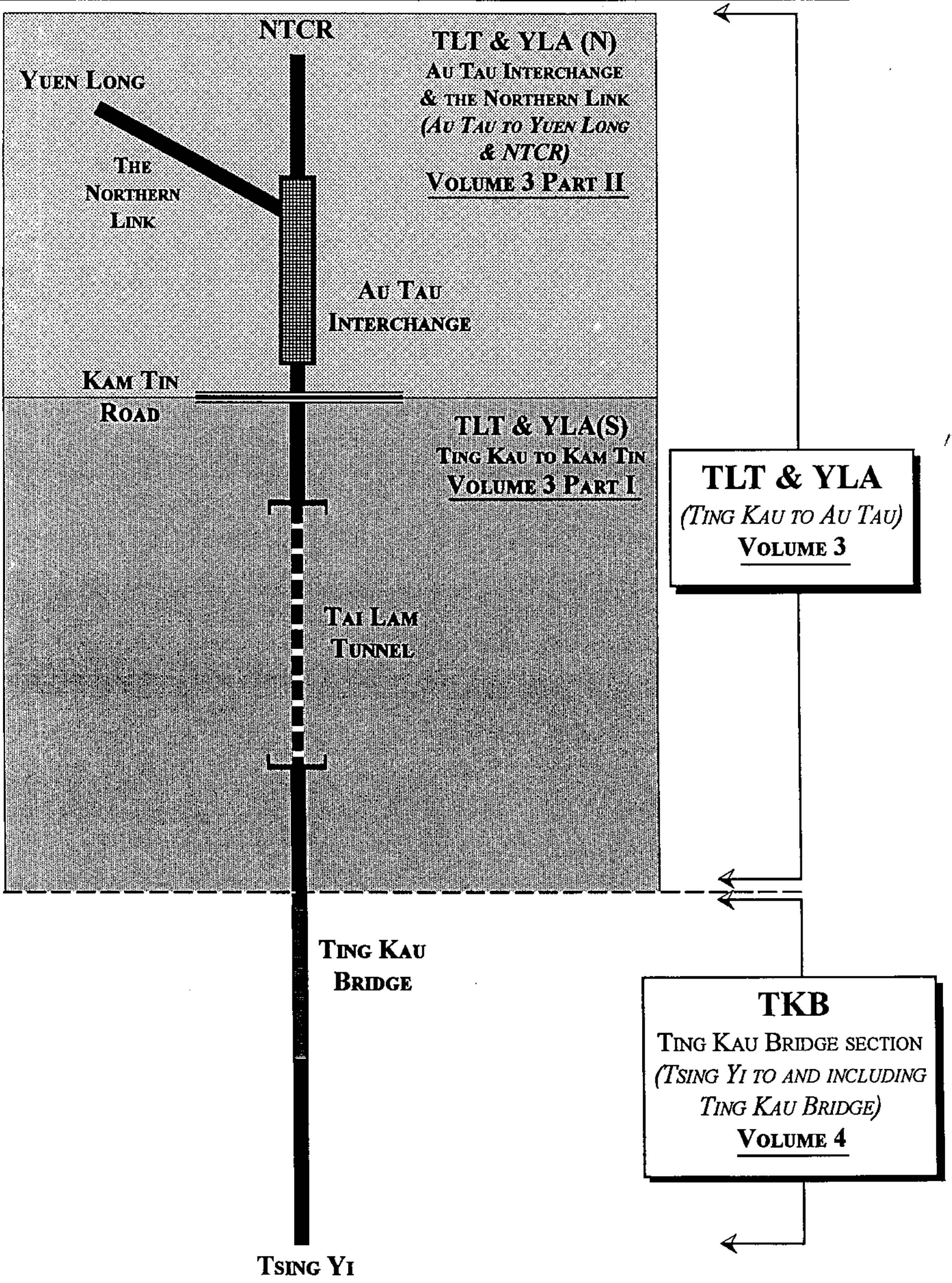
Environmental Assessment - Technical Report

EXPLANATORY NOTE

The Tai Lam Tunnel and Yuen Long Approach Road (TLT & YLA) Environmental Impact Assessment is structured according to specialist subject areas. However due to alignment revisions and the later addition of the Au Tau Interchange and the Northern Link (Au Tau to Yuen Long), Volume 3A is presented in two parts. Part I comprises the assessment of the southern component of TLT & YLA from Ting Kau to Kam Tin and henceforth is referred to as TLT & YLA (S). Part II comprises the assessment of the northern component of TLT & YLA comprising: Au Tau Interchange and the Northern Link and is subsequently referred to as TLT & YLA (N). A combined list of abbreviations and references for Part I and Part II is presented at the end of the Report.

Appendices to the EIA provide data from environmental surveys, monitoring and modelling, and are presented as a separate document (Volume 3B). In-keeping with Volume 3A, the Appendices Report is divided into two sections: Part I - TLT & YLA (S): Ting Kau to Au Tau, and Part II - TLT & YLA (N): Au Tau Interchange & the Northern Link. All Appendices have been referenced chronologically according to the relevant specialist chapters.



Schematic Presentation of Route 3 CPS.
Environmental Impact Assessment

VOLUME 3 - ENVIRONMENTAL ASSESSMENT

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INTRODUCTION

CHAPTER 1

1. INTRODUCTION

1.1 TERMINOLOGY

The part of Route 3 which this Environmental Impact Assessment (EIA) covers was originally called the Country Park section (CPS) and all previous reports have used this terminology. However Government has amended this such that it is now termed the Tai Lam Tunnel and Yuen Long Approach Road (TLT & YLA) and the former TKB Section and CPS combined is now referred to as the Route 3 Country Park Section (Route 3 CPS).

The Route 3 CPS EIA has similarly been divided into two Reports:-

- **TKB** - Ting Kau Bridge, the southern component of Route 3 CPS from Tsing Yi to and including Ting Kau Bridge; and

- **TLT & YLA** - Tai Lam Tunnel and Yuen Long Approach Road, the northern component of Route 3 CPS from Ting Kau to Au Tau, including the Northern Link (Au Tau Interchange to Yuen Long) and the connection to New Territories Circular Road (NTCR).

This Chapter is the Summary of Part I which is the assessment of the southern component of TLT & YLA from Ting Kau to Kam Tin, and is subsequently referred to as TLT & YLA (S). The remaining northern section of TLT & YLA, from Kam Tin to Au Tau, Yuen Long and the connection to the NTCR is referred to as TLT & YLA (N) and is presented as Part II. The assessment focuses on the adopted alignment henceforth referred to as the Alignment.

1.2 BACKGROUND

It is currently proposed that the airport at Kai Tak will be replaced by a new airport at Chek Lap Kok on the north coast of Lantau Island. The new airport which is scheduled to commence operations in 1997 will require extensive infrastructure development and the construction of connecting transport links which will additionally serve the proposed container terminals on Lantau Island. TLT & YLA as part of Route 3 CPS will form an integral part of this supporting transport network.

A Feasibility Study and Preliminary Design Stage 1 study were completed in October 1989 and July 1992 respectively. These studies considered the prospective alignments of Route 3 CPS and culminated in selection of a preferred scheme; in addition certain sections of the scheme have been the subject of further feasibility studies. In February 1993, Freeman Fox Maunsell were commissioned by the Highway's Department to undertake the Preliminary Design Stage 2 for the TLT & YLA road and necessary environmental studies (culminating in the preparation of the EIA) of the Route 3 CPS project.

In July 1993 the Draft EIAs for the two original Sections of Route 3 CPS were issued, which compared possible alternative alignment options for both the TLT & YLA and the TKB section. Since production of the Draft EIA a preferred alignment has been endorsed and subsequently adopted, in addition to which an alternative alignment to the YL3b option called the Northern Link has been identified and endorsed. The Northern Link was assessed at the draft stage in a separate report, which included the Au Tau Interchange and Connection to

NTCR and has been incorporated into this Volume 3 Report as Part II (see also Explanatory Note).

The final TKB EIA was completed in December 1993 and was issued as Volume 4 of the Route 3 Country Park Section and Ting Kau Bridge Preliminary Design Stage 2 Report.

1.3 OBJECTIVES

1.3.1 Objectives

The EIA has been undertaken to provide a comprehensive assessment of the potential environmental impacts arising from the construction and operation of TLT & YLA. This Part of the assessment consolidates the findings of the environmental studies for the TLT & YLA (S).

In accordance with the Study Brief the report comprises the Final EIA and has the following objectives:

i) to describe the characteristics of the proposed development and related facilities and requirements for their development;

ii) to identify and describe the elements of the community, landscape and environment likely to affect or be affected by the proposed development;

iii) to minimize pollution, environmental disturbance and nuisance arising from the development and related facilities, and its construction and operation;

iv) to identify, predict and evaluate the expected net environmental impacts and cumulative effects from construction and operation of the development upon the existing landscape and community, planned community and neighbouring land usage;

v) to identify and specify methods, measures and standards for the inclusion into the detailed design in order to mitigate these impacts to an acceptable level;

vi) to recommend environmental monitoring and audit requirements necessary to ensure the effectiveness of the environmental protection measures adopted;

vii) to identify additional studies where necessary to fulfil the objectives or requirements of this Environmental Impact Assessment Study.

1.3.2 Implementation of the Environmental Assessment

It is proposed that the TLT & YLA be developed on a BOT basis, which will provide the Contractor with a high degree of autonomy in terms of the detailed design and construction. It is important therefore that adequate provisions are included in the tender process and works supervision to ensure that environmental issues are addressed, and that the findings are translated into the final scheme.

The EIA has therefore been conducted concurrent with the preliminary design engineering studies, and a focus of the environmental assessment has been to contribute positively to the evolving design of the project. The EIA consolidates this work and sets out a range of issues which should be taken into account in the detailed design of the final scheme.

1.4 SCOPE

The scope of the EIA for the Route 3 CPS draws directly from the Consultancy Agreement no. *CE 27/92, Route 3 - CPS and TKB Section, Stage 2 Preliminary Design, Environmental Impact Assessment, Study Brief (the Study Brief)*. The TLT & YLA component of Route 3 CPS raises a number of environmental issues that need to be addressed as part of the assessment, including:

- fresh water quality impacts;
- air quality impacts;
- noise impacts;
- effect on terrestrial ecology;
- landuse and community issues; and
- waste and spoil management.

The EIA comprises quantitative and where appropriate qualitative assessment of the potential environmental impacts resulting from the construction and operation of the road. The detailed methodologies adopted in undertaking the evaluation are described in the appropriate sections of the Report as outlined in Section 1.8).

Monitoring requirements for both construction and operation have been identified in order to provide a mechanism for ensuring that environmental impacts resulting from the project are maintained at acceptable levels.

1.5 STUDY AREA

1.5.1 Infrastructure Links

The TLT & YLA (S) connects to Ting Kau Bridge at its southern end, and receives traffic from the new airport at Chek Lap Kok, and the proposed container terminals on Lantau Island, the coastal areas westward toward Tuen Mun and south, from Hong Kong Island, and Kowloon via the West Kowloon Expressway (Figure 1.1).

The proposed location of TLT & YLA is shown in Figure 1.2. Since the preliminary feasibility study to explore prospective alignments of Route 3 CPS, certain sections of the highway and bridge have been subject to further feasibility studies.

In the north, the TLT & YLA (S) will connect to Kam Tin Road via sliproads that feed traffic to the eastern area of the New Territories and towards the Au Tau interchange and Yuen Long. The bulk of the traffic, however, will head north onto the NTCR, which will provide a major crossing to the People's Republic of China (PRC). The TLT & YLA (N) connects NTCR with Castle Peak Road at Yuen Long and the proposed Yuen Long Southern Bypass.

1.5.2 Study Area Boundary

The Study Area of the EIA extends northwards from the boundary of the TKB Section situated at Tuen Mun Road. The mainline continues through green belt to the southern portal of the Tai Lam Tunnel. The Tai Lam Portal is located in a catchment area outside the border of Tai Lam Country Park, and drains to a stream which currently supplies the San Miguel Brewery Reservoir situated adjacent to Sham Tseng.

The road then continues for 3.8 kms in tunnel under the Tai Lam Country Park. The Tai Lam Tunnel will be a dual three-lane tunnel. The Alignment emerges at the Northwest New Territories in the Kam Tin Valley.

The mainline will then proceed north to allow access to the Lok Ma Chau crossing north of its connection to the NTCR. The Study Area boundary follows this route and extends outwards from the route as appropriate.

1.6 APPROACH

1.6.1 Assumptions

In order to complete the EIA it has been necessary to make a number of assumptions, the most important of which are listed below:

- Due to the contractual (BOT) nature of the project, the detailed design, construction, programming and phasing may ultimately be determined by the Contractor. Construction techniques assessed are therefore representative and typical of construction activities necessary for the completion of TLT & YLA (S).

- The construction of Route 3 CPS, TLT & YLA will necessarily occur simultaneously with other infrastructure projects in the Territory which may influence or be influenced by the development of Route 3. Other transport infrastructure projects are reviewed in section 1.7.

The route corridor has assumed the development of the Western Corridor Railway, and has been extended accordingly in the northern section of the Study Area, however, consequent effects have not been assessed.

1.6.2 Project Co-ordination Prior to Completion of the EIA Report

Meetings have been held between Freeman Fox Maunsell and various Government departments including the Agriculture and Fisheries Department (AFD), Highway's Department (Senior Landscape Architect), and Environmental Protection Department (EPD). The First Environmental Working Group Meeting was held on the 27th of April 1993. The meeting was attended by the client, the consultants and representatives of all the relevant government departments involved in the Route 3 CPS project. The various meetings have involved aspects such as the landuse adjacent to the Alignment, major impacts, proposed criteria and methodology relevant to the Study.

Discussions within the project study team regarding construction and operation of the Alignment and possible mitigation measures have been held continuously throughout the assessment. This has enabled the engineering feasibility of the mitigation measures and other factors such as associated costs to be considered during the design process.

1.7 RELATIONSHIP TO OTHER TRANSPORT INFRASTRUCTURE

1.7.1 Chek Lap Kok Airport

Route 3 CPS will form an integral part of the transport infrastructure that is required to serve the new airport at Chek Lap Kok. Traffic will flow either east towards Kowloon on Route 3 CRA1 and the West Kowloon Expressway, or north towards Yuen Long and the PRC via TKB and the TLT & YLA.

1.7.2 Kwai Chung and Container Terminal No.9

With the development of the new port facilities at Kwai Chung and in particular Container Terminal No.9 (CT9) there is a forecast increase in vehicle traffic through Tsing Yi, particularly along CRA1 Route 3 leading to the North West Tsing Yi Interchange and thus across the TKB and north through TLT & YLA.

1.7.3 Tuen Mun Road

At its southern end the TLT & YLA, and in particular the Ting Kau Interchange will provide access to the Tuen Mun Road heading east (Route 2) via ramps C and D.

1.7.4 North West New Territories - Yuen Long and the PRC

TLT & YLA will enable traffic to flow north to the North West New Territories, in particular Yuen Long and further to the border of the PRC.

1.7.5 Castle Peak Road - Ngau Tam Mei (New Territories Circular Road)

The mainline continues northward to connect to Route 2. Ramp K connects the route to Castle Peak Road - Ngau Tam Mei (New Territories Circular Road)

1.7.6 Route 3 Western Corridor Railway Reserve

Part of the northern section of TLT & YLA will allow for the provision of a corridor to facilitate the Route 3 CPS Western Corridor Railway, which will run to the PRC Border; and include a spur to Yuen Long.

1.8 STRUCTURE OF THE REPORT

In addition to this introductory chapter, Part I of the TLT & YLA (S) assessment comprises 13 further chapters:

- **Chapter 2** describes the project characteristics including road alignment details, construction activities and programme, and projected traffic flows.
- **Chapter 3** describes the existing environmental conditions within the Study Area.
- **Chapters 4-11** detail the specialist studies involving the assessment of air quality impacts, noise, water quality impacts, waste and spoil management, visual/landscape impacts, community issues and ecology. All specialist chapters present

recommendations and detail mitigation requirements.

- **Chapter 12** details environmental monitoring and audit requirements.
- **Chapter 13** provides a summary of the assessment.
- **Chapter 14** presents the mitigation measures and recommendations detailed in the specialist chapters of Part I.

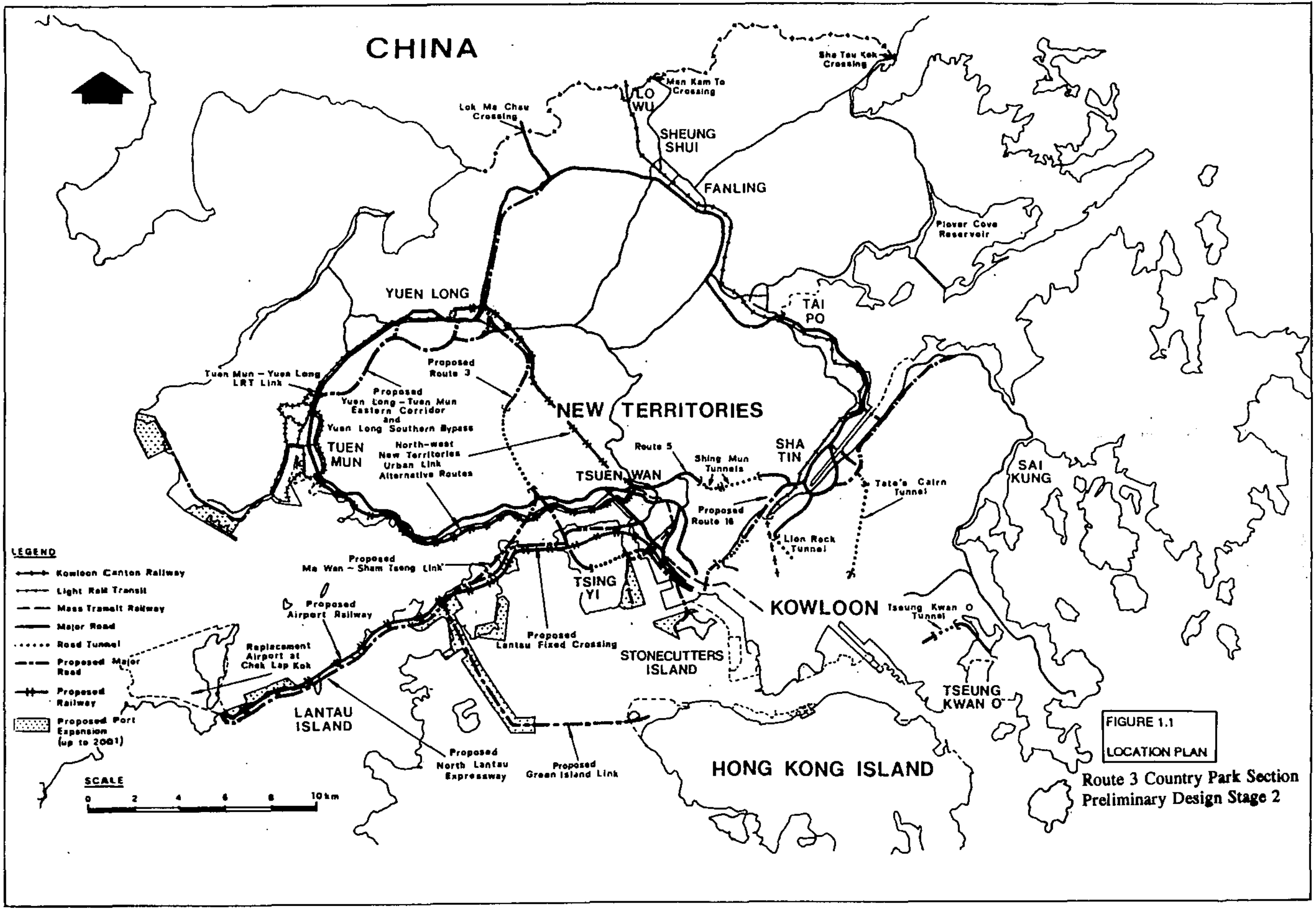
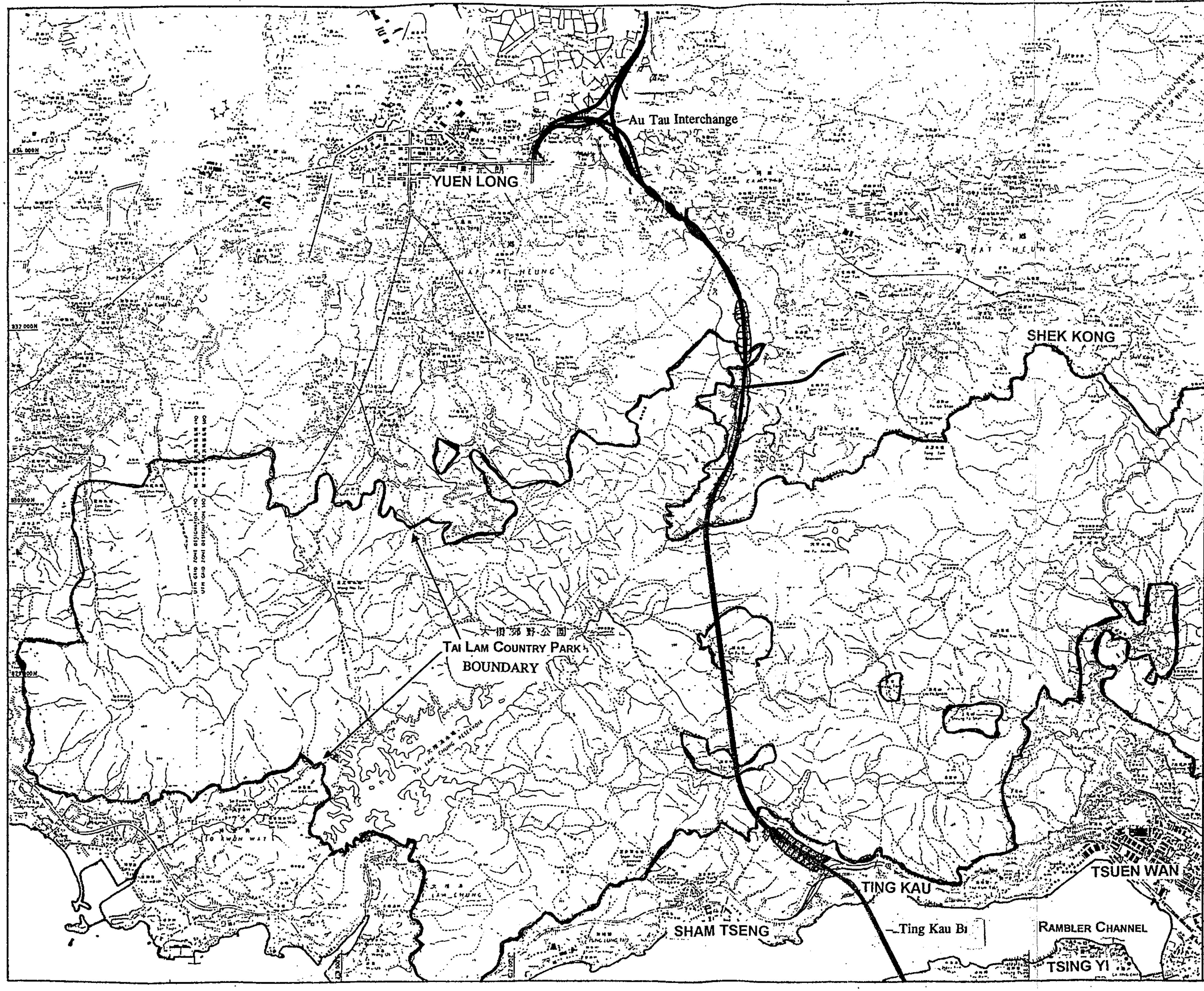


FIGURE 1.1

LOCATION PLAN

Route 3 Country Park Section
Preliminary Design Stage 2



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Date	SEP. 1993	© Copyright Reserved	
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HIGHWAYS DEPARTMENT

WESTERN HARBOUR LINK OFFICE

ROUTE 3 COUNTRY PARK SECTION
PRELIMINARY DESIGN STAGE 2

Figure 1.2

KEY PLAN

Drg No 92393/01/100

FREEMAN FOX-MAUNSELL

PROJECT DESCRIPTION

CHAPTER 2

2. PROJECT DESCRIPTION

2.1 GENERAL

The main features of TLT & YLA (S), are described below and presented in Figures 2.1 and 2.2:

- Ting Kau Interchange links the TLT & YLA with the Ting Kau Bridge and Tuen Mun Road to the east. The bridge approach viaduct (part of TKB) crosses over Tuen Mun Road and ends at an abutment where the TLT & YLA (S) section starts. The road will be dual 3 lane at this point.

- Tai Lam Tunnel runs from the hillside north of Sham Tseng, below Tai Lam Country Park and emerges southwest of Ho Pui immediately outside the northern boundary of the Country Park. The tunnel exit is situated below the Water Supplies Department (WSD) catchwater and adjoining service road, on the steep hill slope at the southern end of Kam Tin Valley.

- From the proposed northern tunnel portal, the Alignment runs on the western side of Kam Tin Valley generally on an embankment with some short cuttings on the slopes, the tollplaza is located as shown in Figure 2.2.

- The route joins onto the NTCR via a ramp over Castle Peak Road, the North West Railway Corridor north of Au Tau, and the realigned Kam Tin River Channel.

It should be noted that although the boundary between TLT & YLA (S) and TKB is at Tuen Mun Road, cross boundary effects are taken into consideration where appropriate.

The Alignment is described in Section 2.2.1, followed by a description of the now superseded original alignment (as outlined in the Preliminary Design Stage 1) for information purposes.

2.2 STRUCTURAL CONSIDERATIONS

2.2.1 The (Adopted) Alignment

Ting Kau Interchange

The Ting Kau Interchange consists of the mainline, two ramps G and H, and two link roads C and D. Of these, link roads C and D are included in the TLT & YLA and will be considered in this EIA (see Figure 2.1). The mainline is at approximately 8 metres above Tuen Mun Road.

Southern Tunnel Portal

The southern portal is situated below the WSD catchwater just outside the Tai Lam Country Park at 70mPD (Figure 2.1). The position of the portal allows clearance away from the WSD catchwater, and straightens the alignment to the Ting Kau Interchange. In order to obtain an acceptable gradient, the position of the portal will necessitate a deep area of excavation and cutting between the Ting kau Interchange and the deep 'V' shaped valley that lies at the mouth of the southern portal.

En route to the portal, the Alignment runs adjacent to a burial area. However, it is sufficiently distant that no additional precautions, (eg. retaining wall) are needed to support the area.

In the near vicinity of the portal a handling area is proposed (although the precise location is not yet determined) where excavated and cut material will be crushed and screened prior to being transported to a proposed barge loading area at the headland for disposal (between Gemini and Hoi Mei beaches). It is intended that the material be moved via a conveyor belt system, this is preferred to transport by road due to the large number of truck movements which would be required and the associated potential impacts such as traffic, noise and air quality impacts.

Tai Lam Tunnel

Tai Lam Tunnel comprises a dual three lane road, provision for future extension has been allowed for on either side. The tunnel is 3.8 km long and runs beneath the Country Park. The ventilation and service buildings will be located outside the Country Park at both Portals.

Northern Tunnel Portal

The tunnel emerges at 45mPD just outside the Country Park on a small hill below the WSD catchwater (Figure 2.2). Ventilation buildings will be located in the south west end of Kam Tin Valley some 200 metres from the portal.

Kam Tin Valley

The Alignment runs along the western foothills of the Kam Tin Valley in partial cut and fill on sidelong ground, and also a section of cutting through a spur north of the toll plaza. This cutting allows the fill requirements needed for embankments to be minimized in the area to the north of the tunnel. The proposed toll plaza location is approximately 1,500 metres from the tunnel portal (Figure 2.2) and is constructed on embankment above the valley floor.

The Alignment affects a number of grave sites, however, it is located away from the flood plain and from planned and existing housing.

Part of the route cuts across a small section of Country Park which protrudes from the main body of the park. The ecology of the affected area within the Country Park has been assessed in detail in a paper submitted to AFD and Country Park Board Members (Ecological Assessment of Country Park Area, November 1993), and the Country Park Board are currently considering an application to excise this small area of land from the Country Park.

Connection with Castle Peak Road, NTCR

Route 3 CPS connects with NTCR via a ramp over Castle Peak Road and the Western Railway Corridor. The ramp is approximately 15 metres above ground and gradually descends to the level of NTCR.

2.2.3 Original Alignment - Stage 1 Design

Background

The original alignment of TLT & YLA, was determined during the Feasibility Study (1989) but was not developed in detail to determine the optimum route. During the Preliminary Design Stage 2, as more details have been studied and taken into account, it became apparent that there were a number of problems and issues with the original alignment that had not been fully addressed in earlier studies. Four main areas along the route that were subject to changes in alignment:

- Ting Kau Interchange and the southern tunnel portal;
- the northern tunnel portal;
- part of the section along Kam Tin valley; and
- the link to Yuen Long Southern Bypass.

Ting Kau Interchange and Southern Tunnel Portal

The original tunnel portal was proposed to be located within the south eastern margin of Tai Lam Country Park. However, AFD has advised that this design would not be acceptable, and could only be considered if no other alternative was feasible and practicable. In this case it would be difficult to obtain approval from Country Park Board for any construction activities within the park boundary as the adopted alternative presents itself as being feasible.

Northern Tunnel Portal

The original tunnel portal would have affected the WSD catchwater and encroached on the Country Park. To avoid this and to retain the tunnel gradient the northern portal has been lowered 20 metres from 65mPD to 45mPD (see Section 2.2.1). The reduced level of the tunnel exit reduces the embankment height and this means that less fill material will be required for this section.

Kam Tin Valley

The originally proposed alignment ran east of the adopted route on the Kam Tin valley floor on an extensive embankment. This embankment would have significant impacts on the flood storage. These implications were discussed in working Paper No. 6 Drainage Impacts.

The adopted alignment affects more grave sites, however has the advantage of moving the road off the flood plain and away from planned and existing housing. This alignment also has the benefit of removing the need for bulk excavation, disposal of spoil and importation of fill for embankment formation from remote borrow areas in the North West New Territories.

2.3 CONSTRUCTION PHASE

2.3.1 Introduction

The construction phase characteristics of the project are briefly discussed in the following section. The assessment of the potential environmental impacts during construction is considered in the relevant specialist chapters of this report.

2.3.2 Construction Sites

The detailed specifications for the location of the construction sites and the proposed use and distribution of plant etc., cannot be determined at this stage and much of this information will not be available until during the detailed design stage, when the tenderers will decide their method of work. Therefore typical conditions have been used and assumptions have been made where necessary.

There will be major work areas at the two tunnel portals with large excavations and/or filling activities to provide for access and loading areas for excess material. It is proposed that excess material from the southern portal will be transported via a conveyor system to a loading area in the vicinity of the northern Rambler Channel, for further transport by barge and disposal to reclamation. This will require the material to be crushed and screened, and the most likely location for this operation is in the vicinity of the cutting outside the south portal. Therefore space for the crushing and screening equipment, and temporary storage, will be needed.

Larger work areas will also be required at the interchanges at Ting Kau and at the connection with NTCR. Depending on the methods of construction chosen the size of work areas may vary but they will need to accommodate storage areas and batching plants as well as facilities for disposal of wash water and construction waste. It is envisaged that staff offices and workshops will need to be provided at the sites.

The route itself, with the exception of the tunnel, will form a linear work site, with activities taking place at various stages of the constructions programme. Major concentrations of work activity will be at sections where cut and fill is required and where sliproads and ramps are to be constructed.

2.3.3 Construction Access

The details of the work areas are not yet finalised and the access points (other than Kam Sheung access road) will be confirmed by the successful tenderer during detailed design stage: It has been proposed to construct some bridge structures, over Kam Tin Road and NTCR for example, at an early stage to allow material to be transported and hauled within the work site. The Alignment and positions of the access roads will be designed to cause minimum impact on existing traffic flow, noise levels and air quality.

2.3.4 Construction Traffic

The construction traffic will mainly consist of heavy vehicles for the transport of equipment and material to and from the work areas, and internal traffic between the sites. Transport of excess material from the southern portal will be via a conveyor belt and this will reduce construction traffic significantly.

2.3.5 Construction Programme

A review of the construction sequencing indicates that an overall duration of four years is required for construction of TLT & YLA as a whole. The programme shows construction taking place between January 1995 and December 1998 and, although these starting and finishing dates may change the construction period is anticipated to remain at approximately four years.

2.3.6 Construction Activities

The main construction activities are:

- excavation works
- fill/embankment works
- superstructure works.

Excavation Works

Along the route a number of excavations will be undertaken to enable construction activities to take place. The areas of operation are:

- Ting Kau - a major excavation is required for construction of Ting Kau Interchange and connections to Tuen Mun Road and Ting Kau Bridge. The Southern Tunnel Portal approach requires a large cutting, with a short section of embankment where a deep gorge is crossed immediately outside the portal.

  While bulk excavation will comprise standard methods, the lack of suitable crossing points at the busy Tuen Mun Road and Castle Peak Road and, the large volumes involved and the extremely steep descent to the site of the proposed barge loading point, effectively preclude haulage by truck. It has, therefore, been assumed that except for those volumes which will be used as fill material to form the embankment in the valley south of the tunnel, the spoil will be transported via a fixed conveyor system to the barge loading point.

- Kam Tin Valley - in Kam Tin Valley the road will be partly in a cutting and partly on an embankment.

  Some excavation may be required where an embankment is situated on the valley floor. The construction method proposed instead of excavation is to overload the mud and use wick drains and geotextiles to facilitate settlement of the ground. This method takes a little longer but is generally less costly and avoids the haulage of spoil on roads, disposal requirements, and therefore the associated impacts.

- Tunnel portals - excavation will be required for the portals and ventilation buildings.

  The excavation at the southern portal will only be small (mainly fill required), but there will be extensive excavation at the northern end of the tunnel.

- Tai Lam Tunnel - The tunnel is designed to be a dual 3 lane road.

  It is anticipated that the tunnel will be excavated simultaneously from both portals using drill and blast techniques.

Fill/Embankment Works

Immediately outside the southern portal, the approach is situated in a deep cut gorge between steep hillside slopes, and fill material will be required to bring the road structure up to the right level. It is proposed that this fill material should come from the adjacent large area of cutting. To the north of the tunnel, fill needed for embankment construction will come from the adjacent large areas of cut on either side of the toll plaza.

Superstructure Works

Construction of the elevated ramps at Ting Kau Interchange and the connection to NTCR may involve either in-situ casting of the structures, or the use of precast sections transported to the site for assembly. However, the detailed method of construction will be proposed by the tenderer at the detailed design stage.

Should a concrete batching plant(s) (of total silo capacity exceeding 50 tonnes) be utilised the successful tenderer will be required to obtain a Specified Process Licence from EPD. A similar licence would also be required for any crushing plant with a processing capacity of over 5000 tonnes per annum.

2.4 OPERATIONAL PHASE

The main operational characteristics of the road, in environmental terms, are traffic volumes, types and flows, which may result in noise and air quality impacts.

Indicative traffic volumes used in this assessment and provided by the Transport Department are shown in Figure 2.3. These figures were circulated for comment/confirmation early in the study to relevant departments including Transport Department, Highway's Department and EPD. The predicted traffic breakdown indicated a very high proportion of heavy vehicles (which is partly due to the likely use of the road by container lorries) and this is significant in terms of potential noise and air quality impacts. The assumed design speed for the different sections of TLT & YLA, are:

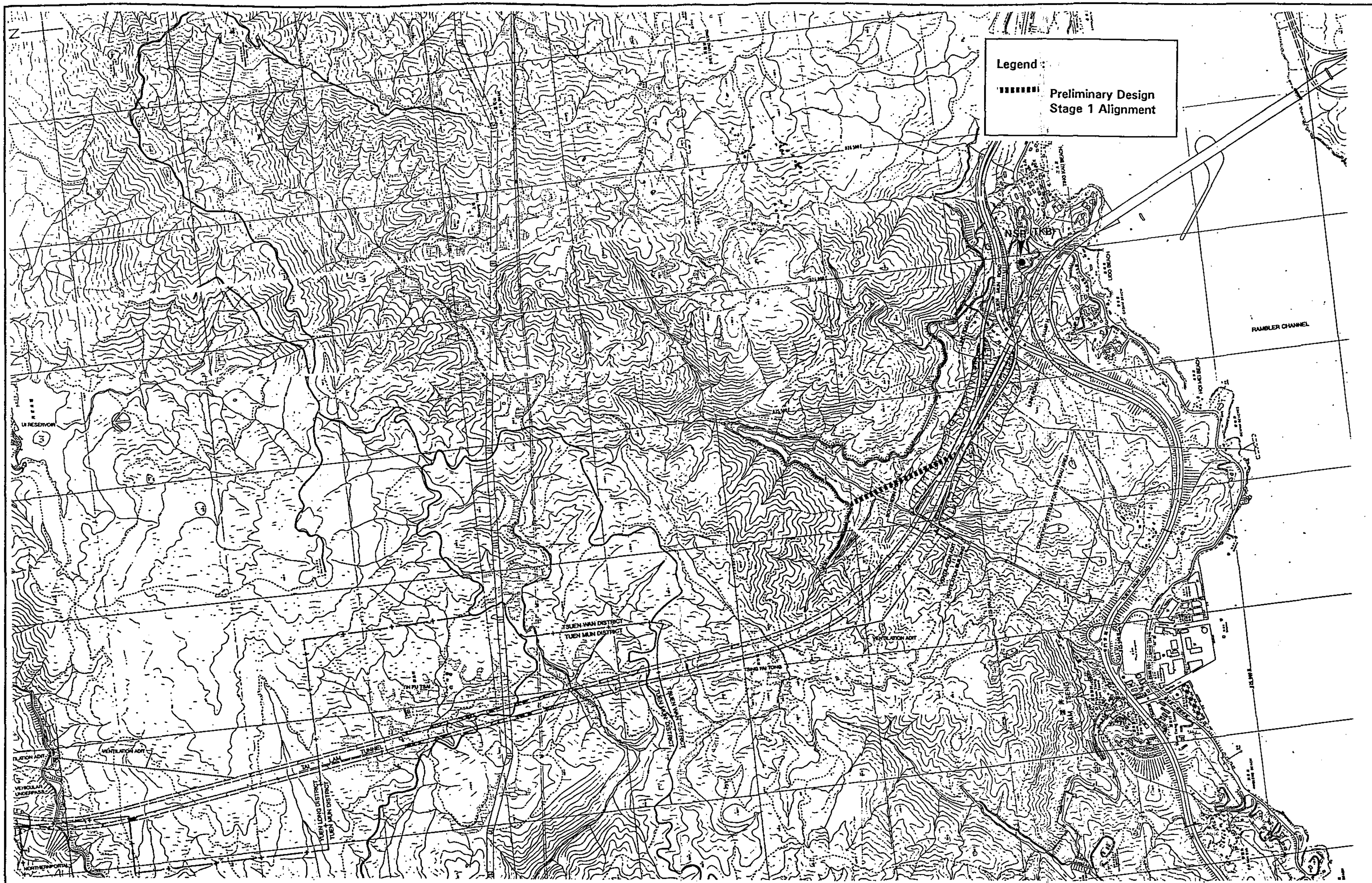
- Mainline (YL3) - 100km/hr
- Ramps G, H & F - 70km/hr
- Link and slip roads - 85km/hr.

The road is designed for free flow of traffic, with minimum braking and acceleration and no stopping except under extreme conditions. As traffic volumes will increase approaching design capacity in year 2011, it is anticipated that travelling speed will fall.

Upon completion of the route a high quality road link will exist between the PRC border and Hong Kong Island, whilst also serving the North-West New Territories, thus relieving the existing major cross border routes via Tuen Mun Highway and Tolo Highway.

This diversion or removal of traffic in general and heavy vehicles in particular from the existing road network is anticipated to provide an overall reduction in impacts and disturbance in many locations. This is considered to be a significant positive impact of the project and during initial consultation with the relevant District Boards some members have expressed general support for the project, albeit with concerns regarding potential environmental impacts.

During operation the route will be visible from the mountain areas around the Kam Tin Valley. The tollplaza will have to be floodlit by night and this may subsequently disturb residential development close by. The route will also open up the New Territories for further potential development, as well as having impacts on existing rural development and culture.



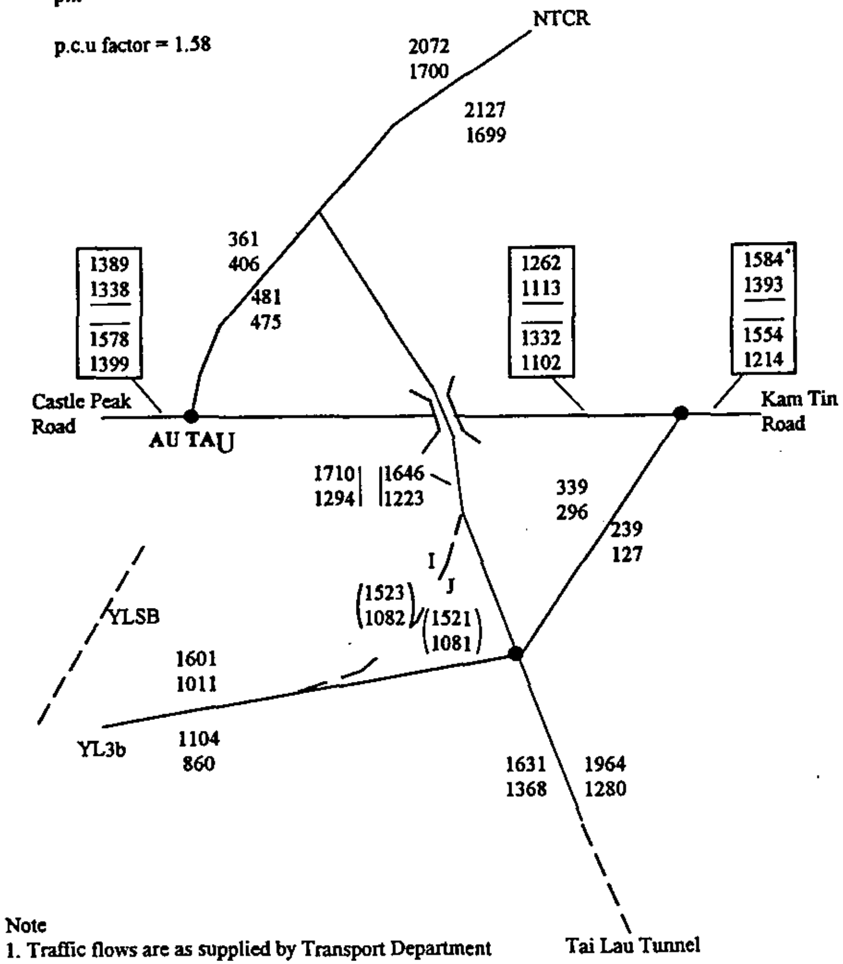
FREEMAN FOX MAUNSELL	Dwg. Title: General Layout Plan Tai Lam Tunnel & Yuen Long Approach Road - Southern Area	Job Title: ROUTE 3 : COUNTRY PARK SECTON EIA	
		Scale: Date : Jan 1994	Job No. 058000	Fig. No: 2.1

FREEMAN FOX MAUNSELL	Dwg. Title : General Layout Plan Tai Lam Tunnel & Yuen Long Approach Road - Nothern Area	Job Title : ROUTE 3 : COUNTRY PARK SECTON EIA	
		Scale : Date : Jan 1994	Job No. 058000	Fig. No: 2.2

YEAR 2001

am
pm peak hour flows in vehicles / hour

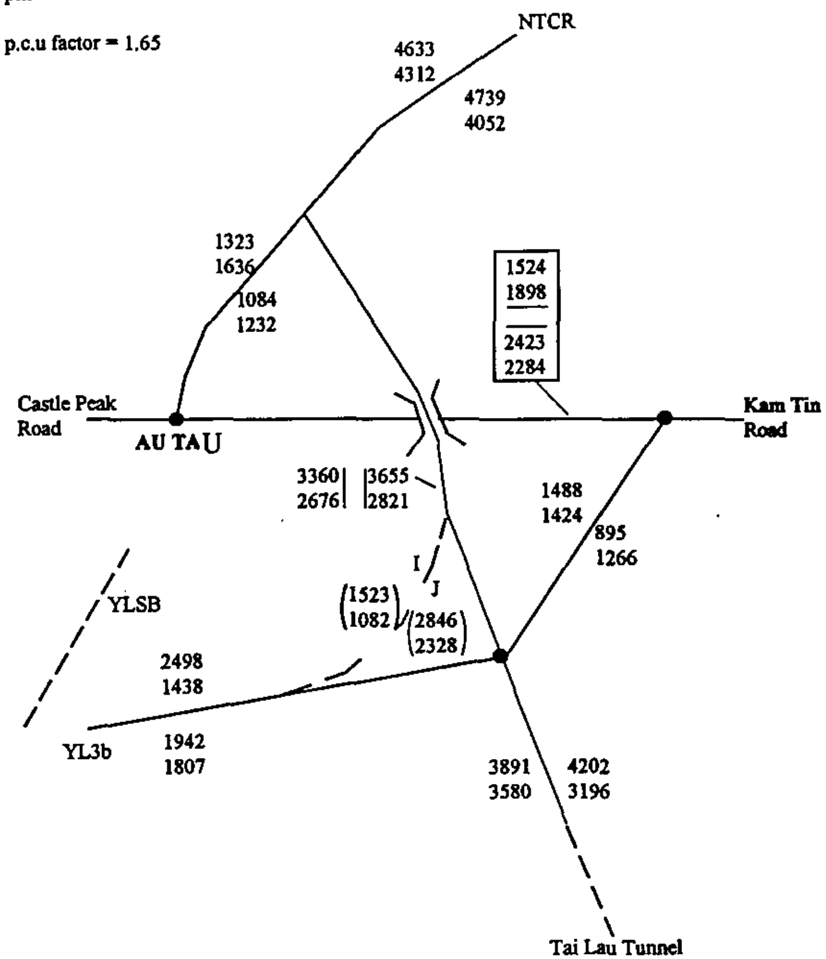
p.c.u factor = 1.58



YEAR 2011

am
pm peak hour flows in vehicles / hour

p.c.u factor = 1.65



Note
1. Traffic flows are as supplied by Transport Department (converted from p.c.u to veh/hr by applying a factor as indicated).
2. Flows on I/J are Freeman Fox Maunsell interpretation of Transport Department flows.

FREEMAN FOX MAUNSELL	Dwg. Title : TRAFFIC FLOWS YEAR 2001 AND 2011	Job Title : ROUTE 3 COUNTRY PARK SECTION - PRELIMINARY DESIGN STAGE 2
		Scale : / Date : July 1993 — Job No. 058000 — Fig. No: 2.3

EXISTING ENVIRONMENT

CHAPTER 3

3. EXISTING ENVIRONMENT

3.1 INTRODUCTION

The Route 3 CPS Project by virtue of its scale, nature, location and duration will potentially give rise to significant environmental impacts. It is therefore important that an understanding of the area, in which the development will occur, is achieved as a baseline against which to measure potential impacts.

To provide a basis for analysis and identification of environmental aspects for TLT & YLA (S), site surveys (including noise monitoring) have been undertaken together with reviews of aerial photographs, maps, previous reports (Feasibility Study, Preliminary Design Stage 1) and other existing data.

The TLT & YLA environmental assessment covers a large area from Ting Kau in the south to beyond Au Tau in the north. The mainline runs from Tuen Mun Road (Route 2) in the south, continuing north west towards the Tai Lam Country Park and then enters a tunnel which runs beneath the Country Park. The tunnel's northern portal opens to the Kam Tin River Valley. The route then runs on an embankment along the western flank of the Kam Tin River Valley. Two ramps connect the Yuen Long Approach with Kam Tin Road. The mainline continues north in the vicinity of Au Tau to connect with Route 2 New Territories Circular Road.

3.2 GENERAL DESCRIPTION

The proposed Study Area, shown in Figures 2.1 and 2.2, can be broken into two distinct main areas: South of Tai Lam Country Park and north of Tai Lam Country Park. The first area takes in the hill which lies between the deep valley located north east of Sham Tseng, and Ting Kau. The south facing slopes north of Ting Kau support a mixture of grasses and patches of woodland interspersed with tall scrubland maturing to woodland. The hill has well vegetated slopes.

The northern side of the hill drops into the well vegetated deep 'V' shaped valley which runs north east from Sham Tseng. The valley acts as the catchment for the San Miguel Reservoir despite being partially dewatered by the catchwater located close to its head. The area is characterised by steep rounded mountains with upper levels sparsely vegetated with grasses. The associated valleys and patches of the foothills in contrast tend to be well vegetated with scrubland and established woodland.

From Tuen Mun Road to the southern portal the proposed Route 3 CPS will run on or along the hill side. The mountains in this area rise up to approximately 200 mPD. The road intersects with a stream that runs from within Tai Lam Country Park towards Sham Tseng and the San Miguel Reservoir. From Sham Tseng a number of footpaths cross this area and continue into the Country Park. A catchwater runs from Tsuen Wan west to Tai Lam Chung Reservoir, together with a service road that connects to Castle Peak Road, in the vicinity of the southern tunnel portal. The tunnel runs beneath the Tai Lam Country Park for approximately 3.8 kilometres, however, the Park is not directly affected.

The Tai Lam Country Park landscape provides many scenic and important amenity locations. Its southern face adjacent to Sham Tseng has only sparsely vegetated steep rounded mountains falling to well vegetated valleys. The north western side of the Country Park that faces the

Kam Tin Valley consists of steep mountain sides which have been revegetated to aid their function as a water gathering ground for both the Ho Pui Reservoir and the Tai Lam Chung Reservoir. Catchwaters are situated in the foothills and drain the catchment toward Tai Lam Chung Reservoir.

The north east side of the Tai Lam Country Park that faces the Kam Tin Valley is sparsely vegetated with grass, small shrubs and patchy, thin tree cover. The hill tops are badly eroded and this is clearly visible from the valley below. The foot hills of the north east side of the Country Park below the catchwater tend to be in much better condition with mature woodland established in pockets.

The second distinct area covers the Kam Tin River Valley. The Kam Tin River runs from the head of the valley located near Tai Lam Chung Reservoir via the Au Tau area to Deep Bay. Small tributaries drain from the surrounding foothills and mountains. The valley is mainly rural in nature, consisting of scattered villages, houses and agricultural buildings set amidst a mixture of working and unworked agricultural lots and fish/duck ponds.

Access to these rural areas is provided by small (occasionally unsurfaced) roads. At the northern end of the Kam Tin River Valley some of the more accessible areas are being filled, undergoing a transition to open storage areas and sites for mixed business. Some of these include: storage for containers, motor vehicles and earth-moving equipment, motor vehicle breaking yards and timber milling yards.

The northern portal is situated just outside Tai Lam Country Park south of Ho Pui village. The tunnel portal emerges below an existing catchwater, which flows into the Tai Lam Chung reservoir, and also below a service road leading into the Country Park. A steep slope has been cut for the catchwater and road. Vegetation has regenerated below the cut, but above the cut the face has been concreted in order to stabilise the slope. The northern portal will be visible from the recreational areas adjacent to the catchwater.

The Alignment encroaches on a section of the Country Park (Figure 2.2). Compared to the vegetation in the vicinity of the portal the area concerned consists of degraded scrubland with scarce vegetation, mainly due to recent bushfires.

There are many footpaths used for recreation in this area as part of the footpath network in the Country Park; the footpaths also access the various grave sites dotted amongst the foothills. The area has a cultural value as a significant number of grave sites are located on the hill sides of the mountains in Kam Tin Valley and an area south of Yuen Long. There are also temples in Tai Kok and Nga Yiu Tau, together with some small churches in the area.

It is understood that proposed plans for the area include:

- a reserve for a rail link from Tsuen Wan, a station and a depot;
- Ko Po Tsuen village extension;
- upgrading of Kam Tim road; and
- river drainage channels forming part of a new flood protection scheme around Kam Tin.

3.3 EXISTING AND COMMITTED IMPACT SOURCES

3.3.1 Introduction

Existing and committed impact sources in the vicinity of the Alignment, have been identified in relation to their effect on the existing environment. The TLT & YLA (S) is mainly situated in an relatively undisturbed environment which means that there are only a limited number of existing impact sources. Potential impact sources are identified and outlined below.

3.3.2 Noise

The main noise impact source along the area of the route is traffic. The northern part is affected by traffic generated on Castle Peak Road, which runs through Yuen Long and Au Tau before it connects to the NTCR and eventually Route 3 CPS. From Au Tau Roundabout, Kam Tin Road runs east of the TLT & YLA (S) alignment, affecting the residential development in this area. A further noise impact source is the ongoing construction activity in the Yuen Long - Au Tau area.

3.3.3 Air Quality

As there is no major air polluting industry in the Study Area the main impact source on the air quality is the road traffic. The construction under progress in Yuen Long may also have an adverse localised effect on air quality as a result of fugitive dust and vehicle emissions. This mainly affects the sensitive receivers in the Au Tau, Kam Tin and Yuen Long area.

3.3.4 Water Quality

EPD rate the river water quality of the Kam Tin River as being bad. This is due to high direct inputs from agriculture, run-off from motor vehicle breaking yards, open storage areas and the practise of burning rubbish along the river banks.

3.4 KEY EXISTING AND COMMITTED SENSITIVE RECEIVERS

Key existing SRs adjacent to the route alignment have been identified (See Figure 3.1a, b and c) in relation to their susceptibility to noise and air emissions together with cultural, recreational, ecological, visual and livelihood aspects. The key existing SRs include:

- residential development in the villages Ma On Kong, Ho Pui, Tin Sam Tsuen, Shek Wu Tong, Ko Po San Tsuen, Ko Po Tsuen, Shek Tong Tsuen, Chuk San Tsuen and Kong Tan San Tsuen, Ha Ko Po Tsuen;
- scattered housing in the Kam Tin Valley and the Shap Pat Heung area;
- fish/duck farming and agriculture in Kam Tin Valley;
- people using the Country Park for recreation within sight of the Alignment;
- grave sites on the foot-hills of the Kam Tin Valley and the Shap Pat Heung area, south of Yuen Long;
- Tai Lam Chung and Ho Pui Reservoirs;

- catchwaters located close to both tunnel portals;
- catchment of the San Miguel Reservoir north east of Sham Tseng, which provides wash water for San Miguel Brewery;
- water treatment plant, pumping station and two service reservoirs at Au Tau;
- Fishery Research Station near Castle Peak Road at Au Tau;
- upstream catchment of small stream at southern portal;
- proposed SSSI - a heron and eagle nesting area in fung shui forests located between Ma On Kong and Ho Pui;
- Temple north west of Shek Wu Tong; and
- St Joseph's School in Ko Po San Tsuen.

3.5 ENVIRONMENTAL QUALITY

3.5.1 Introduction

The existing environmental conditions are described in order to set the environmental context within which the Route 3 CPS development will occur, and to provide an overall picture of the present environmental situation in the TLT & YLA (S) Study Area. The environmental quality might differ slightly at the time of construction due to proposed projects and development, for which impacts are difficult to predict at this stage.

3.5.2 Air Quality

No previous studies to establish background air quality in the vicinity of the Alignment has been undertaken. However, during Preliminary Design Stage 1 predictive methods were used to estimate background levels arising from existing sources within and adjacent to the study area. This survey indicated levels of pollutants well within the HKAQO.

Although outside the study area, an air quality survey was undertaken at Yuen Long Kau Hui, and the results indicated that the air quality was well within the AQO, this can be used as an indication of air quality in the study area as pollution levels are expected to be significantly lower in the Yuen Long - Kam Tin Valley area. As there is no significant industry along the route from its southern end to Au Tau, the air quality is considered to be good. The only potential source of pollution is odour from the scattered farming activities in Kam Tin Valley.

3.5.3 Noise

During June/July 1993 a baseline noise survey was carried out in order to determine the background noise in the Study Area. The survey, which was undertaken at five different locations, established that the background noise level was variable, in the region of 50 - 60 dB(A) for Kong Tau Tsuen and Ma On Kong, and around 55 - 65 dB(A) for Sha Po Tsuen and Tin San Tsuen, but with higher levels being attained for short periods (Appendix A5.1).

3.5.4 Water Quality

Kam Tin River and Yuen Long Creek are situated towards the north the Study Area. These watercourses are severely polluted by livestock waste and run-off wastewater from car breaking, storage yards and workshops. Past intrusion of tidal currents from Deep Bay has reduced the dispersion of the polluted riverflow so that accumulation of the pollutants has occurred. (Water quality monitoring data is available in the annual EPD publication *River Water Quality in Hong Kong*). The upper catchment of the small stream that flows to the Rambler Channel at the eastern end of Lido Beach at Tin Kau lies within the Study Area.

No water quality monitoring has been carried out in the streams in Kam Tin Valley, however a similar but less severe situation can be expected due to farming activities in the river flood plain. The quality of water in the small streams within and adjacent to the Country Park is assumed to be good as no significant polluting sources are present in the Country Park.

3.5.5 Ecology

The vegetation from Tuen Mun Road to the southern tunnel portal is characterised by grassland and semi-mature/mature woodland with large trees. At the northern portal, in the vicinity of the Country Park, semi-mature woodland/shrub dominates but gradually turns into disturbed, cultivated land in the Kam Tin Valley. There are no rare species of trees or plants along the Alignment. However, there are a number of mature specimen trees such as planted pine and fung shui woods, of value.

The region is known to be one of the richest and most diverse documented sites for birds in Hong Kong. Less common species, in Hong Kong, include the black baza and the northern sparrow hawk. The area around Ho Pui is of interest as Chinese Pond Herons and eagles roost here, in addition to which the egretry west of Ho Pui is a proposed Site of Special Scientific Interest (SSSI) by AFD.

The ecology in the area of Country Park affected by the alignment has been assessed in detail and a report submitted to AFD and the Country Park Board (Impact on Tai Lam Country Park, November 1993).

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Date		© Copyright Reserved	
Scale			

HIGHWAYS DEPARTMENT

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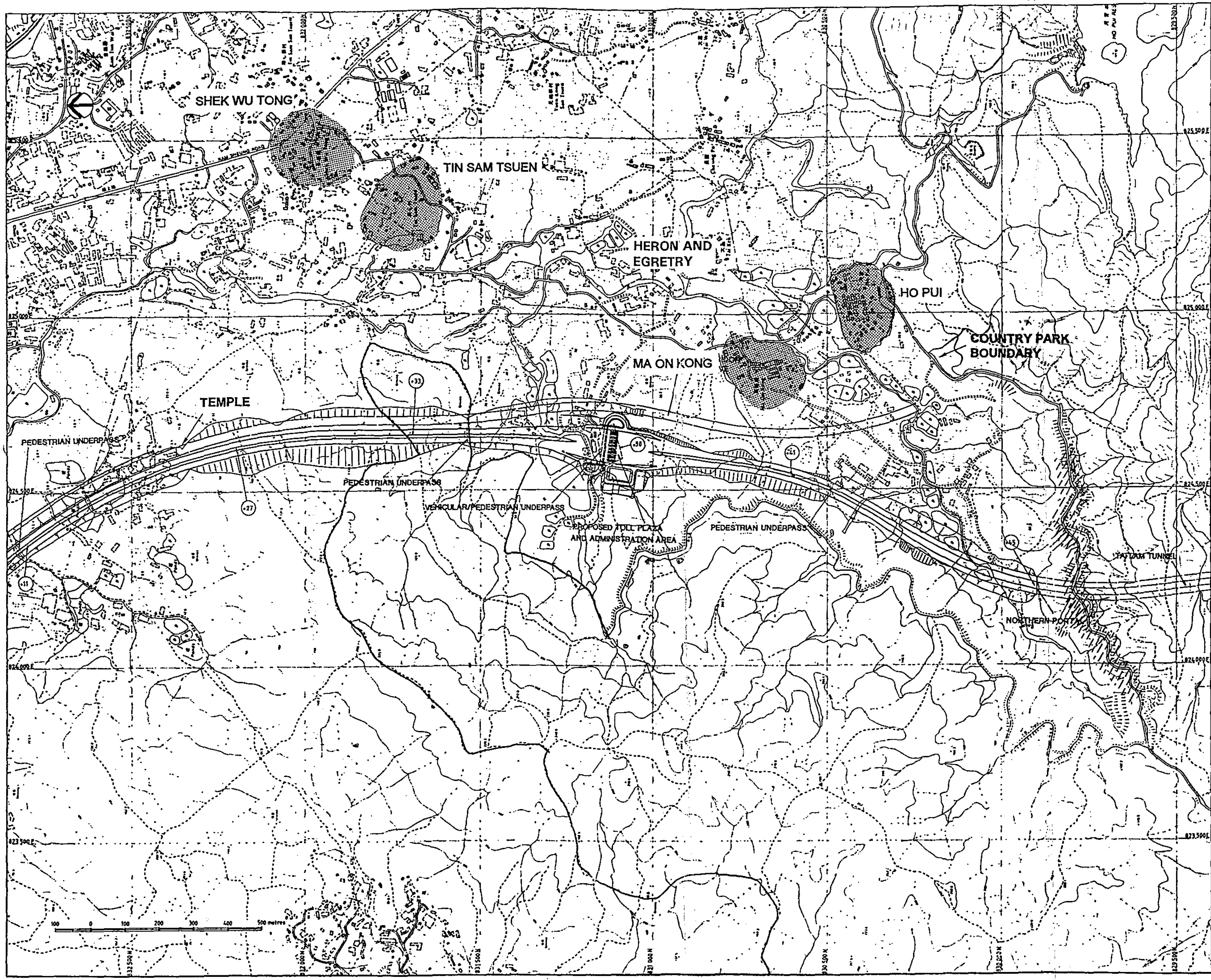
ROUTE 3 COUNTRY PARK SECTION
PRELIMINARY DESIGN STAGE 2

FIGURE 3.1a

EXISTING SENSITIVE RECEIVERS, SOUTH OF TUNNEL PORTAL

Drg. No.

FREEMAN FOX MAUNSELL



LEGEND :

- CUT SLOPE
- EMBANKMENT
- SPOT LEVEL
- VILLAGE
- CATCH WATERS

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		Revision	

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Drawn	Checked
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Scale	

HIGHWAYS DEPARTMENT

WESTERN HARBOUR LINK OFFICE

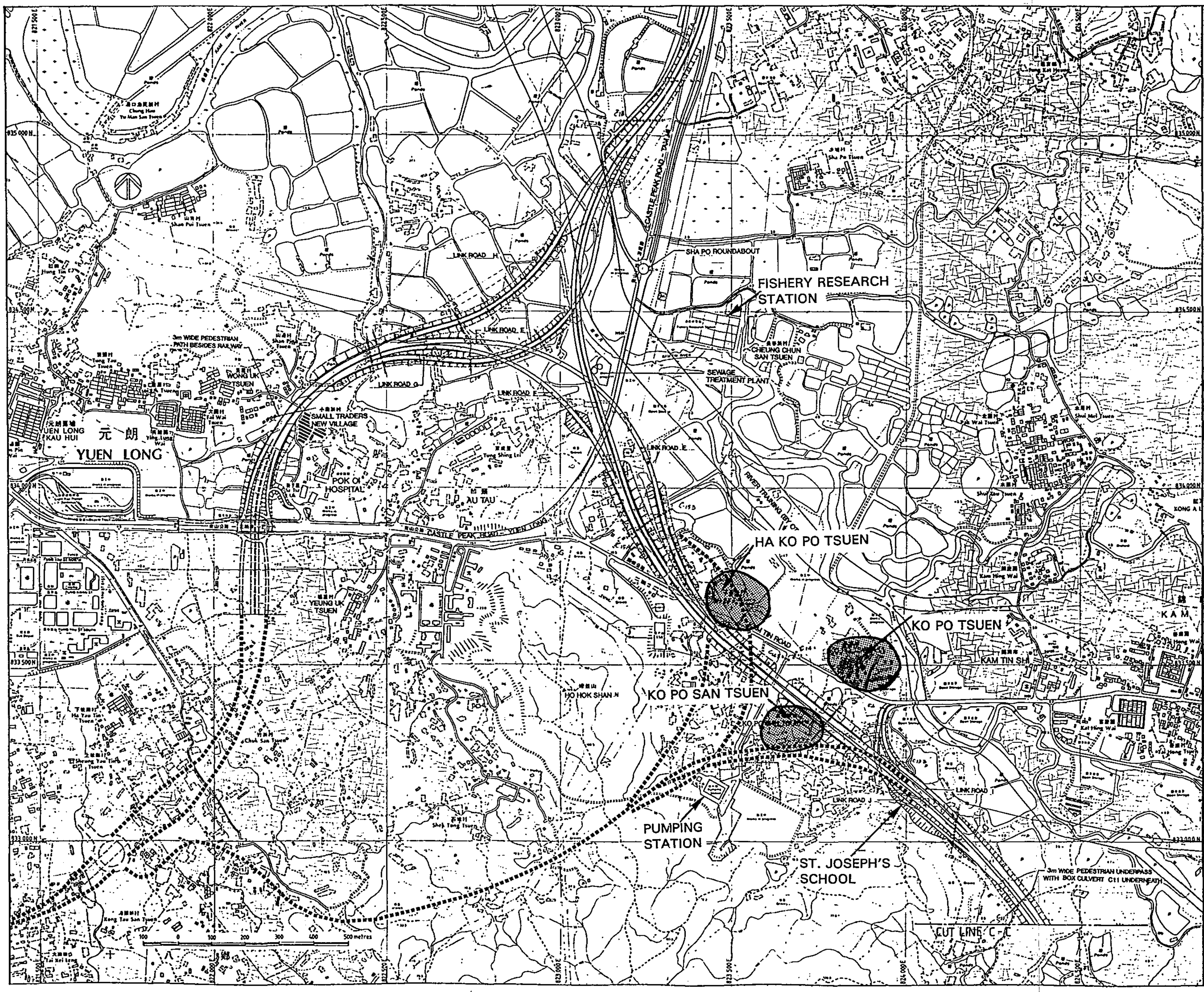
ROUTE 3 COUNTRY PARK SECTION
PRELIMINARY DESIGN STAGE 2

FIGURE 3.1b

EXISTING SENSITIVE RECEIVERS, TAI LAM TUNNEL AND YUEN LONG APPROACH ROAD

Drg No

FREEMAN FOX MAUNSELL



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ROUTE 3 COUNTRY PARK SECTION
PRELIMINARY DESIGN STAGE 2

FIGURE 3.1c

EXISTING SENSITIVE RECEIVERS - TAI LAM TUNNEL AND YUEN LONG APPROACH ROAD

Drg. No. 92393/SK/258

FREEMAN FOX MAUNSELL

AIR QUALITY

CHAPTER 4

4. AIR QUALITY

4.1 INTRODUCTION

4.1.1 Study Area

The Study Area of the TLT & YLA (S) comprises two main areas:

- the southern Tai Lam Tunnel portal and the Ting Kau Interchange (including Ramps C and D)
- the northern end of the 3.4 km, dual-3 lane Tai Lam Tunnel, and some of the Kam Tim Valley in the Northwest New Territories. In this area, three villages were earlier identified (Feasibility Study, 1989) as SRs for the purpose of the air quality impact assessment during both construction and operation of the road. These villages are Shek Tong Tsuen, Tin Sam Tsuen, and Ma On Kong.

The construction air quality impact assessment has examined the effects of earthworks, aggregate handling and storage, and rock crushing and screening at the tunnel portals. Dust-generating construction works are expected to extend over a large platform area near Kam Tin and along the road alignment, as well as at both the tunnel portals.

The operational air quality impact assessment has investigated the effects of traffic on the road its ramps and emissions from the Tai Lam Tunnel ventilation buildings.

4.1.2 Existing Environment

South of Tai Lam Tunnel

No current baseline air quality measurements are available for this site; due to current Route 3 construction at Tsing Yi Island. However, baseline air quality monitoring was conducted from 14 September to 11 October 1990 at the rooftop of Ching Pak House, Cheung Ching Estate (Tsing Yi Island) (Preliminary Design Stage 1). Ambient concentrations of Carbon Monoxide (CO), Oxides of Nitrogen (NO_x), Total Suspended Particulates (TSP) and Respirable Suspended Particulates (RSP) were monitored, and are shown in Table 4.1. This assessment has used the mean concentration value to represent background pollutant levels in the Study Area. The pollutant levels are well within the Hong Kong Air Quality Objectives (HKAQO) (Table 4.3).

North of Tai Lam Tunnel

When the road emerges from the Tai Lam Tunnel, it continues northward through the Kam Tim Valley in the Northwest New Territories. The Alignment runs close to three villages: Shek Tong Tsuen, Tin Sam Tsuen, and Ma On Kong.

No background air quality monitoring has been undertaken for this area. However, in 1992, ambient pollution concentrations were monitored over a two week period at Yuen Long Kau Hui, west of the Study Area and are presented in Table 4.2. Compared to SRs in the Study Area, the Kau Hui monitoring station was much closer to Yuen Long Industrial Estate (a significant source of airborne pollution), pollution levels recorded are likely to be higher than those in the TLT & YLA (S) Study Area. Nevertheless, background air quality from that station can be used as an indication of ambient pollution levels in the Study Area and are well within HKAQO (Table 4.3).

TABLE 4.1 MONITORED POLLUTANT CONCENTRATIONS
Cheung Ching Estate, Tsing Yi Island
September-October 1990

Pollutant	Pollutant Concentration ($\mu g/m^3$)		
	Mean	Hourly Maximum	Maximum 24-hr Average
Carbon Monoxide	275	1294	–
Nitrogen Dioxide (NO_2)	39	132	64
Total Suspended Particulates (TSP)	72	–	108
Respirable Suspended Particulates (RSP)	34	–	52

Source: *Route 3 Technical Report No. 19: Environmental Impact Assessment (Draft)* (SPHW, November 1990), quoted in Table 4.1, *Route 3 Country Park Section and Ting Kau Bridge, Preliminary Design Stage 2: Initial Environmental Assessment* (Freeman Fox Maunsell, 1993).

TABLE 4.2 MONITORED POLLUTANT CONCENTRATIONS
Yuen Long Kau Hui
March 1992

Pollutant	Pollutant Concentration ($\mu g/m^3$)		
	Mean	Hourly Maximum	Maximum 24-hr Average
Carbon Monoxide	N/A	N/A	N/A
Nitrogen Dioxide (NO_2)	38	82	52
Total Suspended Particulates (TSP)	71	–	103
Respirable Suspended Particulates (RSP)	57	–	82

Source: *Environmental Impact Assessment for Yuen Long Kau Hui Development* (Territory Development Department, November 1992).

4.2 AIR QUALITY ASSESSMENT: OPERATION PHASE

4.2.1 Assessment Criteria

The HKAQO stipulate maximum acceptable concentrations of air pollutants. These concentrations are shown in Table 4.3:

TABLE 4.3 HONG KONG AIR QUALITY OBJECTIVES

POLLUTANT	Concentration ($\mu g/m^3$)	
	1 hour[1]	24 hours[2]
Carbon Monoxide (CO)	30000	–
Nitrogen Dioxide (NO_2)	300	150
Total Suspended Particulates (TSP)	—	260
Respirable Suspended Particulates (RSP)	—	180

NOTES:
- Concentrations measured at 298°K (25°C) and 101.325 kPa.
- [1] One-hour criteria not to be exceeded more than three times per year.
- [2] 24-hour criteria not to be exceeded more than once per year.

4.2.2 Assessment Methodology

For open-road traffic, maximum one-hour concentrations of CO, NO_x and RSP have been predicted using the CALINE4 air pollution modelling system. Gases have been assumed to be inert, and concentrations of NO_2 have been taken as 20 percent of the total NO_x concentration as a NOx to NO_2 conversion factor of 20% was used. The following input parameters to CALINE4 were used:

Wind Speed	2 m/s
Wind Direction	worst case
Wind Direction Variation	11.5 degrees
Stability Class	D
Mixing Height	500 m
Temperature	25 degrees C

For emissions from the two tunnel ventilation buildings, the ISC Model has been used. The ventilation system assumed for this assessment is that provided in Preliminary Design Stage 1, which directs all vitiated tunnel air through the ventilation stacks; no significant emissions are assumed to escape through the tunnel portals. Pollutants inside the tunnel are assumed to be vented equally out of the northern and southern exhaust points.

The following input parameters to ISC were used:

Efflux Velocity	12 m/s
Vent Elevation	78 mPD (north of Tai Lam Tunnel) 109.5 mPD (south of Tai Lam Tunnel)

Vent Area	107 m^2
Royal Observatory Data	Lau Fau Shan Station (north of Tai Lam Tunnel) Tuen Mun Station (south of Tai Lam Tunnel)
Vent Gas Temperature	30 degrees C

This assessment has been based on Preliminary Design Stage 1 details of the tunnel ventilation system; under the Study Brief, no change is made to the tunnel details. The Stage 1 design has assumed that no vitiated tunnel air is exhausted through the tunnel portals. For this reason, emissions from the tunnel portals have not been separately modelled.

The assessment has been based on EPD-supplied future fleet average emission factors for CO, NO_x and particulates. Emission factors for NO_x and particulates are derived from the FTP 75 standard (for passenger cars, taxis, and 2.5 ton vans) and the US Transient 88 standard (for goods vehicles); emission factors for CO are based on a number of sources.

Morning peak hour flows for the years 2001 and 2011 on the road, its associated slip roads, and connection to the Yuen Long Bypass have been used. Traffic flows are provided in Appendix A4.1. It should be noted that the flows used were based on traffic volumes for the major links supplied by Transport Department (TD). As detailed link flows for the route and for Tuen Mun Road were not available, it was necessary to make some assumptions on those link flows based on certain links being saturated. This approach was suggested by TD; the resulting traffic flows were generally thought to be conservative and should indicate the maximum provision of mitigation measures. We suggest the level of mitigation required should be examined in more detail based on potential franchisees' predicted traffic levels, at detailed design stage.

4.2.3 Impact Assessment

Pollution isopleths for the Alignment are shown in Appendix A4.5.

At ground level, concentrations of NO_2 and RSP at close proximity to the Alignment will exceed AQO limits however outside the immediate proximity of the Alignment these are expected to remain within acceptable limits in both assessment years.

Concentrations of CO, NO_2, and RSP due to tunnel ventilation emissions in 2001 and 2011 will be within acceptable limits at ground level.

At elevations near the exhaust stacks, CO concentrations at both the northern and southern portals are expected to remain well within AQO acceptable limits. At the southern tunnel portal, RSP and NO_2 are similarly expected to stay within acceptable limits around the level of the stack. At the northern tunnel portal, however, NO_2 concentration near stack level would preclude future highrise development within about 650 m of the tunnel ventilation building in year 2011.

In order to examine the cumulative effects of pollutants at ground level, the contributions of the open Alignment, the tunnel ventilation outlet and the existing background levels of NO_2 and RSP were added at particular ground level receivers. Four representative receivers were chosen. The results are shown in Table 4.4 and indicate that cumulative levels at the chosen receivers are not expected to exceed AQO maxima.

TABLE 4.4 CONCENTRATION OF CRITERIA POLLUTANTS AT REPRESENTATIVE GROUND LEVEL RECEIVERS

Pollutant and Year Source	Peak Hour Pollutant Concentration ($\mu g/m^3$)			
	Casam Beach [1]	Ho Pui Village [2]	Ma On Kong Village [3]	Tai Kek Village [4]
NO_2 (Year 2001)				
Background and Open Alignment	180	60	90	65
Tunnel Ventilation	5	5	5	5
Total	185	65	95	70
NO_2 (Year 2011)				
Background and Open Alignment	170	90	120	110
Tunnel Ventilation	10	10	10	10
Total	180	100	130	120
RSP (Year 2001)				
Background and Open Alignment	150	90	95	90
Tunnel Ventilation	5	5	5	5
Total	155	95	100	95
RSP (Year 2011)				
Background and Open Alignment	140	100	120	110
Tunnel Ventilation	10	5	5	5
Total	150	105	125	115

NOTES :

1. Representative receiver lies above Casam Beach, 75m from Ramp G Alignment. Approximate elevation is 60 mPD.
2. Representative area lies at west end of Ho Pui Village, 450 m from TLT & YLA (S). Approximate elevation is 16 mPD.
3. Representative area lies at west end of Ma On Kong Village, 200m from TLT & YLA (S) alignment. Approximate elevation is 18mPD.
4. Representative area lies at west end of Tai Kek Village, 400 m from TLT & YLA (S) alignment. Approximate elevation is 11mPD.

4.3 AIR QUALITY ASSESSMENT: CONSTRUCTION PHASE

4.3.1 Introduction

Construction Programme

Construction is expected to take four years. Currently, the construction programme is anticipated to start in January 1995, though this date is subject to change.

Construction Activities

Along the Alignment, as well as ramps and connecting roads, excavation, cutting and filling will be performed as necessary to form the roadbed. Cuttings will be necessary where the road runs along the hillside and fill material will be needed where the road is on embankment. Access routes and the magnitude of construction-related traffic volumes were assessed in the Traffic Impact Working Paper (Freeman Fox Maunsell, Traffic Assessment - During Construction Stage, Working Paper No.7). There is no works area proposed for this section of the Alignment. Additional dust-generating construction activities will take place at the following sites along the Alignment:

- Southern Tunnel Portal

  Major works areas will be located near the southern tunnel portals. Excavation spoil from tunnelling will be brought to the portal area, crushed and screened, and transported by conveyor belt to a loading area by the Rambler Channel.

  In order to accommodate these activities, as well as to provide necessary storage area, a large excavation near the portal site within the proposed cutting is anticipated. The tunnel ventilation building will also be built alongside the portal.

- Northern Tunnel Portal

  As with the southern portal, a large excavation is planned at the northern portal site, to provide a site for staging of the tunnel excavation (by boring), processing and loading of spoils, and construction of the ventilation building. It is expected that tunnel spoils evacuated from the northern portal will be used to help meet fill requirements north of the tunnel.

- Ting Kau Interchange

  A large excavation is planned at the Ting Kau Interchange to facilitate building Ramp C and D.

- Toll Plaza

  Filling will be required to widen the road at the site of the toll plaza.

  Dust will be emitted during earthworks, tunnel excavation, and processing of excavated spoils. Other minor air pollution sources which are unlikely to have a significant impact include asphalt emissions during laying of the road surface, and exhaust emissions from powered mechanical equipment.

The impact of fugitive dust depends on its quantity and drift potential. Large particles tend to settle out near the source, creating a local nuisance, while smaller particles are dispersed further from the source. The distance that particles will drift is determined by their injection height, terminal settling velocity, and the degree of atmospheric turbulence.

4.3.2 Assessment Criteria

For construction dust, EPD's maximum acceptable TSP level over a one-hour period is 500 $\mu g/m^3$. The maximum acceptable TSP concentration averaged over a 24-hour period is 260 $\mu g/m^3$ (Table 4.3).

4.3.3 Assessment Methodology

Construction Phase Air Quality Modelling

One-hour and 24-hour average concentrations of TSP have been calculated using the Fugitive Dust Model (FDM). Dust sources have been modelled as area sources, with area size, location, dust generation and density provided as inputs. Emission factors from the US EPA publication *Compilation of Air Pollutant Emission Factors (AP-42)* have been used, along with 1992 continuous weather data from the Royal Observatory's Tuen Mun and Lau Fau Shan Stations.

Given the rate of dust generation, the impacts on the air quality at sensitive receivers will depend primarily on the settling rates of the particulates under both calm and windy conditions. Particles with size greater than 30 microns tend to settle out within a few metres of the source under typical wind conditions; smaller particles have much slower rates of settling, and are therefore more affected by wind turbulence. One category of particle size (0 to 30 microns) with a particle density of 2500 kg/m^3 has been assumed.

In the absence of a well-defined construction programme at this stage of the assessment, it has been assumed that construction is proceeding simultaneously at all sites associated with TLT & YLA (S) and its slip roads.

Assumptions for a number of FDM input parameters are provided in Appendix A4.2.

4.3.4 Impact Assessment

The results of air quality modelling to determine hourly and 24-hour construction dust concentrations at ground level are shown in Appendix A4.6.

Due to the size of the construction sites and the number of assumed concurrent construction activities, adverse air quality impacts are expected at areas adjacent to the site. Both the 1-hour and 24-hour desirable TSP maxima are expected to be exceeded at nearby sensitive receivers. However, construction dust generation is amenable to mitigation measures, such as those discussed in Section 4.3.5 below.

The cumulative effects of other large construction projects in the area south of the tunnel (such as CRA1, Lantau Fixed Crossing, and Tuen Mun Road Widening) are not included, and may further degrade air quality in the immediate vicinity of interaction.

The use of a conveyor system (rather than a haul road) to transport spoils, allows dust to be better controlled by enclosing the conveyor; further dust control measures associated with this system are outlined below.

4.3.5 Mitigation Measures

The control of dust during earthworks is commonly achieved by wetting or covering exposed earth. Watering is the most common dust control method for exposed site surface, but its effectiveness depends on the degree of coverage and the frequency of application. A twice-daily watering, with complete coverage, can reduce dust emissions by up to 50 percent, depending on a number of other factors such as ambient temperature and level of site activity. The effectiveness of wetting can be prolonged by the use of wetting agents that agglomerate dust particles; however, the use of chemical wetting agents may have adverse effects on plants and animals exposed to contaminated run-off.

Effective water sprays may be used during delivery and handling of fill when dust is likely to escape. At active cuts, excavation and fill sites, chemical stabilization is not effective because of the degree of disturbance caused by mechanical equipment. Chemical stabilizers are more useful on completed cuts and fills to reduce wind erosion. Up to 80% reduction in emissions may be achieved.

To help control dust generated by the transport of soil by dumptruck, materials with the potential to create dust should not be loaded to a level higher than the side and tail boards, and should be dampened and covered before transport. Dust levels can be further reduced by providing a gravel surface (assumed for this assessment) or a temporary sealed surface on unpaved site roads. The speed of all traffic on unpaved roads should be regulated to as low a speed as is practical, but this measure is limited by the difficulty of enforcement. At all vehicle exit points leading from unpaved construction areas onto public roads, wheel washing troughs should be provided.

Concrete batching plants (with a total site capacity exceeding 50 tonnes and crushing plants (processing capacity exceeds 5000 tonnes per annum) are classified as Specified Processes where the Air Pollution Control Ordinance. Best practical means is required to control pollutant emissions. During operation of such plant, dust is subject to control at several stages in the process: during handling of sand and aggregate, handling of concrete, and loading of dry concrete mix. Control of fugitive dust can be accomplished by enclosing the handling areas, conveyors and elevators, and using a baghouse filter to extract dust. The vents of concrete storage bins should also be filtered. An assessment to determine an acceptable location for any concrete batching plant should be part of the detailed design EIA.

At the crushing and screening plant, control of fugitive dust emissions should be undertaken. The jaw crusher should be totally enclosed in a four-walled enclosure with top; the outlet of the jaw crusher should be enclosed in a well sealed structure. Water suppression spray should be fitted to the throat of the jaw crusher and at the outlet; alternatively, if this control proves inadequate the outlet emissions should be vented through a bag filter of suitable design and capacity. These filters generally reduce 70% of emissions. The feed opening of the jaw crusher should be enclosed on three sides and (as far as practicable) at the top. The height of this enclosure should be at least 3 m above the truck unloading point.

The belt conveyor used to transfer crushed stone products should be enclosed at transfer points, and also on the top and two sides by dust curtains, and provided with wind boards at the bottom to prevent entrainment of dust from the crushed stone products. Water spray nozzles should be used to wash off any dust deposited on the bottom wind boards at transfer points as necessary, and scrapers should be fitted at the discharge end of the belt to remove dust on the belt surface.

It is desirable that an automatic system be used to activate water sprays whenever stone crushing or its associated processes are in operation.

The control of dust from aggregate and crushed rock stockpiles is generally achieved by enclosing or covering the stockpiles during storage, and application of water in dry and windy conditions. Enclosures should be rigid and reach above the height of the stockpile. In addition, the use of a chemical wetting agent to better wet the fines and retain the moisture film may be effective. Watering or temporary paving of the access area around stockpiles, where loading and unloading vehicles manoeuvre, can be effective in reducing emissions arising from mobile equipment.

The conveyor system for removing excavation spoil from near the southern tunnel portal is the subject of a Supplementary Study which will form part of this EIA. General mitigation measures which can be applied to any use of conveyors within the project include the need for it to be covered. This will prevent accidental spilling of the moving load, and will help to minimise windborne losses. The conveyor should be enclosed on the top and two sides by curtains, and provided with wind boards on the bottom. Water sprays should be used at transfer points as necessary, and to wash off any dust deposited on the bottom wind boards. Scrapers should be fitted at the discharge end of the belt to remove dust on the belt surface.

At the loading and unloading points, measures should be taken to minimise losses during handling. Wetting and the use of windbreaks near loading, unloading, and transfer points are recommended. Alternatively, if these points can be confined in an enclosure, a baghouse filter may be used to filter dust during transfer or loading.

Dust control measures should be incorporated in the contract documents. Possible contract provisions are provided in Appendix A4.4.

4.3.6 Monitoring and Audit Requirements

The objective of a monitoring and audit programme is to identify as early as possible a deterioration in air quality due to construction dust, and enact measures to reduce its impact. Outline air quality monitoring schedules and audit requirements are presented in Chapter 12.

4.4 CONCLUSIONS

The operational air quality impact assessment has investigated the effects of traffic on the TLT & YLA (S), including ramps and emissions from Tai Lam Tunnel ventilation buildings. The construction air quality impact assessment has examined the effects of earthworks, aggregate handling and storage, rock crushing and screening at the tunnel portals.

Operational air quality has been assessed against the HKAQO; construction dust has been assessed against EPD's maximum acceptable TSP level in air over a one-hour period (500 $\mu g/m^3$) and the 24-hour AQO (260 $\mu g/m^3$).

The operational air quality impact assessment has found that concentrations of NO_2 will not exceed AQO limits. RSP levels outside the immediate proximity of the Alignment are expected to remain within acceptable limits. At ground level, cumulative pollution concentrations from tunnel ventilation sources, the open alignment and the background are not expected to exceed AQO maxima in neighbouring residential areas.

Concentrations of CO, NO_2 and RSP due to tunnel ventilation emissions in 2001 and 2011 will be within acceptable limits at ground level. In 2011, NO_2 concentration would be most significant, precluding high rise development at stack elevation within a radius of about 650m of the ventilation stack.

Due to the size of the construction sites and the number of assumed concurrent construction activities, adverse air quality impacts exceeding the desirable limit are expected in areas near the site. Both the 1-hour and the 24-hour desirable maxima are expected to be exceeded at nearby SRs. The control of construction dust can be controlled to comply with HKAQO and this has been addressed through recommendation of mitigation measures, contract specifications, and audit procedures.

NOISE

CHAPTER 5

5. NOISE

5.1 INTRODUCTION

This Chapter includes a detailed noise impact assessment for both the construction and operation phases of TLT & YLA (S) from immediately north of the Tai Lam Tunnel up to grid line 833 000N up to but excluding Ko Po San Tseun (near Kam Tin).

The route to the north of Tuen Mun Road up to the southern portal of the Tai Lam Tunnel and the tunnel itself have been excluded from the detailed analysis presented herein, since no noise sensitive receivers have been identified adjacent to these road sections.

The following noise impact assessment has been divided into two separate sections dealing with construction and operational noise. Noise contours for the Alignment have been prepared and at the beginning of each section, calculations are presented for noise levels at two representative noise sensitive receivers (NSRs). These detailed calculations, serve as a useful starting point for investigating whether criteria for acceptable noise levels will be generally achieved and provide an indication of the degree of noise mitigation that is required.

Where predicted noise levels at the two representative NSRs are above the relevant noise criteria best practical means of mitigation have been considered and additional calculations presented for the scenario with noise mitigation. Later on, in both the construction and operation sections, a broad assessment is reported that considers all existing NSRs along the alignment and identifies individual NSRs that will be exposed to noise levels in excess of the relevant criteria, even with recommended noise mitigation in place.

It is the latter broad analysis that should be considered in assessing the acceptability of the noise impact from the road alignment and the effectiveness of the recommended mitigation measures.

5.2 ENVIRONMENTAL NOISE SURVEY AND IDENTIFICATION OF NOISE SENSITIVE RECEIVERS

5.2.1 Environmental Noise Survey

Environmental noise surveys have been conducted at five locations along the alignment. These survey locations have been agreed with the EPD, they are shown in Figure 5.1 a to e, as YL1 to YL5.

Twenty-four hour environmental noise surveys were conducted at each measurement position over the period between 21st June to 3rd July 1993. These surveys recorded hourly Leq, L_{10}, L_{50} and L_{90} noise levels, for each hour of the twenty four hour period. Noise measurement equipment used was as follows:

Sound Level Meter	Bruel & Kjaer Type 2231
Preamplifier	Bruel & Kjaer Type 2639
Condenser Microphone	Bruel & Kjaer Type 4155
Calibrator	Bruel & Kjaer Type 4230
Windscreen	Bruel & Kjaer UA 0237

Results of the environmental noise surveys are presented as Appendix A5.1. In all cases reported, noise levels correspond to levels at one metre in front of the facade, at upper storey level. The survey results are summarised in Table 5.1:-

Table 5.1 Summarised Baseline Noise Monitoring Results

Measurement	Morning Peak hour (0900 hours) L_{10} dB(A) (1 hour)	Minimum daytime (0700 to 1900 hours) L_{eq} dB(A) (1 hour)
YL1 Sha Po Tsuen	66	61
YL2 Ko Po Tsuen	77	72
YL3 Kong Tau	55	51
YL4 Ma On Kong	61	56
YL5 Sha Po Tseun	58	55

Note: YL1 & YL3 are within the TLT & YLA (N) Study area

Of the noise monitoring positions, only YL2 was found to be exposed to prevailing traffic noise levels in excess of 70dB(A).

At YL4 (Ma On Kong), the minimum daytime Leq of 55.86 dB(A) occurred at 19:00 hrs, while at YL5 Sha Po Tsuen the minimum daytime Leq was 55.5 dB(A) at 08:00 hrs.

5.2.2 Identification of Noise Sensitive Receivers

In assessing the noise impact of both the construction and operation phases, the most important parameter is considered to be the total number of noise sensitive receivers (NSRs) (as defined in the *Technical Memorandum on Noise From Construction Work Other Than Percussive Piling*) that are exposed to noise levels in excess of the acceptable criteria. (Noise criteria are discussed in detail later in this chapter).

Identification of specific NSRs has been based upon buildings shown on the following Hong Kong Government, Survey and Mapping Office, series HP 5C maps:

6-SE-A	Edition 2	4-90
6-NE-A	Edition 3	6-91
6-NE-C	Edition 2	6-88
6-NW-B	Edition 3	12-89
6-NW-D	Edition 3	1-91

A detailed site survey has been conducted along the Alignment in order to identify buildings which can not be classified as NSRs (mostly farm buildings and storage buildings). In addition, reference has been made to the Draft Land Requirement Plans so that properties to be demolished as part of the road construction scheme are not counted as NSRs.

Whilst the identification of NSRs has been conducted with great care, it should be noted that "temporary housing accommodation" is included under the NSR category. From the surveys it is known that some temporary accommodation is not shown on latest government maps. Access was not possible to some of these buildings and they include extension rather than discrete units and are therefore not included for within this assessment. In order to obtain the precise number of NSRs affected, it would be necessary to conduct a very detailed site survey (including achieving access to all the properties to determine their nature and status) at the detailed design stage taking into account the final alignment and its land take requirements.

5.3 CONSTRUCTION PHASE

5.3.1 Noise Assessment Criteria

Noise from construction activities is controlled under the Noise Control Ordinance (NCO). The use of powered mechanical equipment, other than percussive piling, for work in a construction site within restricted hours (that is any period outside of the hours between 0700 and 1900 on normal weekdays) requires application for a Construction Noise Permit (CNP). The details are set out in the *Technical Memorandum on Noise from Construction Work other than Percussive Piling.*

Daytime works during non-restricted hours are not subject to NCO control, however, government contracts commonly include a noise limit of 75 dB(A) L_{eq} (30-min). A noise limit of 10dB(A) above background noise level, has also been used for some past projects. Based upon the results of environmental noise monitoring, the 75 dB(A) criterion is generally seen to be the less stringent criterion of the two for most of the road alignment. It is however considered that the more stringent criterion is not realistic or practical for this scale of construction project. The assessment of construction noise has therefore been based exclusively on the level of 75 dB(A) L_{eq} (30-min), being the upper limit for acceptable day time construction noise emissions. This limit is applicable at one metre from the most exposed facade of NSRs.

5.3.2 Construction Noise Assessment Methodology

A construction phase noise impact assessment has been conducted, based upon the procedures outlined in the *Technical Memorandum on Noise from Construction Work other than Percussive Piling.*

It is anticipated that construction will last for three to four years. An assumed schedule of construction plant to be used in the area under detailed consideration is attached as Appendix A5.3. A preliminary analysis of the construction programme revealed that construction noise will be at its highest levels during the third quarter of the second year, although the limited information currently available indicates that the number and type of construction plant used will remain fairly consistent throughout the construction period.

Latest information suggests that there will not be a requirement for any rock crusher in this road section.

Due to the large size and complex geometry of the site it was not considered appropriate to assume that all plant will be located at a single point in the centre of the site, instead the plant was assumed to be distributed in three equally spaced groups.

5.3.3 Construction Noise Impact Assessment

Detailed calculations for construction noise levels at locations one metre from the facade of two representative NSRs are included as Appendix A5.4. The calculated noise levels are stated below in Table 5.2. The locations of NSR 1 and 2 are shown on attached Figures 5.3 a and b.

These basic noise level calculations do not account for any noise mitigation except that in the case of the type of *poker vibrators* that are expected to be used, the sound power level given under item CNP170 of the Technical Memorandum is considered to be unduly high. In this isolated case noise data has been used from BS 5228: Part 1: 1984, for a 2KW poker vibrator.

Table 5.2 Noise Level Predictions at Representative NSRs for Worst Case Construction Noise - No Mitigation.

Location	Noise Level, L_{eq} dB(A)
NSR1	80.6
NSR2	80.0

5.3.4 Construction Noise Mitigation

It is currently envisaged that all significant construction work will take place during periods not covered by the NCO; i.e. Monday to Saturday between 0700 hours and 1900 hours. Nevertheless the calculated noise levels are considered to be sufficiently high for noise mitigation measures to be required.

Most of the road section under consideration will either be in a cutting or on an embankment. At a given distance from the road, maximum construction noise levels will be significantly higher for sections where cutting is required. This is because cutting, unlike filling, will require extensive use of noisy equipment such as rock drills. As the cutting work progresses, noise levels at the NSR may reduce significantly due to the cutting created, acting as a noise barrier. This affect has however been ignored for the purposes of the current analysis. To mitigate construction noise in these areas it is recommended that temporary noise barriers are erected around areas of rock cutting.

To be effective these acoustic screens should be constructed of a barrier material with a minimum mass per surface area of 7 kg/m^2. There should be no gaps or openings at joints in the barrier material. Depending upon the precise geometry of the area being screened it is likely that a sound absorbent material, (nominally 50mm thick) will be required on the side of the barrier facing the noise source. A calculation is included in Appendix A5.4 that indicates that such acoustic screens should be capable of reducing the noise level at NSR1 from over 80 dB(A) without screens to less than 75dB(A) with screens. It is thus recommended that such screens are employed for all areas of cutting where noise levels would be above 75dB(A) at NSRs without their use.

For a given height of noise barrier near to the construction equipment, the noise reduction achieved at an NSR will increase as the separation between barrier and noise source is reduced. The noise reduction achieved will also generally be greater as the elevation of the road construction increases relative to the elevation of the NSR.

In view of the fact that cutting work will generally take place on sloping ground, the elevation of the base of a noise barrier will not necessarily be at the same elevation as the noise source. Considering the specific case of cutting work closest to NSR1, at an elevation of 16 metres above the upper storey of NSR1; with a screen located ten metres from the noise source, the top of the screen would need to be approximately one metre above the elevation of the noise source in order to achieve a 10 dB(A) reduction in noise level from the individual noise source.

As an alternative to use of temporary noise barriers the Contractor may elect to investigate the use of quiet plant. If this is to provide a satisfactory alternative to temporary barriers, then all breakers and rock drills used would need to be at least 10 decibels quieter in operation than the corresponding noise levels specified in the *Technical Memorandum on Noise from Construction Work other than Percussive Piling*. A justification and confirmation of equipment types would need to be provided for works checker's approval prior to intended use.

Where the road is to be constructed on an embankment, use of acoustic screens is not considered to be appropriate, as the screens would need to be more than 10 metres in height, however as discussed above, construction noise levels will be lower in these areas as the construction activities involved are less noisy when the road is constructed on an embankment compared to noise levels resulting from construction where cutting activities are required.

Noise mitigation should also be provided by locating all carpentry operations using powered equipment, such as electric planers and circular saws, in an enclosed, or substantially screened yard, to be located at least 100 metres from the nearest residential building. The precise location of the works yard should be determined accordingly at the detail design stage.

Based upon implementation of all of the noise control strategies discussed above, a *75 dB(A) construction noise contour* (including a +3 dB(A) facade reflection) has been calculated and plotted on Figures 5.3 a and b. For properties on the road side of these boundaries the worst case construction noise level at one metre from the most exposed facade will be above 75 dB(A). Properties outside the boundary should not experience construction noise levels (L_{eq} 30-minutes) above 75 dB(A) (see Table 5.3).

In deriving these boundaries, it has been necessary to carefully consider the movement of the construction equipment with time. Thus these boundaries will always represent the worst case, i.e. construction activity taking place at the road section nearest to the receiver in question.

Table 5.3 Construction Noise Levels - Worst Case with Described Mitigation.

Sound pressure level one metre in front of facade, 5 metres above ground level	NSR reference, see Figure 5.5
75-80 dB(A)	A,C,D,E,I,K,M,
80-85 dB(A)	B,F,H,J,L,
85-90 dB(A)	G

5.3.5 Construction Traffic Noise Impact Assessment

The construction noise calculations detailed in section 5.3.3 above account for movement of construction vehicles within the construction site itself. There is only one proposed site access road (Kam Sheung access road) within the area under detailed consideration within this report. It is proposed to use this route, shown on Figure 5.2, to provide access for the tunnel construction works. The proposed road will be single carriageway and 6.75 metres in width. With reference to "Working Paper No.7. Traffic Impact Assessment For the Construction Stage", the Alignment attempts to provide a balanced cut and fill for earth works north of Tai Lam Tunnel, thus the proposed traffic flows along the site access road will be relatively low, estimated at 20 vehicles per hour maximum.

Assuming that all of these vehicles will be lorries, a noise assessment of traffic noise has been conducted using the *method for mobile plant on haul roads or in similar situations where they will take regular well defined routes,* from British Standard 5228: Part 1: 1984. (Noise Control on construction and open sites). This calculation, presented in Appendix A5.2, based upon assumed traffic speed of 30 km/hr, indicates that so long as the access route is aligned such that a minimum separation of 2 metres is achieved between construction vehicles and NSRs, then the construction noise limit of 75 dB(A) L_{eq} will not be exceeded. With reference to Figure 5.2 it appears feasible to maintain this separation.

5.3.6 Discussion

It is recommended that the above noise mitigation strategies should be incorporated into the contract documents. The contract documents should also require the Contractor to maintain all equipment regularly.

Using these construction noise contours, the number of NSRs exposed to construction noise levels over 75 dB(A) has been estimated as thirteen properties only. These are marked boldly on Figure 5.3 b. None of the NSRs in the area shown on Figure 5.3 a should be exposed to construction noise levels over 75 dB(A).

In order to estimate the number of people living in these affected properties reference has been made to the 1991 population census. Most of the NSRs exposed to noise levels over 75dB(A) lie within the same "Village Cluster Group" (number 531/05) (these VCG refer to an area and therefore their village name cannot be used). This area has an average occupancy per living quarter of 3.8 persons. The two remaining NSRs lie within VCG 531/15 which has an average occupancy per living quarter of 3.7 persons. Thus it is predicted that by employing the recommended noise mitigation, construction noise levels greater than 75dB(A) will impact approximately 49 people along the TLT & YLA (S).

As discussed in section 5.2 above, for the purposes of identifying affected NSRs, Hong Kong Government survey maps have been used. Whilst it is possible that these maps do not show all existing NSRs it is understood that these are the most up to date maps available for the area in question. During the visits it has been noted that extensions and extra buildings have been/are being added on, on an ad-hoc basis in some locations. It is recommended that in order to identify the number of noise affected residences at the time, a detailed site survey should be conducted along the Alignment during the detailed design stage.

In assessing the number of persons affected by construction noise levels above 75dB(A) no allowance has been made for impact on future buildings. Currently we are not aware of any significant developments planned along the highway alignment that will be completed prior to completion of the highway construction phase.

5.4 OPERATIONAL PHASE

5.4.1 Noise Criteria

The Hong Kong Planning Standards and Guidelines (HKPSG) recommend that peak hour L_{10} traffic noise levels should not exceed 70 dB(A) at openable window locations ventilating habitable rooms of residential buildings.

In accordance with the HKPSG, noise emissions from the Tai Lam Tunnel ventilation building to the nearest NSR should be limited to a level 5 dB(A) below the Acceptable Noise Level defined by the *Technical Memorandum For the Assessment of Noise From Places Other Than Domestic Premises, Public Places or Construction Sites*, or the background noise level if this is lower.

The nearest NSR to the proposed ventilation building location is approximately 120 metres to the east north-east of the building. Background noise levels measured at Ma On Kong (YL4) recorded minimum hourly Leq levels of 54 and 51 dB(A) for daytime (0700 to 2300) hours and nighttime (2300 hours to 0700 hours) respectively. It is assumed that these background noise levels are representative of those currently prevailing at the NSR nearest to the ventilation building.

With reference to the *Technical Memorandum For the Assessment of Noise From Places Other Than Domestic Premises, Public Places or Construction Sites*, the NSR will have an Area Sensitivity Rating of B since it will be at least indirectly affected by the new road. Thus the Acceptable Noise Levels minus 5 decibels are 60 dB(A) day time and 50 dB(A) nighttime.

Thus in order to comply with HKPSG, the noise emissions from the ventilation building to the nearest NSR should be limited to 50 dB(A) at nighttime and 54 dB(A) during the daytime.

5.4.2 Methodology

Traffic noise calculations have been based on the U.K. Department of Transport's "The Calculation Of Road Traffic Noise". Initially traffic noise levels have been calculated at locations one metre from the most exposed window location at two representative NSRs, (NSR1 and NSR2 shown on Figures 5.4 a and b). Where these preliminary calculations indicated that noise mitigation was required, calculations have been repeated with barriers in place. Noise contours have then been calculated for the road alignment with recommended noise barriers in place. These contours are 67.5 dB(A) *free field* noise contours. Thus the contour represents noise assessment positions, that if positioned with an unobstructed view of the road and located one metre in front of a building, would be exposed to a noise level of 70 dB(A), including a facade reflection factor of +2.5 dB(A).

The calculations have been based upon traffic flow data for the year 2011 provided by Transport Department and provided to EPD for comment. Peak hour traffic flow data (the morning peak hour) has been used for the basis for assessment. These flows are stated in Table 5.4 below:

Table 5.4 - Peak Hour Traffic Flows - Year 2011

Road Section	Flow (vehicles per hour)
Route 3 - northbound	3891
Route 3 - southbound	4202

Traffic speeds have been derived in accordance with *"The Calculation Of Road Traffic Noise"* from the road classification and speed limit data provided. The traffic speed have been assumed as follows:

- Route 3 CPS mainline : 97km/hr;
- Castle Peak Road, Kam Tin Road: 50km/hr;
- Ramps I and J : 70km/hr. These speeds have been corrected for percentage heavy goods vehicles and gradient.

All calculations have been based upon traffic flow comprising the recommended 80 % heavy vehicles and as defined by "The Calculation Of Road Traffic Noise".

Use of porous friction course road surfacing has been assumed for all new roads with the exception of the toll plaza section. This type of road surfacing is known to produce a substantial noise benefit in comparison to other common road surfacing materials.

5.4.3 Initial Traffic Noise Impact Assessment

The predicted road traffic noise levels at one metre from the most exposed facade of NSRs 1 and 2, without noise barriers, are stated in Table 5.5 below:

Table 5.5 - Traffic Noise Levels - No Noise Barriers.

Location	Noise Level L_{10} dB(A), peak hour
NSR1	68.7
NSR2	76.2

Detailed calculations for the noise level at NSR1 is presented in Appendix A5.6.

The results of this preliminary analysis indicated that NSRs in the southern half of the section, shown on Figure 5.4 a, would generally not be exposed to noise levels above 70 dB(A), even without noise barriers. This is partly due to the road being in a cutting in this area. NSRs at the north of the section, shown on Figure 5.4 b, and particularly those to the west of the alignment, in the vicinity of NSR2, would however be exposed to noise levels above 70 dB(A) without noise barriers. It is estimated that a total of approximately 23 dwellings would be affected by these high noise levels. These dwellings are presented in Table 5.6 below and their locations are shown in Figure 5.5:

Table 5.6 **Peak Hour Traffic Noise Levels - No Noise Barriers**

Sound pressure level one metre in front of facade, 5 metres above ground level	NSR reference, see Figure 5.5
70-75 dB(A)	B,C,D,E,N,O,Q,R,S,T,U,V,W,X
75-80 dB(A)	F,I,J,K,L,M,P
80-85 dB(A)	H,G

The remainder of the analysis thus focused on the scenario of provision of road noise barriers at appropriate locations.

Ramp C and D - Ting Kau Interchange

Ramps C and D of the Ting Kau Interchange are part of the TLT & YLA BOT contract and their potential impacts have been considered. A detailed noise assessment including this aspect is included in the Route 3 CPS and TKB Environmental Assessment - Technical Report Volume 4A and the relevant aspects are discussed below:

It should be noted that it is not appropriate to assess noise sources such as Ramp C or D in isolation from the other noise sources and the cumulative impact has been assessed. It was predicted that the 70 db(A) noise criteria would be exceeded (71.5 db(A)) at only one NSR. This was referred to as NSR3 (North facade) in the TKB Environmental Assessment Report and its location is shown as NSR(TKB) in Figure 2.1 of this Report.

In general mitigation of noise at source is the preferred approach and therefore the likely effectiveness of noise barriers has been considered and tested. Applying a 3m high, 400m long noise barrier to Ramp D would achieve the required reduction. This could also be achieved by placing a similar extent of noise barrier on Tuen Mun Road or by a large number of permutations of road side barriers including a combination of smaller barriers on two or more of the noise sources (roads). However use of a long barrier to produce such a small reduction is not a very efficient method of mitigation and given that only one NSR building is affected it is unlikely to be cost effective and barrier mitigation is not therefore recommended. It is recommended that an indirect technical remedy is applied to the NSR. This is consistent with the TKB Environmental Assessment Report which recommends noise insulation at this receiver. If this recommendation is followed then no road side barrier mitigation to protect this single NSR would be required by the TLT & YLA Contractor.

5.4.4 Tai Lam Tunnel Northern Ventilation Building

The proposed location for this building is shown on Figure 5.4 a. The ventilation building is approximately 120 metres from the nearest NSR. A calculation for noise emissions from the exhaust air discharge is included as Appendix A5.5.

This calculation is based upon noise data provided by a leading fan manufacturer for a preliminary fan selection. The calculation shows that discharge noise could be limited to a level below 50 dB(A) by using three metre long discharge silencers. In order to restrict the pressure drop across these silencers to approximately 100 Pa the maximum face velocity should not exceed 5 metres per second. Some modification of the preliminary ventilation building design may be required to achieve this face velocity.

By orientating the fresh air intake louvres to point south and providing a similar level of silencing to that considered for the exhaust fans, noise from the fresh air intake should not make a significant contribution at the nearest NSR location. Thus the calculation indicates that it should be possible to achieve the nighttime noise limit of 50 dB(A) at the nearest residential receiver with some modification of the preliminary ventilation building design and it is recommended that this be addressed in the detail design stage.

The southern ventilation building is remote from any NSRs (approximately 750m) and is therefore not considered to be a potential source of impact.

5.4.5 Assessment and Mitigation Measures

General

In section 5.4.3 exceedance of noise guidelines for some receivers were predicted in the absence of mitigation. Possible mitigation options include enclosure of road sections, provision of noise barriers at roadside or nearer the receivers and insulation or even removal of receivers.

Given the nature (1-2 storey, temporary buildings) and the low number of receivers affected, the long length of road sections involved (associated high costs) and the undesirable visual implications, it is considered that stringent mitigation measures such as road enclosures or semi-enclosures are not appropriate.

Barrier Mitigation

A detailed noise assessment has therefore been conducted based upon provision of a single noise barrier in order to establish the mitigation necessary to protect the receivers. Modelling was carried out with a 2m barrier and a 3.5m barrier located adjacent to the hard shoulder as shown on Figure 5.4 b.

The placement of a 3.5 metre high barrier, approximately 650 metres long, effectively reduces the noise levels at most of the receivers in the vicinity of NSR2 (on the west side of the road) to levels below 70 dB(A). Only one NSR, which is very close to the road alignment, will be affected in this locality with such a barrier.

Calculations, based upon a 2 metre high noise barrier positioned in the same location, indicated that approximately seven NSRs in this area would be exposed to levels above 70 dB(A).

The above numbers of affected receivers compare with eighteen NSRs exposed to levels above 70 dB(A) without any noise barrier.

The effects of placing 2m and 3.5m high noise barriers on the west side of this section of the TLT & YLA (S) can be summarised as shown in Table 5.7 below. (Note, this has no affect on the eastern side).

Table 5.7 **Effect of Barrier Heights on Impact**

		BARRIER HEIGHT (on west side only)		
		None	2m	3.5m
Numbers of Dwellings Affected	west of road	18	7	1
	east of road	5	5	5
Estimated Number of People Affected	Total	87	46	23

The above discussion all refers to placing a barrier on the western side of the road only. The possibility of placing a barrier on the eastern side has been considered. However only four (of the five) dwellings identified on the eastern side of the road would benefit. It is however not considered cost effective to provide a barrier on the east side of the road to protect only four dwellings and mitigation at receiver for those dwellings is recommended.

To reduce the traffic noise level at NSR b to below 70 dB(A), a 1m high noise barrier would be required, approximately 350 metres long, located adjacent to the hardshoulder on the east side of the road. In order to reduce the noise level a NSRs C, D, E and F to levels below 70 dB(A), a 2 metre high noise barrier would be needed approximately 500 metres long, located adjacent to the hardshoulder, on the east side of the road.

A 3.5m high noise barrier extending for 650m in length and located as shown in Figure 5.4b is recommended. Some discussion of the residual impacts and receivers affected with such barrier in place is given below:

For the 3.5m high noise barrier, using the noise contour shown on Figures 5.4 a and b (and making negative corrections where receivers have a restricted angle of view of the road), together with identification of NSRs as described in section 5.2.2 above, only a total of six NSRs have been identified for which noise levels will exceed 70 dB(A). These are marked boldly on Figure 5.4 b.

In order to estimate the number of people living in these six affected properties, reference has been made to the 1991 population census. Most of the NSRs exposed to noise levels over 70dB(A) lie within the same "Village Cluster Group" (number 531/05). This area has an average occupancy per living quarter of 3.8 persons. The one remaining NSR lies within VCG 531/15 which has an average occupancy per living quarter of 3.7 persons. Thus it is predicted that by employing the recommended noise mitigation, future road traffic noise levels greater than 70dB(A) will impact approximately 23 people along the section of Route 3 under consideration.

In view of the location of the six affected NSRs, either very close to the proposed alignment, or isolated from other buildings, construction of noise barriers is not considered to be a cost effective noise control strategy for these receivers. Instead noise insulation is recommended, or depending on their planning/legal status possibly re-housing the occupants.

Notwithstanding the recommendation of the 3.5m high noise barrier, it is considered that the franchisee should be allowed the flexibility to consider more extensive receiver mitigation in this area. This could only be justified after a further detailed noise assessment with the benefit of confirmed traffic figures and in the knowledge of the number of receivers present shortly prior to construction and their status. Any findings or changes to the recommended mitigation would require approval by EPD.

General Costing Information

[Costing of mitigation measures is not within the scope of the current study however some information has been obtained from other projects in response to a request from EPD. While this information may be useful to the franchisee/detailed design Contractor it must be stressed that this should only be used for indicative purposes. The costing information give below is for December 1992 with a 5% increase to bring the prices up to date.

- Sha Tin Route 5 Barriers - plexiglas panel fixed onto the viaduct parapet.

0.7m (1.5m incl.parapet)	HK$2,100/m
1.2m (2.0m .)	HK$3,600/m
3.2m (4.0m .)	HK$8,500/m

- Road T7 Sha Tin - noise barrier on ground, wall and paraglass.

3m high barrier HK$14,000/m

- Road T5 Sha Tin - noise barrier on ground, wall and paraglass with more elaborate finishes and design.

3m high barrier HK$28,500/m]

5.5 NOISE MONITORING AND AUDIT REQUIREMENTS

Noise monitoring is required to confirm compliance with assessment criteria for construction noise. Monitoring and audit requirements for both construction and operation including outline schedules and action plans are detailed in Chapter 13.

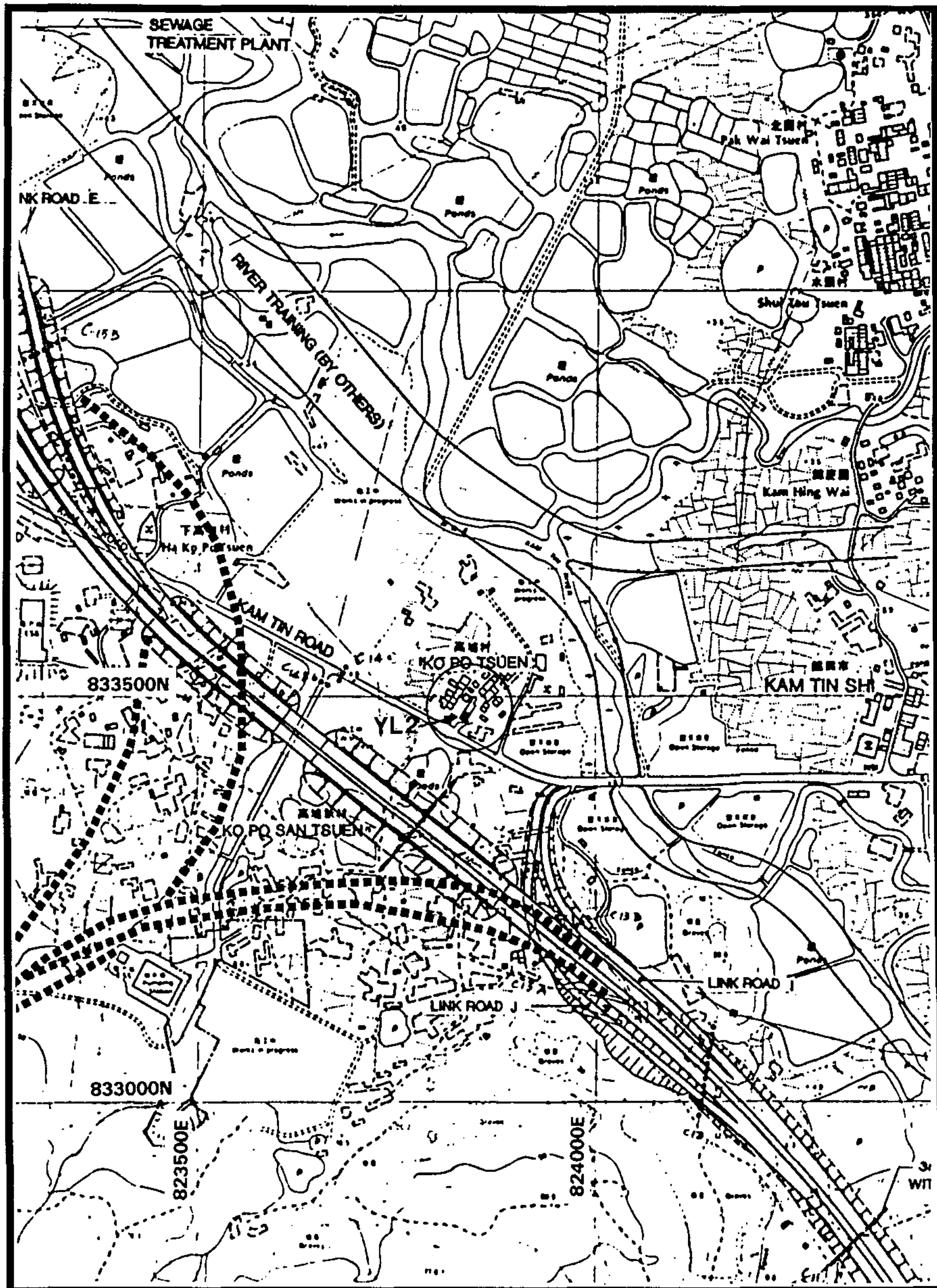
5.6 CONCLUSIONS

5.6.1 Construction

The number of NSRs exposed to construction noise levels over 75 dB(A) is estimated comprise 13 properties. By employing recommended noise mitigation, it is anticipated that construction noise levels greater than 75 dB(A) will impact approximately 49 people along the Alignment. However in order to ensure that all residences potentially affected are identified, a detailed site survey should be conducted along the alignment during the detailed design stage.

5.6.2 Operation

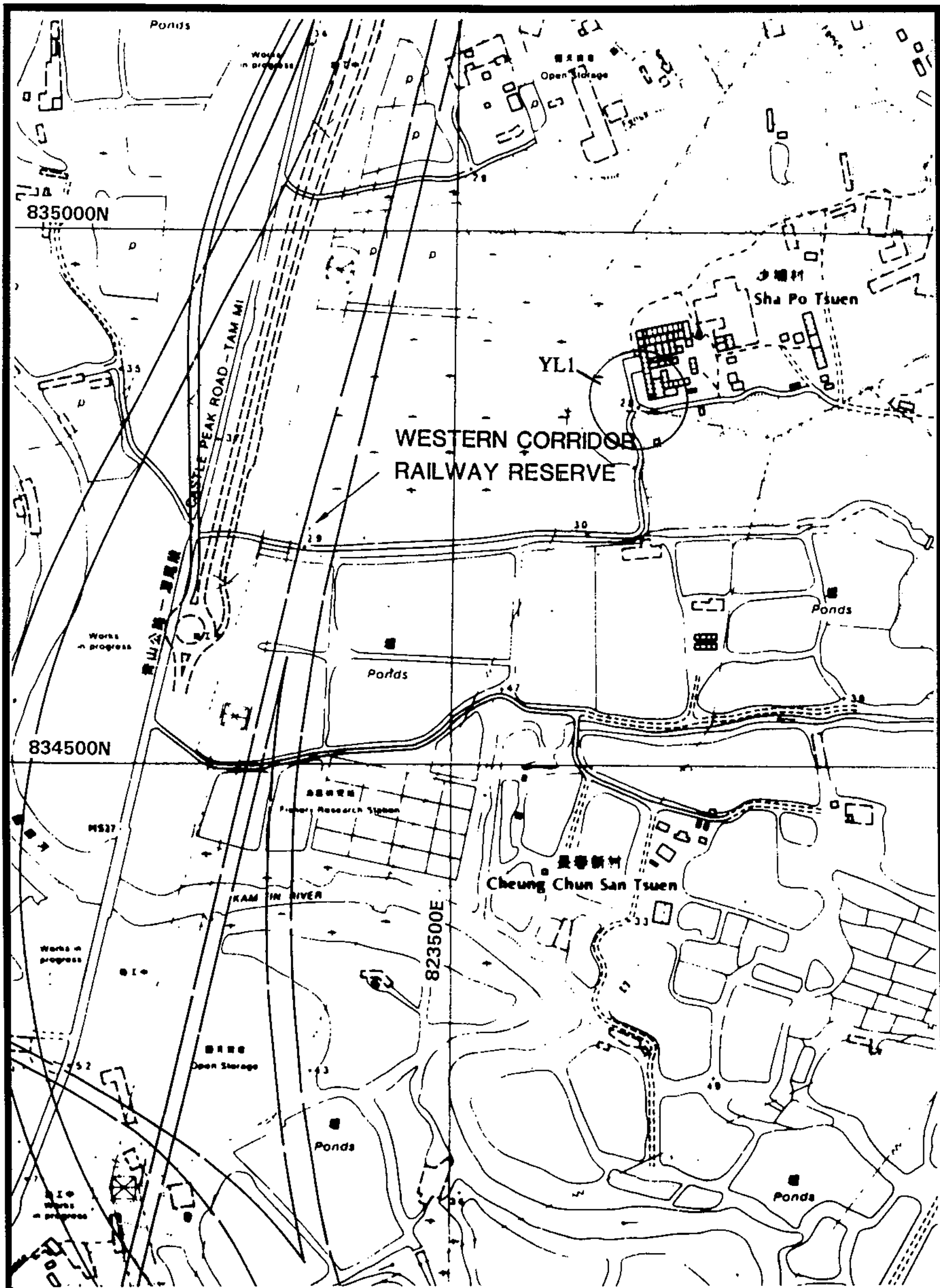
It is predicted that a total of 23 dwellings NSRs would be exposed to noise levels above 70 dB(A) by the unmitigated operation of this section of Route 3 CPS. A 3.5m high noise barrier stretching 650m in length is recommended for the western side of the section of road as shown in Figure 5.4b. A total of six NSRs (referred to as B,C,D,E,F and G in Figure 5.5) will still be exposed to high noise levels, however this predicted number of noise affected receivers is relatively low considering that the road section being assessed is approximately 3.5 km long. It is also considered that more stringent mitigation in the form of higher barriers or enclosures would be very significant in visual terms and not justified on grounds of cost effectiveness. Receiver mitigation is recommended for the six NSRs referred to above. Similarily mitigation at the receiver is considered the most cost effective and appropriate mitigation to reduce noise impacts from Ramp D and associated roads (as detailed in the TKB Report). It is considered that the detailed design Contractor should carry out a further detailed noise assessment.



FREEMAN FOX MAUNSELL

Job Title :	ROUTE 3 COUNTRY PARK SECTION
Drg Title :	Baseline Monitoring Location YL2

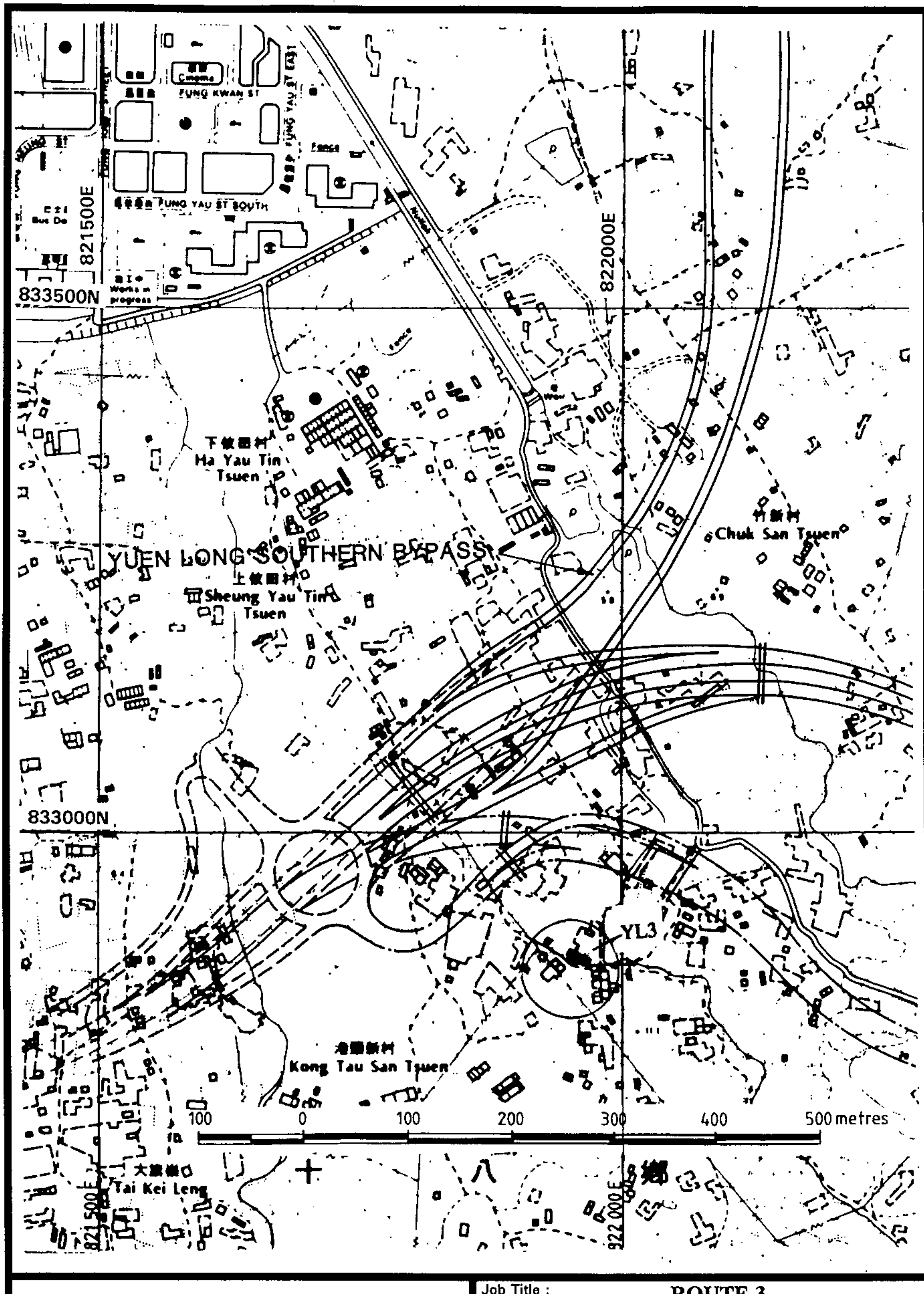
Scale : N.T.S.	Job No.	Fig. No.
Date : Oct. 93	058 000	5.1a



FREEMAN FOX MAUNSELL

Job Title :	ROUTE 3 COUNTRY PARK SECTION
Drg Title :	Baseline Monitoring Location YL1

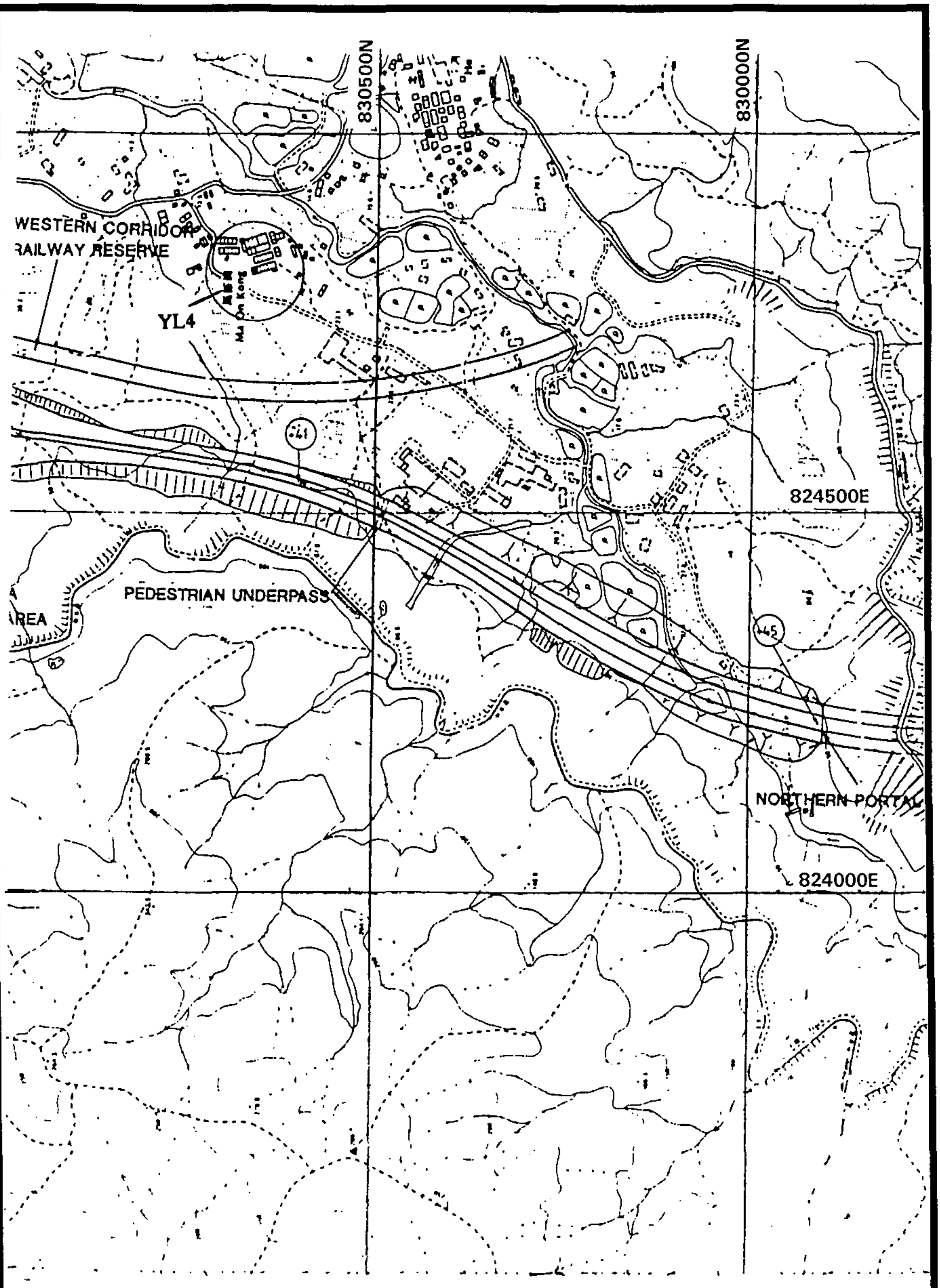
Scale : N.T.S.	Job No.	Fig. No.
Date : Oct. 93	058 000	5.1b



FREEMAN FOX MAUNSELL

Job Title :	ROUTE 3 COUNTRY PARK SECTION
Drg Title :	Baseline Monitoring Location YL3

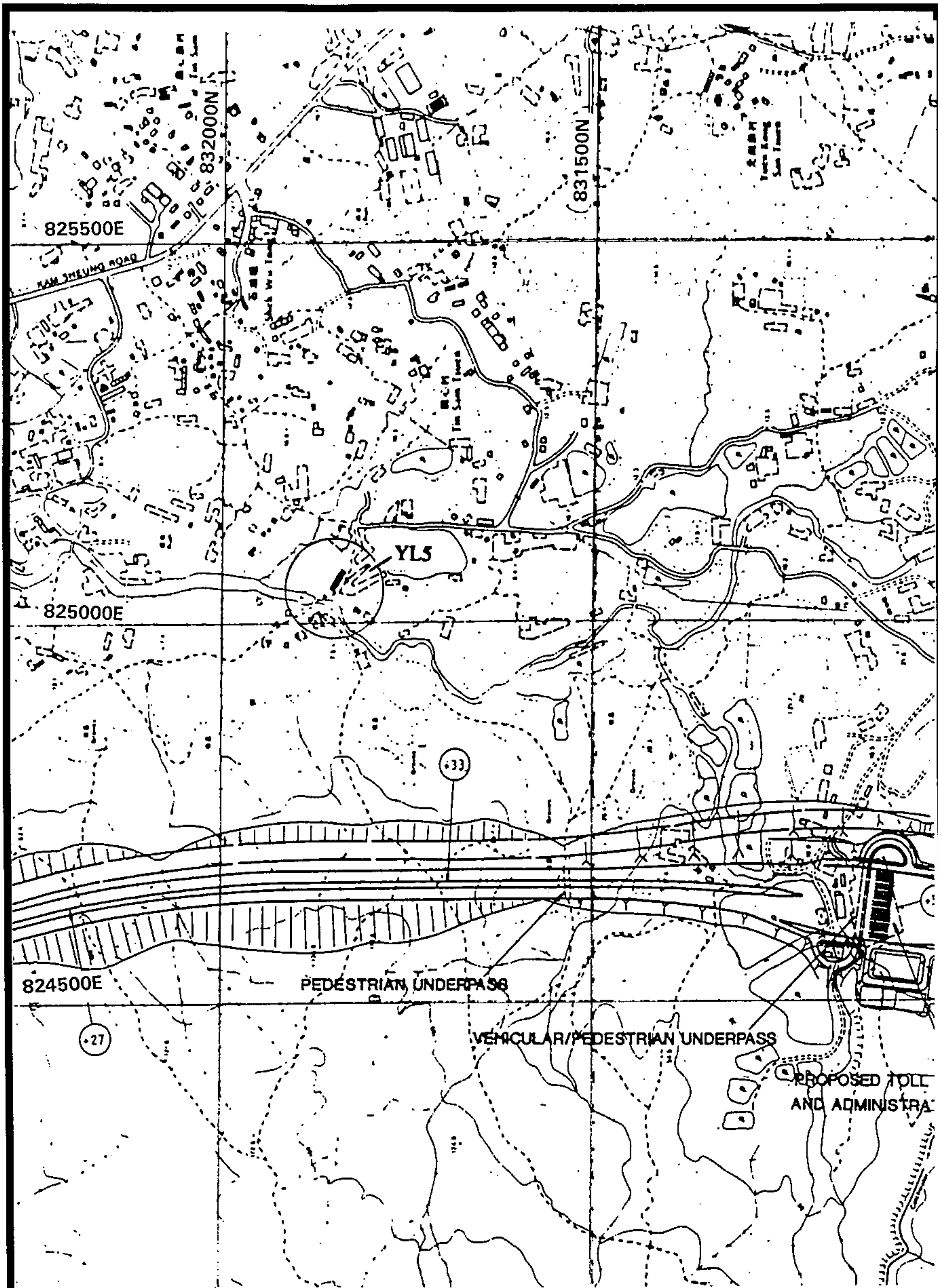
Scale : N.T.S.	Job No.	Fig. No.
Date : Oct. 93	058 000	5.1c



FREEMAN FOX MAUNSELL

Job Title :	ROUTE 3 COUNTRY PARK SECTION
Drg Title :	Baseline Monitoring Location YL4

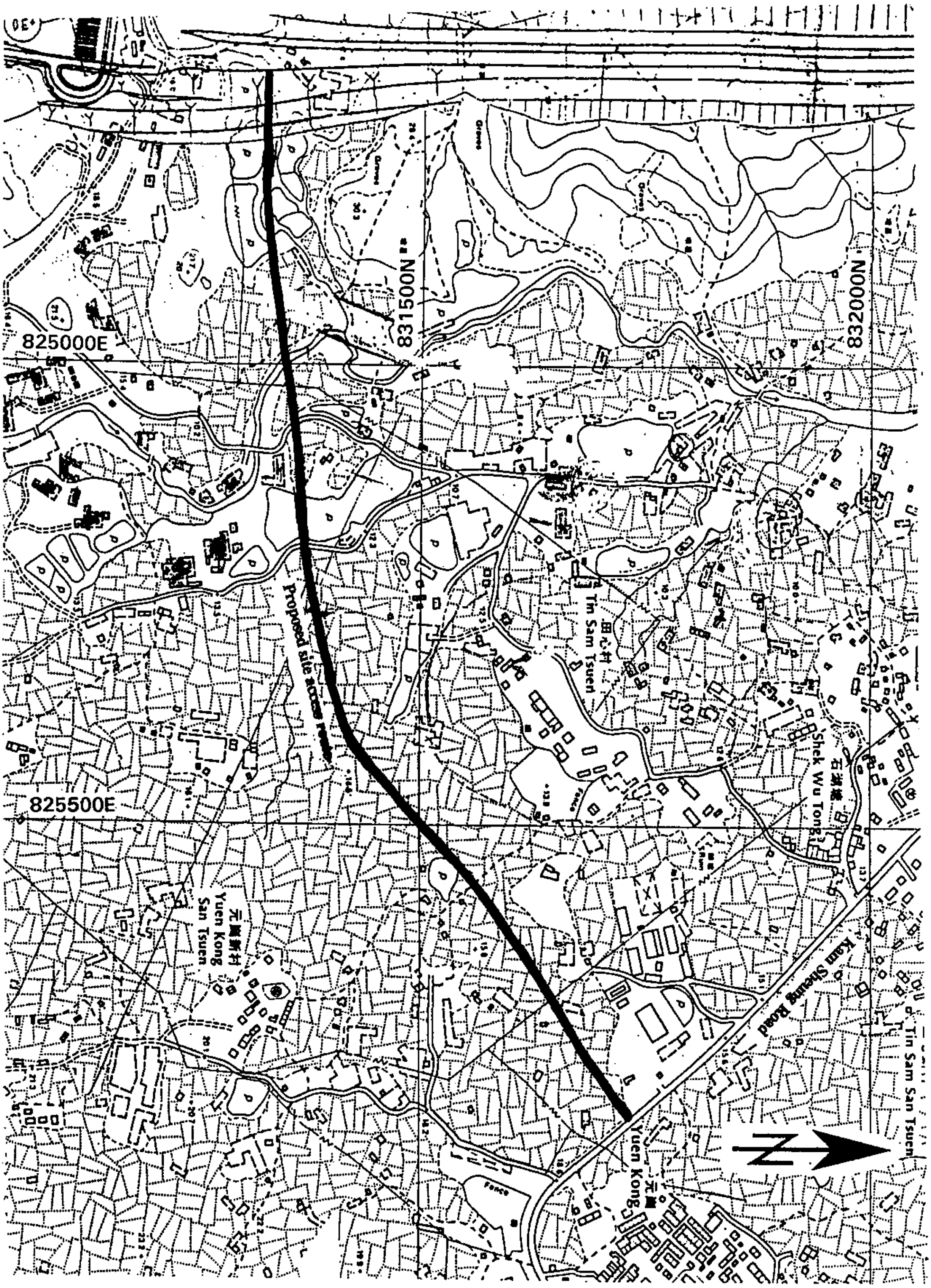
Scale : N.T.S.	Job No.	Fig. No.
Date : Oct. 93	058 000	5.1d



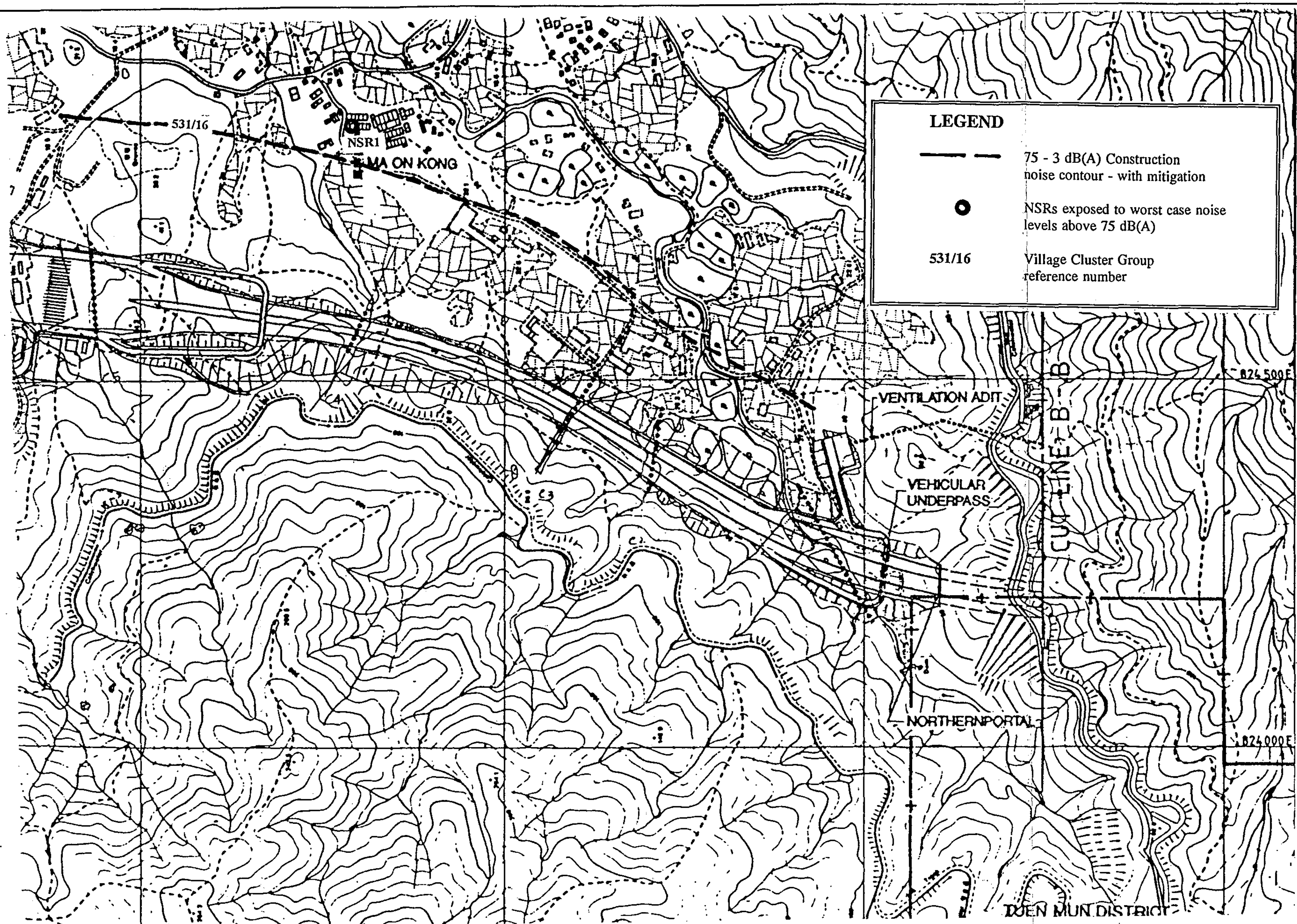
FREEMAN FOX MAUNSELL

Job Title :	ROUTE 3 COUNTRY PARK SECTION
Drg Title :	Baseline Monitoring Location YL5

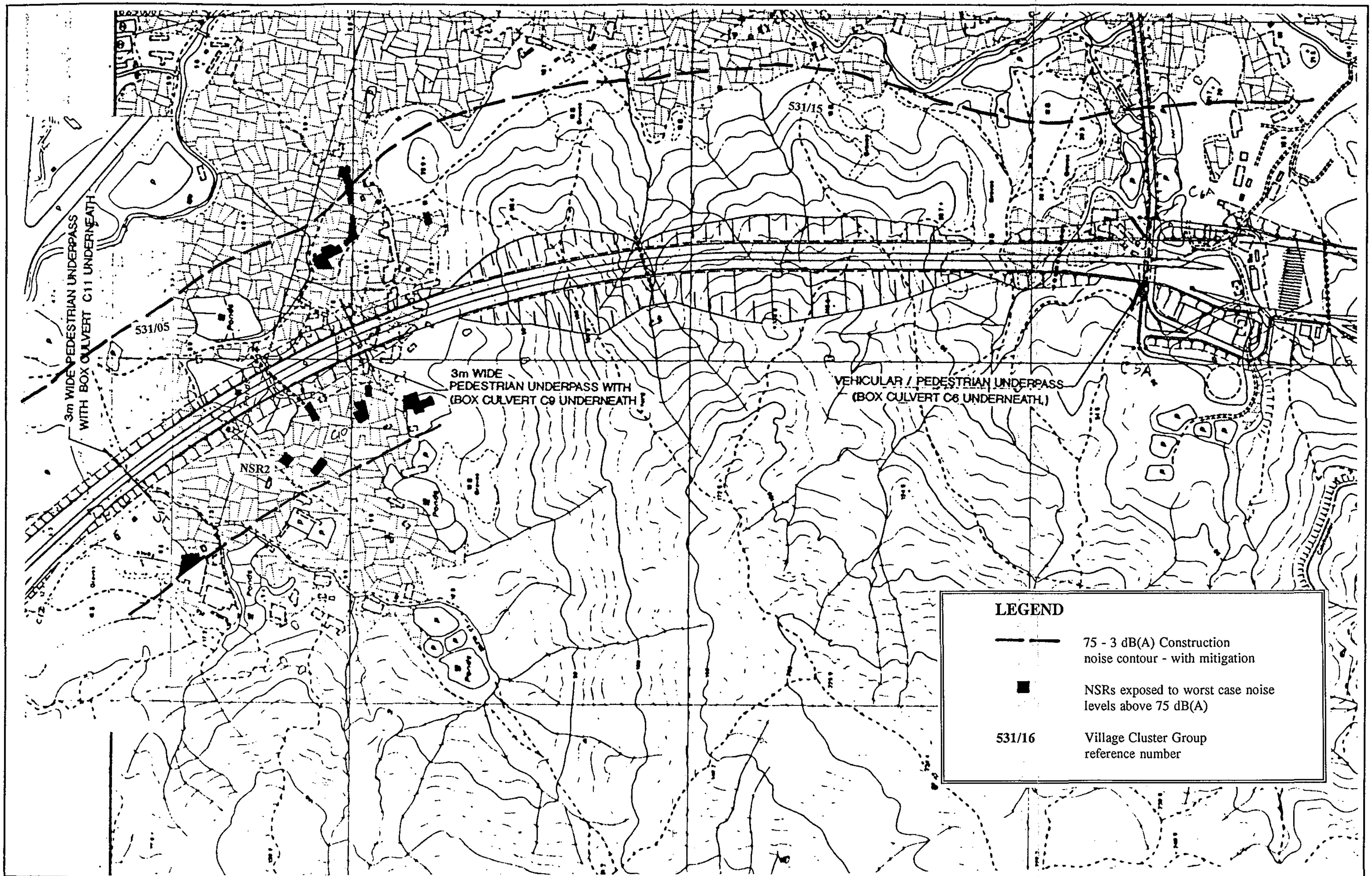
Scale : N.T.S.	Job No.	Fig. No.
Date : Oct. 93	058 000	5.1e



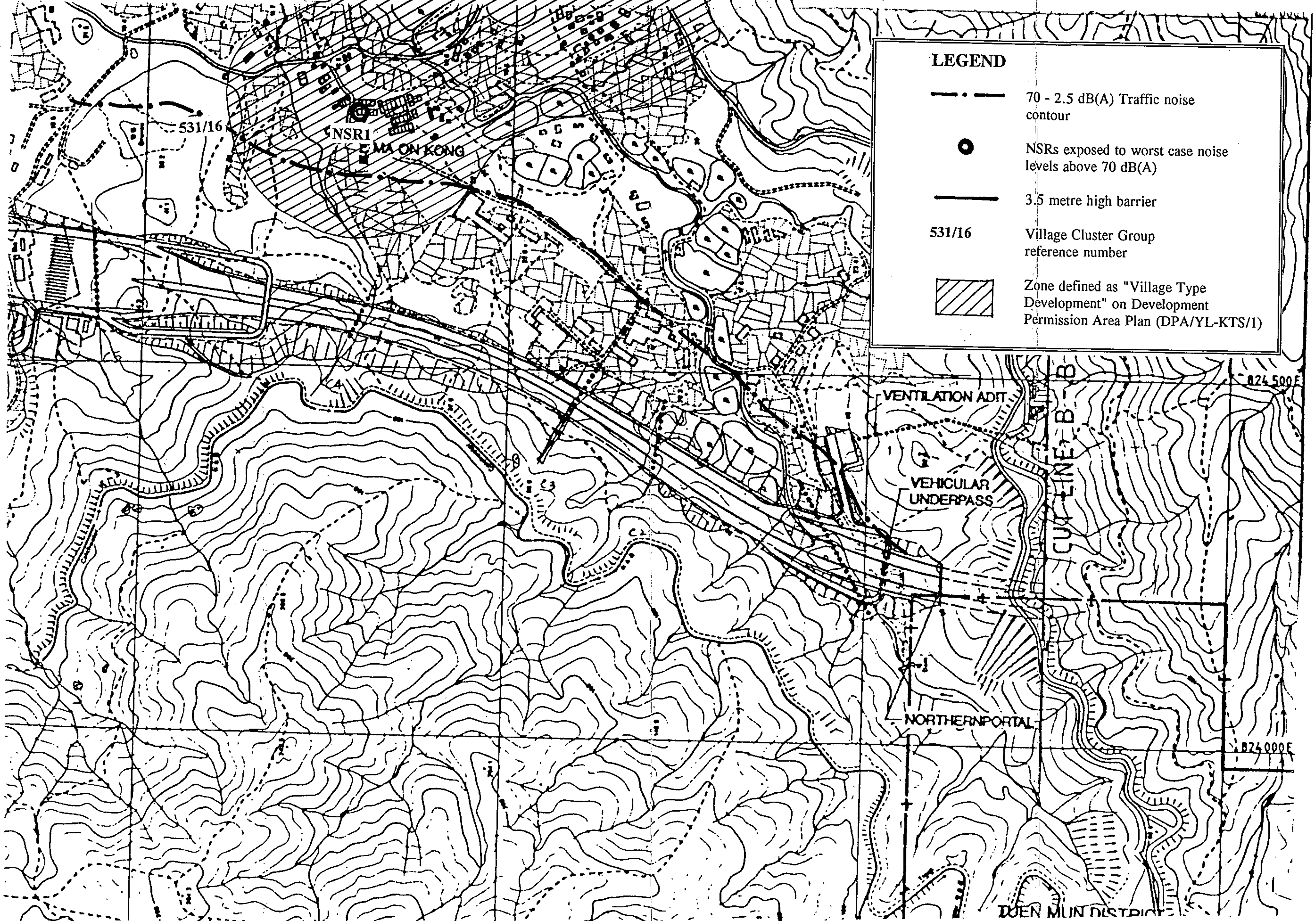
FREEMAN FOX MAUNSELL	Job Title : ROUTE 3 COUNTRY PARK SECTION		
	Drg Title : Site Access Route		
	Scale : N.T.S.	Job No. 058 000	Fig. No. 5.2
	Date : Oct. 93		



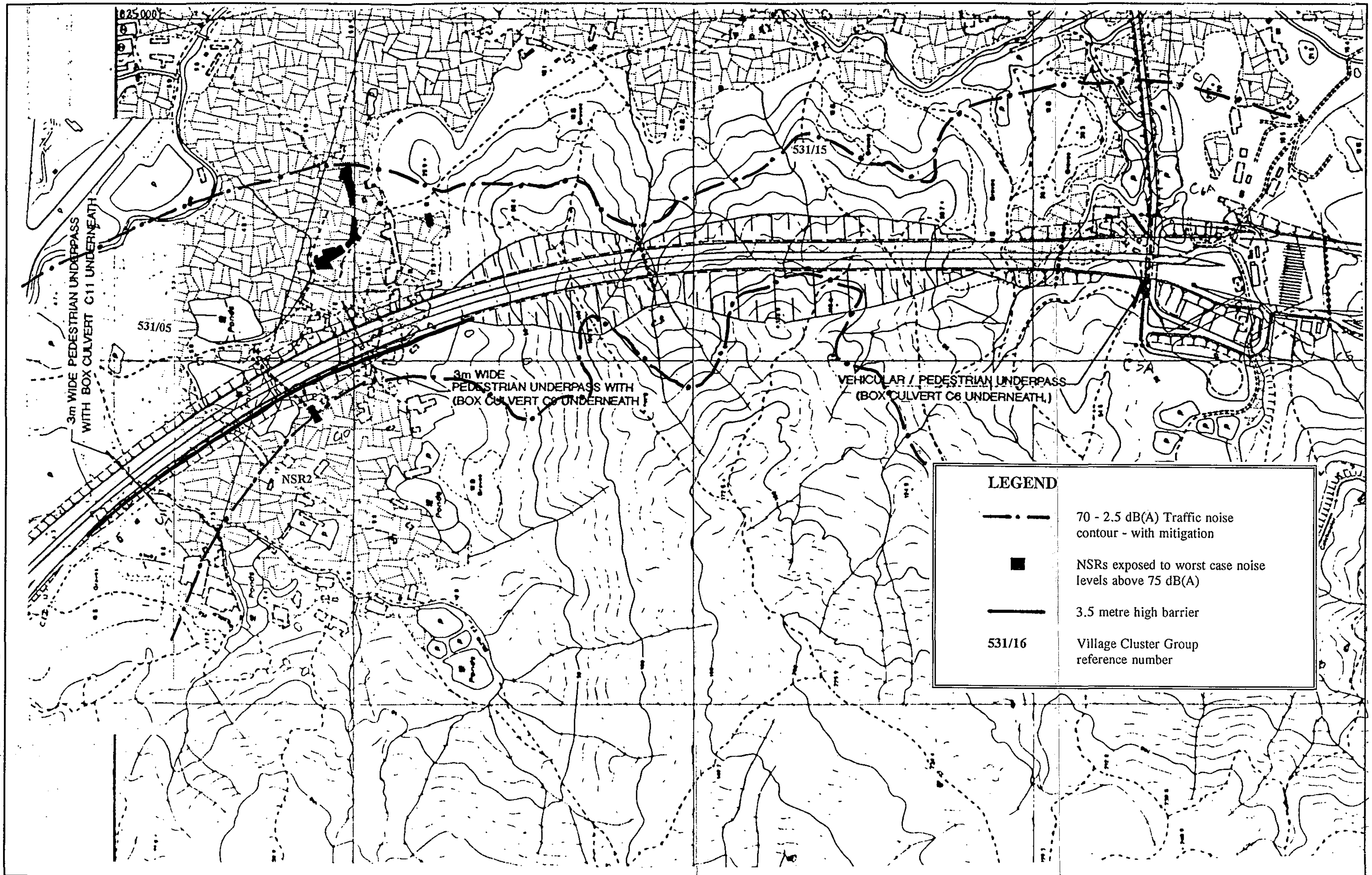
FREEMAN FOX MAUNSELL	Dwg. Title: CONSTRUCTION NOISE CONTOUR (75 - 3 dB(A)) - WITH MITIGATION	Job Title: ROUTE 3 : COUNTRY PARK SECTON EIA		
		Scale: N.T.S. / Date: Jan 1994	Job No. 058000	Fig. No: 5.3a



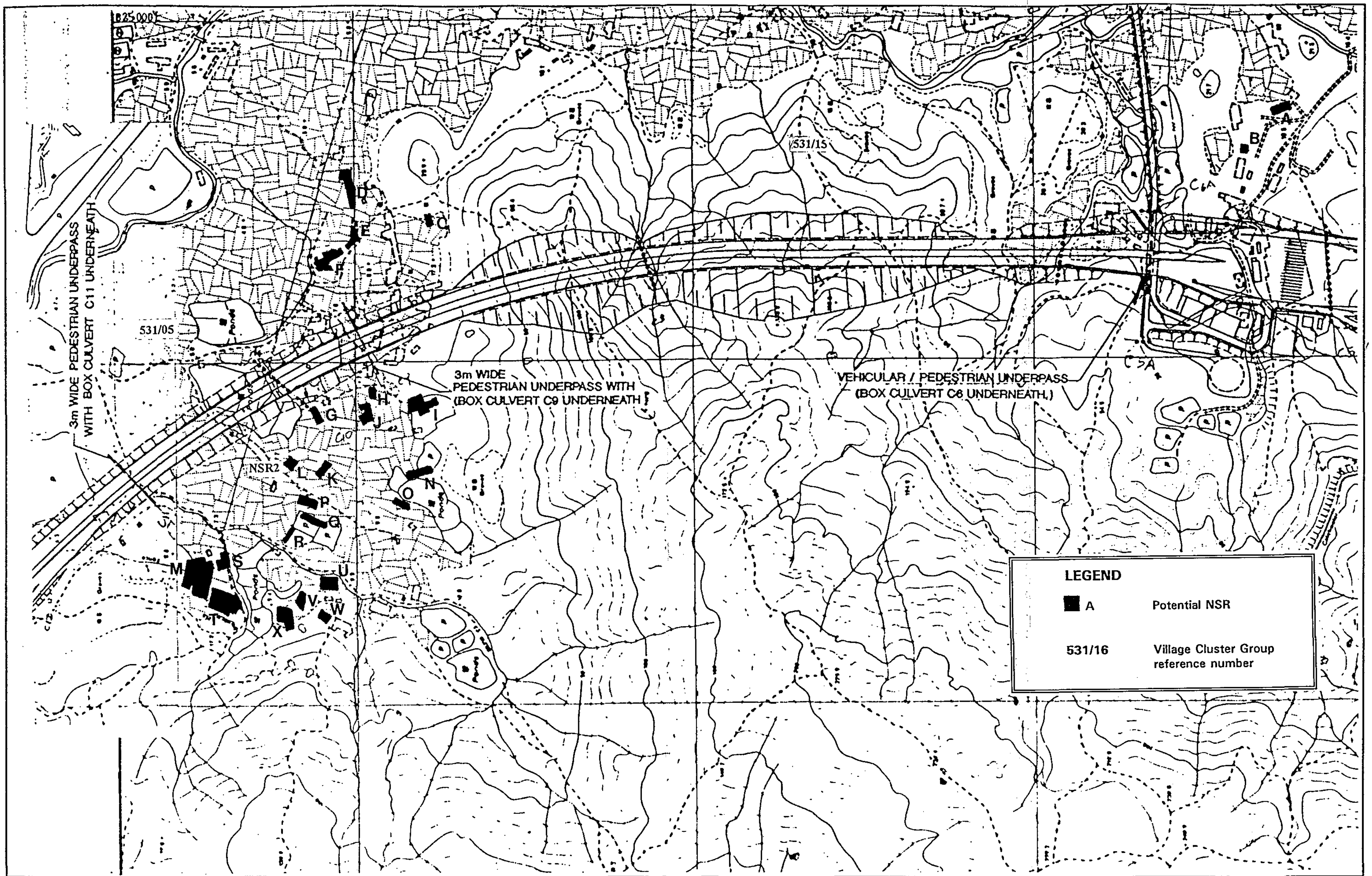
FREEMAN FOX MAUNSELL	Dwg. Title : CONSTRUCTION NOISE CONTOUR (75 - 3 dB(A)) - WITH MITIGATION	Job Title : ROUTE 3 : COUNTRY PARK SECTON EIA		
		Scale : N.T.S. Date : Jan 1994	Job No. 058000	Fig. No: 5.3b



FREEMAN FOX MAUNSELL	Dwg. Title : TRAFFIC NOISE CONTOUR (75 - 2.5 dB(A)) - WITH MITIGATION	Job Title : ROUTE 3 : COUNTRY PARK SECTON EIA		
		Scale : N.T.S. Date : Jan 1994	Job No. 058000	Fig. No: 5.4a



FREEMAN FOX MAUNSELL	Dwg. Title : TRAFFIC NOISE CONTOUR (75 - 2.5 dB(A)) - WITH MITIGATION	Job Title : ROUTE 3 : COUNTRY PARK SECTON EIA
		Scale : N.T.S. Date : Jan 1994 — Job No. 058000 — Fig. No: 5.4b



FREEMAN FOX MAUNSELL	Dwg. Title : LOCATION OF POTENTIAL NSRs	Job Title : ROUTE 3 : COUNTRY PARK SECTON EIA
		Scale : N.T.S. Date : Jan 1994 — Job No. 058000 — Fig. No: 5.5

WATER QUALITY

CHAPTER 6

6. WATER QUALITY

6.1 LOCATION OF SENSITIVE RECEIVERS

Impacts on the freshwater quality of the Study Area will arise during the construction stage of the road. Water quality sensitive receivers near the original Alignment have been identified and these are discussed below and shown in Figures 3.1a, b and c:

- The stream course located in the deep 'V' shaped valley that runs north-east from Sham Tseng. This serves the San Miguel Brewery in Sham Tseng. The stream is directed into two small reservoirs for storage. The collected water is sometimes used by the brewery as flushing water and consequently must be clean. At present the water quality is low and the water is not used by the brewery. The brewery is not dependent on this reservoir.

- The two catchwaters in the Study Area. Both of these drain the eastern area of the Tai Lam Country Park and direct the water towards the Tai Lam Chung Reservoir via a series of water tunnels and open culverts. The first is located at the southern border of the Tai Lam Country Park adjacent to the southern tunnel portal. The second is located at the northern boundary of the Tai Lam Country Park located adjacent to the northern portal of the Tai Lam Tunnel.

- Water tunnel which is located in the area south of TLT & YLA (S). These connect the Tai Lam Chung Reservoir to Tsuen Wan and link the catchwater adjacent to the southern portal, to the Tai Lam Chung reservoir via the Sham Tseng Settlement Basin reservoir.

- Lido Beach. The section of the Alignment immediately above the Ting Kau Interchange crosses the head of the catchment of a stream which drains to Lido Beach.

- Gemini Beach. The spoil produced during the construction of TLT & YLA (S) will be transferred via a conveyor belt system to a barge loading point, located at Gemini Beach. During the loading of the crushed spoil, there could be significant impacts on the local water quality due to spillage during the loading operations with a consequent increase in suspended solids, without appropriate mitigation measures.

- The Kam Tin River, located to the north of the Tai Lam Country Park. This river drains much of the area to the east of Yuen Long, which would be affected by the development of the road. At present the river water quality is classified as 'very bad' by EPD, due to the gross pollution from livestock waste.

- Fish and duck ponds. At present there are extensive areas of land on the Yuen Long flood plain taken up by the ponds. Some of these ponds are in a state of disuse, however correspondence with the Agriculture and Fisheries Department (AFD) indicates that there are many 'active' ponds in the area.

- The two Water Control Zones (WCZ) which drain the study area of the route section. The discharge of effluent into these areas is subject to the controls as laid out in the Water Pollution Control Ordinance (WPCO). The two WCZ's are the Western Buffer WCZ and the Deep Bay WCZ.

6.2 CONSTRUCTION STAGE IMPACTS

6.2.1 Introduction

The construction of the road could create significant impacts on the freshwater quality of the area. Specific activities will lead to a degradation, (although temporary), in water quality. These activities and their impacts are discussed below. The discussion follows the route from the Ting Kau interchange northwards to Yuen Long and is separated into three distinct lengths: Ting Kau interchange to the southern portal; the Tai Lam Tunnel section; and the route north of the northern tunnel portal.

6.2.2 Ting Kau Interchange to the Southern Portal

The impacts associated with this section focus on the extensive land formation works that will occur in and around the saddle which runs from Ting Kau to the deep 'V' shaped valley north west of Sham Tseng. These include the large cutting needed for the road to traverse the valley's eastern flank, the works areas, the excavated spoil transport system, and the effluent derived from the works within the tunnel. Generally, impacts arising during the construction activities would be related to an increase in surface run-off containing high levels of suspended solids (SS). Mitigation measures would largely centre on the control of the filling activities to ensure that excessive amounts of fill material does not escape and cause suspended solids to enter the stream course and the reservoirs down stream.

There are a number of water quality SRs at the head of the Ting Kau Valley, including the head of a catchment, the southern stream of which flows to Lido Beach (Ting Kau) and the northern stream flowing to San Miguel Brewery Reservoir, the catchwater, and a water tunnel.

The earthworks necessary for the approach road cutting (hillside spur east of the portal) will expose large areas of earth. During heavy rainfall events, erosion of these areas will increase and the surface run-off will carry significant amounts of SS. At present, the surface water flows towards the two streams, on either side of the valley saddle. Increases in SS loadings would have significant detrimental effects on the ecology and water quality in these streams and the receiving waters.

The site works area is likely to be located in the cutting at the saddle. In this location there would be offices, plant maintenance areas, the spoil loading and transport system, an explosives magazine, a concrete batching plant, etc. These facilities have the potential to create significant water quality impacts. Spoil storage mounds will, during rainfall events, create run-off with high levels of SS which if uncontrolled would enter the stream courses. Within plant maintenance areas there is a potential that spillage of oils, hydraulic fluids, fuels, etc., will occur. These hydrocarbons could contaminate the surrounding soil and surface waters, and are potentially toxic to fresh water biota.

During the course of construction, large quantities of concrete will be required. A potential source of impact would be the release to surface waters via run-off or other routes, of liquors containing significant quantities of cement derived materials. The discharge or run-off of lime-based materials, if uncontrolled, would be likely to cause the following impacts: localised increases in turbidity, localised elevations in pH and the accretion of high pH solids. Detrimental effects to fresh-water biota would result from contact with elevated levels of pH and sediments in the water.

A further additional impact from the works area would be from any uncontrolled discharge of domestic wastes from canteens, washroom and toilet facilities. The additional BOD, nutrient and faecal bacteria loadings are obviously undesirable as they would have further impacts on the fresh water quality in this area.

The location of the southern portal high on the north western valley side will mean that a section of valley gorge that lies to the east of Sham Tseng will be filled to allow the road to traverse the gorge. At this area where the mainline crosses the valley to enter the southern portal it will be necessary to direct the valley stream through box culverts. During filling, water quality of the stream could be degraded due to significantly increased SS levels and reduced dissolved oxygen (DO) levels.

Unless strict and comprehensive mitigation measures are incorporated into the works contracts, these impacts will adversely affect the fresh water fauna and flora of the stream, owing to increases in turbidity levels; reduced DO levels; the smothering of benthic organisms; and the clogging of fish gills with fine sediments.

6.2.3 Tai Lam Tunnel

It is proposed that the tunnel will be constructed using drill and blast techniques, with works occurring concurrently at both north and south portals. The portal areas can be considered as the sources of water quality impact, as all effluent produced within the tunnels during the construction stage would be directed to these points.

There are a number of water quality SRs in the portal areas that will be affected by both the construction of the tunnel and the approach roads. For the southern portal these SRs include: the catchment area and its stream course; the catchwater, which runs along the southern edge of the Tai Lam Country Park; and the water tunnel which connects the catchwater to the Tai Lam Chung Reservoir, via the Sham Tseng Settlement Basin Reservoir. The northern portal SRs include the upper reaches of the Kam Tin River; a catchwater which runs along the southern foothills of the Kam Tin River Valley; the Kam Tin River flood plain and the numerous fish and duck ponds in the area.

Specific activities within the tunnel that could create impacts include the transport of the excavated material out of the tunnel, any grouting works within the tunnel to stop the ingress of ground waters, and the use of concrete for the tunnel lining. As all effluent produced within the tunnel will be directed to the portals, these impacts will be discussed in the sections for these areas.

6.2.4 Northern Tunnel Portal to Yuen Long

The impacts associated with the tunnel construction and works areas encountered at the northern portal will be the similar in nature to those encountered at the southern portal, discussed above. A number of SRs will be affected, including the Kam Tin River and its tributaries, a catchwater leading to Tai Lam Chung Reservoir and numerous fish and duck ponds distributed about the Yuen Long floodplain.

The northern portal is located below the catchwater. Not far from the portal is a stream that crosses the proposed alignment. As with the stream in the Ting Kau valley it is proposed to divert the stream through a culvert. This would create significant detrimental impacts on the water quality of the stream, thus affecting the local stream ecology.

It should be noted that the existing water quality of the Kam Tin River is classed as very bad by the EPD, and has been for over 10 years. Pollution in the stream is derived from animal wastes and the indiscriminate disposal of domestic wastes into the stream courses. Not withstanding this, any increases in the pollution loading to the river from the construction of Route 3 CPS would be unacceptable.

The Alignment cuts across the western slopes of the Kam Tin Valley, necessitating a large cutting through a spur of hillside partly within the Tai Lam Country Park, and consequently large areas of hill side are exposed during the construction stage and operational stage. This will lead to an increase in the potential for soil erosion during heavy rainfall. Increases of SS in the run-off from these areas would have detrimental effects on the streams that drain the area and the receiving water bodies. In addition the Alignment will cross areas of poor sediments, and it is proposed that these be left in - situ and dewatered using wick drains.

The area is characterised by numerous duck and fish ponds, and those ponds nearby to the route may be affected by run-off from the construction works. These ponds are of significant ecological importance; despite being disturbed and intensively cultivated areas, they provide foraging sites for wild birds and an important habitat for foraging and breeding sites for an abundant population of amphibian and reptilian species.

The toll plaza and administration area is proposed to be located approximately 1.5km north of the northern portal. Direct negative impacts of this location are that a small number of ponds (about five) will be lost. The toll plaza will encompass a large area of land, with potentially significant land and drainage effects. The alluvial deposits in this area are unsuitable for use as foundation material. It had been proposed to remove them and replace the deposits with a suitable graded fill, however this has since been reviewed and the mud is now proposed to be left in-situ.

6.2.5 Mitigation Measures

The key criteria governing 'acceptability' of impact are the Water Quality Objectives gazetted under the Water Pollution Control Ordinance.

Any effluent produced during the construction stage will be subject to control under the WPCO. Guidelines as to the effluent standards that would normally need to be achieved are given in the *Technical Memorandum on the Standards for Effluent Discharged into Drainage and Sewage Systems, Inland and Coastal Waters, January 1991*, (TM). In view of the potential impacts described above, controls should be applied and site run-off treated to prevent or minimise impacts and ensure that they do not cause the quality of the receiving water body to deteriorate such that the gazetted WQOs could not be maintained. Clauses will be included in the construction contracts requiring such measures to be carried out.

Control and treatment measures should include the following:

- site compounds should be designed to take account of contaminated surface water. This will involve the provision of drainage channels and settlement lagoons to allow the interception and controlled release of settled/treated waters;

- discharges from concrete batching plants should be settled and if necessary pH adjustments made to the supernatant liquor. In the event of settlement alone being insufficient to settle colloidal material, consideration should be given to further treatment with settling agents, such as polyelectrolytes, prior to discharge;

- suitable treatment facilities should be included at the site works areas where latrines and/or canteens are to be located so that discharges from these facilities comply with the TM;

- oil interceptors should be provided in site compounds and regularly emptied to prevent release of oil and grease into the surface water drainage systems after accidental spillage. The interceptors should have a by-pass to prevent flushing during high intensity rain storm events. Oil and fuel bunkers should be lined with an impervious material and bunded to prevent discharges owing to accidental spills or breaching of tanks;

- wheel washing facilities should be provided for site vehicles to use prior to leaving site works areas and embarking on public highways;

- the quantities of wastewater should be minimised and construction wastewater should be reused where possible;

- any stockpiles of spoil and fill materials should be treated to reduce erosion and sediment release, e.g. use of coverings and silt traps. In the case of the excavated spoil from the tunnels and Yuen Long flood plain, it may be prudent to provide a separate settlement system to collect and treat contaminated surface waters prior to discharge to the sites' general drainage system;

- where possible, connection of sewage discharges should be to a foul sewerage system. Alternatively, chemical toilet facilities with appropriate disposal arrangements should be considered and provided where necessary. In any office or site canteen, foul water should be directed to either a foul sewer or a treatment facility; and

- it is recommended that a trench to divert and collect run-off from the site during construction/operation should be constructed to avoid stream contamination. It is further recommended to route the section of the stream in close proximity to the Alignment through a box culvert with a short section of pipe to further isolate stream water from contamination.

- steps should be taken to prevent stream and reservoir contamination from the Route 3 associated construction.

6.2.6 Monitoring and Audit Requirements

Monitoring and Audit requirements are given in Chapter 12, some general requirements are:

- discharges should be monitored and managed to achieve compliance with the TM;

- streams and active duck/fish ponds should be monitored to ensure water quality impacts are maintained at acceptable levels.

- inspections should be carried out periodically to ensure that good site practice is being observed and that oil intercepters, grease traps, settlement tanks and lagoons are maintained to ensure that optimum performance is achieved;

- in the case of wastes containing cement derived materials and cementations wastewaters, periodic checks should be made on the pH of the liquors discharged and the receiving waters immediately surrounding the discharge point; and

- periodic inspection of oil interceptors should be made to ensure that these are working satisfactorily and that any oily wastes are regularly collected. For appropriate disposal off-site these materials would be classified as chemical waste under the Chemical Waste Ordinance, and as such would have to be collected and disposed of by a licensed chemical waste contractor. The contractor would have to register as a chemical waste producer.

6.3 OPERATIONAL STAGE IMPACTS

6.3.1 The operational phase impacts should be significantly less than the construction stage. The main potential impact is from the run-off of the road and its associated sliproads, and the transport of materials to fresh water bodies and eventually the sea.

The main sources of potential impact are:

- run-off of contaminated surface waters;
- the accumulation of sediments on the road and the sliproads;
- run-off of contaminated wash-water produced during tunnel maintenance and cleaning;
- contamination with hydrocarbons and other materials resulting from the vehicular usage of the road;
- run-off and contamination with hazardous and toxic materials following accidental spillage and road traffic accidents;
- the replacement of many of the streams in the area with predominantly straight concrete lined channels. This will significantly alter the velocity distribution and hence the aquatic regime, and the consequences of these actions must be addressed in the detailed design stage. In the short term, velocities will increase leading to an enhanced transportation of sediment from the middle portions of the Kam Tin Basin. The sediment load will be deposited in the mangrove areas proposed in the downstream reaches of the Shan Pui and Kam Tin Rivers and ultimately, Deep Bay.

Sediment loads in the run-off from the road are likely to be small. The most likely sections of the road for the incidence of silt and debris build-up would be the slightly depressed and at grade sections. The quantities of sediment involved in run-off from the road would not be significant and would be similar to those which might be expected for the surrounding area. Initially, impacts on freshwater from run-off could be significant, but this would be reduced as the landscape works become established.

Contamination can arise from the loss of oil and petroleum from passing motor vehicles. Contamination from lead, zinc and cadmium also arises as a result of traffic, which can be a major source of these toxic heavy metals. However it is felt that the quantities of these elements found in the run-off from the road would not be expected to be any different to those found in any urban run-off derived from large scale vehicular transport infrastructure.

The discharge of this run-off would be unlikely to produce any quantifiable adverse impacts and does not justify the incorporation of special mitigation measures.

The potential spillage of hazardous/toxic materials as a result of a traffic accident could have significant impacts on the freshwater quality of the receiving water bodies. However, the traffic accidents involving such materials would be anticipated to be very infrequent. The number of variables involved makes the incidence of such events difficult to predict and assess.

The Tai Lam Tunnel will drain by gravity towards the northern portal. Wash-water created during the tunnel maintenance and cleaning operations are likely to contain high levels of sediments which may be contaminated with heavy metals, zinc, lead and cadmium, and also surfactants which would be used to clean the tunnel walls. The discharge of this effluent to a freshwater course might create significant impacts on the water quality and subsequently the biota present in the streams, especially if the contaminants are present in high concentrations.

6.3.2 Mitigation Measures

The transport of sediments, albeit small quantities, from the road to the fresh water environment would be minimised by the incorporation of appropriate sediment traps within the roadway drainage system.

Reduction or prevention of impacts arising from the spillage of hazardous materials could be effected by the installation of 'close-off' valves at strategic points within the roadway's drainage system. In the event of a road traffic accident involving the spillage of hazardous/toxic compounds, the valves would be closed thereby sealing the system and preventing the spilled material from reaching the environment. Assuming that rain is not occurring, the spilled material would be contained within the drainage system and could be removed for disposal.

The frequency of such accident events is low, and it would be hard to justify the additional costs of a system described above. However, for certain sections of the Alignment it would be possible to contain localised system drainage of potential concern. One such section is the Tai Lam Tunnel, where the drainage system gravitates to the northern portal and it would be possible to intercept all the flows originating from within the tunnel. The collected flows could then be treated to remove the contaminants prior to discharge. At places where the incorporation of a closed drainage system is too costly and impracticable, any spilled materials should be contained and recovered, rather than allowing them to enter the drainage systems.

6.3.3 Monitoring

With the exception of routine inspection and maintenance of the drainage system to ensure that sediments traps and any close-off valves within the system are cleared and in good working order, no other monitoring would be required. Outline monitoring schedules and audit requirements are presented in Chapter 12.

6.4 CONCLUSIONS

During the construction phase, the key issues will be the prevention of run-off which is contaminated with chemicals, fuels, oils, sewage and high SS from entering the water courses, and thus the marine waters. Suitable clauses should be included in the contract documentation to limit any impacts to acceptable levels.

Impacts arising during the operational phase will be related to road traffic accidents and the spillage of toxic and/or hazardous materials, and the roadway run-off, which may contain high levels of SS. The latter would be especially important during the early years of operation, when the landscaping and revegetation works are not fully established. Suitable clauses should be included in the contract documentation to ensure impacts are maintained at acceptable levels.

WASTE AND SPOIL MANAGEMENT

CHAPTER 7

7. WASTE AND SPOIL MANAGEMENT

7.1 INTRODUCTION

The earth works on the Route 3 CPS project fall essentially into two distinct geographical areas either side of the Tai Lam Tunnel. To the south of the tunnel there will be a large surplus and north of the tunnel where there will be a smaller surplus. (Previous alignments involved a deficit in the section north of the tunnel and therefore the use of remote borrow areas. However the adopted alignment achieves a better balance of cut/fill requirements within the works site which has removed the need for borrow areas and all the associated environmental impacts related to them).

The dividing line between the TKB section and the TLT & YLA (S) section of the route is near the abutment position north of Tuen Mun Road and is shown in Figure 1.1. The spoil arising near to the southern portal of the Tai Lam Tunnel is therefore in the TLT & YLA (S) section, however the proposed disposal route(s) are to the south and technically within the TKB study area. This issue is therefore discussed in both the TKB and TLT & YLA EIAs as appropriate.

7.2 GENERAL CONSTRUCTION WASTES

7.2.1 Waste Arisings

Wastes will arise from numerous construction activities and sources, of which the main ones includes:

- demolition, clearance and site preparation;
- excavation for foundation works;
- residues from construction materials/processes;
- plant and vehicle maintenance and servicing; and
- workforce generated wastes.

In addition, it is possible that some of the demolition and excavation wastes could have been contaminated from previous uses or activities. Therefore a brief study of current and previous land uses of the areas where demolition and excavation are planned will eventually need to be carried out.

If the construction processes produce chemical wastes then the Contractor will be required to register with EPD as a Chemical Waste Producer and provide information including:

- particulars of the waste producer, a nominated contact person and type of business;
- particulars of the waste generation processes and location of waste arising; and
- waste types, quantities and generation rate.

All wastes which fall within the definition of chemical waste as provided in the Waste Disposal (Chemical Waste) (General) Regulation will require disposal by appropriate means (such as to the Chemical Waste Treatment Facility) and may require pre-notification to EPD before disposal.

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 Practise on the

Packaging Labelling and Storage of Chemical Wastes.

As the precise location of the works areas, and the construction methods are unknown and will be determined by the Contractor it is not possible at this stage to estimate the extent and nature of wastes. However these wastes are discussed in general terms.

7.2.2 Demolition, Clearance and Site Preparation

There will be a need for vegetation clearance and demolition of the existing buildings. Wastes will also arise from site preparation activities both at the proposed works sites and the landfall sites and these will consist mainly of concrete, cement and soil.

7.2.3 Excavation for Foundation Works

The excavation required for foundation works could include material from piling operations and other foundation activities.

The information available regarding previous landuse for the likely excavation areas has not given any indication of significant industrial activities or other polluting activities and this would be suitable for reuse as fill material.

7.2.4 Residues from Construction Materials/Processes

The residues from construction materials could include:

- cement and grout from on site concrete activities;
- waterproofing and curing materials;
- bitumen; and
- concrete dust from removal of rough edges and general finishing of units.

The residues from these sources should be of limited quantity. It will be very important to monitor and enforce site cleanliness and good housekeeping.

7.2.5 Plant and Vehicle Maintenance

The main items of construction plant and equipment will require regular maintenance and servicing for efficiency reasons as well as to minimise noise and air pollutant emissions. This will generate limited quantities of dirty lubricants, spent air and oil filters and other sundry materials. While relatively inert and solid materials, such as the air filters, are suitable for landfill disposal and can be disposed of via the normal waste stream it is important to prevent oil, grease, gearbox fluids etc., from contaminating the groundwater or land. Thus an acceptable system for collection, storage and proper disposal will be required. It may be possible to identify a recycling Contractor for the waste oil and this will be worth consideration at the appropriate time.

Waste oil, grease, gearbox fluids are classified as chemical waste. If they are not recycled, they should be treated at the Chemical Waste Treatment Centre.

7.2.6 Workforce Generated Wastes

Waste from the workforce engaged in construction will comprise of general refuse such as food scraps, paper and empty containers etc., and also sewage. The general refuse will be of only minimal quantities and therefore is insignificant. Temporary toilets and wash facilities (as well as refuse containers) should be provided by the Contractor for use by the workforce.

7.3 SPOIL ARISINGS AND FILL REQUIREMENTS

7.3.1 Main Spoil Generation Locations

There are three main areas of construction activity associated with the Alignment where surplus spoil or excavation material will be generated (the Tai Lam Tunnel portals are considered as two separate areas as they are physically separated):

- Ting Kau - where a major excavation is required to prepare the formation for the Ting Kau Interchange and the approach to the southern portal of the Tai Lam Tunnel. This will generate in the region of 5.5Mm^3.

- Tai Lam Tunnel - where the estimated volume of tunnel spoil arising is approximately 1Mm^3. It is anticipated that this will be divided equally between the northern portal and southern portal and therefore represents just over half a million m^3 each.

- North of the tunnel - where a major cutting is required to facilitate moving the alignment out of the flood plain. This will generate an estimated 2Mm^3 of material.

It is proposed that the surplus excavated material to the south of the tunnel will be transported to a barge loading point at Gemini Beach (west) via a fixed, covered, conveyor system. The handling and transport of spoil is discussed in Section 7.5.

The Route will run in a cutting along the western Kam Tin Valley side rather than on the floor of the valley as originally proposed and it will not therefore be necessary to remove the soft material from the agricultural areas and ponds from as many locations although some ponds and low lying fields will still be affected. It is also proposed to carry out construction on a 'soft material retained basis' in the area further north in the Yuen Long Approach.

7.3.2 Fill Requirements

As the Alignment has been designed to achieve a better balance of cut/excavation and fill requirements than previous alternatives (Draft EIA, July 1993), it is anticipated that no fill material need be imported.

7.4 SPOIL DISPOSAL

7.4.1 Disposal Options

Reuse as Fill within the Project

As has already been indicated the preferred option for dealing with excavated spoil would be to use it as fill material either within the TLT & YLA (S) or along the rest of the Route 3 CPS alignment. Thus the aim is to achieve a balance of cut/excavation and fill requirements, and consideration has been given to design changes which would reduce the excess material and involve reuse of the remaining material wherever practicable.

Reuse as Fill for other Projects

Given the current level of activity and number of major projects in the Territory, including Airport Core Projects, reuse as fill for other projects should be a viable option. Obviously from both a cost and environmental view point the less spoil handling and transportation required the better and nearby projects would be favoured. There will be a requirement for physical preparation of the material to ensure its suitability as a fill material.

As a consequence of the traffic impact to local roads, practicalities of haulage of such a large volume by truck and the difficulty in transporting spoil due to the topography, it is proposed that a covered conveyor belt system be used to transport the $6Mm^3$ of spoil from the major cutting south of the Tai Lam Tunnel to a waterfront location on the Rambler Channel. It will then be possible to load the spoil into barges for marine transportation to the utilisation location. The projects which can receive barge-transported material will be the most appropriate recipients of this material. It has also been proposed that some of the surplus material from north of the tunnel is utilised in making embankments for the Northern Corridor Railway. However the timing would require this to be advance works for the Railway.

7.4.2 Discussion

A review of the quantities of rock/soft material identified for the main area of the southern tunnel portal and the major cutting to the south of this indicates a nett total surplus of such material amounting to some $6mm^3$ Discussions with the Fill Management Committee (FMC) indicated a desire to ensure that any such surplus suitable material is used in other contracts exhibiting a corresponding deficit.

It is presently expected that given the requirement to construct the breakwater early to facilitate construction of Ting Kau Bridge north tower, the majority of material excavated in the early part of the contract period will be utilised in construction of this item. It may, therefore, be assumed that the surplus material will become available thereafter, i.e. from 1996 onwards.

Reference to the FMC's Database of Fill Requirements and Surpluses (dated March 1992) indicates several projects with a requirement for land source fill during the required time period. Of particular note is the nearby Lantau Port Development with a land source fill requirement in excess of $10Mm^3$/year between 1996 and 2000 inclusive. It is possible that all surplus rock/soft material from the southern tunnel portal and the approach from the Ting Kau Interchange could be taken by barge to the Lantau Port Development and used for reclamation purposes.

It is appreciated that this possibility would be dependent on the respective project timings. However current projections for the Lantau Port Development - Container Terminals 10 & 11 appear favourable with scheduled commissioning of berths during 1997 and 1998 and reclamation activities therefore required prior to and during this period. It should also be noted that Civil Engineering Department (CED) have advised that any material would require to be crushed and screened to appropriate size prior to loading onto barges.

In addition, CED suggest that a fall-back disposal option should be identified in parallel. This fall-back disposal option would ideally be another major reclamation project. It is not productive to attempt to specify any individual project as a fall-back as potentially this would be subject to the same delays, or problems etc., as the Lantau Port Development. Therefore it is considered that the fall-back should be which ever suitable project is available at the appropriate time. This can be identified at a later stage when projects are firmly committed. Notwithstanding the above, the Tseung Kwan O reclamation is another identified project with a requirement for fill material.

The use of spoil of the Railway embankments is preferred from an environmental point of view, and while it is important to bring this issue to the Contractor's attention, it will have to be resolved during the detailed design stage.

7.5 SPOIL DISPOSAL IMPACTS

7.5.1 Introduction

In terms of the potential for environmental effects, spoil disposal activities can be considered to be essentially limited to construction related impacts, although further consideration needs to be given to end state impacts. These are effects related to the restoration, aftercare and longer-term use of a selected disposal location. This only applies within the TLT & YLA project area, as if spoil is supplied to other projects (such as the Lantau Port Development reclamation) or is disposed of to a marine site then any end state restoration etc., will be outside of the TLT & YLA project's control.

7.5.2 Construction Related Impacts

These are effects specifically related to construction and disposal activities, most importantly these include:

- production and handling of spoil at construction sites;
- temporary storage or stockpiling of spoil;
- transport of spoil to disposal sites; and
- treatment and placement of spoil within a disposal site.

The avoidance or mitigation of environmental effects is a primary objective of this study. In the simplest situations this has involved the choice of the least environmentally damaging disposal option. At the site specific level a range of environmental protection measures are likely to be required including:

- measures aimed at avoiding damage such as ensuring transport and access routes bypass sensitive areas such as residential areas or areas of high ecological interest; and

- the design and programming of site disposal activities to minimise long term impact and maximise environmental gain.

The range of activities involved in spoil disposal, and the potential environmental effects and opportunities to mitigate them, are discussed below.

7.5.3 Production and Handling of Spoil

At the main locations within the TLT & YLA (S) section where spoil will arise, it will be important to ensure that all spoil handling activities are carried out using techniques which minimise the escape of fugitive dust, particularly during periods of dry and windy weather.

This will require minimal handling, use of dust control equipment such as covered hoppers and mitigation measures such as fine water sprays and dust sheeting of vehicles.

Similarly, prevention of run-off and/or leachate carrying high levels of silt from escaping from the spoil handling areas will be necessary particularly for large scale operations and during wet weather. This will require covering of handling areas and measures to divert rainwater and surface water and prevent ingress to the handling areas.

Current estimates of earthwork quantities indicate an overall surplus of material north of the tunnel. It is proposed that some of this may be used in forming the embankments for the Western Corridor Railway. If not, over 0.5Mm^3 will require disposal in construction sites in the Kam Tin/Yuen Long area.

The spoil arising from the southern portal of the Tai Lam Tunnel and the major cutting between this portal and the Ting Kau Interchange will be transported by truck to the start of the conveyor belt. While definitive details are not available it is proposed that this location for the start of the main conveyor will remain fixed and a short movable and extendable length of conveyor may be added to service the various cutting faces. Spoil will be trucked to the movable conveyor from the place of arising, which will vary with time.

A handling and pretreatment (crushing and screening) area will be required. Ideally spoil will be loaded onto the conveyor belt directly from the pretreatment equipment to prevent double handling, possibly by utilising a direct feed and hopper arrangement. In practise temporary storage in spoil heaps etc., will probably be required and these are therefore discussed in Section 7.5.3.

An area will be prepared on the north coast of the Rambler Channel to enable a barge loading facility to be constructed. The location of such a barge loading area to cope with say 10,000m^3 of spoil per day would potentially have major impact on the amenity use of the chosen location. It is proposed that Gemini Beach is used. This issue is discussed in detail in a Supplementary Report called the Route 3, CPS-TLT & YLA Conveyor System Environmental Assessment, which will be a separate document but is part of this EIA.

7.5.4 Stockpiling of Spoil

It is expected that stockpiling of spoil will be necessary for operational reasons. This is because it is not realistic to plan for the removal of spoil (from the various locations where it will arise) at exactly the same rate as it is transported and/or deposited:

- Whatever transportation systems are used, they are unlikely to possess sufficient capacity to remove all surplus spoil as it is delivered.

- It is anticipated that some construction activities (such as tunnelling) will operate 24 hours per day but spoil removal and transport may not be permitted to occur outside of pre-set working hours because of potential disturbance and nuisance. Thus spoil will accumulate at various handling locations awaiting disposal.

It is possible that each construction site and some of the transport rehandling locations will require a spoil stockpile to accommodate disruptions to the spoil transport and disposal system (such as would occur due to extreme weather). The size and use of stockpiles will be dependent on a number of factors including size, location and physical layout of each site and the method of spoil transport employed. It would be prudent to allow for sufficient capacity to accommodate several days throughput at each location.

The creation of spoil stockpiles presents a particular set of potential environmental problems. However, it is necessary to know specific details regarding the expected size and location of stockpiles and the nature and physical condition of the spoil to accurately predict the specific impacts at each site. As the quantities of spoil arising, disposal locations and routes are uncertain and subject to change, this issue will best be covered at the detailed design stage where acceptable proposals for managing and controlling impacts at stockpiles (and for all spoil handling and transport) should be required as a contract condition.

The key impacts that need to be considered in respect of each stockpile site include:

- Noise from plant used for movement of spoil at the stockpile locations and its potential impact on local residents.
- The handling of dry material and drying out of stockpiled material could result in increases in airborne dust, and deposition within homes and on surrounding vegetation.
- Water run-off and/or leachate from stockpiled spoil material; two key concerns are:
    - contamination of surface water which could affect habitat areas and lead to temporary increases in turbidity in surrounding water bodies; and
    - contamination of groundwater.
- Temporary land take. Some land chosen for temporary stockpiling may be used for agriculture, recreational use etc..
- Visual intrusion. If poorly sited, stockpiles are likely to be unacceptable to the local population and County Park visitors.

7.5.5 Transport of Spoil

The transport of spoil from source to the disposal site(s) consists of two main aspects:

- the movement of material by the primary mode(s) of transport i.e. road, conveyor, marine barge, etc; and
- the handling and subsequent transport at or near the disposal site to achieve access to, and distribution within, the particular site.

Transport costs increase with both the distance travelled and time taken. Similarly, other things being equal, the nuisance due to transport of spoil is reduced for closer sites. Therefore, from both a cost and environmental viewpoint, disposal sites nearer to the point of arisings are preferable, provided the transport infrastructure connecting them is adequate.

The choice of transport method is usually governed to a large extent by the overall quantity of spoil, its rate of production and the location at which it arises.

The types of trucks to be used will depend on the accessibility of the construction sites, and the susceptibility of the surrounding environment to disturbance. Generally, in order to keep the number of truck loads to a minimum and in the interests of economy, the largest trucks permissable are expected to be used.

In general, the advantages of road transport of spoil are:

- suitability for small quantities of spoil;
- high flexibility, allowing for changes in the point of arising and the disposal site; and
- no need for secondary handling as trucks can usually drive up to the disposal point.

The disadvantages of road transport of spoil include:

- uneconomic over large distances;
- relatively small capacity; and
- high potential nuisance.

More specifically large quantities of spoil will arise from the cutting for the section between the Ting Kau Interchange and the Southern Portal of the Tai Lam Tunnel. The handling aspects are discussed in Section 7.4.2. Given the environmental and logistic benefits, based on a 12 hour day, over 2 trucks every minute, each way would be required for road haulage disposal) it is proposed that the spoil will be transported by a covered conveyor belt.

The proposed route for this conveyor system passes through the TKB Section and it has been selected to avoid SRs as far as possible and crosses the Tuen Mun Road on a bridge to a barge loading point at Gemini Beach. This transport method is environmentally preferred as it will either completely remove or minimise potential impacts from vehicular transport, traffic disruption, dust and noise emission and should reduce spillage.

7.5.6 Treatment and Placement at Disposal Site

If the preferred spoil disposal option is realised, i.e. reuse of material for reclamation, then the treatment will be limited to ensuring that the material is acceptable to the receiving project. This will involve crushing and screening of material.

The placement of material will be under the control of the project manager/engineer. For contaminated material and if the reuse option becomes impracticable and marine dumping is required then standard procedures agreed with EPD will need to be strictly followed including controls to prevent 'short dumping' or any malpractice.

7.6 PROTECTION AND MITIGATION MEASURES

Specific protection and mitigation measures which may be considered where impacts are anticipated are as follows:

- Noise reduction: by selection of quietest plant and working methods and limiting hours of operation, if necessary.

- Attenuation of noise, control of dust spread and reduction in visual intrusion: by carefully locating stockpiles in relation to existing topography, creating new earth bunds and retaining existing tree belts.

- Prevention of surface water pollution, by banding and directing run-off to settlement ponds.

- Minimising land take, particularly productive land, by limiting the size of the stockpiles and associated working areas.

- Protecting productive agriculture, important habitats and landscape features, and fencing all the boundaries to keep the working areas and stockpiles contained.

- Avoiding disruption to public rights of way and provision of temporary footpath diversions if required.

- At the end of the stockpiling activity, restoration of land to its original use and former quality.

7.7 SUMMARY AND CONCLUSION

The Alignment which has now been adopted achieves a better balance of cut and fill requirements than other previous alternatives. However there are still a number of locations where an excess of spoil material will occur.

The three main locations are:

- Ting Kau (5.5Mm^3) - cutting for the interchange and the approach to the southern portal of the Tai Lam Tunnel.

- Tai Lam Tunnel portals (1Mm^3) - tunnel spoil divided equally between the north and south portals.

- North of the Toll Plaza (2Mm^3) - cutting to move the alignment out of the flood plain.

The main disposal option is to reuse this material for other contemporary projects. It is proposed to removed 6Mm^3 from Ting Kau (5.5Mm^3) and the southern portal (0.5Mm^3) by use of a covered conveyor system to a barge loading location at the western Gemini Beach for transportation to a reclamation project. This could be Tseung Kwan O or the Lantau Container Port development or other suitable project.

The surplus spoil arising along the Yuen Long Approach Road will be removed by truck and is expected to be used in other projects. A favoured possibility would be to use some in forming embankments for the proposed Western Corridor Railway, however this cannot be confirmed at this stage.

It is likely that some stockpiling of spoil will be required and this is a potential source of significant impacts. General mitigation measures have been provided which can be made more specific during the detailed design stage.

The final placement/disposal of spoil will require control to prevent impacts however this aspect cannot be usefully assessed as the disposal locations cannot be identified at this stage.

LANDSCAPE AND VISUAL IMPACT ASSESSMENT

CHAPTER 8

8. LANDSCAPE AND VISUAL IMPACT ASSESSMENT

8.1 INTRODUCTION

The potential visibility of the Alignment and its importance as a gateway corridor to Hong Kong from the Chinese border, places considerable importance upon the assessment of the landscape and visual impacts. The Alignment is illustrated in Figure 2.1 and 2.2.

8.2 TERMINOLOGY

For the purposes of the environmental assessment a clear distinction is drawn between *landscape* and *visual* impacts:

- landscape impact relates to the effect upon the physical characteristics or components, which together form a landscape, eg. the landform, woodlands or stream courses; and
- visual impacts relates to the changes arising from development to individual 'receiver groups' views of the landscape eg. local residents or visitors to the Country Parks within the area.

In the assessment high quality landscape and views are considered to be an environmental resource of equivalent value to, say, clean air or water.

The area of study for the assessment of landscape and visual impacts is defined by the 'Visual Envelope' or Zone of Visual Influence (ZVI) for the <u>whole</u> proposed highway corridor. There may also be off site indirect impacts of construction caused, for example, by construction traffic movements or deposition of tunnel spoil.

8.3 OBJECTIVES

Specific landscape and visual impact assessment objectives include:

- assessment of the existing landscape character, and quality;
- identification of the overall Visual Envelope created by the proposed route corridor;
- identification of the key visual receiver groups within the Visual Envelope;
- assessment of impact of the proposed route, both during construction and once operational, on the existing landscape; and
- identification of residual impacts of the proposed route.

8.4 EXISTING ASSESSMENT LEGISLATION AND GUIDELINES

There is no legislation in Hong Kong which specifically relates to the landscape and visual impact of development. However, a degree of control is achieved through the requirement to address visual issues as part of the environmental review and assessment process. Whilst these policy objectives were originally related to the specific environmental issues of noise, air, water and waste disposal, they may now be regarded as applying equally to the landscape and visual impacts of development.

8.5 METHODOLOGY

8.5.1 Introduction

The form of landscape and visual impact assessment adopted for Route 3 CPS has been formulated in order to address the specific issues typically raised by a development of this scale and nature. The following section outlines the main components of this methodology.

8.5.2 Appraisal of Baseline Conditions and Project Description

In order for the impact assessment to be evaluated objectively, the existing landscape context must first be established. The baseline conditions are then projected forward to predict a 'no development' alternative to the construction of Route 3 CPS, TLT & YLA. Establishment of baseline conditions will include identification and assessment of the following elements:

- Visual Envelope and existing views;
- topography, natural drainage and vegetation cover;
- built development;
- access and circulation;
- landscape character; and
- receiver groups.

8.5.3 Assessment of Landscape and Visual Impacts

Potential landscape and visual impacts (both positive and negative) will be considered at three points in time. These are during construction, on day of opening and in year 15 of operation.

Through the assessment of impacts at these three points in time, distinction will be drawn between temporary, short-term and permanent effects.

Landscape impacts are predicted primarily on the basis of the order of change to baseline conditions prevalent at the time of assessment (ie. 1993) and are assessed at two levels:

- firstly, in terms of the systematic consideration of impact upon the landscape features within each Landscape Character Area along the route corridor. This will 'build up' an overview of landscape impact along the route; and

- secondly, in terms of the overall impacts of development upon the site and its landscape context.

The assessment of visual impacts is structured by receiver groups in order to present a systematic and structured appraisal. Receivers are identified through the definition of a Visual Envelope, or ZFI within which views of the road are possible, and the categorisation of individuals into 'user groups' within that envelope area: -

Receiver Type	Sensitivity of Visual mpact
Residents	High
Users of recreational facilities	High
Users of community facilities	Moderate
Travellers	Low
Employees within business and Industrial areas	Low

The visual assessment will also consider the quality of view, for motorists using the new road in terms of 'serial vision' (ie. the sequence of visual experiences for motorists travelling in each direction).

8.5.4 Prediction and Evaluation of Impacts

The degree of severity of landscape and visual impacts are categorised into severe, moderate, low and insignificant impacts.

Impacts on Landscape Resources are predicted by assessing:

- character and quality of existing landscape;
- nature of predicted impacts;
- degree of change to key features and existing landscape;
- ability of landscape to accommodate change; and
- significance of change within local, and regional context.

Impacts on visual amenity are predicted by identifying changes such as:

- value of existing views;
- degree of change to existing views;
- proximity of receiver;
- sensitivity of receiver;
- number of receivers in group; and
- availability and amenity value of alternative views.

Impacts on landscape resources and visual impacts are closely related, since both may result from a single change in baseline conditions. The relative severity may, however, differ according to the precise nature and context of the change. For example, a new structure may obstruct existing views from nearby residential properties severely reducing the visual quality of their views. Its position, however, may be predominantly urban and its construction may not involve the loss of any existing features resulting in a minimal impact on the overall character of the area.

8.6 LANDSCAPE CONTEXT

Landscape character develops through the interaction of a number of factors. The basic structure of a landscape is created by its geomorphological features, which, in turn, effect the indigenous vegetation cover. This basic structure is further changed by the actions of man, for example, through the construction of towns or the development of agricultural areas. This interaction of the basic natural resource and human intervention creates areas of discrete landscape character. Character areas may hold special meaning for many people, as a source of numerous personal experiences and memories. Many of these are visual, but at times these may also evoke other sensual, cultural and even spiritual responses.

The Feasibility Study for Route 3 identified 14 character zones within the overall Study Area. Nine of these are located within the TLT & YLA (S) Study Area as identified in Table 8.1, Figure 8.1 a and b. Table 8.2 provides a more detailed summary of the baseline conditions of the character areas within the study area.

The broad landscape character of the region is that of steep slopes in the high ground supporting sparse scrub and grassland, and lowlying flat land in the major valleys and along the coastal plain where intensive agriculture, residential, commercial and industrial activities occur.

8.7 BASELINE CONDITIONS

8.7.1 Introduction

For establishing a general picture of the existing baseline conditions, the Study Area may be divided into two distinct landscape types, that of high and low ground. This basic division is based upon the degree of human influence on the indigenous landscape, which also indicates the areas sensitivity to change.

In the lowlying areas, human interaction has been extensive and is an important element of the resultant landscape character. Introduction of a further man-made element would not have a significant impact on the landscape but would impact on the visual quality of properties in its immediate vicinity. In contrast the high ground remains largely devoid of direct human influence. The introduction of a man made element in this natural landscape has a potentially devastating effect on the landscape character and visual quality of the area, and on the isolated rural properties in proximity to the proposed route corridor.

8.7.2 Lowland Areas

This broad landscape character area encompasses the area below 30mPD to the north of the Study Area as shown on Figure 8.1b.

Visual Envelope

The Visual Envelope of the lowland character area is divided into two broad types:

Views within the character area itself are short, restricted by the vegetation and built development and compounded by the flat relief of the area that enclose and limit the view. Typically the views are of scattered settlements (both new and traditional) set within agricultural fields bounded by trees and tall rushes, against the backdrop of the abruptly rising hills.

Views to and from the high ground surrounding the lowlying land are more extensive. The grass/scrub slopes generally provide unrestricted elevated views of the extensive lowlying areas unfolding below. A network of scattered settlements, intensive agricultural production (including large areas of ponds), major traffic corridors results in a congested arrangement of man made and natural forms.

Topography Vegetation and Water Features

The topography is typically lowlying flat featureless alluvial floodplain. Natural vegetation cover is restricted to field boundaries and settlements whilst water features (ponds and river courses), form a significant element of certain areas (eg. in the Kam Tin floodplain).

Built Development

Built development occurs throughout the lowlands ranging from modern new towns, associated suburban fringe development as Yuen Long and to a lesser extent Shek Kong, to isolated traditional rural agricultural villages sited at the base of the steeply sloping hillside, as for example Hoi Pui. With the increase of cargo handling within the area, there is an increasing amount of agricultural land being used for storage purposes, which can lead to a fundamental change in the landscape character and its quality.

Access and Circulation

Generally more modern developments such as Yuen Long and its satellite suburban fringe villages are well served by detailed vehicular roads. More isolated settlements are more difficult to access, and in some cases are impossible to reach by vehicles. There is a limited functional network of public footpaths throughout the agricultural area primarily linking settlements with areas of graves at the base of the hill slopes.

TABLE 8.1 DEFINITION OF LANDSCAPE CHARACTER ZONES

Extract from Table 5.1 The Feasibility Study for Route 3				
Character Reference	Landform	Vegetation	Human Settlement	Hydrology
1	Alluvial Plain	Not applicable	Urban Area	Not applicable
2	Alluvial Plain	Individual trees/ herbaceous	Urban fringe	Not applicable
3	Alluvial Plain	Individual trees/ herbaceous	Dense, modern villages, settlements	Ponds
4	Alluvial Plain	Individual trees/ herbaceous	Scattered traditional villages + isolated agricultural buildings	Ponds
5	Flat bottomed valley	Individual trees/ herbaceous	Scattered traditional villages + isolated agricultural buildings	Ponds
6	Rounded low hills badly eroded	Predominantly grassland/ herbaceous	Not applicable	Not applicable
9	Wide valley	Woodland/ scrubland	Not applicable	Major water body (reservoir)
11	V-shape valley	Woodland/ scrubland	Not applicable	Major stream
13	Steep hill slope	Scrubland/ grassland	Not applicable	Coast

TABLE 8.2 TABLE OF BASELINE CONDITIONS

Character Area/Context	Visual Envelope	Topography/ Vegetation	Built Development	Access and Circulation	Landscape Character	Receiver Groups
(13) South west facing hill slopes above Tuen Mun Road in the vicinity of Sham Tseng/Ting Kau.	Extensive. Steep undeveloped scrub/grassland slopes that form a small element within the wider landscape context.	Steep slopes rising abruptly from coastline supporting grassland/scrub vegetation.	No. of residential units positioned to base of slope associated with Ting Kau village.	Restricted vehicular access along water catchment road. Limited No. of footpaths (predominantly associated with area of graves.)	Uninhabited steeply sloping coastal grassland hill slopes, with an open aspect and extensive views.	Limited No. of sensitive groups within study area. Outside study area: - Vehicular traffic on Tuen Mun Road - Waterborne traffic on coastal waters - Islands to south - Visitors to Tai Lam Country Park
(11) V shaped valley to northeast of Sham Tseng.	Restricted - steep valley sides form an introspective Visual Envelope.	Steep slopes rising from valley base forming typical V shaped valley, supporting scrub/woodland vegetation.	N/A	Extremely restricted (pedestrian access only)	Undeveloped visually introspective v shaped valley supporting scrub/woodland vegetation with limited access.	Limited No. of transient receivers within the study area itself. More distant views from upper elevations of high rise development at Sham Tseng.
(6) Foot hills, adjacent to coastal plains to south east of Yuen Long.	Extensive, encompassing views from coastal plain area (Shap Pat Heung and Kam Tin).	Rounded, low hills (200m) supporting grass/scrub, with occasional tree cover occurring along the lower slopes, and to the south of the K area.	Isolated rural properties concentrated along base of slope.	Limited to footpath access to ridge tops and areas of graves along base of slopes.	Badly eroded, undeveloped rounded hills supporting grass/scrub, visible across a wide area.	Limited No. of receivers within the study area. More distant receivers include large numbers of residential properties/traffic, industrial and agricultural production activities on the coastal plains.
(5) Small valley bases between spurs of hills in character area (6) and main valley floor (2,3,4).	Restricted by Topography and vegetation cover.	Flat valley base supporting scrub and some tree cover (usually associated with properties and margin with high ground.	Scattered traditional villages insolated agricultural rural properties and agricultural buildings.	Limited vehicular and footpath access and circulation.	Isolated, introspective agricultural valleys with scattered housing, ponds and tree cover at base of rounded hills.	Residential properties/transient receivers within character areas. Transient receivers from surrounding high ground.
(4) Alluvial Plan at base of character area (6).	Restricted by low, flat relief and vegetation cover.	Major alluvial flood plain supporting intensive agricultural production and limited tree cover.	Scattered traditional villages and isolated agricultural buildings.	Limited vehicular and footpath access and circulation.	Agricultural landscape of small fields and ponds, agricultural buildings, scattered Traditional Villages set with flat alluvial flood plain.	Residential properties/transient receivers within the character area. Transient receivers from surrounding high ground.
(3) Alluvial Plain supporting much recent village development/sub urban fringe.	Restricted by low, flat relief, vegetation cover and existing built development	Major alluvial flood plain supporting intensive agricultural production and some suburban fringe activities and limited tree cover.	Dense modern village settlements.	Limited major infrastructure, with extensive local informal network of vehicular routes and footpaths associated with modern settlements.	Agricultural/urban fringe landscape of small fields and ponds, agricultural buildings and storage areas, with increasing number of dense modern village developments.	Residential properties/transient receivers within the character area. Transient receivers from surrounding high ground.
(2) Urban fringe surrounding Yuen Long and Shek Kong.	Restricted by low, flat relief, vegetation cover and existing built development.	Major alluvial flood plain supporting substantial built development interspersed with limited agricultural production and tree cover.	Urban fringe including much recent development and expansion of existing villages. Industrial premises.	Residential areas well served by local network of vehicular routes and footpaths, with good links to major circulation routes within the area.	Urban fringe landscape of built development interspersed with small agricultural fields, industrial fields, industrial buildings and storage areas.	Residential properties/transient receivers and industrial premises within the character area. Transient receivers from surrounding high ground.
(1) Urban area of Yuen Long.	Restricted by built development and low, flat relief.	Major alluvial flood plain with major residential development Vegetation cover extremely limited.	Major new town development.	Residential area well served by local network of vehicular and footpaths. Existing major infrastructure congested (by density of numbers) through urban area.	Typical new town urban landscape character of dense highrise building with little streetscape quality.	Residential properties/transient and industrial premises within the urban area itself. Transient receivers from high ground to the south east.

Landscape Character

The floodplain may be broadly divided into distinct character areas as identified on Table 8.2, primarily associated with the degree of human interaction with the area. Character areas identified range from ones dominated by man made elements, such as the modern new town development at Yuen Long, to the traditional rural agricultural landscapes in more isolated situations.

Receiver Groups

Receiver groups within the lowlying land range from residential receivers within urban areas to isolated rural properties; transient receivers both within the area and from surrounding high ground and low grade receivers employed in industrial activities throughout the area.

8.7.3 Areas of High Ground

This broad landscape character area encompasses land above 30mPD, concentrated to the centre and south of the overall study area. Much of the high ground lies within the Tai Lam Country Park.

Visual Envelope

Due to the elevated nature of the high ground, much of it becomes visible over a wide area. Views both within and to and from the area are generally extensive, the high ground being perceived as an undeveloped, often denuded landscape of steeply sloping hills supporting sparse grassland/scrub vegetation.

Topography and Vegetation

The high ground is typified by steep slopes supporting grass and sparse scrub cover. Isolated pockets associated with the boundary between high and lowland areas and areas deep within the Tai Lam Chung reservoir which has significant localised influence.

Built Development

The absence of buildings plays an important part in the visual quality of the character area, creating remote 'wild' areas devoid of human settlement. Areas of graves associated with the base of the hillsides do however have significant localised impact on the landscape and spiritual quality of the area.

Access and Circulation

Vehicular and to a lesser extent, pedestrian access is limited in these upland areas. Access consists of minor vehicular roads (to isolated properties), and a footpath network that provides links to, and along the main ridgelines of the area. Informal localised access occurs in the areas of graves, predominantly concentrated to the base of the highland slopes.

Landscape Character

The resultant character of the landscape is of undeveloped sparsely populated steep hill slopes supporting a sparse grassland/scrub vegetation with minimal intentional human influence.

Receiver Groups

Receiver groups within the character area predominantly comprise transient walkers on the footpath network in the Tai Lam Country Park. Receivers outside the character area consist of residential properties, transient receivers on the existing traffic and footpath network, and employees within industrial premises on the lowlying plains surrounding the high ground.

8.7.4 Route Alignment

From the Ting Kau Interchange in the south of the Study Area, the route corridor swings north towards the Tai Lam Country Park boundary where it enters the tunnel. It passes under the Country Park to emerge in the vicinity of Ho Pui and progresses northward before linking with the New Territories Circular Road to the north.

Major earthworks are required along the entire length of the route corridor to maintain an acceptable vertical and horizontal alignment. Large embankments and cuttings are proposed in the vicinity of the tunnel portals and embankments across the lowlying land.

The lowland area will be affected by other major engineering works such as the river diversion/flood control and the proposed Western Corridor Railway.

8.8 ASSESSMENT OF LANDSCAPE AND VISUAL IMPACT

8.8.1 Introduction

For the purpose of this assessment, the proposed development falls into two distinct components:

- the tunnel portals and associated ventilation buildings; and
- the major construction works associated with the route corridor in the lowlying areas.

8.8.2 Landscape Impacts

The route corridor will have a landscape impact along its entire length. The most significant impact will be associated with regrading works, and to a lesser degree the embanked road corridor in lowlying areas.

Tuen Mun Road to Tai Lam Country Park

The Alignment, which is positioned to remain outside the Tai Lam Country Park, pays little respect to the existing topography. It will involve deep and substantial cuttings, effectively removing the top of the existing hill that forms the basis of the Sheung Sin Wan promontory.

Extensive cutting is necessary in order to achieve horizontal and vertical alignments between the Tuen Mun Road and the proposed tunnel southern entry point, causing extensive impact on the local landscape of this area. The ventilation buildings, in close proximity to the tunnel entrance, will have an impact on the local landscape (through formation of a flat construction area) as will it's access road.

The Northern Portal

The northern tunnel portal and its associated ventilation building will cause significant localised landscape impact.

Regraded Slopes, Hill Slopes on the Yuen Long approach (southern section)

From the tunnel portal the road corridor proceeds along the minor river valley, and continues along the margin between the high and low ground. The more extensive plateau area being established for the Toll Plaza in this area, and the splitting of the common road/rail corridor will entail further direct impacts on the existing landscape.

8.8.3 Impact on Landscape Character

Hill Slopes Above Ting Kau Village

The route corridor and its associated tunnel southern ventilation housing will have a significant detrimental effect on the quality of local rural landscape character of the area. The proposed slope regrading and valley embankments would fundamentally change the landscape features within the area, effectively truncating the narrow V shaped valley and destroying much of the rounded coastal hill slopes above Tuen Mun Road. In addition, the introduction of a busy road corridor will introduce vehicular noise and movement into the quiet, remote rural landscape on the outskirts of the Tai Lam Country Park.

Ho Pui/Ma On Kong Area

The route corridor and its associated northern tunnel ventilation housing will have a similar impact in the Ho Pui/Ma On Kong area, as will the southern tunnel portal on its surrounding landscape. Significant deformation of the natural landscape, necessary to achieve the desirable engineering alignment, together with the introduction of vehicular noise and movement will have a significant detrimental impact on the quality of local landscape character.

In addition this area has a large number of graves on the base of the hill slopes, and so holds special meaning to many people in the community. The Alignment has been selected to create minimal direct impact on these graves, but will fundamentally change the quiet rural atmosphere of these spiritual resting areas.

Lowland Plains (southern Kam Tin Valley)

The route broadly reflects the existing contour alignment, and follows the change in slope between high and low ground, which enables a potential successful visual integration into the surrounding landscape.

At present the route would have a significant detrimental impact on the adjacent rural agricultural landscape character of the area. However, its development can offer the opportunity to address the overall integration in what will essentially be a new landscape character area. Strategies, such as the *North West New Territories Development Statement Study - Landscape Strategy*, have addressed the comprehensive development of the valley and urges integrated development of the overall area.

8.8.4 Visual Impacts

The Visual Envelope as detailed in Figures 8.2 and 8.3 identifies two broad types of visual intrusion:

- areas in close proximity suffering visual intrusion/obstruction; and
- long distance views from the high ground.

Immediate Surroundings

The most significant visual impact would be on sensitive receivers located in areas with direct views, and in close proximity to the proposed route. To the north of the tunnel the route corridor passes in close proximity to a number of traditional village and isolated residential properties.

Receivers within these residential areas will suffer varying degrees of visual intrusion, depending on height orientation and presence of intervening structures, ranging from visual obstruction (where the route corridor and its associated structures will physically obstruct the view from a property) to no significant change. Generally to the south of the northern section, the introduction of the route corridor will fundamentally change the visual outlook of many of these properties creating severe visual intrusion of an artificial structure within an essentially natural, rural landscape.

In contrast, to the north, the villages are increasingly influenced by the urban infrastructure of Yuen Long and its suburbs, and the major existing highway corridors. Consequently the impact of the route to receivers within these areas will not be as significant, their views already being influenced by more modern artificial structures. The introduction of a further man made element within the view would not significantly alter the perception of the area, and may, with attention to the detailed scale and form of the road corridor, in fact become a positive feature in this congested landscape.

Creating an open cutting through the spur to the west of the Tin Sam Tsuen reduces the potential visual impact on villages in that area but would cause a visual scar to transient users within the Tai Lam Country Park. For some of the users the view would be 'end on' to the cutting and therefore less significant. It is likely that the use of a cut and cover construction in this section would reduce this impact on views from the Tai Lam Country Park, and would maintain good local circulation links between the hill slopes within the Tai Lam Country Park and the residential areas within the Kam Tin flood plain.

Distant Views

Further from the route corridor visual intrusion occurs from more elevated positions. Transient recreational users in the surrounding high ground, much of which is in the Tai Lam Country Park will look down onto the proposed route corridor, broadly following the alignment of the adjacent river course. The degree of visual intrusion caused, varies depending on the distance from the source, most footpaths are some distance from the proposed route and resultant visual intrusion will be minimal, when viewed against the overall degree of human development within the plain below.

The most prominent features from these elevated positions would be that of the Toll Plaza area, and the cuttings that truncate the natural spur formations along the boundary between the high and low ground, which would cause a significant permanent feature with the landscape.

Distant visual intrusion may also occur from receivers in lowlying areas with views towards the high ground. From these more distant viewpoints, the most significant element of the visual intrusion created by the route corridor would be that of the regraded slopes in the Ho Pui/Ma On Kong area. The initial impacts would soften through time, as the landscape mitigation measures become established. In addition, the profile of the vertical alignment minimises this potential impact and its position ensures that it would not be viewed by sensitive residential receivers in the Ho Pui area. It would however be more prominent to transient receivers within the facing hill slopes that lie within the Tai Lam Country Park.

Illumination

The proposed illumination of the road will cause nocturnal visual intrusion throughout the zone of visual influence. Visual receivers in the immediate vicinity of the route may suffer glare from the proximity and orientation to the light source. This would be especially so from high mast lighting in the toll plaza however this can be minimised by shielding and/or using directional lighting. More distant receivers would suffer intrusion from the linear light aura created by the route corridor and its associated traffic.

8.9 IMPACTS THROUGH TIME

8.9.1 Construction Phase

The construction of the proposed route will take approximately 4 years, during which time the principal sources of impact would be from:

- site formation;
- tunnel boring;
- construction access and storage areas;
- construction of the proposed route; and
- transportation on and off site.

The majority of activity involved with the reclamation and construction will be localised, contained predominantly within the proposed route corridor. Large scale construction will be required for piling and slope regrading, increasing the initial visual impact on the surrounding area. Additional impacts on local receivers are anticipated as equipment and materials are brought onto site.

Temporary visual intrusion may be suffered by receivers throughout the Visual Envelope. The severity of the intrusion is dependant on the proximity to the construction works, with the residential properties immediately adjacent to the route being subjected to the most severe intrusion from the construction works in their immediate vicinity.

Initial impacts created through the construction of the route will soften through time with the implementation of the landscape mitigation measures and as receivers become accustomed to the visual change in their environment.

High Ground

In the high ground the route corridor would involve extensive regrading of the hill slopes causing significant visual intrusion in its immediate vicinity during its construction.

Additional construction impacts on local receivers are anticipated through the movement of construction traffic outside the boundary of the highway corridor.

Tunnel

Visual intrusion could occur associated with removal and disposal of the tunnel arisings (large volume anticipated) if the spoil is allowed to accumulate. The exact method and site of disposal has not yet been determined.

Lowland Areas

Within the lowland areas, construction of the route would involve stripping existing material, establishing a stable foundation and transporting fill material to establish the low embanked road, and the embankments to the grade separated Au Tau intersection. Inevitably this will involve extensive movement of vehicles on the site with a lesser number of movements off-site, and resultant visual intrusion on receivers within its immediate vicinity.

8.9.2 Operational Phase

Once constructed and operational the principle sources of the impact would be the physical presence of the road and its associated structures and the movement of traffic along the highway.

High Ground

The position of the route in tunnel, or in cutting will minimise the visual impact of the operational route in the areas of high ground. Moving traffic along the highway should in time be screened by the proposed landscape planting within the highway corridor. The most significant visual impact will be views from surrounding high ground looking down onto the moving traffic on the route corridor.

Lowland Areas

Lowland views of the operational route corridor shall be minimal owing to the associated mitigation works. The most significant impact of the operational route would be the introduction of elevated artificial structures.

Views from the surrounding high ground will look down onto the route corridor and its associated moving traffic. Mitigation measures at the source of the view will be more effective than those within the highway boundary from these elevated views.

8.9.3 Residual Impacts (Year 10)

The adoption of mitigation measures recommended in Chapter 9 of this report will do much to reduce the impact of sections of the route from more distant views. In time the road would become fully integrated with its surroundings and visually screened from the majority of sensitive receiver groups. Planting experience on Tsing Yi Island, Tsuen Wan and a wide range of other New Territory sites indicate that tree cover becomes established quickly and would create well established stands in 10 years.

The proposed tree planting associated with the regraded slopes would develop into a well structured, visually attractive wooded slope, improving the currently degraded character of the existing landscape along certain sections of the route corridor and tying into areas of existing woodland cover.

However the impact of the grade separated interchange at Tuen Mun Road will remain a permanent significant visual element within the character of that area. Its acceptability as a significant permanent visual element will depend on the detailed design of its scale and proportions, in relation to the surrounding landscape.

The introduction of lighting along the corridor would also have a permanent residual impact. In most cases it would be successfully filtered by proposed tree planting to reduce glare in its immediate vicinity, (with the exception of the elevated structures associated with the proposed interchanges); however it would create a linear light aura in areas not currently affected by public street lighting.

8.10 VIEW FROM THE ROAD

There is scope to make this TLT & YLA (S) section of the Alignment a pleasant and memorable driving experience. A succession of planting regimes along the route corridor would reflect the surrounding landscape character through which the road is passing, establishing character and identity, and aiding orientation. The quality of the view within the tunnel will depend on the attention to the detail design. Considerable scope exists to create visual features to relieve the monotony of travelling through the long tunnel and aid in its illumination.

Structures encountered by the motorist will have a significant impact on the quality of view, the ease of driving along the route and consequently the overall perception of the route corridor. A well structured signing system should be adopted and detailed attention given to the visual quality and the comprehensive utilisation of the toll booth. The detailed design of the bridge parapets and street furniture should be addressed and where possible, views from the road corridor to adjacent landmarks maintained to aid orientation.

8.11 CONCLUSIONS

The route corridor will result in significant landscape impacts associated with regrading works, and to a lesser degree the embanked road corridor in lowlying areas. In these areas, although the Alignment would have a significant detrimental impact on adjacent rural agricultural landscape, this should be viewed in light of the major development proposal in the area.

Visual impact will occur in the immediate vicinity of the Alignment, particularly, to the south of the northern section where the route corridor will fundamentally change the visual outlook of man of the nearby residential properties, in so doing creating severe visual intrusion. In addition such receivers may suffer glare from the proximity and orientation of the road illumination.

Distant visual instruction will occur largely for transient recreational users in the surrounding high ground, much of which is in the Tai Lam Country Park.

The visual and landscape impact may be reduced by the adoption of suitable landscape mitigation measures as outlined in Chapter 9 such as:

- use of false cuttings where the route passes in close proximity to residential areas;
- off site planting by agreement;
- attention to the interface between man made/natural landform;

- minimal use of lighting (especially in remote rural areas); and
- inclusion of other circulation networks (rail, cycle and pedestrian within the common route corridor).

These and other possible general measures should be considered during the detailed design stage where practicable and appropriate.

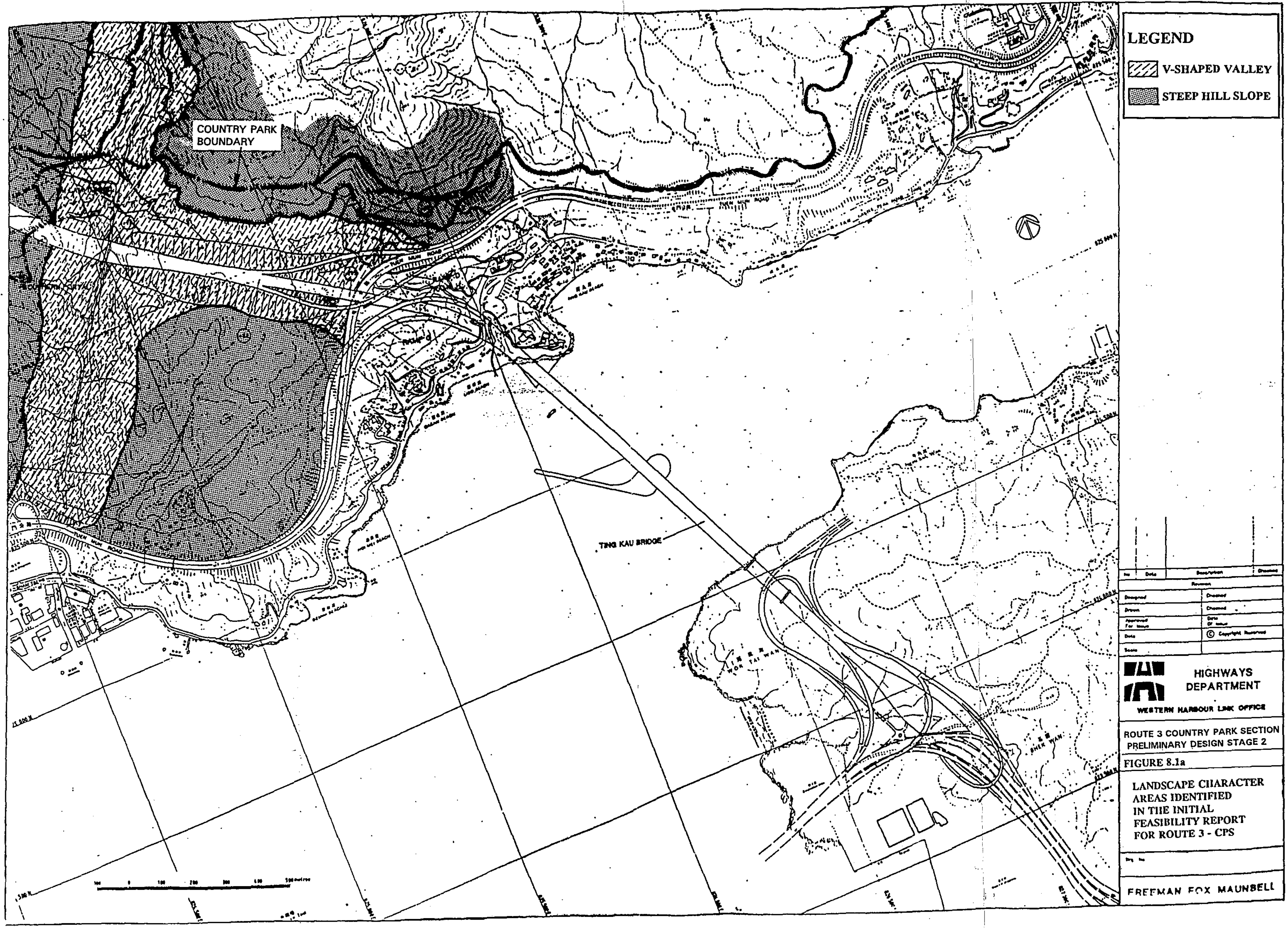
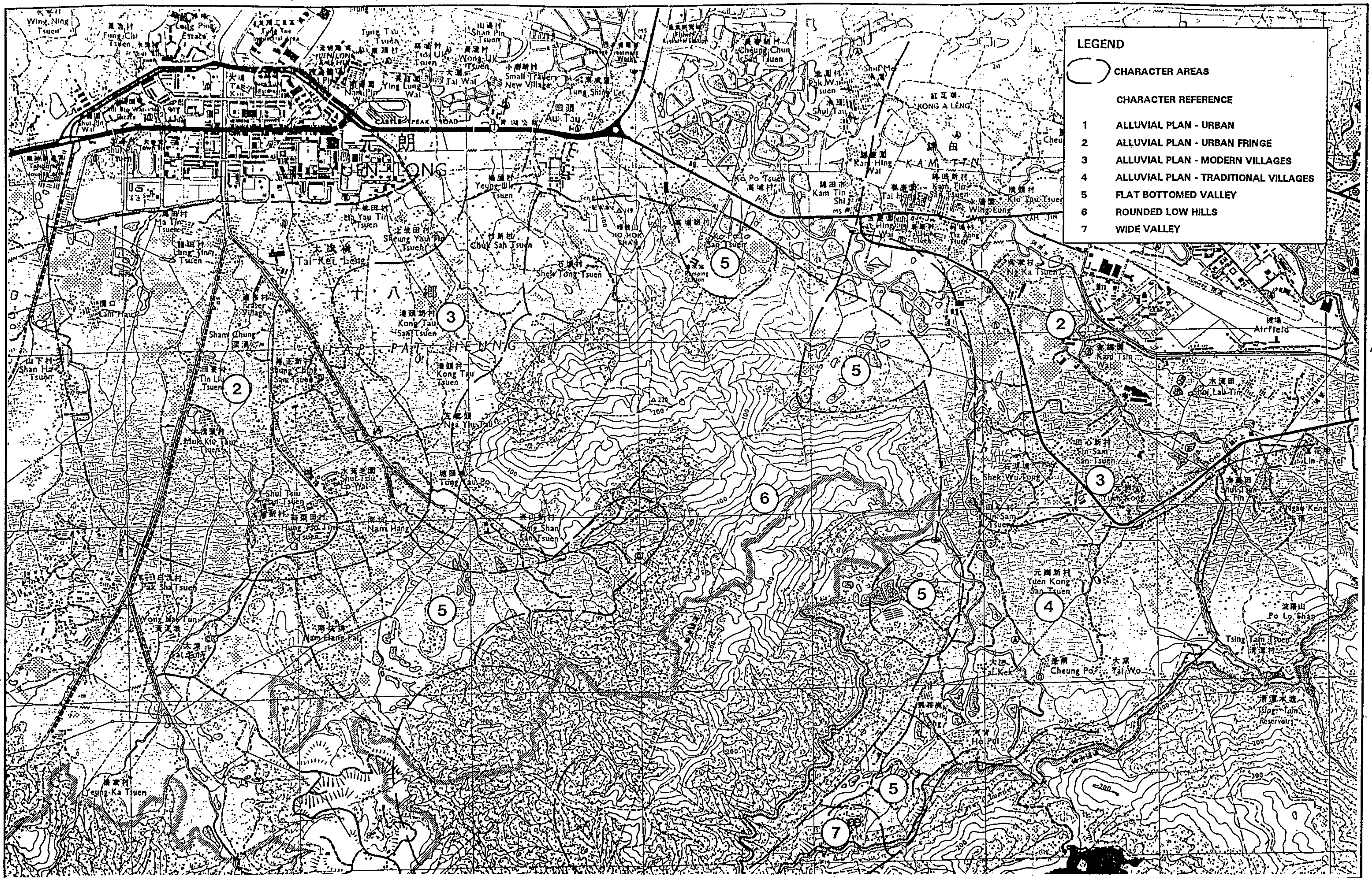
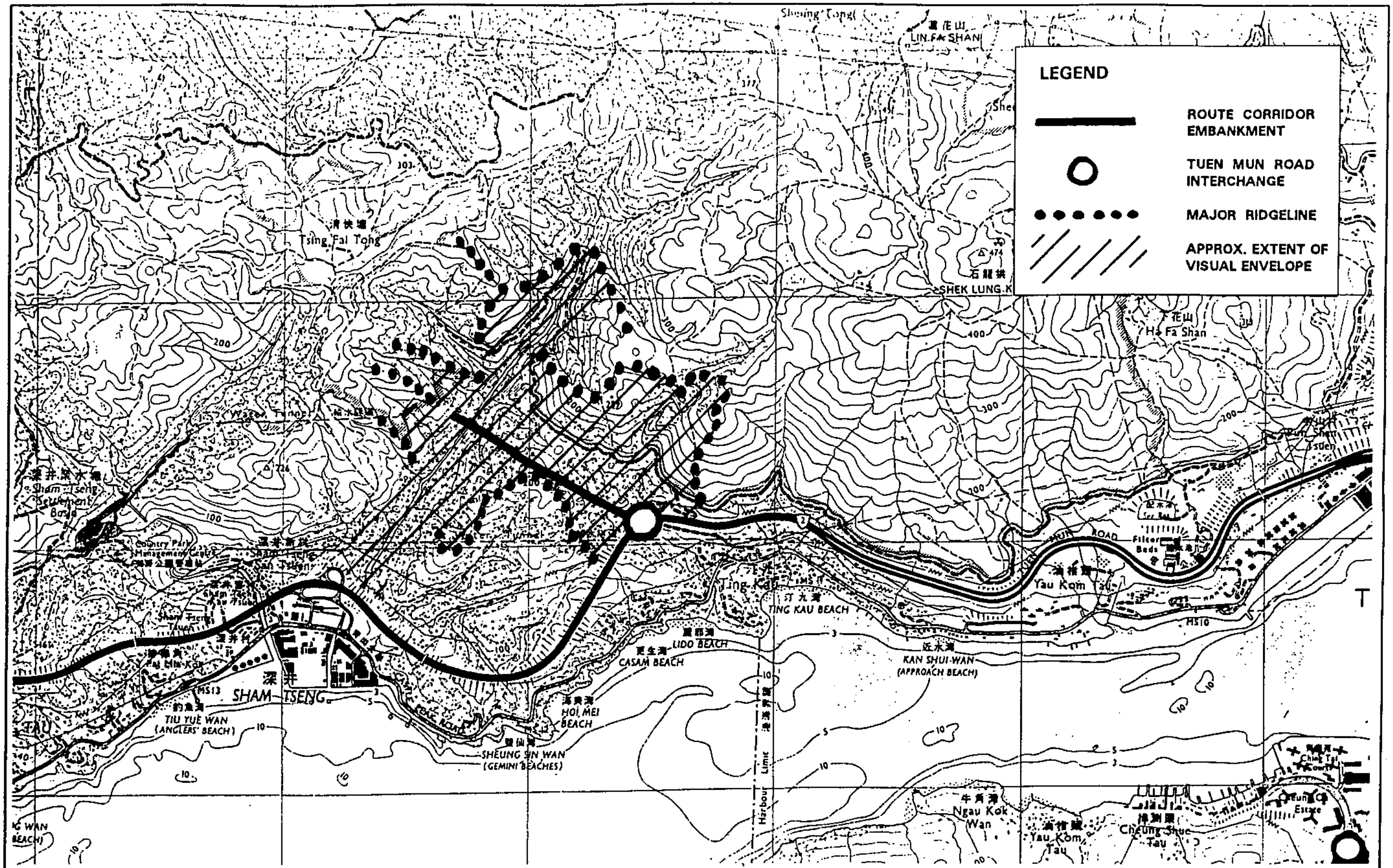


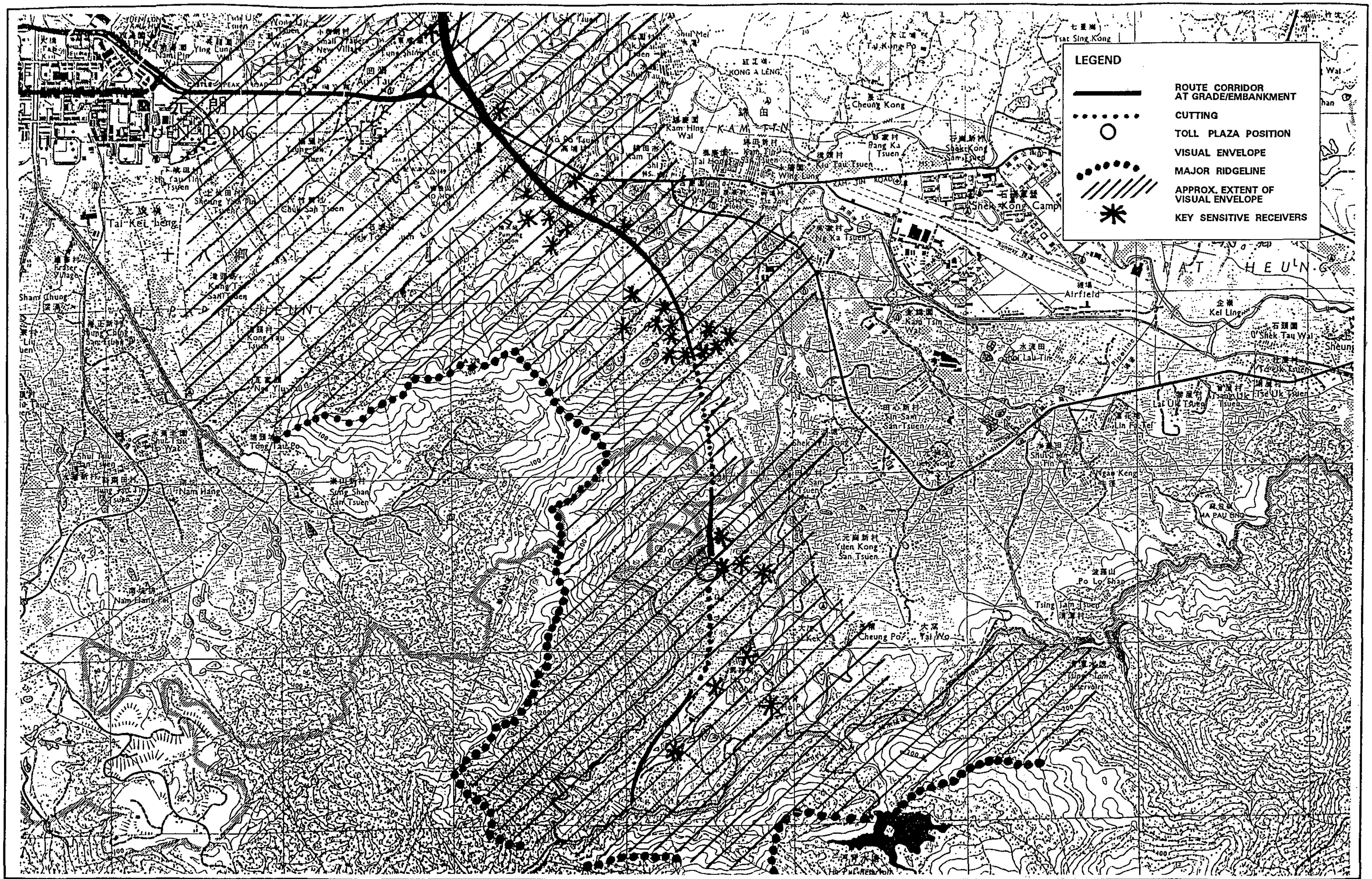
FIGURE 8.1a
LANDSCAPE CHARACTER AREAS IDENTIFIED IN THE INITIAL FEASIBILITY REPORT FOR ROUTE 3 - CPS



FREEMAN FOX MAUNSELL	Dwg. Title : Landscape Character Zones Identified in the Initial Feasibility Report for Route 3	Job Title : ROUTE 3 COUNTRY PARK SECTION EIA
		Scale : 1 : 20,000
		Date : July 1993
		Job No. 058000
		Fig. No: 8.1b



FREEMAN FOX MAUNSELL	Dwg. Title : Zone of Visual Influence South of Tunnel Portal	Job Title : ROUTE 3 COUNTRY PARK SECTION EIA
		Scale : 1 : 20,000 — Date : July 1993 — Job No. 058000 — Fig. No: 8.2



FREEMAN FOX MAUNSELL

Dwg. Title : Zone of Visual Influence North of Tunnel Portal	Job Title : ROUTE 3 COUNTRY PARK SECTION EIA	
Scale : 1 : 20,000	Job No. 058000	Fig. No: 8.3
Date : July 1993		

LANDSCAPING AND REHABILITATION

CHAPTER 9

9. LANDSCAPING / REHABILITATION

9.1 INTRODUCTION

The construction of the TLT & YLA(S) will necessitate substantial disturbance of the existing landscape. Large cut and fill operations will occur in steep terrain leading up to the Tai Lam Tunnel. Appropriate landscaping and rehabilitation of these areas represents one of the important environmental challenges facing the project.

Landscape and visual considerations are closely linked. In this regard landscaping specifications flow from and include recommendations contained in the Landscape and Visual Impact Assessment (Chapter 8).

Substantial information relating to the landscaping of Route 3 CPS has been referenced in previous reports (*Stage 1 Preliminary Design*, July 1992). Results from these studies have been incorporated in this Chapter.

Landscape recommendations contained in this Report have been designed to be consistent and integrate with landscape works proposed for the Ting Kau Bridge Section of the Route 3 CPS.

9.2 OBJECTIVES

Route 3 CPS will link the new airport at Chak Lap Kok with the New Territories and finally the PRC border.

An important objective will be to create a high standard gateway corridor along the route. To achieve this it will be necessary to reinstate areas of existing high landscape value as well as improve the visual appearance of more degraded areas.

The following specific objectives will apply to the landscape design:

- Minimize the visual impacts of the works by blending disturbed areas back into the terrain;
- Maximize the establishment of quality habitat;
- Maximize the advantageous effects of revegetation on slope stability, noise and dust amelioration and pedestrian and traffic management. Landscape works should also be designed to retard the movement of hill fires and improve water run-off characteristics wherever possible;
- Other objectives, including minimizing landscape maintenance, encouraging self propagation, and linking new tree planting areas with existing woodland.

9.3 LANDSCAPE GUIDELINES

There is currently no legislation which specifically relates to landscape impacts that arise from development. However, landscape and revegetation guidelines and specifications have been produced by various government departments and these should be followed when implementing the work. Particular attention has been given to HKPSG Chapter 10.

The need to address landscape/rehabilitation issues that arise from development has been identified and is now an expectation within all major projects. The most valuable landscape guidelines often come from recognition of the basic elements of past successful landscape projects.

9.4 EXISTING LANDSCAPE ENVIRONMENT

The baseline conditions are described within the landscape and visual impact assessment in Chapter 8. The route corridor broadly runs through two distinct character types, that of high and low ground, which will effect the type of landscape mitigation proposed at the detailed design stage of the route corridor design. High ground generally supports more woodland cover (especially to the south, in the Ting Kau area) whilst the landscape character of the lowlands is heavily influenced by the agricultural and industrial activities of the area.

Other than visual and ecological impacts, the proposed engineering works potentially affect surface erosion and slope stability; increase noise and air pollution; and alter surface water run-off characteristics. Works in this area also have the potential to affect access to the Country Park (both positively and negatively). Landscape mitigation measures should, where possible, encompass all these potential impacts.

9.5 METHODOLOGY

This Chapter provides a practical description of ameliorative landscaping measures required to mitigate those landscape and visual impacts which have been identified. Particular attention is given to soft landscaping works.

The following approach was adopted:

- Summarize landscape mitigation requirements identified in other specialist studies within this Report;
- Particular attention was paid to route sections containing construction activities that will have a serious impact on the existing landscape received particular attention (such as the tunnel portals); and
- Appropriate remedial soft landscaping measures have been identified. Landscape recommendations have drawn on existing government guidelines, the results of flora studies and past experience in similar projects.

The outline landscape mitigation proposals considered a number of factors including:

- Roadway and alignment design: Sections of the route, particularly near either end of the tunnel will be characterized by extensive cut and fill operations;
- Linkages and circulation: The alignment has the potential to present visual, ecological, and pedestrian barriers particularly as a result of changes in landform and the use of elevated structures; and
- Adjacent land use: Adjacent land uses were examined and proposed landscape measures matched for compatibility. The Alignment passes through green belt, land

of unspecified use and a small section of Tai Lam Country Park.

Environmental mitigation processes: A variety of factors and techniques have been manipulated to maximize environmental repair. A strong emphasis has been placed on extensive tree planting in landscaping recommendations.

9.6 MITIGATION MEASURES

9.6.1 Introduction

The mitigation measures undertaken in association with the Route 3 CPS proposals will play an important part in the successful integration of the new road within its surrounding landscape. Landscape mitigation measures fall into two main categories:

- Temporary measures associated with reducing the impact of the roads construction phases;
- Permanent measures adopted to reduce the impact of the operational route on surrounding receivers, and to aid the integration of the route within the character of the landscape it traverses. Other relevant factors are erosion control, surface and subsurface slope stability, noise and dust amelioration and pedestrian management.

9.6.2 Temporary Mitigation Measures

The following measures are recommended to reduce the impact of the construction phase of the route:

- Restrict volume of construction traffic on local road network;
- Restrict construction working areas to a minimum;
- Enclose the working areas with hoardings to define boundary edge and screen low level construction activities (eg. car/truck movement) from surrounding receivers;
- Restrict heights of storage materials, stock piles and spoil heaps to low levels;
- Minimize night-time working and lighting.

Advanced planting and ground modelling in designated landscape areas should be adopted where potential damage from construction activity can be avoided. This will enable the landscape to become established prior to the route becoming operational and make its screening qualities effective in a shorter length of operational time.

9.6.3 Permanent Mitigation Measures

The following measures are recommended to reduce the permanent impact of the route highway corridor. Many items do not fall directly into a landscape context, nevertheless they should be carefully considered to enable the successful integration of the route within its surroundings:

- Detailed alignment of the route enabling retention of significant landscape features;

- Treatment of the interface between man-made and natural landforms;
- Position of associated operational buildings;
- The use, location and design of retaining walls;
- Specific attention to the visual quality of structures associated with the route;
- Landscape treatment within, and immediately outside the highway boundary;
- Colour and materials used for structures should reflect the colours and materials of the surrounding landscape. As a general principle strong contrast in colour should be avoided and muted colours related to the natural environment should be used with darker colour concentrated to the base of the structure to create a sense of stability;
- Detailed attention to the gradients and the profile of regraded slopes, and earth modelling to ensure they reflect the gradients of the natural slopes in the vicinity;
- The use of tunam or shotcrete treatment of regraded slopes should be avoided;
- Screen planting within the curtilage of residential properties to screen the view of source;
- Incorporating areas of redundant land within the highway landscape proposal scheme to aid the integration of the route with its surroundings and avoid the creation of areas of derelict land; and
- The extent and form of highway illumination adopted. The size, height, design and orientation of the light should ensure effective lighting of the highway corridor whilst minimising the potential leakage of light. The use of reflective paints and signing should be fully investigated to determine the need for permanent lighting along the entire length of the highway corridor (tunnel stretches excepted).

9.6.4 Landform Regrading Works

The visual quality of the regraded slopes within the highway corridor will play a major part in the successful integration of the route with its surrounding landscape character.

Whilst geotechnical and engineering requirements dictate the basic form of the slope, there is however scope, with the attention to the detailed slope profile, to soften its impact. Wherever possible the formed slopes should reflect the angle and alignment of the natural slopes within the area. The slope should not be greater than 1.5 (horizontal): 1 (vertical), with a gentler slope of 2:1 being preferable. However, this may be difficult to achieve for the cutting slopes.

Attention to the interface between the surrounding topography and the engineered highway slopes should be addressed to reduce the potentially sharp divide and consequent visually intrusive element created between the natural and man made landforms. The long profile of the slope should follow a shallow inverted "S" alignment.

Similarly the edges of the regraded slopes should merge into the surrounding landform, rather than appear to be cut out from it. This may involve extra regrading work, outside the geotechnical and engineering requirements, requiring extra land, however the resultant overall landform will be more visually acceptable both from receivers within its immediate vicinity and more distant views (when the new landform will form a component of the overall landscape).

Disturbed areas should be designed to be stable and capable of revegetation wherever possible. It is important that landscape considerations receive high priority and early consideration in the detailed design phase.

A smooth compacted surface is not conducive to vegetation establishment. Wherever consistent with safe geotechnical considerations, the surface of bare earth areas should not be overly compacted and should be left with a textured surface to assist seed and water retention.

Similarly exposed rock faces are not conducive to revegetation. Rock faces should be either covered with a minimum of 0.5m of soft spoil material and hydroseeded or benched.

The collection and reuse of quality topsoil material along the highway corridor is strongly recommended, and a reliable supply of revegetation seed and seedling stock secured (Section 11.5)

9.6.5 Landscape Philosophy

To be successful, landscaping and rehabilitation works will require adoption of a basic philosophy:-

- Areas of current high landscape value must be reinstated to at least an equivalent standard;

- An opportunity to upgrade visual and ecological values of the route corridor exists through well designed landscape mitigation measures incorporating extensive tree planting (particularly to the north of the route corridor);

- To the south the landscape mitigation measures must blend and be consistent with the proposed works for the TKB section of Route 3 CPS. To the north the associated landscape works must accommodate and reflect the more urban environment through which it passes;

- TLT & YLA works will be only one source of disturbance in the area and landscape works in this and other projects must be extended to include all adjacent areas; and

- Revegetation works should not be restricted to artificial boundaries delineated by TLT & YLA earthworks. Tree planting must not highlight cut and fill slopes but rather blend them into the landscape by extending further uphill and into valleys. Tree planting must also extend laterally into adjacent engineering formations.

9.7 LOCATION OF LANDSCAPE WORKS

The principles to be adopted for the general design of landscape works from south to north of TLT & YLA do not differ from what was proposed during Preliminary Design Stage 1 shown in Appendix A9.1 (Landscape Issues, Working Paper, 1989) and based on a previous alignment. A large area will be disturbed and much of this will be available for soft landscaping.

Major sectors requiring soft landscaping include:

- Area 1 (North of Tuen Mun Road to the southern tunnel portal): Extensive cut slopes will be formed in this section together with a large fill embankment across the main valley before the portal. High quality woodland will require reinstatement in this area, which is currently zoned green belt.

- Area 2 (North of the northern portal to the New Territories Circular Road): Extensive earthworks will be required in steep country along this section. The route will pass through green belt, unspecified use zones and a small section of Tai Lam Country Park.

9.8 SPECIFIC LANDSCAPE DETAILS

9.8.1 Introduction

The extent and nature of proposed landscape works are shown in Appendix A9.1

Both cut and fill slopes can be initially stabilized by hydroseeding and engineering erosion control techniques. The hydroseed mix should incorporate both grass and appropriate tree seeds to simulate the natural seed bank in the soil thereby increasing species diversity and understorey development beyond that provided through planting. Into this, Woodland or Shrub Mixes will be planted. The mixes specified vary in the size distribution of plant material and planting density. Specific plant species should be selected at the detailed design stage to respond to local conditions and vegetation types identified along the Route 3 CPS corridor (Tables 11.1 and 11.3). The proposed treatments are described in Table 9.1.

TABLE 9.1 SUMMARY OF LANDSCAPE TREATMENTS

LANDSCAPE TREATMENT	DESCRIPTION
WOODLAND MIX A	Hydroseed with grass and tree seed. Plant trees on 100% of area. Pit plant 80% tree/shrub whips, 20% light standard trees. Density: 1.5m staggered centres.
WOODLAND MIX B	Hydroseed with grass and tree seed. Plant trees on 100% of area. Pit plant 75% tree/shrub whips, 25% light standard trees. Density: 1.5m staggered centres.
WOODLAND MIX C	Pit plant 100% of area with tree/shrub whips. Density 1.5m staggered centres.
ROADSIDE PLANTING	Import 450mm topsoil mix, mulch. Plant medium shrubs at 600mm staggered centres and standard trees at average 1 tree/5 lin. m.

All tree and berm planting will be into appropriately sized pits. Fifty (50) grams of slow release fertilizer (minimum release period 8-9 months) should be placed in the bottom of each hole and well mixed with soil prior to tree planting. The quantity of fertilizer to be used should be appropriate for the tree but as a guide the following quantities should be used:-

- for whip planting - 50g, and
- trees of size such as light-standard and/or standard - 150g.

The planting mixes are:

- WOODLAND MIX A: This mix could be used on the western embankment of the Kam Tin River flood plain where slopes are low and not in direct view of villages. The light standard trees could be informally grouped along the embankment to create an initial variation in height. The whips will establish rapidly to create a random and natural stand of trees and shrubs. When viewed from the floodplain, these slopes will merge with existing vegetation on lower slopes.
- WOODLAND MIX B: This mix should be prescribed for the more extensive cut and fill slopes on the fringes of the Country Park. The larger, light standard tree will be used on the lower slopes where they will create a greater initial impact from the road.
- WOODLAND MIX C: This mix should be prescribed for planting above and below formed slopes along the route.
- ROADSIDE PLANTING of trees and amenity shrubs should be confined to the more

visible sections of the road, such as at the interchanges and also at the Toll Plaza where traffic speed will be reduced. These areas are more accessible permitting a higher level of maintenance. Site specific landscape plans will be required for the toll plaza and ventilation buildings.

This planting mix should have a high component of shrubs and fire resistant species and will provide a transition between taller trees on lower slopes and adjacent grass hillsides.

9.8.2 South Portal Approach

Through the introduction of the south portal approach, the creation of a deep cutting is necessary, which creates an alignment that is visually intrusive. In order to minimise this intrusion the interface with the existing topography must be carefully considered. Woodland Mix B could be used within this area to create initial mitigation and to link into the existing County Park Vegetation.

Northern Portal and Embankment Approach

The introduction of a low embankment to this section of the route cuts down the degree of visual intrusion, although the portal is in a more prominent location.

Roadside Planting and Woodland Mix B could be used to mitigate the landscape impact of this portal and embankment, effectively softening the structure into the existing landscape and minimising the visual intrusion to transient receptors in the Country Park. Off site planting could also be offered to sensitive receivers in Ho Pui to minimise the visual impact.

Yuen Long Approach

Roadside planting and a heavy use of shrub mix could be used to mitigate the impact of the proposed Toll Plaza and Administration Area. Within the area of the interchange Woodland Mix A and a predominance of shrubs could be used to mitigate the impact of the ramps within the scheme.

9.9 LONG TERM RESIDUAL EFFECTS

Experience on Tsing Yi Island and at Tsuen Wan and a wide range of New Territory sites indicates that vigorous and healthy tree cover can be established on cut and fill slopes similar to those in Route 3 CPS. In these areas a range of fire protection measures have been successfully used and planted woodland some 10-12 years old is showing good resistance to hill fire damage.

Within these areas self seeding and establishment of native ground covers are common. Good results have been shown for both cut and fill slopes and for a range of substrate. There appears to be no long term unfavourable residual effects associated with cut and fill slopes if broad principles are established at the detailed design stage.

9.10 MONITORING AND MAINTENANCE

Several salient points regarding implementation and maintenance of landscape and rehabilitation works require highlighting:

All landscape works should be regularly checked and maintained. Monitoring should not only check the general health of tree stands and grass swards but also ensure that species diversity is maintained and that ground cover remains adequate to prevent erosion. Pure stands of some species such as *Casuarina equisetifolia* can cause ground cover decline. Monitoring will also ensure that surface drainage structures are intact and have not been interfered with by vegetation.

Necessary maintenance works may include fertilizing, thinning tree stands, replanting or resowing, watering and fire protection (in early stages), and all works necessary to ensure beneficial development of landscape areas.

As previously discussed the need for maintenance should decline with time and will vary with the various categories of landscaping proposed. A minimum maintenance period of two growing seasons is recommended, with fire break maintenance to four years for relevant areas.

Consideration within the design could be given to the storage of surface run-off water from paved areas for the irrigation of landscaped areas after passing through silt and oil traps. Wherever possible landform depressions should be used to maximize water availability to plants.

Landscape design should be discussed with the relevant maintenance authority at an early stage.

Other monitoring and maintenance measures noted in Chapter 11 (Ecology), and in particular Section 11.5, are also relevant.

LAND USE AND COMMUNITY ISSUES

CHAPTER 10

10. LAND USE AND COMMUNITY ISSUES

10.1 INTRODUCTION

It is important to identify and assess the impacts and implications of the TLT & YLA (S) in terms of community issues and neighbouring land uses.

The importance of landuse issues is recognised by the Hong Kong Government as demonstrated by the recent approval of several papers on landscape issues by the Land Development Policy Committee (LDPC), and the incorporation of Chapter 9 on Environment in HKPSG (Hong Kong Government, 1990). A specific Chapter providing guidelines for Landscape and Conservation (Chapter 10) is currently being drafted by EPD for inclusion into HKPSG.

This Chapter is intended to:

- identify the nature of neighbouring landuse, and its significance in terms of potential impacts from the road on the local community, recreation/resource value of the area, local amenity and development potential;

- identify elements of the community potentially affected by the construction and operation of the road, and assess the potential impacts; and

- highlight key problem areas in order to contribute to the resolution of any community concerns regarding the project.

10.2 OVERVIEW OF LANDUSE AND COMMUNITY ISSUES

10.2.1 General

Construction and operation of the road will inevitably result in landuse impacts along, and in close proximity to the alignment. These will include not only direct effects such as disruption, loss of amenity/recreation, community severance (perceived and actual) and landtake, but also constraints imposed on future development and urban design, due in particular to noise and air quality impacts, and visual intrusion. The main landuse and community issues are discussed in the following sections.

10.2.2 Loss of Recreation/Amenity

During the construction and operation of the road there may be short and/or long term effects, which by altering the character and nature of the area will affect existing recreational and amenity value. Such impacts are often a result of visual intrusion or increases in the background levels of dust, noise and general nuisance, or a combination of the above.

10.2.3 Impacts on Sensitive Sites/Conservation Areas

Sites/areas which may be important in terms of their conservation value, religious, historic and cultural significance (e.g archaeologically important sites, religious establishments, burial grounds etc.) were identified. Although less tangible in nature than noise and air quality impacts for example, such impacts are important particularly in terms of the local community and the recreational/amenity value of land resources.

10.2.4 Community Severance

Community severance arises through changes in community lifestyle patterns as a result of landuse changes. It may be defined as the separation of residents in a community from facilities, services, friends and neighbours. With respect to the TLT & YLA (S) development this may result from barriers created by the construction of sections of roadway. Severance may also occur with respect to reduced public access to recreational areas.

Community severance may be assessed in terms of perception by a community, actual separation from areas previously accessible and separation from essential facilities. The evaluation of impacts to local communities therefore necessarily involves a subjective element and was undertaken by considering the landuse, nature and location of communities in the Study Area.

10.2.5 Disruption and Disturbance

Disruption and disturbance can be viewed in terms of increased road traffic, the occurrence of local diversions and obstructions,and physical (measurable) impacts such as noise, dust etc. These effects will generally inconvenience the local community through reducing mobility, interrupting daily activities and creating general nuisance to local residents.

10.2.6 Landtake

Landtake will inevitably occur as a result of developing the road. In addition to the permanent primary landtake there will also be impacts as a result of initial temporary landtake during the construction period for work areas, access roads etc.

10.2.7 Development Potential

Changing landuse patterns in terms of increased road traffic, deterioration in air quality and increase in ambient noise will potentially alter the overall character and nature of the area. This in turn is likely to impose constraints on the extent and nature of future development, and may also result in devaluation of existing properties.

10.3 APPROACH

Landuse impacts have been identified in terms of both the construction and operation of the road, and where appropriate the implications of impacts have been considered.

Impacts have been assessed in relation to Government landuse zoning and planning policies, the degree and nature of disturbance to both members of the public and visitors to the Study Area, and the importance of the affected areas in terms of their resource value. The significance of potential impacts have been assessed in relation to the nature and extent of sensitive receivers affected. The following sections necessarily draws upon information contained within the preceding chapters of this Report.

Government designated landuses were used to identify where landuse may be a constraining factor on existing and proposed landuse within the Study Areas, and sites of archaeological and historic interest were identified through consultation with the Antiquities and Monuments Office (AMO).

10.4 EXISTING AND PROPOSED LANDUSE IN THE STUDY AREA

10.4.1 General

A review of 1:20,000 and 1:1,000 scale maps, Outline Zoning Plans (OZP), non metropolitan landuse plans, the Territory Development Strategy (TDS) and a series of site visits established the existing and proposed landuse in the Study Area.

In general terms this section of the road passes through a mixture of landuse which is predominantly rural in nature, comprising unprotected woodland in the south, Country Parkland and active farmland, giving way to unstructured low rise light industry and residential development in the north.

From the southern TLT & YLA (S) road section boundary located at Tuen Mun Road, the alignment traverses steep sloped woodland before going into tunnel outside the boundary of the Tai Lam Country Park. The Alignment emerges at the northern portal in a Countryside Conservation Area, and proceeding further north traverses Rural Activity Areas, along the western slopes of the Kam Tin Valley towards Yuen Long. Nearer Yuen Long the Alignment passes in close proximity to human settlements before terminating at the New Territories Circular Road in the north.

In these non metropolitan areas, little committed development has been identified, consequently associated landuse impacts are focused on existing landuse. However, consultation with the Planning Department established that there are plans to rationalise the different categories for landuse zoning which currently exist; this will involve re-zoning areas of land, which has implications for future development. Relevant proposals are reviewed in Section 10.4.3.

10.4.2 Identification of Key Landuse/Community Features

Local Communities/ Settlements

The Alignment passes through a number of communities from the northern portal through to Yuen Long and the northern boundaries of the Study Area.
Immediately north of the northern tunnel portal the landuse typically supports small farming settlements. In addition to general production and agricultural activities, farming practices include pig, chicken, fish and duck farming. As the route proceeds northwards the rural, agricultural nature of landuse gives way to unstructured and unplanned light industry typically including open storage areas and low rise workshops etc.

The main communities and settlements identified are presented in Table 10.1. In addition to those settlements identified there are numerous walled villages immediately south of Kam Tin Road, however these communities are located approximately 500m from the Alignment.

TABLE 10.1 COMMUNITIES/SETTLEMENTS IDENTIFIED IN THE STUDY AREA

Settlement/ Community	Location	Description
Ma On Kong	150m due east of alignment	Typically small village/cottage farming communities
Ho Pui	500m due east of alignment	" "
Tin Sam Tsuen/ Shek Wu Tong	500m/700m due east of the alignment	" "
Ko Po San Tsuen	Located in the immediate vicinity of the Kam Tin interchange. Sections of the village are enclosed by the development	Low rise village communities interspersed with unplanned light industry
Ko Po Tsuen	80m north east of the alignment	" "

Recreation/Amenity

The eastern side of Kam Tin valley is used for walking and general outdoor recreation. Although there are a number of footpaths in the area, the water catchment area overlooking the valley is most used for walking.

Conservation Areas and Sensitive Sites

On emerging from the northern portal the route crosses land currently zoned as a Countryside Conservation Area and Rural Activity Area.

Country Parks are a statutory designation under the Country Parks Ordinance for the purpose of providing informal outdoor recreation and conserving landscape, wildlife and historical features. Land within the Country Park is subject to the control and approval of the Country Park Authority. Development within Country Parks is restricted and in the majority of cases undesirable.

Countryside Conservation Areas are non statutory designations where development is normally restricted to agricultural and small scale recreational uses.

Rural Activity Areas are non statutory designations (formerly called Agriculture Priority Areas) for which development will normally be restricted to agricultural and recreational uses only.

As discussed in Section 10.4.3, these planning control areas are likely to become more restrictive through the introduction of statutory planning restrictions in the future.

Graves and Burial Sites - There are a large number of graves and burial sites in the hillsides surrounding the Kam Tin Valley and to the east of Yuen Long, and also in close proximity to the southern tunnel approach (Figure 10.1 a,b,c). The graves are particularly sensitive sites and are located to give a positive aspect of the surrounding environment.

Temple - One Temple within the Study Area has been identified (Chapter 3, Figure 3.1), located to the north west of Shek Wu Tong. This Temple is a small modern structure and serves a sparsely populated community in the immediate vicinity. Most of this community will be directly affected by the Alignment and will have to be re-provisioned.

St Joseph's School - St Joseph's school is located in the route corridor at Ko Po San Tsuen (Chapter 3, Figure 3.1c) and will require to be reprovided at a new site.

Sites of Archaeological Interest/Historic Buildings - Consultation with the AMO has established that there are no sites of archaeological significance within the Study Area. There are however three sites of historical interest as listed in Table 10.2 below and presented in Figures 10.1 b and c.

TABLE 10.2 HISTORICAL BUILDINGS/STRUCTURES IN THE STUDY AREA

Site	Address	Year of Construction	AMO ref, no.	Grade
Tang Wai-Kap Grave	Au Tau crossroads	Before 17.c.	770136	-
Choi Ancestral Hall	Shek Wu Tong	1969	830329	Grade 3
Shum Ka Wai (Chinese building)		1934	830320	Grade 2

Au Tau Water Treatment Works - The works is located immediately to the west of Route 3 CPS near Yuen Long. The works is a designated Potentially Hazardous Installation (PHI) due to the storage of chlorine.

10.4.3 Proposed Landuse

Proposals for the Study Area include re-zoning the Countryside Conservation and Rural Activity Areas immediately north of the Country Park to Conservation Areas, Green Belt and Recreational Areas. It is proposed that these areas will be gazetted and any development will be restricted according to statutory controls relevant to each zoning category.

The statutory controls will be graded according to the landuse zone such that Conservation Areas will be designated around the borders of the Country Park, and will subsequently be subject to more stringent controls than Green Belt areas. It is hoped that this re-zoning will provide a buffer between the country parkland and adjacent areas to prevent development encroaching on the parks. Recreational zoning will be generally less restrictive and directed at encouraging recreational uses.

In addition, AFD have proposed that an area of land in the vicinity of Ma On Kong and Ho

Pui (Figure 10.1b) be designated as a SSSI to protect the roosting habitats of the Chinese Pond Heron, Little Egret and Cattle Egret. This is discussed further in Chapter 11.

10.5 CONSTRUCTION

10.5.1 General

The main construction activities which will potentially result in landuse and community impacts include:

- storage and transport (using heavy vehicles) of construction materials;
- transportation of heavy plant and machinery;
- excavation, cutting and filling activities;
- construction of toll plaza access roads and work sites;
- disposal of spoil and, installation of a conveyor belt system from south of the tunnel to the Rambler Channel; and
- excavation of borrow areas and transportation of fill.

10.5.2 Loss Of Recreation/Amenity

There will inevitably be temporary reduction of recreation and amenity associated with the construction of the road both through reduced accessibility and from emission of noise and dust in a predominantly rural environment. This will deter casual use of the area for recreational purposes and possibly disturb the limited number of bird watchers which frequent the area.

10.5.3 Sensitive Sites/Conservation Areas

The proximity of the Alignment to the Chinese Pond Herons and egrets roosting ground at Ma On Kong and the resulting filling activities during construction, is unlikely to significantly disturb the breeding habits of these birds (Section 11.4).

There will be inevitable loss and disruption to graves and burial sites in close proximity to the development. In the area of the Yuen Long approach there are 14 distinct graves (1 significant in size). These figures however are indicative only, and are taken from map surveys and aerial photographs. It should be noted that Tang Wai Kap Grave located at Au Tau crossroads is listed by the AMO as a historical site.

10.5.4 Community Severance

Severance impacts during the construction phase will generally be limited to perceived severance as a result of the storage and movement of materials, plant and equipment in the immediate vicinity of the local villages. These impacts will be notable to the north of the Study Area, which is typically more populated and in close proximity to the Alignment. Actual severance would depend on the operation of access roads.

10.5.5 Disruption and Disturbance

In particular, settlements at Tin Sam Tsuen, Ma On Kong, Ko Po San Tsuen and Ko Po Tsuen are likely to be severely disrupted during the construction phase, particularly where excavations will be undertaken, for example the construction of ramps from Kam Tin Road.

Scattered settlements will also be affected due to construction traffic including heavy vehicles for the transportation of equipment and materials, potentially creating disruption and disturbance through local traffic diversions, temporary blockage of access roads and general nuisance. Traffic flow on Castle Peak Road and Kam Tin Road is likely to be disrupted dislocating communities in the Kam Tin and Yuen Long areas. In addition, a deterioration in air quality due to dust and the increase in noise levels on local communities are a likely impact of such large scale construction activities.

The levels and effects of dust and noise are detailed in Chapters 4 and 5 respectively.

10.5.6 Landtake

Landtake during construction of the Alignment will comprise the temporary and on occasion the permanent use of areas of land. It is anticipated that there will be major works areas at the two portals and at the toll plaza, with large excavations and/or fill requirements to provide access and loading areas for excess material.

Temporary landtake will be particularly significant in the Kam Tin valley area which supports farming practices, and will therefore affect local communities and settlements in terms of their livelihood.

10.6 OPERATION

10.6.1 General

The main issues associated with the TLT & YLA (S) post construction, include community severance, disruption to sensitive sites, landtake, noise, air quality and visual impacts.

By the time this section opens, most of the impacts incurred in the construction phase will have ceased. Residual impacts from these activities will largely depend on the effectiveness and efficiency of mitigation measures adopted in earlier stages, and therefore effective implementation of such measures wherever practicable is essential.

10.6.2 Loss of Amenity/Recreational Value

The southern portal and its southern approach is situated in close proximity to the south eastern margin of Tai Lam Country Park. This area of the Country Park comprises steeply sloping woodland with relatively little access. Consequently the area is little used for recreational purposes and loss of this section of the Park as a recreational resource should be minimal. The conservation value of this undisturbed area is however high and the loss of it will be significant. Practicable consideration should be given to the re-instatement of any disturbed footpaths.

On emerging from the northern tunnel portal the route traverses the floor of Kam Tin Valley. Siting the Alignment in this location will be visually intrusive (having a significant impact on the rural agricultural landscape character of the area) to walkers particularly on the eastern slopes of the Kam Tin Valley where walks along the water catchment are popular.

Through general disruption and disturbance, the operation of Route 3 CPS could potentially reduce the recreational value of the area for bird watchers.

10.6.3 Sensitive Sites/Conservation Areas

Further north of the northern portal, the Alignment encroaches on approximately 1.4 - 1.5 hectares of Country Parkland. The area lost comprises poor quality grassland and scrub vegetation and is therefore not particularly significant in terms of conservational or recreational value, however development within Country Parks is undesirable and should be avoided wherever possible.

AFD have indicated that the Country Parks Authority would have to consider any proposal involving surrendering an area of Parkland. A presentation has been made to the Country Parks Board and it is considered that no other practicable alternative exists. It is proposed to provide an access road, car park and visitor information facility as part of the project. This Country Park issue is discussed in the Ecology Chapter, Section 11.43 and the paper submitted to the Country Parks board is attached in Appendix A11.3.

The Alignment passes in relatively close proximity to roosting grounds of the Chinese Pond Heron, Cattle Egrets and Little Egrets (in the vicinity of Ma On Kong). This egretry is located in a stand just west of Ho Pui village, and is proposed to be designated a Site of Special Scientific Interest (SSSI) by AFD, who, have expressed a wish to preserve this area.

However the development is considered to be sufficiently distant from the roosting grounds and the operation of the roadway is unlikely to have a detrimental impact on the breeding habits of the birds (Section 11.4.2).

The Temple will be located outside the route corridor of the Alignment but will be in such close proximity that severe disruption may occur.

St Joseph's School is sufficiently close to the Alignment such that the school should be reprovisioned elsewhere. It is understood that the Planning Department have indicated that an alternative site can be found, and the Director of Education and District Lands Office have been consulted with regard to identifying a suitable alternative. Further consultation with other interested parties such as parents should be undertaken.

10.6.4 Community Severance

Effective community severance will arise due to the location of the road severing several footpaths used by the local villagers, dividing settlement, and separating them from areas previously accessible. These areas include fish ponds, farming land and such sensitive sites as the graves and burial grounds located on the western slopes of the valley. In particular the latter is likely to be a significant community issue.

10.6.5 Landtake

Permanent primary landtake is an inevitable result of such a large scale road development. Of particular significance will be the loss of farming land, fish ponds (particularly in the vicinity of the toll plaza) and scattered settlements in the Kam Tin Valley. The position of the toll plaza results in the loss of a market garden and chicken farms along access roads and 2 large duck ponds. It will however supply upgraded vehicular and pedestrian access to the Country Park in this immediate area.

10.6.6 Development Potential

Development potential is affected by the general quality of the surrounding urban environment. It is anticipated that the presence of Route 3 CPS will change the existing environment such that future non-industrial development in the vicinity of the route may be limited in scope. However this is typical of any major road development, and the consultants are not aware of any specific development plans for the Study Area.

10.7 MITIGATION MEASURES

10.7.1 Construction

The scope for mitigation of landuse impacts during construction is often limited. The most effective mitigation is to avoid siting construction activities and particularly work sites in close proximity to sensitive receivers. However due to the nature of the location of the Study Area this will be difficult, particularly in relation to the toll plaza. Care should be taken in setting out work areas and during daily practices to ensure that associated impacts are minimised.

Timing of works can be important in reducing disruption due to traffic congestion, and avoiding using roads for heavy plant and equipment during sensitive periods.

Where practicable re-instatement, which may provide opportunities for improvement to the environment, should be undertaken on completion of the construction works. Reinstatement of access to existing properties, particularly the farming areas should be required and made a requirement of the contract.

There is no realistic mitigation of the permanent landtake impacts associated with the roadway foundations, supports, drainage channels etc.. For temporary landtake impacts associated with the works sites, storage areas etc., it is essential that careful and sympathetic restoration of the sites is carried out. This will require post construction specialist landscaping and replanting works.

10.7.2 Operation

Mitigation of landuse impacts will to a certain extent be achieved as a result of noise, air quality and landscape mitigation measures recommended in the preceding Chapters of this report.

Additional mitigation can be provided through detailed design and management measures. A positive commitment to the management and maintenance of roadside landscape should be undertaken to maintain both the recreational and amenity value of the affected areas and their development potential and land values.

10.8 OPPORTUNITIES AND POTENTIAL BENEFITS

Implementation of restoration practices post construction, provides the opportunity to (in certain circumstances) improve existing environmental quality in the area and create positive features within the local environment.

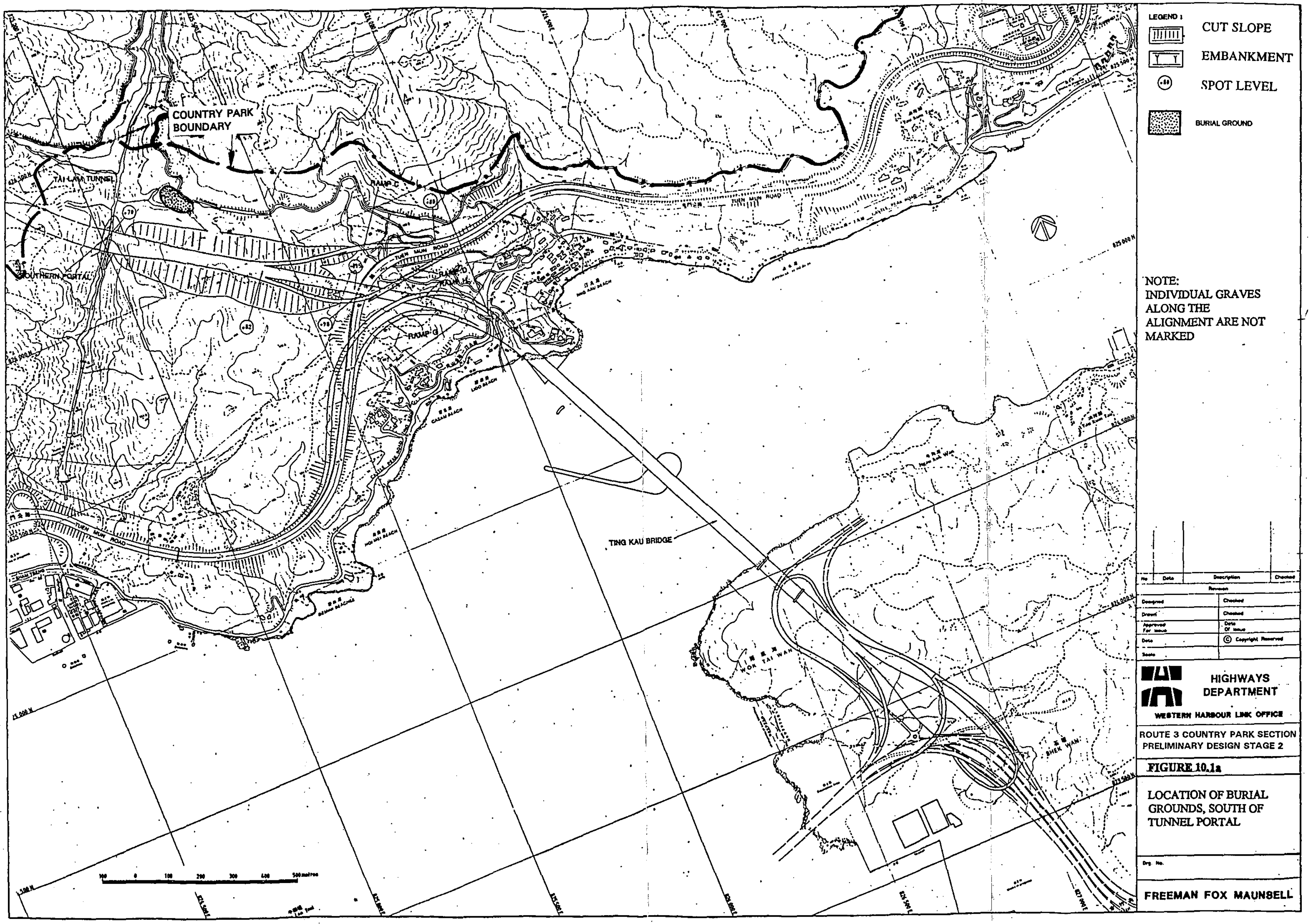
It is considered that such opportunities in relation to the construction of the road section should be seized wherever practicable. The following have been identified as areas where potential benefits could be realized:

- if additional temporary access roads are required during the detailed design stage, then their reinstatement as cycle paths possibly improving access to areas of the Parkland and creating a recreational resource could be considered; and

- the access road to the administration area at the toll plaza could be extended after construction to provide greater public access to the Country Park. At present access in this area is limited, such a proposal would necessarily require resolution of the necessary additional maintenance requirements and responsibilities, and the associated resource implications. A car parking area and visitor information facility is also proposed.

10.9 CONCLUSIONS

Potential landuse impacts and community issues resulting from the construction and operation of the Alignment will include severance, disruption to sensitive sites/areas, loss/disturbance to local amenity and recreational resources and land take. Mitigation will generally be achieved for the more physical (measurable) impacts through the implementation of recommendations presented in the specialist chapters of this Report. The more intangible impacts relevant to community issues are more difficult to assess due to the often subjective nature of concerns. Identification of any further appropriate mitigation is therefore sometimes best achieved through public consultation.


COUNTRY PARK BOUNDARY
TAI LAM TUNNEL
SOUTHERN PORTAL
RAMP C
RAMP D
RAMP G
TUEN MUN ROAD
TING KAU BEACH
LIDO BEACH
CASAM BEACH
HOI MEI BEACH
TING KAU BRIDGE
WOK TAI WAN
SHEK WAN
LEGEND :
CUT SLOPE
EMBANKMENT
SPOT LEVEL
BURIAL GROUND
NOTE:
INDIVIDUAL GRAVES ALONG THE ALIGNMENT ARE NOT MARKED
HIGHWAYS DEPARTMENT
WESTERN HARBOUR LINK OFFICE
ROUTE 3 COUNTRY PARK SECTION
PRELIMINARY DESIGN STAGE 2
FIGURE 10.1a
LOCATION OF BURIAL GROUNDS, SOUTH OF TUNNEL PORTAL
FREEMAN FOX MAUNSELL

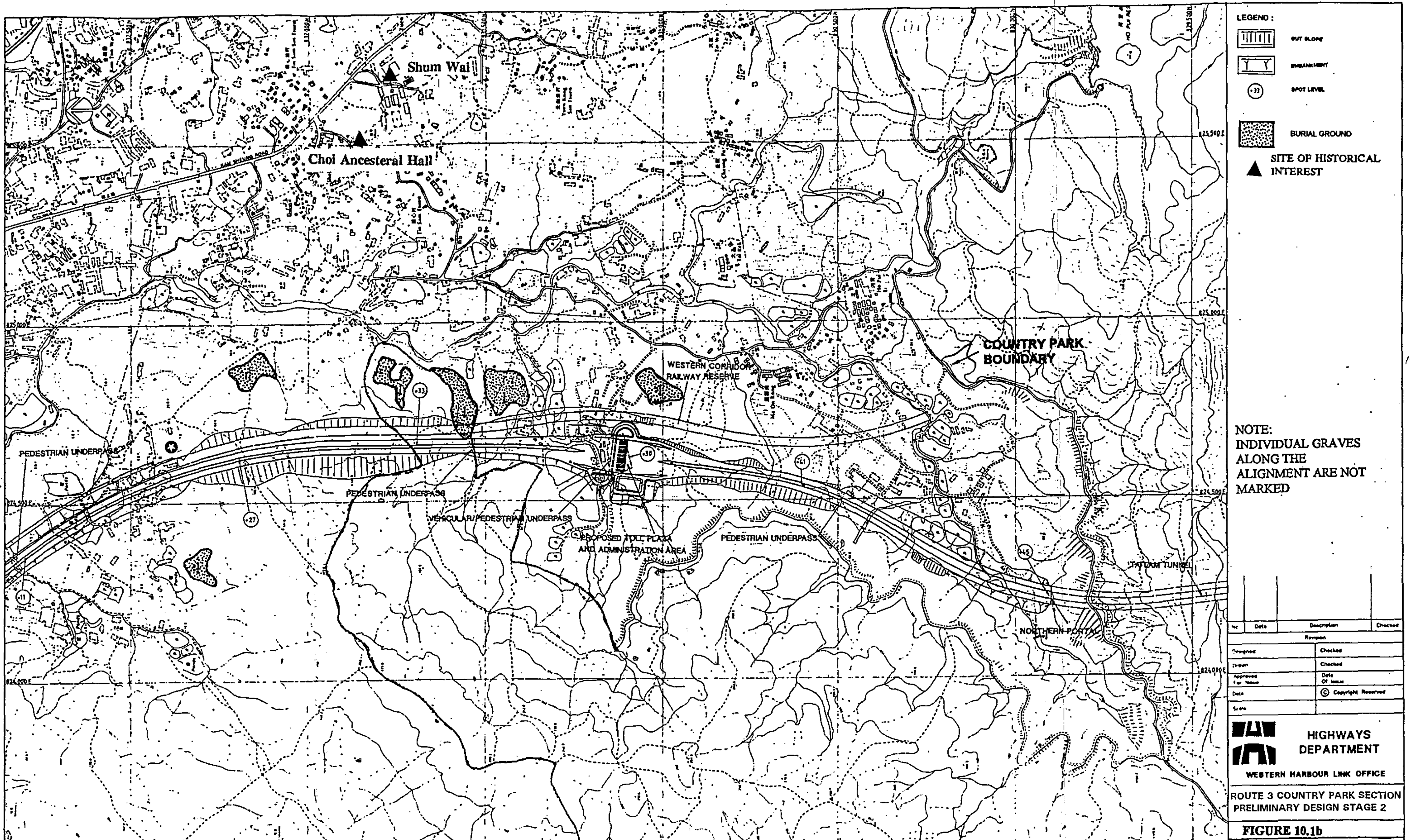
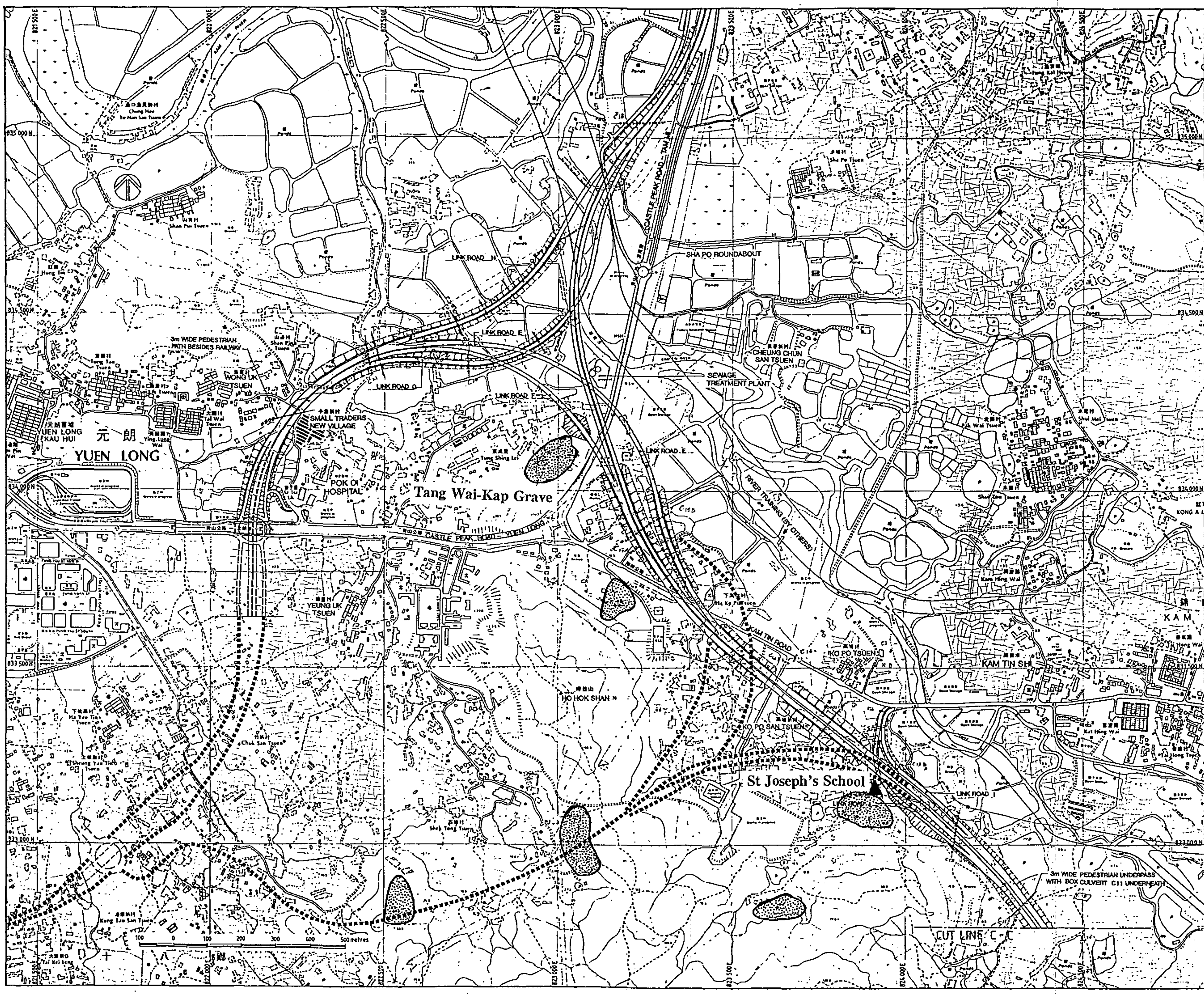


FIGURE 10.1b

LOCATION OF BURIAL GROUNDS, TAI LAM TUNNEL AND YUEN LONG APPROACH ROAD

FREEMAN FOX MAUNSELL



LEGEND :

CUT SLOPE

EMBANKMENT

SPOT LEVEL

BURIAL GROUND

No.	Date	Description	Checked
		Revision	

Designed		Checked	
Drawn	H K CHENG	Checked	
Approved For Issue		Date Of Issue	
Date	OCT. 1993	© Copyright Reserved	
Scale	1 : 5000		

HIGHWAYS DEPARTMENT

WESTERN HARBOUR LINK OFFICE

ROUTE 3 COUNTRY PARK SECTION
PRELIMINARY DESIGN STAGE 2

FIGURE 10.1c

LOCATION OF BURIAL GROUNDS, TAI LAM TUNNEL AND YUEN LONG APPROACH ROAD

Drg. No. 92393 / SK / 258

FREEMAN FOX MAUNSELL

ECOLOGY

CHAPTER 11

11. ECOLOGY

11.1 ECOLOGY SURVEY METHODS

Field surveys were conducted on the proposed Alignment between 13 March and 1 June 1993. The objective was to determine the conservation significance of the study area, and to determine whether species of plants and animals which are protected by local regulation or international convention occurred on the study area. For the purpose of ecological survey the total project site was sub-divided into two discrete Study Areas, a southern and a northern study area and potential impacts and mitigation measures are discussed accordingly. In addition, due to the importance of Tai Lam Country Park, potential impacts on the park are discussed in a separate sub section. A presentation was made to the Country Park Board in November 1993 and the assessment in included in Appendix A11.3.

The southern area (from Tuen Mun Road north to the south tunnel portal) was surveyed non-systematically during daylight hours on 13 March, 15 April, 27 May and 30 May, and at night on 31 May and 1 June. The daytime survey was to assess the overall conservation value of the area, including the dominant species of flora and the suitability of the habitat for wildlife. The night-time survey focused on the stream, with particular emphasis on amphibians. The flora and fauna surveys are not considered comprehensive because they covered only the spring and early summer season.

The northern area (from the north portal to Yuen Long) was surveyed non-systematically at night on 26 May, and during day-time on 13 March, 15 April, 5 May and 27 May. Features of the dominant flora and fauna were noted.

11.2 SOUTH AREA SURVEY RESULTS

11.2.1 Flora

The south area was composed of four different habitats: a mosaic of scrubland and grassland (or low scrubland), shrub-woodland, woodland, and agriculture-disturbance habitat (Figure 11.1). The mosaic habitat of grass and shrubs is typical of granite hill-slopes in Hong Kong, and is well-represented in the Country Park system. The woodland habitat appeared to have been undisturbed for quite a long time, and consequently was quite diverse floristically. Therefore, it may be expected to provide useful habitat for various animal groups.

The agriculture-disturbance habitat consisted of patches of orchard or crop areas together with buildings and associated surface disturbance.

Plants were identified to species level, where possible to determine presence of protected, rare, or endangered species. In addition, for protected species habitat types were used as the basis for assessment of the impacts of the project.

11.2.2 Shrub-Grassland Habitat

The shrub-grassland mosaic included interspersed patches of both grassland and shrubland habitats, neither of which was adequately large or continuous in coverage to be designated a separate habitat.

The grassland was dominated by common grass species of Hong Kong hillsides. These included *Ischaemum spp.*, *Arundinella setosa*, *Eulalia* spp., and *Cymbopogon* spp. Interspersed shrubs included *Baeckea frutescens*, *Rhodomyrtus tomentosa*, *Raphiolepis indica* and *Eurya japonica*. Climbers recorded throughout the area included *Cassytha filiformis*, *Gnetum montanum* and *Smilax glabra*.

The shrubland patches were varied in species composition. The commonest species, in addition to those listed above, were *Litsea rotundifolia*, *Diploprora dubia*, *Melastoma sanguineum*, *Cratoxylum ligustrinum* and *Sterculia lanceolata*.

11.2.3 Woodland Habitat

Woodland habitat was mainly located on the hill-slope of the east face of the valley below the proposed south portal. This habitat contained a dense growth of common native woodland species, such as *Sapium discolor*, *Artocarpus hypargyrea*, *Celtis sinensis*, *Schefflera octophylla*, *Quercus glauca*, and *Quercus myrsinaefolia*. In the under-storey climbers like *Gnetum montanum*, *Jasminum lanceolatum* and *Alyxia sinensis* were quite common.

11.2.4 Shrub-Woodland Habitat

Some shrubland areas on the site were maturing, and contained taller shrubs in addition to small trees. There was adequate coverage of this type of habitat to map distinct areas of its occurrence. Species were those of the shrubland and woodland habitats listed above, with a predominance of shrub and tree species.

11.2.5 Agriculture-Disturbance Habitat

A small portion of a village orchard plot lies within the construction disturbance area. This site has been abandoned and is becoming overgrown with native species typical of the shrubland-grassland habitat described above.

11.2.6 Rare and Protected Plant Species

No species of plant recorded on the proposed southern disturbance area is listed as rare or endangered in Hong Kong. However, two recorded species are protected by Hong Kong legislation. *Enkianthus quinqueflorus* is protected under the Forestry Regulation, (Cap.96, section 3), while *Phoenix hanceana*, is covered by the Animals and Plants (Protection of Endangered Species) Ordinance (Cap. 187).

Recorded species are listed in Table 11.1.

TABLE 11.1 PLANT SPECIES RECORDED BETWEEN TUEN MUN ROAD AND THE PROPOSED SOUTH TUNNEL PORTAL.

Abarema lucida	*Dianella ensifolia*	*Millettia reticula*
Acronychia pedunculata	*Dicranopteris linearis*	*Millettia speciosa*
Adinandra millettii	*Dioscorea spp.*	*Millettia nitida*
Adiantum caudatum	*Diospyros vaccinoides*	*Miscanthus floridulus*
Albizia corniculata	*Diploprora dubia*	*Morinda umbellata*
Alymia hypargyrea	*Embelia laeta*	*Mussaenda pubescens*
Alyxia sinensis	*Embelia ribes*	*Neyraudia reynaudiana*
Ampelopsis cantoniensis	*Enkianthus quinqueflorus*	*Ormosia emarginata*
Antidesma bunius	*Eulalia spp.*	*Pandanus spp.*
Antirrhea chinensis	*Euonymus chinensis*	*Phoenix hanceana*
Alymia hypargyrea	*Eurya japonica*	*Phyllanthus cochinchiensis*
Alyxia sinensis	*Ficus superba*	*Phyllanthus emblica*
Ampelopsis cantoniensis	*Ficus variolosa*	*Phyllanthus reticulatus*
Antidesma bunius	*Gahnia tristis*	*Pinus massoniana*
Antirrhea chinensis	*Garcinia oblongifolia*	*Psychotria rubra*
Aporusa chinensis	*Gardenia jasminoides*	*Psychotria serpens*
Ardisia crenata	*Gnetum montanum*	*Pteridium aquilinum*
Artocarpus hypargyrea	*Glochidion wrightii*	*Quercus glauca*
Arundinella setosa	*Glochidion eriocarpus*	*Quercus myrsinaefolia*
Aster spp.	*Grewia hirsuta*	*Rava microphylla*
Atalantia buxifolia	*Hedyotis acutangula*	*Rhaphiolepis indica*
Baeckea frutescens	*Helieteres angustifolia*	*Rhodomyrtus tomentosa*
	Heterosmilax gaudichaudiana.	
Bauhinia championii	*Homalium cochinchinensis*	*Rhus chinensis*
Blechnum orientale	*Hypserpa nitida*	*Rhus succedanea*
Bridelia monoica	*Ilex asperella*	*Rhynchospora rubra*
Broussonetia papyrifera	*Ilex pubescens*	*Rubus reflexus*
Brucea japonica	*Ilex viridis*	*Sapium discolor*
Caesalpinia vernalis	*Inula cappa*	*Sapium suberiferum*
Carallia brachiata	*Ishaemum spp.*	*Schefflera octophylla*
Cassytha filiformis	*Itea cainea*	*Schima superba*
Celtis sinensis	*Itea chinensis*	*Schinia spp.*
	Jasminum lanceolatum	*Schizoloma ensifolia*
Cinnamomum camphora	*Lantana camara*	*Scleria chinensis*
Citrus microcarpa	*Liriope spicata*	*Smilax china*
Clausena lansium	*Litsea rotundifolia*	*Smilax glabra*
Clerodendrum fortunatum	*Lithocarpus glabra*	*Sterculia lanceolata*
Cratoxylum ligustrinum	*Litsea cubeba*	*Strophanthus divaticula*
Croton lachnocarpus	*Litsea glutinosa*	*Styrax suberifolius*
Cyclea racemosa	*Lophatherum gracile*	*Symplocos laurina*
Cymbopogon spp.	*Lygodium japonicum*	*Ternstroemia gymnanthera*
Dalbergia benthamii	*Machilus chinensis*	*Tetracera asiatica*
Dalbergia hancei	*Melastoma dodecandum*	*Uvaria microcarpa*
Dendrotrophe frutescens	*Melastoma sanguineum*	*Zanthoxyllum avicennae*

11.2.7 Invertebrate Fauna

The southern area appeared to be a good site for butterflies. Several species of swallowtail butterflies (Papilionidae), including *Papilio memnon, P. polytes, P. paris, P. xuthus* and *Graphium doson*, were seen along the catchment trail. Most of these species are generally fairly common and widespread throughout the Territory. However, *Papilio xuthus* is not known to be common at any Hong Kong site, and is in fact absent or rare in most years. Coincidentally, when it does appear, it is found most commonly at Ho Pui (near the proposed northern portal) and seldom elsewhere in Hong Kong (M. Bascombe, pers. comm.). The high diversity and abundance of swallowtail butterflies are probably due to the abandoned citrus orchard on the west-facing hillside. Citrus species are used as larval food plants by most species of *Papilio* occurring in the Territory. Additionally, several species of whites and yellows (Pieridae) were present, as well as a number of species from other families.

Recorded ant species are considered common in Hong Kong and have relatively unspecific habitat requirements. Recorded species included *Polyrhachis, Anoplolepis, Camponotus, Diacamma* and *Paratrechina*.

The catchwater along the Country Park boundary supports some fauna, including an unusual variety of dragonflies. These include *Orthetrum pruinosum* and *O. glaucum*, both common and widespread species, as well as some more restricted species such as *Trithemis festiva*. The latter were observed mating over the catchwater, as was an unidentified species of Gomphidae. However, the catchwater does not support a large growth of aquatic macrophytes, and benthic microhabitats are limited. It is likely that some species of dragonfly had flown long distances to forage at the site.

11.2.8 Amphibians, Reptiles and Fish

Changeable lizards (*Calotes versicolor*) were seen near the catchment trail. Asiatic common toads (*Bufo melanostictus*) were foraging in the woodland, shrubland, and grassland in the site during the survey nights. Lesser spiny frogs (*Rana exilispinosa*) were quite common and were breeding in both the main stream and the side streams. One brown tree frog (*Polypedates leucomystax*) was also found calling near a stream pool. Paddy frogs (*Rana limnocharis*) also were recorded as breeders in rainwater pools near the catchment road.

11.2.9 Birds

Bird species recorded when seen or heard in the survey area are listed in Table 11.2. Only two recorded species seen are considered to be uncommon to rare in Hong Kong. These are the red-winged crested cuckoo and the crested goshawk. All other recorded species are widespread or locally common in Hong Kong. Winter visiting birds such as flycatchers and thrushes would also be expected to use this type of habitat.

Due to the size of the proposed impact area and the characteristically dense vegetative cover, additional bird species not recorded during this survey are certainly using this site. The position of the study site near the Tai Lam Country Park makes it a favourable location for birds of prey, which typically forage over large undeveloped areas. This area may present one of the deepest undisturbed mainland gorges remaining in Hong Kong.

TABLE 11.2 LIST OF AVIAN FAUNA RECORDED AT TIN KAU (27 MAY 1993)

COMMON NAME (Latin Name)	STATUS
Black eared kite (*Milvus migrans*)	R
Crested goshawk (*Accipiter trivirgatus*)	R
Chinese francolin (*Francolinus pintadeanus*)	R
Spotted dove (*Streptopelia chinensis*)	R
Collared scops owl (*Otus bakkamoena*)	R
Red-winged crested cuckoo (*Clamator coromandus*)	SV
Large hawk cuckoo (*Cuculus sparverioides*)	SV
Indian cuckoo (*Cuculus micropterus*)	SV
Koel (*Eudynamis scolopacea*)	R
Greater coucal (*Centropus sinensis*)	R
White breasted kingfisher (*Halcyon smyrnensis*)	R
House swift (*Apus affinis*)	R
Swallow (*Hirundo rustica*)	SV
Magpie (*Pica pica*)	R
Jungle crow (*Corvus macrorhynchus*)	R
Crested mynah (*Acridotheres cristatellus*)	R
Hwamei (*Garrulax canorus*)	R
Violet whistling thrush (*Myiophoneus caeruleus*)	R
Black-faced laughing thrush (*Garrulax perspicillatus*)	R
Crested bulbul (*Pycnonotus jocusus*)	R
Chinese bulbul (*Pycnonotus sinensis*)	R
Great tit (*Parus major*)	R
Long-tailed tailor bird (*Orthotomus sutorius*)	R
Yellow-bellied wren warbler (*Prinia flaviventris*)	R
White eye (*Zosterops japonica*)	R
Key to symbols:	R = resident SV = summer visitor

The significance of the study site to birds may change seasonally. In particular, during winter bird species richness would be expected to increase. This is because the area contained apparently good habitat for such winter visitors as flycatchers and warblers.

All bird species are protected under the Wild Animals Protection Ordinance (revised edition 1980, Chapter 170).

11.2.10 Mammals

A scat of a civet, probably either the masked palm civet *(Paguma larvata)* or the small Indian civet *(Viverricula indica)*, was found near the catchment trail on a grave overlooking the ravine. Occurrence of civets would be expected on this site because the woodlands and shrublands provide suitable habitat for these and other mid-sized mammals.

A barking deer was also heard near the southern area. Because of their characteristically high mobility, it is quite likely that barking deer forage in the study site. The vegetation was too dense to permit a search for mammal burrows during the current survey.

The walls and roofs of the catchment tunnels, which potentially provide roost sites for bats, were probably too smooth for bat use. No bats were seen roosting there during this survey.

11.2.11 Summary

The habitats on the south area were shrubland, grassland and woodland. Woodland habitats are of greatest interest from the points of view of floral and faunal diversity. The coexistence of different vegetation types favours some animal species. The mammal fauna of the ravine below the proposed tunnel portal site is expected to be quite rich, while birds evidently benefit from the lack of disturbance in this site and in the Tai Lam Country Park area as a whole.

The stream is not an important frog habitat, probably because of past human impact (water upstream is collected by the catchwater) and the lack of extensive woodlands in the surrounding area. No systematic sampling of aquatic invertebrates was undertaken in this preliminary survey. However, because the stream is small and intermittent, it is unlikely that it would support a particularly diverse or abundant invertebrate community.

11.3 NORTH AREA SURVEY RESULTS

11.3.1 Flora

The Alignment will cross areas composed of four different habitats: agriculture, fernland, low density shrubland and woodland (Figures 11.2a and b). Dominant, unusual, rare or protected species were noted in each of these habitats. Descriptions of the habitats and associated wildlife are given below.

11.3.2 Agriculture

From the proposed north portal site to Yuen Long, the non-residential or commercial areas of the valley floor have been used for agriculture. Primary forms of agriculture are farming and animal husbandry. Numerous ponds for fish and duck rearing are interspersed with vegetable and paddy plots. Although the area is intensively cultivated, it provides foraging sites for wild birds, and abundant amphibian and reptile foraging and breeding sites.

11.3.3 Fernland

The fernland was comprised almost exclusively of *Dicranopteris linearis*. Other vegetation types could only be found occasionally around rock outcrops or among the *Dicranopteris*. These included shrubs *Ficus variolosa, Adinandra milletia, Ilex asperella*, *Raphiolepis indica* and *Litsea glutinosa*, as well as climbers like *Smilax china* and *Embelia laeta*. The species diversity of this habitat type was very low probably due to extensive hill-fires as many graves can be found in the area.

11.3.4 Shrubland

Shrublands were quite patchy and the recorded species composition is well-represented in large areas of the Territory. The dominant species were *Eurya japonica, Aporusa chinensis, Baeckea frutescens, Cratoxylum ligiutrinum, Ficus variolosa, Rhodomyrtus tomentosa*, as well as *Ilex asperella*. They were usually between 1-2 metres high. Climbers like *Gnetum montanum*, and *Smilax glabra*; and several species of grass like *Arundinella setosa*, *Cymbopogon* spp., and *Gahnia tristis* were present among the shrubs. However, stands of *Pinus massoniana* of 3-4 metres high were also common. This type of habitat is quite common in the higher altitude in the north-western part of the Territory.

11.3.5 Woodland

Two different types of woodland were recorded: planted pine and fung shui woodland. *Pinus massoniana* was dominant in most of the open planted pine areas, reaching a height of over 20 metres. The understorey was not very rich in flora and was mainly covered by *Dicranopteris* and those common grasses listed above. Low floral diversity in the pine understorey probably resulted from frequent hill fires.

A diverse fung shui wood with some *Pinus massoniana* was present at the back of Ho Pui village and on the slope behind. The dominant species included *Sapium discolor, Celtis sinensis, Glochidion wrightii, Zanthoxyllum avicennae, Rhus succedanea, Schleffera octophylla, Sterculia lanceolata, Cinnamomum camphora*, and some fig species including *Ficus superba, Ficus variegata chlorocarpa* and *Ficus hispida*. In the woodland under-storey shrubs including *Psychotia rubra, Litsea rotundifolia*, and *Ilex* spp., and climbers such as *Millettia nitida, Alyxia sinensis*, and *Tetracera asiatica* were also common.

Except for the wooded slopes behind the villages most of the hill sides around the proposed development area experienced frequent hill fires. The lower hill slopes were covered mainly by *Dicranopteris* and were probably of limited ecological value. However, the well-preserved woodland had great structural and species diversity.

11.3.6 Rare and Protected Species

No species of plant recorded on the northern area is rare or endangered in Hong Kong. However, two species are protected under current legislation. *Rhododendron simsii* is protected under the Forestry Regulation, (Cap.96, section 3), while *Phoenix hanceana*, is covered by the Animals and Plants (Protection of Endangered Species) Ordinance (Cap. 187). *Rhododendron simsii* is the most common wild rhododendron in Hong Kong and patches of it can be found in the Territory.

11.3.7 Invertebrate Fauna

Many dragonflies were seen over the ponds south and west of Ho Pui, including *Anax guttatus* and *Sinictogomphus clavatus*. The latter species has only been recorded twice before in the Territory (Keith Wilson, pers. comm.). At least 53 butterfly species occur at Ho Pui (M. Bascombe, unpubl. data, see Appendix A11.1). Two of the recorded species are the rare *Papilio xuthus* (for which Ho Pui is the best site in Hong Kong) and the moderately rare *Zizeeria karsandra*. Vast numbers of cocoons of a species of atlas moth were found on the trunk and branches of one large village tree (*Cinnamomum camphora*) with a girth exceeding 5m.

The ant fauna seen in the village area included common taxa such as *Polyrhachis dives, Tapinoma* spp. and *Pheidologeton* spp.

TABLE 11.3 PLANT SPECIES RECORDED ON THE NORTHERN AREA

Abarema lucida	*Ficus hispida*	*Mucuna championi*
Adinandra millettii	*Ficus superba*	*Mussaenda pubescens*
Adiantum caudatum	*Ficus variegata chlorocarpa*	*Neyraudia reynaudiana*
Adina pilulifera	*Ficus variolosa*	*Osbeckia chinensis*
Ageratum spp.	*Gahnia tristis*	*Pandanus spp.*
Alpinia zerumbet	*Gardenia jasminoides*	*Phoenix hanceana*
Ampelopsis cantoniensis	*Gnetum montanum*	*Phyllanthus conconchiensis*
Aporusa chinensis	*Glochidion wrightii*	*Phyllanthus emblica*
Aporusa dioica	*Glochidion eriocarpus*	*Pinus massoniana*
Aralia dasyphylla	*Gymnema alterniflorus*	*Psychotria rubra*
Artabotrys hexapetalus	*Hedyotis acutangula*	*Psychotria serpen*
Artocarpus hypargyrea	*Helicteres angustifolia*	*Pteridium spp.*
Arundinella setosa	*Homalium cochinchinensis*	*Pteroloma triquetrum*
Asparagus cochinchinensis	*Hypsorpa nitida*	*Rapanea neriifolia*
Aster spp.	*Ilex asperella*	*Rhaphiolepis indica*
Baeckea frutescens	*Ilex pubescens*	*Rhododendron simsii*
Bredelia monoica	*Ilex rotunda*	*Rhodomyrtus tomentosa*
Breynia fructicosa	*Inula cappa*	*Rhus chinensis*
Brucea japonica	*Ishaemum spp.*	*Rhus succedanea*
Cassytha filiformis	*Jasminum lanceolatum*	*Rhynchospora rubra*
Centella asiatica	*Lantana camara*	*Sageratia theezans*
Cinnamomum camphora	*Leriope spicata*	*Sapium discolor*
Clerodendrum fortunatum	*Liquidambar formosana*	*Sapium suberiferum*
Cratoxylum ligustrinum	*Litsea rotundifolia*	*Schefflera octophylla*
Cyclea racemosa	*Litsea glutinosa*	*Schizoloma ensifolia*
Cymbopogon spp.	*Lygodium japonicum*	*Setaria spp.*
Dalbergia benthamii	*Machilus breviflora*	*Smilax china*
Dalbergia hancei	*Machilus chinensis*	*Smilax glabra*
Dendrotrophe frutescens	*Maesa perlarius*	*Sporobolus*
Dianella ensifolia	*Mallotus apelta*	*Sterculia lanceolata*
Dicranopteris linearis	*Melastoma dodecandum*	*Strophanthus divaricatus*
Diospyros morrisiana	*Melastoma sanguineum*	*Symplocos chinensis*
Diploprora dubis	*Melothria heterophylla*	*Syzygium buxifolia*
Elephantopus scabra	*Microcos paniculata*	*Tetracera asiatica*
Embelia laeta	*Millettia reticula*	*Uvaria microcarpa*
Embelia ribes	*Millettia speciosa*	*Vitis flexuosa*
Eremochloa ciliaris	*Millettia nitida*	*Wikstroemia indica*
Eulalia spp.	*Miscanthus floridulus*	*Zanthoxylum avicennae*
Eurya japonica	*Morinda umbellata*	

TABLE 11.4 REPTILES AND AMPHIBIANS RECORDED NEAR HO PUI

Species	Status	Habitat
Bufo melanostictus Asiatic Common Toad	Common	F,W,G,Sh
*Rana limnocharis** Paddy Frog	Rare	F
*Rana rugulosa** Chinese Bullfrog	Rare	F
*Rana guentheri** Gunther's Frog	Abundant	F,M,P,St
*Polypedates leucomystax** Brown Tree Frog	Abundant	F,M,P
*Kalophrynus pleurostigma** Narrow-mouthed Frog	Rare	M
*Kaloula pulchra** Asiatic Painted Frog	Common	M
*Microhyla butleri** Butler's Pigmy Frog	Common	P
*Microhyla ornata** Ornate Pigmy Frog	Common	F,M
*Microhyla pulchra** Marbled Pigmy Frog	Rare	F
Hemidactylus bowringi Bowring's Gecko	Rare	V
Gekko chinensis Chinese Gecko	Rare	V
Calotes versicolor Changeable Lizard	Rare	Sh
Ptyas korros Indo-chinese Rat Snake	Rare	W
Opheodrys major Greater Green Snake	Rare	Sh
*=breeding	F=field	M=marsh
P=pond	W=woodland	St=stream
V=village	Sh=shrubland	G=grassland

11.3.8 Amphibians, Reptiles and Fish

Ten species of amphibians and five species of reptiles were recorded in the Ho Pui area, and are listed in Table 11.4.

All of the amphibians except the Asiatic common toad (*Bufo melanostictus*) were breeding in the various wetlands during the survey. The Asiatic common toad probably also breeds in the area but was missed in this survey because it normally reproduces in early spring. All ten species are typical lowland species associated with agricultural fields, ponds and marshes. Three of them are locally uncommon: Chinese bull frog (*Rana rugulosa*), narrow-mouthed frog (*Kalophrynus pleurostigma*) and Butler's pigmy frog (*Microhyla butleri*).
All five reptiles recorded are common and widespread throughout the Territory. The banded krait (*Bungarus fasciatus*), which is a locally rare snake, has also been recorded in the area. Other reptile species not recorded but probably occurring on the site are.

Chinemys reevesi	Reeves' terrapin
Leiolopisma reevesi	Reeves' smooth skink
Eumeces chinensis	Chinese skink
Ramphotyphlops braminus	common blind snake
Elaphe radiata	copperhead racer
Ptyas mucosus	common rat snake
Oligodon formosanus	Taiwan kukri snake
Lycodon aulicus	common wolf snake
Amphiesma stolata	buff-striped keelback
Xenochrophis piscator	checkered keelback
Enhydris plumbea	plumbeous water snake
Enhydris chinensis	Chinese water snake
Bungarus multicinctus	many-banded krait
Naja naja	Chinese cobra
Trimeresurus albolabris	bamboo snake

The species listed above can be found in other rural areas with wet agricultural fields or on other hillsides in the New Territories. It is unlikely that any rare reptile would occur within the site.

11.3.9 Birds

This region of the central New Territories is already known to be one of the richest and most diverse documented sites for birds in Hong Kong (Hong Kong Bird Watching Society reports). Species seen on the two survey days with less common status in the Territory were the black baza (*Aviceda leuphotes*) and the northern sparrowhawk (*Accipiter nisus*). Both of these raptors have very local status in Hong Kong and are generally uncommon. The Sek Kong catchment area is one of the preferred localities of the black baza, and recent sightings of young birds in the area suggest that this species now breeds at this location. The black baza appears to be expanding its range in Hong Kong as a local breeder. The other bird species sighted during the survey were either locally common or widespread in Hong Kong.

The agricultural fields, fish ponds and disused rice paddy surrounding Ho Pui village appear to offer the most important feeding habitat for local birds. The hills to the west have been regularly burnt so the vegetative cover is quite low. However, some of the tall pines provide potential nest sites for raptors.

There is an egretry in a stand of bamboo just west of Ho Pui village which is proposed to be designated a Site of Special Scientific Interest (SSSI) by the Agriculture and Fisheries Department. Cattle Egrets, Little Egrets and chinese pond herons were seen nesting in the egretry and had young during the survey period. All species were seen foraging in the fields surrounding the village. The egretry probably supports approximately 200 birds (Lew Young, pers. comm.). The two raptors mentioned above were also seen hunting over the area surrounding the village. Birds recorded near Ho Pui village during the survey period are listed in Table 11.5.

11.3.10 Mammals

Signs of mammal activity (scats, tracks and burrows) were noted during the survey. Local villagers at Ho Pui reported frequently hearing barking deer and seeing civets and pangolins. All of these mammals have been reported from nearby Sek Kong, so their presence is to be expected. Reports from villagers suggest that large mammals are fairly frequently encountered in the Ho Pui area.

On 27th May at 1640h a Javan mongoose (*Herpestes javanicus*) was seen southwest of the Ho Pui village. This mammal has a very localised recorded distribution in Hong Kong, with only a few reports from the Deep Bay area. This is thought to be the furthest south it has been recorded in Hong Kong. The fish ponds and farms of the village area probably provide plentiful prey in the form of small mammals, frogs, reptiles and invertebrates. Tracks belonging to a large rodent (probably *Rattus* spp.) were found in the village area.

Two species of bat were seen at dusk on 26th May. These were the Japanese pipistrelle (*Pipistrellus abramus*) and Leschenault's rousette bat (*Rousettus leschenaulti*). The former is an insectivorous bat very widespread in Hong Kong. It probably roosts in the village houses. The latter is a fruit-eating bat, the largest such species in Hong Kong. It's status is rare locally due to a lack of suitable sites for its cave roosting habit. The largest colony of this species so far discovered in the Territory is located very close to Ho Pui village. Both bat species are protected in Hong Kong. The rousette bat may have been foraging on fruit trees located in or around the village (eg. *Ficus* spp. and citrus).

All mammals mentioned above (except for *Rattus* spp.) are protected in Hong Kong under the Wild Animals Protection Ordinance, Chapter 170.

TABLE 11.5 BIRDS RECORDED NEAR HO PUI VILLAGE (26 AND 27 May 1993)

COMMON NAME (Latin Name)	STATUS
Black baza (*Aviceda leuphotes*)	SV
Northern sparrowhawk (*Accipiter nisus*)	WV
Black-eared kite (*Milvus migrans*)	R
Chinese pond heron (*Ardeola bacchus*)	R
Little egret (*Egretta garzetta*)	R
Cattle egret (*Bubulcus ibis*)	R
Night heron (*Nycticorax nycticorax*)	R
White-breasted waterhen (*Amaurornis phoenicurus*)	R
Chinese francolin (*Francolinus pintadeanus*)	R
Spotted dove (*Streptopelia chinensis*)	R
Feral pigeon (*Columba livia*)	I
Indian cuckoo (*Cuculus micropterus*)	SV
Large hawk-cuckoo (*Cuculus sparverioides*)	SV
Koel (*Eudynamis scolopacea*)	R
White-breasted kingfisher (*Halcyon smyrnensis*)	R
House swift (*Apus affinis*)	R
Swallow (*Hirundo rustica*)	SV
Rufous-backed shrike (*Lanius schach*)	R
Black drongo (*Dicrurus macrocercus*)	SV
Magpie (*Pica pica*)	R
Greater coucal (*Centropus sinensis*)	R
Lesser coucal (*Centropus bengalensis*)	R
Black-necked starling (*Sturnus nigricollis*)	R
Crested mynah (*Acridotheres cristatellus*)	R
Crested bulbul (*Pycnonotus jocosus*)	R
Chinese bulbul (*Pycnonotus sinensis*)	R
Red-vented bulbul (*Pycnonotus aurigaster*)	R
Magpie robin (*Copsychus saularis*)	R
Tree sparrow (*Passer montanus*)	R
Long-tailed tailor bird (*Orthotomus sutorius*)	R
Yellow-bellied wren warbler (*Prinia flaviventris*)	R
Brown wren warbler (*Prinia subflava*)	R
White eye (*Zosterops japonica*)	R
Fork-tailed sunbird (*Aethopyga christinae*)	R

Key to symbols: R=resident
WV=winter visitor
SV=summer visitor
I=introduced

11.4 POTENTIAL IMPACTS AND MITIGATION MEASURES

11.4.1 South Area

This area is characterized by shrub-grassland and secondary forest near Tuen Mun Road which grades to more mature, closed-canopy forest on rugged terrain in the vicinity of the proposed tunnel portal. Remoteness and absence of grave sites have contributed to conservation of the woodland in the latter area through suppression of timber harvest and wildfire. The floristic diversity of this type of mature forest habitat, although once common, is now unusual in Hong Kong, and is therefore important from a conservation perspective. Loss of 6 hectares of mature forest habitat due to construction of the project is seen as a severe impact in the short term. In addition, loss of 9.5 hectares of shrub-woodland is also seen as a moderate short term impact because of the number of native plant species represented in this habitat.

Loss of agriculture-disturbance habitat (1 hectare) and shrub-grassland habitat (0.5 hectare) is not predicted to be a significant impact because of the limited extent of habitat disturbance. Both habitats are well represented in western New Territories. One abandoned orchard site provided habitat for a diverse and abundant butterfly community. This site does not lie within the disturbance boundary, and consequently will not be affected by the project.

Mitigation of loss of forest habitat can be accomplished over a longer term (10-15 years) through revegetation of fill areas and cut slopes using native species endemic to the proposed disturbance site. Species potentially useful for replanting are listed in Appendix A11.2 of this report and in previous reports on this project. A useful supplement to these lists appears in Corlett (1992) which lists plants attractive to fruit-eating birds in Hong Kong.

Two species of protected plants were recorded in the proposed disturbance area (*Enkianthus qinqueflorus*, and *Phoenix hanceana*). *Enkianthus qinqueflorus* is a shrub which was recorded on both the south and north areas of the Alignment. It is likely to occur at other sites in the immediate vicinity which will not be disturbed by construction, and therefore will not be eliminated from Hong Kong's flora due to construction of the project. This species is neither rare, nor of restricted distribution in Hong Kong. Protected status was conferred presumably to preclude commercial harvest for the Lunar New Year. Because of its status as a protected plant, it should be included in the seed mix for revegetation, or individual plants should be transplanted from disturbance areas to nurseries for cultivation and later re-planting on re-contoured areas.

Phoenix hanceana is a palm which is fire resistant. It was also recorded on both the south and north areas. This species is widely distributed in Hong Kong due to frequent occurrence of hill fires. Therefore, loss of individual plants due to project construction is considered to be a slight impact.

The abandoned citrus orchard located on a west-facing slope in the southeast of the study area should be protected from development to the extent possible, as it appears to be an unusually good site for butterflies.

Filling the ravine to construct the approach apron to the south portal would severely impact the stream and effectively isolate the upstream from the downstream portion of the ravine. This would have an adverse impact on populations of mammals, reptiles and amphibians occupying the ravine, as it would inhibit localized movement. To mitigate this impact consideration should be given to providing wildlife corridors beneath the roadway along the stream channel. This would reduce hazards both to animals attempting to cross the road and to motorists trying to avoid them. The corridors could consist of box or pipe culverts of adequate dimensions to permit wildlife movement.

Disturbance of the stream bed and riparian vegetation during construction should be minimized through design and operational measures. Sedimentation of the stream is to be avoided through careful planning and phasing of the culverting and fill operations, as it would potentially cause severe impacts on downstream aquatic life. Delays in establishment of vegetative cover on disturbed sites could result in substantial erosion and consequent sedimentation of the stream bed. Therefore, it will be important to stabilise disturbed sites using erosion control matting and rapid replanting immediately following completion of construction works.

Use of native plant species which are most useful to local wildlife will partially mitigate loss of habitats due to construction of the roadway. Planning re-vegetation species composition and placement with the intent of providing large plots of dense tree and bamboo cover could result in a long-term increase in availability of suitable nest sites for wading birds such as pond herons.

The recommended measures to decrease the potential for adverse impacts of the project are to organize construction work sites and access roads to avoid excessive loss of wetlands, and specifically to avoid the Ho Pui area.

The Ho Pui fruit trees represent an important feeding resource for birds and especially for the rousette bat. Loss of fruit trees would cause a severe impact on these species, and should be avoided.

Two plant species which are protected by Hong Kong regulations occur on the north area. These are *Rhododendron simsii*, and *Phoenix hanceana*. *Rhododendrom simsii* is the most common rhododendron in Hong Kong, and is represented in other sites in the Territory. It was recorded in the Country Park outside the proposed disturbance boundary, and no plants are expected to be lost due to construction. *Phoenix hanceana* (discussed above) was recorded in the disturbance area, but due to its wide distribution in the Territory, loss of individual plants is not predicted to pose a threat to survival of the species in Hong Kong.

11.4.2 North Area

The habitats to be lost along the Alignment are historically disturbed by hill fires and timber harvest. Because these habitats are of lesser significance from a conservation perspective, the Alignment would result in a net gain. Species which would benefit are primarily invertebrates and their predators that occupy the existing wetland agricultural habitats, which would not be disturbed. Aquatic species in the Kam Tin River might also benefit from retention of the existing river channel and avoidance of habitat disturbance due to sedimentation or hydrologic changes in the river.

A secondary gain which could result from the Alignment would be due to the firebreak function of the highway. The Alignment passes above several grave sites at the foot of the slope. Because many hill fires are started during grave worship ceremonies (AFD, pers. comm.), fires which begin below the highway would stop when they reached the roadway. Reduction in frequency and coverage of hill fires in the area could have a long-term positive impact of promoting regeneration of mature forest cover in the nearby area of Tai Lam Country Park. This could have secondary benefits such as reduced soil erosion, increased water retention, and provision of habitat for upland forest wildlife species.

11.4.3 Tai Lam Country Park Area

In addition to previous site surveys, a detailed survey was undertaken on 6 October to the Country Park area affected by the road. The detailed assessment was presented to AFD and the Country Park Board and is attached in Appendix A11.3. The section of the Alignment which crosses Tai Lam Country Park will affect approximately 1.6ha of Country Park surface area. The affected area, as shown in Figure 11.2a, contains both southerly and easterly slopes ranging from 22 to 118 m in elevation.

The primary habitat types found on the affected area are grassland and rock outcrop with sparse shrubs and few trees. These habitats are not of particular conservation significance as they are maintained by frequent burning of the hillside due to fires probably started at the nearby grave sites. The low grassland and rock outcrop habitats provide little cover or potential for wildlife foraging. Due to the southerly and easterly slope aspects and the sparse vegetative cover resulting from frequent fires, the site is quite dry and inhospitable to wildlife. Therefore, it is unlikely that the site harbours wildlife which would be of conservation interest or protected by local regulations or international conventions.

Within the Country Park immediately east of and downslope from the Alignment is an open stand of *Pinus* spp. woodland with open tall shrub understorey. This habitat is of greater ecological utility than the grassland or rock outcrop which would be disturbed by the road alignment. It provides some cover and potential nest sites for tree or shrub nesting birds. This habitat lies outside the works boundary, therefore it should not be significantly affected by construction or operation of the roadway. Care should be exercised to ensure that the slope cutting operation during road construction does not disturb this habitat. Revegetation of affected areas should be accomplished using native species of documented value to wildlife.

Within the Country Park to the west of the Alignment lies an area of relatively dense woodland with a dense shrub understorey. The dominant overstorey tree species is *Pinus* spp. The western cut slope for the roadway would come within 50m of this habitat. Because the wooded area lies outside the works limit, there should be no direct impact to this habitat. Again, care should be exercised to ensure that there is no impact to this habitat during formation of the cut slopes.

The assessment has indicated that this area and the habitats to be disturbed are not of major ecological significance. It was concluded that potential impacts to Tai Lam Country Park from construction of the roadway could be reduced by tunnelling through ridge beneath the Country Park. This option would have the added advantage of reducing visual and landscape impacts of the alignment. However this has been ruled out as impractical from feasibility and practicality reasons.

11.5 MONITORING MEASURES

Prior to onset of construction a reliable supply of revegetation seed and seedling stock should be secured. If necessary, government plant nurseries should initiate programmes to cultivate plants for revegetation of disturbance areas.

Revegetation and erosion control should be monitored during and following construction by a qualified environmental supervisor on the project site. The environmental supervisor should report to the site engineer, and should have authority to direct revegetation or erosion control works to achieve minimal adverse impacts. Success of revegetation and requirements for further planting or cultivation should be monitored during the first five years following completion of construction. Areas where plantings have failed to establish or where excessive erosion has occurred should receive immediate corrective action.

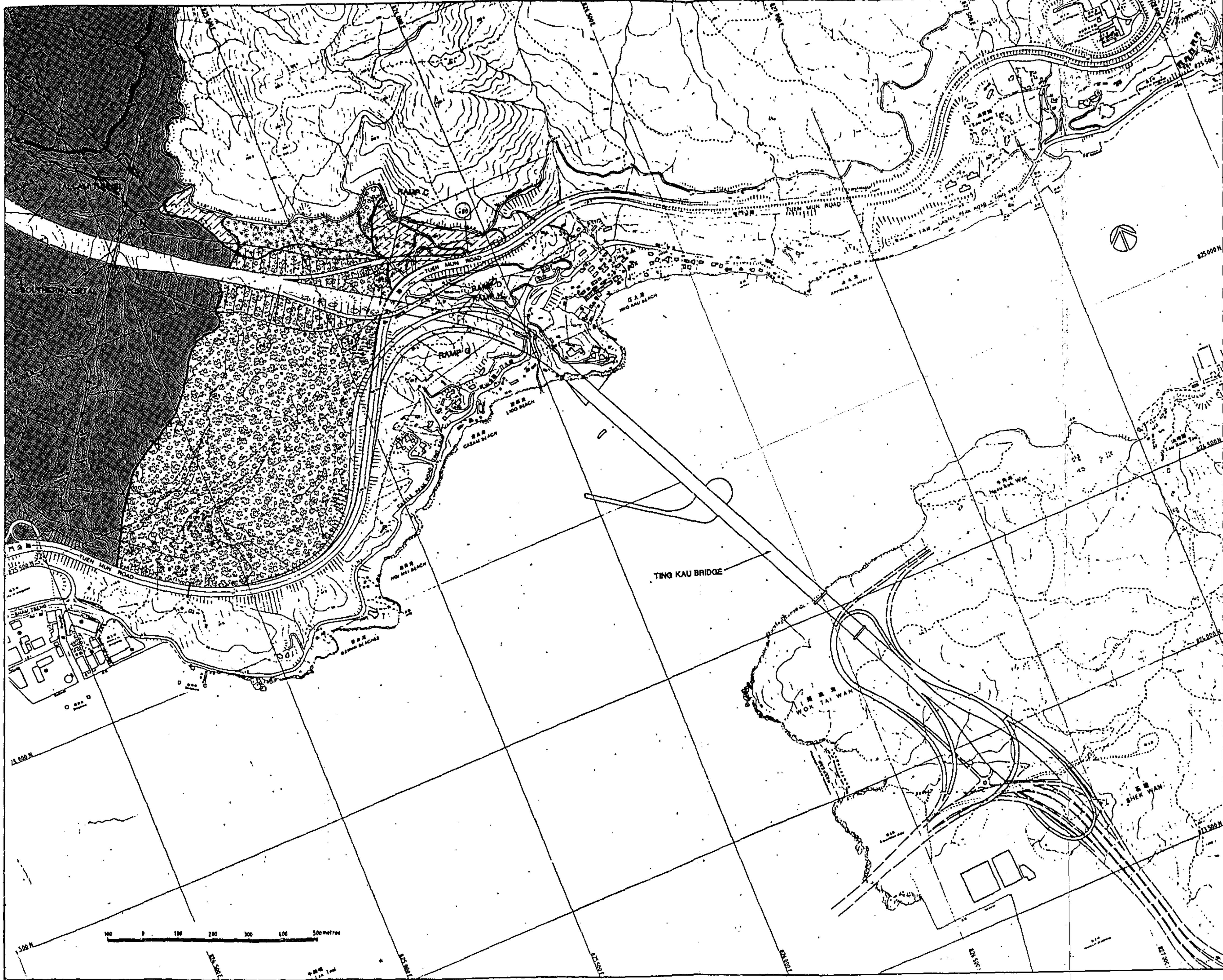
Vehicle collisions with wildlife should be monitored near the southern portal by examining the roadway and roadside during early morning hours periodically during the first 2 years of operation. If wildlife fatalities are recorded, fencing should be constructed to direct animals toward passage routes around the tunnel portal.

11.6 CONCLUSIONS

Significant ecological impacts are anticipated to arise in the Study Area as a result of the project, and mitigation has been identified which will reduce potential impacts to acceptable levels. These include the organisation of work sites and access roads to avoid excessive loss of wetlands, and specifically to avoid Ho Pui (a particularly sensitive area), construction of wildlife corridors and revegetation.

Adverse impacts were identified notably in the southern survey area due to loss of habitats during construction works in particular the anticipated loss of 6 hectares of mature forest (which is important in terms of its conservation value), and as a result of the Alignment location. Due to the lesser significance of the northern area from a conservation perspective, potential impacts in this area of are of little concern, and the Alignment may actually result in a net-gain.

Impingement on the Country Park is not desirable, however a detailed survey of the area potentially affected by the road indicated that the habitats to be disturbed are not of major ecological significance.



LEGEND :

- CUT SLOPE
- EMBANKMENT
- SPOT LEVEL
- AGRICULTURE / DISTURBANCE
- SHRUB GRASSLAND
- SHRUBLAND
- WOODLAND

No	Date	Description	Checked

Revision

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Date		© Copyright Reserved	
Scale			

HIGHWAYS DEPARTMENT

WESTERN HARBOUR LINK OFFICE

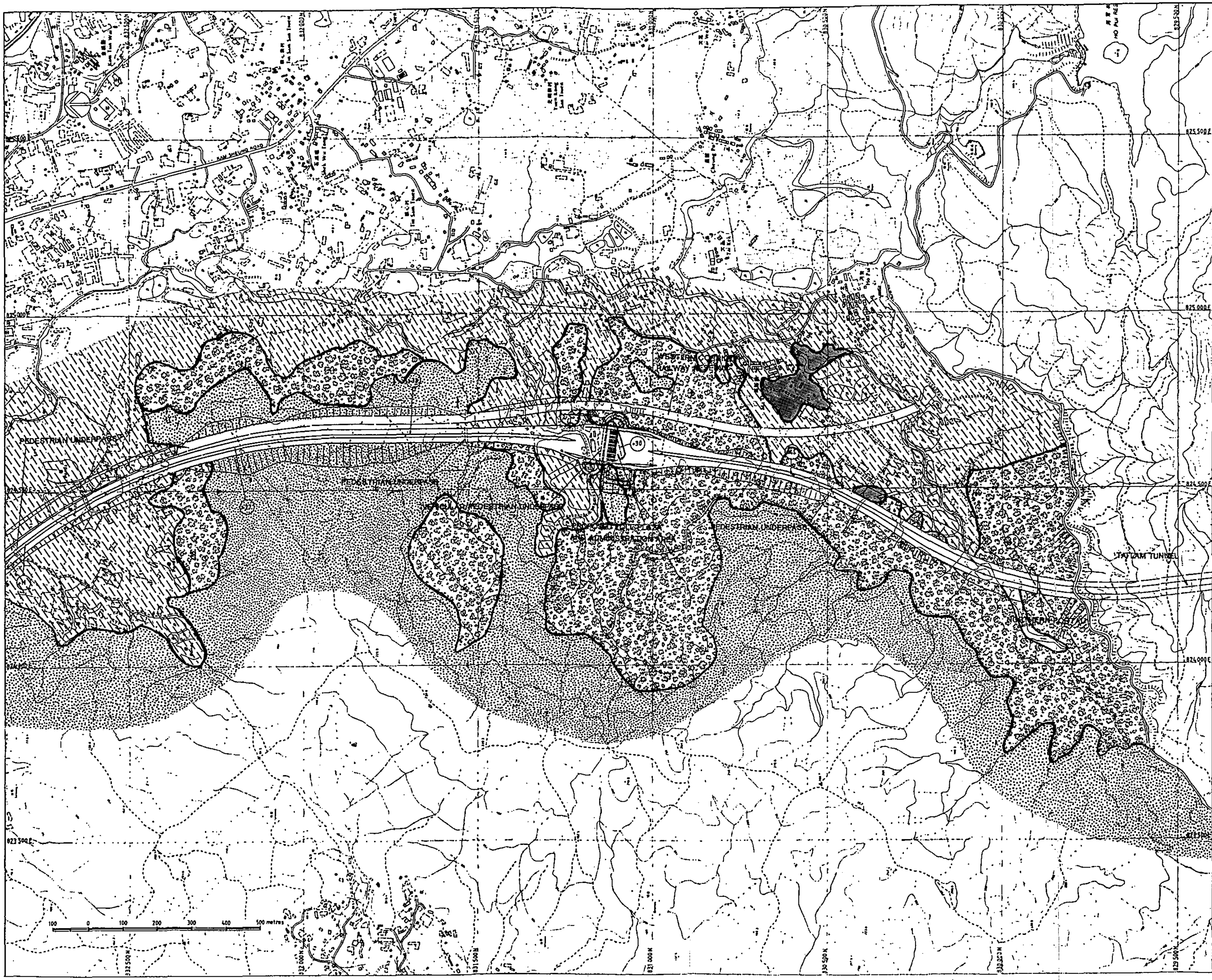
ROUTE 3 COUNTRY PARK SECTION
PRELIMINARY DESIGN STAGE 2

FIGURE 11.1

HABITAT MAP, SOUTH OF TUNNEL PORTAL

Drg. No.

FREEMAN FOX MAUNSELL



LEGEND :

CUT SLOPE

EMBANKMENT

SPOT LEVEL

FERN LAND / GRASSLAND

SHRUBLAND

WOODLAND

AGRICULTURE/DISTURBANCE

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Scale	

HIGHWAYS DEPARTMENT

WESTERN HARBOUR LINK OFFICE

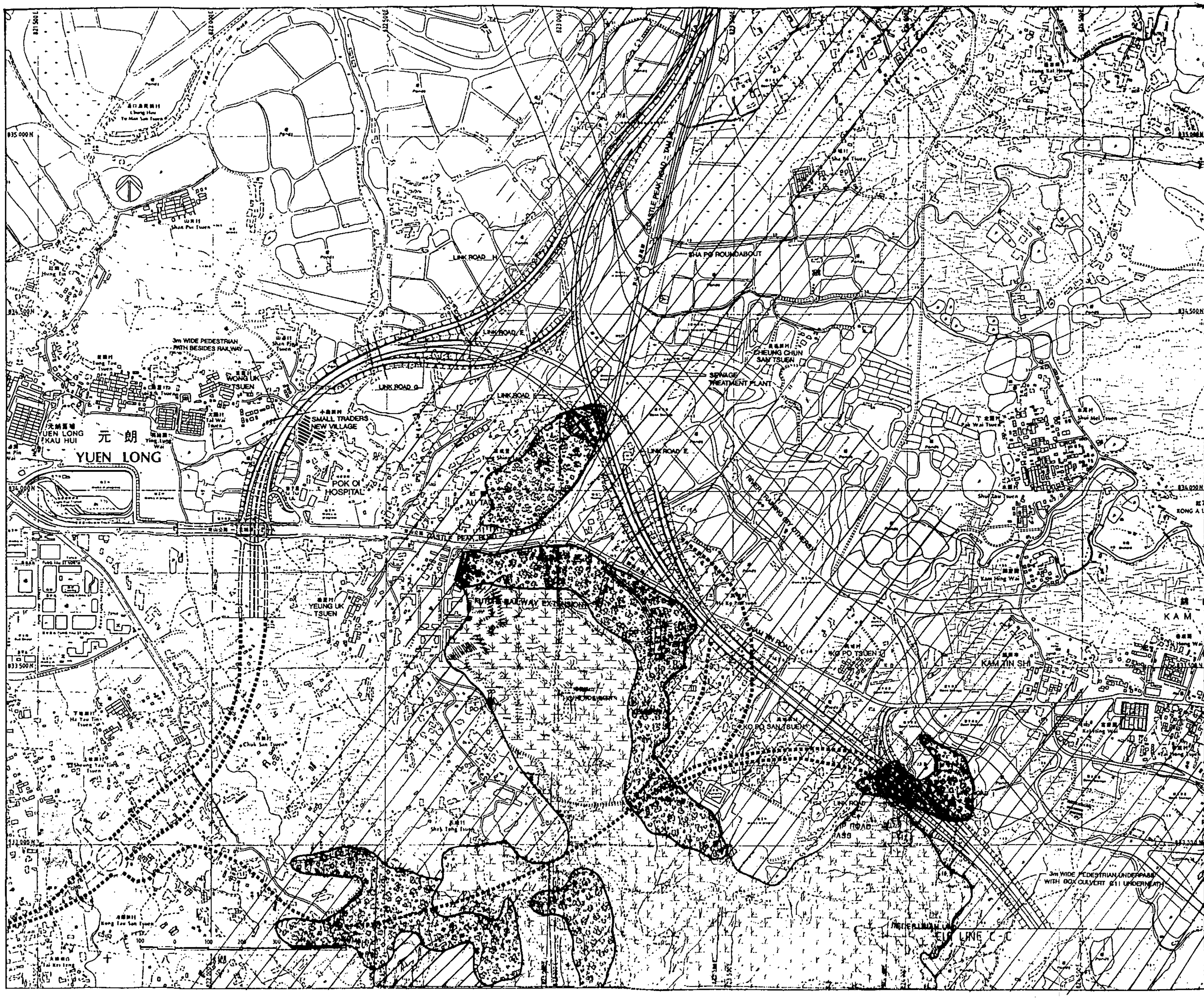
ROUTE 3 COUNTRY PARK SECTION
PRELIMINARY DESIGN STAGE 2

FIGURE 11.2a

HABITAT MAP, NORTH OF TUNNEL PORTAL

Drg No

FREEMAN FOX MAUNSELL



LEGEND

FERNLAND / GRASSLAND

SHRUBLAND

AGRICULTURE / DISTURBANCE

No.	Date	Description	Checked
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HIGHWAYS DEPARTMENT

ROUTE 3 COUNTRY PARK SECTION
PRELIMINARY DESIGN STAGE 2

FIGURE 11.2b

HABITAT MAP,
NORTH OF
TUNNEL PORTAL

Drg. No. 92393 / SK / 258

FREEMAN FOX MAUNSELL

ENVIRONMENTAL MONITORING AND AUDIT

CHAPTER 12

12. ENVIRONMENTAL MONITORING AND AUDIT SCHEDULES

12.1 INTRODUCTION

Environmental monitoring schedules and audit procedures are essential in order to:

- ensure that any environmental impacts resulting from the construction and operation of the road are minimised or kept to 'acceptable' levels at all times;
- establish procedures for checking that mitigation measures have been applied and are effective, and that the appropriate corrective action is undertaken if and when required;
- provide a means of checking compliance with environmental objectives, recording anomalies and documenting corrective action.

This Chapter outlines monitoring and audit requirements for the construction and operation of TLT & YLA in relation to air quality, noise and water quality, the details of which may be referred to in the appropriate chapters.

Monitoring and audit activities for both construction and operation should be consistent and complementary. It should be noted that monitoring during the operation of roadways is not specified by government. However, in order to confirm the findings of the EIA and ensure impacts are maintained at acceptable levels, it is recommended that operational monitoring be undertaken, as detailed in the appropriate chapters.

Monitoring schedules have been provided for the necessary environmental parameters (Tables 12.1 to 12.4) relevant to TLT & YLA (S), however at this stage it is only possible to provide outline schedules as guidance. Schedules for YLT & YLA (N) are presented in Part II, Chapter 25.

Detailed monitoring and audit requirements should be incorporated into the construction contract(s) for TLT & YLA in the form of environmental clauses. These clauses should be agreed in consultation with EPD before being finalised and will be prepared during the detailed design stage.

It is important to emphasise that monitoring and audit details presented in the schedules, such as monitoring frequency, location etc. (Tables 12.1 to 12.4), are for reference only. As with the contract clauses such details will need to be finalized during the detailed design, in order that the successful tenderer can, in consultation with EPD, confirm/identify the appropriate monitoring requirements prior to commencing construction. These specifications would be stated in the Environmental Monitoring and Audit Manual (see Section 12.2.4).

12.2 TECHNICAL/PERSONNEL REQUIREMENTS

12.2.1 Responsibilities

TLT & YLA will be constructed on a Build, Operate, Transfer basis. The successful tenderer will therefore be responsible for construction and initial operation of the road, and will henceforth be referred to as the Franchisee. The Franchisee shall be responsible for ensuring that the Contractor meets all necessary environmental protection requirements contained within the contract documents.

12.2.2 Staff Organisation and Structure

The monitoring and audit work should be carried out by suitably qualified and experienced personnel. It is recommended that the Franchisee employ an independent organisation (the environmental team) to undertake all baseline and compliance monitoring. Such personnel would report directly to the Works Checker (WC), and there should be sufficient staff to carry out the necessary tasks.

Whilst required to possess appropriate technical knowledge and training to carry out the tasks, monitoring staff should also have access to a specialist advisor for each main aspect (i.e noise, air quality, water quality, waste management). It would be advisable for details such as qualifications and experience of the appropriate environmental staff to be sent to EPD for information/comment.

12.2.3 Equipment/Analysis

The environmental team should be responsible for providing the appropriate approved monitoring and sampling equipment and other facilities to enable the monitoring to be carried out. The equipment should be approved in advance by EPD.

All analysis should be undertaken by an HOKLAS approved (or equivalent) laboratory to the specification of the environmental monitoring team.

12.2.4 Monitoring and Audit Manual

The environmental team should be required to prepare an environmental monitoring and audit (EM & A) manual to be submitted to EPD and the WC. The content of the manual should be agreed with EPD prior to the start of the construction works, and should include:

- the construction programme and the required EM & A programmes to assess the environmental impacts due to the development with time;
- the location, frequency and type of environmental monitoring and audit requirements to assess the environmental impacts of the construction;
- the form/content of event/Action Plans for air, water and noise impacts;
- review of pollution sources and working practices/procedures required in the event of environmental pollution levels being exceeded;
- the content/presentation of monitoring data, their audit and the actions taken with respect to non-compliance with environmental pollution levels;
- appropriate report formats/frequency of submission/special event reports, etc.;
- complaints/consultation procedures ;
- equipment service records and calibration requirements;
- the locations of sensitive receivers.

12.2.5 Reporting

A monthly Monitoring and Audit Report should be prepared by the monitoring team within 7 days of the end of each month with the first Report due in the month after construction commences. Copies of the report should be submitted to the WC and simultaneously sent to EPD and Highway's Department.

The report should be a relatively brief and concise account of the environmental monitoring during the previous month and should include a summary of:

- *Project Data* - A synopsis of the project organisation, project programme, management liaison structure;
- *Monitoring/Audit Requirements* - Summary of monitoring parameters, Trigger/Action/Target Levels, Action Plans, environmental protection requirements in contract documents, land lease and engineering conditions;
- *Monitoring Methodology* - Monitoring equipment used, locations, duration/frequency;
- *Monitoring Results* - Parameter, date, time, environmental conditions, location, etc.;
- *Audit Results* - Review of pollution sources, working procedures in the event of non-compliance with environmental monitoring levels; action taken in the event of non-compliance; follow-up procedures related to earlier non-compliance actions;
- *Complaints* - Liaison and consultation undertaken; subsequent action; database of telephone/written complaints, location of complaints; Action Plan and follow-up procedures etc;
- *Appendices* - Appropriate drawings/tables of monitoring locations, sensitive receiver locations, environmental monitoring and audit requirements etc.

The monthly Monitoring and Audit Reports should be supported by submission of a six monthly and annual summary.

12.3 ENVIRONMENTAL MONITORING SCHEDULES

12.3.1 General

Environmental monitoring falls broadly into two categories: firstly baseline monitoring which should be undertaken to establish or update/confirm the existing conditions in the Study Area (this makes it possible to set limits for the construction and operational phases of the project); and secondly compliance monitoring, which should be carried out during both the construction and operational phases of the development to achieve the following 'general' objectives:

- to assess the performance of construction/operation activities in environmental terms;
- to obtain early warning of potential problem areas, permit timely remedial action and identify any environmental impacts;

- to comply with appropriate standards and environmental objectives;
- to provide reassurance to local communities.

As part of the monitoring schedules three levels have been devised to monitor compliance with environmental objectives and to provide early warning of potential problem areas, thus stimulating the implementation of mitigation before the regulatory standards are reached. The three levels are described below:

- the **Trigger Level** is a reference value to be used as an 'early warning' of a deterioration in environmental quality. Achievement of this level may stimulate increasing the frequency of monitoring and undertaking preliminary investigation (for example to identify any obvious causes) and possibly remedial action if appropriate; and
- the **Action level** indicates that deterioration is significant and that urgent corrective action is required;
- the **Target Level** is the maximum permissible level which will achieve compliance with the appropriate regulatory standards, or other standards such as construction noise criteria outside restricted hours, and is therefore the upper boundary/limit which is acceptable in terms of environmental quality. Consequently, achievement of this level is undesirable and may lead to the cessation of activities. Compliance monitoring schedules are therefore devised such that remedial action is taken to prevent this level being attained. The Target level should under no circumstances be considered as the desired level.

As identified in the relevant chapters of this Report, monitoring will be required to measure noise levels, TSP (for air quality), total suspended solids and dissolved oxygen for water quality. In addition, monitoring will involve checking on general working practices and compliance with the various control and mitigation measures identified in preceding chapters of this Report. Monitoring results should be reported to Highway's Department and EPD, and reviewed on a regular basis.

The requirements for each of the environmental parameters are different, and therefore it is not possible to propose a single monitoring programme for all aspects. Requirements for the individual parameters are summarized below, and where appropriate outline schedules for TLT & YLS (S) are presented in Tables 12.1 to 12.5.

12.3.2 Construction

Environmental monitoring during construction will be the responsibility of the environmental team. For each construction site a check list should be prepared relating to each of the environmental issues as identified in the EIA. Together with environmental clauses in the contract documents, this check list will form the basis of a proforma for the environmental monitoring programme.

Air Quality Monitoring

A programme of particulate monitoring should be developed to ensure both the effectiveness of dust control measures and to highlight any associated deterioration of air quality during the construction phases. This may involve simultaneous wind direction and wind speed monitoring, depending on the proximity of a Royal Observatory station. Baseline monitoring should be undertaken at the selected appropriate SRs prior to commencing construction. Compliance monitoring should subsequently be undertaken during dust generating construction activities to check that appropriate air quality standards are maintained.

An outline air quality monitoring schedule is presented in Table 12.1. The Target Level comprises the accepted TSP limits for construction sites, of $500\mu g/m^3$ (1hr average) and $260\mu g/m^3$ (24hr average). Definitions of the Trigger level is given by the exceedance of the sample in relation to the baseline for the Study Area plus 30%, thereby allowing for fluctuating ambient levels. The Action Level is defined by the average of the Trigger and Target values. On breaching the warning levels, action should be taken as described in an outline Action Plan (Table 12.5).

It is recommended that baseline monitoring should be carried out for at least two consecutive weeks prior to commencing construction activities. Continuous 24-hour monitoring should be undertaken, and 1 hour samples should be obtained at least three times daily at times when the highest dust impact is expected. Checking of baseline TSP levels should be carried out four times per year, during periods when construction activities are not taking place.

It is recommended that compliance monitoring be carried out at the boundaries of the construction sites. The number, size and location of construction sites has not yet been determined and therefore it is not possible to specify the number or location of monitoring sites, however samplers should be located down wind of active working areas in the vicinity of sensitive receivers.

Location of samplers should be remote from influencing factors such as roads, local obstructions, etc. As a minimum, 24hr samples should be taken at each monitoring location once every six days (at all monitoring stations) and hourly samples should be taken at least three times every six days. The frequency and location of monitoring may alter in accordance with local meteorological conditions and the nature of construction activities.

In the event that unacceptable concentrations of TSP are experienced, more frequent monitoring should be carried out within 24-hours, and should continue until excessive dust emissions are reduced. Details of corrective action are provided in Section 12.3.4 (Table 12.6).

In addition, it will also be necessary to monitor and check the effectiveness of mitigation measures. Depending on the size and nature of the construction site and therefore use of mitigation measures utilized, this will involve monitoring the efficiency, maintenance and use of:

- wheel washers;
- water sprays;
- dust covers;
- plant with filtration equipment; and
- barriers and enclosures.

Regular checks should be made to ensure:

- regular servicing of plant and site vehicles;

- that appropriate construction methods are being utilised and work sites are located away from SRs;

- site cleanliness and the implementation of good site practice.

Noise Monitoring

Baseline monitoring should be carried out (24-hour) for a minimum of two weeks prior to the commencement of construction works. The baseline should also be checked approximately every 3 months.

Compliance noise monitoring will be required to verify compliance with the guidelines for construction noise and with requirements of any construction noise permits (CNP) and criteria contained in the contract documents. In the absence of statutory controls relevant to unrestricted day-time hours (0700-2300hrs Monday to Saturday inclusive), it is generally accepted that a limit of 75dB(A)$L_{Aeq(30\ min)}$ or 10dB(A) above ambient (whichever is lower) should be used as a guideline. Consequently, for daytime noise, the Target, Trigger and Action Levels have been devised such that the Trigger is 5dB(A) above background noise levels. Action and Target Levels should be 10dB(A) and 15dB(A) respectively above background.

Construction noise during restricted hours i.e. night-time (2300-0700hrs), public holidays and Sundays will be controlled under the provisions of a CNP. However, based on current understanding that construction will be scheduled during unrestricted daytime hours only, it is recommended that only daytime compliance monitoring be undertaken. Should construction activities take place within restricted hours, noise monitoring comprising Leq(5min) measurements should be undertaken.

Day-time compliance monitoring should be undertaken, three times per week and involve measurement of 30 minute time periods during typical activity. Periods of high ambient noise, such as during peak traffic flows should be avoided. Monitoring will be carried out according to the TM on 'Noise from Construction Work other than Percussive Piling'.

Regular checks will also be required to establish the implementation and effectiveness of mitigation measures. This will require checking and monitoring on a regular basis:

- the use, maintenance and efficiency of construction equipment;
- the appropriate location of noisy plant/equipment;
- the hours of operation;
- the use and effectiveness of noise enclosures and barriers; and
- the implementation of good site practice.

Water Quality Monitoring

The objective of water quality monitoring is to minimise adverse impacts on water quality which may result from construction activities. Monitoring will be required of fresh water during construction stage.

Fresh Water Quality Compliance Monitoring

Fresh water quality monitoring will be required to measure impacts from construction activities identified in Chapter 6, and should be undertaken for dissolved oxygen, suspended solids/turbidity and various other parameters including pH.

Samples should be taken twice per week from each main discharge point, the environmental team should be responsible for all necessary analysis and the results should be reported to the WC within 24 hours from the completion of analysis.

Should the results exceed the values allowed in the TM *Standards for Effluent discharged into Drainage and Sewage Systems, Inland and Coastal Waters* or EPD's requirements :

- the frequency of readings will be increased to a level to be decided by the WC in the circumstances; or
- the Contractor shall institute measures so as to comply with the Specification; or
- the polluting operations shall be suspended at the WC's direction until the Contractor demonstrates that the additional measures are sufficient to ensure compliance with the Specification.

In the event that remedial measures consented to by the WC are not being implemented and serious impacts persist, the WC may direct the Contractor to suspend work until such measures are implemented and impacts are reduced to acceptable levels.

The response of sensors and electrodes should be checked with certified standard solutions before each reading. The turbidity meter shall be calibrated to establish the relationship between turbidity readings in "Nephelometric Turbidity Units" (NTU) and levels of suspended solids (in mg/l). Once this relationship has been established it is expected that only turbidity will be measured, however, this aspect will have to be agreed with EPD.

The environmental monitoring team should supply to the WC each month at least three copies of a monitoring and audit report in both printed and magnetic media form, to an agreed format, giving the dates, times of each series of measurements and equipment in use. This will include a summary report of any repeat baseline or impact monitoring and/or remedial measures taken to maintain the water quality.

The actual measurements of each recording, together with comments on any discarded measurements, shall also be submitted.

A fresh water quality monitoring schedule is presented in Table 12.3 and an associated Action Plan in Table 12.7.

12.3.3 Operation

Environmental monitoring during the operation of the development is necessary to verify the findings of the EIA and confirm that recommended mitigation measures have been applied and are effective. This is the responsibility of the Franchisee. Outline post-project monitoring requirements for air and noise are presented in Table 12.4 and reviewed below.

Air Quality Monitoring

In order to confirm the findings of the EIA it is recommended that operational monitoring be undertaken for vehicle emissions. This could effectively be achieved by an annual monitoring program commencing a suitable period after opening the road (e.g. approximately 3 months). Parameters to be assessed include NO_2, TSP and RSP.

Noise Monitoring

Operational noise monitoring should be undertaken by the operator to ensure compliance with the relevant NCO requirements. It is proposed that an annual noise monitoring program be implemented with measurements to be taken at potentially significant NSRs a suitable time period after the opening of the road. As with air quality monitoring a period of approximately 3 months is considered to be suitable. Monitoring should also be carried out in response to complaints where appropriate in accordance with the relevant technical memorandum.

Water Quality

It is anticipated that once Route 3 CPS construction is completed and the route is operational impacts from the TLT & YLA are not expected to arise and consequently monitoring will not be required.

12.3.4 Action Plans

Action Plans should be devised to facilitate the appropriate and immediate response by relevant personnel, in the event that the Target, Action and Trigger Levels are either attained or exceeded. The appropriate action is determined by the frequency of complaints and/or exceedence of the compliance monitoring levels.

The requirement for Action Plans should be contained in the contract conditions and suitable plans should subsequently be submitted by the Contractor to EPD. An example of an appropriate Action Plan for the development is outlined in Table 12.5 to Table 12.7.

12.4 ENVIRONMENTAL AUDITING

12.4.1 General

The purpose of environmental auditing is to review the effectiveness of the overall environmental protection programme (for both construction and operation) in terms of monitoring, implementation of mitigation and corrective action. The audit process should not be divorced from general management activities, and should promote a pro-active approach to environmental protection.

12.4.2 Construction Phase Auditing

Construction phase auditing should be carried out in conjunction with the construction monitoring programme. The audits should be conducted monthly during the construction of the development. It is also considered prudent to conduct some audits to coincide with major construction activities.
Records of environmental monitoring should be maintained by the Contractor and Franchisee, and the environmental audit should seek to check:

- records of noise monitoring procedures;

- records of environmental monitoring results;
- records of exceedance of any regulatory requirements/target levels;
- details of control and mitigation action taken in response to unacceptable environmental impacts; and
- records of any complaints from residents/SRs in the Study Area and the actions taken once the complaints have been received.

Assessment of monitoring records will ensure that any unanticipated impacts are being addressed and that any improvements required for future monitoring programmes are identified.

Findings of the audits should be presented in the monthly Monitoring and Audit Report.

12.4.3 Operational/Post-Project Auditing

A post-project audit should be carried out after completion of the construction phase to assess the environmental performance of the road once operational (However, it is envisaged that air quality and noise monitoring and auditing should be carried out on an annual basis thereafter).

The audit should be undertaken after a sufficient time period from TLT & YLA (S) becoming operational (e.g. 3 months), such that any findings are representative of the road in operation. Post project auditing should verify the findings of the EIA and provide a mechanism for:

- reviewing the effectiveness of, and requirement for on-going monitoring programmes;
- reviewing environmental management practices in terms of achieving environmental objectives;
- reviewing the effectiveness of environmental mitigation; and
- recommending improvements in environmental controls in the event that environmental objectives are not achieved and environmental impacts are unacceptable.

A post- project audit report and executive summary should be submitted to EPD and Highways Department within 5 weeks of completing the audit.

TABLE 12.1

AIR QUALITY MONITORING SCHEDULE (CONSTRUCTION)

PARAMETER	OBJECTIVE	TRIGGER LEVEL	ACTION LEVEL	TARGET LEVEL	LOCATION	FREQUENCY/TIMING
TSP	Baseline assessment	N/A	N/A	N/A	Selected SRs	For a period of at least two consecutive weeks prior to commencing construction activities. 24hr monitoring continuously, and 1-hr sample 3 times daily to coincide with periods when the highest dust impact is expected.
TSP	Check baseline	N/A	N/A	N/A	Selected NSRs	Four times/year and not less than one month intervals between measurements; to be carried out when construction activities are not taking place.
TSP	Compliance monitoring	1hr TSP, 24hr TSP $\geq$ **baseline + 30%	Average of Trigger and Target Levels	500$\mu g/m^3$ 1hr average 260$\mu g/m^3$ 24hr average	3 monitoring stations at Site Boundary in line with nearest SRs, locations to be reviewed monthly to take account of dust generating activities	At least one 24hr sample every 6 days, 3 one hour samples every 6 days or more frequently depending on site and wind conditions
**Wind speed	Assessment parameter/ compliance monitoring	N/A	N/A	N/A	Air Quality Monitoring Station and where necessary to account for wind direction with respect to SRs	Continuous
**Wind direction, and standard deviation of wind direction	Assessment parameter/ compliance monitoring	N/A	N/A	N/A	Air Quality Monitoring Station and where necessary to account for wind direction with respect to SRs	Continuous

Note : ** No values recommended, potential impacts are dependant on the nature of the construction activity. High wind speeds during dusty activities and/or wind direction towards an SR should act as a trigger. Need for meteorological monitoring is dependent on proximity of a Royal Observatory station.

* The standard high volume sampling method as set out in the Title 40 of Code of Federal Regulations, Chapter 1 (Part 50), Appendix B should be followed.

SRs Sensitive Receivers

N/A Not Applicable

TSP Total Suspended Particulates

TABLE 12.2

NOISE MONITORING SCHEDULE (CONSTRUCTION)

PARAMETER	OBJECTIVE	TRIGGER LEVEL	ACTION LEVEL	TARGET LEVEL	LOCATION	FREQUENCY/TIMING
L_{10}, L_{50}, L_{90}, $L_{Aeq\ (30\ min)}$	Baseline Assessment	N/A	N/A	N/A	NSRs	24hr monitoring period for at least 2 weeks.
L_{10}, L_{50}, L_{90}, $L_{Aeq\ (30\ min)}$	Check Baseline	N/A	N/A	N/A	NSRs	To be carried out four times per year, and not less than one monthly intervals (when construction activities are not taking place). One 24hr period every 3 months or as near as possible for a typical 24hr period, when construction activities are not taking place.
$L_{Aeq\ (30\ min)}$	Spot Check	Background + 5dB(A)	Background + 10dB(A)	Background + 15dB(A)	NSRs	Minimum of once per week for each NSR during construction activities.
$L_{Aeq\ (30\ min)}$	* Compliance monitoring (non-restricted daytime hours)	Background + 5dB(A)	Background + 10dB(A)	Background + 15dB(A)	NSRs	Minimum of 3 times per week between 0700 and 1900hrs, (2300) during general construction work; as appropriate during noisy activities.
$L_{Aeq\ (30\ min)}$	Response to complaints (non-restricted daytime hours)	Background + 5dB(A)	Background + 10dB(A)	Background + 15d B(A)	Complainant	As appropriate.

Note :
- * - Should construction activities take place during restricted hour, additional monitoring (Leq15min) should be undertaken.
- NSRs - Noise Sensitive Receivers
- N/A - Not Applicable

TABLE 12.3

FRESH WATER QUALITY MONITORING SCHEDULE

PARAMETER	OBJECTIVE	TRIGGER LEVEL	ACTION LEVEL	TARGET LEVEL	LOCATION	FREQUENCY/TIMING
Dissolved oxygen (mg/l and %) Suspended solids/turbidity	Baseline assessment Baseline checking	N/A	N/A	N/A	Active duck/fish ponds, San Miguel Stream	**Assessment :** Prior to commencing construction for a period of 2 months and a frequency of twice per week. **Checking :** Check baseline at all the monitoring stations every 3 months.
Dissolved Oxygen Suspended Solids/ Turbidity	Compliance monitoring	80% Target Level	Average of Target and Trigger Level	* Technical Memorandum Discharge Standards	Main Discharge Points, Active duck/fish ponds, San Miguel Stream	During the course of construction, twice per week at each main discharge point.
pH		80% Target Level	Average of Target and Trigger Level		Main Discharge Points, Active duck/fish ponds, San Miguel Stream	During the course of construction, twice per week at each discharge point from the concrete batching plants.

Note : N/A Not applicable

* *Technical Memorandum: Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters*

TABLE 12.4

POST PROJECT ENVIRONMENTAL MONITORING

PARAMETER	OBJECTIVE	STANDARD	LOCATION	FREQUENCY/TIMING
* AIR QUALITY				
NO_2 TSP RSP	Confirm the findings of the air quality assessment to ensure that air quality impacts are maintained at acceptable levels.	*** AQOs	Potentially significant sensitive receivers	To be undertaken annually once the road has become **operational.
NOISE				
L_{Aeq}	Check the accuracy of noise modelling and prediction in order to confirm that noise impacts are maintained at acceptable levels, continuing assessment of environmental performance of the road.	Appropriate ANLs	Potentially significant NSRs	To be undertaken annually once the road has become **operational, and over a 24hr period

Note : * NO_2, TSP and RSP should represent the minimum parameters to be sampled.

** The Franchisee's operational period

*** The standard to be used for operational monitoring to be agreed with EPD at the time.

TABLE 12.5
AIR QUALITY ACTION PLAN - SUSPENDED PARTICULATES

EVENT	FREQUENCY	ACTION: *Environmental Team*	ACTION: *Works Checker*	ACTION: *Contractor*
Breach of Trigger Value	**One sample**	Inform Contractor and WC		
	Two consecutive samples	Inform EPD, Contractor and WC; resample to confirm result	Check working methods/practices to identify any immediate causes; take appropriate remedial action if necessary	
Breach of Action Level	**One sample**	Inform EPD, Contractor and WC; resample to confirm result	Check working methods/practices to identify any immediate causes; take appropriate remedial action if necessary	Review dust sources: plant, equipment and working procedures, impose necessary mitigation measures.
	Two consecutive samples	Inform EPD, Contractor and WC; resample to confirm result	Undertake detailed check of working methods and practices.	Review dust sources: plant, equipment and working procedures, impose necessary mitigation measures.
		Increase frequency of monitoring to daily		
		Propose remedial action to Contractor and WC	Ensure implementation of remedial action	Carry out remedial action as recommended by environmental monitoring team.
		Continue monitoring after completion of remedial action to confirm action is effective	Inform EPD of remedial action	
		Record events in monitoring report for submission to the WC and EPD		Amend method statement, if appropriate.
Breach of Target Level	**One sample**	Inform EPD, Contractor and WC;	Undertake immediate check of activities plant and equipment and employ any appropriate mitigation.	Review plant equipment and working procedures ensure.
		Confirm result & increase monitoring frequency to daily		
		Propose remedial action to Contractor and WC	Ensure corrective action has been undertaken as proposed by (monitoring team) and is effective	Undertake remedial action and provide evidence of having done so.
		Undertake monitoring at nearest SR	In extreme cases cease Contractor's activities	
		Continue monitoring after completion of remedial action to confirm action is effective	Inform EPD of remedial action	Amend method statement, if appropriate.
		Complete Monitoring Report and submit to Contractor and EPD		

Note : WC = Works Checker

TABLE 12.6

NOISE ACTION PLAN

EVENT	ACTION		
	Environmental Team	*Works Checker*	*Contractor*
Breach of: daytime (unrestricted hours) **Trigger value**	Inform EPD, Contractor, WC; re-monitor to confirm result	Investigate complaint***	
Breach of: daytime (unrestricted hours) **Action Value;** 1 complaint	Inform Contractor, EPD and WC; resample at NSR to confirm monitoring result ($L_{Aeq\ (5\ min)}$ within restricted hours, $L_{Aeq\ (30\ min)}$ outside restricted hours)	Check working methods, practices, to identify causes, take appropriate remedial action if necessary	Review plant equipment and working procedures
	**Submit report to EPD within two weeks of receipt of complaint should the measured noise level exceed the Target, proposals to reduce noise should be recommended in the report	Inform EPD of remedial action taken	Undertake appropriate remedial action
*** 2 complaints**	Inform Contractor, EPD and WC; resample to confirm monitoring result ($L_{Aeq\ (5\ min)}$ within restricted hours, $L_{Aeq\ (30\ min)}$ outside restricted hours)	Undertake detailed check of working methods and practices. Investigate complaint and increase impact monitoring***	Review plant equipment and working procedures
	Increase frequency of monitoring at affected NSRs to at least two measurements per time period or daily as appropriate		
	Propose remedial action	Ensure corrective action has been undertaken and is effective	Undertake appropriate remedial action and provide evidence of having done so
	Continue monitoring after completion of remedial action to confirm was effective, - **until no further complaint is received within two weeks of the last complaint	Inform EPD of remedial Action	Amend method statement if appropriate
	**Submit report to EPD within two weeks of receipt of complaint should the measured noise level exceed the target, proposal to reduce noise should be recommended in report.		
	Confirm corrective action has been undertaken and is effective in monitoring and audit report		

note:
- * In the event of creeping ambient levels, Trigger Level = 1 complaint, Action Level = 2 complaints
- ** Action associated with response to complaints
- *** The Action Plan for the target level should be adopted and implemented whenever the noise levels measured during any complaint investigation exceed the appropriate target level.
- WC Works Checker

TABLE 12.6 (continued)

NOISE ACTION PLAN

EVENT	ACTION		
	Environmental Team	*Works Checker*	*Contractor*
Breach of:	Inform Contractor WC, EPD	Review noise sources and working procedures and methods	Review plant equipment and working procedures
daytime (unrestricted hours)/Target Value,	Confirm monitoring result and repeat measurement for a further 15 minutes (3x5 min) and 30 minutes respectively for exceedence of Target level within and outside restricted hours following the implementation of noise reduction measures		
	Increase frequency of monitoring	Undertake immediate check of construction activities and employ appropriate mitigation Ensure implementation of immediate remedial action as proposed by monitoring personnel	
	Propose remedial action	In extreme cases cease Contractor's activities Inform EPD of remedial Action	Implement remedial action and provide evidence of having done so. Amend method statement if appropriate
	Confirm corrective action has been undertaken and is effective in monitoring and audit report		

Note: * In the event of creeping ambient levels, Trigger Level = 1 complaint, Action Level = 2 complaints
** Action associated with response to complaints

TABLE 12.7

FRESH WATER QUALITY ACTION PLAN - SUSPENDED SOLIDS AND DISSOLVED OXYGEN

EVENT	FREQUENCY	ACTION		
		Environmental Team	*Works Checker*	*Contractor*
Breach of Trigger Value	One sample	Inform Contractor & WC		
	Two consecutive samples	Inform EPD, Contractor and WC; resample to confirm result	Check working methods/practices to identify any immediate causes; take appropriate remedial action if necessary	
Breach of Action Level	One sample	Inform EPD, Contractor and WC; resample to confirm result	Check working methods/practices to identify any immediate causes; take appropriate remedial action if necessary	Review plant, equipment and working procedures
	Two consecutive samples	Inform EPD, Contractor and WC; resample to confirm result Increase frequency of monitoring Propose remedial action Continue monitoring after completion of remedial action to confirm action is effective Record event in monitoring report for submission to Contractor and EPD	Undertake detailed check of working methods and practices Ensure implementation of remedial action Inform EPD remedial action Ensure corrective action has been undertaken and is effective	Review plant, equipment and working procedures Carry out appropriate remedial action Inform EPD of remedial action Amend method statement, if appropriate
Breach of Target Level	One sample	Inform EPD, Contractor and WC; Confirm result & increase monitoring frequency Propose remedial action Undertake monitoring at nearest water quality SR Continue monitoring after completion of remedial action to confirm action is effective Complete Monitoring Report and submit to Contractor and EPD	Under take immediate check of activities and employ any appropriate mitigation. Ensure immediate implementation of remedial action Inform EPD of remedial action Ensure corrective action has been undertaken as proposed by (monitoring team) and is effective In extreme cases cease activities	Review plant, equipment and working procedures Implement remedial action and provide evidence of having done so Amend method statement, if appropriate

Note : WC = Works Checker

SUMMARY

CHAPTER 13

13. SUMMARY

13.1 INTRODUCTION

13.1.1 Background

Route 3 Country Park Section (CPS) comprises approximately 15.5 km of roadway connecting north west Tsing Yi in the south to Yuen Long and Route 2 in the north. Ting Kau Bridge (TKB) is the major southern component of Route 3 CPS and together with the Tai Lam Tunnel and Yuen Long Approach Road (TLT & YLA) (which extends from Ting Kau in the south to Au Tau in the north), will become a major element in Hong Kong's land transport infrastructure. Apart from being the first and main approach to the new airport at Chek Lap Kok it will be a vital link to serve the growing traffic demand in the North West New Territories, West Kowloon and the expanding port at Kwai Chung.

A Feasibility Study and Preliminary Design Stage 1 study for the Project were completed in October 1989 and July 1992 respectively. These studies considered the prospective alignments of Route 3 CPS and culminated in the selection of a preferred scheme; in addition certain sections of the scheme have been the subject of further feasibility studies.

In February 1993, Freeman Fox Maunsell were commissioned by the Highway's Department to undertake the Preliminary Design Stage 2 and necessary environmental studies for the Route 3 CPS, TLT & YLA. In addition, Freeman Fox Maunsell were commissioned to complete the environmental studies for the Route 3 CPS, TKB. These environmental studies have been consolidated into two respective EIA Reports for the TKB and the TLT & YLA sections of Route 3 CPS.

As the project will be constructed under two separate contracts, both the engineering design and EIA have been divided into two separate studies. The section of Route CPS from the Ting Kau Interchange to Au Tau, including the Northern Link (Au Tau Interchange to Yuen Long) and the connection to the New Territories circular Road (NTCR) is referred to as the TLT & YLA Section and has been assessed in two parts.

This Chapter of the Report provides an overview of the southern component of TLT & YLA(S) (Part I), and summarises the key findings of the associated environmental studies. The equivalent summary for TLT & YLA (N) is summarised in Part II, Chapter 26 of this Report.

13.1.2 Purpose and Objectives

The EIA has been undertaken to provide a comprehensive assessment of the potential impacts arising from the construction and operation of the road. In accordance with the Study Brief the EIA has the following specific objectives:

- to provide a comprehensive description of the proposals.
- to identify and describe the elements of the community, landscape and environment likely to affect/be affected by the proposed development;
- to identify, predict and evaluate the net potential environmental impacts and cumulative effects resulting from the construction and operation of the development;

- to identify and specify methods, necessary to mitigate impacts to an acceptable level;
- to identify environmental monitoring and audit requirements; and
- to identify any additional necessary studies to fulfil the EIA objectives.

13.1.3 Approach

TLT & YLA (S) will be developed on a Build, Operate and Transfer basis, providing the Contractor with a high degree of autonomy in terms of the detailed design, construction and initial operation. It is therefore important that the findings of the EIA are translated into the final scheme. Consequently the EIA has been conducted concurrent with the engineering studies, and a focus of the EIA has been to contribute positively to the design of the project.

13.1.4 Scope

The scope of the EIA for Route 3 CPS draws directly from the Consultancy Agreement no. *CE 27/92, Route 3 - CPS and TKB Section, Stage 2 Preliminary Design, Environmental Impact Assessment, Study Brief (the Study Brief).* The TLT & YLA (S) component of Route 3 CPS raises a number of environmental issues that have been addressed as part of the assessment, including:

- fresh water quality impacts;
- air quality impacts;
- noise impacts;
- effect on terrestrial ecology;
- landuse and community issues; and
- waste and spoil management.

13.2 TLT & YLA (S) - PROJECT OVERVIEW

13.2.1 Route Description

TLT & YLA (S) extends northwards from the boundary of the TKB section of Route 3 CPS at Tuen Mun Road and passes across green belt land to the southern portal of the Tai Lam Tunnel. The route continues in tunnel under the Tai Lam Country Park, emerging in the North West New Territories in the Kam Tin Valley. The mainline proceeds north to allow access to the Lok Ma Chau Crossing north of its connection to the NTCR.

13.2.2 Structural Components

The main structural features of TLT & YLA (S), are:

- Tin Kau Interchange which comprises the mainline and sliproads (ramps C and D).
- The Southern Tunnel Portal situated below the WSD catchwater just outside Tai Lam Country Park.
- Tai Lam Tunnel (a dual 3 lane road) which runs 3.8 km from the hillside north of Sham Tseng, beneath Tai Lam Country Park and emerging southwest of Ho Pui immediately outside the northern boundary of Tai Lam Country Park.

- The Northern Portal where the tunnel emerges just outside the Country Park below the WSD catchwater. Ventilation buildings will be located some 200 m from the portal.

- Routing through the western foothills of Kam Tin Valley in partial cut and fill on sidelong ground, and also a section of cutting through a spur north of the toll plaza. The toll plaza is located approximately 1,500 m from the tunnel portal.

13.2.3 Construction

Construction activities associated with the road will take place over a period of approximately four years (including the TKB section) to a schedule which has yet to be finalised. The main construction works relevant to TLT & YLA (S) fall into four main categories:-

- excavation works;
- fill/embankment works;
- road construction at grade; and
- superstructure works.

There will be major works areas at the two tunnel portals with large excavations and/or filling activities to provide for access and loading areas for excess material. Larger works areas will also be required at the interchanges at Ting Kau and at the connection with the NTCR. It is proposed that excess material from the southern portal be transported via a conveyor system to a loading area in the vicinity of the northern Rambler Channel, for transport by barge prior to final disposal. The route itself with the exception of the tunnel will form a linear work site, and major concentrations of work activity will occur at sections where cut and fill is required and where sliproads and ramps are to be constructed.

13.2.4 Operation

The main operational characteristics of the road from an environmental perspective, are traffic volume and vehicle types and flows which may result in noise and air quality impacts. The predicted traffic breakdown indicates a very high proportion of heavy vehicles which is particularly significant in terms of the potential noise and air quality impacts.

13.3 STUDY AREA AND ENVIRONMENTAL BASELINE

13.3.1 General Description of the Study Area

The Study Area comprises the route corridor of the Alignment and adjacent areas. The area south of Tai Lam Country Park is characterised by steep rounded mountains sparsely vegetated with grasses. The associated valleys and patches of the foothills in contrast, tend to be well vegetated with scrubland and established woodland.

The north western side of the Country Park facing the Kam Tin Valley consists of steep mountain sides that are vegetated with revegetation growth to aid their function as a water gathering ground for both the Ho Pui Reservoir and the Tai Lam Chung Reservoir. Catchwaters are situated in the foothills which drain the catchment toward Tai Lam Chung Reservoir.

The Alignment encroaches on a section of Country Park which in this vicinity comprises degraded scrubland with scarce vegetation. The foot hills of the north east side of the Country Park below the catchwater tend to be in much better condition with pockets of mature woodland.

The Study Area north of Tai Lam Country Park includes the Kam Tin River Valley. The valley is mainly rural in nature, consisting of scattered villages, houses and agricultural buildings set amidst a mixture of working and unworked agricultural lots and fish/duck ponds. Further north towards Yuen Long development increases and the area is characterised by unplanned, open storage areas and workshops.

13.3.2 Sensitive Receivers

Key SRs in the Study Area include numerous residential premises in the vicinity of the Alignment, fish/duck farming in Kam Tin Valley, Country Park users, graves and burial grounds, Tai Lam Chung and Ho Pui Reservoirs, a proposed SSSI, heron and eagle nesting area (Ho Pui), Temple (Shek Wu Tong) and St Joseph's School.

13.3.3 Existing Environmental Conditions

In order to determine existing environmental conditions in the Study Area as a baseline for the assessment, information has been drawn from:

- landuse surveys;
- review of existing environmental data;
- selected monitoring of ambient noise levels along the route; and
- ecological/vegetation surveys.

The main sources of impact upon existing environmental conditions comprise traffic noise from Castle Peak Road and contaminated run off into the Kam Tin River from agricultural land and light industrial areas. There are no major air pollution sources in the Study Area and air quality is generally considered to be good.

Results of baseline noise surveys undertaken in June/July 1993 established the background noise level in the vicinity of Kong Tau Tsuen and Ma On Kong to be relatively low in the region of 50 - 60 dB(A), rising slightly to between 55 - 65 dB(A) for Sha Po Tsuen and Tin San Tsuen.

Existing water quality in the Kam Tin River is rated by EPD as 'bad' being polluted from livestock waste and run-off from car breaking storage yards and workshops.

With regard to terrestrial ecology, no rare species of trees or plants were recorded along the Alignment. However the region is known to be one of the richest and most diverse documented sites for birds in Hong Kong. The area around Ho Pui is of interest as Chinese Pond Herons and eagles roost in this area and the egretry west at Ho Pui is a proposed SSSI by AFD. The ecology in the area of the Country Park affected by the Alignment has been assessed in detail as part of the environmental studies, and a paper submitted by Highways Department to AFD and presented to the Country Park Board.

13.4 ENVIRONMENTAL IMPACTS

13.4.1 Air Quality

Operation

The operational air quality impact assessment has investigated the effects of traffic on the TLT & YLA (S), including ramps and connection to Yuen Long Southern By Pass, and emissions from Tai Lam Tunnel ventilation buildings.

Air quality modelling was carried out using CALINE 4 for the years 2001 and 2011, inputting both data supplied by the Transport Department and assumed traffic figures. The assessment found that concentrations of NO_2 will not exceed AQO limits, and RSP levels outside the immediate proximity of the Alignment are expected to remain within acceptable limits.

With regard to emissions from the ventilation towers the concentrations of CO, NO_2, and RSP (for 2001 and 2011) due to tunnel ventilation emissions were predicted using the ISC model. At elevations near the exhaust stacks, CO concentrations at both the northern and southern portals were predicted to remain well within AQO acceptable limits. At the southern tunnel portal, RSP and NO_2 are similarly expected to stay within acceptable limits around the level of the stack. At the northern tunnel portal, however, NO_2 concentrations near stack level would preclude future highrise development within about 650 m of the tunnel ventilation building in year 2011.

At ground level, cumulative pollution concentrations from tunnel ventilation sources, the open alignment and the background were calculated at representative ground level receivers and were not predicted to exceed AQO maxima.

Construction

Air quality modelling was undertaken in the absence of a defined construction programme. It has therefore been assumed that construction will proceed simultaneously at all work sites associated with the route, including works for the slip roads.

Due to the size of the construction sites and the number of assumed concurrent construction activities taking place, both the 1hr and 24hr TSP limits (500 $\mu g/m^3$ and 260 $\mu g/m^3$ respectively) are expected to be exceeded at nearby SRs. However, construction dust generation is generally amenable to mitigation measures, and emissions can be effectively reduced through the implementation of measures (largely adoption of good site practice) such as those detailed in Chapter 4.

The cumulative effects of other large construction projects in the area south of the tunnel (such as CRA1, Lantau Fixed Crossing, and Teen Mun Road Widening) are not included in the assessment, and may further degrade air quality in the immediate vicinity.

13.4.2 Noise

A detailed noise assessment was carried out for both the construction and operation of the TLT & YLA (S). Noise modelling was undertaken based on predicted construction activities/equipment and traffic volumes on the road.

Baseline monitoring was undertaken at five locations in the TLT & YLA Study Area, of which three are relevant to this southern section. The results of the survey confirmed the quiet nature of the area in the vicinity of Kam Tin.

Construction

In addition to noise contours, detailed noise calculations at two representative NSRs were carried out. The calculations and contours indicate that a number of receivers, will be affected by noise levels of 75 dB(A) and above, hence mitigation measures have been identified and recommended.

To reduce noise levels to acceptable levels in these areas, temporary noise barriers (hoardings) should be erected around areas of cutting activities. However, even with the proposed barriers in place for the cutting works, it has been estimated that 13 properties will be affected by excessive noise levels, equating to approximately 49 people along the Alignment. It is recommended that a detailed site survey is conducted during the detailed design stage to confirm the number of residences present at that time.

Operation

The predicted noise levels were assessed against HKPSG noise criteria at 70 dB(A). The results of the modelling analysis showed that with no mitigation 23 dwellings would be subject to excessive noise levels. Based on these findings, various heights of barriers along certain sections of the route were assessed in more detail. Mitigation measures such as enclosures were not considered due to the low number of receivers, the high cost and associated significant visual intrusion.

A 650m long, 3.5m high noise barrier was recommended, to be located on the western side of the road, as shown in Figure 5.4 b. A total of six dwellings will then still be exposed to high noise levels, and it is recommended that these dwellings should be protected at the receiver through noise insulation measures as mitigation in the form of barriers or enclosures would as indicated be very significant in visual terms. It is however strongly recommended that the Franchisee/Contractor carry out further detailed assessment to determine the specific mitigation necessary.

13.4.3 Water Quality

Water quality impacts were identified in relation to the construction and operation of TLT & YLA (S). Mitigation measures for construction impacts have been recommended, which when incorporated into the construction contract should maintain potential impacts at acceptable levels. Mitigation during operation will be limited to incorporation of appropriate sediment traps within the roadway drainage system and consideration of specific areas where drainage can be collected and treated if necessary.

Construction

Construction related water quality impacts are largely a result of works occurring at the tunnel portals and along the Yuen Long Approach. During the construction phase, the key issues will be the prevention of run-off which is contaminated with chemicals, fuels, oils, sewage and high suspended solids from entering the water courses, and thus the marine waters.

At both the southern and northern portal, large scale earthworks are proposed which would give rise to an increase in surface run-off containing significant concentrations of suspended solids. In addition, cementitious waste water and run-off and discharge of domestic wastes from work sites is likely to occur. However, mitigation has been proposed to minimise this in the form of collecting run-off with drainage trenches and work site waste water at discharge points and applying settlement and treatment as necessary. It is also recommended that the Contractor deals with work force generated waste and sewage in an appropriate manner. Although existing water quality in the Study Area is of a poor standard, uncontrolled discharges would potentially effect the stream draining south to Lido Beach and the water catchment in the vicinity of the Sham Tseng River, causing adverse effects on the ecology and water quality in these receiving waters.

Operation

Potential impacts arising during the operational phase would be related to road traffic accidents with spillage of toxic and/or hazardous materials, and the general day to day roadway run-off, which may contain high levels of suspended solids. The former is unpredictable but the latter would be especially important during the early years of operation, when the landscaping and revegetation works are not fully established.

13.4.4 Waste and Spoil Management

Likely construction waste and spoil arisings have been assessed and recommendations made concerning appropriate management practices.

Construction Wastes

Construction wastes will arise as a result of:

- demolition, clearance and site preparation;
- excavation for foundation works;
- construction materials/processes residues;
- plant and vehicle maintenance and servicing; and
- workforce generated wastes.

These wastes will need to be collected, and handled properly prior to disposal, it will therefore be important to monitor and enforce site cleanliness and good housekeeping. If the construction processes produce chemical wastes then the Contractor will be required to register with EPD as a Chemical Waste Producer and provide particular in formation concerning handling storage and disposal.

Spoil

The main environmental issues to be addressed with regard to spoil and fill requirements for the TLT & YLA (S) are: minimisation of the amount of spoil arising; the desire to balance excavation and fill; the requirements for borrow areas; and collection, handling and disposal arrangements.

A review of fill and excavation requirements has established that the Alignment achieves a better balance of excavation and fill requirements than previous alternatives. However, there are still a number of locations where an excess of spoil material will occur:

- Ting Kau - cutting for the interchange and the approach to the southern portal of the

Tai Lam Tunnel.

- Tai Lam Tunnel portals - tunnel spoil divided equally between the north and south portals.

- North of the Toll Plaza - cutting to move the alignment out of the flood plain.

The main disposal option is to reuse this material for other contemporary projects. It is proposed to remove 6 Mm^3 from Ting Kau and the southern portal by use of a covered conveyor system to a barge loading location at the western Gemini Beach for transportation to a reclamation project. This could be Tseung Kwan O, the Lantau Container Port development or other suitable projects.

It is likely that some stockpiling of spoil will be required and this is a potential source of adverse environmental impact. General mitigation measures have been provided which can be made more specific during the detailed design stage. The final placement/disposal of spoil will require control to prevent impacts however this aspect cannot be usefully assessed as the disposal locations cannot be identified at this stage of the project.

13.4.5 Landscape and Visual Impacts

A comprehensive landscape and visual impact assessment was completed through identification of the visual envelope and sensitive receiver groups, and projection of the change in baseline conditions with time.

The assessment enabled the recommendation of specific mitigation measures to minimise long term adverse visual and landscape impacts, and whenever possible to enhance the landscape character of the Study Area.

The Alignment will potentially give rise to significant landscape impacts particularly in the vicinity of the southern portal and its approach, where due to the deep cutting, large scale landscape mitigation is recommended.

Visual impact will occur in the immediate vicinity of the Alignment, particularly, to the south of the northern section where the route corridor will fundamentally change the visual outlook of many of the nearby residential properties, in so doing creating severe visual intrusion. In addition such receivers may suffer glare from the proximity and orientation of the road illumination. Distant visual intrusion will occur largely for transient recreational users in the surrounding high ground, much of which is in the Tai Lam Country Park.

Considering the Yuen Long approach, although the Alignment is located away from SRs and the flood plain into a cut slope, there will still be a major local impact. Consequently, landscape mitigation will be required, but the restoration of this area and the Alignment acting as a fire break could result in the improvement of the surrounding areas with time.

The visual and landscape impact may be reduced by the adoption of suitable landscape mitigation measures as outlined in Chapter 9 landscape rehabilitation, and summarized below.

13.4.6 Landscape and Rehabilitation

Landscape design and rehabilitation proposals have been identified in order to:

- minimize the visual impacts of the works by blending disturbed areas back into the terrain;
- maximize the establishment of quality habitat;
- maximize the advantageous effects of revegetation; and
- minimize landscape maintenance, encouraging self propagation, and linking new tree planting areas with existing woodland.

Both temporary and permanent landscaping measures have been identified to reduce the impact of the project during and post construction and are based on the findings of the landscape and visual impact assessment summarized in Section 13.4.5. In particular the visual quality of the regraded slopes within the highway corridor will play a major part in the successful integration of the route with its surrounding landscape character.

The location and general design of landscape works from south to north of TLT & YLA (S) are shown in Appendix A9.1 and do not differ from proposals put forward during Preliminary Design Stage 1 (Landscape Issues, Working Paper, 1989). A large area will be disturbed as a result of the road, much of which will be available for soft landscaping:-

- the area North of Teen Mun Road to the southern tunnel portal where extensive cut slopes will be formed together with a large fill embankment across the main valley before the portal. High quality woodland will require reinstatement in this area, which is currently zoned green belt; and
- north of the northern portal to the New Territories Circular Road where extensive earthworks will be required.

All landscape works should be regularly checked and maintained and landscape design should be discussed with the relevant maintenance authority at an early stage. Monitoring should not only check the general health of tree stands and grass swards, but also ensure that species diversity is maintained and that ground cover remains adequate to prevent erosion.

13.4.7 Land Use and Community Issues

Potential landuse impacts and community issues resulting from the construction and operation of TLT & YLA (S) will include severance, disruption to sensitive sites/areas, loss/disturbance to local amenity and recreational resources and land take. Mitigation will generally be achieved for the more physical (measurable) impacts through the implementation of recommendations presented in the specialist chapters of this Report. The more intangible impacts relevant to community issues are more difficult to assess due to the often subjective nature of concerns, and identification of appropriate mitigation is therefore best achieved through public consultation.
Key areas of concern with regard to landuse and community issues include encroachment on Tai Lam Country Park, disturbance/loss of graveyards and burial sites, the potential loss of St. Joseph's school and loss of recreational amenity through both visual intrusion and interference with footpaths.

The Alignment will cause significant disturbance to the many graves and burial grounds which are scattered throughout the slopes of the valley and will encroach on the north eastern margin of the Country Park and disturbance of graves will potentially be a significant community issue.

A small area of Country Park will be lost, however this area is not well frequented by the public. It is proposed to provide an access road, car park and visitor information facility as part of the Project to enable greater access to the adjacent Country Park area.

13.4.8 Ecology

Field surveys were conducted on the proposed Alignment between March and June 1993. In order to determine the conservation significance of the Study Area.

Potential impacts on ecology resulting from the development of the TLT & YLA (S) comprise the loss/disturbance of habitats. Mitigation has been identified which will reduce potential impacts to acceptable levels. These include the organisation of work sites and access roads to avoid excessive loss of wetlands, and specifically to avoid Ho Pui (a particularly sensitive area), construction of wildlife corridors and revegetation.

Adverse impacts were identified notably in the southern survey area due to loss of habitats during construction works, in particular the anticipated loss of 6 hectares of mature forest (which is important in terms of its conservation value), as a result of landtake. Due to the lesser significance of the northern area from a conservation perspective, potential impacts in this area are of little concern, and the Alignment may actually result in a net-gain.

Impingement on the Country Park is not desirable, however a detailed survey of the area potentially affected by the road indicated that the habitats to be disturbed are not of major ecological significance.

13.4.9 Monitoring and Audit

Environmental monitoring and audit requirements for the construction and operation of TLT & YLA (S) have been identified and outline monitoring schedules and action plans defined with respect to air quality, water quality and noise. The effective implementation of a comprehensive monitoring and audit programme is essential in order to:

- ensure that any environmental impacts resulting from the construction and operation of the road are minimised or kept to 'acceptable' levels at all times;
- establish procedures for checking that mitigation measures have been applied and are effective, and that the appropriate corrective action is undertaken if and when required;
- provide a means of checking compliance with environmental objectives, recording anomalies and documenting corrective action.

In order to ensure that these objectives are achieved, it is recommended that monitoring and audit requirements should be incorporated into the contract documents for the project for implementation during both construction and operation of TLT & YLA (S).

RECOMMENDATIONS AND MITIGATION MEASURES

CHAPTER 14

14. RECOMMENDATIONS & MITIGATION MEASURES

14.1 GENERAL

This Chapter consolidates recommendations and mitigation measures proposed in the previous Chapters of Part I of this Report. Mitigation measures recommended should be incorporated into the contract documents and specific measures should be agreed with EPD.

It is understood that the Works Checker may not have the authority to instruct the Contractor to modify working practices (such as limited working hours in a specific location/period etc.) or to stop work (in a repeated or extreme case of environmental pollution).

It is considered that this could reduce the effectiveness and enforcement potential for the environmental monitoring and auditing and leaves a gap in the control mechanism. It is therefore recommended that this authority is given to the Works Checker or other person who will be available on site on a regular and frequent basis. The monitoring and audit Chapter has been written on this assumption.

General recommendations and mitigation measures are outlined below:

- It is understood that a further and targeted EIA will be required of the successful tenderer/Contractor, and this is recommended. It is very important that specific and detailed traffic flow predictions are confirmed and are available as input to the air quality and noise impact assessments and it recommended that these are obtained. Each tenderer will need to address any differences between his design and the design upon which this EIA has been based.

- It is recommended that the Contractor is required to maintain and regularly service all equipment, plant and vehicles regularly and in accordance with manufacturer's requirements.

- In order to accurately determine the number of sensitive receivers present (at the time) a detailed site survey is recommended to be undertaken early in the detailed design stage.

- Environmental monitoring and audit should be carried out in accordance with the requirements outlined in Chapter 12 for noise, air quality and water quality. In addition monitoring of landscape measures, restoration and planting works should be carried out.

14.2 AIR QUALITY

14.2.2 Construction

- Effective water sprays should be used during the delivery and handling of fill when dust is likely to arise. The effectiveness of wetting can be prolonged by the use of wetting agents that agglomerate dust particles, however, the use of chemical wetting agents may have adverse effects on plants and animals exposed to contaminated runoff. It should be noted that at active cuts, excavation and fill sites, chemical stabilization is not effective because of the degree of disturbance caused by mechanical equipment. Chemical stabilizers are more useful on completed cuts and fills to reduce wind erosion.

- During transportation (e.g by dumptruck), materials with the potential to create dust should not be loaded to a level higher than the side and tail boards, and should be dampened and covered before transport.

- Gravel surface or temporary sealed surface on haul roads should be provided.

- The proposed conveyor system to remove excavated material should be covered. At both ends of the conveyor system, measures should be taken to minimise losses during handling. Wetting and the use of windbreaks near loading, unloading, and transfer points are recommended. Alternatively, if these points can be confined in a shed, a baghouse filter may be used to filter dust during transfer or loading.

- A programme of air quality monitoring should be implemented during and post construction should be developed. Guidelines and outline schedules are presented in section 13.

- The speed of all traffic on unpaved roads should be regulated to as low a speed as is practical, however this measure is limited by the difficulty of enforcement.

- At all vehicle exit points leading from unpaved construction areas onto public roads, wheel washing troughs should be provided.

- At concrete batching plants, dust should be subject to control at several stages in the process: during handling of sand and aggregate, handling of concrete, and loading of dry concrete mix.

- Fugitive dust should be controlled by enclosing the handling areas, conveyors and elevators, and using a baghouse filter to extract dust. The vents of concrete storage bins should also be filtered.

- At the crushing and screening plant, control of fugitive dust emissions should be undertaken. The jaw crusher should be totally enclosed in a four-walled enclosure with top; the outlet of the jaw crusher should be enclosed in a well sealed structure. Water suppression spray should be fitted to the throat of the jaw crusher and at the outlet; alternatively, if this control proves inadequate the outlet emissions should be vented through a bag filter of suitable design and capacity. The feed opening of the jaw crusher should be enclosed on three sides and (as far as practicable) at the top. The height of this enclosure should be at least 3 m above the truck unloading point.

- The belt conveyor used to transfer crushed stone products should be enclosed at transfer points, and also on the top and two sides by dust curtains, and provided with wind boards at the bottom to prevent entrainment of dust from the crushed stone products. Water spray nozzles should be used to wash off any dust deposited on the bottom wind boards at transfer points as necessary, and scrapers should be fitted at the discharge end of the belt to remove dust on the belt surface.

- Where possible an automatic system should be used to activate water sprays whenever stone crushing or its associated processes are in operation.

- Dust from aggregate and crushed rock stockpiles should be controlled by enclosing or covering the piles during storage, and application of water in dry and windy conditions. Dust enclosures should be rigid and reach above the height of the stockpile. In addition, the use of a chemical wetting agent to better wet the fines and retain the moisture film may be effective.

- The access area around stockpiles should be sprayed with water or have temporary paving where loading and unloading vehicles manoeuvre.

- The conveyor system should be enclosed to prevent accidental spilling of the moving load, and to minimise windborne losses. The conveyor should be enclosed on the top and two sides by curtains, and provided with wind boards on bottom. Water sprays should be used at transfer points as necessary, and to wash off any dust deposited on the bottom wind boards. Scrapers should be fitted at the discharge end of the belt to remove dust on the belt surface.

- At the loading and unloading points of the conveyor system, measures should be taken to minimise losses during handling. Wetting and the use of windbreaks near loading, unloading, and transfer points are recommended. Alternatively, if these points can be confined in an enclosure, a baghouse filter may be used to filter dust during transfer or loading.

- Dust control measures should be incorporated in the contract documents.

- If a concrete batching plant is to be utilised within this section of the route, it is recommended that the Contractor undertakes an assessment of the potential environmental impacts.

- The use of a conveyor system (rather than a haul road) to transport large quantities of spoils from an area to the south of the southern tunnel portal is recommended to allow dust to be better controlled.

14.2.3 Operation

The predicted concentration of NO_2 from the ventilation stack would preclude high rise development within approximately 650m of the ventilation stack. It is recommended that this is viewed as a constraint for such development however this should be reviewed/confirmed during the detailed design stage.

14.3 NOISE

14.3.1 Construction

- Temporary noise barriers should be erected around areas of rock-cutting.

- The screens should be constructed of a barrier material with a minimum mass per surface area of 7 kg/m^3, with no joints, gaps or openings.

  Depending on the geometry of the area being screened, it may be appropriate to attach a noise absorbent material (approximately 50mm thick) on the side of the barrier facing the noise sources.

- For the specific case of cutting close to NSR1, the top of the screen will need to be approximately 1m above the elevation of the noise source in order to achieve at 10dB(A) reduction in noise level from the individual noise source.

- The Contractor may consider the use of quiet equipment as an alternative to noise barriers. If it is to provide a satisfactory alternative, all breakers and rock drills need to be at least 10dB(A) quieter in operation than corresponding noise levels specified in the TM *(Noise from construction work other than percussive piling)*. A justification and conformation on proposed equipment needs to be provided for the Works Checker's approval.

- Screens are not considered to be appropriate where the road is to be constructed on an embankment.

- Noise mitigation should be provided by locating all carpentry operations using powered equipment at least 100m from the nearest NSR.

14.3.2 Operation

- It is recommended (and accepted by Highway's Department) that porous friction course (to reduce noise) will be used for all new roads except the toll plaza section.

- At the northern ventilation building, the fresh air intake and discharge fan should be provided with 3m long silencers. In addition, the fresh air intake should be facing north, not to disturb the nearest NSR. The ventilation building design needs to be addressed further at the Detailed Design Stage as some design modifications may be require to achieve the criteria.

- A 3.5m high noise barrier, approximately 650m long, is recommended on the west side of the road in the vicinity of NSR2 (see Figures 5.4a and b).

- Receivers exposed to noise levels above the criteria (70 dB(A)) not protected by a barrier are recommended to receive noise insulation. It is predicted that a total of 6 receivers with require indirect technical mitigation (possibly at the building).

14.4 WATER QUALITY

14.4.1 Construction

- Site compounds should be designed to take account of contaminated surface water and should include the provision of drainage channels and settlement lagoons to allow the interception and controlled release of settled/treated waters.

- Discharges from concrete batching plants should be settled and if necessary pH adjustments made to the supernatant liquor. In the event of settlement alone being insufficient to settle colloidal material, consideration should be given to further treatment with settling agents, such as polyelectrolytes, prior to discharge.

- Suitable treatment facilities should be included at the site works areas where latrines and/or canteens are to be located so that discharges from these facilities comply with the TM.

- Oil interceptors should be provided in site compounds and regularly emptied to prevent release of oil and grease into the surface water drainage systems after accidental spillage. The interceptors should have a by-pass to prevent flushing during high intensity rain storm events. Oil and fuel bunkers should be lined with an impervious material and bunded to prevent discharges owing to accidental spills or breaching of tanks.

- The stockpiles of spoil and fill materials should be treated to reduce erosion and sediment release, e.g. use of coverings and silt traps. In the case of the excavated spoil from the tunnels and Yuen Long Approach, it may be prudent to provide a separate settlement system to collect and treat contaminated surface waters prior to discharge to the site's general drainage system.

- Where possible, connection of sewage discharges should be to a foul sewerage system. In any office or site canteen, foul water should be directed to either a foul sewer or a treatment facility. Alternatively, chemical toilet facilities with appropriate disposal arrangements should be considered and provided where necessary.

- It is recommended that a trench is constructed to direct and collect run-off from the site.

- The section of the stream close to the road (near to the northern tunnel portal) should be directed through a box culvert with a short section of pipe to further isolate the stream course from contamination

14.4.2 Operation

- The transport of sediments, albeit small quantities, from the road to the fresh water environment can be minimised by the incorporation of appropriate sediment traps within the roadway drainage system.

14.5 WASTE AND SPOIL MANAGEMENT

It is recommended that surplus spoil and excavation material should be reused wherever possible. In order of preference this would be in projects selected according to minimising distances involved to the disposal site. Essentially this is therefore within this project, to projects in the area (such as the Western Corridor Railway) and then projects outside the local area.

It is recommended that the very large quantity of spoil (estimated $6Mm^3$) arising south of the southern tunnel portal is removed by means of a covered conveyor to the Rambler Channel for barge transport to a reuse location.

Specific protection and mitigation measures which may be considered where impacts are anticipated are as follows:

- Noise reduction measures should be implemented to include selection of quietest plant and working methods, and limiting hours of operation if necessary.

- Careful consideration should be given to locating stockpiles in relation to existing topography, creating new earth bunds and retaining existing tree belts as mitigation to noise, dust emissions and visual intrusion.

- Mitigation for the prevention of surface water pollution should include bunding and directing run-off to settlement ponds.
- Land take should be minimised (particularly productive land) through limiting the size of stockpiles and associated working areas.
- All boundary lines should be fenced to keep the working areas and stockpiles contained, and to protect productive agriculture, important habitats and landscape features.
- Temporary footpath diversions should be provided where necessary to avoid disruption to public rights of way.
- At the end of the stockpiling activity, land should be restored to its original use and quality.
- Site disposal activities should be designed and programmed to minimise long term impact and maximise environmental gain.
- Damage/disturbance to sensitive areas (e.g. residential, areas of ecological interest) should be avoided by ensuring spoil transport routes pass by such areas and not through them.

14.6 LANDSCAPE AND VISUAL IMPACT

The construction and location of the road will cause significant landscape and visual impacts and it is recommended that careful and detailed landscape treatment is carried out in accordance with the philosophy outlined in Chapter 8.

14.6.1 Temporary Mitigation Measures (Construction Phase)

- The volume of construction traffic should be restricted on the local road network.
- Construction working areas should be restricted to the minimum practicable size.
- Working areas should be enclosed with hoardings to define boundary edge and screen low level construction activities (eg car/truck movement) from surrounding receivers.
- Heights of storage materials, stock piles and spoil heaps should be maintained at low levels.
- Night-time working and lighting should be minimised.
- Advance planting and ground modelling should be undertaken in designated landscape areas where damage from construction activity can be avoided to facilitate establishment of the landscape prior to the route becoming operational.

14.6.2 Permanent Mitigation Measures

Consideration should be given to:

- Detailed alignment of the route enabling retention of significant landscape features.
- Careful positioning of associated operational buildings.
- The use, location and design of retaining walls.
- Specific attention to the visual quality of structures associated with the route.
- Landscape treatment within, and immediately outside the highway boundary.
- Colour and materials used for structures should reflect the colours and materials of the surrounding landscape. As a general principle strong contrast in colour should be avoided and muted colours related to the material environment should be used with darker colour concentrated to the base of the structure to create a sense of stability.
- The use of tunam or shotcrete treatment of regraded slopes should be avoided.
- Screen planting within the curtilage of residential properties should be undertaken to screen the view at source.
- Areas of redundant land should be incorporated within the highway landscape proposal scheme to aid the integration of the route with its surroundings and avoid the creation of areas of derelict land.
- The size, height, design and orientation of the lighting system should ensure effective lighting of the highway corridor whilst minimising the potential leakage of light. The use of reflective paints and signing should be fully investigated to determine the need for permanent lighting.

14.6.3 Landform Regrading Works

- Wherever possible formed slopes should reflect the angle and alignment of the natural slopes within the area. The slope should not however be greater than 1.5 (horizontal) : 1 (vertical), with a gentler slope of 2:1 preferable.
- Attention should be given to the interface between the surrounding topography and the engineered highway slopes in order to reduce the potentially sharp divide and consequent visually intrusive element created between the natural and man made landforms.
- The long profile of the formed slope should follow a shallow inverted "S" alignment, include natural landforms profile.
- The edges of the regraded slopes should merge into the surrounding landform, rather than appear to be cut out from it which may involve extra regrading work, outside the geotechnical and engineering requirements, requiring extra land.
- Disturbed areas should be designed to be stable and capable of revegetation wherever

possible. It is important that landscape considerations receive high priority and early consideration in the detailed design stage.

- Wherever consistent with safe geotechnical considerations, the surface of bare earth areas should not be overly compacted and should be left with a textured surface to assist seed and water retention.

- Wherever practicable rock faces should be either covered with a minimum of 0.5m of soft spoil material and hydroseeded or benched and treated as indicted in Table 9.1.

- Quality topsoil material along the highway corridor should be collected and reused wherever possible.

14.6.4 Landscape Works

The extent and nature of proposed landscape works are shown in Appendix A9.1. A total approximate area of 36ha of land (plan area) will be disturbed. It will be desirable to reinstate approximately 55ha.

(i) *General*

Landscaping works should be carried out as follows: -

- Reinstatement of high quality woodland from the southern tunnel portal to Tuen Mun Road .

- Soft landscaping works north of the northern portal (to the new territories circular road as a result of extensive earthworks.

(ii) *Specific*

- Both cut and fill slopes should be initially stabilized by hydroseeding and engineering erosion control techniques. The hydroseed mix should incorporate both grass and appropriate tree seeds to simulate the natural woodland composition thereby increasing species diversity through planting. Into this, *Woodland* or *Shrub Mixes* will be planted.

- Specific plant species should be selected at the detailed design stage to respond to local conditions and vegetation types identified along the TLT & YLA alignment.

- All tree and berm planting should be into appropriately sized pits. Fifty grams of slow release fertilizer (minimum release period 8-9 months) should be incorporated into the base of each hole and well mixed with the soil prior to tree planting.

The following is recommended:

  - Woodland mix A to be used on the western embankment of the Kam Tin River flood plain where slopes are low and not in direct view of villages. The light standard trees could be informally grouped along the embankment to create an initial variation in height. The whips will establish rapidly to create a random and natural stand of trees and shrubs. When viewed from the floodplain, these slopes will merge with existing vegetation on lower slopes.

- Woodland mix B for the more extensive cut and fill slopes on the fringes of the Country Park. The larger, light standard tree will be used on the lower slopes where they will create a greater initial impact from the road.

- Woodland mix C for planting above and below formed slopes along the route.

- Roadside Planting of trees and amenity shrubs should be confined to the more visible sections of the road, such as at the interchanges and also at the Toll Plaza where traffic speed will be reduced. These areas are more accessible permitting a higher level of maintenance. Site specific landscape plans will be required for the toll plaza and ventilation buildings.

To be successful landscaping and rehabilitation works will require adoption of a basic philosophy.

- Areas of current high landscape value must be reinstated to at least an equivalent standard.

- An opportunity to upgrade visual and ecological values of the route corridor exists through well designed landscape mitigation measures incorporating extensive tree planting (particularly to the north of the route corridor);

- To the south the landscape mitigation measures must blend and be consistent with the proposed works for the TKB section of Route 3 CPS. To the north the associated landscape works must accommodate and reflect the more urban environment through which it passes;

- This project's works will be only one source of disturbance in the area and landscape works in this and other projects should be extended to include all adjacent areas;

- Revegetation works must not be restricted to artificial boundaries delineated by the road's earthworks. Tree planting must not highlight cut and fill slopes but rather blend them into the landscape by extending further uphill and into valleys. Tree planting must also extend laterally into adjacent engineering formations;

14.6.5 Fire Control Recommendations

The following protection measures should be implemented to ensure the early survival of trees:

- Plant a 20m wide buffer strip of fire resistant *Acacia* species around the periphery of planted slopes.

- Planting of the more fire resistant species in the top half of slopes. Exotic species such as *Pinus elliottii* which are extremely susceptible to fire at all stages of growth, should not be included within the planting mix.

- Liaison with local fire brigades to develop a quick response system to hillfires in the vicinity of TLT & YLA landscape works and provide relevant fire brigades with landscape location plans and access details.

- Encourage the quick growth of trees above scotch height through optimum initial fertilization, establishment and maintenance techniques.

14.6.6 Monitoring

- All landscape works should be regularly checked and maintained. Monitoring will also ensure that surface drainage structures are intact and have not been interfered with by vegetation.

- Necessary maintenance works should include fertilizing, thinning tree stands, replanting or resowing, watering and fire protection (in early stages), and all works necessary to ensure beneficial development of landscaped areas.

14.7 LANDUSE AND COMMUNITY ISSUES

Mitigation of landuse impacts will to a certain extent be achieved as a result of noise, air quality and landscape mitigation measures recommended in the specialist Chapters of this Report.

- Care should be taken in setting out work areas and during daily practices to ensure that associated impacts are minimised.

- Timing of works should be programmed where possible to minimise traffic congestion etc., e.g. avoiding using roads for heavy plant and equipment during busy traffic periods and important public holidays.

- Where practicable re-instatement should be undertaken on completion of the construction works. Reinstatement of access to existing properties and for areas with high recreational and amenity value should be required and made a contractual condition.

- It is recommended that consultation is undertaken with relevant parties including parents regarding the reprovisioning of St Joseph's School.

- Public consultation should be undertaken to explain the project requirements and inform local residents of impending major construction activities.

14.8 ECOLOGY

- Mitigation of loss of forest habitat should be accomplished over a relatively long term (10-15 years) period through revegetation of fill areas and cut slopes using native species endemic to the proposed disturbance site.

- Fill areas and cut slopes should be revegetated using native species endemic to the proposed disturbance site. Species potentially useful for replanting are listed in Appendix A11.2 of this Report.

- Because of its status as a protected plant, *Enkianthus qinqueflorus* plant species should be included in the seed mix for revegetation, or individual plants should be transplanted from disturbance areas to nurseries for cultivation and later re-planting on re-contoured areas.
- The abandoned citrus orchard should be protected from development/ disturbance as far as possible as it appears to be an unusually good site for butterflies.
- To mitigate the impacts from in-filling the steep sided valley outside the southern portal, consideration should be given to providing wildlife corridors beneath the roadway along the stream channel. This would reduce hazards both to animals attempting to cross the road and to motorists trying to avoid them. The corridors could consist of box or pipe culverts of adequate dimensions to permit wildlife movement.
- Disturbance of the stream bed and riparian vegetation during construction should be minimized through design and operational measures. Sedimentation of the stream is to be avoided through careful planning and phasing of the culverting and fill operations. It will be important to stabilise disturbed sites using erosion control matting and rapid replanting immediately following completion of construction works.
- Where possible the loss of fruit trees should be avoided as they are an important feeding resource for the rousette bat and bird species in the area.

NOTE: The area of Tai Lam Country Park affected by the Alignment has been assessed in detail. This assessment is presented in Appendix A11.3.

14.9 ENVIRONMENTAL MONITORING AND AUDIT

- It is recommended that a suitably qualified, experienced and independent consultant/organisation (environmental team) is employed, prior to commencement of construction works, to undertake all recommended monitoring activities. It is understood that this will be the responsibility of the successful tenderer/Franchisee.
- A comprehensive Environmental Monitoring and Audit Manual should be produced by the environmental team prior to commencing the works.
- Prior to and during the works, environmental monitoring should be carried out for air quality, (suspended particulates) fresh water quality and noise, and should include baseline monitoring; where specified additional monitoring as a control to determine changes in the baseline not associated with the project; and compliance monitoring to ensure compliance with environmental monitoring Target, Action and Trigger levels.
- All baseline and compliance monitoring should be carried out by the environmental team comprising suitably qualified and experienced staff.
- A monthly Monitoring and Audit Report should be prepared by the environmental monitoring team and submitted to the Works Checker, EPD and the Highway's Department.

- Operational monitoring to be undertaken by the environmental team for noise and air quality should be carried out annually, with the first annual monitoring commencing a suitable time period (e.g. 3 months) after the road becomes operational.

PART II

TLT & YLA (N) : AU TAU INTERCHANGE & THE NORTHERN LINK

INTRODUCTION

CHAPTER 15

15. INTRODUCTION

15.1 BACKGROUND

The Route 3 CPS EIA, has been divided into two separate studies, delineated according to sections of the alignment. The southern section from Tsing Yi to (and including) Ting Kau Bridge (TKB) and the northern section from Ting Kau to Au Tau called the Tai Lam Tunnel & Yuen Long Approach Road Section (TLT & YLA) (see Figure 15.1, Part II). After the Country Park Section (CPS) EIA Draft Final Report was prepared an alternative route to the YL3b (Yuen Long Approach) connection was proposed.

This Report covers this alternative alignment for the YL3b. This alignment was known as the 'Proposed Alignment Yuen Long Approach and Northern Connection to Yuen Long Southern Bypass. It is represented in Drg. No. 92393/01/073 and given as Figure 15.1 and will be referred to as TLT & YLA (N), being the northern component of TLT & YLA.

It should be noted that the TLT & YLA (N) has been endorsed by the Route 3, CPS Steering Group, and is included in the BOT Documentation for the project.

15.2 OBJECTIVES

This EIA study has been undertaken to provide an assessment of the environmental impacts arising from the construction and operation of the proposed TLT & YLA (N). The main objectives can be summarised as follows:

- to describe the characteristics of the proposed road and related facilities and requirements for their development;
- to identify and describe the elements of the community, landscape and environment likely to affect or be affected by the proposed road;
- to minimize pollution, environmental disturbance and nuisance arising from the road and related facilities, and its construction and operation;
- to identify, predict and evaluate the expected net environmental impacts and cumulative effects from the construction and operation of the road upon the existing landscape and community, planned community and neighbouring land usage; and
- to identify and specify methods, measures and standards for the inclusion in the detailed design in order to mitigate these impacts to an acceptable level.

A further objective of this EIA is to recommend further specific environmental studies that should be undertaken at the detailed design stage of the project.

15.3 SCOPE

The scope of the study draws broadly upon the *Route 3 - CPS and TKB Sections, Stage 2 Preliminary Design, Environmental Impact Assessment, Study Brief No. CE27/92*. In common with the overall study, the TLT & YLA (N) has a number of environmental issues which need to be addressed including :

- fresh water quality impacts;
- air quality impacts;
- noise impacts;
- effect on terrestrial ecology;
- visual and landscape issues;
- landuse and community issues; and
- waste and spoil management.

15.4 STUDY AREA

The TLT & YLA (N) Study Area extends northwards along the Kam Tim Valley, north of the proposed Tai Lam Tunnel. The Alignment connects with the Kam Tim Road, and the main line runs along the Western side of the Valley. The western arm of the Alignment follows the proposed western Corridor Railway's Yuen Long connection to join with the Yuen Long Southern Bypass.

The alignment passes close or through settlements; Ha Ko Po Tsuen, Ko Po Tsuen, Ko Po San Tsuen, Tung Shing Lei, Tai Wai Tsuen, Au Tau, Sz Tsz Uk, Shan Pin Tsuen, Small Traders New Village, Wong Uk Tsuen, Kam Tin Shi and Yuen Long.

The mainline of the road proceeds north to connect to New Territories Circular Road giving access to Lok Ma Chau at the border of the PRC.

15.5 PROJECT DESCRIPTION

15.5.1 General

The main features of the TLT & YLA (N) are described below and presented in Figure 15.2:

- Two link roads (I and J) connect the alignment to the Kam Tin Road between the settlements of Ko Po Tsuen and Kat Hing Wai. Link road J runs beneath the mainline.

- The Alignment continues north along the valley side. It bridges the Kam Tin and Castle Peak Roads on elevated sections. The mainline has two major ramps which diverge from it south of Au Tau at the Au Tau Interchange to connect to the Yuen Long Southern Bypass. The mainline continues north along the approximate alignment of Castle Peak Road. Two ramps lead from the Yuen Long Southern Bypass forming part of the Au Tau Interchange. The two ramps head north and connect to the mainline eventually joining with the NTCR.

15.5.2 Construction Phase

Introduction

The nature of construction activities and their environmental considerations are briefly highlighted in this Section, more detailed environmental appraisals are provided in Chapters 17 to 24.

Construction Sites

The detailed specifications and the locations of the construction sites and the proposed use and distribution of plant etc., cannot be determined at this stage as much of the information required will not be available until the detailed design stage, when the franchisee/Contractor will specify their method of work. As a result typical conditions have been used and assumptions have been made where necessary.

It is likely that a large work area will be required at the Au Tau Interchange, including the provision of batching plants, waste water and construction waste disposal facilities, staff offices, workshops and toilet facilities, materials and plant storage, and maintenance areas.

Significant work will be required where embankments, cut and fill slopes, pond reclamation, bridge, sliproads etc., construction is required. Thus the majority of the TLT & YLA (N) will require extensive construction works.

Construction Access

At this stage of design few details for works provisions or the extent of construction are available. The alignment of the access roads would be designed to minimise impacts to existing traffic flows, noise and air quality. Access roads will be constructed at a very early stage to accommodate haulage rather than using public roads which would lead to disturbance and other associated impacts.

Construction Traffic

Construction traffic will be comprised of predominantly heavy plant for the transportation of equipment and material. It is envisaged that significant traffic movements will be required for transportation of the excavated material that will arise from the northern tunnel portal and the areas of cutting that will be undertaken at the Yuen Long Approach. The tunnel and cutting arisings will be used as fill for ponds and embankments. Disruption to public roads and their traffic flows will be minimal due to the transportation of the material along the construction route and over elevated sections of the alignment which will be constructed in the initial phases of the project to facilitate the need to remove excavated spoil.

Construction Programme

A review of the construction sequencing indicates that an overall duration of four years is required for Route 3 CPS. It is anticipated that the construction of the TLT & YLA (N) would not alter the construction timetable. Construction is anticipated to begin in January 1995 and end around December 1998.

Construction Activities

The main construction activities associated with the TLT & YLA (N) are:

- excavation works;
- fill/embankment works;
- superstructure works; and
- duck/fish pond reclamation.

Excavation Works

Along the TLT & YLA (N) excavations are required at the interconnection with Kam Tin Road. Further north a larger cutting runs through a hill which is approximately 35 metres in height and located to the north east of Au Tau. It is assumed that any excavated material obtained from these areas will be utilised as fill for the adjacent embankments.

The chosen construction method to allow for soil settlement in the pond areas will involve minor excavation of pond type sediments followed by the use of a method to enable settling and compaction of soils known as 'overloading'. Wick drains are installed to remove excess interstitial waters associated with the soils. Geotextiles are used to aid settlement. This approach would take longer but would remove the requirement for the costly bulk removal, haulage and disposal of spoil, and therefore the associated impacts.

Fill/Embankment Works

Large sections of the TLT & YLA (N) are planned for construction on embankments. Materials excavated from the cuttings on the Yuen Long Approach and the northern end of the tunnel will be transported for use within the works area to the embankment sections of the Yuen Long Approach. The spoil will be used further north in the areas past the Kam Tin Road where it will be used for the various sliproads and the mainline enabling it to eventually join the NTCR and the Yuen Long Southern Bypass. The volume of fill required for such works is in the order of $1Mm^3$.

Superstructure Works

A large number of bridges will be constructed along the alignment, notably to cross over the Castle Peak Road, Kam Tin River and the proposed Western Corridor Railway. In addition, a number of slip roads and interconnections will be necessary. These superstructures are likely to require a combination of the use of precast and in-situ cast sections for their construction. The detailed method of construction is not known at this stage of the project.

Pond Reclamation

The proposed alignment requires the resumption of fish/duck ponds in the area around Au Tau. This will require the partial removal of the bottom sediments and the use of wick drains and geotextiles to facilitate settlement of the soils prior to construction.

15.5.3 Operational Phase

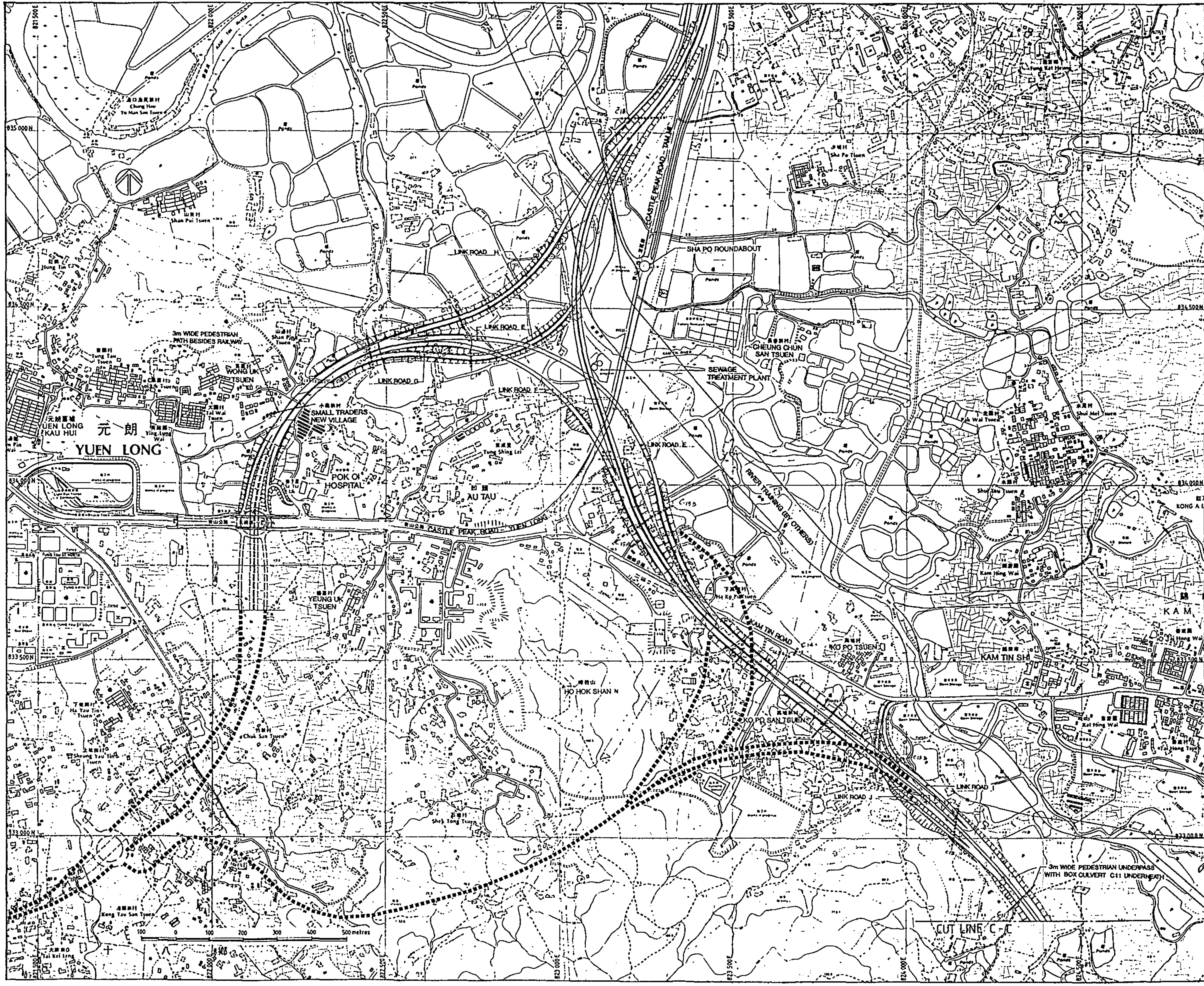
The main operational impacts of the proposed road will be the increased traffic flows in the region, and resulting noise and air quality and visual impacts.

The proposed alignment will serve to open the area for development by providing excellent infrastructure links with the PRC, the new airport at Chek Lap Kok and the port at Kwai Chung. Any resulting development would have potential further impacts upon the existing rural community associated with it and will need to be carefully controlled.

15.6 STRUCTURE OF THE REPORT

In addition to this introductory Chapter, this Part comprises twelve further Chapters and Appendices containing supporting information:

- **Chapter 16** describes the baseline conditions in the Study Area and identifies existing and committed impact sources and sensitive receivers.
- **Chapter 17 - 24** details the environmental implications, involving the assessment, of the alignment air, noise and water quality, waste management, spoil and fill, landscape and visual assessment, community issues, and ecology.
- **Chapter 25** provides environmental monitoring audit requirements for the TLT & YLA (N) to supplement the detailed requirements given in Part I Chapter 12.
- **Chapter 26 and 27** are a summary and list of recommendations/ mitigation measures respectively.



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HIGHWAYS DEPARTMENT

WESTERN HARBOUR LINK OFFICE

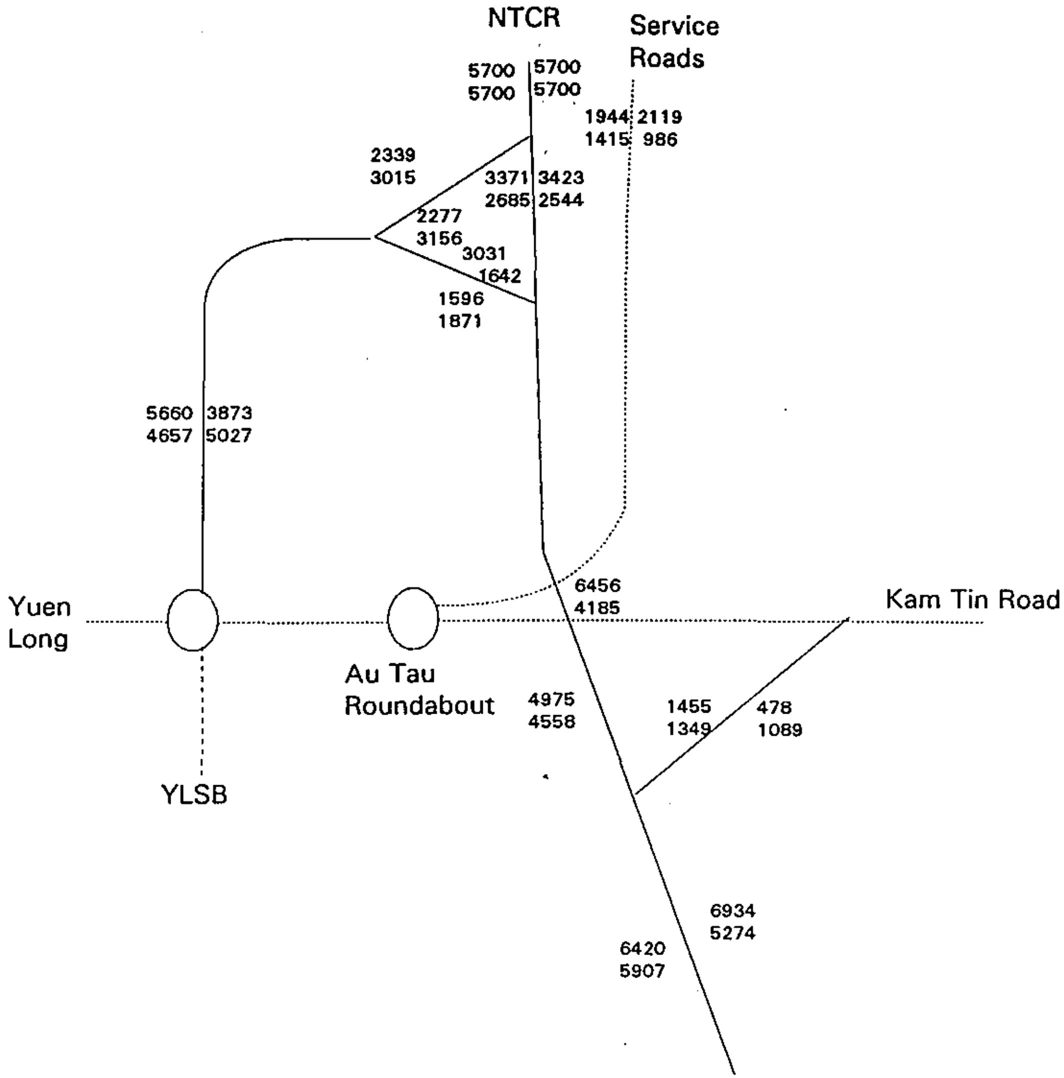
ROUTE 3 COUNTRY PARK SECTION
PRELIMINARY DESIGN STAGE 2

FIGURE 15.1

TLT & YLA (N)
AU TAU INTERCHANGE
& THE NORTHERN LINK

Drg. No. 92393/SK/258

FREEMAN FOX MAUNSELL



Notes:
Prepared by Freeman Fox Maunsell from data provided by the Transport Department

Flows in Pcu/hr

FREEMAN FOX MAUNSELL	Drg. Title : TRAFFIC FLOWS 2011 AM/PM	Job Title : ROUTE 3 : COUNTRY PARK SECTION EIA
		Scale : NTS / Date : Sept 1993 · Job No. 058000 · Fig No. 15.2

EXISTING ENVIRONMENT

CHAPTER 16

16. EXISTING ENVIRONMENT

16.1 INTRODUCTION

A number of site surveys have been conducted in the Study Area including noise and air monitoring. In addition, a review of aerial photographs, maps, previous reports (Feasibility Study, Preliminary Design Stage 1) and other existing data has been undertaken.

16.2 GENERAL DESCRIPTION

The Study Area is shown in Figure 15.1. The area to the north of Kam Tin valley is quite densely populated and includes a number of villages and other developments. It is therefore inevitable that the construction of a major road through this area will cause significant impacts to local residents. These sensitive receivers are discussed in Section 2.4.

The area consists of the predominantly low lying Kam Tin River valley with several tributary streams and numerous fish/duck ponds. In addition, considerable disturbance has been brought about by cultivation. Several ruin and grave sites are situated along the proposed alignment, but vegetation is sparse.

16.3 EXISTING AND COMMITTED IMPACT SOURCES

16.3.1 Introduction

Existing and committed impact sources in the Study Area have been identified in relation to their effect upon the existing environment. Due to the predominantly rural nature of the area these sources are outlined below:

16.3.2 Noise

Road traffic in the Study Area represents the main noise source. Noise from traffic travelling on the Castle Peak Road which runs through Yuen Long and Au Tau before connecting with NTCR in the north, and the Kam Tin Road which runs off the Castle Peak Road at Au Tau through to Kam Tin, affects residential developments throughout the area. A further noise impact source is the on-going construction activity around the Yuen Long/Au Tau area.

16.3.3 Air Quality

In the absence of major polluting industry in the area, any deteriorations in air quality can be attributed to emissions from vehicular sources. Construction activities in Yuen Long may additionally contribute particularly with respect to dust and fugitive emissions from plant. Minor emissions are attributed to the burning of refuse along the river banks.

16.3.4 Water Quality

High direct inputs from agriculture, run off from motor vehicle breaking yards, open storage areas and the practice of burning rubbish along the river banks contribute to the pollution of the Kam Tin River and is a cause of its poor water quality.

16.4 KEY EXISTING AND COMMITTED SENSITIVE RECEIVERS

Key Sensitive Receivers (SRs) in the Study Area have been identified with respect to noise, air and visual impacts, and community, recreation and ecology. These include:

- fish and duck farming, and agriculture in the Kam Tin River Valley;
- residential development in the villages of Ha Ko Po San Tsuen, Ko Po San Tsuen, Kam Tin Shi (close to Kam Tin link roads), Tung Shing Lei, Au Tau, Shan Pin Tsuen, Small Traders New Village, Wong Uk Tsuen, Tai Wai Tsuen, Sz Tsz Uk and Yuen Long;
- users of the Country Park to the south of the section;
- scattered grave and ruin sites along the proposed alignments;
- water treatment plant, pumping station and two service reservoirs at Au Tau;
- fishery research station near Castle Peak Road at Au Tau;
- G/IC site north of Tung Shing Lei (gas pigging and transfer station);
- a number of electricity pylons along the alignment;
- Small Traders New Village west-north-west of Au Tau;
- Kam Tin River;
- Pok Oi Hospital between Sz Tsz Uk and Small Traders New Village; and
- user of a number of footpaths.

16.5 ENVIRONMENTAL QUALITY

16.5.1 Introduction

The existing environmental conditions are described in order to set the environmental context and to provide an overall picture of the present environmental situation in the TLT & YLA (N) Study Area.

16.5.2 Air Quality

Predictive methods used to estimate air quality within and adjacent to the Study Area suggested ambient air quality well within the Hong Kong Air Quality Objectives (HKAQO). Previous air quality survey work outside of the immediate area at Yuen Long Kau Hui confirmed these estimates. Compared to the SRs in the Study Area, the Kau Hui Monitoring Station was much closer to Yuen Long Industrial Estate (a significant source of airborne pollution), the results indicated that the air quality was well within the AQOs. The air quality recorded at this location suggested that existing air quality in the Study Area should be comparable if not better, due to the lack of significant industry along the route. The only potential impact is odour from scattered farming activities.

16.5.3 Noise

During June/July 1993 a baseline noise survey was carried out in the Study Area. Two locations were assessed as part of the overall Route 3 CPS Draft EIA as it was then named. These were located at Ko Po Tsuen, and between Sha Po Tsuen and Castle Peak Road. The background noise levels at these locations was variable with a range of 55 - 65 dB(A), however higher levels were obtained for short periods (see Appendix A5.1).

16.5.4 Water Quality

Kam Tin River lies within the area of influence of the TLT & YLA (N). Information obtained from EPD rates this watercourse as 'very bad', with severe pollution inputs of livestock waste and run-off wastewater from car breaking, storage yards and workshops. Intrusion of tidal currents from Deep Bay reduces the dispersion of the polluted river flow and so accumulates the pollutants *(River Water Quality in Hong Kong, 1989-1990)*.

The water quality in the fish/duck ponds is likely to be variable. A number of the ponds are currently disused, however correspondence with Government indicates that there are 'many active' ponds in the area. These 'active' ponds are likely to be cleaned out periodically (dredged) in order to remove excess build up of nutrients related to normal farming activities.

16.5.5 Ecology

The area is comprised of numerous ponds for duck and fish rearing interspersed with vegetable and paddy plots. Other areas of the valley floor are used for farming and animal husbandry. These areas provide foraging and breeding sites for birds, amphibians and reptiles. Small areas of immature woodland and mixed shrub are found in the valley, however no rare species of trees or plants have been identified along the alignment.

It is likely that the area is important as a foraging ground for raptors which are abundant in and around the Country Park.

AIR QUALITY

CHAPTER 17

17. AIR QUALITY

17.1 INTRODUCTION

17.1.1 Study Area

The Study Area of this report includes much of the Kam Tim Valley in the northwest New Territories. In this area, a number of small villages have been identified as sensitive receivers for the air quality impact assessment. These villages include those grouped around Au Tau, the Ko Po Tsuen group of villages, and Sha Po Tsuen. Individual or representative receivers have not been identified, since air quality contours are being used to assess environmental impacts.

This operational air quality impact assessment has investigated the effects of traffic on the TLT & YLA (N) and it's ramps.

17.1.2 Existing Environment

No background air quality monitoring has been performed for this area. However, in 1992 ambient pollution concentrations were monitored by Enpac Ltd over a two week period at Yuen Long Kau Hui, west of the Study Area. Compared to receivers in the study area, the Kau Hui monitoring station was much closer to Yuen Long Industrial Estate (a significant source of airborne pollution), so that pollution levels indicated by it are likely to be higher than those in the TLT & YLA (N) Study Area (Table 17.1). Nevertheless, background air quality from that station can be used as an indication of ambient pollution levels in the Study Area.

TABLE 17.1 MONITORED POLLUTANT CONCENTRATIONS
Yuen Long Kau Hui March 1992

Pollutant	Pollutant Concentration ($\mu g/m^3$)		
	Mean	Hourly Maximum	Maximum 24-hr Average
Carbon Monoxide	N/A	N/A	N/A
Nitrogen Dioxide (NO_2)	38	82	52
Total Suspended Particulates (TSP)	71	--	103
Respirable Suspended Particulates (RSP)	57	--	82

Source: *Environmental Impact Assessment for Yuen Long Kau Hui Development)* (Territory Development Department, November 1992).

The hourly maximum NO_2 concentration, and the mean RSP concentration, have been included in the pollution isopleths shown in Figures 17.1 to 17.6 of this report.

17.2 CONSTRUCTION PHASE

17.2.1 Introduction

Works Area

It has been assumed that the works area for construction activities associated with the TLT & YLA (N) alignment will be located near Au Tau Interchange. The works area will house staff offices, workshops, a concrete batching plant, and storage facilities for plant and materials, including an aggregate stockpile.

Construction Programme

Construction is expected to take four years. Currently, the construction programme is anticipated to start in January 1995, though this date may be subject to change.

Construction Activities

Road Alignment: along the alignment of the road, it's ramps and connecting roads, excavation, cutting and filling will be performed as necessary to form the roadbed. Where the alignment passes through existing ponds, it is expected that the ponds will be drained, lined with geotextile, and filled with spoils from the Tai Lam Tunnel excavation. Actual access routes and the magnitude of construction-related traffic are not known at this time, as the details of the works are not yet finalised. Additional dust-generating construction activities will take place at the following sites along the alignment.

Connection with Yuen Long Southern Bypass Via Au Tau Interchange and: this will involve a large excavation and works area at the site of the connecting ramps. Ramps are at grade for much of their length, but are elevated where they cross Castle Peak Road.

Connection with New Territories Circular Road: excavation will be required to prepare for the ramp leading onto Castle Peak Road from the Alignment.

General

Dust will be emitted during earthworks, tunnel excavation, and processing of excavated spoils. Other minor air pollution sources which are unlikely to have a significant impact include asphalt emissions during laying of the road surface, and exhaust emissions from powered mechanical equipment.

The impact of fugitive dust depends on its quantity and drift potential. Large particles tend to settle out near the source, creating a local nuisance, while smaller particles are dispersed further from the source. The distance that particles will drift is determined by their injection height, terminal settling velocity, and the degree of atmospheric turbulence.

17.2.2 Assessment Criteria

For construction dust, EPD's maximum acceptable TSP level in air over a one-hour period is 500 $\mu g/m^3$. The maximum acceptable TSP concentration averaged over a 24-hour period is 260 $\mu g/m^3$, shown in Table 17.2, HKAQO.

TABLE 17.2 HONG KONG AIR QUALITY OBJECTIVES

POLLUTANT	Concentration ($\mu g/m^3$)	
	1 hour[1]	24 hours[2]
Carbon Monoxide (CO)	30000	--
Total Suspended Particulates (TSP)	---	260
Respirable Suspended Particulates (RSP)	---	180
Nitrogen Dioxide (NO_2)	300	150

NOTES:
- Concentrations measured at 298°K (25°C) and 101.325 kPa.
- [1] One-hour criteria not to be exceeded more than three times per year.
- [2] 24-hour criteria not to be exceeded more than once per year.

17.2.3 Assessment Methodology

Construction Phase Air Quality Modelling

The Fugitive Dust Model has been used to calculate one-hour average concentrations of TSP. Dust sources have been modelled as area sources, with area size, location, and dust generation provided as inputs. Emission factors from the US EPA publication *Compilation of Air Pollutant Emission Factors (AP-42)* have been used.

Given the rate of dust generation, the impacts on the air quality at sensitive receivers will depend primarily on the settling rates of the particulates under both calm and windy conditions. Particles with size greater than 30 microns tend to settle out within a few metres of the source under typical wind conditions; smaller particles have much slower rates of settling, and are therefore more affected by wind turbulence. One category of particle size (0 to 30 microns) with a particle density of 2500 kg/m^3 has been assumed.

In the absence of a well-defined construction programme at this stage of the assessment, it has been assumed that construction is proceeding simultaneously at all sites associated with the Alignment, its slip roads, and the connecting roads to the Yuen Long Southern Bypass.

17.2.4 Impact Assessment

The results of air quality modelling to determine hourly and 24 hourly construction dust concentrations at ground level are shown in Figures 17.7a and 17.7b.

Due to the size of the construction sites and the number of assumed concurrent construction activities, adverse air quality impacts (exceeding the desirable limit of 500 $\mu g/m^3$) are expected at areas adjacent to the site. The 1-hour desirable maximum is expected to be exceeded at nearby sensitive receivers. In particular, the presence of the Pok Oi Hospital, is noted. However, construction dust generation is amenable to mitigation measures, such as discussed in Section 17.2.5 below.

17.2.5 Mitigation Measures

The control of dust during earthworks is commonly achieved by wetting or covering exposed earth. Watering is the most common dust control method for exposed site surface, but its effectiveness depends on the degree of coverage and the frequency of application. A twice-daily watering, with complete coverage, can reduce dust emissions by up to 50 percent, depending on a number of other factors such as ambient temperature and level of site activity. The effectiveness of wetting can be prolonged by the use of wetting agents that agglomerate dust particles; however, the use of chemical wetting agents may have adverse effects on plants and animals exposed to contaminated runoff.

Effective water sprays may be used during delivery and handling of fill when dust is likely to escape. At active cuts, excavation and fill sites, chemical stabilization is not effective because of the degree of disturbance caused by mechanical equipment. Chemical stabilizers are more useful on completed cuts and fills to reduce wind erosion.

To help control dust generated by the transport of soil by dumptruck, materials with the potential to create dust should not be loaded to a level higher than the side and tail boards, and should be dampened and covered before transport. Dust levels can be further reduced by providing a gravel surface (assumed for this assessment) or a temporary sealed surface on unpaved site roads. The speed of all traffic on unpaved roads should be regulated to as low a speed as is practical, but this measure is limited by the difficulty of enforcement. At all vehicle exit points leading from unpaved construction areas onto public roads, wheel washing troughs should be provided.

At concrete batching plants, dust is subject to control at several stages in the process; during handling of sand and aggregate, handling of concrete, and loading of dry concrete mix. Control of fugitive dust can be accomplished by enclosing the handling areas, conveyors and elevators, and using a baghouse filter to extract dust. The vents of concrete storage bins should also be filtered.

The control of dust from aggregate and crushed rock stockpiles is generally achieved by enclosing or covering the piles during storage. Enclosures should be rigid and reach above the height of the stockpile. Alternatively, the continual use of a chemical wetting agent to better wet the fines and retain the moisture film is effective. Simple watering of the piles is only a temporary measure, and in the absence of chemical wetting agents is not particularly effective. However, watering or temporary paving of the access area around stockpiles, where loading and unloading vehicles manoeuvre, can be effective.

The overall dust reduction obtained by using the above measures is difficult to quantify, since it is very dependent on the weather conditions, on-site practices, and maintenance of mitigation measures. Rough estimations of the reductions that are possible are listed below:

- Twice-daily waterings can reduce dust emissions by up to 50% (assuming complete coverage).
- When handling bulk materials, reducing the drop height by half reduces dust emission by about 50%.
- The efficiency of baghouse filters, which may be used at concrete batching plants, varies with the size of particle. Generally, a reduction of about 70% may be expected.

- A reduction in speed on unpaved construction roads from 40 kph to 20 kph can reduce emissions by about 50%.

- At inactive completed cuts and fills, the use of chemical stabilizers to reduce wind erosion can reduce emissions by about 80%.

Dust control measures will be incorporated in the contract documents. It is worth noting the presence of Pok Oi Hospital, where due to its sensitive nature excessive dust concentrations would be particularly unacceptable. Possible contract provisions are provided in Appendix A4.4.

Monitoring and audit programmes need to be implemented during both the construction and operation phase. The requirements for this are outlined in detail in Part I Chapter 12.

17.3 OPERATION PHASE

17.3.1 Assessment Criteria

The Hong Kong Air Quality Objectives stipulate maximum acceptable concentrations of pollutants in air. These concentrations are shown in Table 17.2, Section 17.2.1.

17.3.2 Assessment Methodology

For open-road traffic, maximum one-hour concentrations of NO_x and RSP have been predicted using CALINE4. Gases have been assumed to be inertial, and concentrations of NO_2 have been taken as 20 percent of the total NO_x concentration. The following input parameters to CALINE4 were used:

Wind Speed	2 m/s
Wind Direction	worst case
Wind Direction Variation	11.5 degrees
Stability Class	D
Mixing Height	500 m
Temperature	25 degrees C

The assessment has been based on EPD-supplied future fleet average emission factors for NO_x and particulates (RSP). Emission factors for NO_x and particulates are derived from the FTP 75 standard (for passenger cars, taxis, and 2.5 ton vans) and the US Transient 88 standard (for goods vehicles).

Morning peak hour flows for the year 2011 on TLT & YLA (N), have been used, however 24hr traffic variation data is not available. Traffic flows are provided in Appendix A17.1.

17.3.3 Impact Assessment

The critical peak hour pollution isopleths are shown in Figures 17.1 to 17.6. At ground level, concentrations of NO_2 and RSP will exceed AQO limits at close proximity to the alignment.

NO_2 Isopleths

Figures 17.1 to 17.3 indicate that NO_2 concentrations are expected to exceed AQO limits at close proximity to the route alignments, but should be acceptable in almost all existing village locations with the exception of a very limited number of Ha Ko Po Tsuen receivers immediately adjacent to the highway works.

RSP Isopleths

Figures 17.4 to 17.6 show hourly RSP concentrations based on 2011 peak hour traffic flows. The AQO have no corresponding hourly RSP averages against which the contours may be assessed; however, assessing the hourly averages against the AQO 24-hour maximum provides an indication of potential areas of concern.

The contours indicate that a wider area of sterilisation, in which RSP concentrations could exceed the AQO criterion, is expected than that for NO_2 concentrations. Specifically, parts of Ko Po Tsuen, the easternmost Yuen Long Kau Hui villages (e.g., Wong Uk Tsuen), and parts of the Small Traders New Village, consisting mainly of rural residential development, may be subject to high levels of RSP. Receivers lying in close proximity to the existing Castle Peak Road -- Yuen Long and Kam Tin Road also appear to be subject to significant future concentrations of RSP.

In the absence of 24-hour RSP concentrations, it is difficult to define the receiver locations at which excessive concentrations can occur.

17.3.4 Mitigation Measures

Almost all sensitive receivers in the study area are located sufficiently far from the Alignment, its ramps and connecting roads, that traffic-generated NO_2 concentrations can be expected to have an acceptable impact. Exceptions to this occur at a very small number of receivers near Ha Ko Po Tsuen, where the planned roadway passes very close to a very limited number of existing dwellings. If these dwellings are not scheduled for resumption due to the landscape needs of the roadway, the inhabitants may require relocation to a site more distant from the roadway.

The extent of land sterilised due to high RSP concentrations cannot be accurately determined at this stage, due to the lack of an hourly AQO standard for this pollutant.

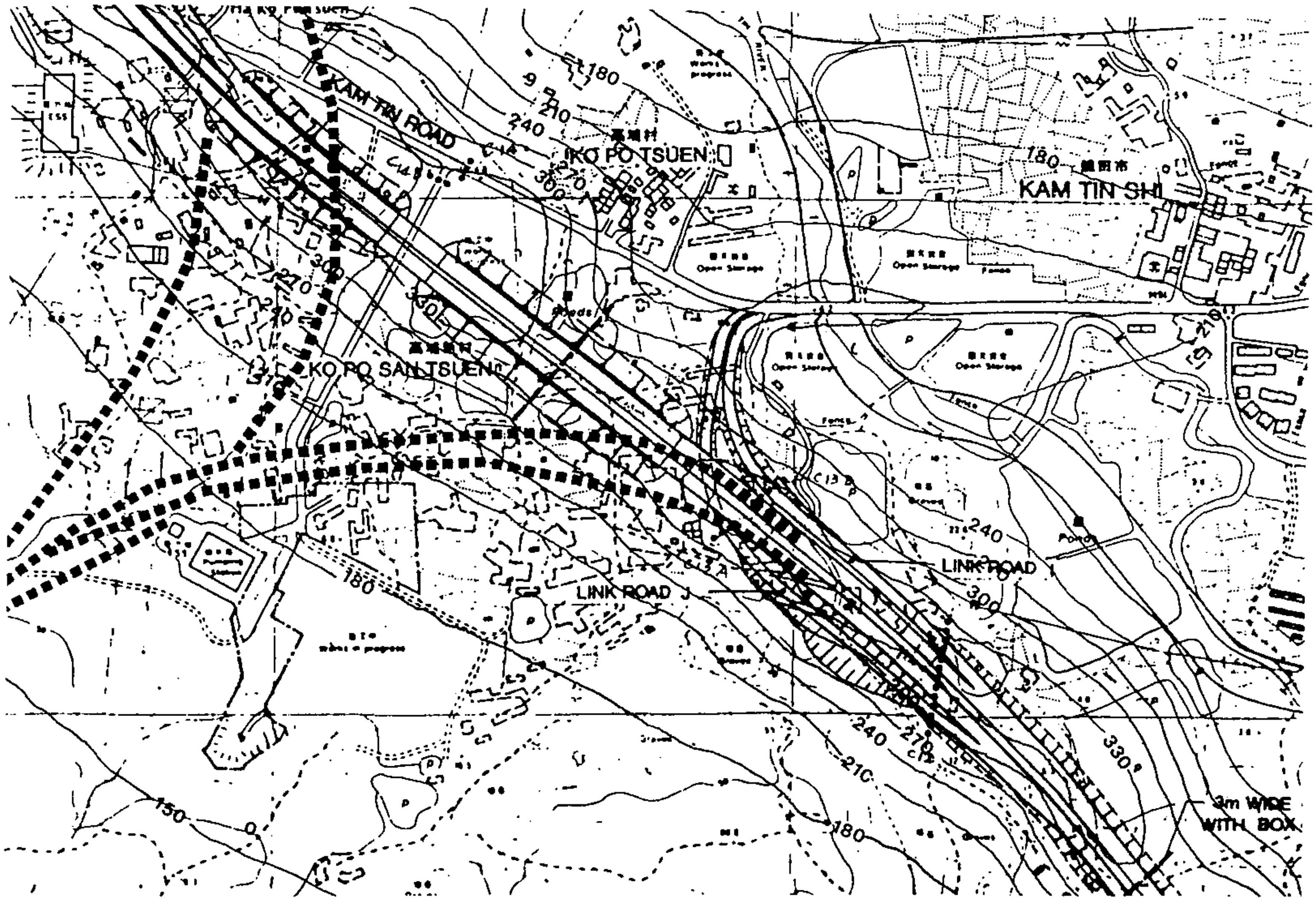
17.3.5 Discussion

The Alignment passes close to densely populated areas, running close to parts of Ko Po Tsuen, the easternmost Yuen Long Kau Hui villages such as Wong Uk Tsuen, and parts of the Small Traders New Village. At close proximity to the roadway, RSP concentrations in these areas may exceed AQO levels. However the degree of exceedance and the affected area (based on a daily RSP impact) should be less than that of the hourly RSP which provides a greater than 'worst case' assessment.

17.4 CONCLUSION

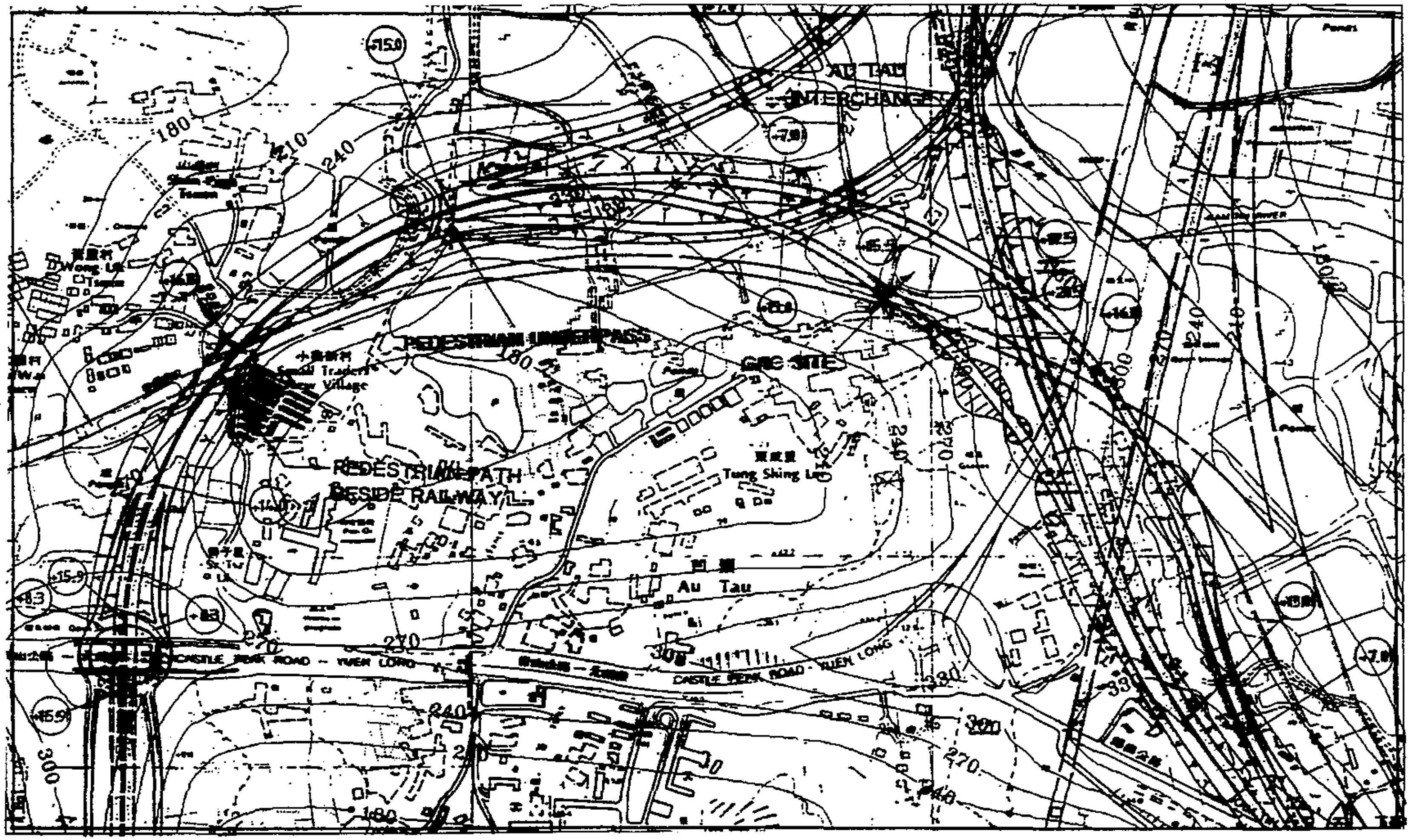
During the construction phase, exceedances of desirable air quality limits are expected. A package of mitigation measures and a monitoring programme have been proposed to minimize such exceedances.

During the operation phase, pollutant concentrations in close proximity to the roadway may exceed AQO maxima during the peak hours. Where this occurs, the only practical mitigation measure is to remove affected receivers from the proximity of the roadway to a more distant position. The need for this could be confirmed during the detailed design stage.



FREEMAN FOX MAUNSELL	Drg. Title : 2011 NO_2 Concentrations ($\mu g/m^3$): Ko Po San Tsuen	Job Title : ROUTE 3 : COUNTRY PARK SECTION EIA

Scale : N/A Date Nov. 93	Job No. 058 000	Fig No. 17.1



FREEMAN FOX MAUNSELL

Drg. Title :

2011 NO_2 Concentrations
($\mu g/m^3$): Au Tau

Job Title :

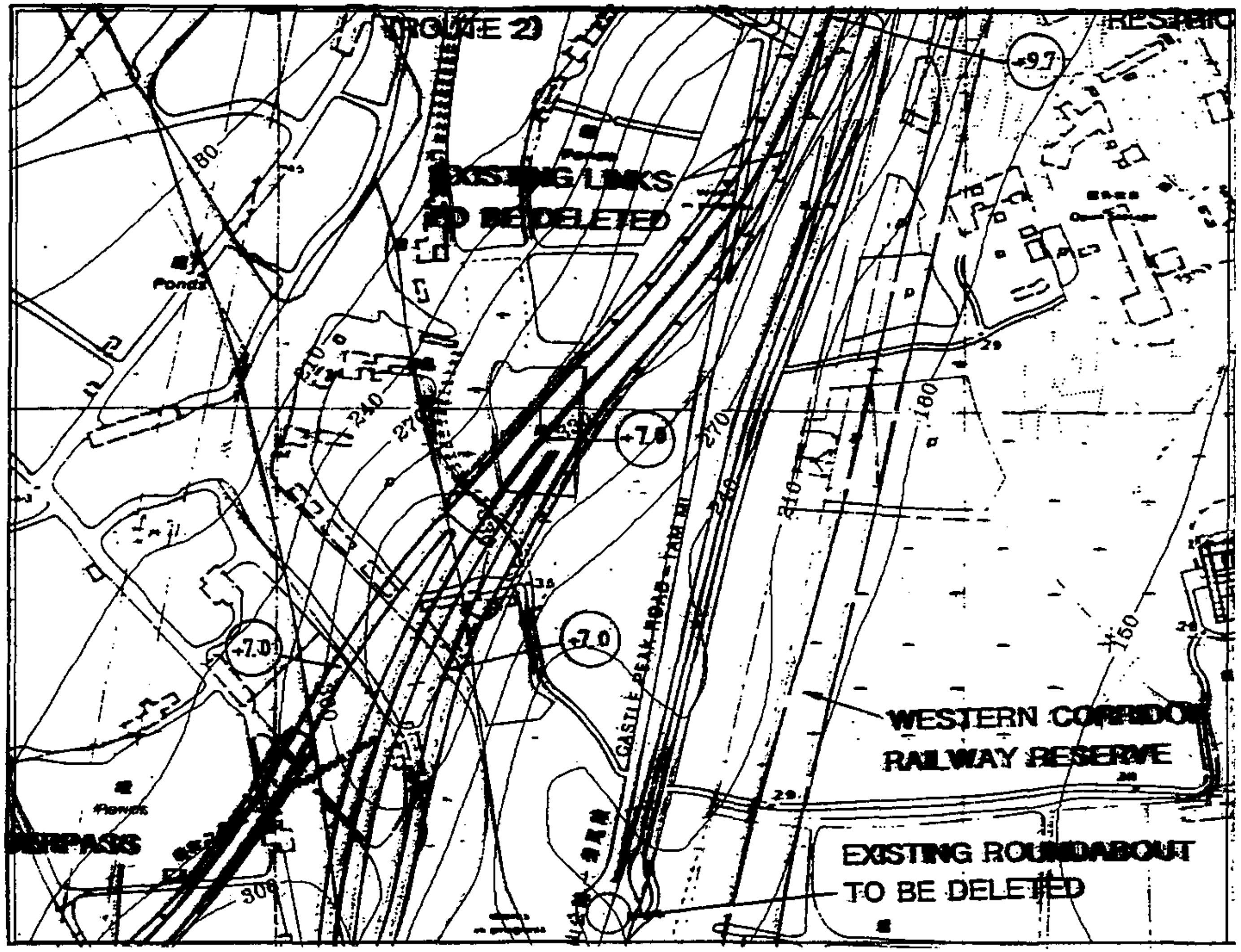
ROUTE 3 : COUNTRY PARK SECTION EIA

Scale : NTS

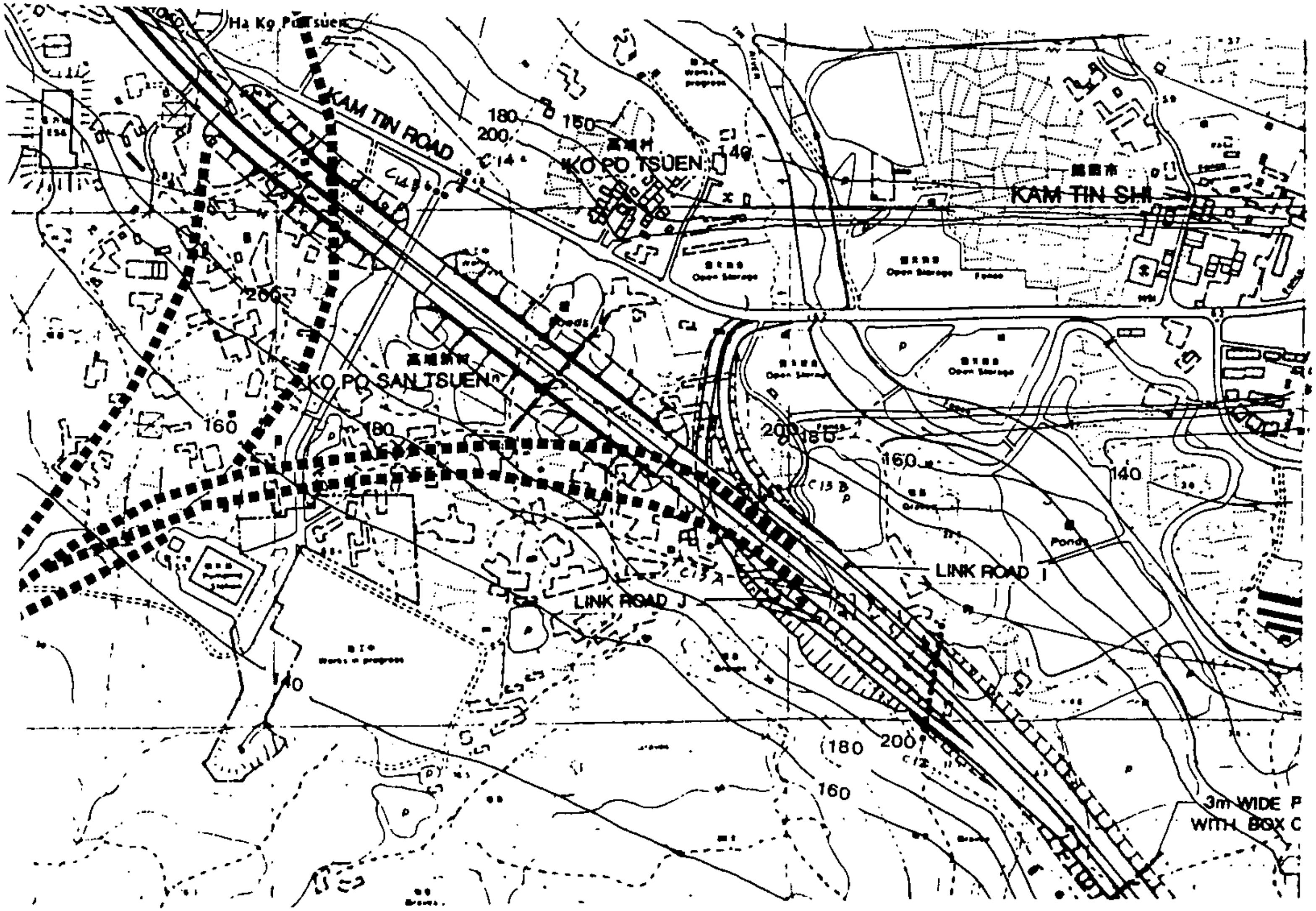
Date : September 1993

Job No. 058000

Fig No. 17.2



FREEMAN FOX MAUNSELL	Drg. Title : 2011 NO_2 Concentrations ($\mu g/m^3$): Northern End	Job Title : ROUTE 3 : COUNTRY PARK SECTION EIA	
		Scale : NTS Date : September 1993	Job No. 058000
			Fig No. 17.3



FREEMAN FOX MAUNSELL	Drg. Title: 2011 RSP Concentrations ($\mu g/m^3$): Ko Po San Tsuen	Job Title: ROUTE 3 : COUNTRY PARK SECTION EIA
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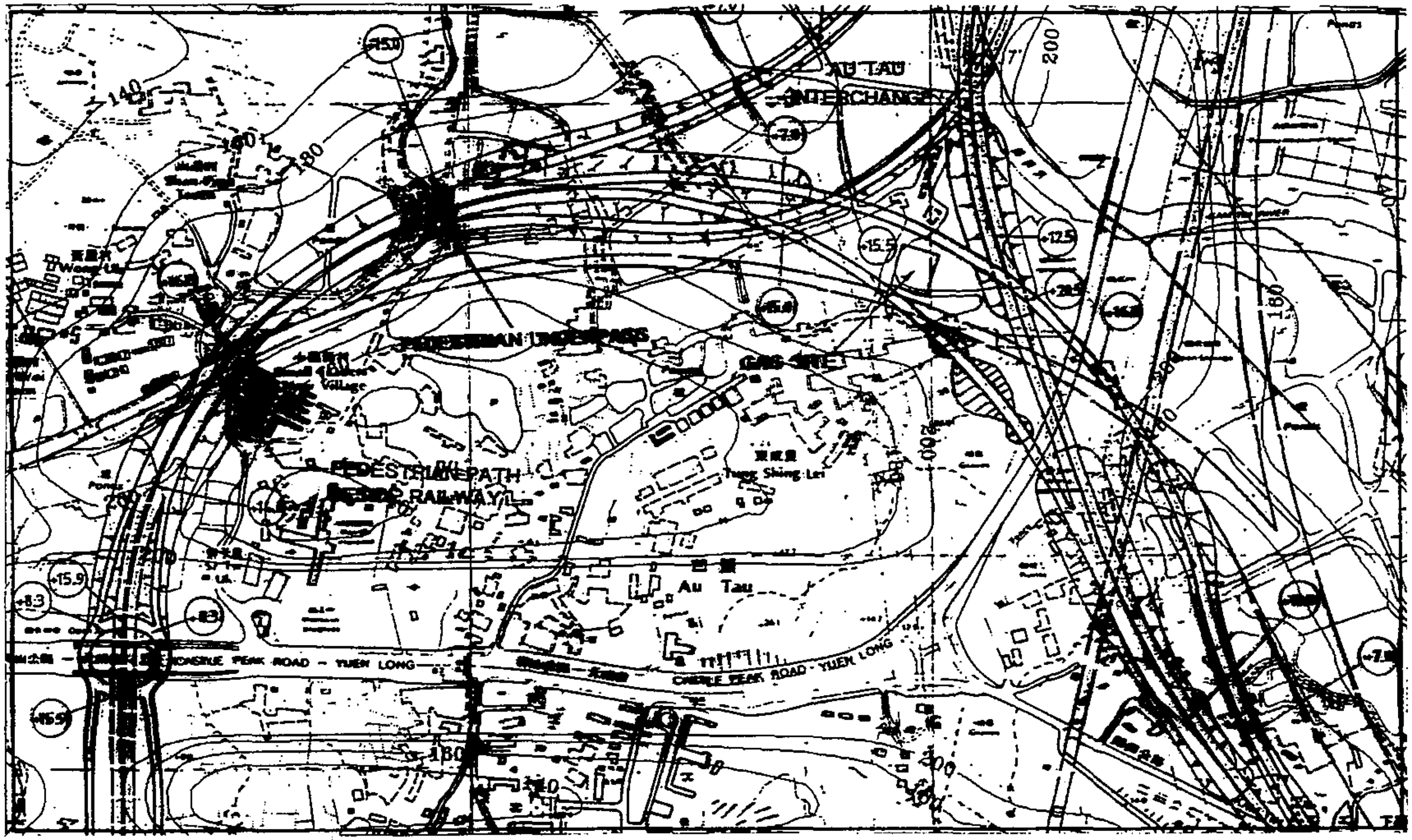
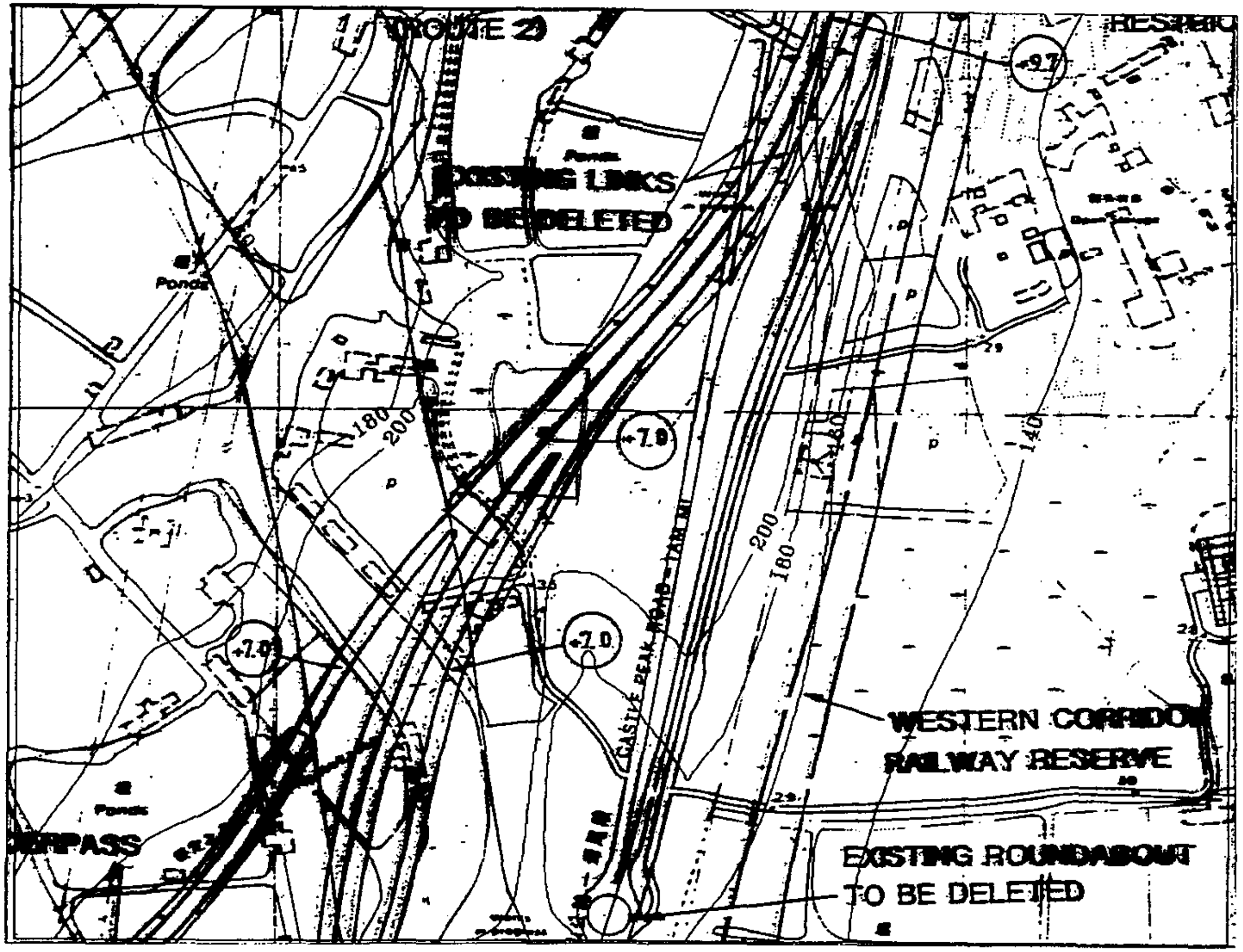
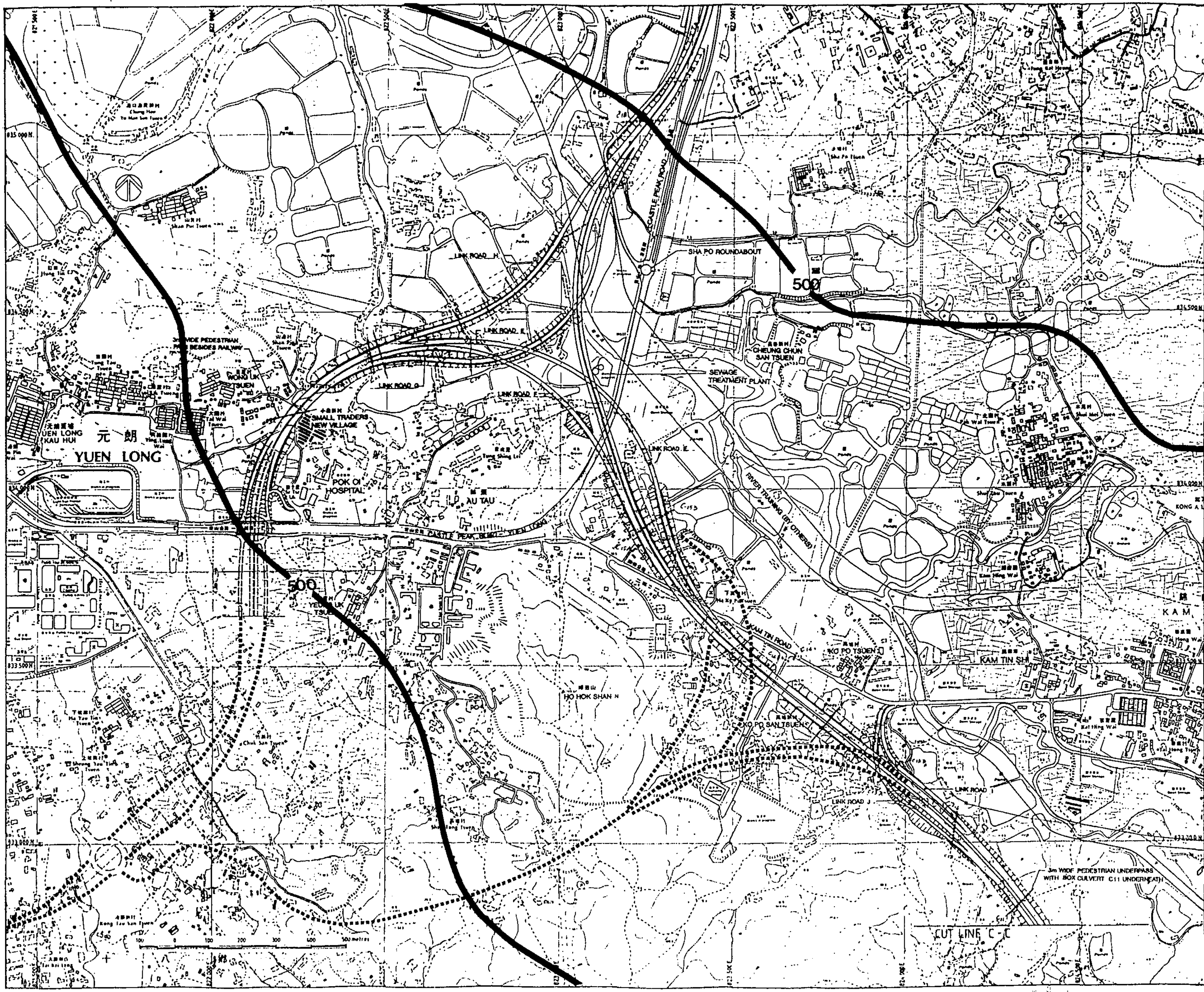
		Date : September 1993
		Job No. 058000
		Fig No. 17.4



FREEMAN FOX MAUNSELL	Drg. Title : 2011 RSP Concentrations ($\mu g/m^3$): Au Tau	Job Title : ROUTE 3 : NORTHERN LINK		
		Scale : NTS Date : September 1993	Job No. 058000	Fig No. 17.5



FREEMAN FOX MAUNSELL	Drg. Title : 2011 RSP Concentrations ($\mu g/m^3$): Northern End	Job Title : ROUTE 3 : COUNTRY PARK SECTION EIA		
		Scale : NTS Date : September 1993	Job No. 058000	Fig No. 17.6



LEGEND

500 μg/m³ DUST LEVEL CONTOUR

CUT SLOPE

EMBANKMENT

SPOT LEVEL

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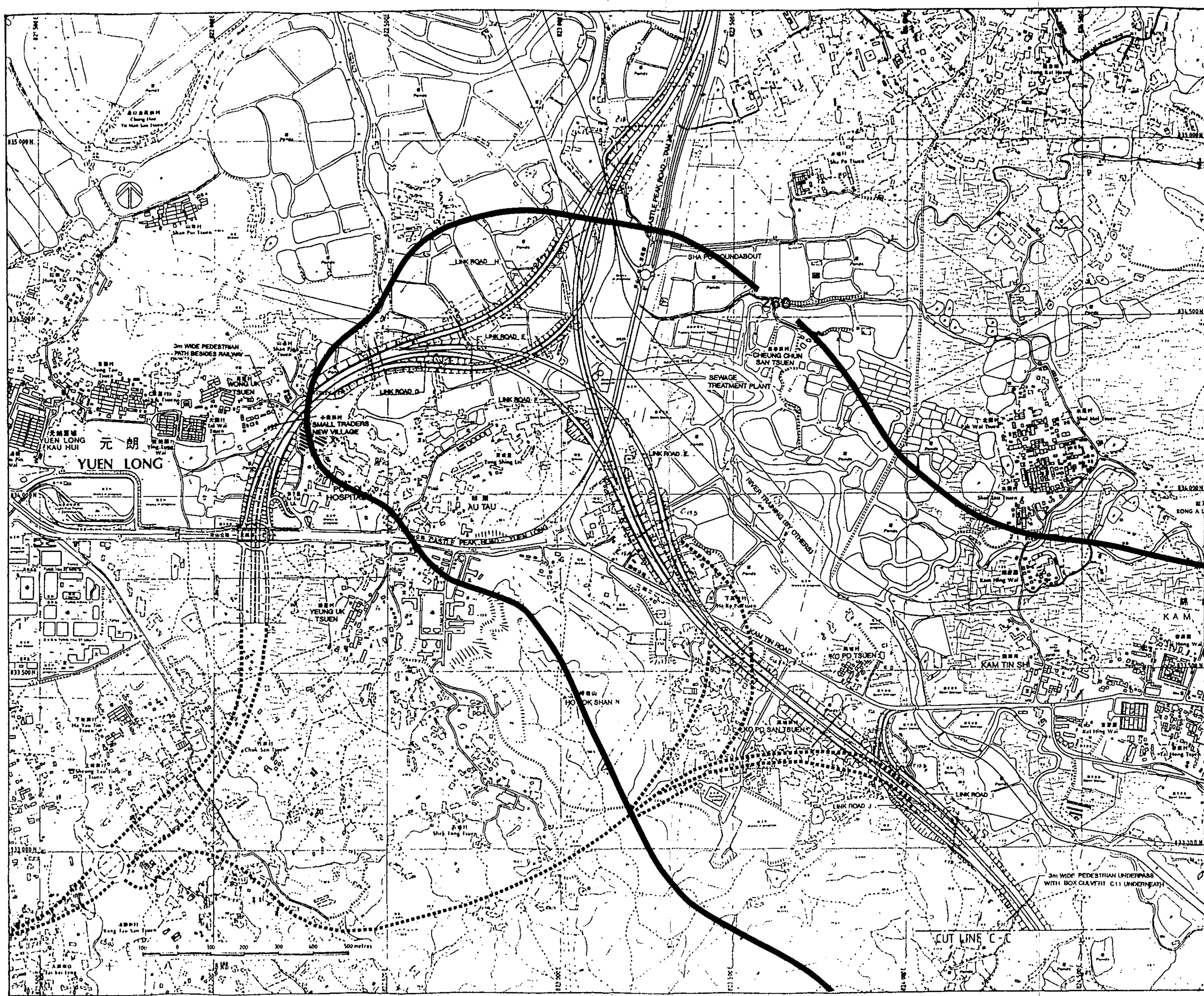
ROUTE 3 COUNTRY PARK SECTION AND TING KAU BRIDGE PRELIMINARY DESIGN STAGE 2

ROUTE 3
COUNTRY PARK SECTION EIA
CONCENTRATION OF CONSTRUCTION DUST (HOURLY AVERAGE)

FIGURE 17.7a

Drg. No. 92393/SK/258

FREEMAN FOX MAUNSELL



LEGEND

260 $\mu g/m^3$ DUST LEVEL CONTOUR

CUT SLOPE

EMBANKMENT

SPOT LEVEL

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Drawn	H K CHENG	Checked	
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ROUTE 3 COUNTRY PARK SECTION AND TING KAU BRIDGE PRELIMINARY DESIGN STAGE 2

ROUTE 3
COUNTRY PARK SECTION EIA
CONCENTRATION OF CONSTRUCTION DUST
(24 HOUR AVERAGE)

FIGURE 17.7b

Drg. No. 92393/SK/258

FREEMAN FOX MAUNSELL

NOISE

CHAPTER 18

18. NOISE

18.1 INTRODUCTION

The noise impact assessment has been divided into separate sections dealing with construction noise and operational noise. Two scenarios have been investigated, with and without mitigation.

The assessment should not be used for the purpose of making a detailed impact assessment for every existing noise sensitive receiver (NSR) at this stage in the design. A broad assessment is provided which considers existing NSRs along the alignment and states the total number of residents and residences along the alignment for which the noise level is predicted to exceed the ExCo criteria.

Background noise levels at selected receivers were monitored for earlier phases of this study, and are shown in Appendix A5.1.

18.2 CONSTRUCTION PHASE

18.2.1 Introduction

Works Area

It has been assumed that the works area for construction activities associated with the TLT & YLA (N) alignment will be located within the Au Tau Interchange. The works area will house workshops, a concrete batching plant and will serve as a depot for mobile construction plant and vehicles.

Construction Programme

Construction is expected to take four years. Currently, the construction programme is anticipated to start in January 1995, though this date is subject to change.

Construction Activities

Road Alignment

Along the Alignment, its ramps and connecting roads, excavation, cutting and filling will be performed as necessary to form the roadbed. Actual access routes and the magnitude of construction-related traffic are not known at this time, as the details of the works are not yet finalised.

A list of assumed construction equipment, as grouped in clusters along the Alignment, is shown in Appendix A18.4. Due to the large size and complex geometry of the site it was not considered appropriate to assume all plant located at a single point in the centre of the site, instead the plant was assumed to be distributed in sections along the alignment, these correspond to the plant schedule in Appendix A18.4 and these have been shown on Figure 18.1.

Anticipated equipment operating in the works area is listed in Table 18.1:

TABLE 18.1 WORKS AREA: ASSUMED EQUIPMENT

Equipment and Approximate SWL (dB(A))		Number
Concrete batching plant	108	1
Conveyor belt	90	1
Concrete lorry mixer	109	2
Crane (mobile)	112	1
Dump truck	117	2
Lorry	112	2
Winch	110	1
Planer	117	1
Circular wood saw	108	2

A 24-hour construction schedule has been assumed for the assessment so that NCO criteria (which deals with construction noise during restricted evening and night hours) can be applied. However at this stage the need for a 24-hour construction schedule has not been finalised.

18.2.2 Assessment Criteria

No existing legislation controls construction noise (other than that from percussive piling) during the daytime on weekdays. However, government contracts commonly include a noise limit of L_{eq} 75 dB(A) (30-min) 0700-1900 hours on normal week days for construction works in urban areas. For the purpose of this assessment, this limit has been taken as the daytime assessment criterion.

The Noise Control Ordinance provides for the control of noise from construction operations (other than percussive piling) on general holidays and between 1900 and 0700 hours on weekdays. Contractors are required to obtain a Construction Noise Permit from EPD, and to observe acceptable noise limits set out in the *Technical Memorandum on Noise from Construction Work other than Percussive Piling*, shown in Table 18.2.

18.2.3 Assessment Methodology

The methodology used in the present assessment follows that provided in the *Technical Memorandum on Noise from Construction Work other than Percussive Piling*.

The analysis has been based on the period of maximum construction activity. No activity equivalent noise level (L_{Aeq}) has been determined, in accordance with the *Technical Memorandum* methodology. Thus, the construction noise levels shown in Table 18.3 are based on the assumption of simultaneous prolonged use of virtually all construction zone equipment at that part of the alignment closest to the receiver. As in reality the equipment will be spread out along the alignment this situation is extremely unlikely to occur in practice. The figures shown in Table 18.3 should therefore be regarded as levels unlikely to be achieved for a 30-minute compliance testing period.

TABLE 18.2 ACCEPTABLE NOISE LEVELS (CONSTRUCTION)

Time Period	Acceptable Noise Levels (dB(A))	
	Not affected	Indirectly affected
All days during the evening (1900-2300 hrs), and general holidays (including Sundays) during the daytime and evening (0700-2300 hrs)	60	65
All days during the night-time (2300-0700 hrs)	45	50

NOTES: 1. Assumes Area Sensitivity Rating of "A", corresponding to rural areas (including villages) and low density residential areas.

2. "Indirectly affected" means that NSRs are located such that noise generated by nearby major roads is noticeable at the NSR, but is not a dominant feature of the noise climate at the NSR. "Not affected" means that the NSRs are located so that noise generated by the road is not noticeable at the NSR.

18.2.4 Impact Assessment

The results of construction noise modelling to determine impacts are shown in Table 18.3.

TABLE 18.3 CONSTRUCTION NOISE PREDICTIONS: NO MITIGATION MEASURES

Location		Noise Level (dB(A))
Identification	Location and Approximate Assessment Distance	
R8	Small Traders New Village (25 m)	100
R17	Tung Shing Lei Village (190 m)	82
R22	Sha Po Tsuen	75
R20	Ko Po Tsuen	86
–	Ko Po San Tsuen (adjacent to alignment)	102

Due to the proximity of the construction site and the number of assumed concurrent construction activities, adverse noise impacts (exceeding the desirable daytime limit of 75 dB(A)) are expected at areas adjacent to the site. However, construction noise is amenable to mitigation measures, such as those discussed in Section 18.2.5 below.

The noise levels shown in the above table are based upon assumptions given in Section 18.2.3 and are not expected to be achieved in practice. They are also without reduction from mitigation. However, the need for mitigation measures is anticipated, and possible mitigation measures are discussed in the following section.

18.2.5 Mitigation Measures

The most effective mitigation measure is to control noise at its source. In the case of powered mechanical equipment, this involves either selecting silenced equipment, or reducing the transmission of noise using mufflers, silencers, or acoustic enclosures.

Construction noise may be mitigated through several measures:

- 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 should be avoided.

- 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.

- Noisy activities can be scheduled to minimise exposure of nearby NSRs 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). As far as possible, noisy operations during teaching hours should be avoided near the existing schools.

- Idle equipment should be turned off or throttled down. Noisy equipment should be properly maintained and used no more often than is necessary.

- The power units of non-electric stationary plant and earth-moving plant can be quietened by vibration isolation and partial or full acoustic enclosures for individual noise-generating components.

- Construction activities can be planned so that parallel operation of several sets of equipment close to a given receiver is avoided.

- If possible, reduce the numbers of operating items of powered mechanical equipment.

- 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.

- Limited hours of use for powered mechanical equipment are recommended; a ten-hour period from 0700 to 1900 hours is suggested. Hours of use could be further restricted by the Works Checker if sufficient and justifiable complaints from affected villagers are received.

- Temporary noise barriers or earth embankments may be used to screen specific receivers. The barrier material should have a mass per unit of surface area of at least 7 kg/m^2. The panels should be absorptive with an acoustic lining, and have a noise reduction capability of up to 10 dB(A).

Evaluation of the exact effectiveness of these measures at a given receiver requires a knowledge of the planned construction schedule, which is not available at this stage. Estimates of the noise reductions capable are provided below:

Stationary and Earth-Moving Plant

These pieces of equipment include compressors, excavators, bulldozers, loaders, and dumptrucks. Noise reduction can be achieved through proper maintenance of the exhaust system, and through exhaust silencers. Additionally, engine noise is amenable to reduction through isolation of vibrating engine components, installation of partial or full acoustic enclosures of noise-generating components, and damping of vibrating panels. U.S. tests have shown that partial or full enclosures can achieve noise reductions of 10 and 25 dB(A) respectively.

Super-silenced compressors incorporate acoustic casing linings, mufflers, and anti-vibration mounts to isolate the engine and compressor unit for the chassis. A reduction of 5 dB(A) can be achieved with the use of a super-silenced compressor relative to a silenced compressor.

Barrier

A purpose-built noise barrier, located close to the noise source, can be fabricated to protect sensitive receivers. Effective barriers are typically lined on the noise-generating side with a noise-absorbing material, and have a surface mass of at least 7 kg/m^2. Assuming that the barrier has no gaps, and that it blocks the line of sight between noise generator and noise receiver, reductions of 5 to 10 dB(A) can be achieved.

With regard to noise emanating from the fixed plant in the works yard, a separate body of mitigation measures can be considered. Since much of the space within the casting yard is expected to be used for storage, it may be possible to position the smaller area devoted to the batching plant as far as possible from sensitive receivers and effectively shield it. Containers/offices on the site can be stacked and positioned so as to shield sensitive receivers from noise. Alternatively, a temporary canopy structure may be devised around the batching plant to partially screen sensitive receivers.

Using these mitigation measures, the following noise levels presented in Table 18.4 could be achieved:

TABLE 18.4 CONSTRUCTION NOISE PREDICTIONS: WITH MITIGATION MEASURES

Location		Noise Level (dB(A))
Identification	Location and Approximate Assessment Distance	
R8	Small Traders New Village (25 m)	85
R17	Tung Shing Lei Village (190 m)	67
R22	Sha Po Tsuen	64
R20	Ko Po Tsuen	71
--	Ko Po San Tsuen (adjacent to alignment)	87

Assuming a package of construction noise mitigation measures, approximate contours showing facade noise levels of 75 dB(A) due to construction activity are shown in Figures 18.2a and b.

In the presence of the mitigating measures outlined above, reasonable daytime noise levels should be achievable in most cases without imposing undue economic hardship on the Contractor. The more stringent noise requirements during restricted hours (holidays, evenings and night-time) impose constraints on the number and types of equipment that the Contractor could expect to operate. Also, dwellings adjacent to the works boundaries, such as at the Small Traders New Village and Ko Po San Tsuen, would be expected to experience noise levels exceeding acceptable limits.

The establishment of good community relations, though not effective in reducing noise levels, can be of great assistance to both the Contractors and receivers. Residents of nearby villages should be notified in advance of planned operations, and informed of progress. If necessary, a liaison body can be established to bring together representatives of the affected communities, the government, and the Contractors. In addition, residents may be provided with a telephone number for the Consultants Environmental Representative's office, where they may register complaints concerning perceived excessive noise. If justified, the Consultants Environmental Representative may authorise noisy operations to cease or to be conducted only during more restricted hours.

While it is not feasible to dictate the methods of construction to be employed by the Contractor, noise control requirements will be incorporated in the tender/contract documents, a strategic noise planning schedule should be submitted by the Contractor demonstrating that the specified noise standards will be met and requirements for noise monitoring are provided in Chapters 12 and 25.

In order to estimate the number of residents living in affected areas within the contour lines, reference has been made to the 1991 population census. The following estimate is based on that census, and includes the estimated number of persons dwelling in both permanent and temporary accommodation that will be affected by construction noise. Since estimates of temporary accommodation (which is extensive in the area) have been included, it should be understood that the numbers shown in Table 18.5 are approximate only. A further detailed site survey should be conducted immediately prior to detailed design of the TLT & YLA (N), to ascertain the actual number of residences to be affected by construction noise.

TABLE 18.5 CONSTRUCTION NOISE IMPACT

1991 Population Census		Construction Noise Impact	
Village Cluster No.	Average Occupancy per Living Quarter	Approximate Number of Affected Living Quarters	Approximate Population Affected (persons)
524/30	3.2	30	96
525/07	4.3	10	43
525/05	3.6	40	144
525/06	2.7	100	270
525/02	3.5	20	70
525/01	3.5	5	18
526/04 & 05	4.1	15	62
526/06	3.6	45	162
		Total	865

NOTE: Shows approximate number of quarters (permanent and temporary) exposed to construction noise exceeding 75 dB(A) at facade. Assumes no barrier effects from existing buildings or topography.

18.3 OPERATION PHASE

18.3.1 Assessment Criteria

The Study Area is generally subject to high noise levels from existing roads, mainly Kam Tin Road and Castle Peak Road. Owing to the fact that the existing noise levels are above HKPSG criteria (70dB(A) L_{10}(1-hr) at sensitive facades of residential buildings), this standard is not feasible or practical to apply in this specific area.

For receivers who are expected to be exposed to excessive traffic noise levels the need for noise mitigation measures will be determined with reference to the criteria resulting from ExCo's directive, "Equitable Redress for Persons Exposed to Increased Noise Resulting from the use of New Roads". The relevant criteria, used to determine whether an individual receiver is eligible for insulation, are the following:

1. The predicted overall noise level from the new road, together with other traffic noise

in the vicinity, must not be less than the HKPSG criteria, i.e., 70dB(A) L_{10} (1hr);

2. The predicted noise level is at least 1.0dB(A) more than the prevailing noise level, i.e., the total traffic noise level existing before the works to construct the road were begun, and

3. The contribution to the increase in the noise level from the new or improved road must be at least 1.0dB(A).

The prevailing noise levels are not available. To make a comparison possible, it has been agreed with EPD that estimated noise levels can be based on data from the *Annual Traffic Census 1992*. This is provided in Appendix A18.1.

18.3.2 Assessment Methodology

Road traffic noise levels have been calculated using the U.K. Department of Transport procedures contained in *Calculation of Road Traffic Noise* (1988).

Noise prediction has been based on the worst-case traffic scenario (2011 evening peak hour) and based on figures supplied by Transport Department and agreed with EPD, taking into account the effects of distance, angle of view, and facade reflection. The traffic flows for year 2011 are given in Figure 15.2. Porous friction course surfacing is assumed as a mitigation measure for all roadways, as are base speeds (adjusted according to gradient and proportion of heavy vehicles) of 100 kph on Route 3 and 85 kph on sliproads. The proportion of heavy vehicles is assumed to be 80 percent on all roads, as advised by Transport Department.

Selected representative NSRs, shown in Figures 18.14 a-g, have been chosen along the proposed alignment. Generally, these representative receivers are low rise residential buildings though a number of school and a hospital have also been evaluated. The most exposed facade was selected at each of these representative NSRs.

Modelling has been undertaken for both unmitigated and mitigated scenarios. In the model 1, 2, 3 and 4m barriers have been assessed and evaluated and noise contours produced.

18.3.3 Impact Assessment with No Mitigation

L_{10} traffic noise levels associated with 2011 traffic flows on the TLT & YLA (N) and existing Castle Peak and Kam Tin Roads are shown in the following Table 18.6. Free-field noise contours at ground level and at 20 mPD are shown in Figures 18.3 and 18.4. The results in Table 18.6 show that high traffic noise levels may be expected at receivers in close proximity to, and with a wide angle of view of, both planned and existing roadways.

TABLE 18.6 UNMITIGATED TRAFFIC NOISE PREDICTIONS

Receiver Identification	Predicted L_{10} Facade Noise Level dB(A)		
	Kam Tin Road and/or Castle Peak Road	TLT & YLA (N) and Slip Roads	Total Noise Level
R1	75.7	70.5	76.8
R2	74.8	69.7	76.0
R3	70.0	66.3	71.5
R4	76.5	68.5	76.8
R5	59.3	68.5	69.6
R6	74.1	75.0	77.6
R7	73.0	68.1	74.2
R8	63.8	68.9	70.1
R9	69.1	71.2	73.3
R10	69.9	70.2	73.1
R11	68.9	67.8	71.4
R12	61.8	70.4	71.0
R13	65.6	68.2	70.1
R14	74.4	69.6	75.9
R15	82.3	67.8	82.5
R16	67.3	67.5	70.4
R17	64.9	70.3	71.4
R18	70.5	72.2	74.4
R19	73.5	74.6	77.1
R20	84.0	72.9	84.3
R21	70.8	67.1	72.3
R22	70.5	67.9	72.4
R23	73.3	67.9	74.4
R24	75.6	69.5	76.6
R25	77.7	68.9	78.2
R26	69.7	64.7	7o.9
R27	69.0	68.0	71.5
R28	78.4	71.0	79.1
R29	83.4	61.8	83.4
R30	77.1	70.0	77.9
R31	77.7	73.3	79.0

Table 18.6 Continued

R32	82.8	59.0	82.8
R33	72.1	69.2	73.9
R34	66.6	69.9	71.6
R35 Ground 4th Storey Top Storey	 46.9 67.8 67.8	 67.9 74.2 75.0	 67.9 75.1 75.8
R36	65.1	66.5	68.9
R37	65.0	68.5	70.1
R38	59.1	68.9	69.3
R39	68.1	74.6	75.5
R40	62.6	68.3	69.3
R41	70.1	71.1	73.6
R42	70.7	69.2	73.0
R43	73.1	70.5	75.0

NOTES:

1. Based on 2011 morning peak hour traffic flows on TLT & YLA (N) and major existing roads.
2. Shows facade noise level at top storey of existing buildings (except Receiver R35, which shows facade noise at three levels).
3. Assumes the following characteristics of traffic on existing roads:
   - 80% heavy vehicles,
   - 70 kph base speed,
   - impervious macadam paving.

   Assumes the following characteristics of traffic on TLT & YLA (N):
   - 80% heavy vehicles,
   - 100 kph (base speed) on TLT & YLA (N) and 85 kph (base speed) on slip roads,
   - porous friction course surfacing,
   - 0.8 m crash barrier along roadsides.

At several representative NSR locations, the contribution from traffic on existing roads exceeds that from traffic on the TLT & YLA (N) and its slip roads. Previous baseline noise surveys conducted for the Route 3 TLT & YLA Section EIA confirmed that peak-hour noise from traffic on existing roadways such as Kam Tin Road is very high. It is apparent that TLT & YLA (N) and its connections have the potential to significantly degrade the existing noise environment in the Study Area. The need for effective mitigation is anticipated.

18.3.4 Impact Assessment with Mitigation

Receivers

Many of the potential receivers will have to be removed as they are within the TLT & YLA (N) works corridor. Also as a means of determining the most appropriate mitigation type (i.e. pathway or at receiver) a further field survey of the receivers has been undertaken. This has confirmed that many of the potential receivers are non noise sensitive such as agricultural buildings.

Many of the buildings/receivers appear temporary in nature, are of wooden and corrugated metal sheet construction, have developed in an ad-hoc manner, have restricted access and therefore could not be investigated further and may well not have planning approval. They are typically 1-2 storeys high and are a mixture of residential and commercial/industrial premises. At least half of the NSRs in the area through which the alignment passes, particularly in Tung Shing Lei and Ko Po San Tsuen, are temporary structures of uncertain planning status.

Mitigation

Various mitigation options have been investigated and considered in order to recommend feasible, practical and cost effective measures. Stringent, and extremely costly mitigation measures such as full or partial road enclosures are considered generally inappropriate given the nature of the housing stock in the area. In addition, the alignment constitutes a long length of road over which visually intrusive mitigation measures would have a high visual impact.
As facade noise levels exceed HKPSG and ExCo criteria at the worst affected facades near the roadway, the use of noise barriers has been considered.

An assessment based on provision of noise barriers has been performed to give some indication of the effectiveness of this form of mitigation. The effects of 1, 2, 3, and 4m barriers at the edge of the hard shoulder are shown in the following Table 18.7, and free-field noise contours for these barrier heights are provided in Figures 18.5 to 18.8. Noise contours are also shown for the various barrier heights modelled at 20mPD, these are shown in Figures 18.9 to 18.12.

TABLE 18.7 MITIGATED TRAFFIC NOISE PREDICTIONS

Receiver Identification	Predicted L_{10} Facade Noise Level dB(A)		
	Kam Tin/Castle Peak Road	TLT & YLA (N) and Slip Roads with barrier (1/2/3/4 m)	Total Noise Level with barrier (1/2/3/4 m)
R1	75.4	70.3/69.8/69.5/69.0	76.8/76.7/76.6/76.5
R2	74.8	69.5/69.1/68.8/68.2	75.9/75.8/75.8/75.7
R3	70.0	65.8/63.9/62.4/61.1	71.4/71.0/70.7/70.5
R4	76.5	63.8/61.7/59.9/58.4	76.7/76.6/76.6/76.6
R5	59.3	68.2/66.9/66.2/65.1	68.7/68.4/67.0/66.1
R6	74.1	72.5/71.0/68.1/66.3	76.4/75.8/75.0/74.7
R7	73.0	67.6/65.3/63.5/61.9	74.1/73.7/73.5/73.3
R8	63.8	68.6/67.3/66.3/65.4	69.8/68.9/68.2/67.6
R9	69.1	70.7/68.1/66.1/65.4	73.0/71.6/70.7/70.2
R10	69.9	69.5/66.8/64.7/63.0	72.7/71.5/70.9/70.5
R11	68.9	67.1/64.6/62.6/61.1	71.1/70.2/69.7/69.4

Table 18.7 Continued

R12	61.8	69.8/67.7/66.2/65.1	70.4/68.6/67.3/66.3
R13	65.6	67.8/66.8/66.0/65.2	69.8/69.3/68.8/68.2
R14	74.4	68.8/66.8/65.2/64.4	75.7/75.3/75.1/75.0
R15	82.3	67.1/66.3/65.4/64.7	82.4/82.4/82.4/82.4
R16	67.3	67.1/66.1/65.2/64.6	70.2/69.8/69.4/69.2
R17	64.9	69.7/68.9/68.0/66.9	70.9/70.2/69.5/68.8
R18	70.5	72.2/72.2/72.2/72.2	74.4/74.4/74.4/74.4
R20	84.0	72.3/71.0/70.1/69.6	84.3/84.2/84.2/84.2
R21	70.8	67.1/67.4/67.4/67.3	72.3/72.4/72.4/72.4
R22	70.5	67.8/67.7/67.7/67.7	72.4/72.3/72.3/72.3
R23	73.3	67.5/66.0/64.9/64.2	74.3/74.0/73.9/73.8
R24	75.6	69.1/67.6/66.7/66.2	76.5/76.2/76.1/76.1
R25	77.7	68.4/66.5/65.2/64.3	78.2/78.0/77.9/77.9
R26	69.7	64.4/63.7/63.3/63.1	70.8/70.7/70.6/70.6
R27	69.0	67.5/65.3/63.7/62.2	71.6/70.8/70.4/70.1
R28	78.4	70.7/69.3/68.4/67.8	79.1/78.9/78.8/78.8
R29	83.4	61.3/60.0/58.9/58.0	83.4/83.4/83.4/83.4
R30	77.1	69.8/69.1/68.6/68.2	77.9/77.8/77.8/77.7
R31	77.7	72.7/70.5/68.9/67.5	78.9/78.5/78.1/78.0
R32	82.8	58.9/57.5/56.7/56.2	82.8/82.8/82.8/82.8
R33	72.1	69.0/68.3/68.0/67.8	74.7/74.5/74.4/74.4
R34	66.6	69.6/68.7/68.0/67.3	71.3/70.7/70.2/69.7
R35 Ground 4th Fl. Top Fl.	 46.9 67.8 67.8	 67.3/65.4/63.9/62.9 73.3/70.1/68.5/67.2 74.9/74.2/72.1/69.3	 67.3/65.5/64.0/63.0 74.4/72.1/71.1/70.5 75.7/75.1/73.4/71.6
R36	65.1	66.3/65.0/64.0/63.1	68.8/68.0/67.4/67.0
R37	65.0	67.7/66.2/65.0/64.0	69.6/68.7/68.0/67.5
R38	59.1	68.6/67.7/67.1/66.7	69.1/68.2/67.6/67.2
R39	68.1	74.4/73.3/72.7/72.4	75.3/74.4/74.0/73.7
R40	62.6	67.8/65.7/64.5/63.7	68.9/67.4/66.5/66.1
R41	70.1	70.6/68.6/66.9/65.5	73.4/72.4/71.7/71.2
R42	70.7	68.6/66.1/64.5/63.2	72.7/71.9/71.5/71.2
R43	73.1	69.9/67.6/66.2/65.1	74.8/74.2/73.9/73.7

NOTES: 1. Based on 2011 morning peak hour traffic flows on TLT & YLA (N) and major existing roads.

2. Shows facade noise level at top storey of existing buildings (except Receiver R35, which shows facade noise at three levels).
3. Assumes the following characteristics of traffic on existing roads:
   - 80% heavy vehicles,
   - 70 kph base speed,
   - impervious macadam paving.

   Assumes the following characteristics of traffic on TLT & YLA (N):
   - 80% heavy vehicles,
   - 100 kph (base speed) on TLT & YLA (N) and 85 kph (base speed) on slip roads,
   - porous friction course surfacing,
   - barriers along roadsides as indicated.

At most locations it has been demonstrated that pathway mitigation to acceptable levels by means of barriers is feasible.

For receivers not adequately protected alternative mitigation measures have been considered. Where numbers of permanent receivers are small it may be acceptable and more cost effective to provide mitigation at the receivers. The indirect mitigation will depend on the severity of the impact; it may be in the form of simple glazed windows with silenced ventilation fans or perhaps double glazing and air conditioning. The HKPSG suggests suitable window types for noise insulation for when the estimated noise level from road traffic will exceed the relevant standard by the following values (dB(A)).

WINDOW TYPES

I - openable well-gasketted window, 6mm pane (< 10 dB(A))

II - openable double-glazed window in well gasketted separate frames with a configuration of 6mm:150mm:6mm (exterior glaze: air-gap:interior glaze) (10-15 dB(A))

III - openable double-glazed window, in well gasketted separate frames with a configuration of 100mm:150mm:6mm (exterior glaze:air-gap:interior glaze) (> 15 dB(A))

Given the nature of the receivers and the lack of future development plans it may be appropriate in some cases to consider removal/reprovisioning of these buildings or provision of 2-3m high barriers (such as in the form of solid fencing) near the receivers rather than provide double/sealed glazing and air conditioning or substantial and extensive roadside barriers. It should be noted that noise mitigation measures should be considered for all 'permanent' BOO approved structures. Other temporary light weight building structures might require individual assessment as simple window type insulation may not be sufficient to provide a tolerable internal noise level.

18.3.5 Discussion

This preliminary design stage noise impact assessment is intended to identify areas where excessive traffic noise levels are likely to occur, and to indicate the effectiveness of mitigation that is likely to be required. For this purpose, representative NSRs have been selected, and unmitigated and mitigated noise levels at their most exposed facades have been calculated. The results for these receivers have been extrapolated to other NSRs in the vicinity subject to similar exposure, to obtain an indication of the future noise environment after operation of Route 3. Table 18.8 summarizes the results shown in Tables 18.6 and 18.7. The recommended barrier configuration given in Table 18.8 is discussed in Section 18.3.7.

Along some stretches of the alignment, the need for mitigation to protect a limited number of receivers is anticipated. Due to the small number of receivers in question, mitigation at the receiver (in the form of indirect technical remedies such as good quality glazing and air conditioning) would normally be most cost-effective. The HKPSG includes temporary housing as potential NSRs, and these were therefore included in the group of representative NSRs. However, the temporary construction of many of these NSRs is likely to preclude the ability to mitigate at receiver. A concern therefore exists as to whether insulation at the receiver is appropriate and it is considered that a policy concerning provision of mitigation to protect temporary NSRs must be formulated before the extent and costs of noise mitigation can be accurately determined.

It is understood that many households share a single residence or building and therefore the number of households is much greater than the number of buildings involved.

For the recommended mitigation measures the estimated number of households meeting the ExCo criteria is estimated to be about 300 which corresponds to about 1200 people. This is a significant number and is viewed with concern.

The number of households/people could be reduced by applying even more stringent mitigation measures (such as higher barriers) and also by further refinement of the proposed mitigation measures when essential information is available.

It is considered that given the information available at this stage the appropriate balance has been achieved between the possible mitigation alternatives, although there is significant scope for further assessment and improvement during the detailed design. It should be stressed however that as findings of any EIA have to be specified and technically incorporated into the detail design the timing of the EIA is critical and should be carried out as early as practicable.

In view of the need for a detailed inventory of permanent and temporary NSRs in the Study Area immediately prior to the start of Route 3 construction, it is recommended that a further noise impact assessment be performed at the detailed design stage to reconfirm the extent of necessary noise mitigation measures.

TABLE 18.8 EFFECTS OF MITIGATED AND UNMITIGATED TLT & YLA (N) NOISE

Receivers	Approximate Number of Exposed Units[1]			
	Households[2]		Population[2]	
Units assessed using representative NSRs	1500	100%	5190	100%
Units exposed to facade noise level over 70 dB(A) L_{10} (peak hour) from *existing roads*	380	25%	1350	25%
Units requiring compensation according to ExCo criteria with *mitigated TLT & YLA and unmitigated existing roads*, using:				
0.8m barriers (in all locations)	1149	76.6%	3976	76.6%
1 m barriers (")	1119	74.6%	3856	74.3%
2 m barriers (")	438	29.2%	1635	31.5%
3 m barriers (")	294	19.6%	1126	21.7%
4 m barriers (")	270	18.0%	1038	20.0%
Units requiring compensation according to ExCo criteria with *mitigated TLT & YLA and unmitigated existing roads*, using the recommended barrier configuration (Figure 18.13)	315	21%	1194	23%

NOTES: [1] Based on approximate evaluation using representative NSRs, shown in Figures 18.7 a-g and listed above in Tables 18.5 and 18.6, to represent household groups. An attempt has been made to include temporary housing, which contributes significantly to the uncertainty of numbers in this evaluation.

[2] Population estimates based on 1991 population census. Village Cluster Groups considered in the evaluation include: 525/01-07, 526/04-06, 521/02-09, 13 and 524/30. Percentages indicate proportion of affected units with reference to total units considered in this survey.

18.3.6 Recommendations for Mitigation

The appropriate configuration of mitigation measures (barrier heights/receiver mitigation etc.) depends on many factors including the nature and planning/legal status of the potential receivers.

Based on the above assessment and a consideration of the ExCo criteria, mitigation measures are recommended. A comparison of noise levels according to criteria is presented in Appendix A18.2.

The route alignment has been divided into four sections (A-D) for the purpose of describing recommended mitigation measures. These are shown in Figure 18.13 which includes a scale and the measures are outlined below.

Section A (1200m of 2m high barrier)

A 2m high barrier approximately 600m long on both the north and south side of the highway as shown in Figure 18.13. This alone is not sufficient to achieve criteria for the Pok Oi Hospital. However, the noise levels are already currently above criteria and it is hence considered most appropriate to apply receiver mitigation at the hospital from the 2nd storey upwards. It is understood that this 8 storey hospital has central air conditioning for the first storey and the operating theatre only.

Section B

No noise barrier is proposed for this section of road. The nature of the existing buildings suggests that mitigation at the receivers (possibly in the form of a solid wall/fence although this can be problematic and would require further investigation) is appropriate and more cost effective than other alternatives.

Section C (2,350m of 4m high barrier)

A 4m high barrier as shown in Figure 18.13. This involves approximately 350m on the south side of link road F, 800m on the western side and 400m on the eastern side of the mainline moving north from the boundary between Section C and D. Further mitigation will also be required at a limited number of receivers in areas close to the alignment.

Section D (1400m of 4m high barrier)

A 4m high barrier as shown in Figure 18.13. This involves 450m on the eastern side and 550m on the western side of the mainline working south from the boundary between Section C and D. In addition 400m on the eastern side of link road I.

18.4 CONCLUSION

During the construction phase, exceedance of desirable noise levels are expected. Appropriate mitigation measures and a monitoring programme are proposed to minimise such exceedances.

During the operation phase, traffic noise levels are expected to be high and above 70dB(A) (HKPSG maxima) at several locations. Owing to the high existing noise levels in the area, assessment against the ExCo criteria is considered more appropriate to apply. However, much of the exceedance is attributable to traffic on existing roads such as Castle Peak Road and Kam Tin Road. It is also significant that there is a high percentage of heavy vehicles predicted for the TLT & YLA traffic. These figures were based on the best available information and their confirmation during detailed design is considered essential.

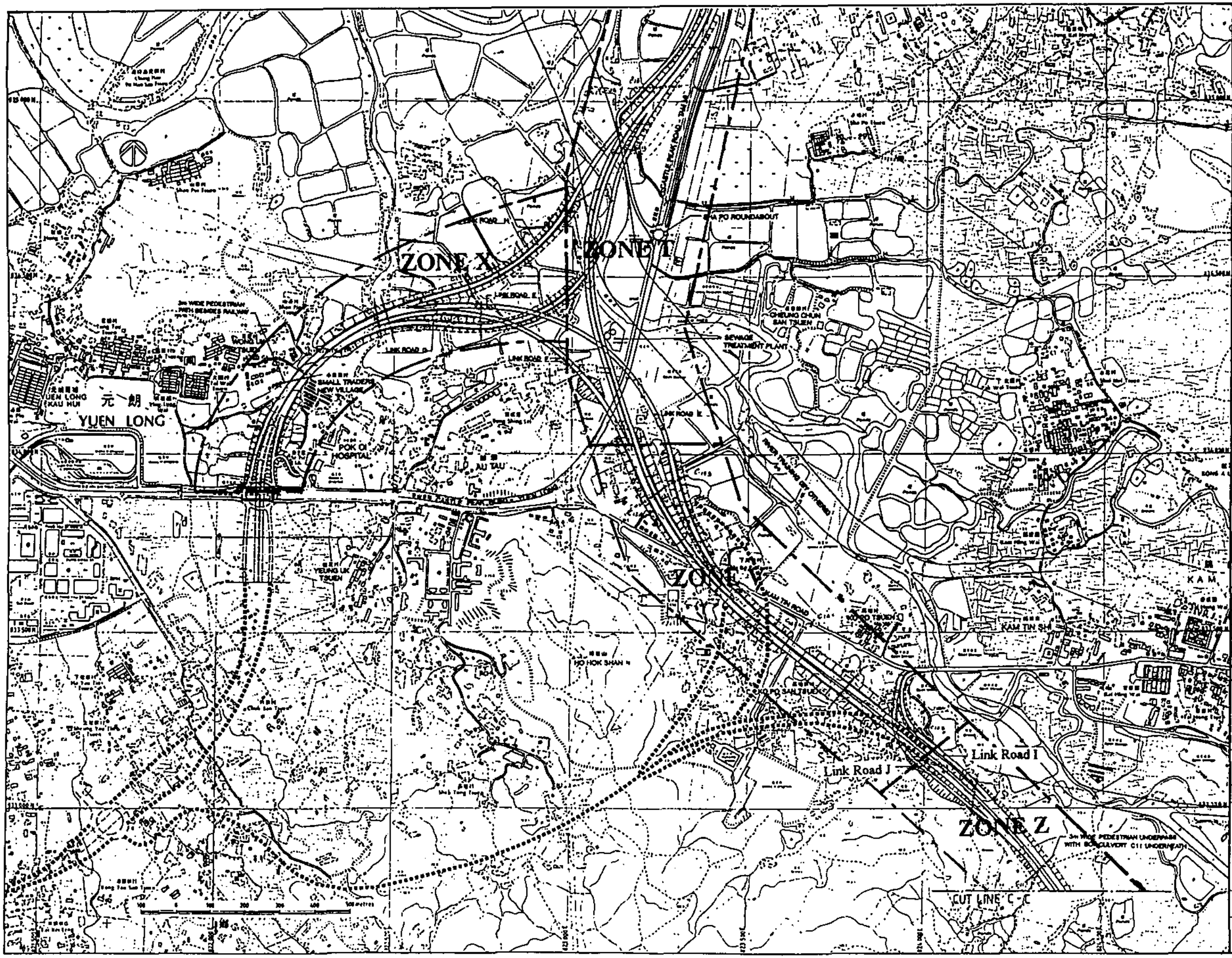
As a means of gauging the likely appropriate level of mitigation required the effectiveness of roadside barriers on the TLT & YLA (N) and its connecting roads has been examined. Barriers are found to be adequate for blocking TLT & YLA (N) traffic noise for many receivers, since the roadway is generally slightly elevated and most receivers are only 1- to 2-storey dwellings on low-lying ground. However, noise levels will still be high, due to traffic on existing roads, at some receivers.

Using the ExCo criteria for compensation as a guide and taking into account the nature of the potential receivers, recommendations for mitigation in the form of road side barriers have been made to reduce the numbers of households/residents exposed to significant noise increases.

In some sections of the TLT & YLA (N) the numbers of sensitive receivers potentially affected are such that mitigation at the receiver is the most appropriate approach. However much of the development within the area is low grade structures and could be considered inappropriate for installation of receiver mitigation and depending on the status of the building they could be removed or reprovisioned.

As there is no known significant development planned along the route it is considered that the presence of the TLT & YLA (N) road should be taken as a constraint on future development.

It is strongly recommended that a further detailed noise assessment is carried out during the detailed design. While this will be based on this current assessment it would have the benefit of finalised design and construction information, approved traffic data projections and will need to confirm the number and status of the receivers.



HIGHWAYS DEPARTMENT

WESTERN HARBOUR LINK OFFICE

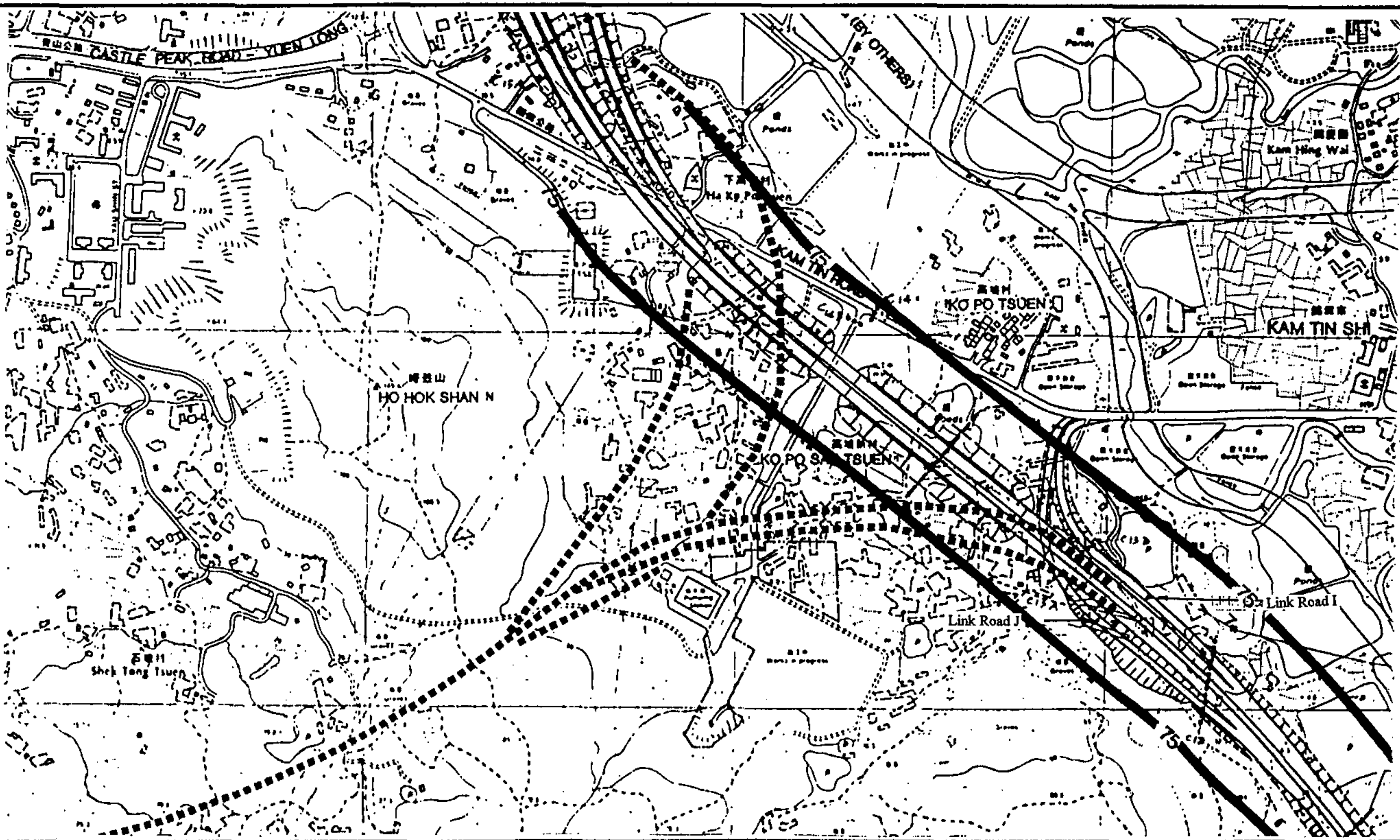
ROUTE 3 COUNTRY PARK SECTION
PRELIMINARY DESIGN STAGE 2

Figure 18.1

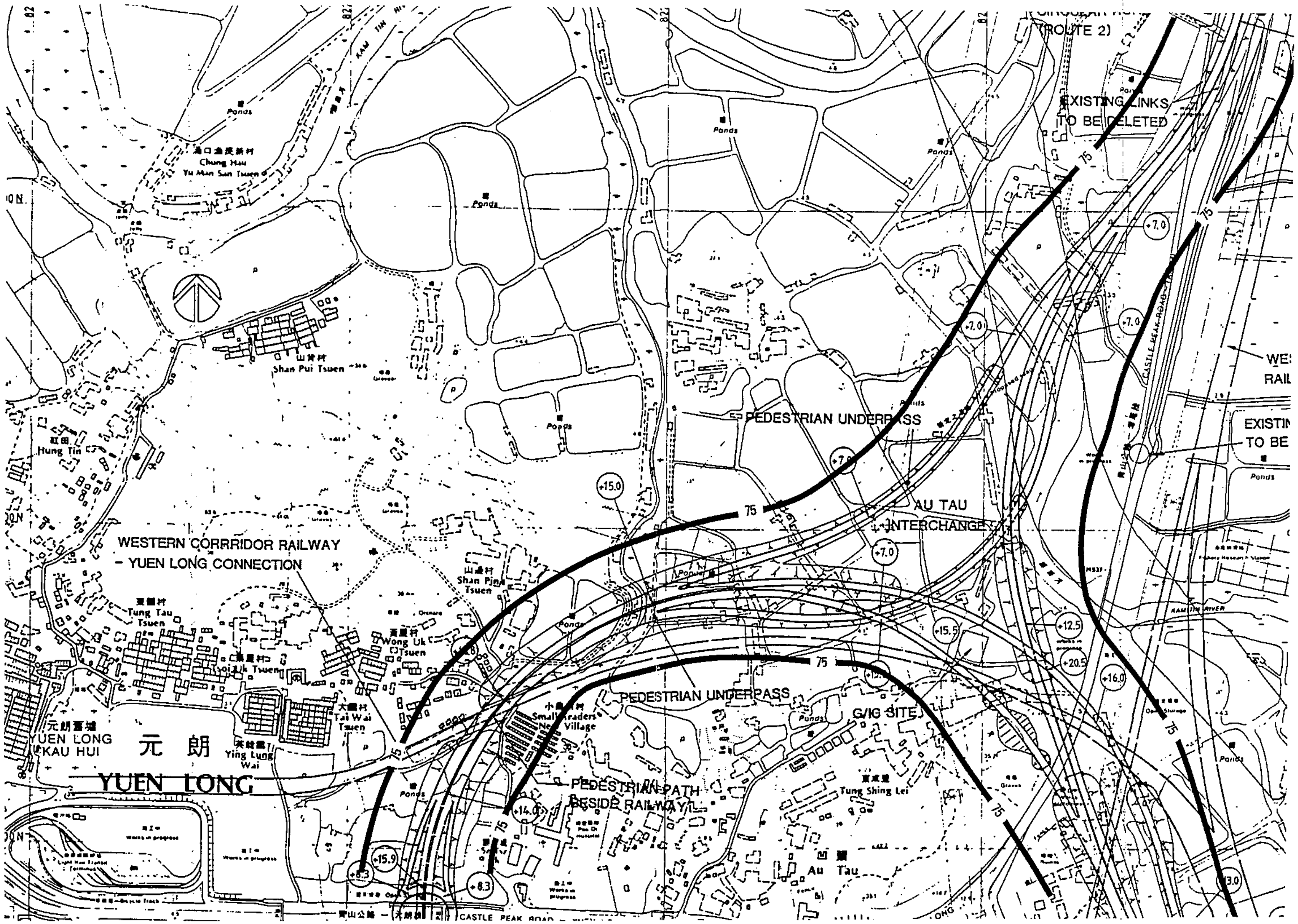
PLANT SCHEDULE
ZONES

92393/SK/258

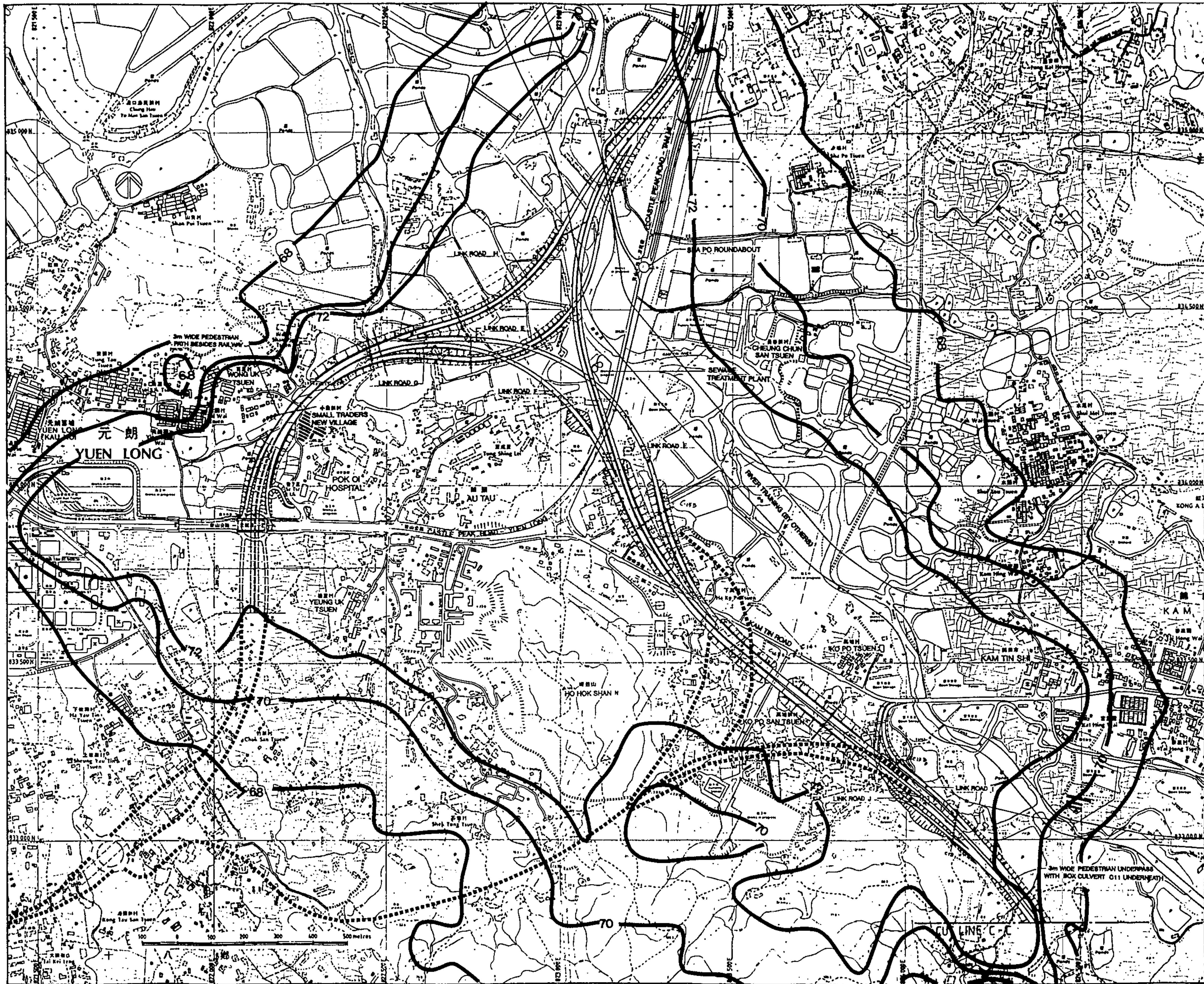
FREEMAN FOX MAUNSELL



FREEMAN FOX MAUNSELL	Drg. Title : Facade Noise Level of 75 dB(A) due to Construction Noise (Mitigated)	Job Title : ROUTE 3 : COUNTRY PARK SECTION EIA
		Scale : N.T.S. / Date Nov. 93 · Job No. 058 005 · Fig No. 18.2a



FREEMAN FOX MAUNSELL	Drg. Title : Facade Noise Level of 75 dB(A) due to Construction Noise (Mitigated)	Job Title : ROUTE 3 : COUNTRY PARK SECTION EIA
		Scale : N/A Date Nov. 93 | Job No. 058 000 | Fig No. 18.2b



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ROUTE 3 COUNTRY PARK SECTION AND TING KAU BRIDGE PRELIMINARY DESIGN STAGE 2

FIGURE 18.3

NOISE CONTOURS UNMITIGATED

1.2 mPD

Drg. No. 92393/SK/258

FREEMAN FOX MAUNSELL

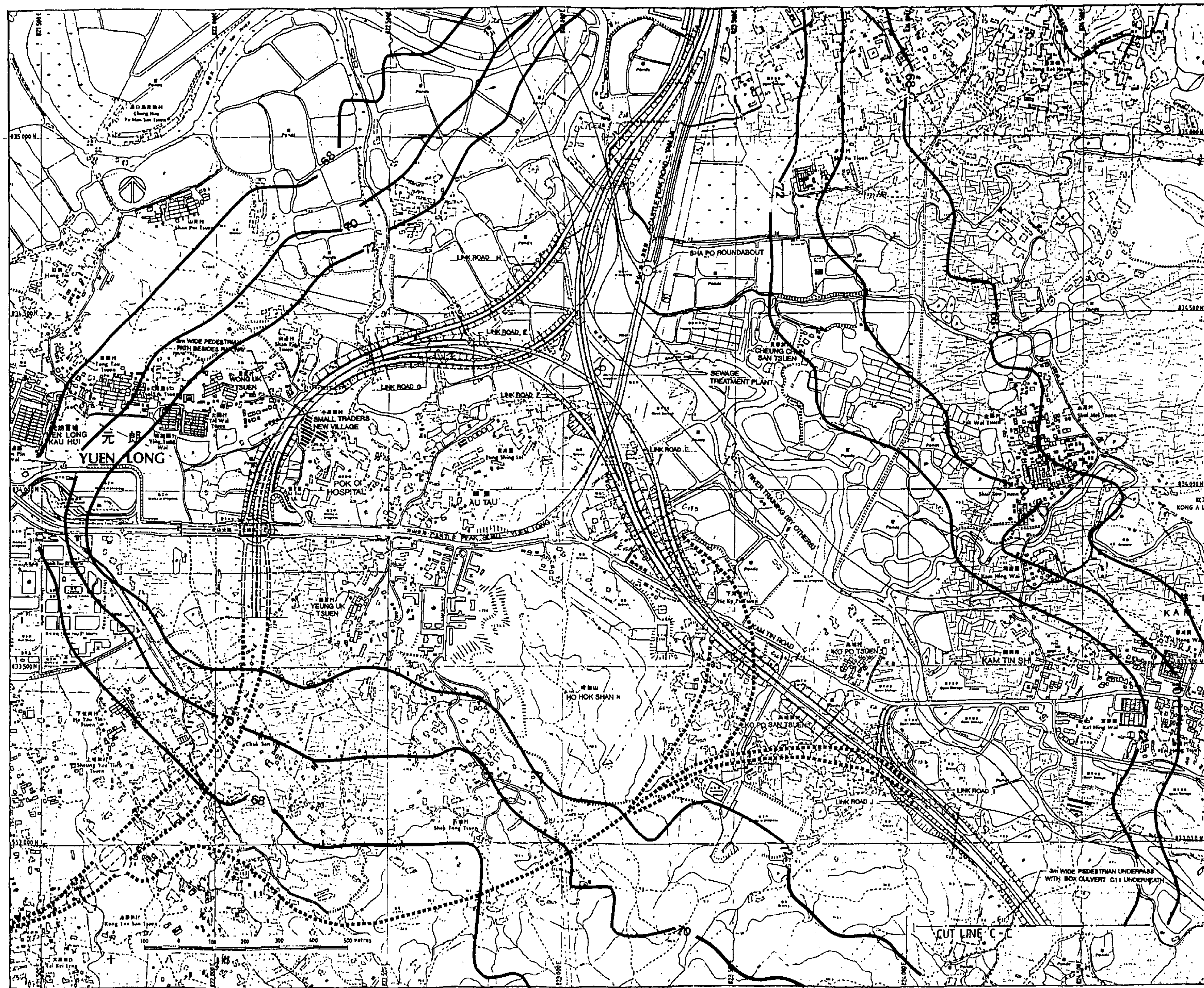

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FIGURE 18.4

NOISE CONTOURS UNMITIGATED

20 mPD

Drg. No. 92393/SK/258

FREEMAN FOX MAUNSELL

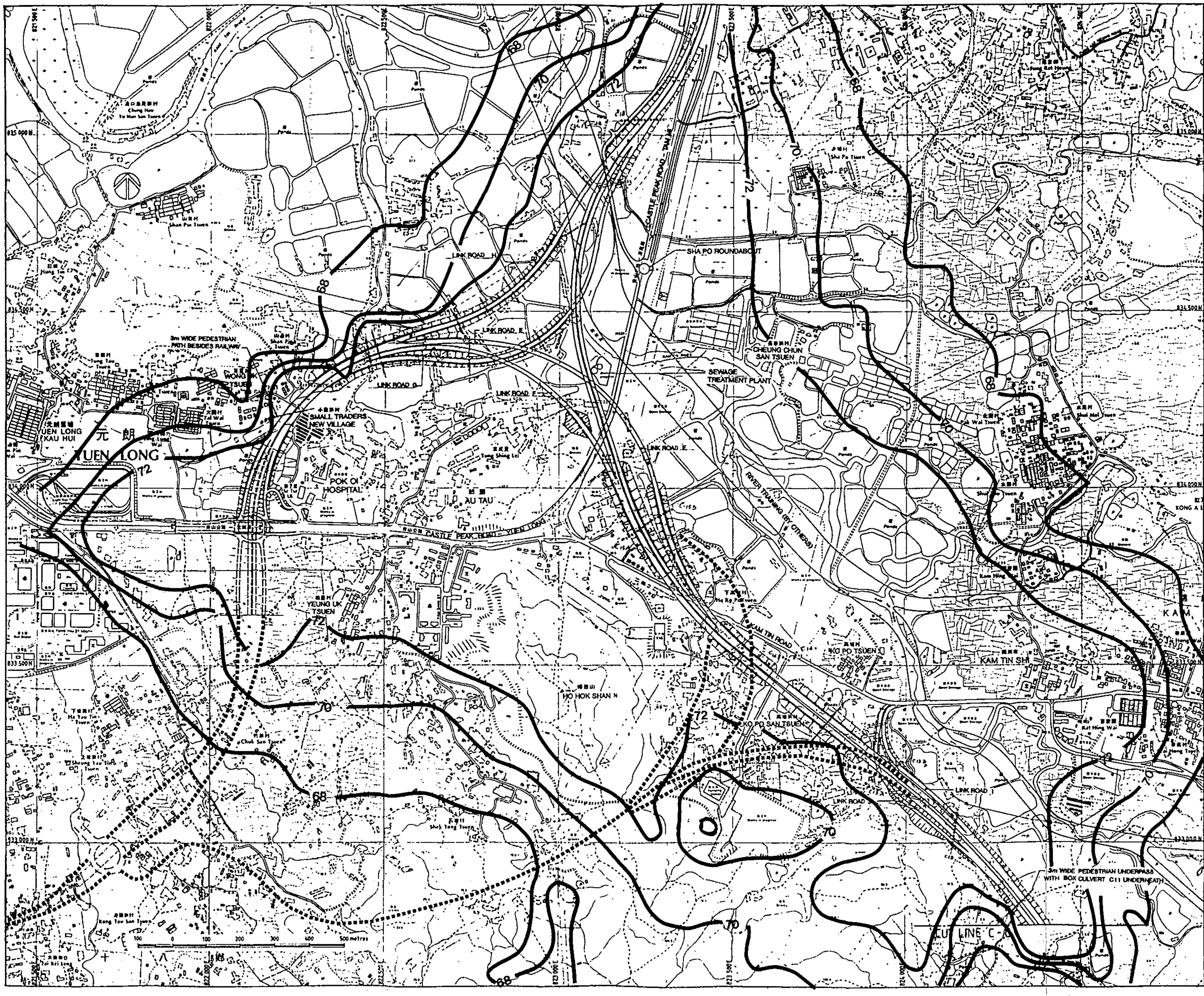

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FIGURE 18.5

NOISE CONTOURS WITH 1M BARRIER

1.2mPD

Drg No. 92393/SK/258

FREEMAN FOX MAUNSELL

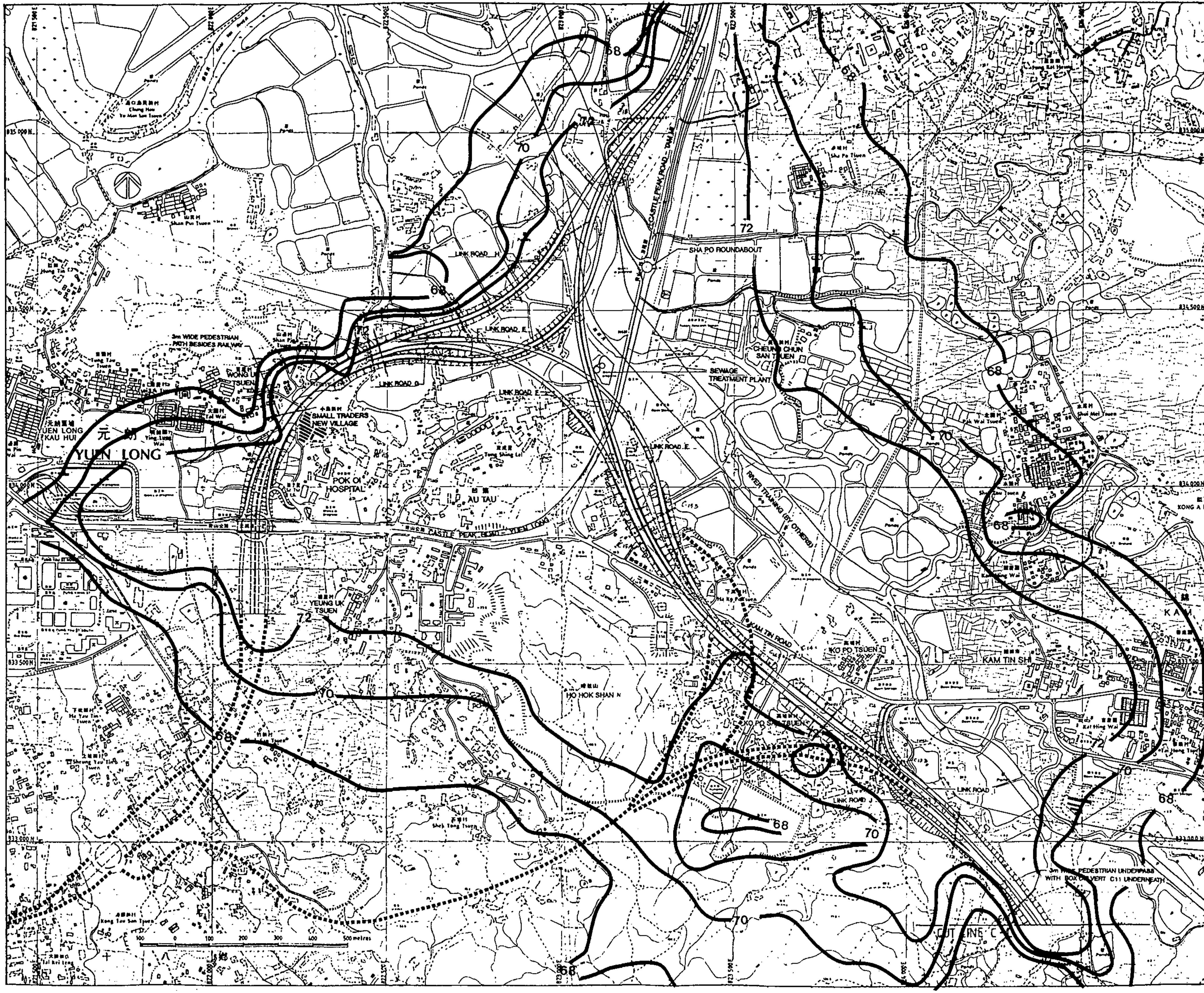

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FIGURE 18.6

NOISE CONTOURS WITH 2M BARRIER

1.2mPD

Drg. No. 92393/SK/258

FREEMAN FOX MAUNSELL

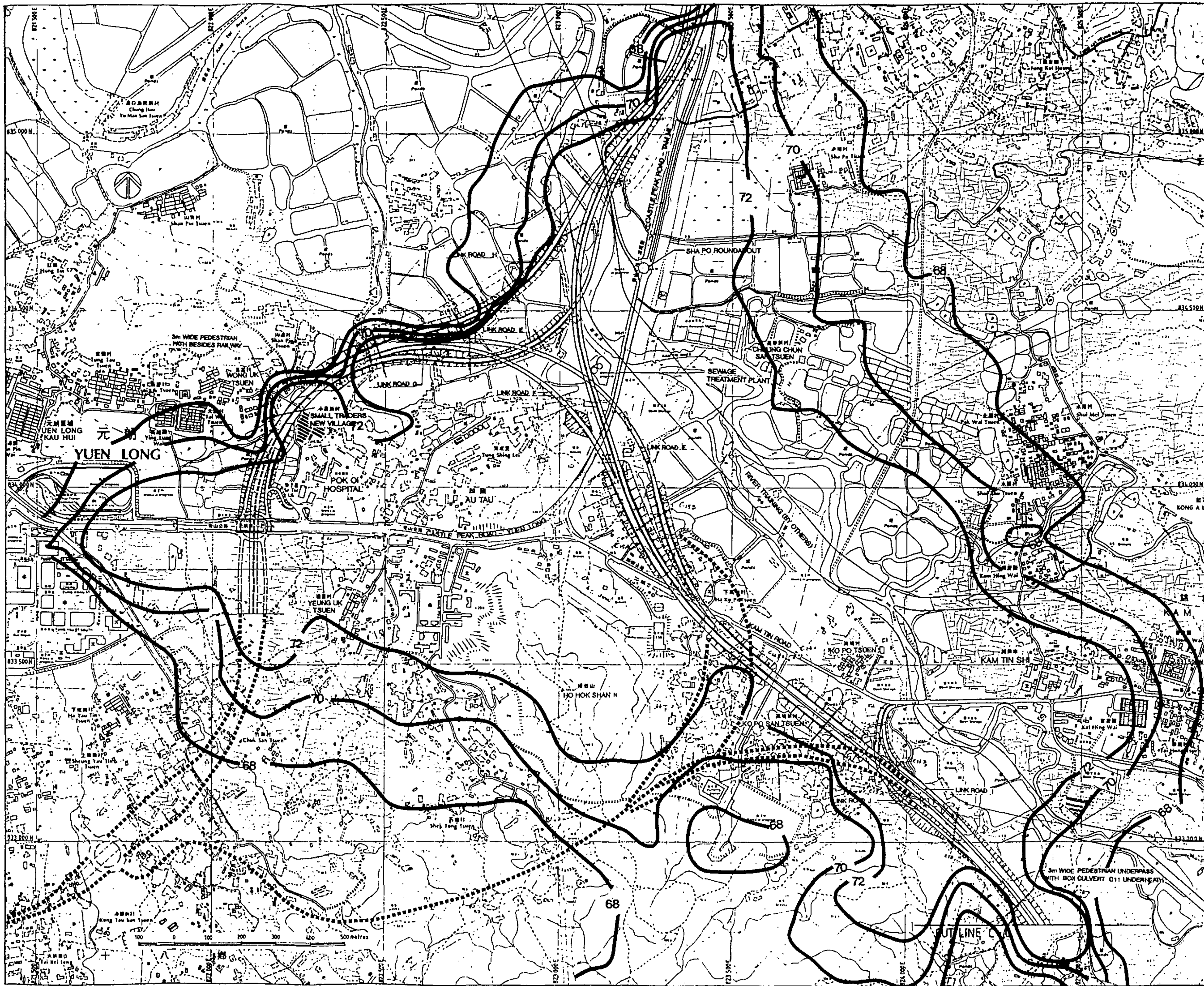

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FIGURE 18.7

NOISE CONTOURS WITH 3M BARRIER

1.2mPD

Drg. No. 92393/SK/258

FREEMAN FOX MAUNSELL

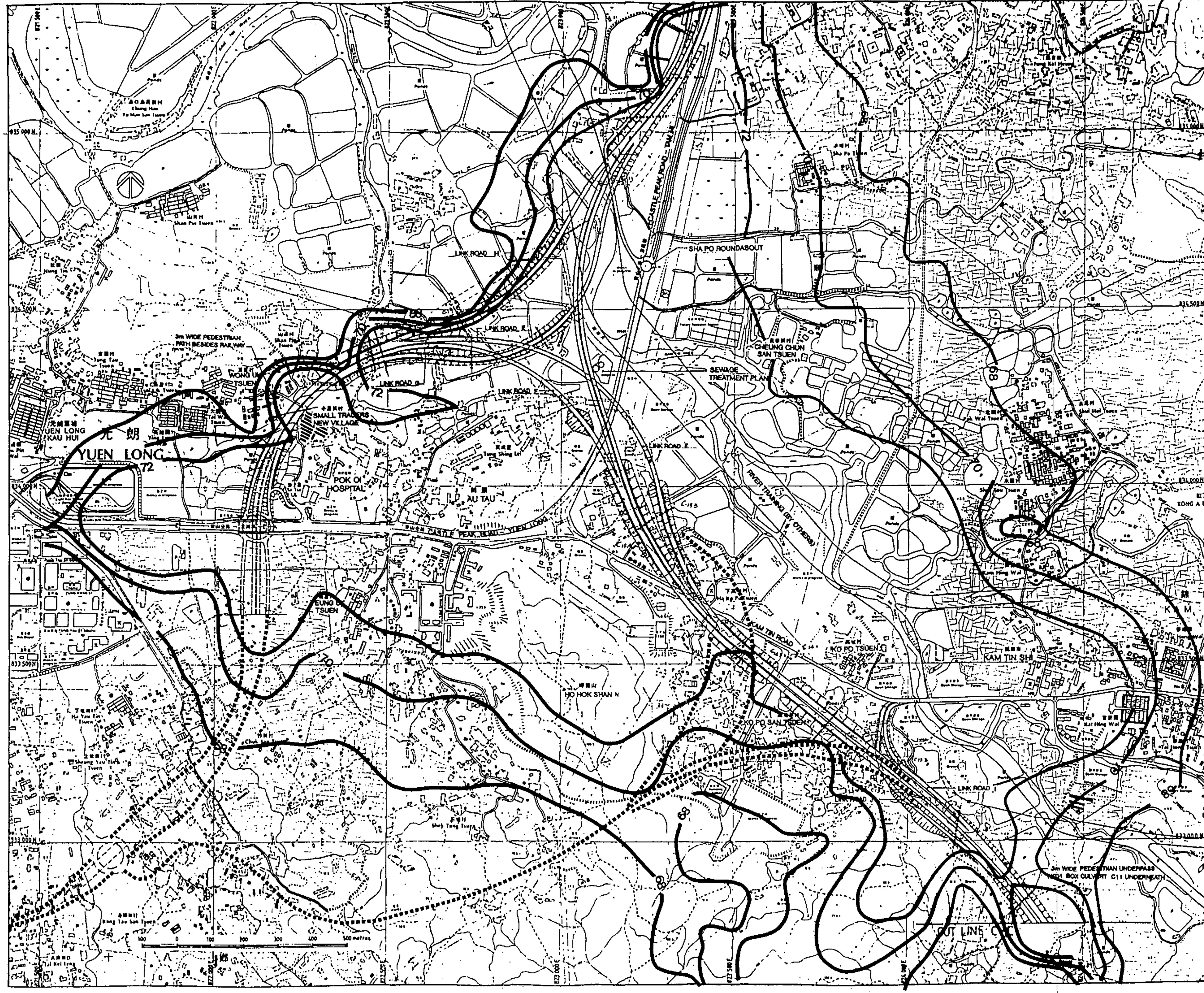

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FIGURE 18.8

NOISE CONTOURS WITH 4M BARRIER

1.2mPD

Drg. No. 92393/SK/258

FREEMAN FOX MAUNSELL

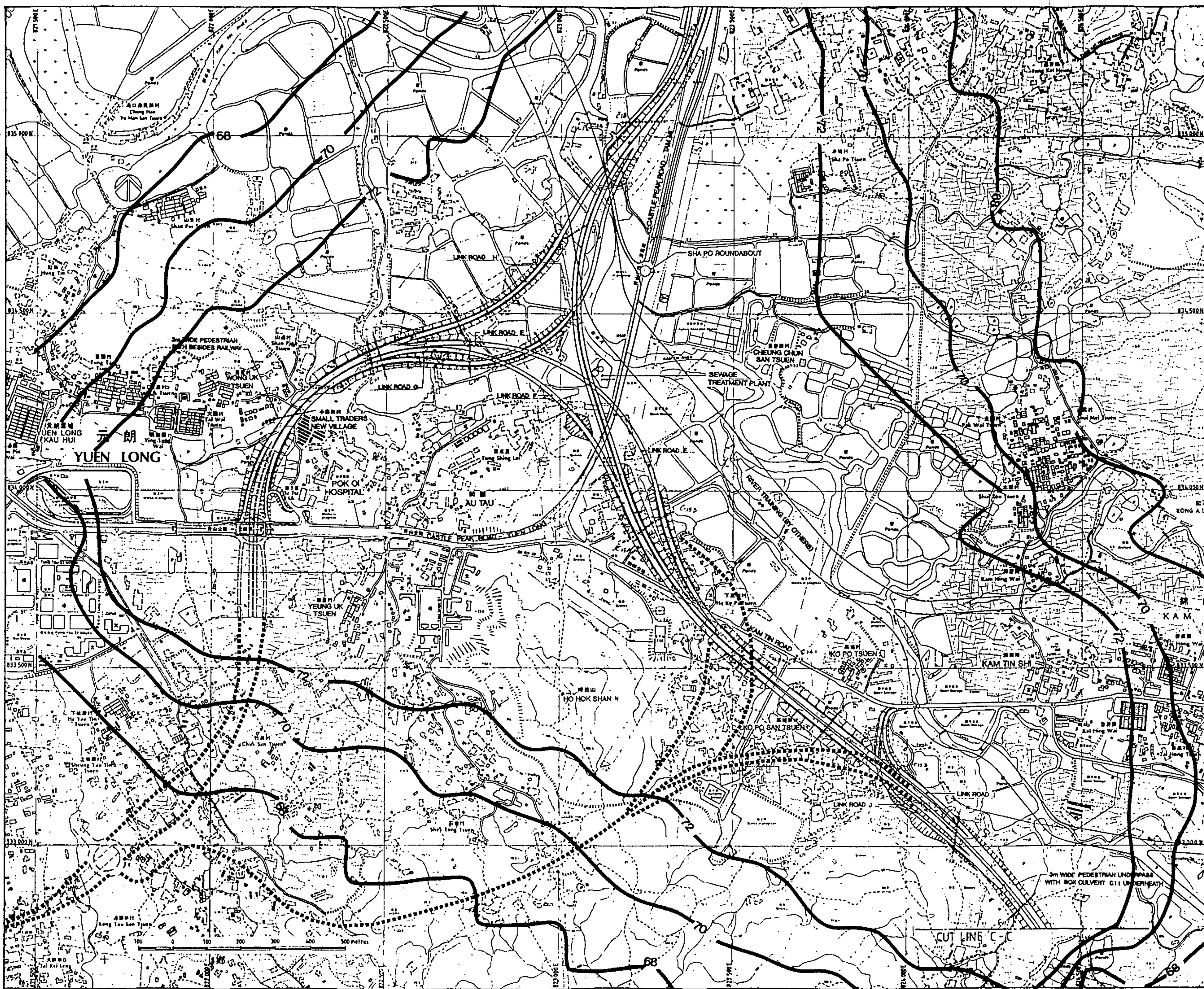

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FIGURE 18.9

NOISE CONTOURS WITH 1M BARRIER

20mPD

Drg. No. 92393 / SK / 258

FREEMAN FOX MAUNSELL

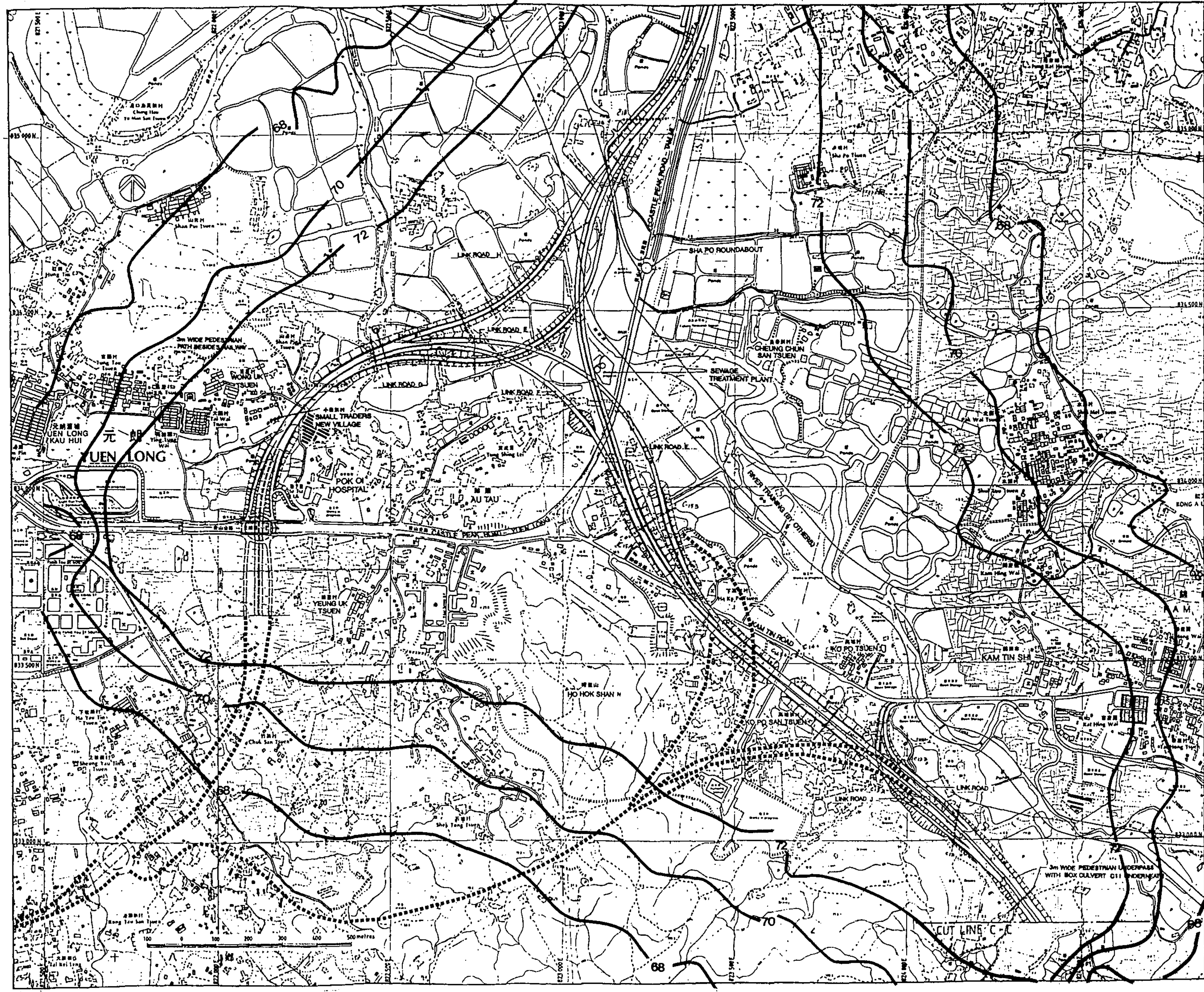

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FIGURE 18.10

NOISE CONTOURS WITH 2M BARRIER

20mPD

Drg. No. 92393/SK/258

FREEMAN FOX MAUNSELL

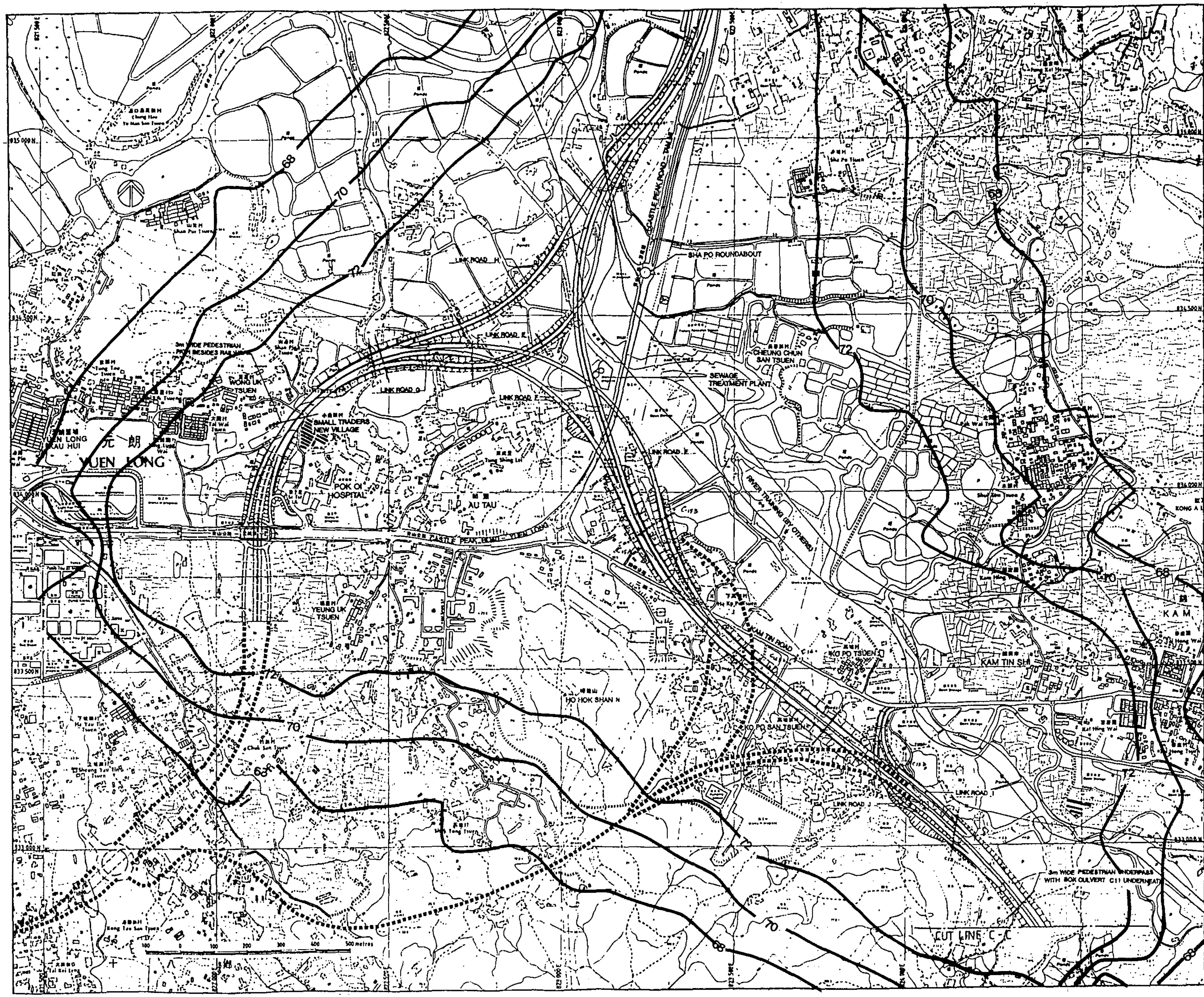

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FIGURE 18.11

NOISE CONTOURS WITH 3M BARRIER

20mPD

Drg. No. 92393/SK/258

FREEMAN FOX MAUNSELL

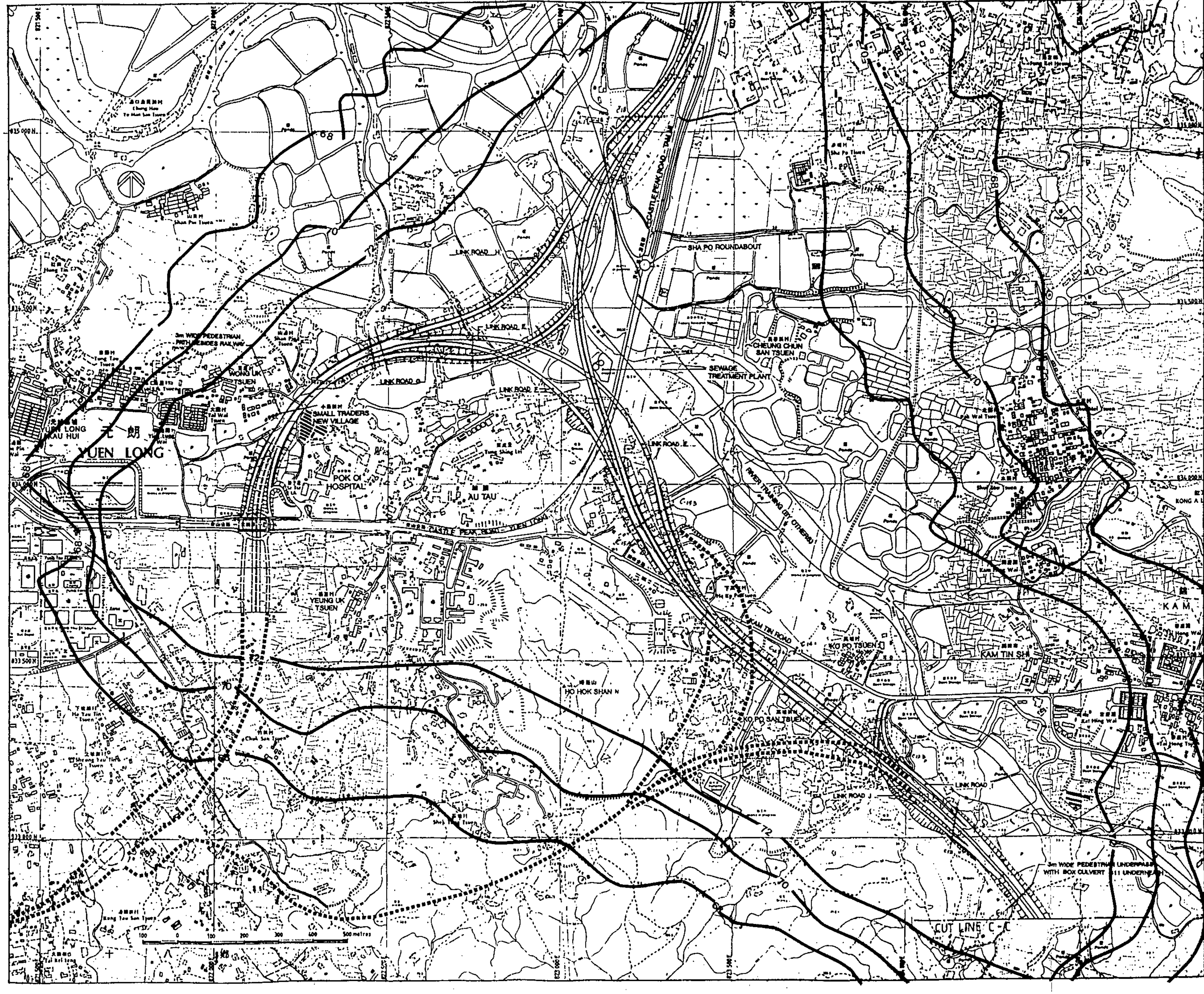

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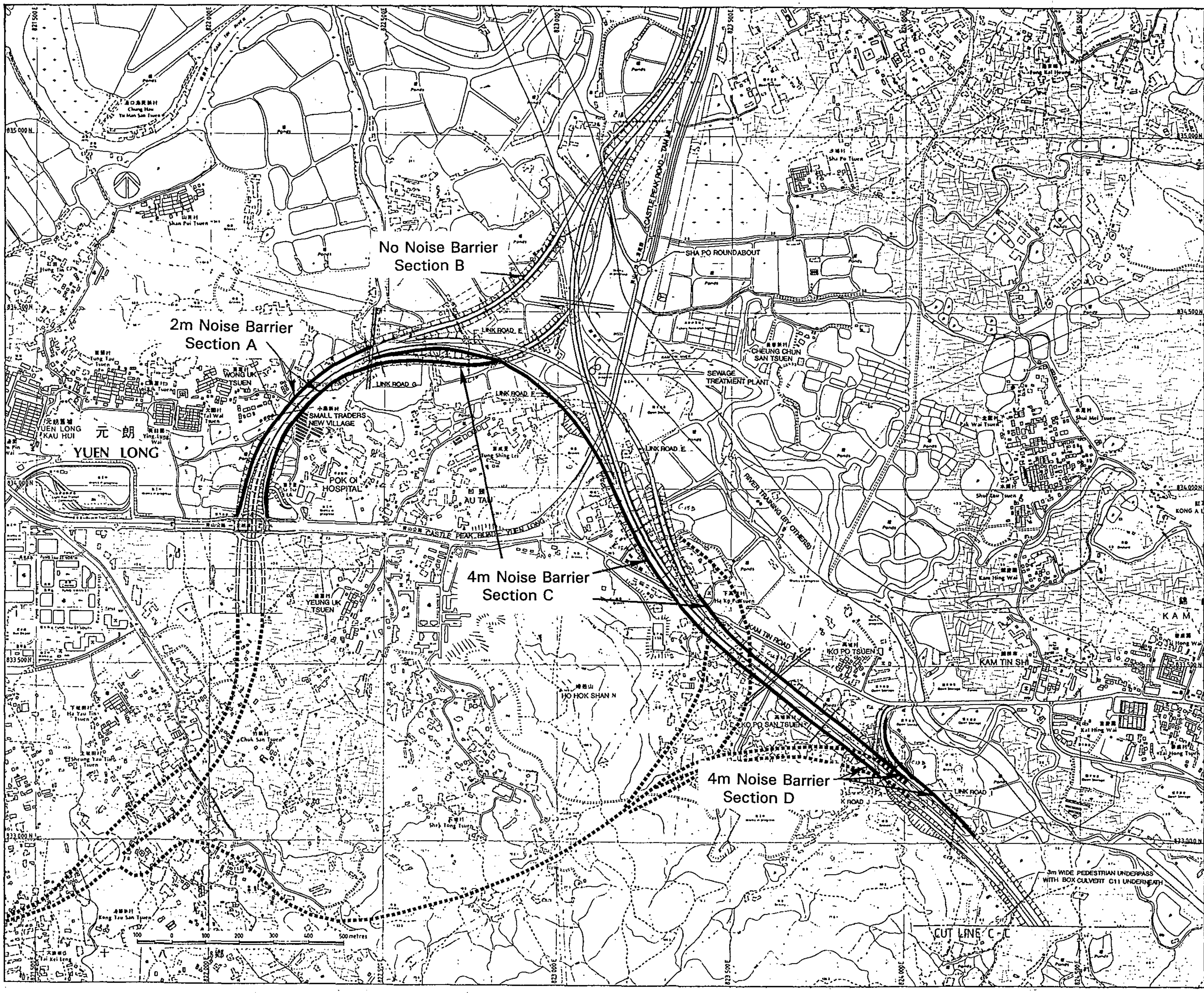
FIGURE 18.12

NOISE CONTOURS WITH 4M BARRIER

20mPD

Drg. No. 92393/SK/258

FREEMAN FOX MAUNSELL



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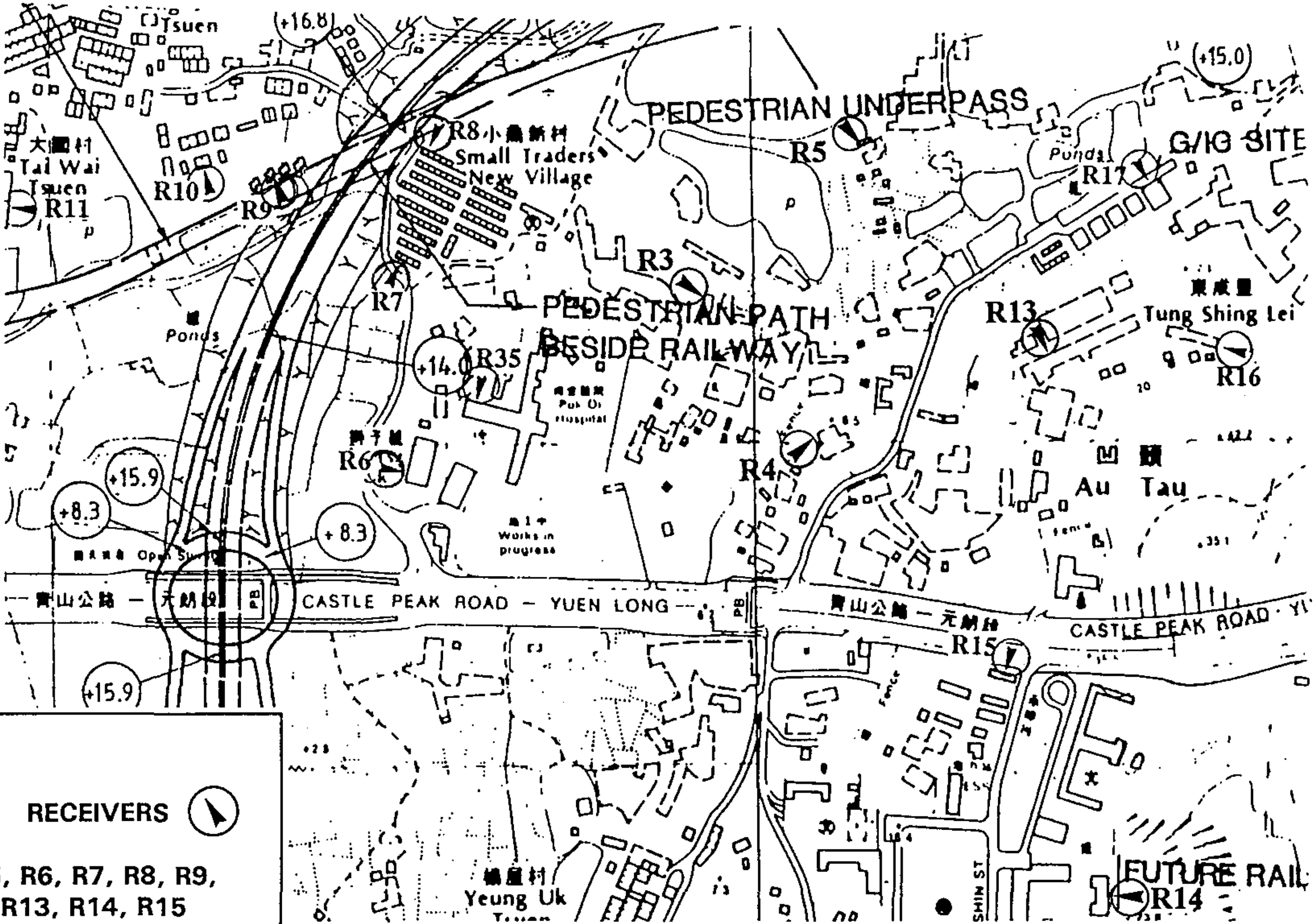
ROUTE 3 COUNTRY PARK SECTION
PRELIMINARY DESIGN STAGE 2

Figure 18.13

PROPOSED NOISE
MITIGATION MEASURES

Drg. No. 92393/SK/258

FREEMAN FOX MAUNSELL



KEY

SENSITIVE RECEIVERS

R3, R4, R5, R6, R7, R8, R9, R10, R11, R13, R14, R15 R16, R17, & R35

FREEMAN FOX MAUNSELL

Drg. Title : Selected Representative Sensitive Receivers

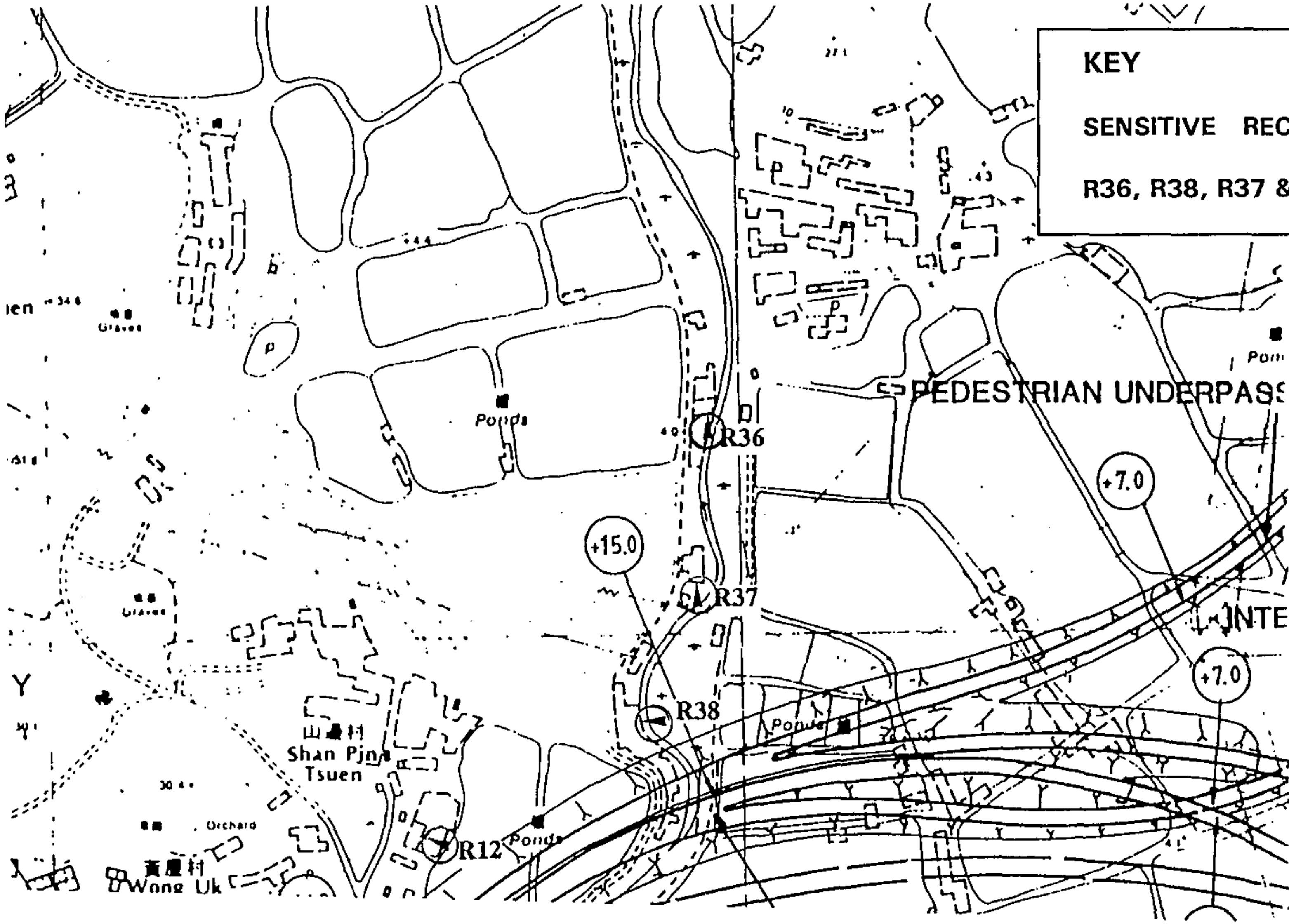
Job Title : **ROUTE 3 : COUNTRY PARK SECTION EIA**

Scale : N.T.S.

Date Sept. 93

Job No. 058 005

Fig No. **18.14a**

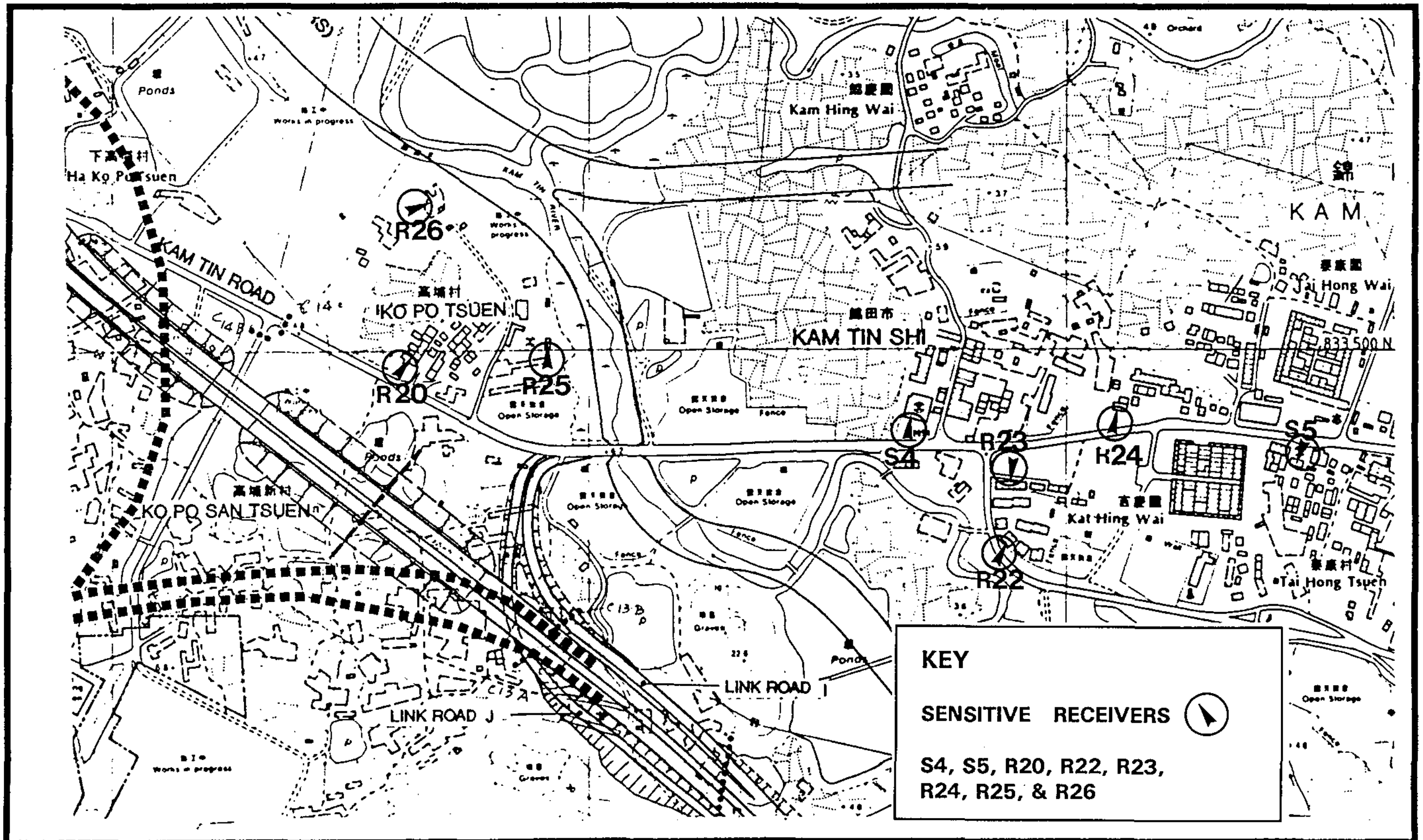


KEY

SENSITIVE RECEIVERS

R36, R38, R37 & R12

FREEMAN FOX MAUNSELL	Drg. Title : Selected Representative Sensitive Receivers	Job Title : ROUTE 3 : COUNTRY PARK SECTION EIA
		Scale : N.T.S. / Date Sept. 93 / Job No. 058 005 / Fig No. 18.14b

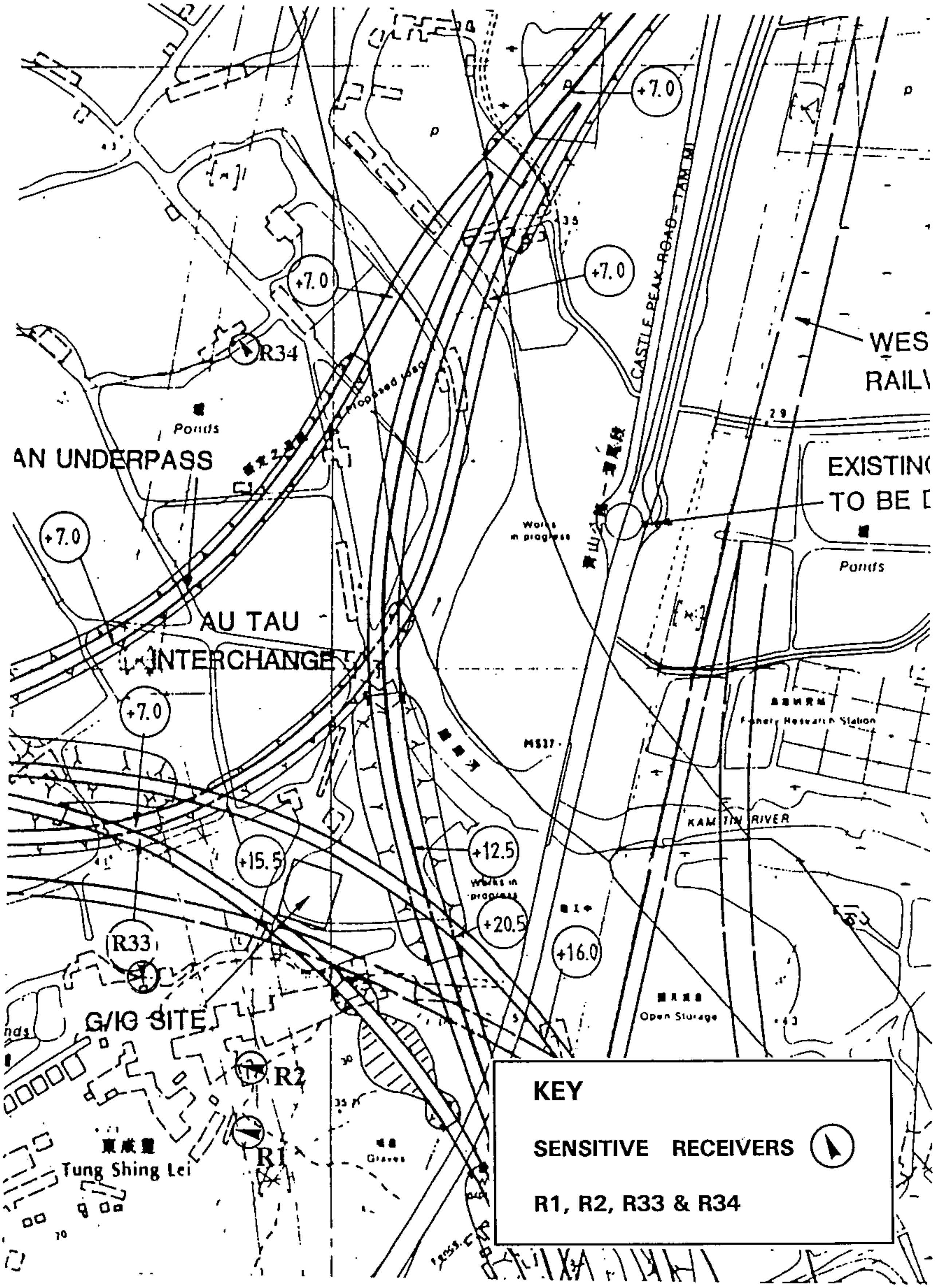


FREEMAN FOX MAUNSELL

Drg. Title : Selected Representative Sensitive Receivers

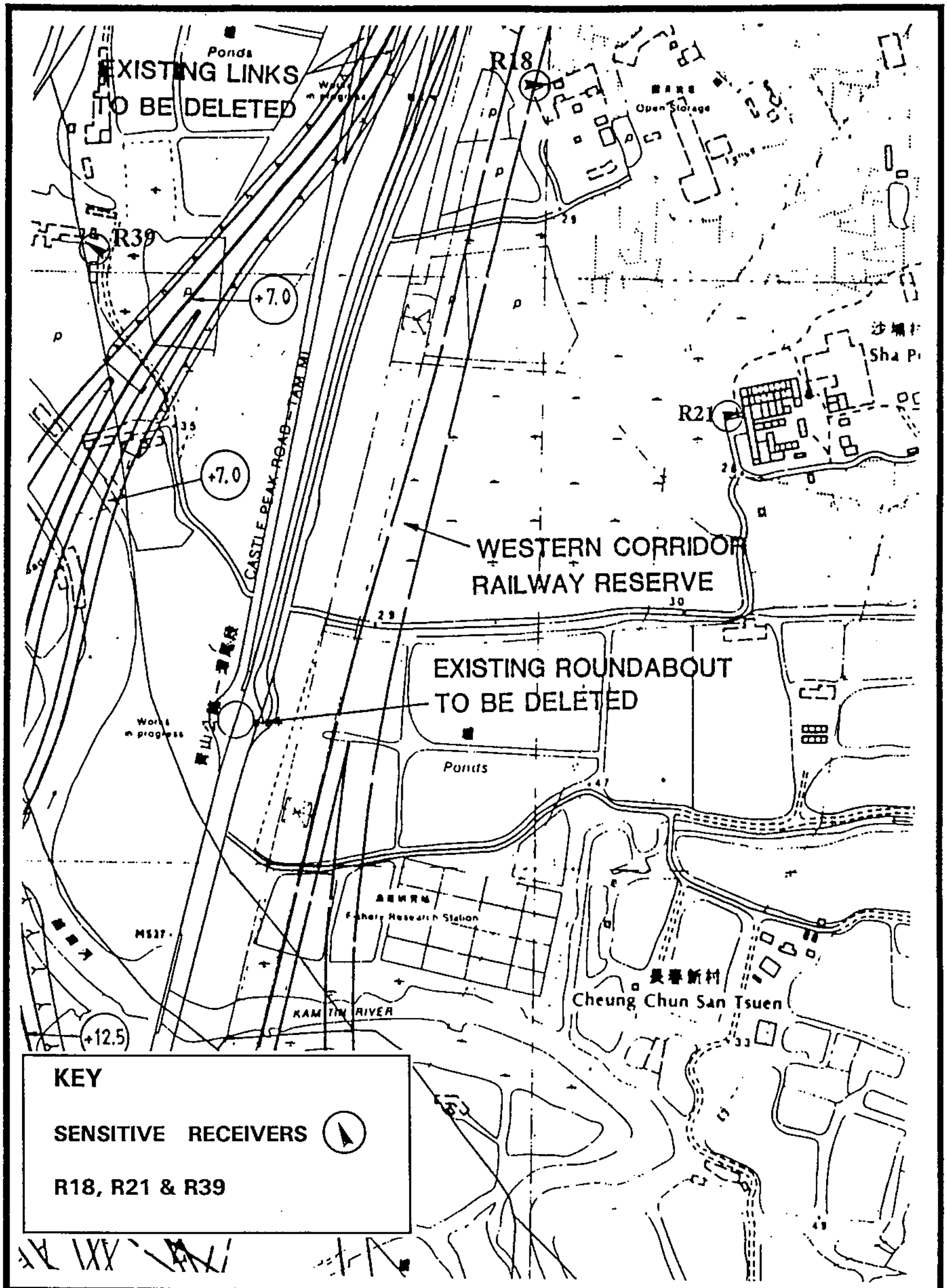
Job Title : ROUTE 3 : COUNTRY PARK SECTION EIA

Scale : N.T.S.	Job No. 058 005	Fig No. 18.14c
Date Sept. 93		



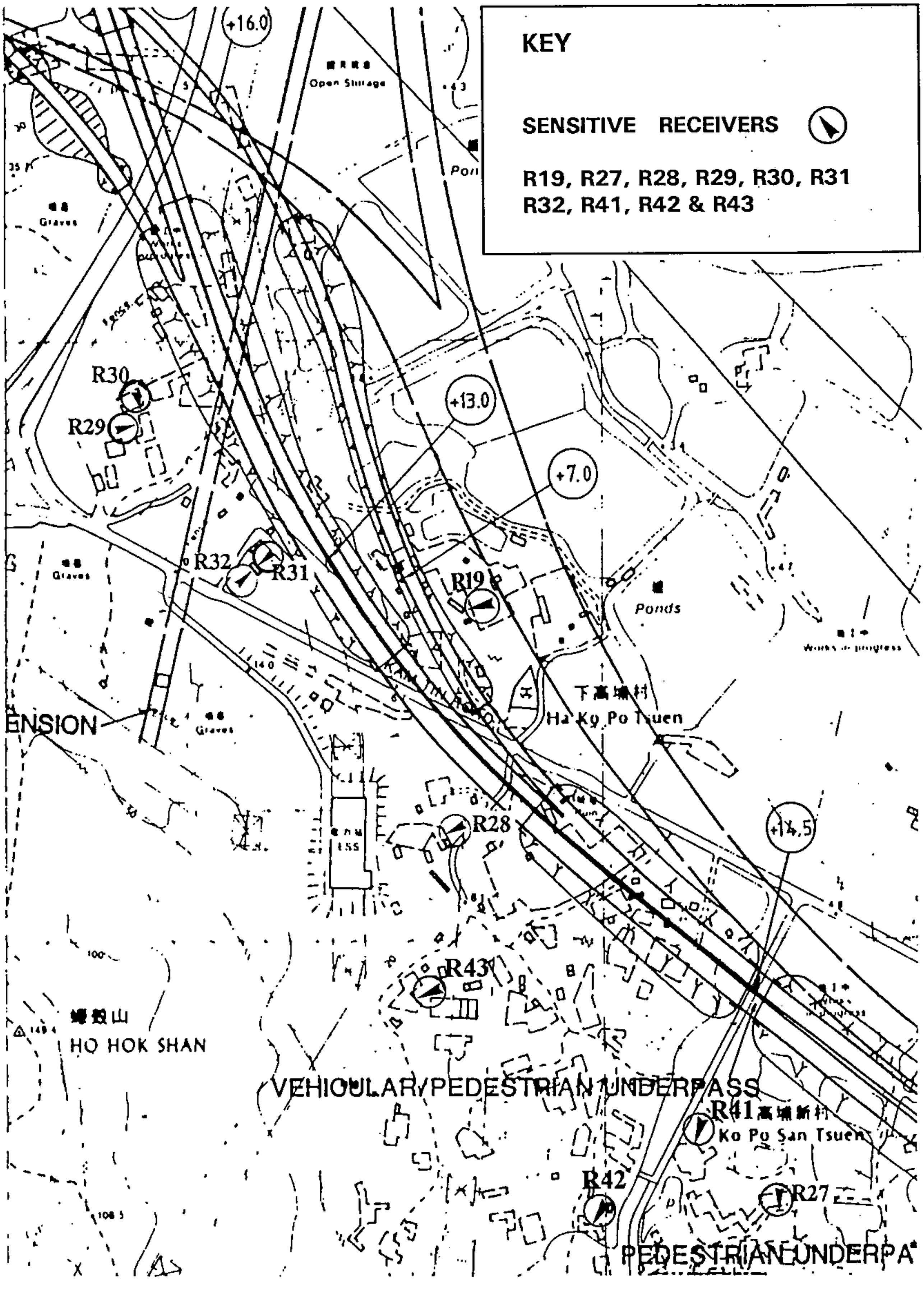
FREEMAN FOX MAUNSELL

Job Title :	ROUTE 3 : COUNTRY PARK SECTION EIA
Drg Title :	Selected Representative Sensitive Receivers
Scale : N.T.S.	Job No. 058 005
Date : Sept. 93	Fig. No. 18.14d



FREEMAN FOX MAUNSELL

Job Title : ROUTE 3 : COUNTRY PARK SECTION EIA		
Drg Title : Selected Representative Sensitive Receivers		
Scale : N.T.S.	Job No. 058 005	Fig. No. 18.14e
Date : Sept. 93		



FREEMAN FOX MAUNSELL

Job Title : ROUTE 3 : COUNTRY PARK SECTION EIA		
Drg Title : Selected Representative Sensitive Receivers		
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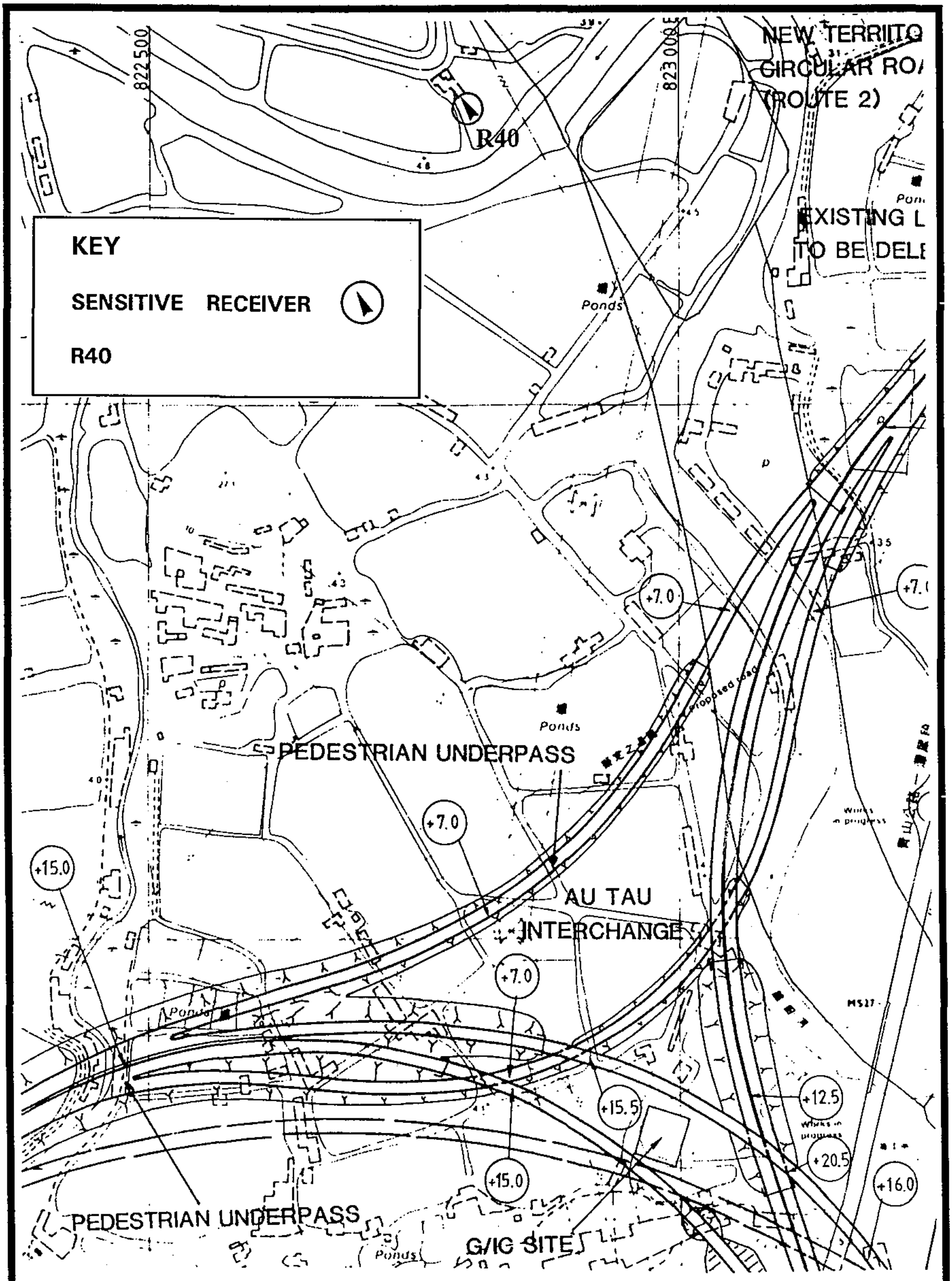
Date : Sept. 93		



FREEMAN FOX MAUNSELL	Job Title : ROUTE 3 : COUNTRY PARK SECTION EIA		
	Drg Title : Selected Representative Sensitive Receivers		
	Scale : N.T.S.	Job No. 058 005	Fig. No. 18.14g
	Date : Nov. 93		

WATER QUALITY

CHAPTER 19

19. WATER QUALITY

19.1 INTRODUCTION

The proposed TLT & YLA (N) alignment runs within the Kam Tin drainage basin affecting two of the three principal sub-catchments i.e. Yuen Long and Kam Tin. The low land areas of the basin have been and continue to be actively developed. Development was originally confined to scattered villages whose livelihood was dependent on paddy cultivation. Through the 1960's and 1970's extensive areas in the lowest parts of the basin were converted from paddy and marsh into fish ponds. In certain areas during the 1980's and 90's many fish ponds and much of the remaining lowlying areas were filled to form platforms for storage of new cars, building materials, and containers, other uses include automotive breakers, scrapyards and light industrial purposes.

19.2 EXISTING SURFACE WATER ENVIRONMENT

The SRs located in the Study Area fall conveniently within three discrete areas. The first area lies to the south of the Kam Tin Road. The route runs through a region that has been converted to open storage areas and includes a relatively small area of fish/duck ponds which will be impacted upon. Ramps I and J run from the mainline and link with the Kam Tin Road just west of the Kam Tin River crossing.

The second area lies between Kam Tin Road and the NTCR. A relatively small number of fish/duck ponds will be affected by the Alignment. A Fisheries Research Station is situated to the east of the NTCR but will not be affected by the alignment.

The third area lies between the NTCR and Castle Peak Road - Yuen Long. This area is characterised by open areas of fish/duck ponds, the main channel of the Kam Tin River and a tributary of the Kam Tin River which drains north.

The water quality in the Kam Tin River is monitored by EPD and is rated as being *very bad*. The water courses are severely polluted by livestock waste and run-off wastewater from car breaking, storage yards, work shops, and the practise of burning rubbish along the river banks. Past intrusion of tidal currents from Deep Bay reduced the dispersion of the polluted river flow and so accumulated the pollutants.

At present extensive areas of land on the Yuen Long flood plain are taken up by the ponds. Some of these ponds are in a state of disuse, however, correspondence with the Agriculture and Fisheries Department (AFD) indicates that there are 'many active ponds' in the area.

There are two water control zones (WCZ) associated with the TLT & YLA (N), the Western Buffer WCZ and the Deep Bay WCZ. The discharge of effluent into these zones is subject to the controls laid out in the Water Pollution Control Ordinance (WPCO).

19.3 CONSTRUCTION STAGE IMPACTS

19.3.1 Introduction

Construction of the Alignment will create significant impacts on the freshwater quality of the area. Specific activities will lead to a degradation, although temporary, in water quality.

These activities and their impacts are discussed below.

19.3.2 Potential Impacts

The impacts associated with the road will arise from three main structural considerations; extensive elevated sections of the alignment; the use of embankments; and an area of cutting.

Generally, impacts arising during the construction activities will be related to an increase in surface run-off containing high levels of Suspended Solids (SS).

The earth works associated with the small cutting (just north of the Au Tau roundabout) and the many sections of the alignment which will run on embankment will expose large areas of earth. During rainfall events, erosion of these areas will increase and surface run-off will carry significant amounts of SS. Increases in SS loadings will have significant detrimental effects on the ecology and water quality in both the fish/duck ponds and adjacent receiving water stream courses of the Kam Tin River.

Any site works and plant maintenance areas, the activities associated with them, and the facilities placed there, have the potential to create significant water quality impact.

During construction large quantities of concrete will be required, particularly for the elevated sections. Liquors containing significant quantities of cement derived material are a potential source of impact if released to surface waters. Discharge or run-off of lime-based materials have the potential to cause the following impacts:

- localised increases in turbidity; and
- localised elevations in pH and the accretion of high pH solids.

Unless strict and comprehensive mitigation measures are incorporated into the works contract, these impacts will adversely affect the fresh water fauna and flora of the stream and any operational fish/duck ponds. Impacts will arise owing to increases in turbidity levels, and reduced DO levels, resulting in smothering of benthic organisms and the clogging of fish gills with fine sediments.

The TLT & YLA (N) crosses many fish/duck ponds which will have to be resumed. Their loss will be a residual impact of the Alignment. Larger ponds, partly affected, may have to cease operation for a time during construction till run-off settles, smaller ponds though not totally affected may need to be filled as they may cease to be commercially viable.

The ponds are of significant ecological importance despite being disturbed and intensively cultivated; they provide foraging sites for wild birds and an important habitat, for (foraging and breedings sites) an abundant population of amphibian and reptilian species.

The alignment encompasses a large area of land, with potentially significant land and drainage effects. These impacts include loss of flood storage, severance of flood storage areas from the main flood plain, and severance of existing drainage paths.

The alluvial deposits in this area are unsuitable for use as foundation material. It is proposed that it would be necessary to partially remove them, and replace some of the deposits with a suitable graded fill. The removal transport and disposal of the alluvial deposits and subsequent filling operations are likely to create significant water quality impacts through the increase in SS levels at sites in the area.

19.3.3 Mitigation Measures

Any effluent produced during the construction stage will be subject to control under the WPCO. Guidelines as to the effluent standards that would normally need to be achieved are given in the *Technical Memorandum on Standards for Effluent Discharged to Drainage and Sewage Systems, Island and Coastal Waters, January 1991*, (TM). In view of the potential impacts described above drainage trenches and channels should be used to collect run-off and, controls should be applied and site run-off treated. General mitigation measures and Monitoring and Audit requirements given in Chapter 6, Sections 6.25 and 6.26 are also applicable here. Environmental Protection Clauses will be included in the construction contracts requiring such measures to be carried out.

19.4 OPERATIONAL IMPACTS

19.4.1 Introduction

The operational stage impacts should be significantly less than the construction stage. The main potential impact is the run-off from the road and associated sliproads, and the transport of materials to fresh water bodies.

19.4.2 Potentials Impacts

The main sources of potential impact are:

- run-off of contaminated surface waters;
- the accumulation of sediments on the road and its associated sliproads;
- contamination with hydrocarbons and other materials resulting from vehicular usage of the road and its sliproads;
- run-off and contamination with hazardous and toxic materials following accidental spillage and road traffic accidents; and
- river diversion works associated with the Kam Tin River which will result in replacement of the natural river course with straight concrete lined channels. This will significantly alter the velocity distribution and hence the aquatic regime, the consequences of these actions must be addressed in the detailed design stage. In the short term, velocities will increase leading to an enhanced transportation of sediment from the middle portions of the Kam Tin Basin. The sediment load will be deposited in the mangrove areas in the down stream reaches of the Shan Pui and Kam Tin Rivers and ultimately, Deep Bay.

19.4.3 Mitigation Measures

The transport of sediments, albeit small quantities, from the road to the fresh water environment could be minimised by the incorporation of appropriate sediment traps within the roadway drainage system.

To enable retention of hazardous materials within the road system from large spillages, 'close-off' valves could be considered and installed where sections of road pass over open water bodies. However the extremely infrequent nature of these events does not appear to justify this although this could be reconsidered during the detail design stage when financial information is available.

19.5 CONCLUSIONS

Overall the TLT & YLA (N) will result in water quality impacts due to the fact that the bulk of the Alignment takes in large areas of fish/duck ponds and crosses the water course of the Kam Tin River and one of its tributaries.

During the construction phase, the key issues will be the prevention of run-off (which is contaminated with chemicals, fuels, oils, sewage and high SS) from entering the water courses, and thus the marine waters. Suitable clauses will be included in the contract documentation to ensure control of run-off waters.

Impacts arising during the operational phase will be related to road traffic accidents involving the spillage of toxic and/or hazardous materials, and the roadway run-off, which may contain high levels of SS. The former would be a rare event and would be in common with many roads in the Territory. The SS content would be especially important during the early years of operation, when the landscaping and revegetation works are not fully established. Suitable clauses should be included in the contract documentation to ensure impacts are kept to acceptable levels.

WASTE AND SPOIL MANAGEMENNT

CHAPTER 20

20. WASTE AND SPOIL MANAGEMENT

20.1 GENERAL CONSTRUCTION WASTES

The likely arisings of general construction wastes and any associated general impacts during construction of the TLT & YLA (N) will be largely common to those described in Part I Chapter 7. However they will occur in an area which is sensitive to water quality impacts due to the presence of duck and fish ponds and the Kam Tin River and its tributaries. These potential impacts and appropriate mitigation measures have been identified and discussed in Section 20 - Water Quality and are not therefore reproduced here.

20.2 SPOIL AND FILL

20.2.1 Spoil Arisings

The major spoil arising for the TLT & YLA (N) will be from a relatively small cutting just to the north of the Au Tau Interchange and shown in Figure 15.1. This area is approximately 35m PD high and will involve cutting to a depth of about 15m.

This cutting is near to a number of graves sites and it is known that these extend beyond the marked burial site on available plans. It may be possible to reduce the size of this cutting for example by replacing slopes with a retaining wall. This would reduce the number of graves affected and the quantity of spoil arising. This would therefore be preferred however while this will be recommended (subject to feasibility) by this environmental study it will be a decision for the successful tenderer to make during the detailed design.

20.2.2 Spoil Disposal/Fill Requirements

The materials excavated from the cutting near Tui San Tsuen will be transported both for use within the works area to the embankment sections of the Yuen Long Approach; and further to the north of Kam Tin Road in embankments of the various slip roads linking the NTCR and Yuen Long Southern Bypass.

The volume required for such works is in the order of 1 Mm^3, which can be translated into a number of heavy vehicles per day and per hour. Use of the public roads in the vicinity of the Au Tau Roundabout by this volume of traffic could be avoided by phasing of the works to allow early construction of the bridge structures over Kam Tin Road and NTCR, thus allowing haulage of fill across these roads within the works site only.

Should the alternative policy of haulage of fill via local roads be adopted, then the volume of traffic solely generated from moving materials from the southern part of the Yuen Long Approach to cross Kam Tin Road for deposition in the northernmost section and interchange embankments is based on the following assumptions.

- Total working days for the site formation works assume to be 600 days;
- Each truck will carry 4 to 6 cubic metres of excavated materials for a single load; and
- Each day would have 8 hours for the transportation of such materials.

The average number of trucks per hour in one direction is estimated to be 35 to 50 vehicles per hour.

Current estimates indicate that the overall earthworks to the north of the Tai Lam Tunnel will result in a surplus of about 0.5 Mm^3 of spoil. Should the cutting for the Western Corridor Railway be included in the TLT & YLA (N) works in order to avoid disruption to the future "live" expressway at the interface, then this surplus would be increased to around 0.8 Mm^3.

The surplus would also require removal via the public road system to external sites which have yet to be identified, probably via Kam Sheung Road and/or Kam Tin Road. Assuming total site formation works over 600 days and each truck removing 4 to 6 cubic metres per load, and an eight hour period permitted each day for such haulage, then the average number of trucks in one direction is estimated at 17 to 26 vehicles per hour, for the disposal of the surplus material from TLT & YLA (N) works only.

It may therefore be preferable to include the main cutting and some embankment works for the Railway within the TLT & YLA (N) works, to allow disposal of the surplus within an area immediately adjacent to the Works Area, with the resultant benefit that greatly reduced haulage would be required along public roads. If necessary this will be addressed in the BOT documents. It is anticipated that a separate EIA will be carried out for the railway project.

The traffic impacts have been addressed in Working Paper No.7 - Traffic Impact Assessment for the Construction Stage.

20.3 DISCUSSION AND CONCLUSIONS

The quantity of spoil arising from the TLT & YLA (N) is relatively small. It is difficult to discuss the disposal of this material in isolation as it is tied in with the proposal to utilise surplus material from north of the Tai Lam Tunnel. It is also possible that the successful tenderer for this BOT project would have interests/involvement in other nearby land or projects and could utilise the material accordingly. This should therefore be addressed during the detailed design by the successful tenderer as part of a detailed EIA study.

At this stage it would appear logical and beneficial to incorporate the cuttings for the Railway in the Route 3 Project however there are other considerations apart from spoil and fill and this has not yet been decided. The importance of reusing this material as fill must be stressed as otherwise traffic related impacts would occur including potential police traffic control problems.

The general mitigation measures which will be required for dealing with spoil handling, stockpiling, transport and disposal have been discussed in Part I, Chapter 7. These will be applicable to spoil arising from the TLT & YLA (N) and have not been repeated here.

It is recommended that the cutting just to the north of Au Tau is kept to the minimum size required possibly by use of retaining walls and subject to feasibility, to minimise spoil arisings and disruption to grave sites. It is noted that the spoil from this cutting as well as spoil from cuttings near Tin San Tsuen will be used in the embankments of the Yuen Long Approach and the slip roads linking the NTCR and the Yuen Long Southern Bypass. It is recommended that any spoil surplus to these requirements be used in nearby projects to be identified during the detailed design stage.

LANDSCAPE AND VISUAL IMPACT ASSESSMENT

CHAPTER 21

21. LANDSCAPE AND VISUAL IMPACT ASSESSMENT

21.1 INTRODUCTION

The potential visibility of the TLT & YLA (N) alignment places considerable importance upon the assessment of the landscape and visual impacts.

The broad landscape character consists of a number of different areas:

- an increasingly developed valley floor;
- surrounding rounded low hills vegetated by scrubland and woods, and scarred by numerous grave sites;
- numerous fish/duck ponds segmented by low earth bunds.

21.2 BASELINE CONDITIONS

To establish a general picture of the existing baseline conditions, the Study Area may be divided into three distinct landscape types (Table 21.1):

- a flat bottomed valley scattered with a mixture of traditional villages, modern village houses, agricultural buildings, open storage and increasingly commercial and light industrial areas;
- small areas of undeveloped upland characterised by scrub but lightly wooded on the lower slopes. The whole area is scattered with numerous grave sites which are interlinked by footpaths into the hills;
- farming of fish/duck ponds characterises the remaining area, where ponds have been formed by the bunding of open water stretches. These areas are fringed by development and main roads and crossed by the main river course and a tributary of the Kam Tin River.

Human interaction in the developed areas particularly around Yuen Long and Au Tau has been extensive. This has given rise to the initiation of an extensive conurbation with numerous visual detractors. Introduction of a further man made element would not have a significant impact on the landscape character of this area. However, the visual impact upon residents of these areas is likely to be severe.

In contrast the open areas of fish/duck pond are largely undisturbed and thereby retain a degree of their original rural appearance. The introduction of a major man-made element amidst this landscape is likely to cause a significant deterioration in the visual amenity/landscape character, both in general terms and significantly from the view of the residents of the scattered villages adjacent to the road.

Table 21.1 Table of Baseline Conditions

CHARACTER AREA/ CONTEXT	VISUAL ENVELOPE	TOPOGRAPHY/ VEGETATION	BUILT DEVELOPMENT	ACCESS AND CIRCULATION	LANDSCAPE CHARACTER	RECEIVER GROUPS
Rounded low hills.	Views from valley floor and surrounding settlements.	Rounded, low hills (50m) supporting scrub/ woodland occurring along the lower slopes.	Isolated rural properties concentrated along base of slope.	Footpath access to ridge tops and areas of graves along slopes.	Eroded, undeveloped rounded hills supporting wood and scrubland, visible across a wide area.	Receivers within the Study Area. More distant receivers may include residential properties/traffic, industrial and agricultural production activities on the surrounding floor.
Alluvial Plain supporting much recent village development/ suburban fringe and traditional villages.	Restricted by low, flat relief, vegetation cover and existing built development.	Major alluvial flood plan supporting intensive agricultural production and some suburban fringe activities and limited tree cover.	Dense modern village settlements. Scattered traditional villages and isolated agricultural buildings.	Limited major infrastructure, with extensive local informal network of vehicular routes and footpaths associated with modern settlements.	Agricultural/urban fringe landscape of small fields and ponds, agricultural buildings and storage areas, with increasing number of dense modern village development.	Residential properties/transient receivers and industrial premises within the character area. Transient receivers from surrounding high ground.
Urban fringe surrounding Yuen Long and Au Tau.	Restricted by low, flat relief, vegetation cover and existing built development.	Major alluvial flood plain supporting substantial built development interspersed with limited agricultural production and tree cover.	Urban fringe including much recent development and expansion of existing villages. Industrial premises.	Residential areas well served by local network of vehicular routes and footpaths, with good links to major circulation routes within the area.	Urban fringe landscape of built development interspersed with small agricultural fields, industrial buildings and storage areas.	Residential properties/transient receivers and industrial premises within the character area. Transient receivers from surrounding high ground.

21.3 VISUAL ENVELOPE

The visual envelope of the character areas are divided into two broad types:

- short range views in the low lying areas are restricted by existing development and the flat relief. However, the views across the fish/duck ponds are longer and more open taking in the scattered settlements bordering the water margins set against the backdrop of surrounding hills;

- views from the high ground surrounding the valley e.g. the Tai Lam Country Park to the south, are more distant but extensive. The grass/scrub slopes generally provide unrestricted, elevated views of the low lying areas along the Kam Tin valley and across to Yuen Long. A network of scattered settlements, intensive agricultural production, fish/duck ponds, and major traffic corridors results in a complex and haphazard mixture of built, natural and quasi-natural landform.

21.4 RECEIVER GROUPS

Receiver groups within the low lying areas range from residential receivers within urban areas to isolated rural properties. Transient receivers will include users of the existing traffic and footpath network and employees within industrial premises. Receiver groups within the higher surrounding areas include transient walkers on the footpath network in the Tai Lam Country Park and the surrounding hills.

21.5 LANDSCAPE IMPACTS

The route corridor will have landscape impacts along its entire length. The major impacts will be associated with embankment works and elevated sections of roadway. However, much of the area will be affected by landscape impacts caused by works associated with the river diversion/flood control works in the Kam Tin valley prior to the construction of the road. The compound impact of these developments will have a significant influence on the existing landscape character of the area. The TLT & YLA (N) comprises a series of linked elevated sections approximately 20mPD running on embankments which reach approximately 15mPD in height.

The proposed filling of many of the ponds and introduction of embankments to the area would fundamentally change the landscape features. The major impact will be the direction of the large area of ponds by the mainline and sliproads that make up the Au Tau Interchange. The rounded hill slope near the Au Tau Roundabout will additionally be subject to a cutting approximately 15m in height.

Significant deformation of the natural landscape, necessary to achieve the desirable engineering alignment, together with the introduction of vehicular noise and movements compounded by the North Western Corridor Railway alignment, will have a significant detrimental impact on the local landscape character.

At present the route would impact upon the mainly rural agricultural landscape character of the area. However, when viewed in light of the major development proposals occurring in the Kam Tin Valley and the Au Tau Area, it offers the opportunity to address the overall landscaping issue in what will essentially be a new landscape character area. Strategies, such as the *North/West New Territories Development Statement Study - Landscape Strategy*, have addressed the comprehensive development of the area and urges its integrated development.

21.6 VISUAL IMPACTS

The visual envelope identifies two broad types of visual intrusion:

- areas in close proximity suffering visual intrusion/obstruction; and
- long distance views from the high ground.

Immediate Surroundings

The most significant visual impact would be on sensitive receivers within areas with direct views, and in close proximity to the proposed route. The route corridor passes in close proximity to a large number of traditional villages and isolated residential properties.

Receivers within these residential areas will suffer varying degrees of visual intrusion, depending on height, orientation and presence of intervening structures. Visual obstruction will be evident for some properties with the road physically obstructing views. Other visual intrusion will occur where the road acts as an addition to the existing landscape and or partially hinders the view across traditionally open areas e.g. across the fish/duck ponds to the surrounding hills.

The visual amenity in the area is currently increasingly reduced by the growing conurbation surrounding Yuen Long and the impact of the existing highway corridors. Due to the presence of these existing visual detractors the likely impact to receivers within these areas may be attenuated. The introduction of a further man made element within the view should not significantly alter the visual amenity of the area, particularly if associated with appropriate redevelopment and mitigation measures as part of an integrated development strategy.

Distant Views

Further from the route corridor visual intrusion occurs from more elevated positions overlooking the proposed route corridor. Transient recreational users in the surrounding high ground in the Tai Lam Country Park and the hills to the east of Shap Pat Heung will have an extensive panoramic view over the area. The degree of visual intrusion caused, varies depending on the distance from the source, most footpaths are some distance from the proposed route and resultant visual intrusion will be minimal, when viewed against the existing widespread development.

The most prominent features from these elevated positions would be that of the alignment running on high embankments, elevated sections of roadway plus to a lesser extent a small area of cutting in a hill close to Au Tau. The initial impacts would soften through time, as the landscape mitigation measures become established.

Illumination

The proposed illumination of the TLT & YLA (N) will cause nocturnal visual intrusion throughout the zone of visual influence. Visual receivers in the immediate vicinity of the route may suffer glare from the proximity and orientation of the light sources. More distant receivers would suffer intrusion from the linear light aura created by the highway corridor and its associated traffic.

Views from the surrounding high ground will look down onto the route corridor and its associated moving traffic. Mitigation measures at the source of the view will be more effective than those within the highway boundary from these elevated views.

21.7 CONCLUSIONS

The adoption of mitigation measures recommended in the landscape and rehabilitation section of this report (Chapter 22) will do much to reduce the impact of sections of the route from more distant views. In time the road would become visually screened from the majority of sensitive receiver groups.

However, the impact of the high embankments, elevated flyovers and separated interchanges particularly north of Castle Peak Road - Yuen Long will remain a permanent significant visual element within the character of that area. Its acceptability as a significant permanent visual element will depend on the detailed design of its scale and proportions, in relation to the surrounding landscape. It should also be noted that this area is already subject to much recent housing and light industrial development, and will be affected by the proposed realignment of the river, and introduction of a rail link corridor that will also fundamentally change the character of the existing landscape.

The initial impact on the landscape may be reduced by the adoption of suitable landscape mitigation measures such as:

- off site planting by agreement;
- attention to the interface between man made/natural landforms; and
- inclusion of other circulation networks (rail, cycle, etc., within the common route corridor if practicable).

LANDSCAPING AND REHABILITATION

CHAPTER 22

22. LANDSCAPE/REHABILITATION

22.1 INTRODUCTION

The construction of the TLT & YLA (N) will substantially disturb the existing landscape and will necessitate appropriate landscaping and rehabilitation measures of areas affected by the proposed road alignment.

The mitigation measures and recommendations for the TLT & YLA (N) have been designed to be consistent, and integrate with landscape works proposed for the Ting Kau Bridge and the TLT & YLA (S) sections of the Route 3 CPS.

22.2 EXISTING LANDSCAPE ENVIRONMENT

The baseline conditions in the Study Area and the construction considerations (design) are presented and outlined in Chapter 15 of this Report.

The Study Area is mainly situated on lowlying land, with the exception of an area northwest of Au Tau Interchange characterised by residential and light industrial development, fish/duck ponds and mixed rural development. Construction of the TLT & YLA (N) on embankment and elevated structure will significantly alter the landform and owing to its height above the valley floor, it will have significant visual influence in the area. However, the extent and nature of disturbance should be kept in perspective. Extensive works will be undertaken within, the Study Area for the connection of Route 3 to the New Territories Circular Road, the proposed Western Corridor Railway link to Yuen Long and the Yuen Long Southern Bypass, although they would not directly affect the part of the Study Area northwest of Au Tau Interchange.

Landscape and rehabilitation works should address the potential impacts from proposed engineering works, that have potential to affect surface erosion and slope stability, increase noise and air pollution as well as alter surface water run-off characteristics. Correctly executed, landscaping/rehabilitation works have potential to minimise these impacts.

22.3 MITIGATION MEASURES

22.3.1 Introduction

The mitigation measures undertaken in association with the route proposals will play an important part in the successful integration of the new road with its surrounding landscape. Landscape mitigation measures fall into two main categories: temporary measures associated with reducing the impact of the road's construction phases; and permanent measures adopted to reduce the impact of the route on surrounding receptors, to aid the integration of the route within the character of the landscape it traverses, as well as being relevant to factors such as erosion control, surface and subsurface slope stability, noise and dust amelioration and pedestrian management.

22.3.2 Temporary Mitigation Measures

The following measures are recommended to reduce the impact during construction:

- Restrict volume of construction traffic on local road network;
- Restrict construction working areas to a minimum;
- Enclose the working areas with hoardings to define boundary edge and screen low level construction activities (eg car/truck movement) from surrounding receptors;
- Restrict heights of storage materials, stock piles and spoil heaps to low levels; and
- Minimise night-time working and lighting.

Advanced planting and ground modelling in designated landscape areas should be adopted where damage from construction activity can be avoided to enable the landscape to become established prior to the route becoming operational and making its screening qualities effective in a shorter length of operational time.

22.3.3 Permanent Mitigation Measures

The following general measures are recommended to reduce the permanent impacts of the TLT & YLA (N) development. Some items do not fall directly into a landscape context, nevertheless they should be carefully considered to enable the successful integration of the route within its surroundings.

- Detailed alignment of the route enabling retention of significant landscape features;
- The treatment of the interface between man made and natural landforms;
- The use, location and design of retaining walls;
- Specific attention to the visual quality of structures associated with the route;
- Landscape treatment within, and immediately outside the route boundary;
- Colour and materials used for structures should reflect the colours and materials of the surrounding landscape. As a general principle strong contrast in colour should be avoided and muted colours related to the material environment should be used with darker colour concentrated to the base of the structure to create a sense of stability.
- Detailed attention to the gradients and the profile of regraded slopes, and earth modelling to ensure they reflect the gradients of the natural slopes in the vicinity.
- The use of tunam or shotcrete treatment of regraded slopes should be avoided;
- Screen planting within the curtilage of residential properties to screen the view at source;
- Incorporating areas of redundant land within the highway landscape proposal scheme to aid the integration of the route with its surroundings and avoid the creation of

areas of derelict land; and

- The extent and form of highway illumination adopted. The size height design and orientation of the light should ensure effective lighting of the highway corridor whilst minimising the potential leakage of light. The use of reflective paints and signing should be fully investigated to determine the need for permanent lighting.

22.4 LANDFORM REGRADING WORKS

Due to the high embankments that will be used throughout the visual quality of the regraded slopes within the highway corridor will play an important part in the integration of the route with its surrounding TLT & YLA (N) landscape character.

Wherever possible the formed slopes should reflect the angle and alignment of the natural slopes within the area. However, as the Study Area is mainly flat, blending the highway on high embankment into the existing landscape will require careful planning. The slope should not however be greater than 1 (vertical) : 1.5 (horizontal), with a gentler slope of 1:2 preferable.

Attention to the interface between the surrounding topography and the engineered highway slopes should be addressed to reduce the potentially sharp divide and consequent visually intrusive element created between the natural and man made landforms. The long profile of the slope should follow a shallow inverted "S" alignment. Similarly the edges of the regraded slopes should merge into the surrounding landform, rather than appear to be cut out from it. This may involve extra regrading work, outside the geotechnical and engineering requirements, requiring extra land, however the resultant overall landform will be more visually acceptable both from receptors within its immediate vicinity and more distant views (when the new landform will form a component of the overall landscape).

Disturbed areas should be designed to be stable and capable of revegetation wherever possible. It is important that landscape considerations receive high priority and early consideration in the detailed design phase.

Duck/fish ponds that are no longer commercially viable should be incorporated into the landscape works by infilling and planting with an appropriate recommended vegetation.

A smooth compacted surface is not conducive to vegetation establishment. Wherever consistent with safe geotechnical considerations, the surface of bare earth areas should not be overly compacted and should be left with a textured surface to assist seed and water retention. Similarly, exposed rock faces are not conducive to revegetation. Rock faces should be either covered with a minimum of 0.5m of soft spoil material and hydroseeded or benched and treated as indicted in Table 22.1.

22.5 LANDSCAPING/REHABILITATION DETAILS

Both cut and fill slopes should be initially stabilized by hydroseeding and engineering erosion control techniques. The hydroseed mix will incorporate both grass and appropriate tree seeds to simulate the natural woodland composition thereby increasing species diversity through planting. Into this, **Woodland** or **Shrub Mixes** will be planted. The mixes specified vary in the size distribution of plant material and planting density. Specific plant species should be selected at the detailed design stage to respond to local conditions and vegetation types identified along the route.

Selection of suitable species would be assisted by information provided in flora studies conducted for this EIA. The proposed treatments are described in Table 22.1 and summarised below.

All tree and whip planting should be into appropriately sized pits. Fifty grams of slow release fertilizer (minimum release period 8-9 months) should be incorporated into the base of each hole and well mixed with the soil prior to tree planting. Recommended quantities are given in Part I, Chapter 9 Section 9.8.1.

Woodland Mix A will be appropriate for use on all embankments to co-ordinate with the density and size distribution of the extended woodland that is recommended for use on the reclaimed fish/duck ponds.

Woodland Mix B should be prescribed for the areas of cut surrounding the sliproads I, J and F. This mix would be designed to blend into the country park landscape.

Extended Woodland should be prescribed for planting on all reclaimed fish/duck ponds. Woodland Mix A should have a high component of shrubs and fire resistant species. It will enable visual shielding of the alignment once the trees/shrubs are established with time.

Roadside Planting of trees and amenity shrubs would be confined to the more visible sections of the road at the interchanges where traffic speed will be reduced. These areas are more accessible permitting higher levels of maintenance.

Berm Planting should be undertaken on cut slopes to the northwest of the Au Tau Interchange.

Good revegetation results have been observed at these sites for both cut and fill slopes and for a range of substrate. There appears to be no long term unfavourable residual effects.

Table 22.1 Summary of Landscape Treatments

LANDSCAPE TREATMENT	DESCRIPTION
WOODLAND MIX A	Hydroseed with grass and tree seed. Plant trees on 100% of area. Pit plant 80% tree/shrub whips, 20% light standard trees. Density: 1.5m staggered centres.
WOODLAND MIX B	Hydroseed with grass and tree seed. Plant trees on 100% of area. Pit plant 75% tree/shrub whips, 25% light standard trees. Density: 1.5m staggered centres.

Table 22.1 Continued

EXTENDED WOODLAND	Pit plant 100% of area with tree/shrub whips. Density 1.5m staggered centres.
BERM PLANTING	Construct random stone wall, average one metre high. Drainage layer, filter fabric, topsoil mix, mulch. 3m wide planting area with climbing/trailing plants (2/lin. m). Medium Shrubs/Whips (3/lin. m), light standard trees (1/lin. m).
ROADSIDE PLANTING	Import 450mm topsoil mix, mulch. Plant medium shrubs at 600mm staggered centres and standard trees at average 1 tree/5 lin. m.

22.6 MONITORING AND MAINTENANCE

Experience on Tsing Yi Island, Tsuen Wan and a wide range of other New Territory sites indicates that vigorous and healthy tree cover can be established on cuttings and embankments slopes similar to those in the TLT & YLA (N). Within these areas self seeding and establishment of native ground covers are common.

Several salient points regarding implementation and maintenance of landscape and rehabilitation works require highlighting.

All landscape works should be regularly checked and maintained. Monitoring should not only check the general health of tree stands and grass swards but also ensure that species diversity is maintained and that ground cover remains adequate to prevent erosion. Pure stands of some species such as *Casuarina equisetifolia* can cause ground cover decline. Monitoring will also ensure that surface drainage structures are intact and have not been interfered with by vegetation.

Necessary maintenance works may include fertilizing, thinning tree stands, replanting or resowing, watering and fire protection (in early stages), and all works necessary to ensure beneficial development of landscaped areas.

As previously discussed the need for maintenance should decline with time and will vary with the various categories of landscaping proposed. A minimum maintenance period of two growing seasons is recommended.

Proposed landscape works should be discussed with the relevant implementation and maintenance authority at an early stage.

22.7 CONCLUSIONS

The construction of the this section of the route will substantially disturb the existing landscape, and landscaping and rehabilitation works will be essential.

Landscape mitigation measures have been identified to reduce impacts during both the construction (temporary measures) and the operation (permanent measures) phases. Some of these measures are general and should be applied as far as practicable.

Advanced planting and ground modelling is required and disturbed areas should be designed to encourage revegetation. Planting of grass, shrubs and trees should be carried out in accordance with the general recommendations of this Report. Maintenance and monitoring will be essential for successful mitigation of the very significant impacts.

LANDUSE AND COMMUNITY ISSUES

CHAPTER 23

23. LAND USE AND COMMUNITY ISSUES

23.1 INTRODUCTION

It is important to identify and assess the impacts and implications of the TLT & YLA (N) in terms of community issues and neighbouring land uses.

This Section is intended to:

- identify the nature of neighbouring landuse, and its significance in terms of potential impacts from the TLT & YLA (N) on the local community, recreation/resource value of the area, local amenity and development potential;
- identify elements of the community potentially affected by the construction and operation of the TLT & YLA (N), and assess the potential impacts; and
- highlight key problem areas in order to contribute to the resolution of any community concerns regarding the project.

23.2 APPROACH

Landuse impacts have been identified in terms of both the construction and operation of the TLT & YLA (N), and where appropriate the implications of impacts have been considered.

Impacts have been assessed in relation to Government landuse zoning and planning policies, the degree and nature of disturbance to both members of the public and visitors to the Study Area, and the importance of the affected areas in terms of their resource value. The significance of potential impacts have been assessed in relation to the nature and extent of sensitive receivers (SRs) affected. The following sections necessarily draw upon information contained within the preceding Chapters of this Report.

Government designated landuses were used to identify where landuse may be a constraining factor on existing and proposed landuse within the Study Areas, and sites of archaeological and historic interest were identified through consultation with the Antiquities and Monuments Office (AMO).

23.3 EXISTING AND PROPOSED LANDUSE IN THE STUDY AREA

A review of 1:20,000 and 1:1,000 scale maps, Outline Zoning Plans (OZP), non metropolitan landuse plans, the Territory Development Strategy (TDS) and a series of site visits established the existing and proposed landuse in the Study Area.

In general terms this section of the Alignment passes through a mixture of landuse which has a history of varied agricultural/farming including fish farming, duck rearing and rice cultivation. However, this has more recently given way to a proliferation of light industry, open storage and residential development. In an area which is characterised by a river valley, numerous ponds and scattered grave and ruin sites.

Consultation with the Planning Department established that there are plans to rationalise the different categories for landuse zoning which currently exist; this will involve re-zoning areas of land, which has implications for future development. Outline Zoning Plans (OZPs) for the area around Au Tau are currently at the draft development phase (Yuen Long OZP (S/YL/1) and Nam Sang Wai OZP (S/YL-NSW/E)) but indicate the probable future landuse within the Study Area. Development Permission Area Plans for Kam Tin North and South indicate the likely future landuse to the north and south of the proposed Au Tau Interchange. was produced in 1991 to enable a guideline for planning in the area, prior to detailed investigation. Relevant future development proposals for the area are reviewed in Section 23.5.

23.4 IDENTIFICATION OF KEY LANDUSE/COMMUNITY FEATURES

23.4.1 Local Communities/ Settlements

The TLT & YLA (N) passes through a number of communities proximate to Au Tau and Yuen Long.

Landuse is typified by fish farming, duck rearing and other farming activities general production and agricultural/farming practices including pig and chicken farming and rice cultivation. However, these practices are being overtaken by unstructured and unplanned light industry, open storage (including car breaking and construction material yards) and residential development.

The main communities and settlements identified in the Study Area are presented in Table 23.1. In addition to those settlements identified in Table 23.1 there are numerous walled villages immediately south of Kam Tin Road, however, these communities are located approximately 200m from the TLT & YLA (N) alignment.

23.4.2 Recreation/Amenity

The eastern side of Kam Tin valley is used for walking and general outdoor recreation. Although there are a number of footpaths in the area, the water catchment area overlooking the valley further to the south from the TLT & YLA (N) is most used for walking.

23.4.3 Conservation Areas and Sensitive Sites

Rural Activity Areas are non statutory designations (formerly called Agriculture Priority Areas) for which development will normally be restricted to agricultural and recreational uses only.

As discussed in Section 23.5, these planning control areas are likely to become more restrictive through the introduction of statutory planning restrictions in the future.

Graves and Burial Sites - There are a large number of graves and burial sites in the hillsides surrounding the Kam Tin Valley and to the east of Yuen Long. The tip of one large grave site will be affected by Link Road F. The graves are particularly sensitive sites and are located to give a positive aspect of the surrounding environment. Two of these grave sites are listed as graded sites see later section (sites of archaeological interest/historic buildings).

St Joseph's School - St Joseph's school is located on the proposed TLT & YLA (N) alignment at Ko Po San Tsuen.

TABLE 23.1 COMMUNITIES/SETTLEMENTS IDENTIFIED IN THE STUDY AREA

Settlement/ Community	Location	Description
Au Tau	200/300m from various points on the alignment's Au Tau Interchange	Low rise development light industry/residential
Tung Shing Lei	100m S and W of the Au Tau Interchange	" "
Shan Pin Tsuen, Wong Uk Tsuen and Tai Wai Tsuen	50/200m west of the alignment prior to its connection with the Yuen Long Southern bypass	Three low rise development areas including light industry and residential landuse
Small Traders New Village and Sz Tsz Uk	25/100m east of the connection with the Yuen Long Southern Bypass	Predominantly residential development
Ko Po San Tsuen	0/100m south west of the alignment, south of the Au Tau interchange	Low rise village communities interspersed with unplanned light industry
Ko Po Tsuen	80m north east of the alignment	" "
Ha Ko Po San Tsuen	50 north east of the alignment	" "
Sha Po Tsuen	500m east of the alignment	" "
Kam Tin Shi	500m east north east of the Kam Tin Road link roads	" "
Yuen Long	500/800m west of the connection with its Southern Bypass	Residential, light industry and open storage

Sites of Archaeological Interest/Historic Buildings - Consultation with the AMO has established that there are no sites of archaeological significance within the Study Area. There are however three sites of historical interest in the Study Area as listed in Table 23.2 below.

TABLE 23.2 HISTORICAL BUILDINGS/STRUCTURES IN THE STUDY AREA

Site	Address	Year of Construction	AMO ref, no.	Grade
Tang Wai-Kap Grave	Au Tau crossroads	Before 17.c.	770136	Grade -
Tang Kun Grave	Hill Behind Pok Oi Hospital	Before 17.c.	770140	Grade -
Pun Uk	Au Tau	1932	820360	Grade 1

Au Tau Water Treatment Works is located immediately to the west of the Alignment near Yuen Long. The works is a designated Potentially Hazardous Installation (PHI) due to the storage of chlorine.

A School allied to the Small Traders New Village is located 100m from the Au Tau bypass section of the alignment and may therefore require the application of mitigation measures to ameliorate traffic related impacts during operation of the route.

A Fisheries Research Station is located 400m north east of the Au Tau Interchange. However, this facility falls on the exact alignment of the North West Railway Corridor and therefore merits consideration at an early stage of the study to be carried out for the railway development.

Other G/IC Sites are found at a number of locations proximate to the alignment. Pok Oi Hospital is situated 100m east of the alignment, and a gas pigging and transfer station is situated in the centre of the Au Tau Interchange. Additional unspecified locations have been identified for use as G/IC sites on the OZPs for the development around Yuen Long and Nam Sang Wai. These will obviously require consideration at the detailed design phase of this project in order to ensure compatible landuse with the TLT & YLA.

23.5 PROPOSED LANDUSE

Proposals for the Study Area include designation of significant areas of green belt and open space land along the corridor of the TLT & YLA (N), particularly around and to the north of the proposed Au Tau interchange. Consultation with the Planning Department for the Study Area has indicated that some of the existing fish ponds are likely to be designated as conservation areas. The TLT & YLA (N) will run close to the proposed conservation area boundary and it has been proposed that the boundary is changed in order to obtain more space between the route alignment and the conservation area. The draft OZP for Nam Sang Wai indicates a 64.95 ha tract of land north of Au Tau as undetermined landuse, this area currently is occupied by squatters, small stone houses and a large area of fish ponds, however their is no intention to designate the latter within a conservation area as with areas of the Mai Po Nature Reserve.

In addition, the OZP for Yuen Long indicates that planning provisions have already been made for the corridor of the Au Tau northern bypass. The planning intention behind designation of undesignated landuse is to safeguard the area from haphazard development, with recommendations for redevelopment to be comprehensively planned. Consideration has also been made to the future provisioning of the North West Railway corridor subsequent to the finalisation of the Railway Development Study.

From the South, the Alignment runs along the Kam Tin valley floor, this area is designated on the Draft Permission Areas Plans as unspecified use. The areas north and south of Kam Tin Road have been included in the Agricultural Land Rehabilitation Scheme (ALARS) to be implemented in 1993/1994. The planning intention for these areas is to preserve and encourage agricultural activities, however it is likely that there may be areas where comprehensive low-rise, low density residential developments may be permitted. Similarly with light industrial applications.

23.6 CONSTRUCTION PHASE

23.6.1 General

The main construction activities which will potentially result in landuse and community impacts include:

- storage and transport (using heavy vehicles) of construction materials;
- transportation of heavy plant and machinery;
- excavation, cutting and filling activities; and
- construction of access roads and work sites.

23.6.2 Loss of Recreation/Amenity

There will inevitably be temporary reduction of recreation and amenity associated with the construction of TLT & YLA (N), both through reduced accessibility and from emission of noise and dust in a predominantly rural environment. This will deter casual use of the area for recreational purposes

23.6.3 Sensitive Sites/Conservation Areas

The sensitive sites in the Study Area have been detailed in Section 23.4.3. The alignment of Link Road H passes close to an area designated as Conservation Area on the Local Layout Plan. However, the alignment cuts across no conservation areas, but is proximate to a number of ponds designated as such. Discussions with the Planning Department have confirmed that they wish to retain ponds wherever possible and are actively stopping unplanned infill of ponds in the area.

23.6.4 Community Severance

Severance impacts during the construction phase will generally be limited to perceived severance as a result of the storage and movement of materials, plant and equipment in the immediate vicinity of the local villages. The area is typically densely populated and in close proximity to the alignment. Actual severance would depend on the operation of access roads, however the nature and extent of such roads in the Study Area have not yet been determined.

23.6.5 Disruption and Disturbance

Due to the construction of much of the roadway on embankment, construction of the TLT & YLA (N) will be particularly disruptive to the local community.

In particular the settlements outlined in Table 23.1 are likely to be severely disrupted during the construction phase, particularly where excavations will be undertaken, for example the construction of embankments, superstructures and the resumption of ponds.

In addition, the scattered settlements will also be affected due to construction traffic including heavy vehicles for the transportation of equipment and materials, potentially creating disruption and disturbance through local traffic diversions, temporary blockage of access roads and general nuisance. Traffic flow on Castle Peak Road and Kam Tin Road is likely to be disrupted dislocating communities in the Kam Tin/Yuen Long areas. Deterioration in air quality due to dust and the increase in noise levels on local communities are additionally a likely impact of such large scale construction activities.

The levels and effects of dust and noise are detailed in Chapters 17 and 18.

23.6.6 Landtake

Landtake during construction of the TLT & YLA (N) will comprise of both temporary and permanent use of land area. Major works will be conducted at the interchange above Au Tau, the connections with the Yuen Long Southern Bypass, and to a lesser extent at Kam Tin and Castle Peak Roads. These works will require significant areas of landtake particularly where superstructures such as bridges and flyovers will be constructed.

23.7 OPERATION

23.7.1 General

The main issues associated with the TLT & YLA (N) post construction, include community severance, disruption to sensitive sites, landtake, noise, air quality and visual impacts.

By the time the road opens most of the impacts incurred in the construction phase will have ceased. Residual impacts from these activities will largely depend on the effectiveness and efficiency of mitigation measures adopted in earlier stages, and therefore effective implementation of such measures wherever practicable is essential.

23.7.2 Loss of Amenity/Recreational Value

The area is characterised by the foothills of the Kam Tin Valley with numerous light industrial and Residential development interspersed with farm uses. As such this area does not represent a significant amenity recreational resource, however, practical consideration should be given to the re-instatement of any disturbed footpaths. There will inevitably be a residual visual impact associated with the development which may deter recreational walkers particularly on the eastern slopes of the Kam Tin Valley where walks along the water catchment are particularly popular.

Through general disruption and disturbance, the operation of the road could potentially reduce the recreational value of the area for bird watchers.

23.7.3 Sensitive Sites/Conservation Areas

There will be inevitable disruption to graves and burial sites in close proximity to the development. It should be noted that Tang Wai Kap Grave located at Au Tau crossroads is listed by the AMO as a historical site as is the Tang Kun Grave behind Pok Oi Hospital. However, these graves should not be significantly affected and are unlikely to require reprovisioning from an access point of view.

The close proximity of the Pok Oi Hospital to the Alignment means that mitigation measures will be required at the detailed design stage in order to ameliorate traffic related impacts. However as the Hospital is exposed to high noise levels from existing roads, the most appropriate mitigation is likely to be in the form of insulation and fixed glazing at the receiver.

A large number of ponds will be affected either totally or in part by the development. These will require resumption which will result in a permanent change of landuse. It is likely that only light industrial landuse would be suitable for areas to the periphery of the road post development. However, the Planning Department is actively designating these ponds as conservation areas and as such it is desirable to retain these ponds wherever possible.

23.7.4 Community Severance

Effective community severance will arise due to the location of the road severing several footpaths used by the local villagers, dividing settlement, and separating them from areas previously accessible. These areas include fish ponds, farming land and such sensitive sites as the graves and burial grounds located on the western slopes of the valley. In particular the severed vehicle/pedestrian route at the Small Traders Village/Wong Uk Tsuen as Road L3 to replace these is not definitely programmed yet, and there many be loss of vehicle access unless this is definitely resolved. The latter is likely to be a significant community issue.

23.7.5 Landtake

Permanent primary landtake is an inevitable result of such a large scale road development. Of particular significance will be the loss of farming land, fish ponds and scattered settlements.

23.7.6 Development Potential

Development potential is affected by the general quality of the surrounding urban environment. It is anticipated that the presence of the road will change the existing environment such that future non-industrial development in the vicinity of the road may be limited in scope. However this is typical of any major road development, and as indicated in the OZPs and DPAPs there are no specific development plans for the Study Area.

23.8 MITIGATION MEASURES

23.8.1 Construction

The scope for mitigation of landuse impacts during construction is often limited. The most effective mitigation is to avoid siting construction activities and particularly work sites in close proximity to sensitive receivers. However due to the nature of the location of the Study Area this will be difficult. Care should be taken in setting out work areas and during daily practices to ensure that associated impacts are minimised.

Timing of works can be important in reducing disruption due to traffic congestion etc., avoiding using roads for heavy plant and equipment during sensitive periods.

Where practicable re-instatement, which may provide opportunities for improvement to the environment, should be undertaken on completion of the construction works. Reinstatement of access to existing properties, particularly the farming areas should be required and made a contractual condition.

There is no realistic mitigation of the permanent landtake impacts associated with the roadway foundations, supports, drainage channels etc. For temporary landtake impacts associated with the works sites, storage areas etc., it is essential that careful and sympathetic restoration of the sites is carried out. This will require post construction specialist landscaping and replanting works.

23.8.2 Operation

Mitigation of landuse impacts will to a certain extent be achieved as a result of noise, air quality and landscape mitigation measures recommended in the relevant sections of this report.

Additional mitigation can be provided through detailed design and management measures. A positive commitment to the management and maintenance of roadside landscape should be undertaken to maintain both the recreational and amenity value of the affected areas and their development potential and land values.

23.9 CONCLUSIONS

Although the TLT & YLA (N) is close to existing roads and located in a sparsely populated area, the Alignment will have a significant impact on the surrounding landuse and local community.

During construction, there will be a loss of recreation/amenity, and residential settlement will be subject to significant disruption and disturbance.

The scope for mitigating these impacts in the Study Area is very limited in the study. Effective mitigation has been identified in the preceding sections of this report and include avoiding siting construction activities and works areas in close proximity to sensitive receivers and timing of works to avoid disruption to traffic. In addition, re-instatement of access to existing properties should be required and made a contractual condition.

Post construction, the Study Area will be subject to landtake, community severance, noise, air and visual impacts. A number of sensitive sites such as at the graves and burial sites will be disturbed potentially giving rise to significant community response. In addition a number of ponds will be filled in resulting in a permanent change of landuse; and permanent landtake will impact the farmers and fishfarmers in the Study Area.

Mitigation during the operational stage of the project will be through noise, air quality and landscape measures implemented during construction and is detailed in the relevant specialist chapters of this report.

ECOLOGY

CHAPTER 24

24. ECOLOGY

24.1 INTRODUCTION

The proposed area of disturbance associated with the TLT & YLA (N) was surveyed in the field on 28 August 1993. Habitat assessment was made from review of aerial photography followed by ground surveys and a habitat map covering the Study Area is presented in Figure 11.2(b).

24.2 FLORA

The Alignment south of Castle Peak Road covers agricultural plots used for wet paddy farming, light industrial developments, and residential buildings. Because the site is heavily disturbed, little or no native flora remains. The few remaining trees are scattered and cultivated species, and are not considered to have conservation significance from a botanical perspective.

North of Castle Peak Road the alignment covers large ponds which are used for rearing fish. There is little vegetation except for some secondary growth on the bunds between the ponds. The disturbance corridor contains no flora of conservation significance.

There are two hills in the vicinity of the TLT & YLA (N) north of Castle Peak Road which are highly disturbed but retain some forest and tall shrub vegetation. The eastern hill (nearest Au Tau) will be affected by a sliproad and its associated cut slopes which will remove 0.6 ha of secondary woodland and shrubland habitat. A number of mature Pinus spp. trees would be lost, but due to the highly disturbed nature of the area, this loss is considered to be a moderate impact. There are no known wildlife uses of these habitats which are of particular conservation significance.

24.3 FAUNA

The lowland agricultural areas and fish ponds are used by wading birds such as members of the Arceidae and Ciconiidae families. Wading birds forage on the paddies as well as on the fish ponds. Escape and hiding cover are limited, however, and these are sought elsewhere. South of Castle Peak Road the areas around houses and between paddies are often vegetated with shrubs or low-growing trees which are also attractive to birds common in the agricultural village environment of the New Territories. No communal bird roosts, feeding areas or nest sites were recorded on the Study Area or are known to occur there. It is unlikely that birds of conservation significance occupy this area due to the high level of human disturbance from villages, light industry, and agriculture.

Reptiles and amphibians occupy the route corridor, using both the agricultural and fish pond habitats. Again, due to the high level of disturbance in these village and agricultural areas, it is unlikely that reptiles or amphibians of conservation significance occupy the site.

No sign of mammalian use of the site was detected. No trails, burrows, or other indication of frequent use by mammals was recorded. Habitats in the Study Area are highly fragmented, vegetative cover is neither dense nor structurally complex. Therefore it is extremely unlikely that mammals would use the area except very infrequently.

24.4 POTENTIAL IMPACTS TO FLORA AND MITIGATION OR ENHANCEMENT MEASURES

Due to the highly disturbed nature of the site, and the absence of native vegetation, potential impacts to flora are not considered to be of significance. However, while there are no current requirements should there be a necessity during the detailed design stage for off-site borrow of fill material, the potential impacts of the borrow operation on vegetation at the borrow site should be investigated.

Impacts due to loss of mature Pinus spp. trees and tall shrub vegetation on the hill near Au Tau should be mitigated via planting native species as identified in the following paragraph.

There will be opportunities to enhance the flora of the disturbance corridor for frugivorous birds by planting shrubs and trees which provide a food source (Corlett 1992). A list of these species is shown in Table 24.1. The choice of trees from this list should be made on the basis of suitability for highway planting. Roadway embankments should be revegetated with shrub or short-tree species which are endemic to Hong Kong and which are known sources of food for local birds. This measure could enhance the utility of the local flora for wintering birds in particular, for which food supply is often a limiting factor. It should be noted that early planning will be required to ensure the supply of seedings especially if the AFD nursery is to supply the stock.

24.5 POTENTIAL IMPACTS TO FAUNA AND MITIGATION OR ENHANCEMENT MEASURES

The primary impact on wildlife resources from the proposed alignment would be loss of agricultural or pond habitats which are currently used for foraging by wading birds, reptiles, and amphibians. On the basis of the available information this impact is considered to be slight in view of the predominance of these types of habitat in the Kam Tin and Yuen Long areas. Because there would be no loss of native vegetation due to construction of the roadway, there would be no impact due to loss of native habitats. Also in the case of wildlife, should off-site borrow of fill material be required, the potential impacts of the borrow operation on wildlife should be investigated.

The habitat enhancement measure mentioned in Section 24.4 above would restore some native species to the road banks and other areas requiring re-vegetation. This would benefit native birds by providing a food source. Should the proposed highway isolate areas such as relatively large median strips, or other areas consideration should be given to re-vegetation using taller and more substantial tree species in groves which could serve as prospective nest colony sites. Tree species selected should include those most commonly used for nesting at the Ho Pui egretry further south in the Kam Tin valley. This re-vegetation measure would provide additional nesting habitat for colony nesters such as herons and egrets. Such species find readily available forage sources, but their local population numbers may be limited by a shortage of colony nesting habitat.

Table 24.1 Native plants attractive to frugivorous birds in Hong Kong

SPECIES	HABIT	BIRDS	ATTRACT	PERIOD
Aralia chinensis	small tree	3	x	Dec-Jan
Berchemia racemosa	climber	3	xx	Mar-Apr
Bridelia tomentosa	small tree	4	xxx	Dec-Mar
Cassytha filiformis	parasites	3	x	Oct-Mar
Celtis sinensis	tree	2	xxx	Jun-Aug
Cinnamomum camphora	large tree	5	xxx	Nov-Jan
Diospyros morrisiana	tree	2	xx	Dec-Jan
Elaeocarpus sylvestris	tree	2	xx	Oct-Nov
Eurya chinensis	shrub	17	xxxx	Oct-Nov
Eurya japonica	shrub	5	xxx	Nov-Jan
Evodia lepta	small tree	14	xxxx	Oct-Nov
Evodia meliaefolia	tree	4	xxx	Nov-Dec
Ficus microcarpa	tree	3	xx	irregular
Ficus superba	tree	3	xx	irregular
Ficus virens	tree	5	xx	irregular
Ilex pubescens	shrub	4	x	Nov-Feb
Litsea rotundifolia	shrub	8	xxx	Oct-Dec
Macaranga tanarius	tree	5	xxx	Jun-Jul
Machilus breviflora	tree	1	x	Oct-Jan
Machilus oreophila	tree	2	xx	April
Machilus thunbergii	tree	2	xx	Jun-Jul
Machilus velutina	tree	1	x	Jan-Feb
Maesa perlarius	shrub	2	xx	Dec-Jan
Mallotus paniculatus	small tree	3	xxx	Dec-Jan
melastoma candidum	shrub	4	xx	Nov-Jan
melastoma sanguineum	shrub	8	xxx	Nov-Jan
Microcos paniculata	small tree	5	x	Oct-Mar
Morinda umbellata	climber	3	xxx	Aug-Sep
paederia scandens	climber	4	xxx	Nov-Mar
psychotria rubra	shrub	8	x	Oct-Jan
Psychotria serpens	climber	7	x	Oct-Mar
Rhaphiolepis indica	shrub	2	xxx	Dec-Jan
Rhodomyrtus tomentosa	shrub	6	xxx	Aug-Nov
Rhus chinensis	small tree	8	x	Nov-Dec
Rhus hypoleuca	small tree	5	x	Nov-Dec
Sapium discolor	tree	12	xxxx	Oct-Dec
Sapium sebiferum	tree	3	xx	Nov-Jan
Schefflera octophylla	tree	7	xxxx	Jan-Mar
Scolopia saeva	tree	2	xx	Dec-Jan
Sterculia lanceolata	tree	4	xxxx	Jul-Sep

Note : BIRDS = number of bird species known to eat the fruit;
ATTRACT = relative attractiveness to birds;
PERIOD = main fruiting period.

Plantnames follow Anon (1978), except *Bridelia tomeniosa* B1. (= *B. monoica*).

24.6 CONCLUSIONS

The TLT & YLA (N) runs through areas that are highly disturbed in nature including fish and duck ponds. On the basis of the surveys conducted the limited flora in the disturbance corridor comprised no habitats which are known to be of conservation significance such as colonial roost or breeding sites, tree nest sites, or feeding sites. In addition, no terrestrial or avian wildlife of conservation importance was recorded in the survey area. The principal habitats to be disturbed are duck and/or fish ponds which are abundant in the region. Loss of such habitats is not significant to the flora and fauna resources of Hong Kong.

ENVIRONMENTAL MONITORING AND AUDIT

CHAPTER 25

25. ENVIRONMENTAL MONITORING AND AUDIT

The purpose and objectives of environmental monitoring and audit and the requirements for the whole TLT & YLA are given in detail in Part I Chapter 12. These apply equally to this section of the road and are not reproduced here. However more specific requirements are provided here in the form of monitoring and audit schedules for the construction and operational phases (Tables 25.1 - 25.4). In particular due to the higher number of sensitive receivers in the TLT & YLA (N) Study Area, it is recommended that the number of monitoring stations is increased during significant construction activities. In addition, although it is recognised that the Kam Tin River is polluted from livestock and farm wastes, it is recommended that water quality monitoring is undertaken to prevent further deterioration in water quality.

It should be noted however that these are only outline schedules at this stage as the construction details are not known. The schedules are therefore useful as a guide but will be subject to update and approval by Highway's Department and EPD during the detailed design stage. Action plans appropriate to TLT & YLA (N) are presented in Chapter 12.

TABLE 25.1

AIR QUALITY MONITORING SCHEDULE (CONSTRUCTION)

PARAMETER	OBJECTIVE	TRIGGER LEVEL	ACTION LEVEL	TARGET LEVEL	LOCATION	FREQUENCY/TIMING
TSP	Baseline assessment	N/A	N/A	N/A	Selected SRs * Pok Oi Hospital, Yuen Long Kau Hui, Sha Po Tsuen, Ko Po Tsuen Electricity Sub Station (north east of Hok Ho Shan)	For a period of at least two consecutive weeks prior to commencing construction activities. 24hr monitoring continuously, and 1-hr sample 3 times daily to coincide with periods when the highest dust impact is expected.
TSP	Check baseline	N/A	N/A	N/A	Selected NSRs	Four times/year and not less than one month internals
TSP	Compliance monitoring	1hr TSP, 24hr TSP $\geq$ **baseline + 30%	Average of Trigger and Target Levels	500$\mu g/m^3$ 1hr average 260$\mu g/m^3$ 24hr average	3 monitoring stations at Site Boundary in line with nearest SRs, locations to be reviewed monthly to take account of dust generating activities. *Pok Oi Hospital, Yuen Long Kau Hui, Sha Po Tsuen, Ko Po Tsuen Electricity Sub Station (north east of Hok Ho Shan)	At least one 24hr sample every 6 days, 3 one hour samples every 6 days or more frequently depending on site and wind conditions
**Wind speed	Assessment parameter/ compliance monitoring	N/A	N/A	N/A	Air Quality Monitoring Station and where necessary to account for wind direction with respect to SRs	Continuous
**Wind direction, and standard deviation of wind direction	Assessment parameter/ compliance monitoring	N/A	N/A	N/A	Air Quality Monitoring Station and where necessary to account for wind direction with respect to SRs	Continuous

Note : * In recognition of the higher number of sensitive receivers in TLT & YLA (N), it is recommended that additional monitoring equipment should be available and used during periods of significant construction activity, at these Sensitive Receivers.

** No values recommended, potential impacts are dependant on the nature of the construction activity. High wind speeds during dusty activities and/or wind direction towards an SR should act as a trigger. Need for meteorological monitoring is dependent on proximity of a Royal Observatory station.
The standard high volume sampling method as set out in the Title 40 of Code of Federal Regulations, Chapter 1 (Part 50), Appendix B should be followed.

SRs Sensitive Receivers N/A Not Applicable TSP Total Suspended Particulates

TABLE 25.2

NOISE MONITORING SCHEDULE (CONSTRUCTION)

PARAMETER	OBJECTIVE	TRIGGER LEVEL	ACTION LEVEL	TARGET LEVEL	LOCATION	FREQUENCY/TIMING
L_{10}, L_{50}, L_{90}, $L_{Aeq\ (30\ min)}$ •	Baseline Assessment	N/A	N/A	N/A	NSRs * Pok Oi Hospital, Yuen Long Kau Hui, Sha Po Tsuen, Ko Po Tsuen	24hr monitoring period for at least 2 weeks.
L_{10}, L_{50}, L_{90}, $L_{Aeq\ (30\ min)}$	Check Baseline	N/A	N/A	N/A	NSRs	One 24hr period every 3 months or as near as possible for a typical 24hr period, when construction activities are not taking place
$L_{Aeq\ (30\ min)}$	Spot Check	Background + 5dB(A)	Background + 10dB(A)	Background + 15dB(A)	NSRs	Minimum of once per week for each NSR during construction activities
$L_{Aeq\ (30\ min)}$	** Compliance monitoring (non-restricted daytime hours)	Background + 5dB(A)	Background + 10dB(A)	Background + 15dB(A)	NSRs * Pok Oi Hospital, Yuen Long Kau Hui, Sha Po Tsuen, Ko Po Tsuen	Minimum of 3 times per week between 0700 and 1900hrs, (2300) during general construction work; as appropriate during noisy activities
$L_{Aeq\ (30\ min)}$	Response to complaints (non-restricted daytime hours)	Background + 5dB(A)	Background + 10dB(A)	Background + 15d B(A)	Complainant	As appropriate

Note : * In recognition of the higher number of sensitive receivers in TLT & YLA (N), it is recommended that additional monitoring equipment should be available and used during periods of significant construction activity at these sensitive receivers.

** Should construction activities take place during restricted hours, additional noise monitoring (Leq5min) should be undertaken.

NSRs - Noise Sensitive Receivers

N/A - Not Applicable

TABLE 25.3

FRESH WATER QUALITY MONITORING SCHEDULE

PARAMETER	OBJECTIVE	TRIGGER LEVEL	ACTION LEVEL	TARGET LEVEL	LOCATION	FREQUENCY/TIMING
Dissolved oxygen (mg/l and %)	Baseline assessment	N/A	N/A	N/A	Active duck/fish ponds, Kam Tin River	Assessment : Prior to commencing construction for a period of 2 months and a frequency of twice per week.
Suspended solids/turbidity	Baseline checking					Checking : Check baseline at all the monitoring stations every 3 months.
Dissolved Oxygen Suspended Solids/ Turbidity	Compliance monitoring	80% Target Level	Average of Target and Trigger Level	* Technical Memorandum Discharge Standards	Main Discharge Points, Active duck/fish ponds, Kam Tin River	During the course of construction, twice per week at each main discharge point.
pH		80% Target Level	Average of Target and Trigger Level		Main Discharge Points, Active duck/fish ponds, Kam Tin River	During the course of construction, twice per week at each discharge point from the concrete batching plants.

Note : N/A Not applicable

* *Technical Memorandum: Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters*

SUMMARY

CHAPTER 26

26. SUMMARY

26.1 BACKGROUND

As indicated in Part I of this Report, the Route 3 CPS EIA, has been divided into two separate studies, delineated according to sections of the Alignment:- the southern section from Tsing Yi to (and including) Ting Kau Bridge (TKB) and the northern section from Ting Kau to Au Tau called the Tai Lam Tunnel & Yuen Long Approach Road Section (TLT & YLA). After the TLT & YLA assessment Draft Final Report was prepared (then known as the Country Park Section) an alternative route to the YL3b (Yuen Long Approach) connection was proposed and revisions made to the northern link.

Part II of this Report covers this alternative alignment for the YL3b and revised northern link. This Alignment was known as the 'Proposed Alignment Yuen Long Approach and Northern Connection to Yuen Long Southern Bypass and will be referred to as TLT & YLA (N), being the northern component of TLT & YLA.

This chapter summaries and highlights the key findings of the environmental assessment resulting from the construction and operation of TLT & YLA (N). The equivalent summary for the southern component, TLT & YLA (S), is presented in Chapter 13. The purpose and objectives, scope and approach to the EIA are as for TLT & YLA (S) and have not been summarized here to avoid unnecessary repetition.

26.2 TLT & YLA (N) - PROJECT OVERVIEW

26.2.1 Route Description

The TLT & YLA (N) Alignment extends along the Kam Tim Valley, north of the proposed Tai Lam Tunnel. The Alignment connects with the Kam Tin Road, and the main line runs along the western side of the valley. The western arm of the Alignment follows the proposed Western Corridor Railway's Yuen Long connection to join with the Yuen Long Southern Bypass.

The Alignment passes in close proximity to numerous villages including Ha Ko Po Tsuen, Ko Po Tsuen, Ko Po San Tsuen, Tung Shing Lei, Tai Wai Tsuen, Au Tau, Sz Tsz Uk, Shan Pin Tsuen, and Small Traders New Village.

The mainline of the road proceeds north to connect to the New Territories Circular Road (NTCR) providing access to Lok Ma Chau at the border of the PRC.

26.2.2 Main Features of TLT & YLA (N)

The main features of TLT & YLA (N) are:

- Two link roads (I and J) connecting the Alignment to the Kam Tin Road between the settlements of Ko Po Tsuen and Kat Hing Wai.
- Elevated Sections across Kam Tin and Castle Peak Road.
- Two major ramps which diverge south of Au Tau at the Au Tau Interchange to connect with the Yeun Long Southern Bypass.

- Major sections of high embankment crossing fish/duck ponds.
- Large sections of roadway on elevated structure.

26.2.3 Construction

The main construction activities associated with TLT & YLA (N) are:

- excavation works;
- fill embankment works;
- superstructure works, and
- duck/fish pond reclamation.

It is likely that a large work area will be required at the Au Tau Interchange, including the provision of batching plants, waste water and construction waste disposal facilities, staff offices, workshops, toilet facilities, materials and plant storage, and maintenance areas. In addition to which significant works will be required for embankments, cut and fill slopes, pond reclamation, bridge, sliproads etc.

26.2.4 Operation

The main operational impacts of the proposed road will be the increased traffic flows in the region, and resulting noise, air quality and visual impacts. The Alignment will serve to open the area for development by providing excellent infrastructure links with the PRC, the new airport at Chek Lap Kok and the port facilities at Kwai Chung and Lantau Island. Any resulting development would have potential further impacts upon the existing rural community associated with it and will need to be carefully controlled.

26.3 STUDY AREA AND ENVIRONMENTAL BACKGROUND

26.3.1 General Description of the Study Area

The area to the north of Kam Tin valley is densely populated and includes a number of villages and other developments. It is therefore inevitable that the construction of a major road through this area will potentially cause significant impacts to local residents.

The area consists of the predominantly low lying Kam Tin River valley with several tributary streams and numerous fish/duck ponds. In addition, considerable disturbance has been brought about by cultivation. Several ruin and graves sites are situated along the proposed alignment, but vegetation is sparse.

26.3.2 Key Sensitive Receivers

Key Sensitive Receivers in the Study Area include: fish/duck farming areas, residential premises (e.g. Ha Ko Po San Tsuen, Ko Po San Tuen, Kam Tin Shi, Tung Shing Lei, Au Taw, Small Traders New Village, Yuen Long); Country Park users, graves/burial sites, Au Tau Water Treatment Works, fishery research station (Au Tau), Kam Tin River and Pok Oi Hospital.

26.3.3 Exiting Environmental Condition

In order to determine existing environmental conditions in the Study Area as a baseline for the assessment, information has been drawn from:

- landuse surveys;
- review of existing environmental data;
- ambient noise level monitoring; and
- ecological/vegetation surveys.

In the absence of major polluting industry in the Study Area, air quality is within the AQOs. Road traffic is the main source of noise pollution, with background noise levels generally in the range of 55 - 65 dB(A). The main water body in the Study Area is Kam Tin River which is characterised by poor water quality, rated as very bad by EPD.

The Study Area encompasses numerous ponds for duck and fish rearing interspersed with vegetable and paddy plots. Other areas of the valley floor are used for farming and animal husbandry. These areas provide foraging and breeding sites for birds, amphibians and reptiles. Small areas of immature woodland and mixed shrub are found in the valley, however no rare species of trees or plants have been identified along the Alignment.

It is likely that the area is important as a foraging ground for raptors which are abundant in and around the Country Park.

26.4 ENVIRONMENTAL IMPACTS

26.4.1 Air Quality

Potential air quality impacts have been assessed in relation to both operation and construction of TLT & YLA (N).

Construction

Construction impacts will generally be a result of dust emissions and have been assessed using the Fugitive Dust Model.

Considering the anticipated size of the construction sites and the number of assumed concurrent activities taking place, the 1hr and 24hr TSP limits ($500\mu g/m^3$ and $\geq 60\mu g/m^3$ respectively) are predicted to be exceeded at nearby SRs during the construction phase.

However, construction dust generation is generally amenable to mitigation measures, and emissions can be effectively reduced through the implementation of measures such as those discussed in Chapter 17 of this report.

Operation

During the operation phase, pollutant concentrations in close proximity to the roadway may exceed AQO maxima during peak hours. Where this occurs, the only practical mitigation measure is to remove affected receivers from the proximity of the roadway to a more distant position. The need for this should be confirmed during the detailed design stage through further detailed assessment.

26.4.2 Noise

Potential noise impacts arising from both construction and operation were assessed under two scenarios; with and without mitigation.

Construction

During the construction phase, exceedance of desirable noise levels (day time limit 75 dB(A)) are predicted at areas adjacent to the works. Appropriate mitigation measures (including good site practice, use of barriers) and a monitoring programme are proposed to minimise such exceedances. While it is not feasible to dictate the methods of construction to be employed by the contractor, noise regulation requirements will be incorporated into the tender/contract documents, and a noise planning schedule will be required to be submitted by the contractor demonstrating that the noise standards will be met.

Operation

During the operation phase, traffic noise levels are predicted to be high and above 70dB(A) (HKPSG maxima) at several locations. Owing to the high existing noise levels in the area, assessment against the ExCo criteria is considered more appropriate. However, much of the exceedance is attributable to traffic on existing roads such as Castle Peak Road and Kam Tin Road. It is also significant that there is a high percentage of heavy vehicles predicted for the TLT & YLA traffic. These traffic figures were based on the best available information, and their early confirmation during detailed design is essential.

As a means of gauging the likely appropriate level of mitigation required the effectiveness of roadside barriers on the TLT & YLA (N) and its connecting roads has been examined. Barriers were found to be adequate for blocking TLT & YLA (N) traffic noise for many receivers, since the roadway is generally slightly elevated and most receivers comprise only 1 to 2 storey dwellings situated on low-lying ground. However, noise levels will still be high at some receivers, due to traffic on existing roads.

Using the ExCo criteria for compensation as a guide, and taking into account the nature of the potential receivers, recommendations for mitigation in the form of road side barriers have been made to reduce the numbers of households/residents exposed to significant noise increases.

In some sections of the TLT & YLA (N) the numbers of sensitive receivers potentially affected are such that mitigation at the receiver is the most appropriate approach. However much of the development within the area consists of low grade structures which could be considered inappropriate for installation of receiver mitigation, depending on the status of the building these premises could be removed or reprovisioned. As there is no known significant development planned along the route it is considered that the presence of the TLT & YLA (N) road should be taken as a constraint on future development.

A further detailed noise assessment is strongly recommended to be carried out during the detailed design. While this will be based on this current assessment it would have the benefit of definite design and construction information, approved traffic data projections and will need to confirm the number and status of the receivers.

26.4.3 Water Quality

The TLT & YLA (N) will result in water quality impacts due to the fact that the bulk of the Alignment takes in large areas of fish/duck ponds and crosses the water course of the Kam Tin River and one of its tributaries.

Construction

During the construction phase, the key issues will be the prevention of run-off (which is contaminated with chemicals, fuels, oils, sewage and high SS concentrations) from entering the water courses, and thus the marine waters. Suitable clauses are recommended to be included in the contract documentation to ensure control of run-off waters.

Operation

Potential impacts arising during the operational phase would be related to road traffic accidents involving the spillage of toxic and/or hazardous materials, and the roadway run-off, which may contain high levels of SS. The former would be a rare event, in common with many roads in the Territory. The SS content would be especially important during the early years of operation, when the landscaping and revegetation works are not fully established. Suitable clauses should be included in the contract documentation to ensure impacts are kept to acceptable levels.

26.4.4 Waste, Spoil and Fill Management

Likely construction waste and spoil arisings have been assessed and recommendations made concerning appropriate management practices.

Waste

The construction of the TLT & YLA (N) will potentially give rise to large quantities of construction wastes however as no specific details are available, the likely arisings of general construction wastes and potential direct impacts are predicted to be largely common to those described in general terms in Chapter 7 and summarised in Chapter 13. As the area is sensitive to water quality impacts (e.g. run-off from waste areas) due to the presence of fish/duck ponds, a river and tributaries these impacts have been addressed in the water quality assessment.

Spoil

The major spoil arisings from the TLT & YLA (N) are from a relatively small cutting just to the north of the Au Tau Interchange. It is recommended that the cutting is kept to a minimum size, possibly by use of a retaining wall. The resulting spoil from this could be used on nearby embankments for this and other projects.

26.4.5 Landscape and Visual Impact Assessment

A landscape and visual impact assessment of the construction and operation of TLT & YLA (N) was completed through identification of receiver groups, the visual envelope and subsequent projection of the change to baseline conditions, over time.

The impact of the high embankments, elevated flyovers and separated interchanges particularly north of Castle Peak Road - Yuen Long will remain a permanent significant visual element within the character of that area. Its acceptability as a significant permanent visual element will depend on the detailed design. It should also be noted that this area is already subject to much recent housing and light industrial development, and will be affected by the proposed realignment of the river, and introduction of a rail link corridor that will also fundamentally change the character of the existing landscape.

The adoption of mitigation measures recommended in the landscape and rehabilitation section of this Report (Chapter 22) will do much to reduce the impact of sections of the route from more distant views. In time the road would become visually screened from the majority of sensitive receiver groups.

26.4.6 Landscaping and Rehabilitation

Landscaping and rehabilitation requirements have been identified based on the findings of the Landscape and Visual Impact Assessment.

The landscape requirements for the TLT & YLA (N) will require large areas of embankment to be revegetated. The embankments of the proposed TLT & YLA (N) are high in profile to allow for the North West Corridor Railway.

Advanced planting and ground modelling is required and disturbed areas should be designed to encourage revegetation. Planting of grass, shrubs and trees should be carried out in accordance with the general recommendations of this Report. Maintenance and monitoring will be essential for successful mitigation of the very significant impacts.

It would be preferable to landscape and revegetate a single combined transport corridor. This would be possible if the TLT & YLA (N) ran roughly parallel to the North West Corridor Railway.

26.4.7 Landuse and Community Issues

The TLT & YLA (N) will have significant impacts on local communities and settlements due to the inevitable land take and potential loss of livelihood, disruption and disturbance. The main issue associated with the Alignment is the landtake of fish/duck ponds with a possible loss of livelihood to their owners. The required loss of the areas of fish/duck ponds is notable as the Planning Department is actively designating them as conservation areas.

Construction

During construction, there will be a loss of recreation/amenity, and residential settlement will be subject to significant disruption and disturbance. The scope for mitigating these impacts is generally limited. Effective mitigation has been identified in the preceding Chapters of this Report and include avoiding siting construction activities and works areas in close proximity to sensitive receivers and timing of works to avoid disruption to traffic. In addition, re-instatement of access to existing properties should be required and made a contractual condition.

Operation

Post construction, the Study Area will be subject to landtake, community severance, noise, air and visual impacts. A number of sensitive areas such as at the graves and burial sites will be disturbed, potentially giving rise to significant community response which can only be addressed in a satisfactory manner by response to a programme of public consultation. In addition, a number of ponds will be filled-in resulting in a permanent change of landuse; and permanent landtake will effect the livelihood of the farmers and fish farmers in the Study Area.

26.4.8 Ecology

As described in Chapters 11 and 24 of this Report, an ecological field survey was conducted over a 3 month period in 1993, to determine the conservation significance of the Study Area.

The Alignment traverses an area that is already highly disturbed in nature and the potential impacts are therefore not considered to be significant. On the basis of the surveys conducted, the limited flora in the disturbance corridor comprised no habitats which are known to be of conservation significance. In addition, no terrestrial or avian wildlife of conservation importance was recorded in the survey area. The principal habitats to be disturbed are duck and/or fish ponds which are abundant in the region. Loss of such habitats is not significant to the flora and fauna resources of Hong Kong.

26.4.9 Environmental Monitoring and Audit

Environmental monitoring and audit requirements have been identified and are detailed and summarized in Part I of this Report (Chapters 12 and 13 respectively).

RECOMMENDATIONS AND MITIGATION MEASURES

CHAPTER 27

27. RECOMMENDATIONS & MITIGATION MEASURES

27.1 GENERAL

This Chapter consolidates recommendations and mitigation measures proposed in the previous Chapters of Part II of this Report. Mitigation measures recommended should be incorporated into the contract documents and specific measures should be agreed with EPD. General recommendations and mitigation measures are given in Part I Chapter 14 and equally apply to Part II. It is considered that Chapter 14 and 27 should be read in conjunction.

27.2 AIR QUALITY

27.2.1 Construction

- Effective water sprays should be used during the delivery and handling of fill when dust is likely to arise. The effectiveness of wetting can be prolonged by the use of wetting agents that agglomerate dust particles.

- During transportation (e.g by dumptruck), materials with the potential to create dust should not be loaded to a level higher than the side and tail boards, and should be dampened and covered before transport.

- Gravel surface or temporary sealed surface on haul roads should be provided.

- The speed of all traffic on unpaved roads should be regulated to as low a speed as is practical.

- At all vehicle exit points leading from unpaved construction areas onto public roads, wheel washing troughs should be provided and their use enforced.

- At concrete batching plants, dust should be subject to control at several stages in the process: during handling of sand and aggregate, handling of concrete, and loading of dry concrete mix.

- Fugitive dust should be controlled by enclosing the handling areas, conveyors and elevators, and using a baghouse filter to extract dust. The vents of concrete storage bins should also be filtered.

- Dust from aggregate and crushed rock stockpiles should be controlled by enclosing or covering the piles during storage, and application of water in dry and windy conditions. Dust enclosures should be rigid and reach above the height of the stockpile. In addition, the use of a chemical wetting agent to better wet the fines and retain the moisture film should be considered.

- The access area around stockpiles should be sprayed with water or have temporary paving where loading and unloading vehicles manoeuvre.

- Dust control measures should be incorporated in the contract documents.

- If a concrete batching plant is to be utilised on site, it is recommended that the Contractor undertakes an assessment of the potential environmental impacts resulting from its operation.

27.2.2 Operation

It is predicted that a very limited number of receivers near Ha Ko Po Tsuen will be affected by NO_2 concentrations in year 2011. The area where these receivers are is shown in Figure 3.1c. These limited number of receivers may be resumed due to the route but if not then it is recommended that they are relocated.

27.3 NOISE

27.3.1 Construction

- 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 should be avoided.

- 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.

- Noisy activities can be scheduled to minimise exposure of nearby NSRs to high levels of construction noise. For example, noisy activities can be scheduled for mid-day, or at times coinciding with periods of high background noise (such as during peak traffic hours). As far as possible, noisy operations during teaching hours should be avoided near the existing schools.

- Idle equipment should be turned off or throttled down. Noisy equipment should be properly maintained and used no more often than is necessary.

- The power units of non-electric stationary plant and earth-moving plant can be quietened by vibration isolation and partial or full acoustic enclosures for individual noise-generating components.

- Construction activities can be planned so that parallel operation of several sets of equipment close to a given receiver is avoided.

- If possible, reduce the numbers of operating items of powered mechanical equipment.

- 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.

- Limited hours of use for powered mechanical equipment are recommended in sensitive locations; a twelve-hour period from 0700 to 1900 hours is suggested. Hours of use could be further restricted by the Work's Checker if sufficient and justifiable complaints from affected villagers are received.

- Temporary noise barriers or earth embankments should be used to screen specific receivers where appropriate. The barrier material should have a mass per unit of surface area of at least 7 kg/m^2. The panels should be absorptive with an acoustic lining, and have a noise reduction capability of up to 10 dB(A).

- Noise control requirements should be incorporated in the contract documents and a strategic noise planning schedule submitted by the Contractor demonstrating that the specified noise standards will be met.

27.3.3 Operation

It is considered that given the information available at this stage the appropriate balance has been achieved between the possible mitigation alternatives, although there is significant scope for further assessment and improvement during the detailed design. It should be stressed however that as findings of any EIA have to be specified and technically incorporated into the detail design the timing of the EIA is critical and should be carried out as early as practicable.

In view of the need for a detailed inventory of permanent and temporary NSRs in the Study Area immediately prior to the start of Route 3 construction, it is recommended that a further noise impact assessment be performed at the detailed design stage to reconfirm the extent of necessary noise mitigation measures.

The appropriate configuration of mitigation measures (barrier heights/receiver mitigation etc.) depends on many factors including the nature and planning/legal status of the potential receivers.

Based on the assessment (Chapter 18) and a consideration of the ExCo criteria the following mitigation measures are recommended:-

Section A (1200m of 2m high barrier)

A 2m high barrier approximately 600m long on both the north and south side of the mainline as shown in Figure 18.13. This alone is not sufficient to achieve criteria for the Pok Oi Hospital. However, the noise levels are already currently above criteria and it is hence considered most appropriate to apply receiver mitigation at the hospital from the 2nd storey upwards. It is understood that this 8 storey hospital has central air conditioning for the first storey and the operating theatre only.

Section B

No noise barrier is proposed for this section of road (Figure 18.13). The nature of the existing buildings suggests that mitigation at the receivers (possibly in the form of a solid wall/fence although this can be problematic and would require further investigation) is appropriate and more cost effective than other alternatives.

Section C (2,350m of 4m high barrier)

A 4m high barrier as shown in Figure 18.13. This involves approximately 350m on the south side of link road F, 800m on the western side and 400m on the eastern side of the mainline moving north from the boundary between Section C and D. Further mitigation will also be required at a limited number of receivers in areas close to the alignment.

Section D (1400m of 4m high barrier)

A 4m high barrier as shown in Figure 18.13. This involves 450m on the eastern side and 550m on the western side of the mainline working south from the boundary between Section C and D. In addition 400m on the eastern side of link road I.

- Consideration should be given to appropriate mitigation at the receiver where the numbers of sensitive receivers potentially affected are such that receiver mitigation is the most appropriate approach, and where this course of action is practicable.

- It is strongly recommended that a further detailed noise assessment is carried out during the detailed design to confirm the number and status of the receivers, as a means to identifying the most appropriate mitigation. (This could be part of the overall detailed design EIA although the results of this noise assessment will be required early in the detailed design stage).

27.4 WATER QUALITY

- Drainage trenches and channels should be used to collect run-off and, controls should be applied and site run-off treated wherever practicable.

- Incorporation of appropriate sediment traps within the roadway drainage system to minimise the transport of sediment to the watercourses.

- To enable retention of hazardous materials within the road system from large spillages, the practicality of 'close-off' valves where sections of road pass over open water bodies should be considered during the detailed design stage.

27.5 WASTE AND SPOIL MANAGEMENT

- It is recommended that the cutting just to the north of Au Tau is kept to the minimum size required possibly by use of retaining walls and subject to feasibility, to minimise spoil arisings and disruption to grave sites.

- It is noted that the spoil from this cutting as well as spoil from cuttings near Tin San Tsuen will be used in the embankments of the Yuen Long Approach and the slip roads linking the NTCR and the Yuen Long Southern Bypass. It is recommended that any surplus is reused in nearby projects to be identified at the detailed design stage.

27.6 LANDSCAPE AND VISUAL IMPACT

The proposed mitigation measures and recommendations covering, temporary and permanent mitigation measures, landform regrading works, landscape works and fire control recommendations are as outlined in Chapter 14.

27.7 LANDUSE AND COMMUNITY ISSUES

The scope for mitigating these impacts within the Study Area is very limited for this study. The most effective mitigation is to avoid siting construction activities and works areas in close proximity to sensitive receivers and timing of works to avoid disruption to traffic. In addition, re-instatement of access to existing properties should be required and made a contractual condition.

- Care should be taken in setting out work areas and during daily practices to ensure that associated impacts are minimised.

- Timing of works should be programmed where possible to minimise traffic congestion etc., e.g. avoiding using roads for heavy plant and equipment during busy traffic periods.

- Where practicable re-instatement should be undertaken on completion of the construction works. Reinstatement of access to existing properties and for areas with high recreational and amenity value should be required and made a contractual condition.

- It is understood that Route 3 will replace the severed vehicle/pedestrian route at the Small Traders New Village/Wong Uk and it is recommended that this significant community issue be addressed by Government provision of road L3.

27.8 ECOLOGY

- A qualified ecologist/biologist should be employed during restoration and revegetation works to supervise all planting etc.

- Revegetation of cut and fill areas using native grass, herb, shrub and tree species should be undertaken to facilitate wild life habitation. A list of such revegetation species is given in Part I Chapter II.

27.9 MONITORING AND AUDIT

- It is recommended that a suitably qualified, experienced and independent consultant/organisation (environmental team) is employed, prior to commencement of construction works, to undertake all recommended monitoring activities. It is understood that this will be the responsibility of the successful tenderer/Franchisee.

- A comprehensive Environmental Monitoring and Audit Manual should be produced by the environmental team prior to commencing the works.

- Prior to and during the works, environmental monitoring should be carried out for air quality (suspended particulates), water quality and noise and should include baseline monitoring; where specified additional monitoring as a control to determine changes in the baseline not associated with the project; and compliance monitoring to ensure compliance with environmental monitoring Target, Action and Trigger levels.

- All baseline and compliance monitoring should be carried out by the environmental team comprising suitably qualified and experienced staff.
- A monthly monitoring report should be prepared by the environmental monitoring team and submitted to the Works Checker, EPD and the Highway's Department.
- Operational monitoring to be undertaken by the environmental team for noise and air quality should be carried out annually, and commencing a suitable time period (e.g. after 3 months) after the road becomes operational.

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REFERENCES

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AFD. Hong Kong Government Agriculture and Fisheries Department Conservation Division

ABBREVIATIONS

ABBREVIATIONS

Measurements

Technical units of measurement in this report are based on the International System of Units (SI) wherever possible. These technical units may be broadly grouped as prefixes and measurements. A prefix applies to the unit of measurement that immediately follows it - for example microgram is abbreviated as μg. Superscripts ^{2} and ^{3} following a linear unit indicate area and volume - for example m^2 (square metres) and m^3 (cubic metres). Different units are combined by a full stop (.) to differentiate units of the same exponential sign, and a solidus (/) to indicate 'per'. For example, kilometres per hour is abbreviated as km/h, while megalitres per day per square kilometre is $Ml/d.km^2$.

The prefixes used in this report are:

M	mega	1,000,000
k	kilo	1,000
m	milli	0.001
μ	micro	0.000,001

Units of measurement which have been used are:

yr	year
dB(A)	decibel, frequency weighting network A
°C	degrees Celsius
g	gram
hr	hour
ha	hectare
Hz	hertz
°K	degrees Kelvin
l	litre
L_{eq}	equivalent sound power level
L_{10}	sound power level exceeded 10% of the time
L_{90}	sound power level exceeded 90% of the time
m	metre
Pa	Pascal
pH	degree of alkalinity/acidity

%	per cent
s	second
t	tonne

Miscellaneous

AFD	Agriculture and Fisheries Department
AQO	Air quality objective
ANL	Acceptable noise level
AOD	Alone Ordnance Datum
ASR	Area Sensitivity Rating
BNL	Base Noise Level
BOD_5	biochemical oxygen demand (five-day test)
BOT	Build, Operate and Transfer
CED	Civil Engineering Department
CNP	construction noise permit
CO	carbon monoxide
CPS	Country Park Section
CT9	Container Terminal 9
DG	dangerous goods
DO	dissolved oxygen
dwt	dead weight tonnage
EAPG	Environmental Assessment Planning Group
EIA	Environmental Impact Assessment
EM&A	Environmental Monitoring and Audit
EPA	Environmental Protection Authority
EPD	Environmental Protection Department
FDM	Fugutive dust model

FMC	Fill Management Committee
GEO	Geotechnical Engineering Office
HKPSG	Hong Kong Planning Standards and Guidelines
HVS	High Volume Sampler
ISCST	Industrial Source Complex Short Term (air dispersion model)
LAPH	Lantau Port and Harbour
LDPC	Land Development Policy Committee
LFC	Lantau Fixed Crossing
mPD	metres Principal Datum
N/A	not applicable
NCO	Noise Control Ordinance
N/D	not detected by analysis in sample
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
NSR	noise sensitive receiver
PD	principal datum
PHI	Proposed hazardous installations
PRC	Peoples Republic of China
RSP	Respirable particulate matter
SR	Sensitive Receiver
SS	suspended solids
TLT	Tai Lam Tunnel
TLT & YLA (S)	Tai Lam Tunnel and Yuen Long Approach Road, South
TLT & YLA (N)	Tai Lam Tunnel and Yuen Long Approach Road, North
TKB	Ting Kau Bridge
TSP	total suspended particulate

US EPA	United States Environmental Protection Agency
WAHMO	Water and hydaulic modelling
WC	Works Checker
WHC	Western Harbour Crossing
WKE	West Kowloon Expressway
WPCO	Water Pollution Control Ordinance
WQCZ	Water quality control zone
WQO	Water quality objective
YLA	Yeun Long Approach
ZVI	Zone of visual Influence